50029

Haynes

Jeep
Wagoneer & Pick-up

1972 thru 1991

Cherokee and Wagoneer (1972 thru 1983)
Grand Wagoneer (1984 thru 1991) □ J-Series Pick-up (1972 thru 1988)

Haynes Repair Manual

Based on a complete teardown and rebuild

PRINTED ON RECYCLED PAPER

Includes essential information for today's more complex vehicles

Jeep Wagoneer Grand Wagoneer Cherokee J-Series Pick-up Automotive Repair Manual

by Jay Storer
and John H Haynes
Member of the Guild of Motoring Writers

Models covered:

Grand Wagoneer 1984 through 1991
Cherokee and Wagoneer 1972 through 1983
J-Series Pick-up 1972 through 1988
Does not include 1984 and later Comanche Pick-up models

(2B2 - 50029)

ABCDE
FGHIJ
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AUTOMOTIVE PARTS & ACCESSORIES ASSOCIATION MEMBER

Haynes Publishing Group
Sparkford Nr Yeovil
Somerset BA22 7JJ England

Haynes North America, Inc
861 Lawrence Drive
Newbury Park
California 91320 USA

Acknowledgements
Technical writers who contributed to this project include Rob Maddox, Mike Stubblefield and Jeff Kibler.

A book in the Haynes Automotive Repair Manual Series

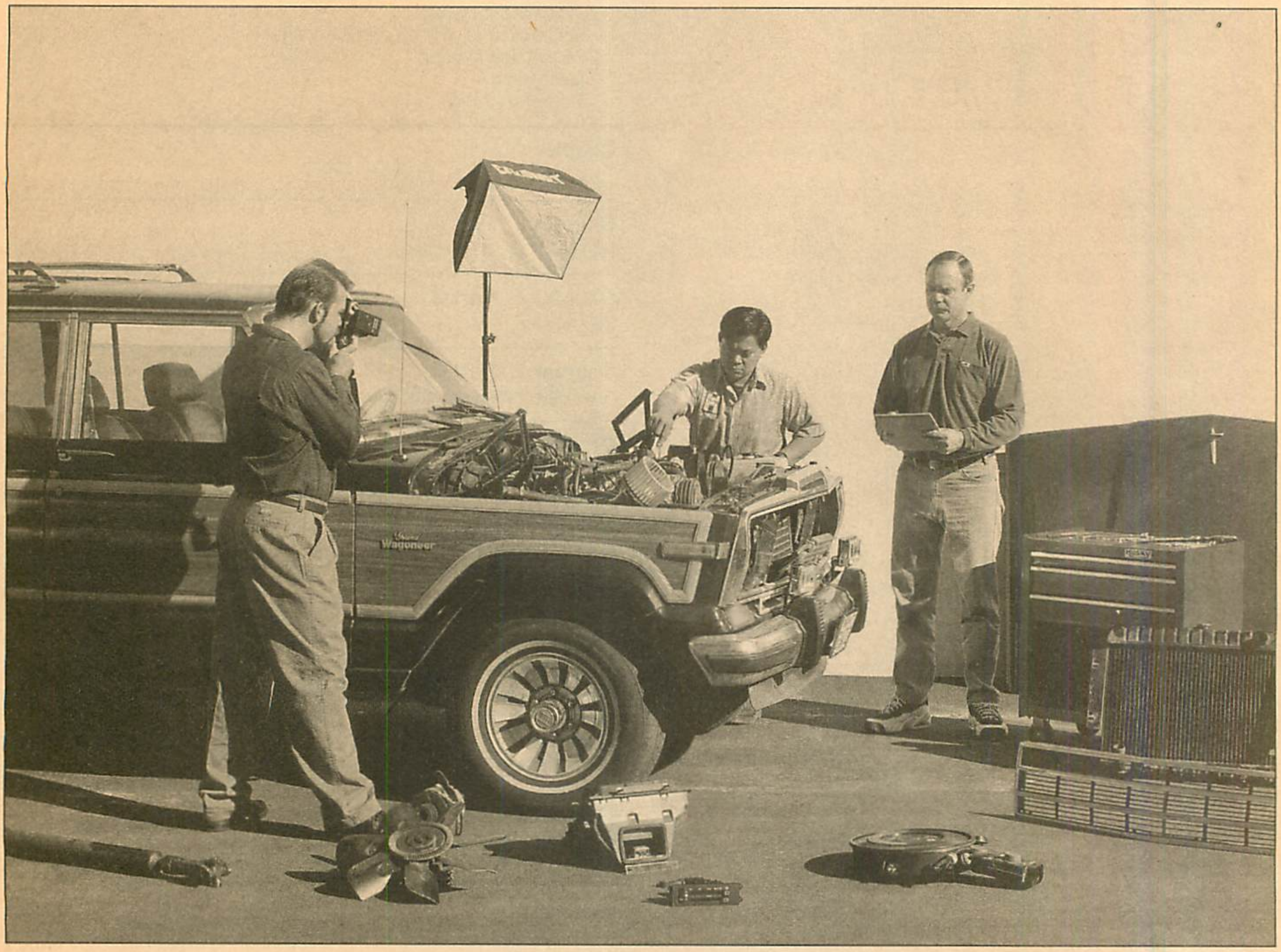
Printed in the U.S.A.

ISBN 1 56392 242 8

Library of Congress Catalog Card Number 96-79992

97-336

Contents



Haynes mechanic, author and photographer with 1986 Jeep Grand Wagoneer

About this manual

Its purpose

The purpose of this manual is to help you get the best value from your vehicle. It can do so in several ways. It can help you decide what work must be done, even if you choose to have it done by a dealer service department or a repair shop; it provides information and procedures for routine maintenance and servicing; and it offers diagnostic and repair procedures to follow when trouble occurs.

We hope you use the manual to tackle the work yourself. For many simpler jobs, doing it yourself may be quicker than arranging an appointment to get the vehicle into a shop and making the trips to leave it and pick it up. More importantly, a lot of money can be saved by avoiding the expense the shop must pass on to you to cover its labor and overhead costs. An added benefit is the sense of satisfaction and accomplishment that you feel after doing the job yourself.

Using the manual

The manual is divided into Chapters. Each Chapter is divided into numbered Sections, which are headed in bold type between horizontal lines. Each Section consists of consecutively numbered paragraphs.

At the beginning of each numbered Section you will be referred to any illustrations which apply to the procedures in that Section. The reference numbers used in illustration captions pinpoint the pertinent Section and the Step within that Section. That is, illustration 3.2 means the illustration refers to Section 3 and Step (or paragraph) 2 within that Section.

Procedures, once described in the text, are not normally repeated. When it's necessary to refer to another Chapter, the reference will be given as Chapter and Section number. Cross references given without use of the word "Chapter" apply to Sections and/or paragraphs in the same Chapter. For example, "see Section 8" means in the same Chapter.

References to the left or right side of the vehicle assume you are sitting in the driver's seat, facing forward.

Even though we have prepared this manual with extreme care, neither the publisher nor the author can accept responsibility for any errors in, or omissions from, the information given.

NOTE

A **Note** provides information necessary to properly complete a procedure or information which will make the procedure easier to understand.

CAUTION

A **Caution** provides a special procedure or special steps which must be taken while completing the procedure where the Caution is found. Not heeding a Caution can result in damage to the assembly being worked on.

WARNING

A **Warning** provides a special procedure or special steps which must be taken while completing the procedure where the Warning is found. Not heeding a Warning can result in personal injury.

Introduction to the Jeep Cherokee, Wagoneer, Grand Wagoneer and J-Series Truck

The models covered by this manual are conventional front engine 4WD vehicles available in two-door and four door station wagon body styles and pick-up trucks. Over the years of production covered by this manual, engine options include the 258 (4.2L) inline six-cylinder, the 304 (5.0L), 360 (5.9L) and 401 (6.6L) V8 engines.

Power is transmitted through either a three, four or five-speed manual transmission or a three speed automatic transmission. A transfer case routes the power through front and rear driveshafts to the axles.

The suspension features solid axles at the front and rear which are suspended by leaf springs, shock absorbers and a track bar on some models.

The steering box is mounted to the left of the engine and is connected to the steering arms through a series of rods which incorporates a damper. Power assist is optional on most models.

The brakes are either four wheel drum or disc at the front and drum at the rear, with power assist as an option.

Vehicle identification numbers

Modifications are a continuing and unpublicized part of vehicle manufacturing. Since spare parts manuals and lists are compiled on a numerical basis, the individual vehicle numbers are essential to correctly identify the component required.

Vehicle Identification Number (VIN)

This very important identification number is stamped on a plate attached to the left side of the dashboard and is visible through the driver's side of the windshield **(see illustration)**. The VIN also appears on the Vehicle Certificate of Title and Registration. It contains valuable information such as where and when the vehicle was manufactured, the model year and the body style.

Body identification plate

The body identification plate is normally located in the engine compartment on the upper left portion of the firewall **(see illustration)**. Like the VIN it contains valuable information about the manufacturing of the vehicle, as well as information on the options with which it is equipped. This plate is especially useful for matching the color and type of paint for repair work.

VIN engine and model year codes

Two particularly important pieces of information found in the VIN are the engine code and the model year code. Counting from the left, on 1972 through 1974 models the engine code letter designation is the 8th digit and the model year code designation is the 2nd digit. On 1975 through 1980 models, the engine code letter designation is the 7th digit and the model year code designation is the 2nd digit. On 1981 through 1988 models, the engine code letter designation is the 4th digit and the model year code designation is the 10th digit. On 1989 through 1991 models, the engine code letter designation is the 8th digit and the model year code designation is the 10th digit.

The Vehicle Identification Number (VIN) is visible through the driver's side of the windshield

The body identification plate is located in the upper left corner of the engine compartment firewall

Location of the engine identification number - six-cylinder models

Location of the engine identification number - V8 models

On the models covered by this manual the engine codes are:

1972

A	258 cu in L6
H	304 cu in V8
N	360 cu in V8

1973

A	258 cu in L6
N	360 cu in V8

1974

A	258 cu in L6
N	360 cu in V8
Z	401 cu in V8

1975

A	258 cu in L6
N	360 cu in V8 (2bbl)
P	360 cu in V8 (4bbl)
Z	401 cu in V8

1976

A	258 cu in L6
N	360 cu in V8 (2bbl)
P	360 cu in V8 (4bbl)
Z	401 cu in V8

1977

C	258 cu in L6
N	360 cu in V8 (2bbl)
P	360 cu in V8 (4bbl)
Z	401 cu in V8

1978

C	258 cu in L6
N	360 cu in V8 (2bbl)
P	360 cu in V8 (4bbl)
Z	401 cu in V8

1979 thru 1988

C	258 cu in L6
N	360 cu in V8

1989 thru 1991

7	360 cu in V8

On the models covered by this manual the model year codes are:

2	1972	C	1982
3	1973	D	1983
4	1974	E	1984
5	1975	F	1985
6	1976	G	1986
7	1977	H	1987
8	1978	J	1988
9	1979	K	1989
0	1980	L	1990
B	1981	M	1991

Engine identification numbers

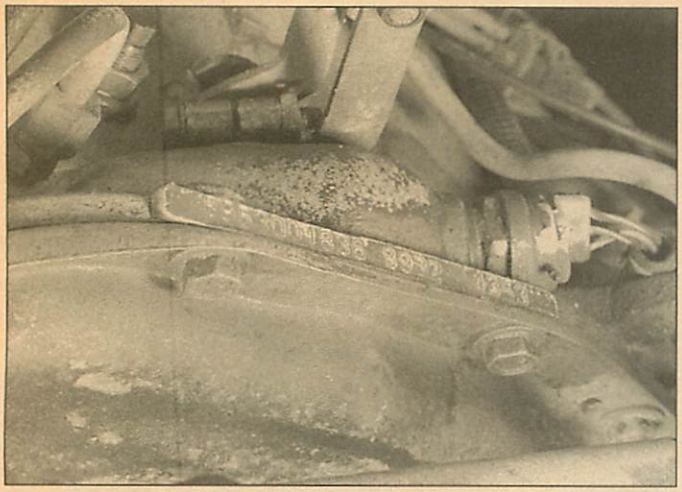
The 258 (4.2L) inline six-cylinder engine number is located on the right (passenger side) of the cylinder block just below the cylinder head **(see illustration)**.

On all V8 engines the engine number is stamped on a plate which is screwed to the passenger side valve cover **(see illustration)**.

Automatic transmission number

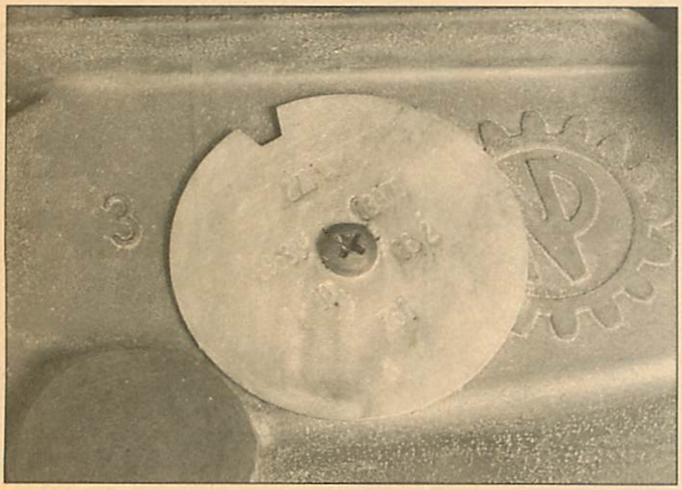
On 1972 thru 1979 transmissions, the ID number is stamped on a plate which is riveted to right side of the transmission housing **(see illustration)**.

Typical automatic transmission identification number - 1972 thru 1979

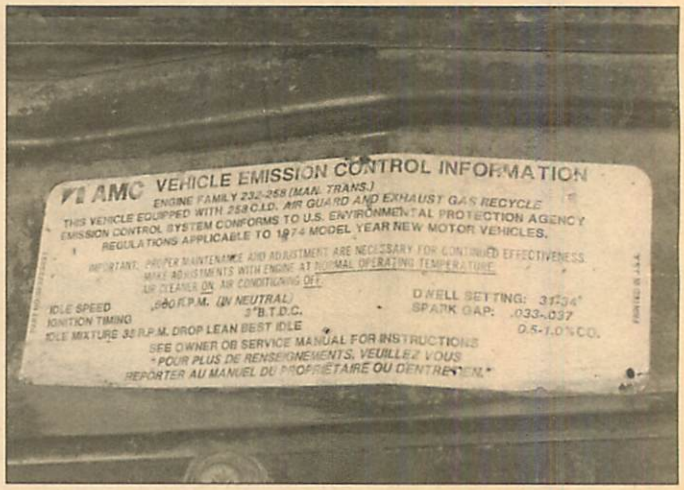


Location of the automatic transmission identification number - 1980 thru 1991

Location of the manual transmission identification number



Typical transfer case identification number



Vehicle Emissions Control Information Label

On 1980 thru 1991 transmissions, the ID number is stamped on the left side of the transmission housing, just above the oil pan **(see illustration)**.

Manual transmission number

The ID number on three, four and five speed transmission can be found on the left side of the case **(see illustration)**.

Transfer case number

The transfer case ID number is stamped on tag which is bolted to the backside of the case **(see illustration)**.

Axle identification numbers

On most axles the identification number is located on a tag attached to the differential housing cover.

Vehicle Emissions Control Information label

This label is found in the engine compartment **(see illustration)**. See Chapter 6 for more information on this label.

Buying parts

Replacement parts are available from many sources, which generally fall into one of two categories - authorized dealer parts departments and independent retail auto parts stores. Our advice concerning these parts is as follows:

Retail auto parts stores: Good auto parts stores will stock frequently needed components which wear out relatively fast, such as clutch components, exhaust systems, brake parts, tune-up parts, etc. These stores often supply new or reconditioned parts on an exchange basis, which can save a considerable amount of money. Discount auto parts stores are often very good places to buy materials and parts needed for general vehicle maintenance such as oil, grease, filters, spark plugs, belts, touch-up paint, bulbs, etc. They also usually sell tools and general accessories, have convenient hours, charge lower prices and can often be found not far from home.

Authorized dealer parts department: This is the best source for parts which are unique to the vehicle and not generally available elsewhere (such as major engine parts, transmission parts, trim pieces, etc.).

Warranty information: If the vehicle is still covered under warranty, be sure that any replacement parts purchased - regardless of the source - do not invalidate the warranty!

To be sure of obtaining the correct parts, have engine and chassis numbers available and, if possible, take the old parts along for positive identification.

Maintenance techniques, tools and working facilities

Maintenance techniques

There are a number of techniques involved in maintenance and repair that will be referred to throughout this manual. Application of these techniques will enable the home mechanic to be more efficient, better organized and capable of performing the various tasks properly, which will ensure that the repair job is thorough and complete.

Fasteners

Fasteners are nuts, bolts, studs and screws used to hold two or more parts together. There are a few things to keep in mind when working with fasteners. Almost all of them use a locking device of some type, either a lockwasher, locknut, locking tab or thread adhesive. All threaded fasteners should be clean and straight, with undamaged threads and undamaged corners on the hex head where the wrench fits. Develop the habit of replacing all damaged nuts and bolts with new ones. Special locknuts with nylon or fiber inserts can only be used once. If they are removed, they lose their locking ability and must be replaced with new ones.

Rusted nuts and bolts should be treated with a penetrating fluid to ease removal and prevent breakage. Some mechanics use turpentine in a spout-type oil can, which works quite well. After applying the rust penetrant, let it work for a few minutes before trying to loosen the nut or bolt. Badly rusted fasteners may have to be chiseled or sawed off or removed with a special nut breaker, available at tool stores.

If a bolt or stud breaks off in an assembly, it can be drilled and removed with a special tool commonly available for this purpose. Most automotive machine shops can perform this task, as well as other repair procedures, such as the repair of threaded holes that have been stripped out.

Flat washers and lockwashers, when removed from an assembly, should always be replaced exactly as removed. Replace any damaged washers with new ones. Never use a lockwasher on any soft metal surface (such as aluminum), thin sheet metal or plastic.

Fastener sizes

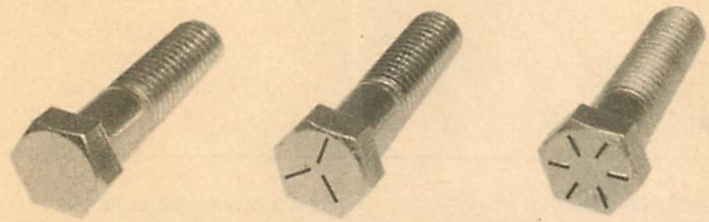
For a number of reasons, automobile manufacturers are making wider and wider use of metric fasteners. Therefore, it is important to be able to tell the difference between standard (sometimes called U.S. or SAE) and metric hardware, since they cannot be interchanged.

All bolts, whether standard or metric, are sized according to diameter, thread pitch and length. For example, a standard 1/2 - 13 x 1 bolt is 1/2 inch in diameter, has 13 threads per inch and is 1 inch long. An M12 - 1.75 x 25 metric bolt is 12 mm in diameter, has a thread pitch of 1.75 mm (the distance between threads) and is 25 mm long. The two bolts are nearly identical, and easily confused, but they are not interchangeable.

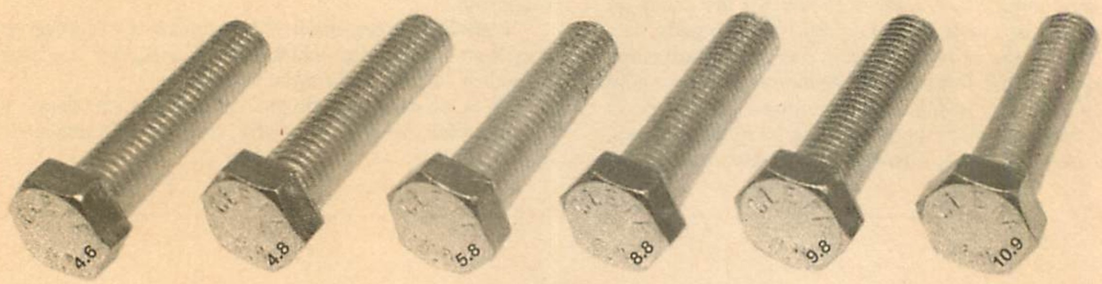
In addition to the differences in diameter, thread pitch and length, metric and standard bolts can also be distinguished by examining the bolt heads. To begin with, the distance across the flats on a standard bolt head is measured in inches, while the same dimension on a metric bolt is sized in millimeters (the same is true for nuts). As a result, a standard wrench should not be used on a metric bolt and a metric wrench should not be used on a standard bolt. Also, most standard bolts have slashes radiating out from the center of the head to denote the grade or strength of the bolt, which is an indication of the amount of torque that can be applied to it. The greater the number of slashes, the greater the strength of the bolt. Grades 0 through 5 are commonly used on automobiles. Metric bolts have a property class (grade) number, rather than a slash, molded into their heads to indicate bolt strength. In this case, the higher the number, the stronger the bolt. Property class numbers 8.8, 9.8 and 10.9 are commonly used on automobiles.

Strength markings can also be used to distinguish standard hex nuts from metric hex nuts. Many standard nuts have dots stamped into one side, while metric nuts are marked with a number. The greater the number of dots, or the higher the number, the greater the strength of the nut.

Metric studs are also marked on their ends according to property class (grade). Larger studs are numbered (the same as metric bolts), while smaller studs carry a geometric code to denote grade.



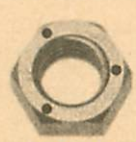
Grade 1 or 2 Grade 5 Grade 8



Bolt strength marking (standard/SAE/USS; bottom - metric)

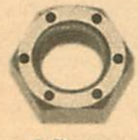
Grade Identification

Hex Nut Grade 5



3 Dots

Hex Nut Grade 8



6 Dots

Standard hex nut strength markings

Grade Identification

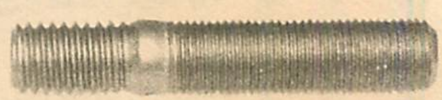
Hex Nut Property Class 9

Arabic 9

Hex Nut Property Class 10

Arabic 10

Metric hex nut strength markings



Class 10.9 Class 9.8 Class 8.8

Metric stud strength markings

00-1 HAYNES

It should be noted that many fasteners, especially Grades 0 through 2, have no distinguishing marks on them. When such is the case, the only way to determine whether it is standard or metric is to measure the thread pitch or compare it to a known fastener of the same size.

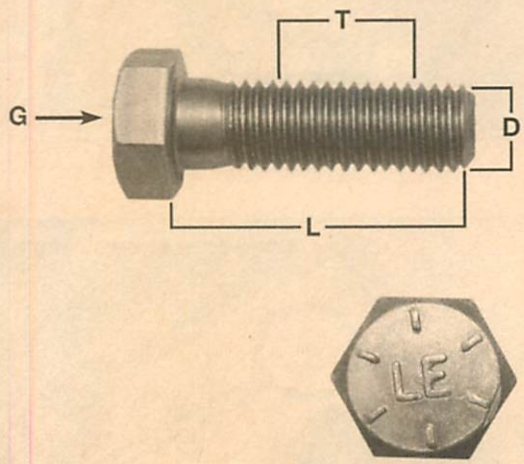
Standard fasteners are often referred to as SAE, as opposed to metric. However, it should be noted that SAE technically refers to a non-metric fine thread fastener only. Coarse thread non-metric fasteners are referred to as USS sizes.

Since fasteners of the same size (both standard and metric) may have different strength ratings, be sure to reinstall any bolts, studs or nuts removed from your vehicle in their original locations. Also, when replacing a fastener with a new one, make sure that the new one has a strength rating equal to or greater than the original.

Tightening sequences and procedures

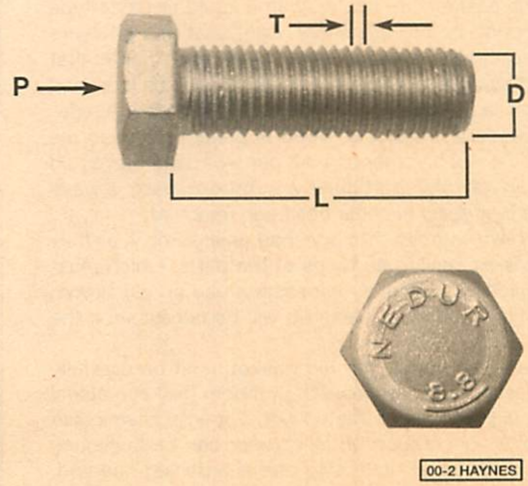
Most threaded fasteners should be tightened to a specific torque value (torque is the twisting force applied to a threaded component such as a nut or bolt). Overtightening the fastener can weaken it and cause it to break, while undertightening can cause it to eventually come loose. Bolts, screws and studs, depending on the material they are made of and their thread diameters, have specific torque values, many of which are noted in the Specifications at the beginning of each Chapter. Be sure to follow the torque recommendations closely. For fasteners not assigned a specific torque, a general torque value chart is presented here as a guide. These torque values are for dry (unlubricated) fasteners threaded into steel or cast iron (not aluminum). As was previously mentioned, the size and grade of a fastener determine the amount of torque that can safely be applied to it. The figures listed

Metric thread sizes	**Ft-lbs**	**Nm**
M-6	6 to 9	9 to 12
M-8	14 to 21	19 to 28
M-10	28 to 40	38 to 54
M-12	50 to 71	68 to 96
M-14	80 to 140	109 to 154
Pipe thread sizes		
1/8	5 to 8	7 to 10
1/4	12 to 18	17 to 24
3/8	22 to 33	30 to 44
1/2	25 to 35	34 to 47
U.S. thread sizes		
1/4 - 20	6 to 9	9 to 12
5/16 - 18	12 to 18	17 to 24
5/16 - 24	14 to 20	19 to 27
3/8 - 16	22 to 32	30 to 43
3/8 - 24	27 to 38	37 to 51
7/16 - 14	40 to 55	55 to 74
7/16 - 20	40 to 60	55 to 81
1/2 - 13	55 to 80	75 to 108



Standard (SAE and USS) bolt dimensions/grade marks

G Grade marks (bolt strength)
L Length (in inches)
T Thread pitch (number of threads per inch)
D Nominal diameter (in inches)



Metric bolt dimensions/grade marks

P Property class (bolt strength)
L Length (in millimeters)
T Thread pitch (distance between threads in millimeters)
D Diameter

here are approximate for Grade 2 and Grade 3 fasteners. Higher grades can tolerate higher torque values.

Fasteners laid out in a pattern, such as cylinder head bolts, oil pan bolts, differential cover bolts, etc., must be loosened or tightened in sequence to avoid warping the component. This sequence will normally be shown in the appropriate Chapter. If a specific pattern is not given, the following procedures can be used to prevent warping.

Initially, the bolts or nuts should be assembled finger-tight only. Next, they should be tightened one full turn each, in a criss-cross or diagonal pattern. After each one has been tightened one full turn, return to the first one and tighten them all one-half turn, following the same pattern. Finally, tighten each of them one-quarter turn at a time until each fastener has been tightened to the proper torque. To loosen and remove the fasteners, the procedure would be reversed.

Component disassembly

Component disassembly should be done with care and purpose to help ensure that the parts go back together properly. Always keep track of the sequence in which parts are removed. Make note of special characteristics or marks on parts that can be installed more than one way, such as a grooved thrust washer on a shaft. It is a good idea to lay the disassembled parts out on a clean surface in the order that they were removed. It may also be helpful to make sketches or take instant photos of components before removal.

When removing fasteners from a component, keep track of their locations. Sometimes threading a bolt back in a part, or putting the washers and nut back on a stud, can prevent mix-ups later. If nuts and bolts cannot be returned to their original locations, they should be kept in a compartmented box or a series of small boxes. A cupcake or muffin tin is ideal for this purpose, since each cavity can hold the bolts and nuts from a particular area (i.e. oil pan bolts, valve cover bolts, engine mount bolts, etc.). A pan of this type is especially helpful when working on assemblies with very small parts, such as the carburetor, alternator, valve train or interior dash and trim pieces. The cavities can be marked with paint or tape to identify the contents.

Whenever wiring looms, harnesses or connectors are separated, it is a good idea to identify the two halves with numbered pieces of masking tape so they can be easily reconnected.

Gasket sealing surfaces

Throughout any vehicle, gaskets are used to seal the mating surfaces between two parts and keep lubricants, fluids, vacuum or pressure contained in an assembly.

Many times these gaskets are coated with a liquid or paste-type gasket sealing compound before assembly. Age, heat and pressure can sometimes cause the two parts to stick together so tightly that they are very difficult to separate. Often, the assembly can be loosened by striking it with a soft-face hammer near the mating surfaces. A regular hammer can be used if a block of wood is placed between the hammer and the part. Do not hammer on cast parts or parts that could be easily damaged. With any particularly stubborn part, always recheck to make sure that every fastener has been removed.

Avoid using a screwdriver or bar to pry apart an assembly, as they can easily mar the gasket sealing surfaces of the parts, which must remain smooth. If prying is absolutely necessary, use an old broom handle, but keep in mind that extra clean up will be necessary if the wood splinters.

After the parts are separated, the old gasket must be carefully scraped off and the gasket surfaces cleaned. Stubborn gasket material can be soaked with rust penetrant or treated with a special chemical to soften it so it can be easily scraped off. A scraper can be fashioned from a piece of copper tubing by flattening and sharpening one end. Copper is recommended because it is usually softer than the surfaces to be scraped, which reduces the chance of gouging the part. Some gaskets can be removed with a wire brush, but regardless of the method used, the mating surfaces must be left clean and smooth. If for some reason the gasket surface is gouged, then a gasket sealer thick enough to fill scratches will have to be used during reassembly of the components. For most applications, a non-drying (or semi-drying) gasket sealer should be used.

Hose removal tips

Warning: *If the vehicle is equipped with air conditioning, do not disconnect any of the A/C hoses without first having the system depressurized by a dealer service department or a service station.*

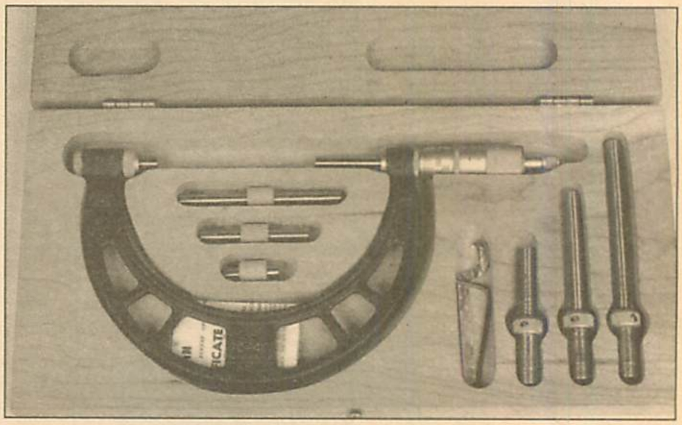
Hose removal precautions closely parallel gasket removal precautions. Avoid scratching or gouging the surface that the hose mates against or the connection may leak. This is especially true for radiator hoses. Because of various chemical reactions, the rubber in hoses can bond itself to the metal spigot that the hose fits over. To remove a hose, first loosen the hose clamps that secure it to the spigot. Then, with slip-joint pliers, grab the hose at the clamp and rotate it around the spigot. Work it back and forth until it is completely free, then pull it off. Silicone or other lubricants will ease removal if they can be applied between the hose and the outside of the spigot. Apply the same lubricant to the inside of the hose and the outside of the spigot to simplify installation.

As a last resort (and if the hose is to be replaced with a new one anyway), the rubber can be slit with a knife and the hose peeled from the spigot. If this must be done, be careful that the metal connection is not damaged.

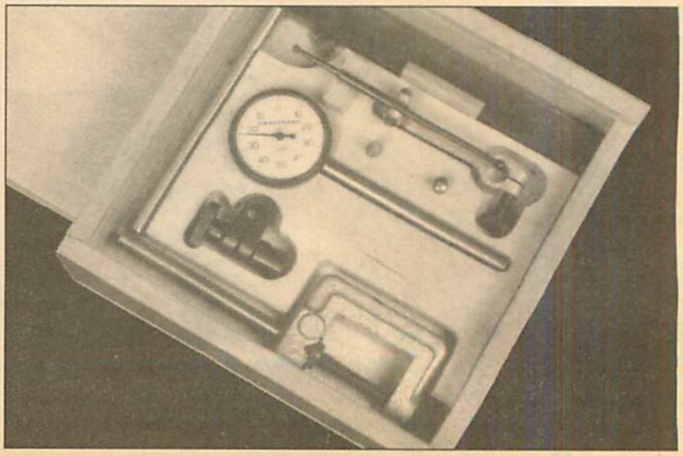
If a hose clamp is broken or damaged, do not reuse it. Wire-type clamps usually weaken with age, so it is a good idea to replace them with screw-type clamps whenever a hose is removed.

Tools

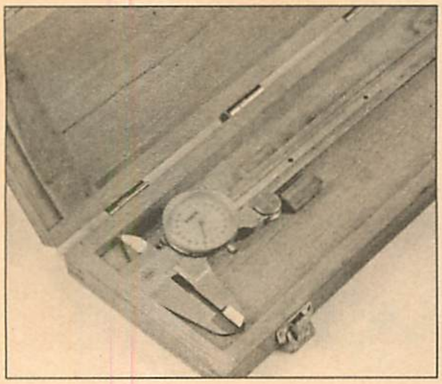
A selection of good tools is a basic requirement for anyone who plans to maintain and repair his or her own vehicle. For the owner who has few tools, the initial investment might seem high, but when compared to the spiraling costs of professional auto maintenance and repair, it is a wise one.



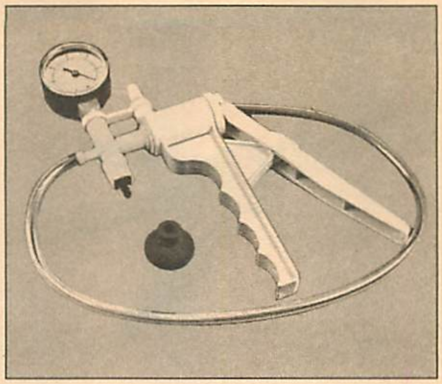
Micrometer set



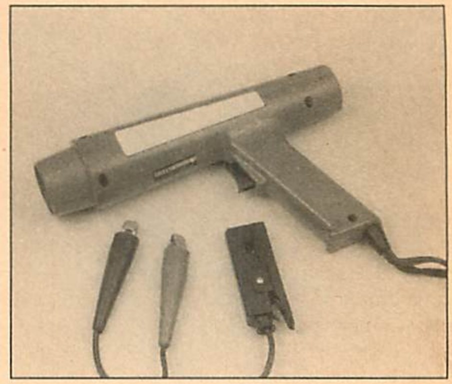
Dial indicator set



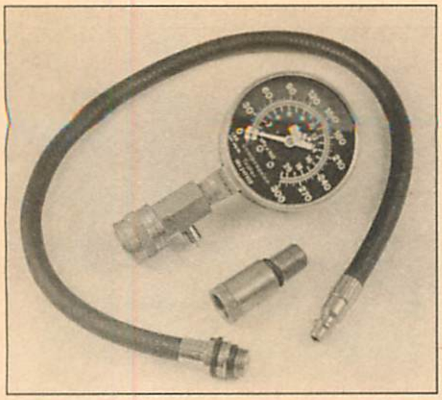
Dial caliper



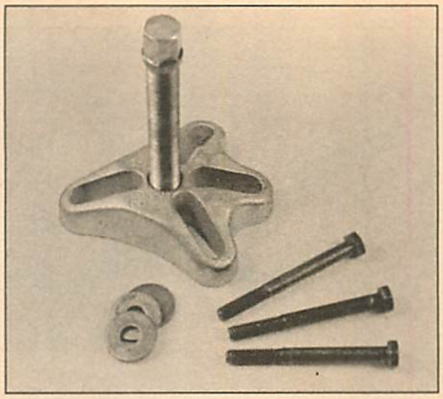
Hand-operated vacuum pump



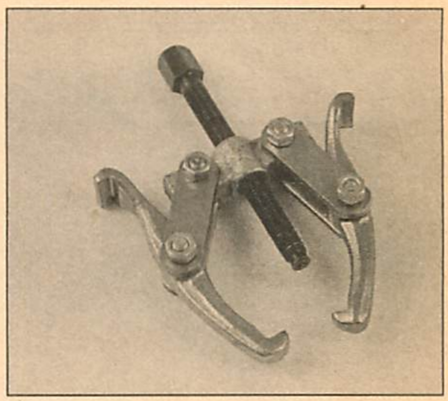
Timing light



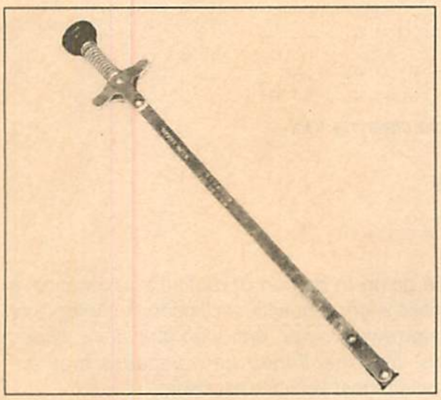
Compression gauge with spark plug hole adapter



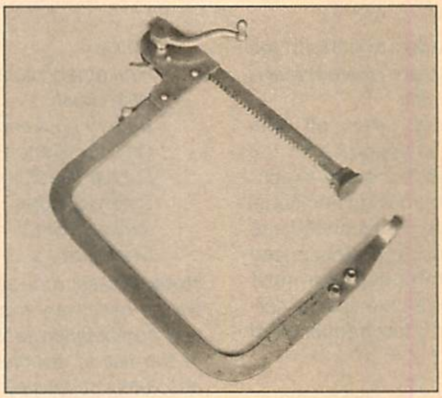
Damper/steering wheel puller



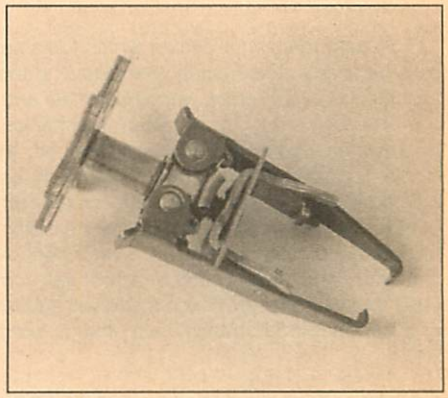
General purpose puller



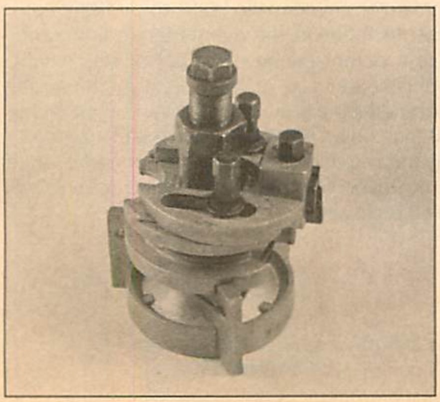
Hydraulic lifter removal tool



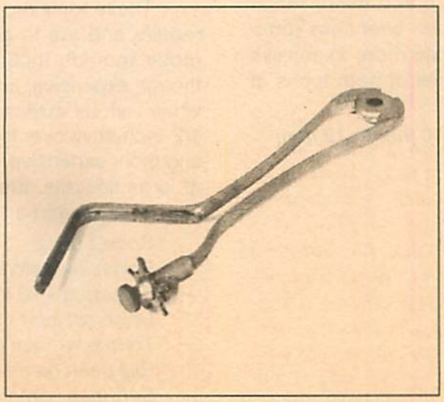
Valve spring compressor



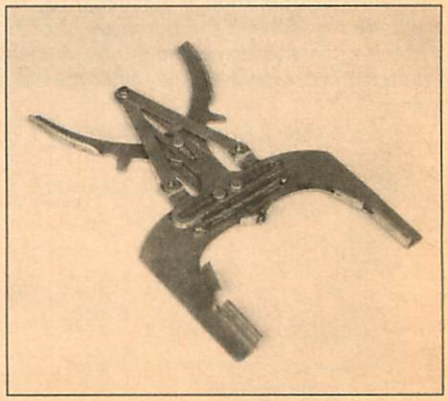
Valve spring compressor



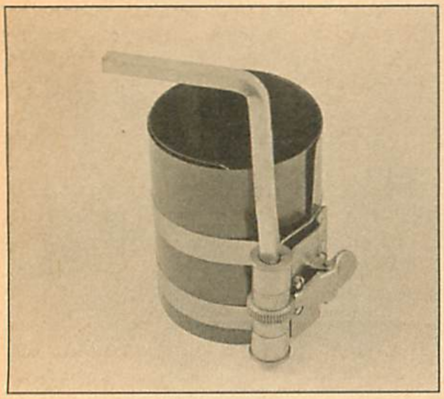
Ridge reamer



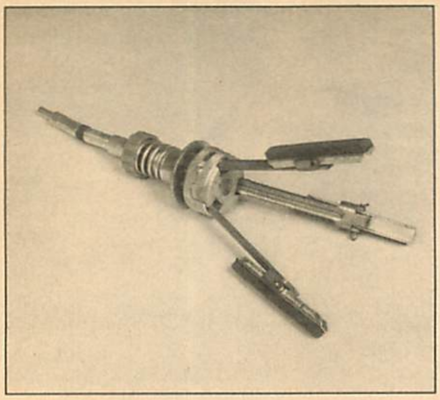
Piston ring groove cleaning tool



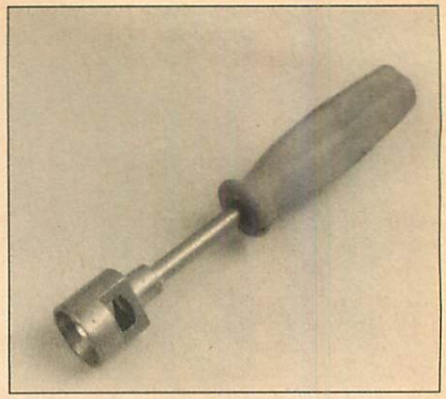
Ring removal/installation tool



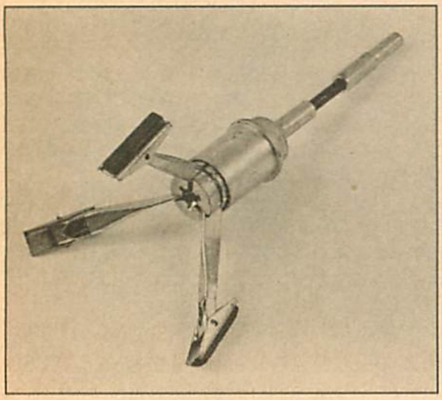
Ring compressor



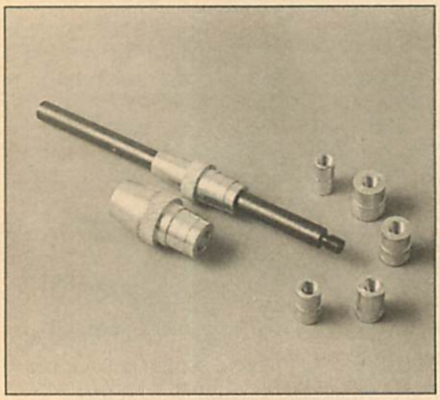
Cylinder hone



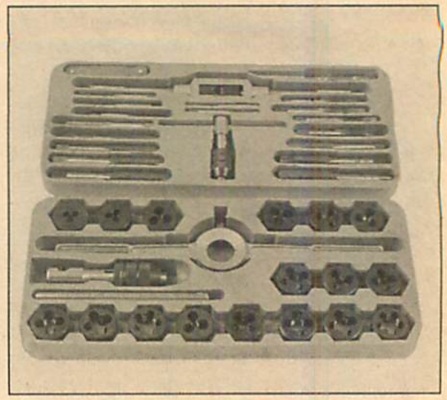
Brake hold-down spring tool



Brake cylinder hone



Clutch plate alignment tool



Tap and die set

To help the owner decide which tools are needed to perform the tasks detailed in this manual, the following tool lists are offered: *Maintenance and minor repair, Repair/overhaul* and *Special.*

The newcomer to practical mechanics should start off with the *maintenance and minor repair* tool kit, which is adequate for the simpler jobs performed on a vehicle. Then, as confidence and experience grow, the owner can tackle more difficult tasks, buying additional tools as they are needed. Eventually the basic kit will be expanded into the *repair and overhaul* tool set. Over a period of time, the experienced do-it-yourselfer will assemble a tool set complete enough for most repair and overhaul procedures and will add tools from the special category when it is felt that the expense is justified by the frequency of use.

Maintenance and minor repair tool kit

The tools in this list should be considered the minimum required for performance of routine maintenance, servicing and minor repair work. We recommend the purchase of combination wrenches (box-end and open-end combined in one wrench). While more expensive than open end wrenches, they offer the advantages of both types of wrench.

Combination wrench set (1/4-inch to 1 inch or 6 mm to 19 mm)
Adjustable wrench, 8 inch
Spark plug wrench with rubber insert
Spark plug gap adjusting tool
Feeler gauge set
Brake bleeder wrench
Standard screwdriver (5/16-inch x 6 inch)
Phillips screwdriver (No. 2 x 6 inch)
Combination pliers - 6 inch
Hacksaw and assortment of blades
Tire pressure gauge
Grease gun
Oil can
Fine emery cloth
Wire brush
Battery post and cable cleaning tool
Oil filter wrench
Funnel (medium size)
Safety goggles
Jackstands (2)
Drain pan

Note: *If basic tune-ups are going to be part of routine maintenance, it will be necessary to purchase a good quality stroboscopic timing light and combination tachometer/dwell meter. Although they are included in the list of special tools, it is mentioned here because they are absolutely necessary for tuning most vehicles properly.*

Repair and overhaul tool set

These tools are essential for anyone who plans to perform major repairs and are in addition to those in the maintenance and minor repair tool kit. Included is a comprehensive set of sockets which, though expensive, are invaluable because of their versatility, especially when various extensions and drives are available. We recommend the 1/2-inch drive over the 3/8-inch drive. Although the larger drive is bulky and more expensive, it has the capacity of accepting a very wide range of large sockets. Ideally, however, the mechanic should have a 3/8-inch drive set and a 1/2-inch drive set.

Socket set(s)
Reversible ratchet
Extension - 10 inch
Universal joint
Torque wrench (same size drive as sockets)
Ball peen hammer - 8 ounce
Soft-face hammer (plastic/rubber)
Standard screwdriver (1/4-inch x 6 inch)

Standard screwdriver (stubby - 5/16-inch)
Phillips screwdriver (No. 3 x 8 inch)
Phillips screwdriver (stubby - No. 2)
Pliers - vise grip
Pliers - lineman's
Pliers - needle nose
Pliers - snap-ring (internal and external)
Cold chisel - 1/2-inch
Scribe
Scraper (made from flattened copper tubing)
Centerpunch
Pin punches (1/16, 1/8, 3/16-inch)
Steel rule/straightedge - 12 inch
Allen wrench set (1/8 to 3/8-inch or 4 mm to 10 mm)
A selection of files
Wire brush (large)
Jackstands (second set)
Jack (scissor or hydraulic type)

Note: *Another tool which is often useful is an electric drill with a chuck capacity of 3/8-inch and a set of good quality drill bits.*

Special tools

The tools in this list include those which are not used regularly, are expensive to buy, or which need to be used in accordance with their manufacturer's instructions. Unless these tools will be used frequently, it is not very economical to purchase many of them. A consideration would be to split the cost and use between yourself and a friend or friends. In addition, most of these tools can be obtained from a tool rental shop on a temporary basis.

This list primarily contains only those tools and instruments widely available to the public, and not those special tools produced by the vehicle manufacturer for distribution to dealer service departments. Occasionally, references to the manufacturer's special tools are included in the text of this manual. Generally, an alternative method of doing the job without the special tool is offered. However, sometimes there is no alternative to their use. Where this is the case, and the tool cannot be purchased or borrowed, the work should be turned over to the dealer service department or an automotive repair shop.

Valve spring compressor
Piston ring groove cleaning tool
Piston ring compressor
Piston ring installation tool
Cylinder compression gauge
Cylinder ridge reamer
Cylinder surfacing hone
Cylinder bore gauge
Micrometers and/or dial calipers
Hydraulic lifter removal tool
Balljoint separator
Universal-type puller
Impact screwdriver
Dial indicator set
Stroboscopic timing light (inductive pick-up)
Hand operated vacuum/pressure pump
Tachometer/dwell meter
Universal electrical multimeter
Cable hoist
Brake spring removal and installation tools
Floor jack

Buying tools

For the do-it-yourselfer who is just starting to get involved in vehicle maintenance and repair, there are a number of options available when purchasing tools. If maintenance and minor repair is the extent of the work to be done, the purchase of individual tools is satisfactory. If, on the other hand, extensive work is planned, it would be a good idea to purchase a modest tool set from one of the large retail chain stores. A set can usually be bought at a substantial savings over the individual tool prices, and they often come with a tool box. As additional tools are needed, add-on sets, individual tools and a larger tool box can be purchased to expand the tool selection. Building a tool set gradually allows the cost of the tools to be spread over a longer period of time and gives the mechanic the freedom to choose only those tools that will actually be used.

Tool stores will often be the only source of some of the special tools that are needed, but regardless of where tools are bought, try to avoid cheap ones, especially when buying screwdrivers and sockets, because they won't last very long. The expense involved in replacing cheap tools will eventually be greater than the initial cost of quality tools.

Care and maintenance of tools

Good tools are expensive, so it makes sense to treat them with respect. Keep them clean and in usable condition and store them properly when not in use. Always wipe off any dirt, grease or metal chips before putting them away. Never leave tools lying around in the work area. Upon completion of a job, always check closely under the hood for tools that may have been left there so they won't get lost during a test drive.

Some tools, such as screwdrivers, pliers, wrenches and sockets, can be hung on a panel mounted on the garage or workshop wall, while others should be kept in a tool box or tray. Measuring instruments, gauges, meters, etc. must be carefully stored where they cannot be damaged by weather or impact from other tools.

When tools are used with care and stored properly, they will last a very long time. Even with the best of care, though, tools will wear out if used frequently. When a tool is damaged or worn out, replace it. Subsequent jobs will be safer and more enjoyable if you do.

How to repair damaged threads

Sometimes, the internal threads of a nut or bolt hole can become stripped, usually from overtightening. Stripping threads is an all-too-common occurrence, especially when working with aluminum parts, because aluminum is so soft that it easily strips out.

Usually, external or internal threads are only partially stripped. After they've been cleaned up with a tap or die, they'll still work. Sometimes, however, threads are badly damaged. When this happens, you've got three choices:

1) *Drill and tap the hole to the next suitable oversize and install a larger diameter bolt, screw or stud.*
2) *Drill and tap the hole to accept a threaded plug, then drill and tap the plug to the original screw size. You can also buy a plug already threaded to the original size. Then you simply drill a hole to the specified size, then run the threaded plug into the hole with a bolt and jam nut. Once the plug is fully seated, remove the jam nut and bolt.*
3) *The third method uses a patented thread repair kit like Heli-Coil or Slimsert. These easy-to-use kits are designed to repair damaged threads in straight-through holes and blind holes. Both are available as kits which can handle a variety of sizes and thread patterns. Drill the hole, then tap it with the special included tap. Install the Heli-Coil and the hole is back to its original diameter and thread pitch.*

Regardless of which method you use, be sure to proceed calmly and carefully. A little impatience or carelessness during one of these relatively simple procedures can ruin your whole day's work and cost you a bundle if you wreck an expensive part.

Working facilities

Not to be overlooked when discussing tools is the workshop. If anything more than routine maintenance is to be carried out, some sort of suitable work area is essential.

It is understood, and appreciated, that many home mechanics do not have a good workshop or garage available, and end up removing an engine or doing major repairs outside. It is recommended, however, that the overhaul or repair be completed under the cover of a roof.

A clean, flat workbench or table of comfortable working height is an absolute necessity. The workbench should be equipped with a vise that has a jaw opening of at least four inches.

As mentioned previously, some clean, dry storage space is also required for tools, as well as the lubricants, fluids, cleaning solvents, etc. which soon become necessary.

Sometimes waste oil and fluids, drained from the engine or cooling system during normal maintenance or repairs, present a disposal problem. To avoid pouring them on the ground or into a sewage system, pour the used fluids into large containers, seal them with caps and take them to an authorized disposal site or recycling center. Plastic jugs, such as old antifreeze containers, are ideal for this purpose.

Always keep a supply of old newspapers and clean rags available. Old towels are excellent for mopping up spills. Many mechanics use rolls of paper towels for most work because they are readily available and disposable. To help keep the area under the vehicle clean, a large cardboard box can be cut open and flattened to protect the garage or shop floor.

Whenever working over a painted surface, such as when leaning over a fender to service something under the hood, always cover it with an old blanket or bedspread to protect the finish. Vinyl covered pads, made especially for this purpose, are available at auto parts stores.

Booster battery (jump) starting

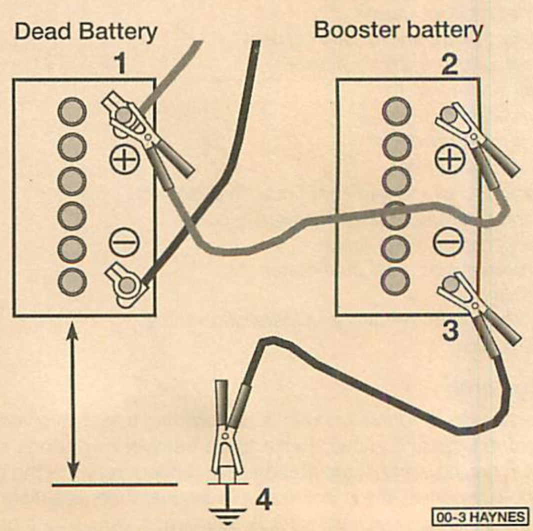
Observe these precautions when using a booster battery to start a vehicle:

a) Before connecting the booster battery, make sure the ignition switch is in the Off position.
b) Turn off the lights, heater and other electrical loads.
c) Your eyes should be shielded. Safety goggles are a good idea.
d) Make sure the booster battery is the same voltage as the dead one in the vehicle.
e) The two vehicles MUST NOT TOUCH each other!
f) Make sure the transaxle is in Neutral (manual) or Park (automatic).
g) If the booster battery is not a maintenance-free type, remove the vent caps and lay a cloth over the vent holes.

Connect the red jumper cable to the positive (+) terminals of each battery **(see illustration)**.

Connect one end of the black jumper cable to the negative (-) terminal of the booster battery. The other end of this cable should be connected to a good ground on the vehicle to be started, such as a bolt or bracket on the body.

Start the engine using the booster battery, then, with the engine running at idle speed, disconnect the jumper cables in the reverse order of connection.



Make the booster battery cable connections in the numerical order shown (note that the negative cable of the booster battery is NOT attached to the negative terminal of the dead battery)

Jacking and towing

Jacking

The jack supplied with the vehicle should only be used for raising the vehicle when changing a tire or placing jackstands under the frame. **Warning:** *Never work under the vehicle or start the engine while this jack is being used as the only means of support.*

The vehicle should be on level ground with the hazard flashers on, the wheels blocked, the parking brake applied and the transmission in Park (automatic) or Reverse (manual). If a tire is being changed, loosen the lug nuts one-half turn and leave them in place until the wheel is raised off the ground.

Place the jack under the vehicle in the indicated position **(see illustrations)**. Operate the jack with a slow, smooth motion until the wheel is raised off the ground. Remove the lug nuts, pull off the wheel, install the spare and thread the lug nuts back on with the beveled sides facing in. Tighten them snugly, but wait until the vehicle is lowered to tighten them completely. Note that some spare tires are designed for temporary use only - don't exceed the recommended speed, mileage or other restrictions accompanying the spare.

Lower the vehicle, remove the jack and tighten the nuts (if loosened or removed) in a criss-cross pattern.

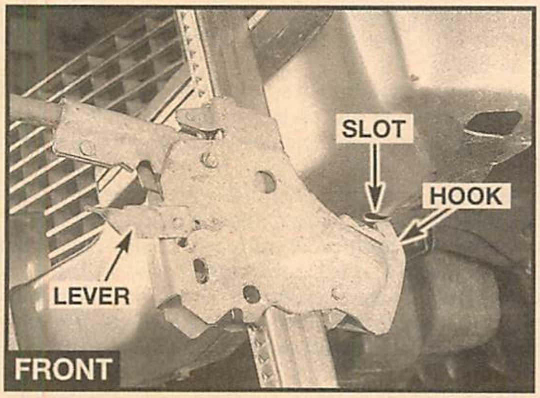
Towing

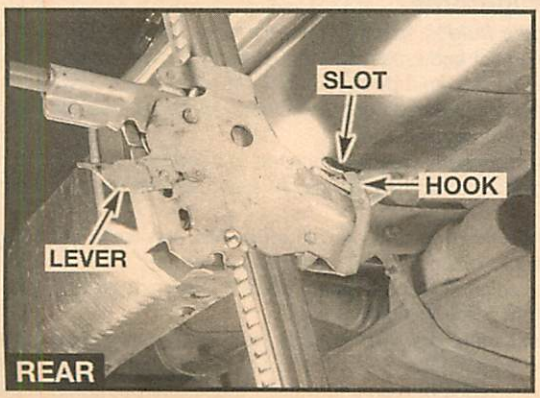
As a general rule, vehicles can be towed with all four wheels on the ground, provided that the driveshaft(s) are removed (see Chapter 8).

Equipment specifically designed for towing should be used and should be attached to the main structural members of the vehicle, not the bumper or brackets. Tow hooks are attached to the frame at both ends of the vehicle. However, they are for emergency use only and should not be used for highway towing. Stand clear of vehicles when using the tow hooks - tow straps and chains may break, causing serious injury.

Safety is a major consideration when towing and all applicable state and local laws must be obeyed. A safety chain must be used for all towing (in addition to the tow bar).

While towing, the parking brake should be released and the transmission and (if equipped) transfer case must be in Neutral. The steering must be unlocked (ignition switch in the Off position). Remember that power steering and power brakes will not work with the engine off.





On early models, a bumper jack is used to raise the vehicle - it either fits into a slot in the bumper , as shown , or hooks onto the lower edge of the bumper at a specific location (see owner's manual for the location)

On later models, place the jack on the side of the vehicle under the frame rail

Automotive chemicals and lubricants

A number of automotive chemicals and lubricants are available for use during vehicle maintenance and repair. They include a wide variety of products ranging from cleaning solvents and degreasers to lubricants and protective sprays for rubber, plastic and vinyl.

Cleaners

Carburetor cleaner and choke cleaner is a strong solvent for gum, varnish and carbon. Most carburetor cleaners leave a dry-type lubricant film which will not harden or gum up. Because of this film it is not recommended for use on electrical components.

Brake system cleaner is used to remove grease and brake fluid from the brake system, where clean surfaces are absolutely necessary. It leaves no residue and often eliminates brake squeal caused by contaminants.

Electrical cleaner removes oxidation, corrosion and carbon deposits from electrical contacts, restoring full current flow. It can also be used to clean spark plugs, carburetor jets, voltage regulators and other parts where an oil-free surface is desired.

Demoisturants remove water and moisture from electrical components such as alternators, voltage regulators, electrical connectors and fuse blocks. They are non-conductive, non-corrosive and non-flammable.

Degreasers are heavy-duty solvents used to remove grease from the outside of the engine and from chassis components. They can be sprayed or brushed on and, depending on the type, are rinsed off either with water or solvent.

Lubricants

Motor oil is the lubricant formulated for use in engines. It normally contains a wide variety of additives to prevent corrosion and reduce foaming and wear. Motor oil comes in various weights (viscosity ratings) from 5 to 80. The recommended weight of the oil depends on the season, temperature and the demands on the engine. Light oil is used in cold climates and under light load conditions. Heavy oil is used in hot climates and where high loads are encountered. Multi-viscosity oils are designed to have characteristics of both light and heavy oils and are available in a number of weights from 5W-20 to 20W-50.

Gear oil is designed to be used in differentials, manual transmissions and other areas where high-temperature lubrication is required.

Chassis and wheel bearing grease is a heavy grease used where increased loads and friction are encountered, such as for wheel bearings, balljoints, tie-rod ends and universal joints.

High-temperature wheel bearing grease is designed to withstand the extreme temperatures encountered by wheel bearings in disc brake equipped vehicles. It usually contains molybdenum disulfide (moly), which is a dry-type lubricant.

White grease is a heavy grease for metal-to-metal applications where water is a problem. White grease stays soft under both low and high temperatures (usually from -100 to +190-degrees F), and will not wash off or dilute in the presence of water.

Assembly lube is a special extreme pressure lubricant, usually containing moly, used to lubricate high-load parts (such as main and rod bearings and cam lobes) for initial start-up of a new engine. The assembly lube lubricates the parts without being squeezed out or washed away until the engine oiling system begins to function.

Silicone lubricants are used to protect rubber, plastic, vinyl and nylon parts.

Graphite lubricants are used where oils cannot be used due to contamination problems, such as in locks. The dry graphite will lubricate metal parts while remaining uncontaminated by dirt, water, oil or acids. It is electrically conductive and will not foul electrical contacts in locks such as the ignition switch.

Moly penetrants loosen and lubricate frozen, rusted and corroded fasteners and prevent future rusting or freezing.

Heat-sink grease is a special electrically non-conductive grease that is used for mounting electronic ignition modules where it is essential that heat is transferred away from the module.

Sealants

RTV sealant is one of the most widely used gasket compounds. Made from silicone, RTV is air curing, it seals, bonds, waterproofs, fills surface irregularities, remains flexible, doesn't shrink, is relatively easy to remove, and is used as a supplementary sealer with almost all low and medium temperature gaskets.

Anaerobic sealant is much like RTV in that it can be used either to seal gaskets or to form gaskets by itself. It remains flexible, is solvent resistant and fills surface imperfections. The difference between an anaerobic sealant and an RTV-type sealant is in the curing. RTV cures when exposed to air, while an anaerobic sealant cures only in the absence of air. This means that an anaerobic sealant cures only after the assembly of parts, sealing them together.

Thread and pipe sealant is used for sealing hydraulic and pneumatic fittings and vacuum lines. It is usually made from a Teflon compound, and comes in a spray, a paint-on liquid and as a wrap-around tape.

Chemicals

Anti-seize compound prevents seizing, galling, cold welding, rust and corrosion in fasteners. High-temperature ant-seize, usually made with copper and graphite lubricants, is used for exhaust system and exhaust manifold bolts.

Anaerobic locking compounds are used to keep fasteners from vibrating or working loose and cure only after installation, in the absence of air. Medium strength locking compound is used for small nuts, bolts and screws that may be removed later. High-strength locking compound is for large nuts, bolts and studs which aren't removed on a regular basis.

Oil additives range from viscosity index improvers to chemical treatments that claim to reduce internal engine friction. It should be noted that most oil manufacturers caution against using additives with their oils.

Gas additives perform several functions, depending on their chemical makeup. They usually contain solvents that help dissolve gum and varnish that build up on carburetor, fuel injection and intake parts. They also serve to break down carbon deposits that form on the inside surfaces of the combustion chambers. Some additives contain upper cylinder lubricants for valves and piston rings, and others contain chemicals to remove condensation from the gas tank.

Miscellaneous

Brake fluid is specially formulated hydraulic fluid that can withstand the heat and pressure encountered in brake systems. Care must be taken so this fluid does not come in contact with painted surfaces or plastics. An opened container should always be resealed to prevent contamination by water or dirt.

Weatherstrip adhesive is used to bond weatherstripping around doors, windows and trunk lids. It is sometimes used to attach trim pieces.

Undercoating is a petroleum-based, tar-like substance that is designed to protect metal surfaces on the underside of the vehicle from corrosion. It also acts as a sound-deadening agent by insulating the bottom of the vehicle.

Waxes and polishes are used to help protect painted and plated surfaces from the weather. Different types of paint may require the use of different types of wax and polish. Some polishes utilize a chemical or abrasive cleaner to help remove the top layer of oxidized (dull) paint on older vehicles. In recent years many non-wax polishes that contain a wide variety of chemicals such as polymers and silicones have been introduced. These non-wax polishes are usually easier to apply and last longer than conventional waxes and polishes.

Conversion factors

Length (distance)					
Inches (in)	X 25.4	= Millimetres (mm)	X	0.0394	= Inches (in)
Feet (ft)	X 0.305	= Metres (m)	X	3.281	= Feet (ft)
Miles	X 1.609	= Kilometres (km)	X	0.621	= Miles
Volume (capacity)					
Cubic inches (cu in; in^3)	X 16.387	= Cubic centimetres (cc; cm^3)	X	0.061	= Cubic inches (cu in; in^3)
Imperial pints (Imp pt)	X 0.568	= Litres (l)	X	1.76	= Imperial pints (Imp pt)
Imperial quarts (Imp qt)	X 1.137	= Litres (l)	X	0.88	= Imperial quarts (Imp qt)
Imperial quarts (Imp qt)	X 1.201	= US quarts (US qt)	X	0.833	= Imperial quarts (Imp qt)
US quarts (US qt)	X 0.946	= Litres (l)	X	1.057	= US quarts (US qt)
Imperial gallons (Imp gal)	X 4.546	= Litres (l)	X	0.22	= Imperial gallons (Imp gal)
Imperial gallons (Imp gal)	X 1.201	= US gallons (US gal)	X	0.833	= Imperial gallons (Imp gal)
US gallons (US gal)	X 3.785	= Litres (l)	X	0.264	= US gallons (US gal)
Mass (weight)					
Ounces (oz)	X 28.35	= Grams (g)	X	0.035	= Ounces (oz)
Pounds (lb)	X 0.454	= Kilograms (kg)	X	2.205	= Pounds (lb)
Force					
Ounces-force (ozf; oz)	X 0.278	= Newtons (N)	X	3.6	= Ounces-force (ozf; oz)
Pounds-force (lbf; lb)	X 4.448	= Newtons (N)	X	0.225	= Pounds-force (lbf; lb)
Newtons (N)	X 0.1	= Kilograms-force (kgf; kg)	X	9.81	= Newtons (N)
Pressure					
Pounds-force per square inch (psi; lbf/in^2; lb/in^2)	X 0.070	= Kilograms-force per square centimetre (kgf/cm^2; kg/cm^2)	X	14.223	= Pounds-force per square inch (psi; lbf/in^2; lb/in^2)
Pounds-force per square inch (psi; lbf/in^2; lb/in^2)	X 0.068	= Atmospheres (atm)	X	14.696	= Pounds-force per square inch (psi; lbf/in^2; lb/in^2)
Pounds-force per square inch (psi; lbf/in^2; lb/in^2)	X 0.069	= Bars	X	14.5	= Pounds-force per square inch (psi; lbf/in^2; lb/in^2)
Pounds-force per square inch (psi; lbf/in^2; lb/in^2)	X 6.895	= Kilopascals (kPa)	X	0.145	= Pounds-force per square inch (psi; lbf/in^2; lb/in^2)
Kilopascals (kPa)	X 0.01	= Kilograms-force per square centimetre (kgf/cm^2; kg/cm^2)	X	98.1	= Kilopascals (kPa)
Torque (moment of force)					
Pounds-force inches (lbf in; lb in)	X 1.152	= Kilograms-force centimetre (kgf cm; kg cm)	X	0.868	= Pounds-force inches (lbf in; lb in)
Pounds-force inches (lbf in; lb in)	X 0.113	= Newton metres (Nm)	X	8.85	= Pounds-force inches (lbf in; lb in)
Pounds-force inches (lbf in; lb in)	X 0.083	= Pounds-force feet (lbf ft; lb ft)	X	12	= Pounds-force inches (lbf in; lb in)
Pounds-force feet (lbf ft; lb ft)	X 0.138	= Kilograms-force metres (kgf m; kg m)	X	7.233	= Pounds-force feet (lbf ft; lb ft)
Pounds-force feet (lbf ft; lb ft)	X 1.356	= Newton metres (Nm)	X	0.738	= Pounds-force feet (lbf ft; lb ft)
Newton metres (Nm)	X 0.102	= Kilograms-force metres (kgf m; kg m)	X	9.804	= Newton metres (Nm)
Power					
Horsepower (hp)	X 745.7	= Watts (W)	X	0.0013	= Horsepower (hp)
Velocity (speed)					
Miles per hour (miles/hr; mph)	X 1.609	= Kilometres per hour (km/hr; kph)	X	0.621	= Miles per hour (miles/hr; mph)
Fuel consumption*					
Miles per gallon, Imperial (mpg)	X 0.354	= Kilometres per litre (km/l)	X	2.825	= Miles per gallon, Imperial (mpg)
Miles per gallon, US (mpg)	X 0.425	= Kilometres per litre (km/l)	X	2.352	= Miles per gallon, US (mpg)

Temperature

Degrees Fahrenheit = (°C x 1.8) + 32   Degrees Celsius (Degrees Centigrade; °C) = (°F - 32) x 0.56

**It is common practice to convert from miles per gallon (mpg) to litres/100 kilometres (l/100km), where mpg (Imperial) x l/100 km = 282 and mpg (US) x l/100 km = 235*

Safety first!

Regardless of how enthusiastic you may be about getting on with the job at hand, take the time to ensure that your safety is not jeopardized. A moment's lack of attention can result in an accident, as can failure to observe certain simple safety precautions. The possibility of an accident will always exist, and the following points should not be considered a comprehensive list of all dangers. Rather, they are intended to make you aware of the risks and to encourage a safety conscious approach to all work you carry out on your vehicle.

Essential DOs and DON'Ts

DON'T rely on a jack when working under the vehicle. Always use approved jackstands to support the weight of the vehicle and place them under the recommended lift or support points.

DON'T attempt to loosen extremely tight fasteners (i.e. wheel lug nuts) while the vehicle is on a jack - it may fall.

DON'T start the engine without first making sure that the transmission is in Neutral (or Park where applicable) and the parking brake is set.

DON'T remove the radiator cap from a hot cooling system - let it cool or cover it with a cloth and release the pressure gradually.

DON'T attempt to drain the engine oil until you are sure it has cooled to the point that it will not burn you.

DON'T touch any part of the engine or exhaust system until it has cooled sufficiently to avoid burns.

DON'T siphon toxic liquids such as gasoline, antifreeze and brake fluid by mouth, or allow them to remain on your skin.

DON'T inhale brake lining dust - it is potentially hazardous (see *Asbestos* below).

DON'T allow spilled oil or grease to remain on the floor - wipe it up before someone slips on it.

DON'T use loose fitting wrenches or other tools which may slip and cause injury.

DON'T push on wrenches when loosening or tightening nuts or bolts. Always try to pull the wrench toward you. If the situation calls for pushing the wrench away, push with an open hand to avoid scraped knuckles if the wrench should slip.

DON'T attempt to lift a heavy component alone - get someone to help you.

DON'T rush or take unsafe shortcuts to finish a job.

DON'T allow children or animals in or around the vehicle while you are working on it.

DO wear eye protection when using power tools such as a drill, sander, bench grinder, etc. and when working under a vehicle.

DO keep loose clothing and long hair well out of the way of moving parts.

DO make sure that any hoist used has a safe working load rating adequate for the job.

DO get someone to check on you periodically when working alone on a vehicle.

DO carry out work in a logical sequence and make sure that everything is correctly assembled and tightened.

DO keep chemicals and fluids tightly capped and out of the reach of children and pets.

DO remember that your vehicle's safety affects that of yourself and others. If in doubt on any point, get professional advice.

Asbestos

Certain friction, insulating, sealing, and other products - such as brake linings, brake bands, clutch linings, torque converters, gaskets, etc. - may contain asbestos. Extreme care must be taken to avoid inhalation of dust from such products, since it is hazardous to health. If in doubt, assume that they do contain asbestos.

Fire

Remember at all times that gasoline is highly flammable. Never smoke or have any kind of open flame around when working on a vehicle. But the risk does not end there. A spark caused by an electrical short circuit, by two metal surfaces contacting each other, or even by static electricity built up in your body under certain conditions, can ignite gasoline vapors, which in a confined space are highly explosive. Do not, under any circumstances, use gasoline for cleaning parts. Use an approved safety solvent.

Always disconnect the battery ground (-) cable at the battery before working on any part of the fuel system or electrical system. Never risk spilling fuel on a hot engine or exhaust component. It is strongly recommended that a fire extinguisher suitable for use on fuel and electrical fires be kept handy in the garage or workshop at all times. Never try to extinguish a fuel or electrical fire with water.

Fumes

Certain fumes are highly toxic and can quickly cause unconsciousness and even death if inhaled to any extent. Gasoline vapor falls into this category, as do the vapors from some cleaning solvents. Any draining or pouring of such volatile fluids should be done in a well ventilated area.

When using cleaning fluids and solvents, read the instructions on the container carefully. Never use materials from unmarked containers.

Never run the engine in an enclosed space, such as a garage. Exhaust fumes contain carbon monoxide, which is extremely poisonous. If you need to run the engine, always do so in the open air, or at least have the rear of the vehicle outside the work area.

If you are fortunate enough to have the use of an inspection pit, never drain or pour gasoline and never run the engine while the vehicle is over the pit. The fumes, being heavier than air, will concentrate in the pit with possibly lethal results.

The battery

Never create a spark or allow a bare light bulb near a battery. They normally give off a certain amount of hydrogen gas, which is highly explosive.

Always disconnect the battery ground (-) cable at the battery before working on the fuel or electrical systems.

If possible, loosen the filler caps or cover when charging the battery from an external source (this does not apply to sealed or maintenance-free batteries). Do not charge at an excessive rate or the battery may burst.

Take care when adding water to a non maintenance-free battery and when carrying a battery. The electrolyte, even when diluted, is very corrosive and should not be allowed to contact clothing or skin.

Always wear eye protection when cleaning the battery to prevent the caustic deposits from entering your eyes.

Household current

When using an electric power tool, inspection light, etc., which operates on household current, always make sure that the tool is correctly connected to its plug and that, where necessary, it is properly grounded. Do not use such items in damp conditions and, again, do not create a spark or apply excessive heat in the vicinity of fuel or fuel vapor.

Secondary ignition system voltage

A severe electric shock can result from touching certain parts of the ignition system (such as the spark plug wires) when the engine is running or being cranked, particularly if components are damp or the insulation is defective. In the case of an electronic ignition system, the secondary system voltage is much higher and could prove fatal.

Troubleshooting

Contents

This Section provides an easy reference guide to the more common problems that may occur during the operation of your vehicle. Various symptoms and their probable causes are grouped under headings denoting components or systems, such as Engine, Cooling system, etc. They also refer to the Chapter and/or Section that deals with the problem.

Remember that successful troubleshooting isn't a mysterious 'black art' practiced only by professional mechanics, it's simply the result of knowledge combined with an intelligent, systematic approach to a problem. Always use a process of elimination starting with the simplest solution and working through to the most complex - and never overlook the obvious. Anyone can run the gas tank dry or leave the lights on overnight, so don't assume that you're exempt from such oversights.

Finally, always establish a clear idea why a problem has occurred and take steps to ensure that it doesn't happen again. If the electrical system fails because of a poor connection, check all other connections in the system to make sure they don't fail as well. If a particular fuse continues to blow, find out why - don't just go on replacing fuses. Remember, failure of a small component can often be indicative of potential failure or incorrect functioning of a more important component or system.

Engine and performance

1 Engine will not rotate when attempting to start

1 Battery terminal connections loose or corroded. Check the cable terminals at the battery; tighten cable clamp and/or clean off corrosion as necessary (see Chapter 1).

2 Battery discharged or faulty. If the cable ends are clean and tight on the battery posts, turn the key to the On position and switch on the headlights or windshield wipers. If they won't run, the battery is discharged.

3 Automatic transmission not engaged in park (P) or Neutral (N).

4 Broken, loose or disconnected wires in the starting circuit. Inspect all wires and connectors at the battery, starter solenoid and ignition switch.

5 Starter motor pinion jammed in flywheel ring gear. If manual transmission, place transmission in gear and rock the vehicle to manually turn the engine. Remove starter (Chapter 5) and inspect pinion and flywheel (Chapter 2) at earliest convenience.

6 Starter relay (1972 through 1988) or solenoid (1989 through 1991) faulty (Chapter 5).

7 Starter motor faulty (Chapter 5).

8 Ignition switch faulty (Chapter 12).

9 Engine seized. Try to turn the crankshaft with a large socket and breaker bar on the pulley bolt.

10 Starter relay terminals corroded (Chapter 5).

2 Engine rotates but will not start

1 Fuel tank empty.

2 Battery discharged (engine rotates slowly). Check the operation of electrical components as described in previous Section.

3 Battery terminal connections loose or corroded. See previous Section.

4 Fuel not reaching carburetor. Check for clogged fuel filter or lines and defective fuel pump. Also make sure the tank vent lines aren't clogged (Chapter 4).

5 Choke not operating properly (Chapter 1).

6 Faulty distributor components. Check the cap and rotor (Chapter 1).

7 Low cylinder compression. Check as described in Chapter 2.

8 Water in fuel. Drain tank and fill with new fuel.

9 Defective ignition coil (Chapter 5).

10 Dirty or clogged carburetor jets. Carburetor out of adjustment. Check the float level (Chapter 4).

11 Wet or damaged ignition components (Chapters 1 and 5).

12 Worn, faulty or incorrectly gapped spark plugs (Chapter 1).

13 Broken, loose or disconnected wires in the starting circuit (see previous Section).

14 Loose distributor (changing ignition timing). Turn the distributor body as necessary to start the engine, then adjust the ignition timing as soon as possible (Chapter 1).

15 Broken, loose or disconnected wires at the ignition coil or faulty coil (Chapter 5).

16 Timing chain failure or wear affecting valve timing (Chapter 2).

3 Starter motor operates without turning engine

1 Starter pinion sticking. Remove the starter (Chapter 5) and inspect.

2 Starter pinion or flywheel/driveplate teeth worn or broken. Remove the inspection cover and inspect.

4 Engine hard to start when cold

1 Battery discharged or faulty. Check as described in Chapter 1.

2 Fuel not reaching the carburetor. Check the fuel filter, lines and fuel pump (Chapters 1 and 4).

3 Choke inoperative (Chapters 1 and 4).

4 Defective spark plugs (Chapter 1).

5 Engine hard to start when hot

1 Air filter dirty (Chapter 1).

2 Fuel not reaching carburetor (see Section 4). Check for a vapor lock situation, brought about by clogged fuel tank vent lines.

3 Bad engine ground connection.

4 Choke sticking (Chapter 1).

5 Defective pick-up coil in distributor (Chapter 5).

6 Float level too high (Chapter 4).

6 Starter motor noisy or engages roughly

1 Pinion or flywheel/driveplate teeth worn or broken. Remove the inspection cover on the left side of the engine and inspect.

2 Starter motor mounting bolts loose or missing.

7 Engine starts but stops immediately

1 Loose or damaged wire harness connections at distributor, coil or alternator.

2 Intake manifold vacuum leaks. Make sure all mounting bolts/nuts are tight and all vacuum hoses connected to the manifold are attached properly and in good condition.

3 Insufficient fuel flow (see Chapter 4).

4 Defective ballast resistor (Chapter 5).

8 Engine 'lopes' while idling or idles erratically

1 Vacuum leaks. Check mounting bolts at the intake manifold for tightness. Make sure that all vacuum hoses are connected and in good condition. Use a stethoscope or a length of fuel hose held against your ear to listen for vacuum leaks while the engine is running. A hissing

sound will be heard. A soapy water solution will also detect leaks. Check the intake manifold gasket surfaces.
2 Leaking EGR valve or plugged PCV valve (see Chapters 1 and 6).
3 Air filter clogged (Chapter 1).
4 Fuel pump not delivering sufficient fuel (Chapter 4).
5 Leaking head gasket. Perform a cylinder compression check (Chapter 2).
6 Timing chain worn (Chapter 2).
7 Camshaft lobes worn (Chapter 2).
8 Valves burned or otherwise leaking (Chapter 2).
9 Ignition timing out of adjustment (Chapter 1).
10 Ignition system not operating properly (Chapters 1 and 5).
11 Thermostatic air cleaner not operating properly (Chapter 1).
12 Choke not operating properly (Chapters 1 and 4).
13 Carburetor dirty, clogged or out of adjustment. Check the float level (Chapter 4).
14 Idle speed out of adjustment (Chapter 1).

9 Engine misses at idle speed

1 Spark plugs faulty or not gapped properly (Chapter 1).
2 Faulty spark plug wires (Chapter 1).
3 Wet or damaged distributor components (Chapter 1).
4 Short circuits in ignition, coil or spark plug wires.
5 Sticking or faulty emissions systems (see Chapter 6).
6 Clogged fuel filter and/or foreign matter in fuel. Remove the fuel filter (Chapter 1) and inspect.
7 Vacuum leaks at intake manifold or hose connections.
8 Incorrect idle speed (Chapter 1) or idle mixture (Chapter 4).
9 Incorrect ignition timing (Chapter 1).
10 Low or uneven cylinder compression. Check as described in Chapter 2.
11 Choke not operating properly (Chapter 1).
12 Carburetor dirty, clogged or out of adjustment. (Chapter 4).
13 Defective resistor wire (Chapter 5).

10 Excessively high idle speed

1 Sticking throttle linkage (Chapter 4).
2 Choke opened excessively at idle (Chapter 4).
3 Idle speed incorrectly adjusted (Chapter 1).

11 Battery will not hold a charge

1 Alternator drivebelt defective or not adjusted properly (Chapter 1).
2 Battery cables loose or corroded (Chapter 1).
3 Alternator not charging properly (Chapter 5).
4 Loose, broken or faulty wires in the charging circuit (Chapter 5).
5 Short circuit causing a continuous drain on the battery.
6 Battery defective internally.

12 Alternator light stays on

1 Fault in alternator or charging circuit (Chapter 5).
2 Alternator drivebelt defective or not properly adjusted (Chapter 1).

13 Alternator light fails to come on when key is turned on

1 Faulty bulb (Chapter 12).
2 Defective alternator (Chapter 5).
3 Fault in the printed circuit, dash wiring or bulb holder (Chapter 12).

14 Engine misses throughout driving speed range

1 Fuel filter clogged and/or impurities in the fuel system. Check fuel filter (Chapter 1) or clean system (Chapter 4).
2 Faulty or incorrectly gapped spark plugs (Chapter 1).
3 Incorrect ignition timing (Chapter 1).
4 Cracked distributor cap, disconnected distributor wires or damaged distributor components (Chapter 1).
5 Defective spark plug wires (Chapter 1).
6 Emissions system components faulty (Chapter 6).
7 Low or uneven cylinder compression pressures. Check as described in Chapter 2.
8 Weak or faulty ignition coil (Chapter 5).
9 Weak or faulty ignition system (Chapter 5).
10 Vacuum leaks at intake manifold or vacuum hoses (see Section 8).
11 Dirty or clogged carburetor (Chapter 4).
12 Leaky EGR valve (Chapter 6).
13 Carburetor out of adjustment (Chapter 4).
14 Idle speed out of adjustment (Chapter 1).

15 Hesitation or stumble during acceleration

1 Ignition timing incorrect (Chapter 1).
2 Ignition system not operating properly (Chapter 5).
3 Dirty or clogged carburetor (Chapter 4).
4 Low fuel pressure. Check for proper operation of the fuel pump and for restrictions in the fuel filter and lines (Chapter 4).
5 Carburetor out of adjustment (Chapter 4).
6 Carburetor requires altitude adjustment for operating conditions over 4,000 ft (Chapter 4).
7 Carburetor requires accelerator pump stroke adjustment (Chapter 4).

16 Engine stalls

1 Idle speed incorrect (Chapter 1).
2 Fuel filter clogged and/or water and impurities in the fuel system (Chapter 1).
3 Choke not operating properly (Chapter 1).
4 Damaged or wet distributor cap and wires.
5 Emissions system components faulty (Chapter 6).
6 Faulty or incorrectly gapped spark plugs (Chapter 1). Also check the spark plug wires (Chapter 1).
7 Check for a vacuum leak at the carburetor, intake manifold or vacuum hoses. Check as described in Section 8.
8 Faulty ignition module (Chapter 5).

17 Engine lacks power

1 Incorrect ignition timing (Chapter 1).
2 Excessive play in distributor shaft. At the same time check for a faulty distributor cap, wires, etc. (Chapter 1).
3 Faulty or incorrectly gapped spark plugs (Chapter 1).
4 Air filter dirty (Chapter 1).
5 Faulty ignition coil (Chapter 5).
6 Brakes binding (Chapters 1 and 9).
7 Automatic transmission fluid level incorrect, causing slippage (Chapter 1).
8 Clutch slipping (Chapter 8).
9 Fuel filter clogged and/or impurities in the fuel system (Chapters 1 and 4).
10 EGR system not functioning properly (Chapter 6).

11 Use of sub-standard fuel. Fill tank with proper octane fuel.
12 Low or uneven cylinder compression pressures. Check as described in Chapter 2.
13 Air leak at the carburetor or intake manifold (check as described in Section 8).
14 Dirty or clogged carburetor jets or malfunctioning choke (Chapters 1 and 4).
15 Carburetor requires accelerator pump stroke adjustment (Chapter 4).
16 Restriction in the exhaust system. Check exhaust pipes, mufflers and catalytic converter (Chapter 4).

18 Engine backfires

1 EGR system not functioning properly (Chapter 6).
2 Ignition timing incorrect (Chapter 1).
3 Thermostatic air cleaner system not operating properly (Chapter 6).
4 Vacuum leak (refer to Section 8).
5 Damaged valve springs or sticking valves (Chapter 2).
6 Intake air leak (see Section 8).
7 Carburetor float level out of adjustment (Chapter 4).

19 Engine surges while holding accelerator steady

1 Intake air leak (see Section 8).
2 Fuel pump not working properly (Chapter 4).

20 Pinging or knocking engine sounds when engine is under load

1 Incorrect grade of fuel. Fill tank with fuel of the proper octane rating.
2 Ignition timing incorrect (Chapter 1).
3 Carbon build-up in combustion chambers. Remove cylinder head(s) and clean combustion chambers (Chapter 2).
4 Incorrect spark plugs (Chapter 1).

21 Engine diesels (continues to run) after being turned off

1 Idle speed too high (Chapter 1).
2 Ignition timing incorrect (Chapter 1).
3 Incorrect spark plug heat range (Chapter 1).
4 Intake air leak (see Section 8).
5 Carbon build-up in combustion chambers. Remove the cylinder head(s) and clean the combustion chambers (Chapter 2).
6 Valves sticking (Chapter 2).
7 EGR system not operating properly (Chapter 6).
8 Fuel shut-off system not operating properly (Chapter 6).
9 Check for causes of overheating (Section 27).

22 Low oil pressure

1 Improper grade of oil.
2 Oil pump worn or damaged (Chapter 2).
3 Engine overheating (refer to Section 27).
4 Clogged oil filter (Chapter 1).
5 Clogged oil strainer (Chapter 2).
6 Oil pressure gauge not working properly (Chapter 2).
7 Worn engine bearings (Chapter 2).

23 Excessive oil consumption

1 Loose oil drain plug.
2 Loose bolts or damaged oil pan gasket (Chapter 2).
3 Loose bolts or damaged front cover gasket (Chapter 2).
4 Front or rear crankshaft oil seal leaking (Chapter 2).
5 Loose bolts or damaged rocker arm cover gasket (Chapter 2).
6 Loose oil filter (Chapter 1).
7 Loose or damaged oil pressure switch (Chapter 2).
8 Pistons and cylinders excessively worn (Chapter 2).
9 Piston rings not installed correctly on pistons (Chapter 2).
10 Worn or damaged piston rings (Chapter 2).
11 Intake and/or exhaust valve oil seals worn or damaged (Chapter 2).
12 Worn valve stems.
13 Worn or damaged valves/guides (Chapter 2).

24 Excessive fuel consumption

1 Dirty or clogged air filter element (Chapter 1).
2 Incorrect ignition timing (Chapter 1).
3 Incorrect idle speed (Chapter 1).
4 Low tire pressure or incorrect tire size (Chapter 11).
5 Fuel leakage. Check all connections, lines and components in the fuel system (Chapter 4).
6 Choke not operating properly (Chapter 1).
7 Dirty or clogged carburetor jets (Chapter 4).
8 Restriction in the exhaust system. Check exhaust pipes, muffler and catalytic converter (Chapter 4).

25 Fuel odor

1 Fuel leakage. Check all connections, lines and components in the fuel system (Chapter 4).
2 Fuel tank overfilled. Fill only to automatic shut-off.
3 Charcoal canister filter in Evaporative Emissions Control system clogged (Chapter 1).
4 Vapor leaks from Evaporative Emissions Control system lines (Chapter 6).

26 Miscellaneous engine noises

1 A strong dull noise that becomes more rapid as the engine accelerates indicates worn or damaged crankshaft bearings or an unevenly worn crankshaft. To pinpoint the trouble spot, remove the spark plug wire from one plug at a time and crank the engine over. If the noise stops, the cylinder with the removed plug wire indicates the problem area. Replace the bearing and/or service or replace the crankshaft (Chapter 2).
2 A similar (yet slightly higher pitched) noise to the crankshaft knocking described in the previous paragraph, that becomes more rapid as the engine accelerates, indicates worn or damaged connecting rod bearings (Chapter 2). The procedure for locating the problem cylinder is the same as described in Paragraph 1.
3 An overlapping metallic noise that increases in intensity as the engine speed increases, yet diminishes as the engine warms up indicates abnormal piston and cylinder wear (Chapter 2).To locate the problem cylinder, use the procedure described in Paragraph 1.
4 A rapid clicking noise that becomes faster as the engine accelerates indicates a worn piston pin or piston pin hole. This sound will happen each time the piston hits the highest and lowest points in the stroke (Chapter 2). The procedure for locating the problem piston is described in Paragraph 1.
5 A metallic clicking noise coming from the water pump indicates

worn or damaged water pump bearings or pump. Replace the water pump with a new one (Chapter 3).

6 A rapid tapping sound or clicking sound that becomes faster as the engine speed increases indicates "valve tapping". This can be identified by holding one end of a section of hose to your ear and placing the other end at different spots along the rocker arm cover. The point where the sound is loudest indicates the problem valve. If the problem persists, you likely have a collapsed valve lifter or other damaged valve train component. Changing the engine oil and adding a high viscosity oil treatment will sometimes cure a stuck lifter problem. If the problem still persists, the lifters, pushrods and rocker arms must be removed for inspection (see Chapter 2).

7 A steady metallic rattling or rapping sound coming from the area of the timing chain cover indicates a worn, damaged or out-of-adjustment timing chain. Service or replace the chain and related components (Chapter 2).

Cooling system

27 Overheating

1 Insufficient coolant in system (Chapter 1).
2 Drivebelt defective or not adjusted properly (Chapter 1).
3 Radiator core blocked or radiator grille dirty and restricted (Chapter 3).
4 Thermostat faulty (Chapter 3).
5 Fan not functioning properly (Chapter 3).
6 Radiator cap not maintaining proper pressure. Have cap pressure tested by gas station or repair shop.
7 Ignition timing incorrect (Chapter 1).
8 Defective water pump (Chapter 3).
9 Improper grade of engine oil.
10 Inaccurate temperature gauge (Chapter 12).

28 Overcooling

1 Thermostat faulty (Chapter 3).
2 Inaccurate temperature gauge (Chapter 12).

29 External coolant leakage

1 Deteriorated or damaged hoses. Loose clamps at hose connections (Chapter 1).
2 Water pump seals defective. If this is the case, water will drip from the weep hole in the water pump body (Chapter 3).
3 Leakage from radiator core or header tank. This will require the radiator to be professionally repaired (see Chapter 3 for removal procedures).
4 Engine drain plugs or water jacket freeze plugs leaking (see Chapters 1 and 2).
5 Leak from coolant temperature switch (Chapter 3).
6 Leak from damaged gaskets or small cracks (Chapter 2).
7 Damaged head gasket. This can be verified by checking the condition of the engine oil as noted in Section 30.

30 Internal coolant leakage

Note: *Internal coolant leaks can usually be detected by examining the oil. Check the dipstick and inside the rocker arm cover for water deposits and an oil consistency like that of a milkshake.*

1 Leaking cylinder head gasket. Have the system pressure tested or remove the cylinder head (Chapter 2) and inspect.
2 Cracked cylinder bore or cylinder head. Dismantle engine and inspect (Chapter 2).
3 Loose cylinder head bolts (tighten as described in Chapter 2).

31 Abnormal coolant loss

1 Overfilling system (Chapter 1).
2 Coolant boiling away due to overheating (see causes in Section 27).
3 Internal or external leakage (see Sections 29 and 30).
4 Faulty radiator cap. Have the cap pressure tested.
5 Cooling system being pressurized by engine compression. This could be due to a cracked head or block or leaking head gasket(s).

32 Poor coolant circulation

1 Inoperative water pump. A quick test is to pinch the top radiator hose closed with your hand while the engine is idling, then release it. You should feel a surge of coolant if the pump is working properly (Chapter 3).
2 Restriction in cooling system. Drain, flush and refill the system (Chapter 1). If necessary, remove the radiator (Chapter 3) and have it reverse flushed or professionally cleaned.
3 Loose water pump drivebelt (Chapter 1).
4 Thermostat sticking (Chapter 3).
5 Insufficient coolant (Chapter 1).

33 Corrosion

1 Excessive impurities in the water. Soft, clean water is recommended. Distilled or rainwater is satisfactory.
2 Insufficient antifreeze solution (refer to Chapter 1 for the proper ratio of water to antifreeze).
3 Infrequent flushing and draining of system. Regular flushing of the cooling system should be carried out at the specified intervals as described in (Chapter 1).

Clutch

34 Fails to release (pedal pressed to the floor - shift lever does not move freely in and out of Reverse)

1 Clutch contaminated with oil. Remove clutch plate and inspect.
2 Clutch plate warped, distorted or otherwise damaged.
3 Diaphragm spring fatigued. Remove clutch cover/pressure plate assembly and inspect.
4 Insufficient pedal stroke. Check and adjust as necessary.
5 Lack of grease on pilot bushing.

35 Clutch slips (engine speed increases with no increase in vehicle speed)

1 Worn or oil soaked clutch plate.
2 Diaphragm spring weak or damaged. Remove clutch cover/pressure plate assembly and inspect.
3 Glazed lining on clutch plate.
4 Defective transmission.

36 Grabbing (chattering) as clutch is engaged

1 Oil on clutch plate. Remove and inspect. Repair any leaks.

2 Worn or loose engine or transmission mounts. They may move slightly when clutch is released. Inspect mounts and bolts.
3 Worn splines on transmission input shaft. Remove clutch components and inspect.
4 Warped pressure plate or flywheel. Remove clutch components and inspect.
5 Diaphragm spring fatigued. Remove clutch cover/pressure plate assembly and inspect.
6 Clutch linings hardened or warped.
7 Clutch lining rivets loose.

37 Squeal or rumble with clutch engaged (pedal released)

1 Improper pedal adjustment. Adjust pedal free play.
2 Release bearing binding on transmission shaft. Remove clutch components and check bearing. Remove any burrs or nicks, clean and lubricate before reinstallation.
3 Pilot bushing worn or damaged.
4 Clutch rivets loose.
5 Clutch plate cracked.
6 Fatigued clutch plate torsion springs. Replace clutch plate.

38 Squeal or rumble with clutch disengaged (pedal depressed)

1 Worn or damaged release bearing.
2 Worn or broken pressure plate diaphragm fingers.

39 Clutch pedal stays on floor when disengaged

Binding linkage or release bearing. Inspect linkage or remove clutch components as necessary.

Manual transmission

Note: *All manual transmission service information is located in Chapter 7, unless otherwise noted.*

40 Noisy in Neutral with engine running

1 Input shaft bearing worn.
2 Damaged main drive gear bearing.
3 Insufficient transmission oil (Chapter 1).
4 Transmission oil in poor condition. Drain and fill with proper grade oil. Check old oil for water and debris (Chapter 1).
5 Noise can be caused by variations in engine torque. Change the idle speed and see if noise disappears.

41 Noisy in all gears

1 Any of the above causes, and/or:
2 Worn or damaged output gear bearings or shaft.

42 Noisy in one particular gear

1 Worn, damaged or chipped gear teeth.
2 Worn or damaged synchronizer.

43 Slips out of gear

1 Transmission loose on clutch housing.
2 Stiff shift lever seal.
3 Shift linkage binding.
4 Broken or loose input gear bearing retainer.
5 Dirt between clutch lever and engine housing.
6 Worn linkage.
7 Damaged or worn check balls, fork rod ball grooves or check springs.
8 Worn mainshaft or countershaft bearings.
9 Loose engine mounts (Chapter 2).
10 Excessive gear end play.
11 Worn synchronizers.

44 Oil leaks

1 Excessive amount of lubricant in transmission (see Chapter 1 for correct checking procedures). Drain lubricant as required.
2 Gasket leaking.
3 To pinpoint a leak, first remove all built-up dirt and grime from the transmission. Degreasing agents and/or steam cleaning will achieve this. With the underside clean, drive the vehicle at low speeds so the air flow will not blow the leak far from its source. Raise the vehicle and determine where the leak is located.

45 Difficulty engaging gears

1 Clutch not releasing completely.
2 Loose or damaged shift linkage. Make a thorough inspection, replacing parts as necessary.
3 Insufficient transmission oil or improper grade of oil (Chapter 1).
4 Transmission oil in poor condition. Drain and fill with proper grade oil. Check oil for water and debris (Chapter 1).
5 Sticking or jamming gears.

46 Noise occurs while shifting gears

1 Check for proper operation of the clutch (Chapter 8).
2 Faulty synchronizer assemblies.

Automatic transmission

Note: *Due to the complexity of the automatic transmission, it's difficult for the home mechanic to properly diagnose and service. For problems other than the following, the vehicle should be taken to a reputable mechanic.*

47 Fluid leakage

1 Automatic transmission fluid is a deep red color, and fluid leaks should not be confused with engine oil which can easily be blown by air flow to the transmission.
2 To pinpoint a leak, first remove all built-up dirt and grime from the transmission. Degreasing agents and/or steam cleaning will achieve this. With the underside clean,
drive the vehicle at low speeds so the air flow will not blow the leak far from its source. Raise the vehicle and determine where the leak is located. Common areas of leakage are:

a) *Fluid pan: tighten mounting bolts and/or replace pan gasket as necessary (Chapter 1).*
b) *Rear extension: tighten bolts and/or replace oil seal as necessary.*
c) *Filler pipe: replace the rubber oil seal where pipe enters transmission case.*
d) *Transmission oil cooler lines: tighten fittings where lines enter transmission case and/or replace lines.*
e) *Vent pipe: transmission overfilled and/or water in fluid (see checking procedures, Chapter 1).*

f) Throttle valve connector: replace the O-ring where throttle valve cable enters transmission case.
g) Modulator valve: inspect for leaking transmission fluid around modulator valve; detach vacuum line and check for fluid inside line and valve vacuum port

48 General shift mechanism problems

Chapter 7 deals with checking and adjusting the shift linkage on automatic transmissions. Common problems which may be caused by out of adjustment linkage are:

a) Engine starting in gears other than P (park) or N (Neutral).
b) Indicator pointing to a gear other than the one actually engaged.
c) Vehicle moves with transmission in P (Park) position.

49 Transmission will not downshift with the accelerator pedal pressed to the floor

Chapter 7 deals with adjusting the TV linkage to enable the transmission to downshift properly.

50 Engine will start in gears other than Park or Neutral

Chapter 7 deals with adjusting the Neutral start switch.

51 Transmission slips, shifts rough, is noisy or has no drive in forward or Reverse gears

1 There are many probable causes for the above problems, but the home mechanic should concern himself only with one possibility: fluid level.
2 Before taking the vehicle to a shop, check the fluid level and condition as described in Chapter 1. Add fluid, if necessary, or change the fluid and filter if needed. If problems persist, have a professional diagnose the transmission.

Driveshaft

Note: *Refer to Chapter 8, unless otherwise specified, for service information.*

52 Leaks at front of driveshaft

Defective output shaft seal. See Chapter 7 for replacement procedure. As this is done, check the splined yoke for burrs or roughness that could damage the new seal. Remove burrs with a fine file or whetstone.

53 Knock or clunk when transmission is under initial load (just after transmission is put into gear)

1 Loose or disconnected rear suspension components. Check all mounting bolts and bushings (Chapters 7 and 10).
2 Loose driveshaft bolts. Inspect all bolts and nuts and tighten them securely.
3 Worn or damaged universal joint bearings. Replace driveshaft (Chapter 8).
4 Worn sleeve yoke and mainshaft spline.

54 Metallic grating sound consistent with vehicle speed

Pronounced wear in the universal joint bearings. Replace U-joints or driveshafts, as necessary.

55 Vibration

Note: *Before blaming the driveshaft, make sure the tires are perfectly balanced and perform the following test.*
1 Install a tachometer inside the vehicle to monitor engine speed as the vehicle is driven. Drive the vehicle and note the engine speed at which the vibration (roughness) is most pronounced. Now shift the transmission to a different gear and bring the engine speed to the same point.
2 If the vibration occurs at the same engine speed (rpm) regardless of which gear the transmission is in, the driveshaft is NOT at fault since the driveshaft speed varies.
3 If the vibration decreases or is eliminated when the transmission is in a different gear at the same engine speed, refer to the following probable causes.
4 Bent or dented driveshaft. Inspect and replace as necessary.
5 Undercoating or built-up dirt, etc. on the driveshaft. Clean the shaft thoroughly.
6 Worn universal joint bearings. Replace the U-joints or driveshaft as necessary.
7 Driveshaft and/or companion flange out of balance. Check for missing weights on the shaft. Remove driveshaft and reinstall 180-degrees from original position, then recheck. Have the driveshaft balanced if problem persists.
8 Loose driveshaft mounting bolts/nuts.
9 Defective center bearing, if so equipped.

56 Scraping noise

Make sure the dust cover on the sleeve yoke isn't rubbing on the transmission extension housing.

57 Whining or whistling noise

Defective center support bearing (if equipped).

Rear axle and differential

Note: *For differential servicing information, refer to Chapter 8, unless otherwise specified.*

58 Noise - same when in drive as when vehicle is coasting

1 Road noise. No corrective action available.
2 Tire noise. Inspect tires and check tire pressures (Chapter 1).
3 Axle bearings loose, worn or damaged (Chapter 1).
4 Insufficient differential oil (Chapter 1).
5 Defective differential.

59 Knocking sound when starting or shifting gears

Defective or incorrectly adjusted differential.

60 Noise when turning

Defective differential.

61 Vibration

See probable causes under *Driveshaft.* Proceed under the guidelines listed for the driveshaft. If the problem persists, check the rear wheel bearings by raising the rear of the vehicle and spinning the wheels by hand. Listen for evidence of rough (noisy) bearings. Remove and inspect (Chapter 8).

62 Oil leaks

1 Pinion oil seal damaged (Chapter 8).
2 Axleshaft oil seals damaged (Chapter 8).
3 Differential cover leaking. Tighten mounting bolts or replace the gasket as required.
4 Loose filler or drain plug on differential (Chapter 1).
5 Clogged or damaged breather on differential.

Transfer case

Note: *Refer to Chapter 7C for 4WD system service and repair information.*

63 Gear jumping out of mesh

1 Incorrectly adjusted linkage (Chapter 7C).
2 Interference between the linkage and the lever inside vehicle.
3 Play or fatigue in the transfer case mounts.
4 Internal wear.

64 Difficult shifting

1 Lack of oil.
2 Internal wear or damage.
3 Incorrectly adjusted linkage.

65 Noise

1 Lack of oil in transfer case.
2 Noise in 4WD, but not in 2WD indicates cause is in the front differential or front axle.
3 Noise in 2WD and 4WD indicates cause is in rear differential or rear axle.
4 Noise in 2HI and 4HI but not in 4LOW, or in 4LOW only, indicates internal wear or damage in transfer case (NP 208 transfer case).

Brakes

Note: *Before assuming a brake problem exists, make sure the tires are in good condition and inflated properly, the front end alignment is correct and the vehicle is not loaded with weight in an unequal manner. All service procedures for the brakes are included in Chapter 9, unless otherwise noted.*

66 Vehicle pulls to one side during braking

1 Defective, damaged or oil contaminated brake pads or linings on one side. Inspect as described in Chapter 1. Refer to Chapter 9 if replacement is required.
2 Excessive wear of brake pad or lining material, drum or disc on one side. Inspect and repair as necessary.
3 Loose or disconnected front suspension components. Inspect and tighten all bolts securely (Chapters 1 and 10).
4 Defective caliper or wheel cylinder assembly. Remove caliper/wheel cylinder and inspect for stuck piston or damage.
5 Pinched or defective brake hose.
6 Scored or out of round drum or disc.
7 Loose caliper mounting bolts.
8 Incorrect wheel bearing adjustment.

67 Noise (high-pitched squeal)

1 Front brake pads worn out. This noise comes from the wear sensor rubbing against the disc. Replace pads with new ones immediately!
2 Glazed or contaminated linings.
3 Dirty or scored drum or disc.
4 Bent support plate.

68 Excessive brake pedal travel

1 Partial brake system failure. Inspect entire system (Chapter 1) and correct as required.
2 Insufficient fluid in master cylinder. Check (Chapter 1) and add fluid - bleed system if necessary.
3 Air in system. Bleed system.
4 Excessive lateral rotor play.
5 Brakes out of adjustment. Check the operation of the automatic adjusters.
6 Defective combination valve. Replace valve and bleed system.

69 Brake pedal feels spongy when depressed

1 Air in brake lines. Bleed the brake system.
2 Deteriorated rubber brake hoses. Inspect all system hoses and lines. Replace parts as necessary.
3 Master cylinder mounting nuts loose. Inspect master cylinder bolts (nuts) and tighten them securely.
4 Master cylinder faulty.
5 Incorrect shoe or pad clearance.
6 Defective check valve. Replace valve and bleed system.
7 Clogged reservoir cap vent hole.
8 Deformed rubber brake lines.
9 Soft or swollen caliper seals.
10 Poor quality brake fluid. Bleed entire system and fill with new approved fluid.

70 Excessive effort required to stop vehicle

1 Power brake booster not operating properly.
2 Excessively worn linings or pads. Check and replace if necessary.
3 One or more wheel cylinder or caliper pistons seized or sticking. Inspect and rebuild as required.
4 Brake pads or linings contaminated with oil or grease. Inspect and replace as required.
5 New pads or linings installed and not yet seated. It'll take a while for the new material to seat against the disc or drum.
6 Worn or damaged master cylinder, wheel cylinder or caliper assemblies. Check particularly for frozen pistons.
7 Also see causes listed under Section 69.

71 Pedal travels to the floor with little resistance

Little or no fluid in the master cylinder reservoir caused by leaking wheel cylinder(s), caliper piston(s) or loose, damaged or disconnected brake lines. Inspect entire system and repair as necessary.

72 Brake pedal pulsates during brake application

1 Wheel bearings damaged, worn or out of adjustment (Chapter 1).
2 Caliper not sliding properly due to improper installation or obstructions. Remove and inspect.
3 Disc not within specifications. Remove the disc and check for excessive lateral runout and parallelism. Have the discs resurfaced or replace them with new ones. Also make sure that all discs are the same thickness.
4 Out of round brake drums. Remove the drums and have them turned or replace them with new ones.

73 Brakes drag (indicated by sluggish engine performance or wheels being very hot after driving)

1 Output rod adjustment incorrect at the brake pedal.
2 Obstructed master cylinder compensator. Disassemble master cylinder and clean.
3 Master cylinder piston seized in bore. Overhaul master cylinder.
4 Caliper assembly or wheel cylinder sticking.
5 Brake pads or shoes worn out.
6 Piston cups in master cylinder or caliper assembly deformed. Overhaul master cylinder.
7 Parking brake assembly will not release.
8 Clogged brake lines.
9 Wheel bearings out of adjustment (Chapter 1).
10 Brake pedal height improperly adjusted.
11 Wheel cylinder needs overhaul.
12 Improper shoe to drum clearance. Adjust as necessary.

74 Rear brakes lock up under light brake application

1 Tire pressures too high.
2 Tires excessively worn (Chapter 1).
3 Rear brake linings contaminated with differential lubricant. Replace axle seal. Clean brake components and drums and replace brake linings.
4 Defective combination valve (Chapter 9).

75 Rear brakes lock up under heavy brake application

1 Tire pressures too high.
2 Tires excessively worn (Chapter 1).
3 Front brake pads contaminated with oil, mud or water. Clean or replace the pads.
4 Front brake pads excessively worn.
5 Defective master cylinder or caliper assembly.
6 Defective combination valve (Chapter 9).

Suspension and steering

Note: *All service procedures for the suspension and steering systems are included in Chapter 10, unless otherwise noted.*

76 Vehicle pulls to one side

1 Tire pressures uneven (Chapter 1).
2 Defective tire (Chapter 1).
3 Excessive wear in suspension or steering components (Chapter 1).
4 Front end alignment incorrect.
5 Front brakes dragging. Inspect as described in Section 73.
6 Wheel bearings improperly adjusted (Chapter 1).
7 Wheel lug nuts loose.

77 Shimmy, shake or vibration

1 Tire or wheel out of balance or out of round. Have them balanced on the vehicle.
2 Loose, worn or out of adjustment wheel bearings (Chapter 1).
3 Shock absorbers and/or suspension components worn or damaged. Check for worn bushings in the upper and lower links.
4 Wheel lug nuts loose.
5 Incorrect tire pressures.
6 Excessively worn or damaged tire.
7 Loosely mounted steering gear housing.
8 Steering gear improperly adjusted.
9 Loose, worn or damaged steering components.
10 Damaged idler arm.
11 Worn balljoint.

78 Excessive pitching and/or rolling around corners or during braking

1 Defective shock absorbers. Replace as a set.
2 Broken or weak leaf springs and/or suspension components.
3 Worn or damaged stabilizer bar or bushings.

79 Wandering or general instability

1 Improper tire pressures.
2 Worn or damaged upper and lower link or tension rod bushings.
3 Incorrect front end alignment.
4 Worn or damaged steering linkage or suspension components.
5 Improperly adjusted steering gear.
6 Out of balance wheels.
7 Loose wheel lug nuts.
8 Worn rear shock absorbers.
9 Fatigued or damaged rear leaf springs.

80 Excessively stiff steering

1 Lack of lubricant in power steering fluid reservoir, where appropriate (Chapter 1).
2 Incorrect tire pressures (Chapter 1).
3 Lack of lubrication at balljoints (Chapter 1).
4 Front end out of alignment.
5 Steering gear out of adjustment or lacking lubrication.
6 Improperly adjusted wheel bearings.
7 Worn or damaged steering gear.
8 Interference of steering column with turn signal switch.
9 Low tire pressures.
10 Worn or damaged balljoints.
11 Worn or damaged steering linkage.
12 See also Section 79.

81 Excessive play in steering

1 Loose wheel bearings (Chapter 1).
2 Excessive wear in suspension bushings (Chapter 1).
3 Steering gear improperly adjusted.
4 Incorrect front end alignment.
5 Steering gear mounting bolts loose.
6 Worn steering linkage.

82 Lack of power assistance

1 Steering pump drivebelt faulty or not adjusted properly (Chapter 1).
2 Fluid level low (Chapter 1).
3 Hoses or pipes restricting the flow. Inspect and replace parts as necessary.
4 Air in power steering system. Bleed system.
5 Defective power steering pump.

83 Steering wheel fails to return to straight-ahead position

1 Incorrect front end alignment.
2 Tire pressures low.
3 Steering gears improperly engaged.
4 Steering column out of alignment.
5 Worn or damaged balljoint.
6 Worn or damaged steering linkage.
7 Improperly lubricated idler arm.
8 Insufficient oil in steering gear.
9 Lack of fluid in power steering pump.

84 Steering effort not the same in both directions (power system)

1 Leaks in steering gear.
2 Clogged fluid passage in steering gear.

85 Noisy power steering pump

1 Insufficient oil in pump.
2 Clogged hoses or oil filter in pump.
3 Loose pulley.
4 Improperly adjusted drivebelt (Chapter 1).
5 Defective pump.

86 Miscellaneous noises

1 Improper tire pressures.
2 Insufficiently lubricated balljoint or steering linkage.
3 Loose or worn steering gear, steering linkage or suspension components.
4 Defective shock absorber.
5 Defective wheel bearing.
6 Worn or damaged suspension bushings.
7 Damaged leaf spring.
8 Loose wheel lug nuts.
9 Worn or damaged rear axleshaft spline.
10 Worn or damaged rear shock absorber mounting bushing.
11 Incorrect rear axle end play.
12 See also causes of noises at the rear axle and driveshaft.

87 Excessive tire wear (not specific to one area)

1 Incorrect tire pressures.
2 Tires out of balance. Have them balanced on the vehicle.
3 Wheels damaged. Inspect and replace as necessary.
4 Suspension or steering components worn (Chapter 1).

88 Excessive tire wear on outside edge

1 Incorrect tire pressure.
2 Excessive speed in turns.
3 Front end alignment incorrect (excessive toe-in).

89 Excessive tire wear on inside edge

1 Incorrect tire pressure.
2 Front end alignment incorrect (toe-out).
3 Loose or damaged steering components (Chapter 1).

90 Tire thread wear in one place

1 Tires out of balance. Have them balanced on the vehicle.
2 Damaged or buckled wheel. Inspect and replace if necessary.
3 Defective tire.

Chapter 1
Tune-up and routine maintenance

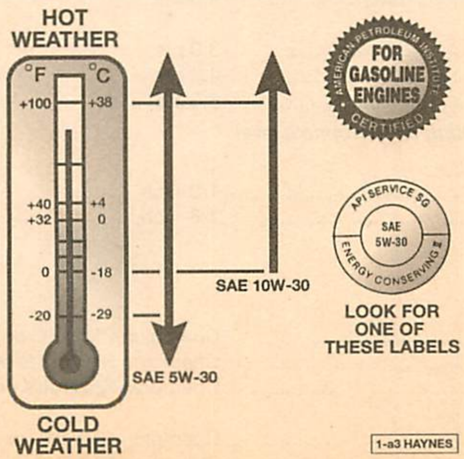
Contents

Specifications

Recommended lubricants and fluids

Note: *Listed here are manufacturer recommendations at the time this manual was written. Manufacturers occasionally upgrade their fluid and lubricant specifications, so check with your local auto parts store for current recommendations.*

Engine oil type	API grade SG or SG/CD multi-grade and fuel efficient oil
Engine oil viscosity	See accompanying chart
Automatic transmission fluid type	
1979 and earlier (THM 400)	Dexron II or III automatic transmission fluid
1980 and later (Torqueflite models 999 and 727)	Mopar ATF Plus Type 7176 automatic transmission fluid
Manual transmission lubricant type	
T-5 (5-speed)	Jeep Manual Transmission Lubricant (part no. 4874464)
All others	SAE 75W-90 API GL-5 gear lubricant



Engine oil viscosity chart - for best fuel economy and cold starting, select the lowest SAE viscosity grade for the expected temperature range

Recommended lubricants and fluids (continued)

Transfer case lubricant type	
1972 through 1979	
Model 20	SAE 75W-90 API GL-5 gear lubricant
Quadra-trac models	Jeep Quadra-trac lubricant
1980 and 1981	SAE IOW-30 engine oil
1982 and later (Models 208, 219 and 229)	DEXRON II or III automatic transmission fluid
Differential lubricant type	
Normal operation (front and rear axles)	SAE 75W-90 API GL-5 gear lubricant
Trailer towing package (rear axle only)	SAE 80W-140 synthetic gear lubricant
Trac-Loc differential	Add MOPAR Friction Modifier to lubricant
Brake fluid type	DOT 3 brake fluid
Power steering fluid	DEXRON II or III automatic transmission fluid
Manual steering gear lubricant type	NLGI no. 2 EP lithium based chassis grease
Chassis grease type	NLGI no. 2 EP lithium based chassis grease

Capacities*

Engine oil (with filter change)	
Six-cylinder engine	6.0 qts
V8 engines	5.0 qts
Cooling system	
Six-cylinder engine	10.5 qts
V8 engines	14.0 qts
Automatic transmission	
1972 through 1979 (THM400)	
Drain and refill	5.0 qts
Dry fill (including torque converter)	11.0 qts
1980 through 1991 (Torqueflite models 999 and 727)	
Drain and refill	8.5 pts
Dry fill (including torque converter)	17.0 pts
Manual transmission	
3-speed (T-14a and T-15a)	2.7 pts
4-speed	
T-18 and T-18a	6.5 pts
T-176	3.5 pts
5-speed (T-5)	4.0 pts
Transfer case	
1972 through 1979	
Model 20	3.2 pts
Quadra-trac models	
without reduction unit	2.0 pts
with reduction unit	2.5 pts
1980 through 1991	
Model 208	6.0 pts
Model 219 (Quadra-trac)	4.0 pts
Model 229 (Selec-trac)	6.0 pts
Differential	
Front axle	
Model 30	2.5 pts
Model 44	
without Selec-Trac	3.0 pts
with Selec-Trac	4.5 pts
Rear axle	
Model 44	3.0 pts
AMC/Jeep	4.8 pts
Model 60	6.0 pts

**All capacities approximate. Add as necessary to bring to appropriate level.*

General

Disc brake pad lining thickness (minimum)	1/8-inch
Drum brake shoe lining thickness (minimum)	1/8-inch

Ignition system

Spark plug type and gap*

Six-cylinder engine	
1972 through 1977	Champion RN14YC or equivalent @ 0.035 inch
1978 through 1980	Champion RN13LYC or equivalent @ 0.035 inch
1981 through 1988	Champion RFN14LY or equivalent @ 0.035 inch
V8 engines	
1972 through 1988	Champion RN14YC or equivalent @ 0.035 inch
1989 through 1991	Champion RN12YC or equivalent @ 0.035 inch

Distributor ignition points

Point gap	0.016 inch
Dwell angle	
Six-cylinder engine	31 to 34 degrees
V8 engines	29 to 31 degrees

Ignition timing and idle speed*

Six-cylinder engine	
1972 through 1975	3 degrees BTDC @ 600 rpm in Drive
1976	
Automatic transmission	8 degrees BTDC @ 550 rpm in Drive
Manual transmission	6 degrees BTDC @ 600 rpm in Drive
1977 and 1978	
Automatic transmission	6 degrees BTDC @ 550 rpm in Drive
Manual transmission	6 degrees BTDC @ 650 rpm in Neutral
1979 and 1980	
Automatic transmission	8 degrees BTDC @ 600 rpm in Drive
Manual transmission	8 degrees BTDC @ 650 rpm in Neutral
1981	
Federal	
Automatic transmission	8 degrees BTDC @ 550 rpm in Drive
Manual transmission	8 degrees BTDC @ 650 rpm in Neutral
California	
Automatic transmission	6 degrees BTDC @ 550 rpm in Drive
Manual transmission	4 degrees BTDC @ 650 rpm in Neutral
1982 and 1983	
All except high altitude	
Automatic transmission	15 degrees BTDC @ 500 rpm in Drive
Manual transmission	15 degrees BTDC @ 600 rpm in Neutral
High altitude	
Automatic transmission	21 degrees BTDC @ 500 rpm in Drive
Manual transmission	19 degrees BTDC @ 600 rpm in Neutral
1984 through 1988	
All except high altitude	
Automatic transmission	9 degrees BTDC @ 600 rpm in Drive
Manual transmission	9 degrees BTDC @ 680 rpm in Neutral
High altitude	
Automatic transmission	16 degrees BTDC @ 650 rpm in Drive
Manual transmission	16 degrees BTDC @ 700 rpm in Neutral
V8 engines	
1972 through 1974	
Automatic transmission	5 degrees BTDC @ 650 rpm in Drive
Manual transmission	5 degrees BTDC @ 700 rpm in Neutral
1975	
Automatic transmission	3 degrees BTDC @ 700 rpm in Drive
Manual transmission	3 degrees BTDC @ 750 rpm in Neutral
1976	
Federal	
Automatic transmission	8 degrees BTDC @ 700 rpm in Drive
Manual transmission	5 degrees BTDC @ 750 rpm in Drive
California	
Automatic transmission	5 degrees BTDC @ 700 rpm in Drive
Manual transmission	5 degrees BTDC @ 750 rpm in Neutral
1977 and 1978	
Automatic transmission	8 degrees BTDC @ 700 rpm in Drive
Manual transmission	5 degrees BTDC @ 750 rpm in Neutral
1979 and 1980	
Automatic transmission	8 degrees BTDC @ 600 rpm in Drive
Manual transmission	8 degrees BTDC @ 800 rpm in Neutral
1981 through 1984	
All except high altitude	10 degrees BTDC @ 600 rpm in Drive (auto) or Neutral (man)
High altitude	16 degrees BTDC @ 600 rpm in Drive (auto) or Neutral (man)
1985 through 1988	
All except high altitude	12 degrees BTDC @ 600 rpm in Drive (auto) or Neutral (man)
High altitude	19 degrees BTDC @ 600 rpm in Drive (auto) or Neutral (man)
1989	12 degrees BTDC @ 600 rpm in Drive
1990 and 1991	10 degrees BTDC @ 600 rpm in Drive

Note: *All timing adjustments must be made with the distributor vacuum line disconnected and plugged.*

**Use the information printed on the Vehicle Emissions Control Information label, if different than the Specifications listed here.*

Firing order and distributor rotation

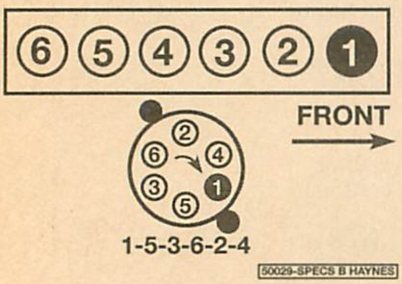
Six-cylinder engine	
Firing order	1-5-3-6-2-4
Distributor rotation	Clockwise
V8 engines	
Firing order	1-8-4-3-6-5-7-2
Distributor rotation	Clockwise

Automatic transmission band adjustment (1980 and later)

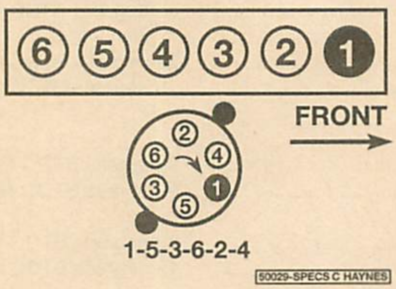
Front band (kickdown)	
1980 through 1981	Tighten to 72 in-lbs, back-off 2 turns
1982 through 1991	Tighten to 72 in-lbs, back-off 2 1/2 turns
Rear band (low-reverse)	
Torqueflite 999	Tighten to 72 in-lbs, back-off 4 turns
Torqueflite 727	Tighten to 72 in-lbs, back-off 2 turns

Torque specifications

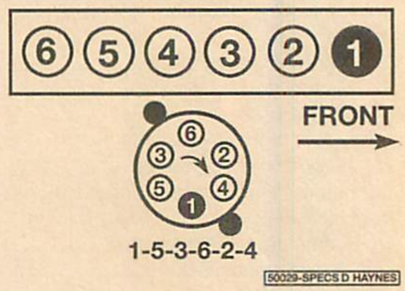
	Ft-lbs (unless otherwise indicated)
Front band adjusting screw locknut	35
Rear band adjusting screw locknut	35
Automatic transmission pan bolts	144 in-lbs
Differential cover bolts	35
Transfer case fill/drain plug	30 to 40
Spark plugs	25 to 30
Engine oil drain plug	20
Wheel lug nuts	80 to 110



1972 thru 1974

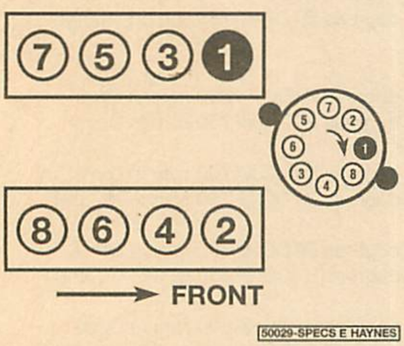


1975 thru 1977

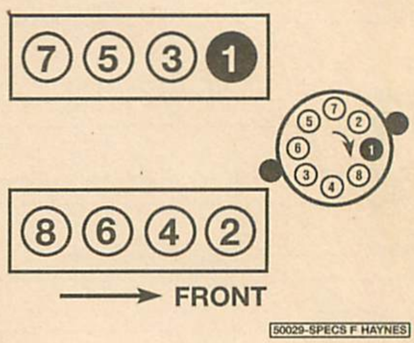


1978 thru 1988

Cylinder location and distributor rotation diagram - six-cylinder engines

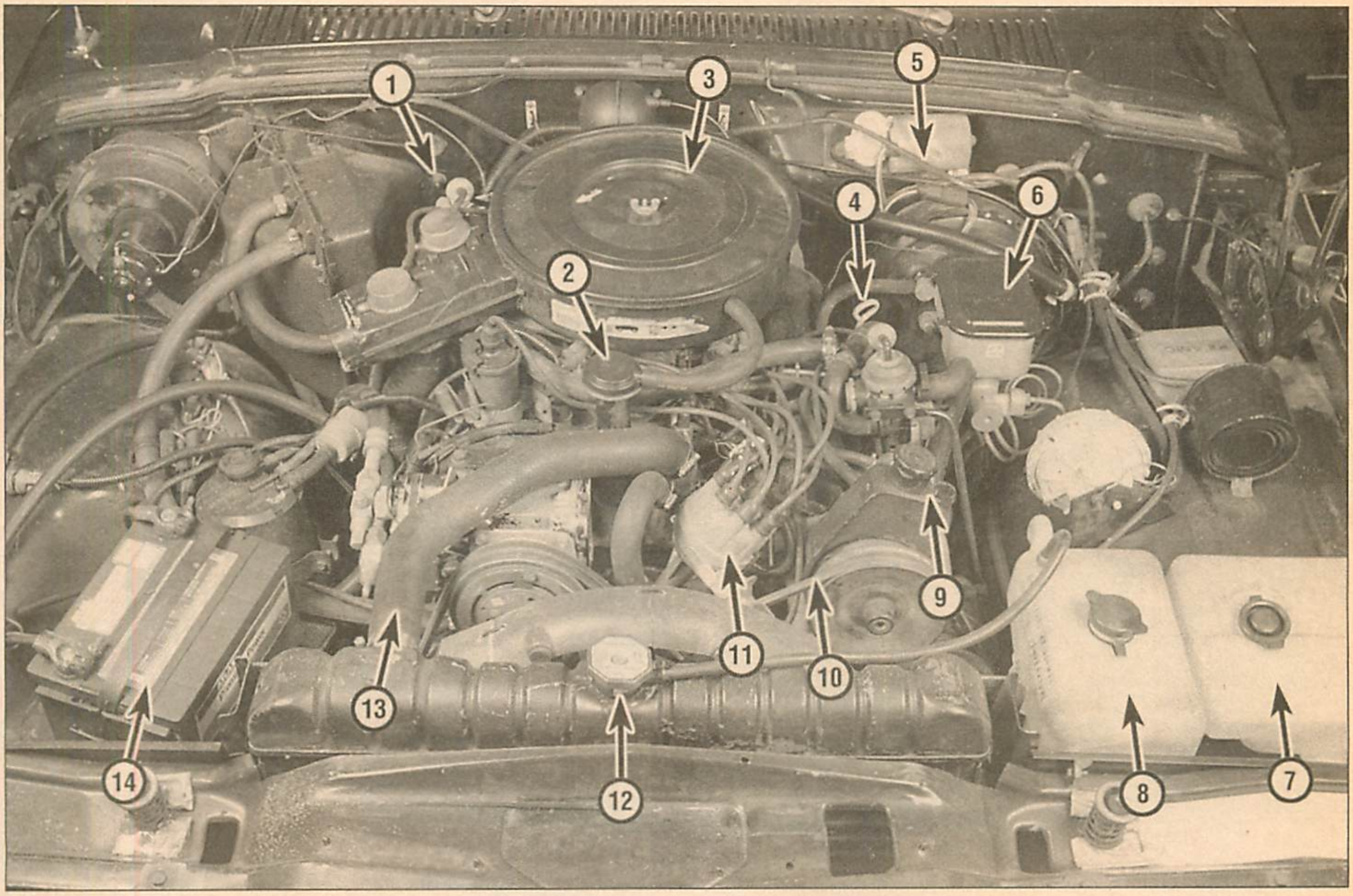


1972 thru 1974



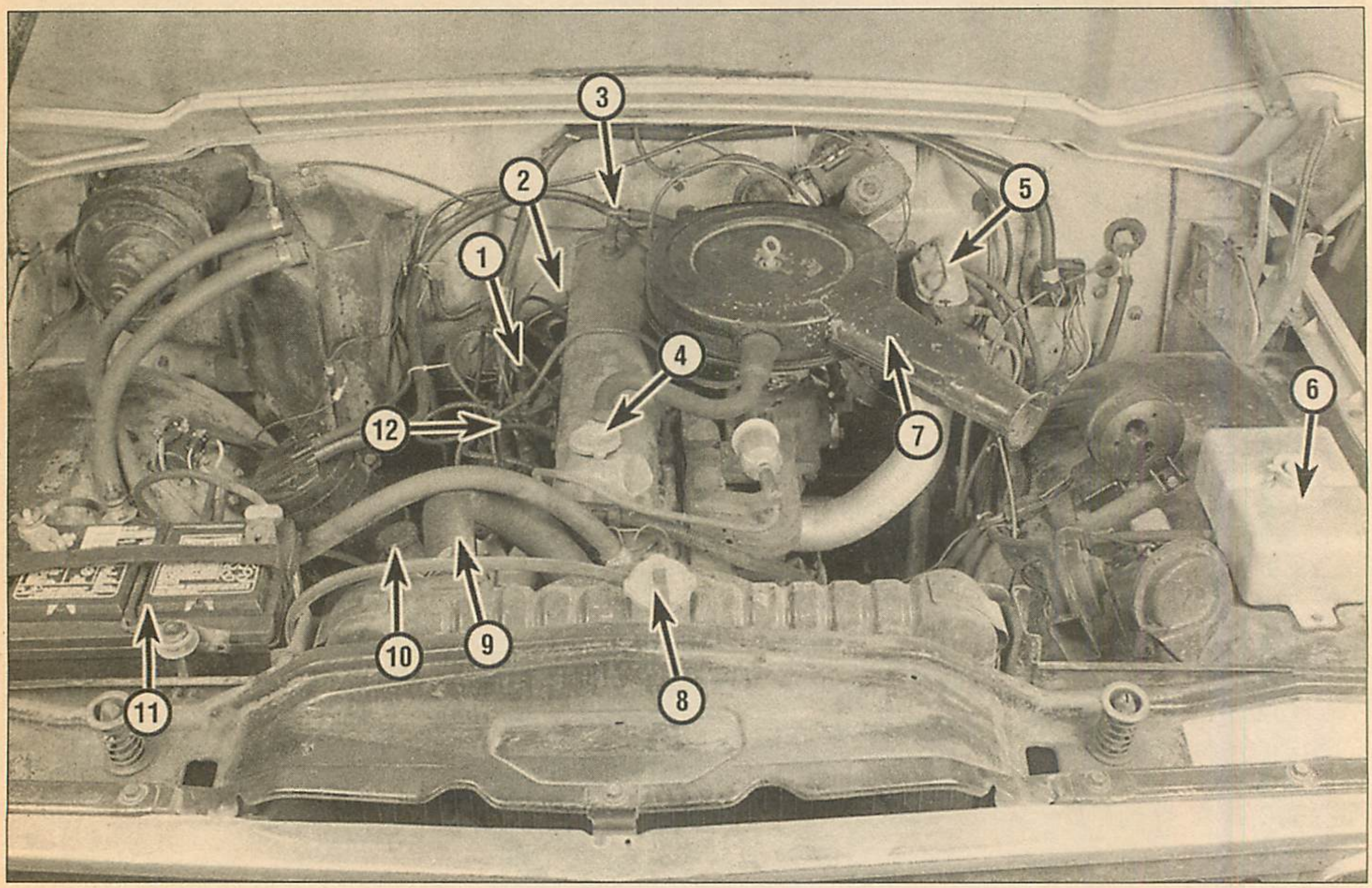
1975 thru 1991

Cylinder location and distributor rotation diagram - V8 engines



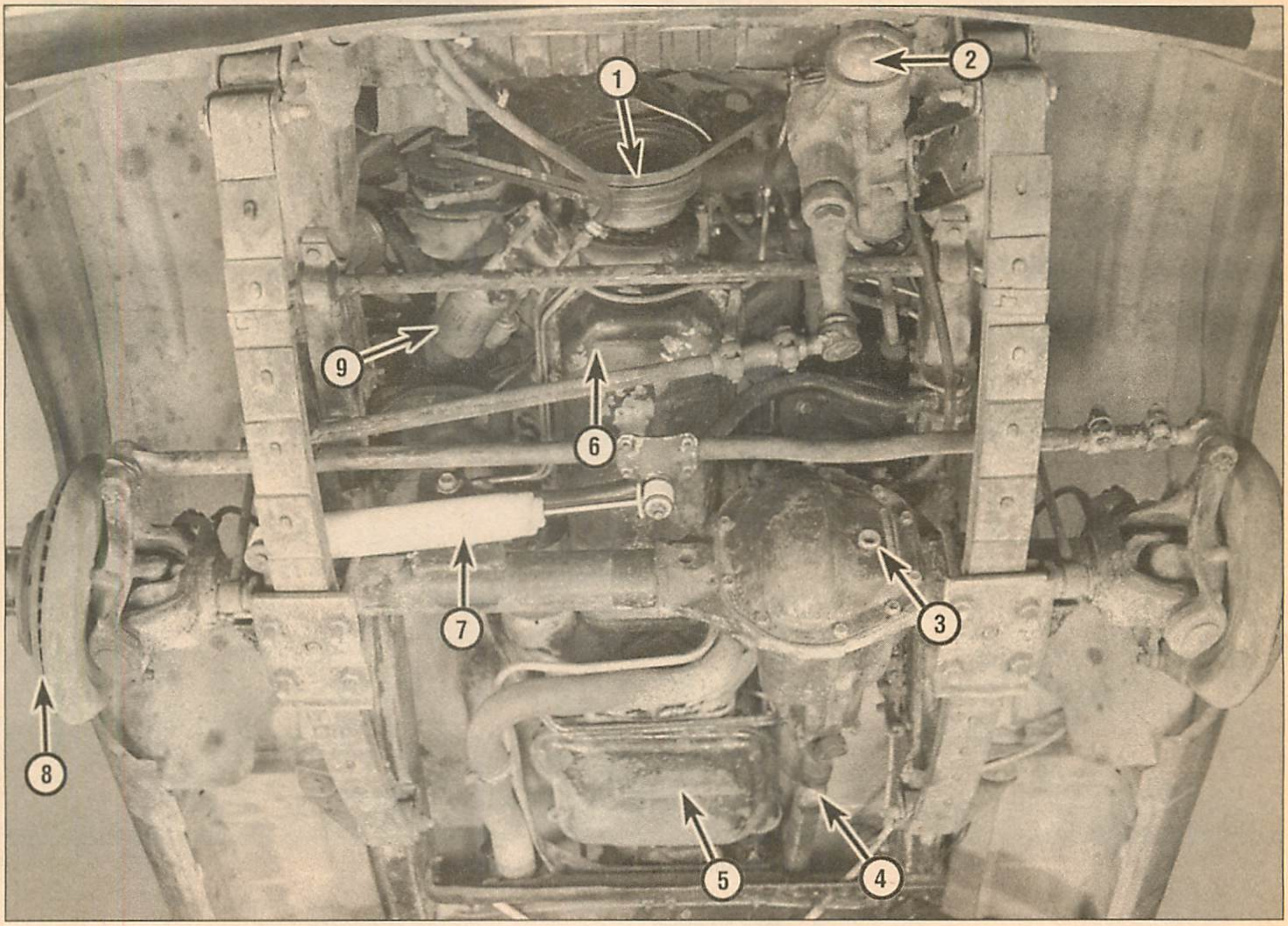
Engine compartment component locations - V8 model

1. *Automatic transmission fluid dipstick*
2. *Engine oil filler cap*
3. *Air cleaner housing*
4. *Engine oil dipstick*
5. *Windshield wiper motor*
6. *Brake fluid reservoir*
7. *Windshield washer fluid reservoir*
8. *Engine coolant reservoir*
9. *Power steering fluid reservoir*
10. *Drivebelts*
11. *Distributor cap and wires*
12. *Radiator cap*
13. *Upper radiator hose*
14. *Battery*



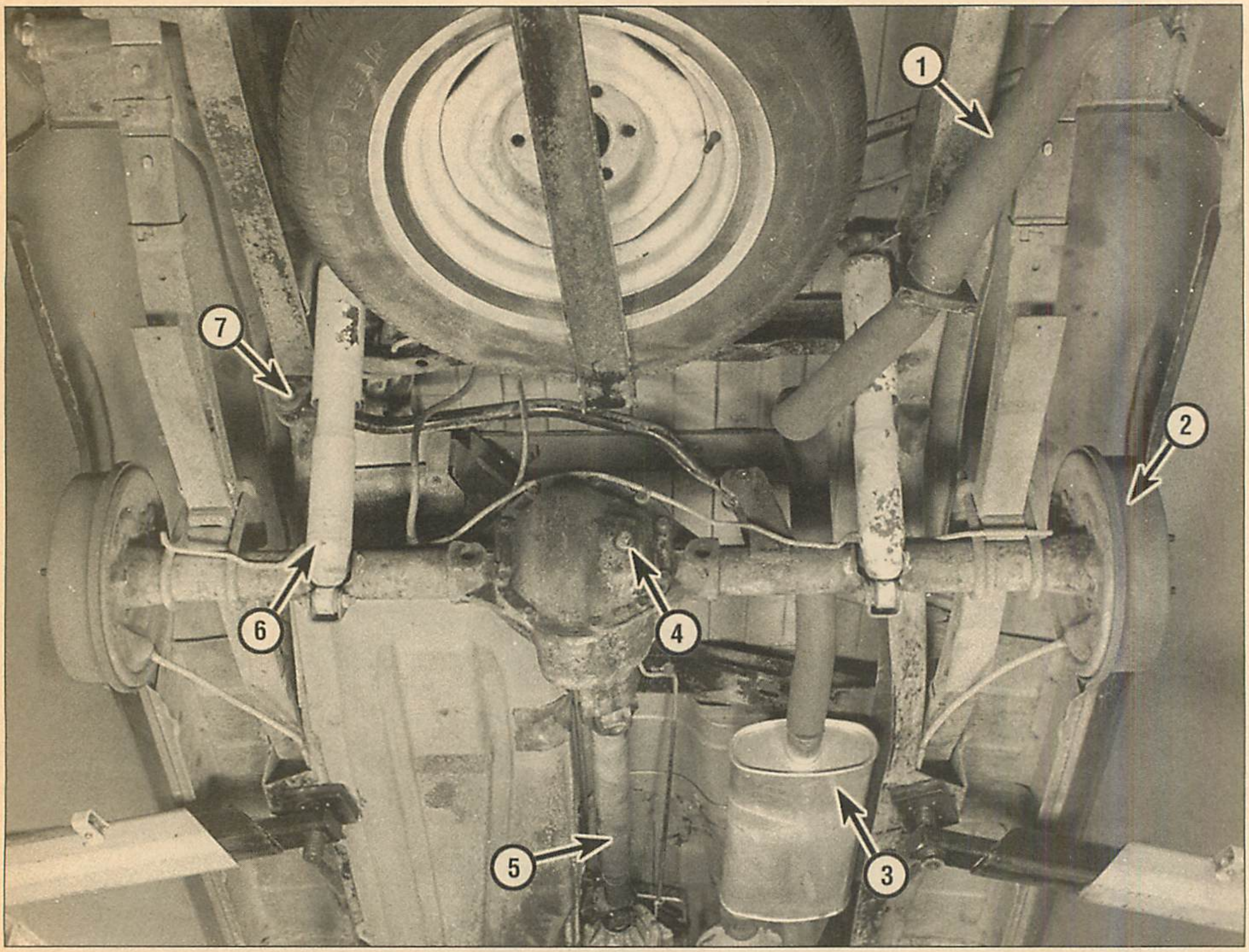
Engine compartment component locations - six-cylinder model

1 *Engine oil dipstick*
2 *Automatic transmission fluid dipstick*
3 *PCV valve*
4 *Engine oil filler cap*
5 *Brake fluid reservoir*
6 *Windshield washer fluid reservoir*
7 *Air cleaner housing*
8 *Radiator cap*
9 *Radiator hose*
10 *Power steering fluid reservoir*
11 *Battery*
12 *Distributor cap and wires*



Typical engine compartment underside component locations

1 Drivebelts
2 Steering gearbox
3 Front differential check/fill plug
4 Front driveshaft
5 Automatic transmission fluid pan
6 Engine oil pan
7 Steering damper
8 Brake disc
9 Engine oil filter



Typical rear underside component locations

1 *Tail pipe*
2 *Rear brake drum*
3 *Muffler*
4 *Differential check/fill plug*
5 *Rear driveshaft*
6 *Rear shock absorber*
7 *Track bar*

1 Jeep Grand Wagoneer and J-Series Pick-up Maintenance schedule

Every 250 miles or weekly, whichever comes first

Check the engine oil level (Section 4)
Check the engine coolant level (Section 4)
Check the windshield washer fluid level (Section 4)
Check the brake fluid level (Section 4)
Check the tires and tire pressures (Section 5)

Every 3000 miles or 3 months, whichever comes first

All items listed above, plus . . .
Check the automatic transmission fluid level (Section 6)
Check the power steering fluid level (Section 7)
Change the engine oil and filter (Section 8)

Every 7500 miles or 6 months, whichever comes first

Check and service the battery (Section 9)
Check the cooling system (Section 10)
Inspect and replace, if necessary, all underhood hoses (Section 11)
Inspect and replace, if necessary, the windshield wiper blades (Section 12)
Rotate the tires (Section 13)
Inspect the suspension and steering components (Section 14)
Lubricate the chassis components (Section 15)*
Inspect the exhaust system (Section 16)
Check the manual transmission lubricant (Section 17)
Check the transfer case lubricant level (Section 18)
Check the differential lubricant level (Section 19)
Check the seat belts (Section 20)

Every 15,000 miles or 12 months, whichever comes first

All items listed above, plus . . .
Inspect the air cleaner thermostatic control valve (Section 21)
Check the exhaust control valve (heat riser) (Section 22)
Inspect the evaporative emissions control system (Section 23)
Check the EGR valve (Section 24)
Check the carburetor choke operation (Section 25)
Replace the fuel filter (Section 26)
Check the Positive Crankcase Ventilation (PCV) system (Section 27)
Replace the air filter and PCV filter (Section 28)
Inspect and replace ignition points (1973 and earlier) (Section 29)
Replace the spark plugs (Section 30)
Inspect the spark plug wires, distributor cap and rotor (Section 31)
Check the idle speed adjustment (Section 32)
Check the ignition timing (Section 33)
Check the engine drivebelts (Section 34)
Inspect the fuel system (Section 35)
Check the brakes (Section 36)
Check the clutch linkage adjustment (Section 37)

Every 30,000 miles or 24 months, whichever comes first

All items listed above, plus . . .
Service the cooling system (drain, flush and refill) (Section 38)
Inspect and repack the front wheel bearings (Section 39)
Adjust the automatic transmission bands (1980 and later) (Section 40)
Change the automatic transmission fluid and filter (Section 41)
Change the manual transmission lubricant (Section 42)
Change the transfer case lubricant (Section 43)
Change the differential lubricant (Section 44)

**This item is affected by "severe" operating conditions, as described below. If the vehicle is operated under severe conditions, perform all maintenance indicated with an asterisk (*) at 3000 mile/three-month intervals. Severe conditions exist if you mainly operate the vehicle . . .*
in dusty areas
towing a trailer
idling for extended periods and/or driving at low speeds when outside temperatures remain below freezing and most trips are less than four miles long

***If operated under one or more of the following conditions, change the automatic transmission fluid and adjust the bands every 15,000 miles:*
in heavy city traffic where the outside temperature regularly reaches 90-degrees F or higher
in hilly or mountainous terrain
frequent trailer pulling

2 Introduction

This Chapter is designed to help the home mechanic maintain Jeep Cherokee, Wagoneer, Grand Wagoneer and J-series truck models with the goals of maximum performance, economy, safety and reliability in mind.

Included is a master maintenance schedule, followed by procedures dealing specifically with each item on the schedule. Visual checks, adjustments, component replacement and other helpful items are included. Refer to the accompanying illustrations of the engine compartment and the underside of the vehicle for the locations of various components.

Servicing your vehicle in accordance with the mileage/time maintenance schedule and the step-by-step procedures will result in a planned maintenance program that should produce a long and reliable service life. Keep in mind that it's a comprehensive plan, so maintaining some items but not others at the specified intervals will not produce the same results.

As you service your vehicle, you will discover that many of the procedures can - and should - be grouped together because of the nature of the particular procedure you're performing or because of the close proximity of two otherwise unrelated components to one another.

For example, if the vehicle is raised for chassis lubrication, you should inspect the exhaust, suspension, steering and fuel systems while you're under the vehicle. When you're rotating the tires, it makes good sense to check the brakes since the wheels are already removed. Finally, let's suppose you have to borrow or rent a torque wrench. Even if you only need it to tighten the spark plugs, you might as well check the torque of as many critical fasteners as time allows.

The first step in this maintenance program is to prepare yourself before the actual work begins. Read through all the procedures you're planning to do, then gather up all the parts and tools needed. If it looks like you might run into problems during a particular job, seek advice from a mechanic or an experienced do-it-yourselfer.

The following maintenance intervals are based on the assumption the vehicle owner will be doing the maintenance or service work, as opposed to having a dealer service department do the work. Although the time/mileage intervals are loosely based on factory recommendations, most have been shortened to ensure, for example, that such items as lubricants and fluids are checked/changed at intervals that promote maximum engine/driveline service life. Also, subject to the preference of the individual owner interested in keeping the vehicle in peak condition at all times, and with the vehicle's ultimate resale in mind, many of the maintenance procedures may be performed more often than recommended in the following schedule. We encourage such owner initiative.

When the vehicle is new it should be serviced initially by a factory authorized dealer service department to protect the factory warranty. In many cases the initial maintenance check is done at no cost to the owner (check with your dealer service department for additional information).

3 Tune-up general information

The term tune-up is used in this manual to represent a combination of individual operations rather than one specific procedure.

If, from the time the vehicle is new, the routine maintenance schedule is followed closely and frequent checks are made of fluid levels and high wear items, as suggested throughout this manual, the engine will be kept in relatively good running condition and the need for additional work will be minimized.

More likely than not, however, there will be times when the engine is running poorly due to lack of regular maintenance. This is even more likely if a used vehicle, which has not received regular and frequent maintenance checks, is purchased. In such cases, an engine tune-up will be needed outside of the regular routine maintenance intervals.

The first step in any tune-up or diagnostic procedure to help correct a poor running engine is a cylinder compression check. A compression check (see Chapter 2, Part B) will help determine the condition of internal engine components and should be used as a guide for tune-up and repair procedures. If, for instance, the compression check indicates serious internal engine wear, a conventional tune-up won't improve the performance of the engine and would be a waste of time and money. Because of its importance, the compression check should be done by someone with the right equipment and the knowledge to use it properly.

The following procedures are those most often needed to bring a generally poor running engine back into a proper state of tune.

Minor tune-up

Check all engine related fluids (Section 4)
Clean, inspect and test the battery (Section 9)
Check the cooling system (Section 10)
Check all underhood hoses (Section 11)
Check the PCV valve (Section 27)
Check the air filter and the PCV filter (Section 28)
Replace the spark plugs (Section 30)
Inspect the spark plug wires, distributor cap and rotor (Section 31)
Check and adjust the idle speed (Section 32)
Check and adjust the ignition timing (Section 33)
Check the drivebelts (Section 34)

Major tune-up

All items listed under Minor tune-up, plus . . .
Check the EGR system (Section 24)
Replace the PCV valve (Section 27)
Replace the air filter and the PCV filter (Section 28)
Replace the ignition points and adjust the dwell (1973 and earlier) (Section 29)
Replace the distributor cap, rotor and spark plug wires (Section 31)
Check the fuel system (Section 35)
Check the charging system (Chapter 5)

4 Fluid level checks (every 250 miles or weekly)

Note: *The following are fluid level checks to be done on a 250 mile or weekly basis. Additional fluid level checks can be found in specific maintenance procedures which follow. Regardless of intervals, be alert to fluid leaks under the vehicle which would indicate a fault to be corrected immediately.*

1 Fluids are an essential part of the lubrication, cooling, brake and windshield washer systems. Because the fluids gradually become depleted and/or contaminated during normal operation of the vehicle, they must be periodically replenished. See *Recommended lubricants and fluids* at the beginning of this Chapter before adding fluid to any of the following components. **Note:** *The vehicle must be on level ground when fluid levels are checked.*

Engine oil

Refer to illustrations 4.2a, 4.2b, 4.4, 4.6a and 4.6b

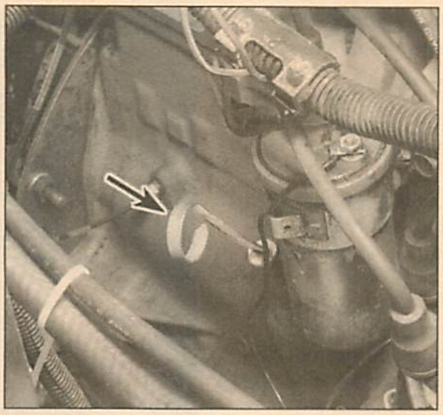
2 The engine oil level is checked with a dipstick that extends through a tube and into the oil pan at the bottom of the engine **(see illustrations)**.

3 The oil level should be checked before the vehicle has been driven, or about 15 minutes after the engine has been shut off. If the oil is checked immediately after driving the vehicle, some of the oil will remain in the upper engine components, resulting in an inaccurate reading on the dipstick.

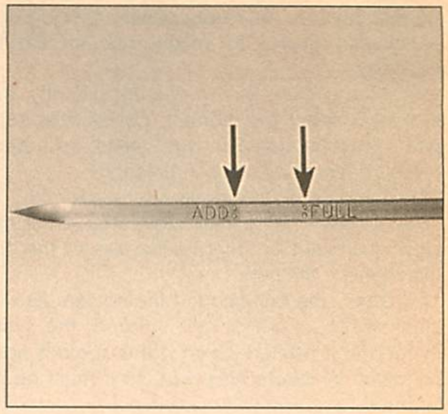
4 Pull the dipstick out of the tube and wipe all the oil from the end with a clean rag or paper towel. Insert the clean dipstick all the way back into the tube, then pull it out again. Note the oil at the end of the dipstick. Add oil as necessary to keep the level between the ADD and FULL marks on the dipstick **(see illustration)**.

5 Do not overfill the engine by adding too much oil since this may

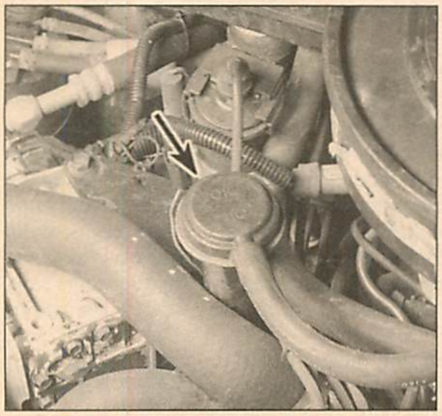
4.2a The engine oil dipstick (arrow) is located on the drivers side of the engine, next to the brake master cylinder on V8 models



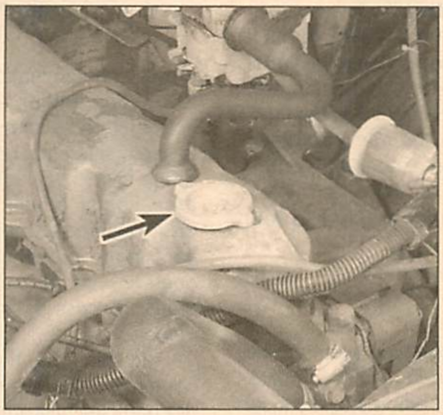
4.2b On six-cylinder models the engine oil dipstick (arrow) is located on the passenger side of the engine, next to the ignition coil



4.4 The oil level must be maintained between the marks at all times - it takes one quart of oil to raise the level from the ADD mark to the FULL mark



4.6a On V8 engines the oil filler tube (arrow) is located at the front of the engine



4.6b On six-cylinder engines oil is added to the engine after removing the twist off cap (arrow) located on the valve cover

4.10 Check the coolant level with the engine hot - it should be visible through the translucent reservoir

result in oil-fouled spark plugs, oil leaks or oil seal failures.

6 Oil is added to the engine after removing a cap from the filler tube on V8 models or from the valve cover on six-cylinder models **(see illustrations)**. A funnel may help to reduce spills.

7 Checking the oil level is an important preventive maintenance step. A consistently low oil level indicates oil leakage through damaged seals, defective gaskets or past worn rings or valve guides. If the oil looks milky or has water droplets in it, the cylinder head gasket(s) may be blown or the head(s) or block may be cracked. The engine should be checked immediately. The condition of the oil should also be checked. Whenever you check the oil level, slide your thumb and index finger up the dipstick before wiping off the oil. If you see small dirt or metal particles clinging to the dipstick, the oil should be changed (see Section 8).

Engine coolant

Refer to illustration 4.10

Warning: *Do not allow antifreeze to come in contact with your skin or painted surfaces of the vehicle. Flush contaminated areas immediately with plenty of water. Don't store new coolant or leave old coolant lying around where it's accessible to children or pets - they're attracted by its sweet smell. Ingestion of even a small amount of coolant can be fatal! Wipe up garage floor and drip pan coolant spills immediately. Keep antifreeze containers covered and repair leaks in the cooling system as soon as they are noted.*

8 Most vehicles covered by this manual are equipped with a pressurized coolant recovery system. A white plastic coolant reservoir located at the front of the engine compartment is connected by a hose to the radiator filler neck. If the engine overheats, coolant escapes through a valve in the radiator cap and travels through the hose into the reservoir. As the engine cools, the coolant is automatically drawn back into the cooling system to maintain the correct level. **Warning:** *Do not remove the radiator cap to check the coolant level when the engine is warm.*

9 If your particular vehicle is not equipped with a coolant recovery system, the level should be checked by removing the radiator cap. However, the cap should not under any circumstances be removed while the system is hot, as escaping steam could cause serious injury. Wait until the engine has completely cooled, then wrap a thick cloth around the cap and turn it to the first stop. If any steam escapes from the cap, allow the engine to cool further. Then remove the cap and check the level in the radiator. It should be one half inch below the bottom of the filler neck.

10 The coolant level in the reservoir should be checked regularly. The level in the reservoir varies with the temperature of the engine. When the engine is cold, the coolant level should be at or slightly above the ADD mark on the reservoir. Once the engine has warmed up, the level should be at or near the FULL mark **(see illustration)**. If it isn't, allow the engine to cool, then remove the cap from the reservoir and add a 50/50 mixture of ethylene glycol-based antifreeze and water.

11 Drive the vehicle and recheck the coolant level. If only a small amount of coolant is required to bring the system up to the proper level, water can be used. However, repeated additions of water will dilute the antifreeze and water solution. In order to maintain the proper ratio of antifreeze and water, always top up the coolant level with the

correct mixture. An empty plastic milk jug or bleach bottle makes an excellent container for mixing coolant. Do not use rust inhibitors or additives.

12 If the coolant level drops consistently, there may be a leak in the system. Inspect the radiator, hoses, filler cap, drain plugs and water pump (see Section 10). If no leaks are noted, have the radiator cap pressure tested by a service station.

13 If you have to remove the radiator cap, wait until the engine has cooled, then wrap a thick cloth around the cap and turn it to the first stop. If coolant or steam escapes, let the engine cool down longer, then remove the cap.

14 Check the condition of the coolant as well. It should be relatively clear. If it's brown or rust colored, the system should be drained, flushed and refilled. Even if the coolant appears to be normal, the corrosion inhibitors wear out, so it must be replaced at the specified intervals.

Windshield washer fluid

Refer to illustration 4.15

15 Fluid for the windshield washer system is located in a plastic reservoir in the engine compartment **(see illustration)**.

16 In milder climates, plain water can be used in the reservoir, but it should be kept no more than 2/3 full to allow for expansion if the water freezes. In colder climates, use windshield washer system antifreeze, available at any auto parts store, to lower the freezing point of the fluid. Mix the antifreeze with water in accordance with the manufacturer's directions on the container. **Caution:** *Don't use cooling system antifreeze - it will damage the vehicle's paint.*

17 To help prevent icing in cold weather, warm the windshield with the defroster before using the washer.

Battery electrolyte

Refer to illustration 4.18

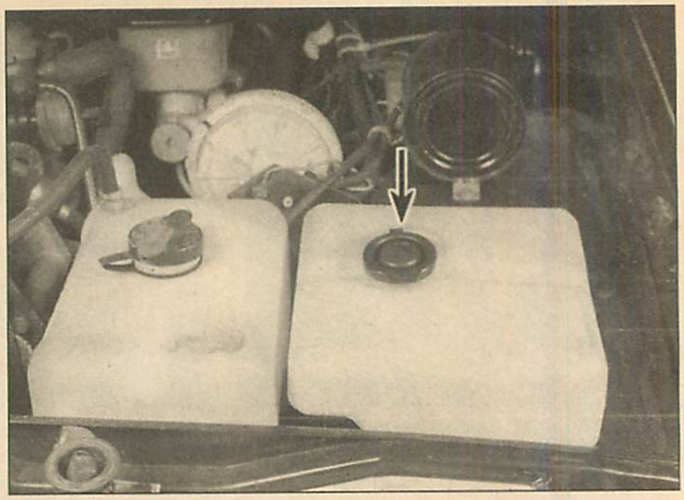
18 If your vehicle is equipped with a maintenance-type battery. The caps on the top of the battery should be removed periodically to check for a low electrolyte level **(see illustration)**. This check is most critical during the warm summer months. Most vehicles will be equipped with a maintenance-free battery, which is permanently sealed (except for vent holes) and has no filler caps. Water doesn't have to be added to maintenance-free batteries at any time.

Brake fluid

Refer to illustrations 4.19a, 4.19b and 4.20

19 The brake master cylinder is mounted on the upper left of the engine compartment firewall **(see illustrations)**.

20 On later models the fluid level can be checked visually from the outside by looking at the translucent plastic reservoir **(see illustration)**. Be sure to wipe the top of the reservoir cover with a clean rag to prevent contamination of the brake system before removing the cover.



4.15 The windshield washer fluid reservoir (arrow) is located at the front of the engine compartment

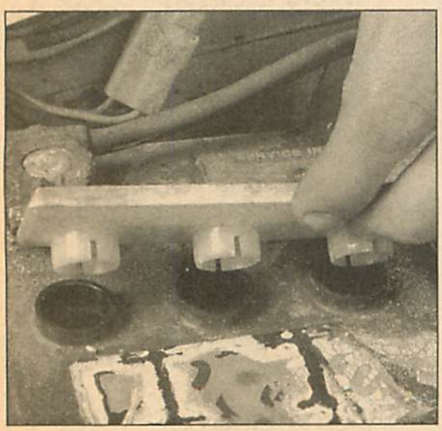
21 When adding fluid, pour it carefully into the reservoir to avoid spilling it on surrounding painted surfaces. Be sure the specified fluid is used, since mixing different types of brake fluid can cause damage to the system. See *Recommended lubricants and fluids* at the front of this Chapter or your owner's manual. **Warning:** *Brake fluid can harm your eyes and damage painted surfaces, so use extreme caution when handling or pouring it. Do not use brake fluid that has been standing open or is more than one year old. Brake fluid absorbs moisture from the air. Excess moisture can cause a dangerous loss of brake performance.*

22 At this time, the fluid and master cylinder can be inspected for contamination. The system should be drained and refilled if deposits, dirt particles or water droplets are seen in the fluid.

23 After filling the reservoir to the proper level, make sure the cover or cap is on tight to prevent fluid leakage.

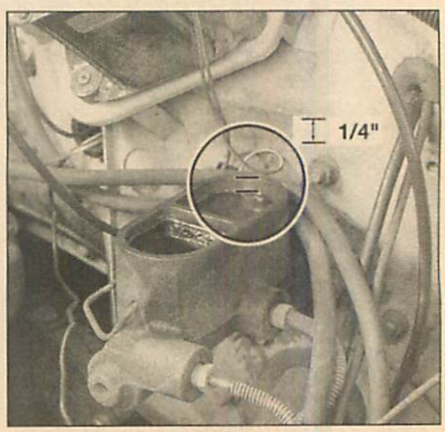
24 The brake fluid level in the master cylinder will drop slightly as the pads at the front wheels wear down during normal operation. If the master cylinder requires repeated additions to keep it at the proper level, it's an indication of leakage in the brake system, which should be corrected immediately. Check all brake lines and connections (see Section 36 for more information).

25 If, upon checking the master cylinder fluid level, you discover one or both reservoirs empty or nearly empty, the brake system should be checked for leaks and bled after repairs have been made (see Chapter 9).

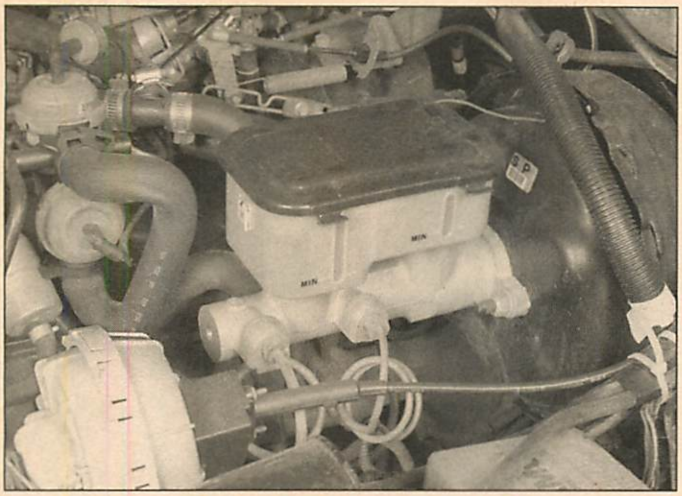


4.18 Remove the cell caps to check the water level in the battery - if the level is to low, add distilled water only

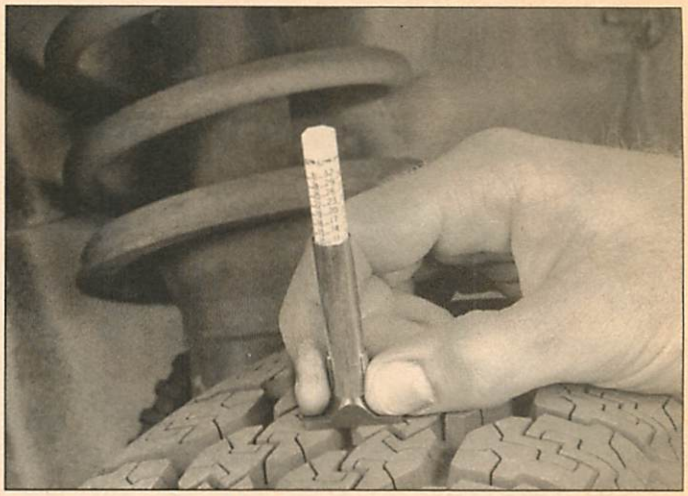
4.19a On early models with a cast iron brake master cylinder, use a screwdriver to pry off the retainer and remove the cover to check the fluid level



4.19b Maintain the brake fluid level 1/4-inch below the top edge (arrow)



4.20 On later models, the fluid level inside the brake reservoir can easily be checked by observing the level from the outside - fluid can be added to the reservoir after the cover is removed by prying up on the tabs



5.2 Use a tire tread depth gauge to monitor tire wear - they are available at auto parts stores and service stations and cost very little

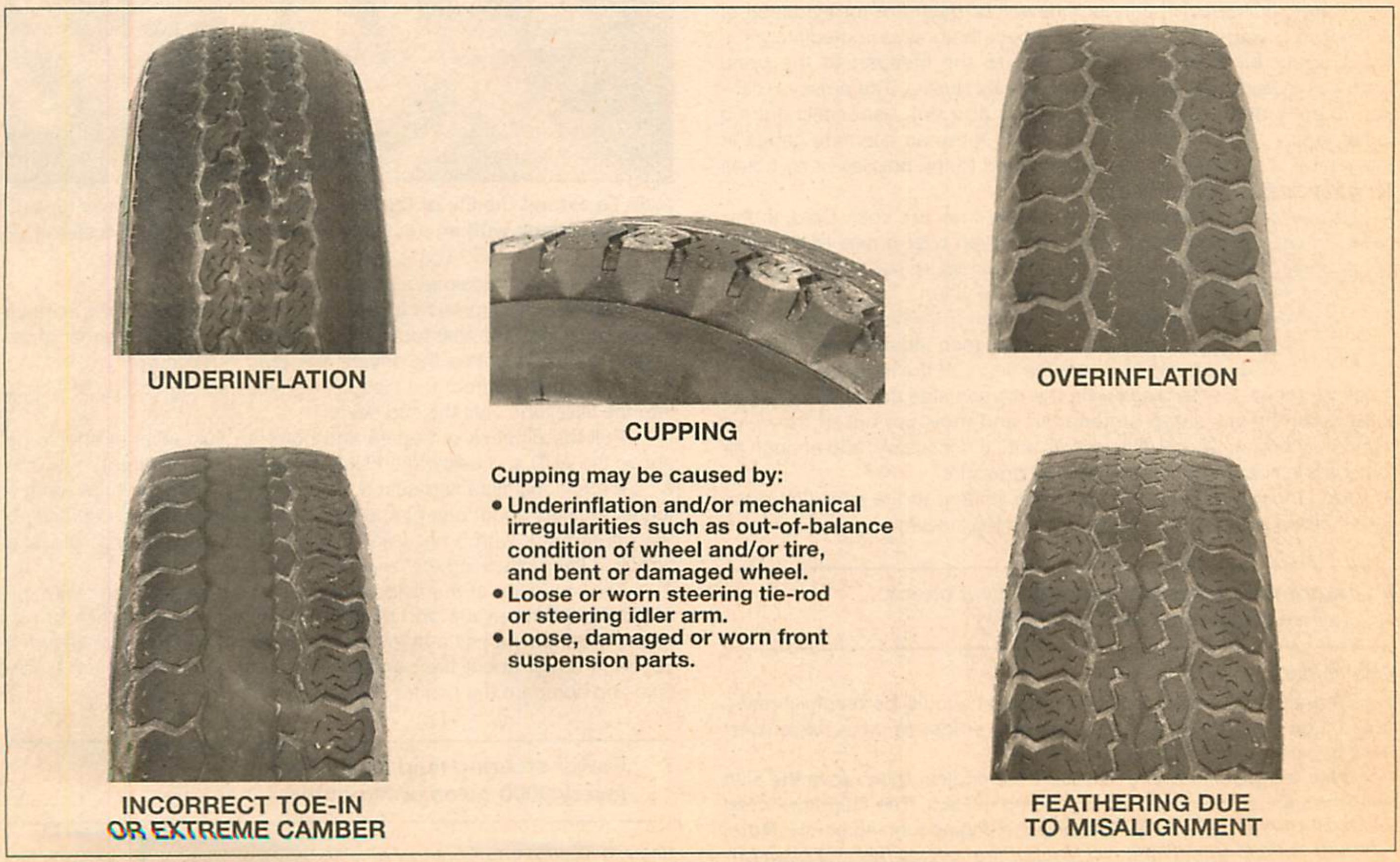
5 Tire and tire pressure checks (every 250 miles or weekly)

Refer to illustrations 5.2, 5.3, 5.4a, 5.4b and 5.8

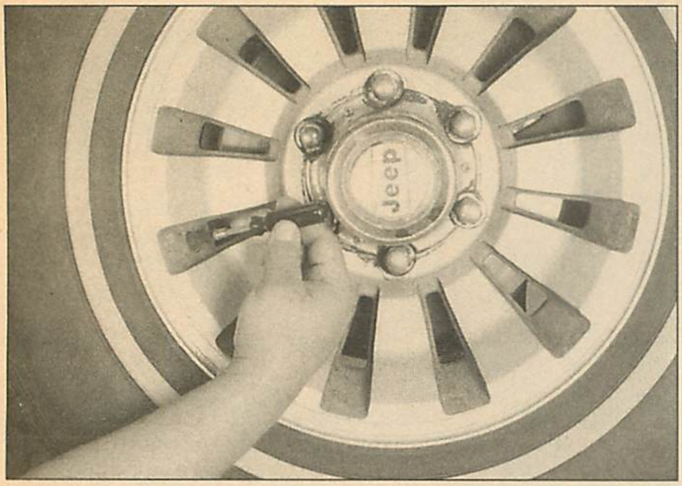
1 Periodic inspection of the tires may spare you the inconvenience of being stranded with a flat tire. It can also provide you with vital information regarding possible problems in the steering and suspension systems before major damage occurs.

2 The original tires on this vehicle are equipped with 1/2-inch wear bands that will appear when tread depth reaches 1/16-inch, but they don't appear until the tires are worn out. Tread wear can be monitored with a simple, inexpensive device known as a tread depth indicator **(see illustration)**.

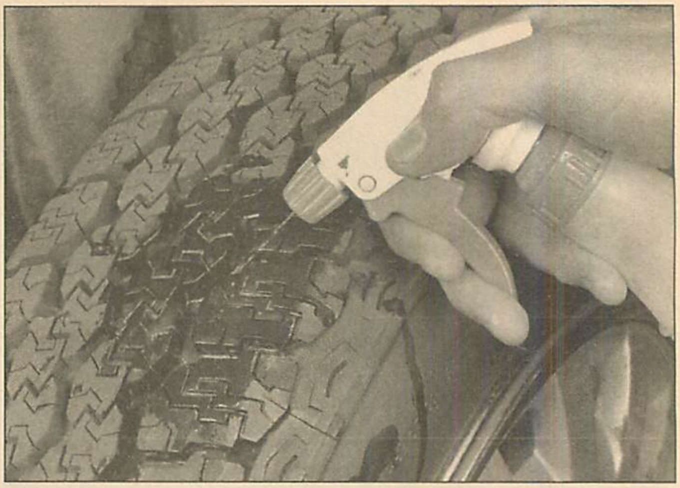
3 Note any abnormal tread wear **(see illustration)**. Tread pattern irregularities such as cupping, flat spots and more wear on one side than the other are indications of front end alignment and/or balance problems. If any of these conditions are noted, take the vehicle to a tire shop or service station to correct the problem.



5.3 This chart will help you determine the condition of the tires, the probable cause(s) of abnormal wear and the corrective action necessary



5.4a If a tire loses air on a steady basis, check the valve core first to make sure it's snug (special inexpensive wrenches are commonly available at auto parts stores)



5.4b If the valve core is tight, raise the corner of the vehicle with the low tire and spray a soapy water solution onto the tread as the tire is turned slowly - leaks will cause small bubbles to appear

4 Look closely for cuts, punctures and embedded nails or tacks. Sometimes a tire will hold air pressure for a short time or leak down very slowly after a nail has embedded itself in the tread. If a slow leak persists, check the valve stem core to make sure it's tight **(see illustration)**. Examine the tread for an object that may have embedded itself in the tire or for a "plug" that may have begun to leak (radial tire punctures are repaired with a rubber plug that's installed in the hole). If a puncture is suspected, it can be easily verified by spraying a solution of soapy water onto the puncture area **(see illustration)**. The soapy solution will bubble if there's a leak. Unless the puncture is unusually large, a tire shop or service station can usually repair the tire.

5 Carefully inspect the inner sidewall of each tire for evidence of brake fluid leakage. If you see any, inspect the brakes immediately.

6 Correct air pressure adds miles to the lifespan of the tires, improves mileage and enhances overall ride quality. Tire pressure cannot be accurately estimated by looking at a tire, especially if it's a radial. A tire pressure gauge is essential. Keep an accurate gauge in the vehicle. The pressure gauges attached to the nozzles of air hoses at gas stations are often inaccurate.

7 Always check tire pressure when the tires are cold. Cold, in this case, means the vehicle has not been driven over a mile in the three hours preceding a tire pressure check. A pressure rise of four to eight pounds is not uncommon once the tires are warm.

8 Unscrew the valve cap protruding from the wheel or hubcap and push the gauge firmly onto the valve stem **(see illustration)**. Note the reading on the gauge and compare the figure to the recommended tire pressure shown on the placard on the driver's side door pillar. Be sure to reinstall the valve cap to keep dirt and moisture out of the valve stem mechanism. Check all four tires and, if necessary, add enough air to bring them up to the recommended pressure.

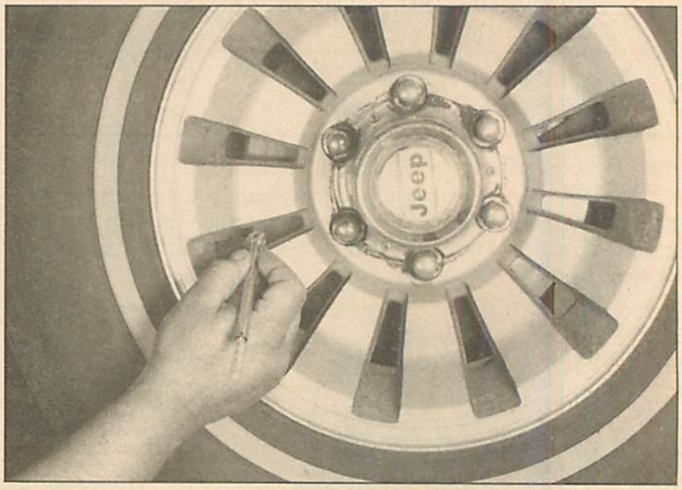
9 Don't forget to keep the spare tire inflated to the specified pressure (refer to your owner's manual or the tire sidewall).

6 Automatic transmission fluid level check (every 3000 miles or 3 months)

Refer to illustrations 6.3 and 6.5

1 The automatic transmission fluid level should be carefully maintained. Low fluid level can lead to slipping or loss of drive, while overfilling can cause foaming and loss of fluid.

2 With the parking brake set, start the engine, then move the shift lever through all the gear ranges, ending in Park. The fluid level must be checked with the vehicle level and the engine running at idle. **Note:** *Incorrect fluid level readings will result if the vehicle has just been driven at high speeds for an extended period, in hot weather in city traffic, or if it has been pulling a trailer. If any of these conditions apply, wait until the fluid has cooled (about 30 minutes).*



5.8 To extend the life of the tires, check the air pressure at least once a week with an accurate gauge (don't forget the spare)

3 With the transmission at normal operating temperature, remove the dipstick from the filler tube. The dipstick is located at the rear of the engine compartment on the drivers side **(see illustration)**.

4 Wipe the fluid from the dipstick with a clean rag and push it back into the filler tube until the cap seats.

5 Pull the dipstick out again and note the fluid level. It should be above the ADD and below the FULL marks **(see illustration)**.

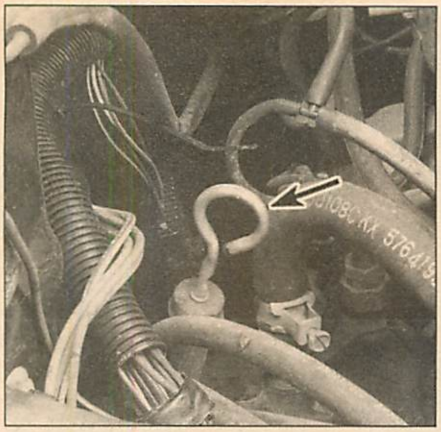
6 If additional fluid is required, pour it directly into the tube using a funnel. It takes about one pint to raise the level from the lower mark to the upper mark with a hot transmission, so add the fluid a little at a time and keep checking the level until it's correct.

7 The condition of the fluid should also be checked along with the level. If the fluid at the end of the dipstick is a dark reddish-brown color, or if the fluid has a burned smell, the fluid should be changed. If you're in doubt about the condition of the fluid, purchase some new fluid and compare the two for color and smell.

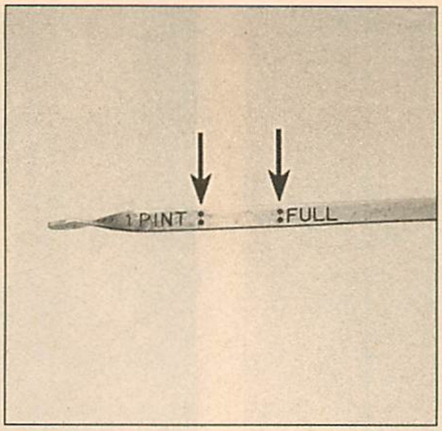
7 Power steering fluid level check (every 3000 miles or 3 months)

Refer to illustrations 7.5 and 7.6

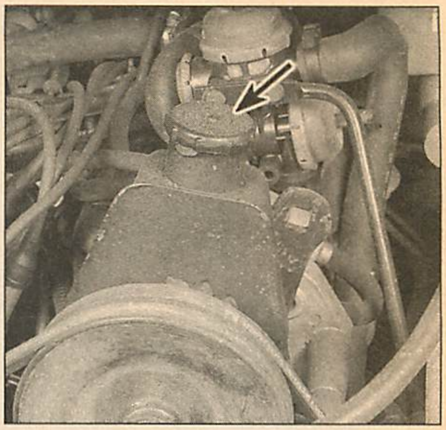
1 Unlike manual steering, the power steering system relies on fluid which may, over a period of time, require replenishing.



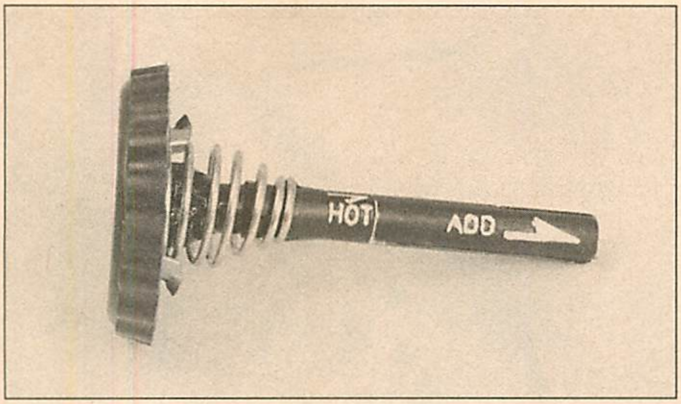
6.3 The automatic transmission fluid dipstick (arrow) is located at the rear of the engine compartment



6.5 The automatic transmission fluid level must be maintained between the ADD mark and the FULL mark (arrows) with the engine idling at operating temperature



7.5 The power steering fluid dipstick is located in the power steering pump reservoir - turn the cap (arrow) counterclockwise to remove it



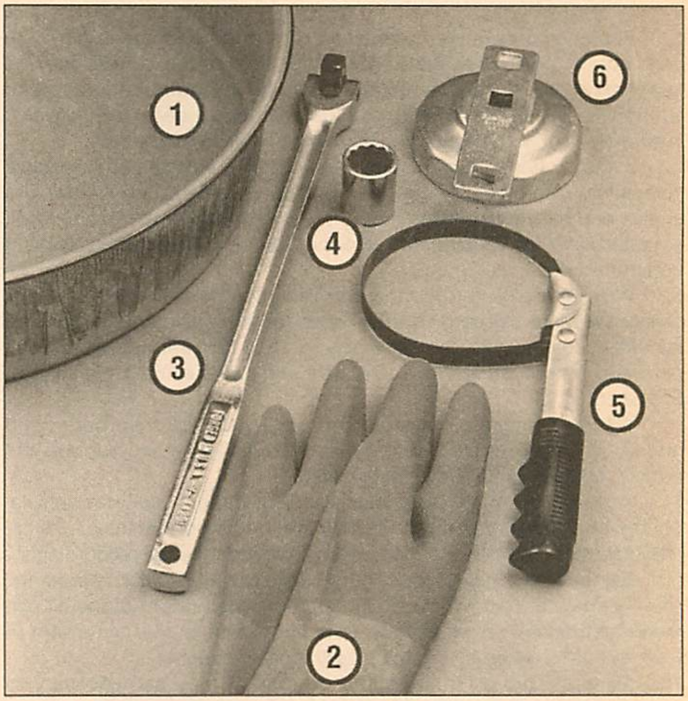
7.6 The marks on the dipstick indicate the safe fluid range

2 The fluid reservoir for the power steering pump is located on the pump body at the front of the engine.
3 For the check, the front wheels should be pointed straight ahead and the engine should be off.
4 Use a clean rag to wipe off the reservoir cap and the area around the cap. This will help prevent any foreign matter from entering the reservoir during the check.
5 Twist off the cap and determine the temperature of the fluid **(see illustration)**.
6 Wipe off the fluid with a clean rag, reinsert the dipstick, then withdraw it and read the fluid level. The fluid should be at the proper level, depending on whether it was checked hot or cold **(see illustration)**. Never allow the fluid level to drop below the lower mark on the dipstick.
7 If additional fluid is required, pour the specified type directly into the reservoir, using a funnel to prevent spills.
8 If the reservoir requires frequent fluid additions, all power steering hoses, hose connections and the power steering pump should be carefully checked for leaks.

8 Engine oil and filter change (every 3000 miles or 3 months)

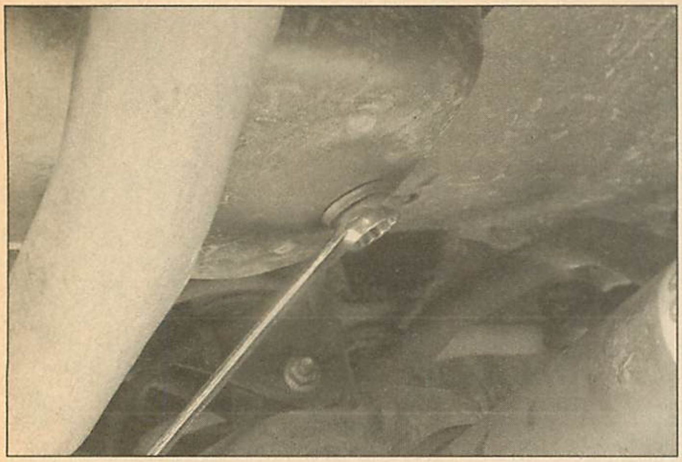
Refer to illustrations 8.3, 8.9, 8.14 and 8.18

1 Frequent oil changes are the most important preventive maintenance procedures that can be done by the home mechanic. As engine oil ages, it becomes diluted and contaminated, which leads to premature engine wear.
2 Although some sources recommend oil filter changes every other oil change, we feel that the minimal cost of an oil filter and the relative ease with which it is installed dictate that a new filter be installed every time the oil is changed.
3 Gather together all necessary tools and materials before beginning this procedure **(see illustration)**.



8.3 These tools are required when changing the engine oil and filter

1 ***Drain pan** - It should be fairly shallow in depth, but wide to prevent spills*
2 ***Rubber gloves** - When removing the drain plug and filter, you will get oil on your hands (the gloves will prevent burns)*
3 ***Breaker bar** - Sometimes the oil drain plug is tight, and a long breaker bar is needed to loosen it*
4 ***Socket** - To be used with the breaker bar or a ratchet (must be the correct size to fit the drain plug)*
5 ***Filter wrench** - This is a metal band-type wrench, which requires clearance around the filter to be effective*
6 ***Filter wrench** - This type fits on the bottom of the filter and can be turned with a ratchet or breaker bar (different size wrenches are available for different types of filters)*



8.9 The engine oil drain plug is located on the bottom of the oil pan - it is usually very tight, so use the proper size box end wrench or socket to avoid rounding it off.

8.14 The oil filter is usually on very tight and will require a special wrench for removal - DO NOT use the wrench to tighten the new filter!

8.18 Lubricate the oil filter gasket with clean engine oil before installing the filter on the engine

4 You should have plenty of clean rags and newspapers handy to mop up any spills. Access to the under side of the vehicle may be improved if the vehicle can be lifted on a hoist, driven onto ramps or supported by jackstands. **Warning:** *Do not work under a vehicle which is supported only by a bumper, hydraulic or scissors-type jack.*

5 If this is your first oil change, get under the vehicle and familiarize yourself with the locations of the oil drain plug and the oil filter. The engine and exhaust components will be warm during the actual work, so note how they are situated to avoid touching them when working under the vehicle.

6 Warm the engine to normal operating temperature. If the new oil or any tools are needed, use this warm-up time to gather everything necessary for the job. The correct type of oil for your application can be found in *Recommended lubricants and fluids* at the beginning of this Chapter.

7 With the engine oil warm (warm engine oil will drain better and more built-up sludge will be removed with it), raise and support the vehicle. Make sure it's safely supported!

8 Move all necessary tools, rags and newspapers under the vehicle. Set the drain pan under the drain plug. Keep in mind that the oil will initially flow from the pan with some force; position the pan accordingly.

9 Being careful not to touch any of the hot exhaust components, use a wrench to remove the drain plug near the bottom of the oil pan **(see illustration)**. Depending on how hot the oil is, you may want to wear gloves while removing the plug the final few turns.

10 Allow the old oil to drain into the pan. It may be necessary to move the pan as the oil flow slows to a trickle.

11 After all the oil has drained, wipe off the drain plug with a clean rag. Small metal particles may cling to the plug and would immediately contaminate the new oil.

12 Clean the area around the drain plug opening and reinstall the plug. Tighten the plug securely with the wrench. If a torque wrench is available, use it to tighten the plug to the torque listed in this Chapter's Specifications.

13 Move the drain pan into position under the oil filter.

14 Use the filter wrench to loosen the oil filter **(see illustration)**.

15 Completely unscrew the old filter. Be careful; it's full of oil. Empty the oil inside the filter into the drain pan, then lower the filter (V8 engine) or lift the filter out from above (six-cylinder engine).

16 Compare the old filter with the new one to make sure they're the same type.

17 Use a clean rag to remove all oil, dirt and sludge from the area where the oil filter mounts to the engine. Check the old filter to make sure the rubber gasket isn't stuck to the engine. If the gasket is stuck to the engine, remove it.

18 Apply a light coat of clean oil to the rubber gasket on the new oil filter **(see illustration)**.

19 Attach the new filter to the engine, following the tightening directions printed on the filter canister or packing box. Most filter manufacturers recommend against using a filter wrench due to the possibility of overtightening and damaging to the seal.

20 Remove all tools, rags, etc. from under the vehicle, being careful not to spill the oil in the drain pan, then lower the vehicle.

21 Move to the engine compartment and locate the oil filler cap.

22 Pour the fresh oil through the filler opening. A funnel may be helpful.

23 Pour four quarts of fresh oil into the engine. Wait a few minutes to allow the oil to drain into the pan, then check the level on the oil dipstick (see Section 4 if necessary). If the oil level is above the ADD mark, start the engine and allow the new oil to circulate.

24 Run the engine for only about a minute and then shut it off. Immediately look under the vehicle and check for leaks at the oil pan drain plug and around the oil filter. If either is leaking, tighten with a bit more force.

25 With the new oil circulated and the filter now completely full, recheck the level on the dipstick and add more oil as necessary.

26 During the first few trips after an oil change, make it a point to check frequently for leaks and proper oil level.

27 The old oil drained from the engine cannot be reused in its present state and should be disposed of. Oil reclamation centers, auto repair shops and gas stations will normally accept the oil, which can be refined and used again. After the oil has cooled it can be drained into a container (capped plastic jugs, topped bottles, milk cartons, etc.) for transport to one of these disposal sites. Don't dispose of the oil by pouring it on the ground or down a drain!

9.1 Tools and materials required for battery maintenance

1 ***Face shield/safety goggles*** - *When removing corrosion with a brush, the acidic particles can easily fly up into your eyes*
2 ***Baking soda*** - *A solution of baking soda and water can be used to neutralize corrosion*
3 ***Petroleum jelly*** - *A layer of this on the battery posts will help prevent corrosion*
4 ***Battery post/cable cleaner*** - *This wire brush cleaning tool will remove all traces of corrosion from the battery posts and cable clamps*
5 ***Treated felt washers*** - *Placing one of these on each post, directly under the cable clamps, will help prevent corrosion*
6 ***Puller*** - *Sometimes the cable clamps are very difficult to pull off the posts, even after the nut/bolt has been completely loosened. This tool pulls the clamp straight up and off the post without damage*
7 ***Battery post/cable cleaner*** - *Here is another cleaning tool which is a slightly different version of Number 4 above, but it does the same thing*
8 ***Rubber gloves*** - *Another safety item to consider when servicing the battery; remember that's acid inside the battery!*

9 Battery check, maintenance and charging (every 7500 miles or 6 months)

Refer to illustrations 9.1, 9.6a, 9.6b, 9.7a and 9.7b

Warning: *Certain precautions must be followed when checking and servicing the battery. Hydrogen gas, which is highly flammable, is always present in the battery cells, so keep lighted tobacco and all other open flames and sparks away from the battery. The electrolyte inside the battery is actually dilute sulfuric acid, which will cause injury if splashed on your skin or in your eyes. It will also ruin clothes and painted surfaces. When removing the battery cables, always detach the negative cable first and hook it up last!*

Maintenance

1 A routine preventive maintenance program for the battery in your vehicle is the only way to ensure quick and reliable starts. But before performing any battery maintenance, make sure that you have the proper equipment necessary to work safely around the battery **(see illustration)**.

2 There are also several precautions that should be taken whenever battery maintenance is performed. Before servicing the battery, always turn the engine and all accessories off and disconnect the cable from the negative terminal of the battery.

3 The battery produces hydrogen gas, which is both flammable and explosive. Never create a spark, smoke or light a match around the battery. Always charge the battery in a ventilated area.

4 Electrolyte contains poisonous and corrosive sulfuric acid. Do not allow it to get in your eyes, on your skin on your clothes. Never ingest it. Wear protective safety glasses when working near the battery. Keep children away from the battery.

5 Note the external condition of the battery. If the positive terminal and cable clamp on your vehicle's battery is equipped with a rubber protector, make sure that it's not torn or damaged. It should completely cover the terminal. Look for any corroded or loose connections, cracks in the case or cover or loose hold-down clamps. Also check the entire length of each cable for cracks and frayed conductors.

6 If corrosion, which looks like white, fluffy deposits **(see illustration)** is evident, particularly around the terminals, the battery should be removed for cleaning. Loosen the cable clamp bolts with a wrench, being careful to remove the ground cable first, and slide them off the terminals **(see illustration)**. Then disconnect the hold-down clamp bolt and nut, remove the clamp and lift the battery from the engine compartment.

9.6a Battery terminal corrosion usually appears as light, fluffy powder

9.6b Removing the cable from a battery post with a wrench - sometimes special battery pliers are required for this procedure if corrosion has caused deterioration of the nut hex (always remove the ground cable first and hook it up last!)

1

9.7a When cleaning the cable clamps, all corrosion must be removed (the inside of the clamp is tapered to match the taper on the post, so don't remove too much material)

9.7b Regardless of the type of tool used on the battery posts, a clean, shiny surface should be the end result

7 Clean the cable clamps thoroughly with a battery brush or a terminal cleaner and a solution of warm water and baking soda **(see illustration)**. Wash the terminals and the top of the battery case with the same solution but make sure that the solution doesn't get into the battery. When cleaning the cables, terminals and battery top, wear safety goggles and rubber gloves to prevent any solution from coming in contact with your eyes or hands. Wear old clothes too - even diluted, sulfuric acid splashed onto clothes will burn holes in them. If the terminals have been extensively corroded, clean them up with a terminal cleaner **(see illustration)**. Thoroughly wash all cleaned areas with plain water.
8 Make sure that the battery tray is in good condition and the hold-down clamp bolts are tight. If the battery is removed from the tray, make sure no parts remain in the bottom of the tray when the battery is reinstalled. When reinstalling the hold-down clamp bolts, do not overtighten them.
9 Any metal parts of the vehicle damaged by corrosion should be covered with a zinc-based primer, then painted.
10 Information on removing and installing the battery can be found in Chapter 5. Information on jump starting can be found at the front of this manual. For more detailed battery checking procedures, refer to the *Haynes Automotive Electrical Manual*.

Charging

Warning: *When batteries are being charged, hydrogen gas, which is very explosive and flammable, is produced. Do not smoke or allow open flames near a battery. Wear eye protection when near the battery during charging. Also, make sure the charger is unplugged before connecting or disconnecting the battery from the charger.*
Note: *The manufacturer recommends the battery be removed from the vehicle for charging because the gas that escapes during this procedure can damage the paint. Fast charging with the battery cables connected can result in damage to the electrical system.*
11 Slow-rate charging is the best way to restore a battery that's discharged to the point where it will not start the engine. It's also a good way to maintain the battery charge in a vehicle that's only driven a few miles between starts. Maintaining the battery charge is particularly important in the winter when the battery must work harder to start the engine and electrical accessories that drain the battery are in greater use.
12 It's best to use a one or two-amp battery charger (sometimes called a "trickle" charger). They are the safest and put the least strain on the battery. They are also the least expensive. For a faster charge, you can use a higher amperage charger, but don't use one rated more than 1/10th the amp/hour rating of the battery. Rapid boost charges that claim to restore the power of the battery in one to two hours are hardest on the battery and can damage batteries not in good condition. This type of charging should only be used in emergency situations.
13 The average time necessary to charge a battery should be listed in the instructions that come with the charger. As a general rule, a trickle charger will charge a battery in 12 to 16 hours.
14 Remove all the cell caps (if equipped) and cover the holes with a clean cloth to prevent spattering electrolyte. Disconnect the negative battery cable and hook the battery charger cable clamps up to the battery posts (positive to positive, negative to negative), then plug in the charger. Make sure it is set at 12-volts if it has a selector switch.
15 If you're using a charger with a rate higher than two amps, check the battery regularly during charging to make sure it doesn't overheat. If you're using a trickle charger, you can safely let the battery charge overnight after you've checked it regularly for the first couple of hours.
16 If the battery has removable cell caps, measure the specific gravity with a hydrometer every hour during the last few hours of the charging cycle. Hydrometers are available inexpensively from auto parts stores - follow the instructions that come with the hydrometer. Consider the battery charged when there's no change in the specific gravity reading for two hours and the electrolyte in the cells is gassing (bubbling) freely. The specific gravity reading from each cell should be very close to the others. If not, the battery probably has a bad cell(s).
17 Some batteries with sealed tops have built-in hydrometers on the top that indicate the state of charge by the color displayed in the hydrometer window. Normally, a bright-colored hydrometer indicates a full charge and a dark hydrometer indicates the battery still needs charging.
18 If the battery has a sealed top and no built-in hydrometer, you can hook up a voltmeter across the battery terminals to check the charge. A fully charged battery should read 12.6 volts or higher after the surface charge has been removed.
19 Further information on the battery and jump starting can be found in Chapter 5 and at the front of this manual.

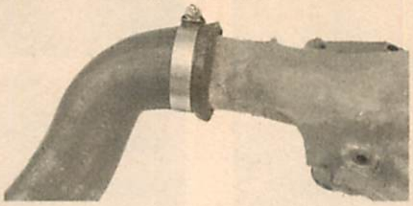
10 Cooling system check (every 7500 miles or 6 months)

Refer to illustration 10.4

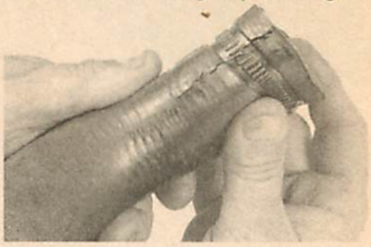
1 Many major engine failures can be attributed to a faulty cooling system. If the vehicle is equipped with an automatic transmission, the cooling system also cools the transmission fluid and thus plays an important role in prolonging transmission life.
2 The cooling system should be checked with the engine cold. Do this before the vehicle is driven for the day or after it has been shut off for at least three hours.
3 Remove the radiator cap by turning it to the left until it reaches a stop. If you hear a hissing sound (indicating there is still pressure in the system), wait until this stops. Now press down on the cap with the palm of your hand and continue turning to the left until the cap can be removed. Thoroughly clean the cap, inside and out, with clean water. Also clean the filler neck on the radiator. All traces of corrosion should be removed. The coolant inside the radiator should be relatively trans-

Check for a chafed area that could fail prematurely.

Overtightening the clamp on a hardened hose will damage the hose and cause a leak.



Check each hose for swelling and oil-soaked ends. Cracks and breaks can be located by squeezing the hose.



Check for a soft area indicating the hose has deteriorated inside.

10.4 Hoses, like drivebelts, have a habit of failing at the worst possible time - to prevent the inconvenience of a blown radiator or heater hose, inspect them carefully as shown here

parent. If it is rust colored, the system should be drained and refilled (see Section 10). If the coolant level is not up to the top, add additional antifreeze/coolant mixture (see Section 4).

4 Carefully check the large upper and lower radiator hoses along with the smaller diameter heater hoses which run from the engine to the firewall. Inspect each hose along its entire length, replacing any hose which is cracked, swollen or shows signs of deterioration. Cracks may become more apparent if the hose is squeezed **(see illustration)**. Regardless of condition, it's a good idea to replace hoses with new ones every two years.

5 Make sure all hose connections are tight. A leak in the cooling system will usually show up as white or rust colored deposits on the areas adjoining the leak. If wire-type clamps are used at the ends of the hoses, it may be a good idea to replace them with more secure screw-type clamps.

6 Use compressed air or a soft brush to remove bugs, leaves, etc. from the front of the radiator or air conditioning condenser. Be careful not to damage the delicate cooling fins or cut yourself on them.

7 Every other inspection, or at the first indication of cooling system problems, have the cap and system pressure tested. If you don't have a pressure tester, most gas stations and repair shops will do this for a minimal charge.

11 Underhood hose check and replacement (every 7500 miles or 6 months)

General

1 **Warning:** *Replacement of air conditioning hoses must be left to a dealer service department or air conditioning shop that has the equipment to depressurize the system safely. Never remove air conditioning components or hoses until the system has been depressurized.*

2 High temperatures in the engine compartment can cause the deterioration of the rubber and plastic hoses used for engine, accessory and emission systems operation. Periodic inspection should be made for cracks, loose clamps, material hardening and leaks. Information specific to the cooling system hoses can be found in Section 10.

3 Some, but not all, hoses are secured to the fittings with clamps. Where clamps are used, check to be sure they haven't lost their tension, allowing the hose to leak. If clamps aren't used, make sure the hose has not expanded and/or hardened where it slips over the fitting, allowing it to leak.

Vacuum hoses

4 It's quite common for vacuum hoses, especially those in the emissions system, to be color coded or identified by colored stripes molded into them. Various systems require hoses with different wall thickness, collapse resistance and temperature resistance. When replacing hoses, be sure the new ones are made of the same material.

5 Often the only effective way to check a hose is to remove it completely from the vehicle. If more than one hose is removed, be sure to label the hoses and fittings to ensure correct installation.

6 When checking vacuum hoses, be sure to include any plastic T-fittings in the check. Inspect the fittings for cracks and the hose where it fits over the fitting for distortion, which could cause leakage.

7 A small piece of vacuum hose (1/4-inch inside diameter) can be used as a stethoscope to detect vacuum leaks. Hold one end of the hose to your ear and probe around vacuum hoses and fittings, listening for the "hissing" sound characteristic of a vacuum leak. **Warning:** *When probing with the vacuum hose stethoscope, be very careful not to come into contact with moving engine components such as the drivebelt, cooling fan, etc.*

Fuel hose

Warning: *There are certain precautions which must be taken when inspecting or servicing fuel system components. Work in a well ventilated area and do not allow open flames (cigarettes, appliance pilot lights, etc.) or bare light bulbs near the work area. Mop up any spills immediately and do not store fuel soaked rags where they could ignite.*

8 Check all rubber fuel lines for deterioration and chafing. Check especially for cracks in areas where the hose bends and just before fittings, such as where a hose attaches to the fuel filter.

9 Only high quality fuel line should be used for fuel line replacement. Never, under any circumstances, use unreinforced vacuum line, clear plastic tubing or water hose for fuel lines.

10 Spring-type clamps are commonly used on fuel lines. These clamps often lose their tension over a period of time, and can be "sprung" during removal. Replace all spring-type clamps with screw clamps whenever a hose is replaced.

Metal lines

11 Sections of metal line are often used in the fuel system. Check carefully to be sure the line has not been bent or crimped and that cracks have not started in the line.

12 If a section of metal fuel line must be replaced, only seamless steel tubing should be used, since copper and aluminum tubing don't have the strength necessary to withstand normal engine vibration.

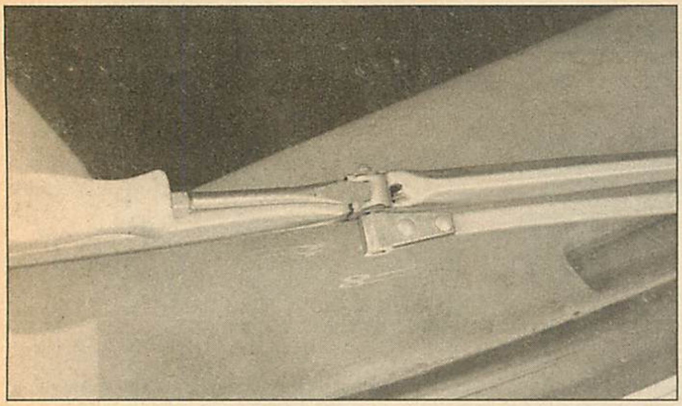
13 Check the metal brake lines where they enter the master cylinder and brake proportioning unit (if used) for cracks in the lines or loose fittings. Any sign of brake fluid leakage calls for an immediate thorough inspection of the brake system.

12 Wiper blade inspection and replacement (every 7500 miles or 6 months)

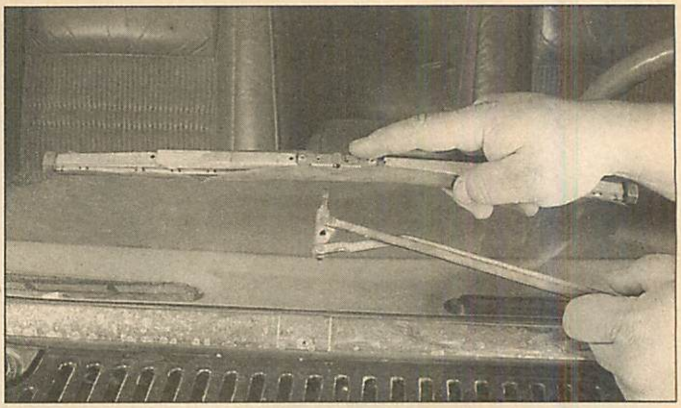
Refer to illustrations 12.6a, 12.6b, 12.6c and 12.6d

1 The windshield wiper and blade assembly should be inspected periodically for damage, loose components and cracked or worn blade elements.

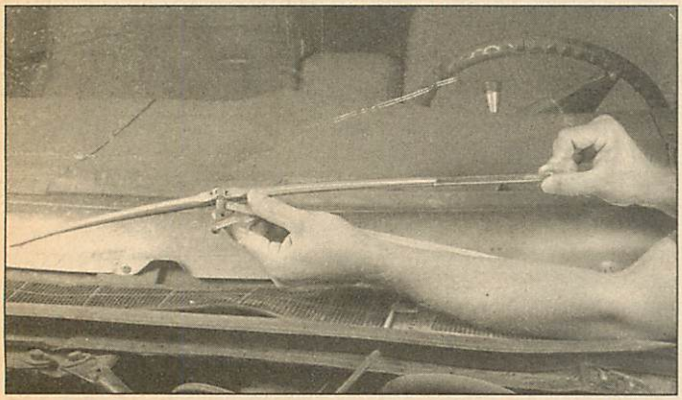
2 Road film can build up on the wiper blades and affect their effi-



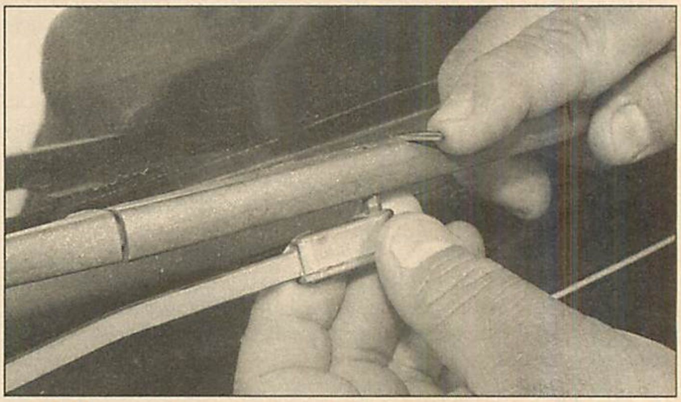
12.6a To remove the original wiper blade assemblies, insert a screwdriver under the wiper release lever, lift up and slide the windshield wiper assembly off the arm stud



12.6b Aftermarket wiper blade assemblies require pushing down on the tab to release the blade assembly



12.6c To remove the wiper element squeeze the end of the element to free it from the bridge claw, then slide the element out



12.6d On rear window wipers, lift the release lever then slide the wiper off the stud

ciency, so they should be washed regularly with a mild detergent solution.

3 The action of the wiping mechanism can loosen the bolts, nuts and fasteners, so they should be checked and tightened, as necessary, at the same time the wiper blades are checked.

4 If the wiper blade elements (sometimes called inserts) are cracked, worn or warped, the blade/arm assemblies should be replaced with new ones.

5 Pull the wiper blade/arm assembly away from the glass.

6 Lift the release lever and slide the blade assembly off the wiper arm and over the retaining stud **(see illustrations)**.

7 Compare the new blade/arm assembly to the old one for length, design, etc.

8 Reinstall the blade assembly on the arm, wet the windshield and check for proper operation.

13 Tire rotation (every 7500 miles or 6 months)

Refer to illustration 13.2

1 The tires should be rotated at the specified intervals and whenever uneven wear is noticed.

2 Refer to the accompanying illustration for the preferred tire rotation pattern.

3 Refer to the information in *Jacking and towing* at the front of this manual for the proper procedures to follow when raising the vehicle and changing a tire. If the brakes are to be checked, don't apply the parking brake as stated. Make sure the tires are blocked to prevent the vehicle from rolling as it's raised.

4 Preferably, the entire vehicle should be raised at the same time. This can be done on a hoist or by jacking up each corner and then lowering the vehicle onto jackstands placed under the frame rails. Always use four jackstands and make sure the vehicle is safely supported.

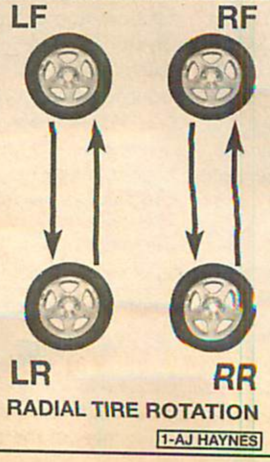
5 After rotation, check and adjust the tire pressures as necessary and be sure to properly tighten the lug nuts.

14 Suspension, steering and driveline check (every 7500 miles or 6 months)

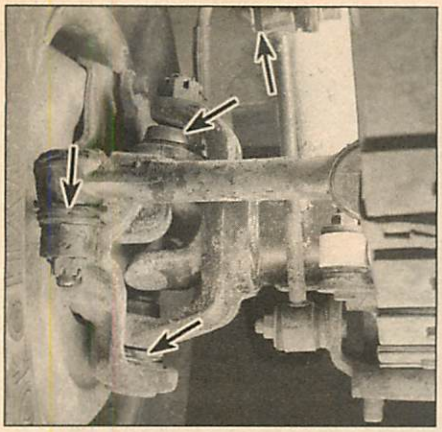
Refer to illustrations 14.4a, 14.4b, 14.6a and 14.6b

1 Indications of a fault in these systems are excessive play in the steering wheel before the front wheels react, excessive sway around corners, body movement over rough roads or binding at some point as the steering wheel is turned.

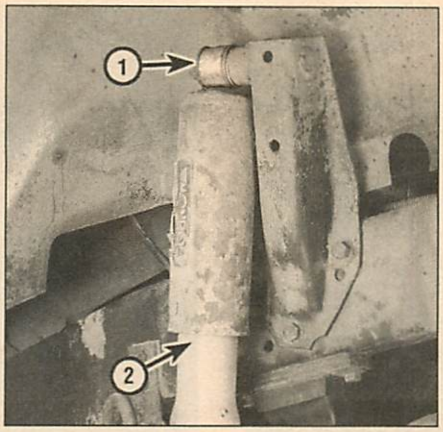
2 Raise the front of the vehicle periodically, support it securely on



13.2 Tire rotation diagram for radial tires



14.4a Inspect the suspension for deteriorated rubber bushings and torn grease seals (arrows)



14.4b Check the shocks for worn bushings at each end of the shock absorber (1) and oil leaks at the center of the shock (2)

14.6a Twist the U-joint from side to side and check for side play, then move it back and forth and check for end play - If any play is found the U-joint should be replaced

jackstands and visually check the suspension and steering components for wear.

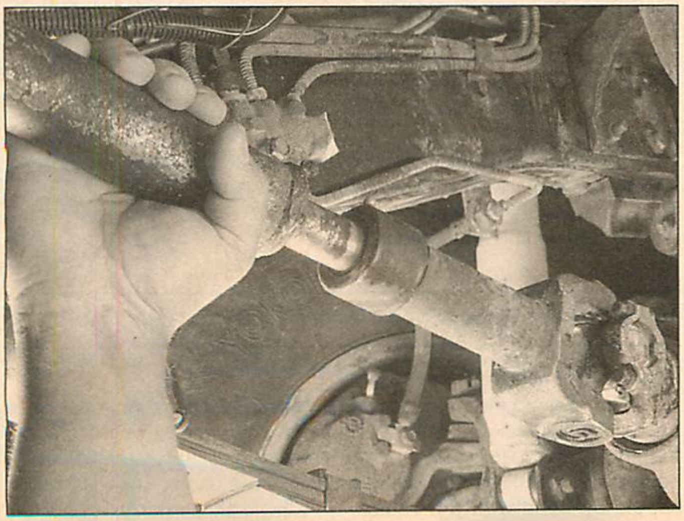
3 Check the wheel bearings. Do this by spinning the front wheels. Listen for any abnormal noises and watch to make sure the wheel spins true (doesn't wobble). Grab the top and bottom of the tire and pull in-and-out on it. Notice any movement which would indicate a loose wheel bearing assembly. If the bearings are suspect, refer to Chapter 10 for more information.

4 From under the vehicle, check for loose bolts, broken or disconnected parts and deteriorated rubber bushings on all suspension and steering components. Look for fluid leaking from the steering gear assembly. Check the power steering hoses, belts and connections for leaks. Inspect the shock absorbers for fluid leaks, indicating the need for replacement **(see illustrations)**.

5 Have an assistant turn the steering wheel from side-to-side and check the steering components for free movement, chafing and binding. If the steering doesn't react with the movement of the steering wheel, try to determine where the slack is located.

6 Inspect the driveshafts for worn U-joints and for excessive play in the slip yoke and spline area **(see illustrations)**. If any play is found at the U-joints or the slip yoke and spline area the components should be replaced (see Chapter 8).

7 Check the transfer case and differentials for evidence of fluid leakage.

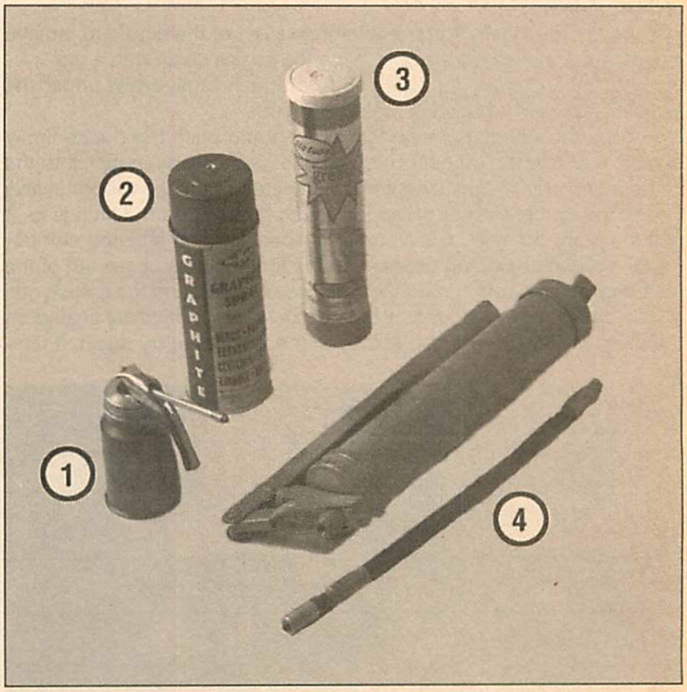


14.6b Grasp the driveshaft and move it up and down to check for play at the slip yoke

15 Chassis lubrication (every 7500 miles or 6 months)

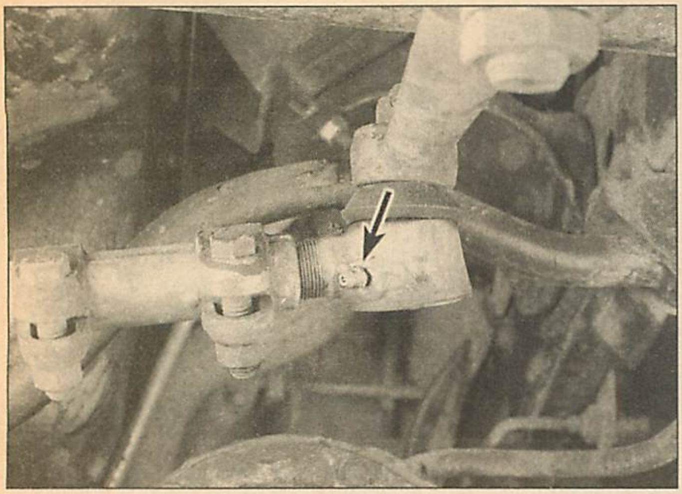
Refer to illustrations 15.1, 15.2, 15.8, 15.9, 15.10, 15.11 and 15.14

1 Refer to *Recommended lubricants and fluids* at the front of this Chapter to obtain the necessary grease, etc. You will also need a grease gun **(see illustration)**. Occasionally plugs will be installed rather than grease fittings. If so, grease fittings will have to be purchased and installed.

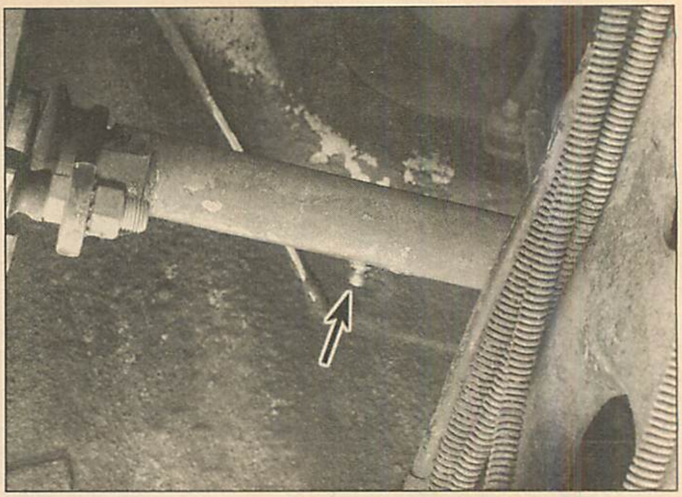


15.1 Materials required for chassis and body lubrication

1 **Engine oil** - *Light engine oil in a can like this can be used for door and hood hinges*
2 **Graphite spray** - *Used to lubricate lock cylinders*
3 **Grease** - *Grease, in a variety of types and weights, is available for use in a grease gun. Check the Specifications for your requirements*
4 **Grease gun** - *A common grease gun, shown here with a detachable hose and nozzle, is needed for chassis lubrication. After use, clean it thoroughly*



15.2 Look under the vehicle for grease fittings (arrow) located on the balljoints, tie rod ends and driveline components



15.8 Lubricate the clutch linkage bellcrank (arrow) and release rod

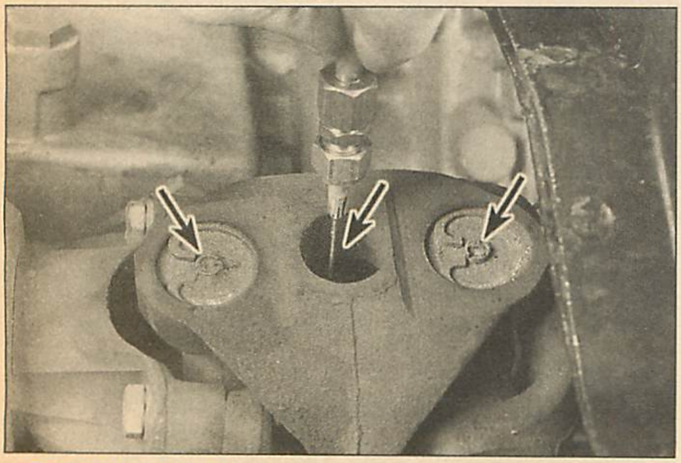
2 Look under the vehicle for grease fittings or plugs on the steering, suspension, and driveline components **(see illustration)**. They are normally found on the balljoints, tie-rod ends and universal joints. If there are plugs, remove them and install grease fittings, which will thread into the component. An automotive parts store will be able to supply the correct fittings. Straight, as well as angled, fittings are available.

3 For easier access under the vehicle, raise it with a jack and place jackstands under the frame. Make sure it is safely supported by the stands. If the wheels are to be removed at this interval for tire rotation or brake inspection, loosen the lug nuts slightly while the vehicle is still on the ground.

4 Before beginning, force a little grease out of the nozzle to remove any dirt from the end of the gun. Wipe the nozzle clean with a rag.

5 With the grease gun and plenty of clean rags, crawl under the vehicle and begin lubricating the components.

6 Wipe the balljoint grease fitting clean and push the nozzle firmly over it. Squeeze the trigger on the grease gun to force grease into the component. The balljoints should be lubricated until the rubber seal is firm to the touch. Do not pump too much grease into the fittings as it could rupture the seal. For all other suspension and steering components, continue pumping grease into the fitting until it oozes out of the joint between the two components. If it escapes around the grease gun nozzle, the fitting is clogged or the nozzle is not completely seated on the fitting. Resecure the gun nozzle to the fitting and try again. If necessary, replace the fitting with a new one.



15.9 In addition to the conventional universal joints at each end of the driveshaft, 4WD models have a Constant Velocity (CV) joint which requires a needle-like adapter on the grease gun - the arrows show the locations of the CV joint grease fittings

7 Wipe the excess grease from the components and the grease fitting. Repeat the procedure for the remaining fittings.

8 On models where the manual transmission shift linkage is accessible, lubricate the shift linkage with a little clean engine oil. Also, lubricate the clutch release linkage with the grease gun (if equipped with grease fittings) **(see illustration)**.

9 Lubricate the front driveshaft Constant Velocity (CV) joint, located at the transfer case end, using a special needle-like adapter on the grease gun **(see illustration)**. Lubricate the transfer case shift mechanism contact surfaces with clean engine oil.

10 Lubricate the driveshaft slip-joints by pumping grease into the fitting until it can be seen coming out of the slip joint seal **(see illustration)**.

11 Lubricate conventional universal joints until grease can be seen coming out of the contact points **(see illustration)**.

12 While you are under the vehicle, clean and lubricate the parking brake cable along with the cable guides and levers. This can be done by smearing some chassis grease onto the cable and its related parts with your fingers.

13 The manual steering gear seldom requires the addition of lubricant, but if there is obvious leakage of grease at the seals, remove the plug or cover and check the lubricant level. If the level is low, add the specified lubricant.

14 Lubricate the contact points on the steering knuckle stop and adjustment bolt **(see illustration)**.

15 Open the hood and smear a little chassis grease on the hood latch mechanism. Have an assistant pull the hood release lever from inside the vehicle as you lubricate the cable at the latch.

16 Lubricate all the hinges (door, hood, etc.) with engine oil to keep them in proper working order.

17 The key lock cylinders can be lubricated with spray-on graphite or silicone lubricant, which is available at auto parts stores.

18 Lubricate the door weatherstripping with silicone spray. This will reduce chafing and retard wear.

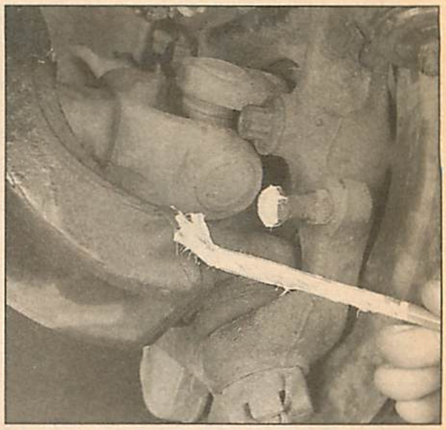
16 Exhaust system check (every 7500 miles or 6 months)

Refer to illustrations 16.2a and 16.2b

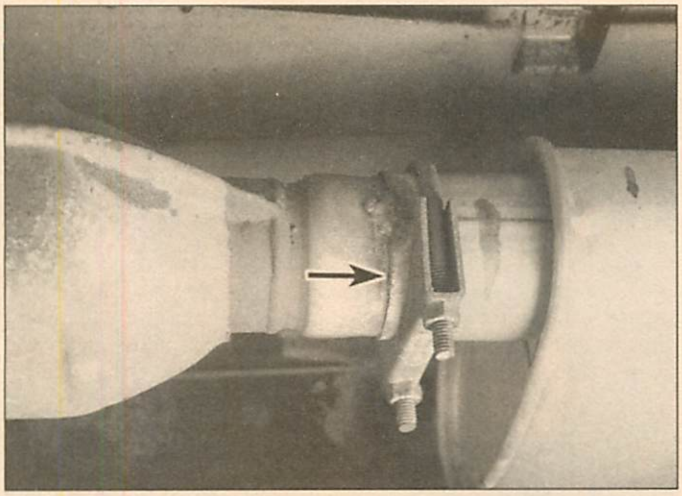
1 With the engine cold (at least three hours after the vehicle has been driven), check the complete exhaust system from the manifold to the end of the tailpipe. Be careful around the catalytic converter (if equipped), which may be hot even after three hours. The inspection should be done with the vehicle on a hoist to permit unrestricted access. If a hoist isn't available, raise the vehicle and support it securely on jackstands.

15.10 The slip joint grease fitting is located on the collar - pump grease into it until it comes out of the slip joint seal

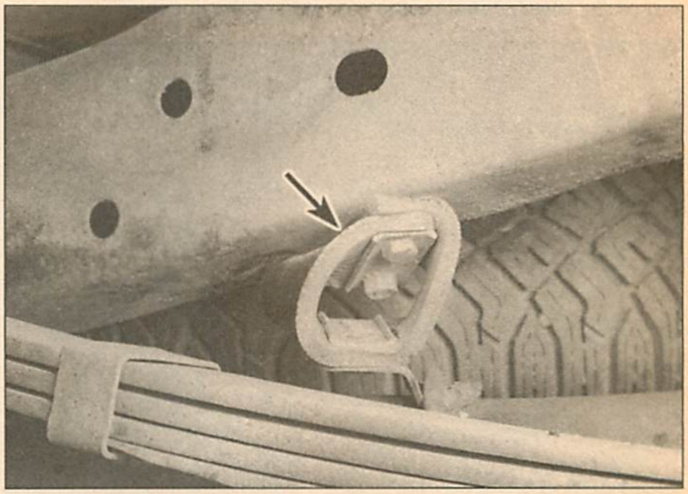
15.11 Pump grease into conventional universal joints until it can be seen coming out of the contact surfaces



15.14 Use lithium base grease to lubricate the contact points on the steering knuckle stop and adjustment bolt



16.2a Check the exhaust pipes and connections (arrow) for signs of leakage and corrosion



16.2b Check the exhaust system rubber hangers for cracks and damage (arrow)

2 Check the exhaust pipes and connections for signs of leakage and/or corrosion indicating a potential failure. Make sure that all brackets and hangers are in good condition and tight **(see illustrations)**.

3 Inspect the underside of the body for holes, corrosion, open seams, etc. which may allow exhaust gasses to enter the passenger compartment. Seal all body openings with silicone sealant or body putty.

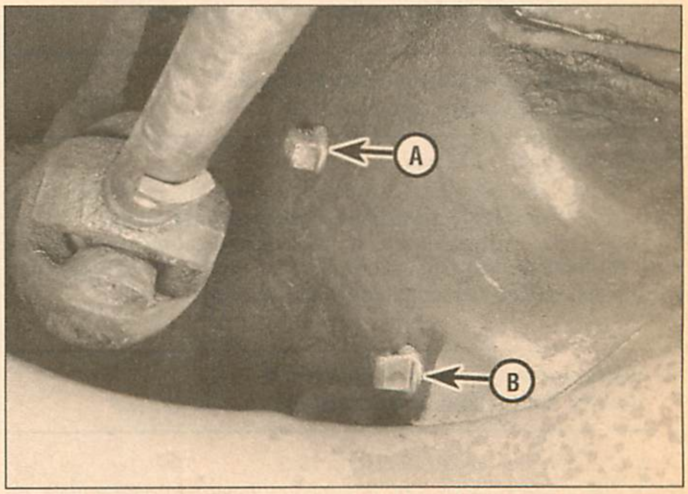
4 Rattles and other noises can often be traced to the exhaust system, especially the hangers, mounts and heat shields. Try to move the pipes, mufflers and catalytic converter. If the components can come in contact with the body or suspension parts, secure the exhaust system with new brackets and hangers.

17 Manual transmission lubricant level check (every 7500 miles or 6 months)

Refer to illustration 17.2

1 The manual transmission has a filler plug which must be removed to check the lubricant level. If the vehicle is raised to gain access to the plug, be sure to support it safely on jackstands - DO NOT crawl under a vehicle which is supported only by a jack! Be sure the vehicle is level or the check may be inaccurate.

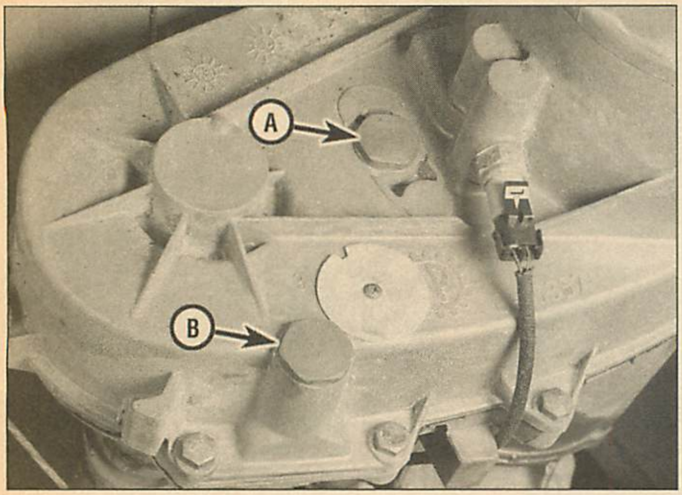
2 Using an open-end wrench, unscrew the fill plug from the transmission **(see illustration)** and use a finger to reach inside the housing to determine the lubricant level. The level should be at or near the bottom of the plug hole.



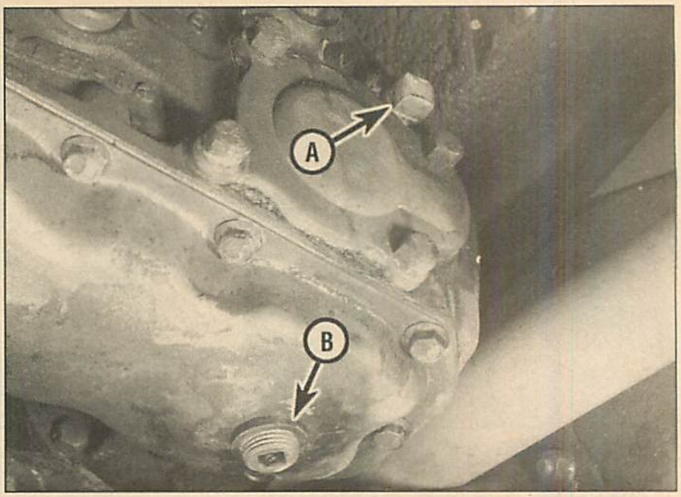
17.2 The manual transmission fill plug (A) and drain plug (B) are located on the side of the transmission case

3 If it isn't, add the recommended lubricant through the plug hole with a pump or squeeze bottle.

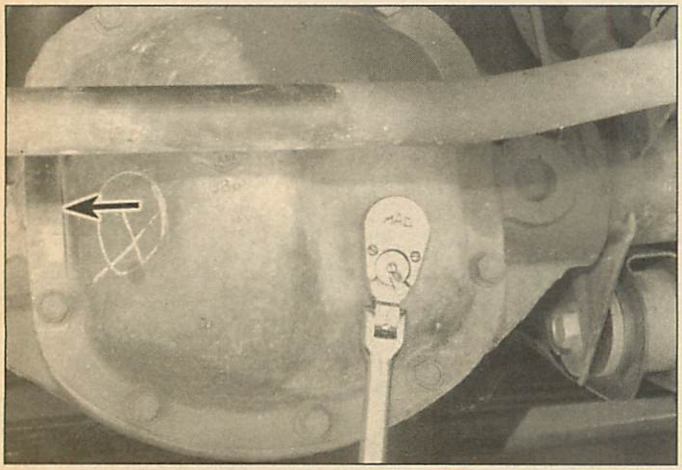
4 Install and tighten the plug and check for leaks after the first few miles of driving.



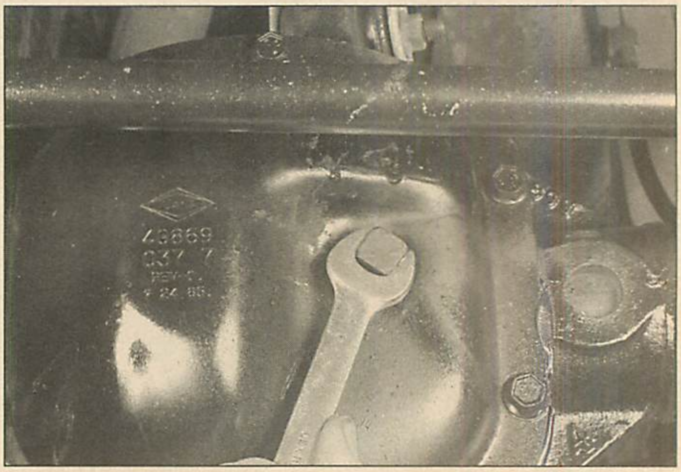
18.1a Later model transfer case fill plug (A) and drain plug (B) are located on the rear side of the housing



18.1b Early model transfer case (Model 20) fill plug (A) and drain plug (B) locations



19.2a On the front differential, remove the inspection plug with a 3/8 ratchet - note the tag (arrow) which contains important information on the differential



19.2b Use the correct size open-end wrench to remove the check/fill plug on the rear differential

18 Transfer case lubricant level check (every 7500 miles or 6 months)

Refer to illustration 18.1a and 18.1b

1 The transfer case lubricant level is checked by removing the upper plug located in the back of the case **(see illustrations)**.

2 Use a finger to reach inside the housing to determine the lubricant level. The lubricant level should be just at the bottom of the hole. If not, add the appropriate lubricant through the opening.

19 Differential lubricant level check (every 7500 miles or 6 months)

Refer to illustrations 19.2a, 19.2b and 19.3

Note: *The models covered by this manual have two differentials, be sure to check the lubricant level in both differentials.*

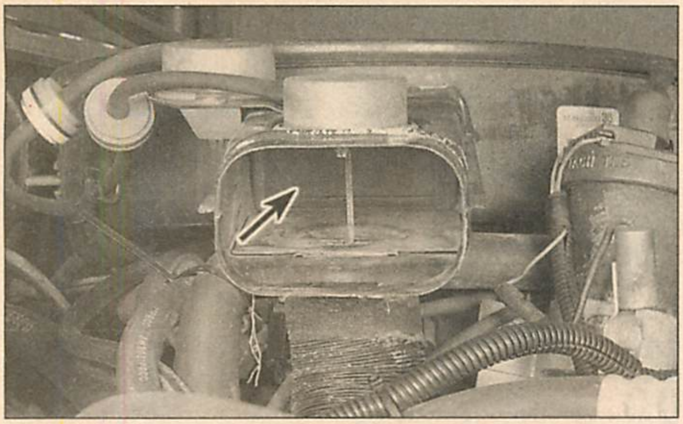
1 The differential has a check/fill plug which must be removed to check the lubricant level. If the vehicle must be raised to gain access to the plug, be sure to support it safely on jackstands - DO NOT crawl under the vehicle when it's supported only by the jack.

2 Remove the oil check/fill plug from the back of the rear differential or the front of the front differential **(see illustrations)**. On some models a tag is located in the area of the plug which gives information regarding lubricant type, particularly on models equipped with a limited-slip differential.

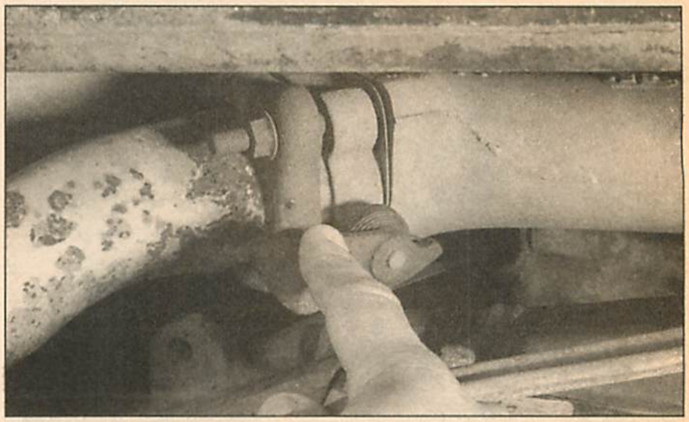
19.3 Use your finger as a dipstick to check the lubricant level

3 Use a finger to reach inside the housing to determine the lubricant level **(see illustration)**. The oil level should be at the bottom of the plug opening. If it isn't, use a hand pump (available at auto parts stores) to add the specified lubricant until it just starts to run out of the opening.

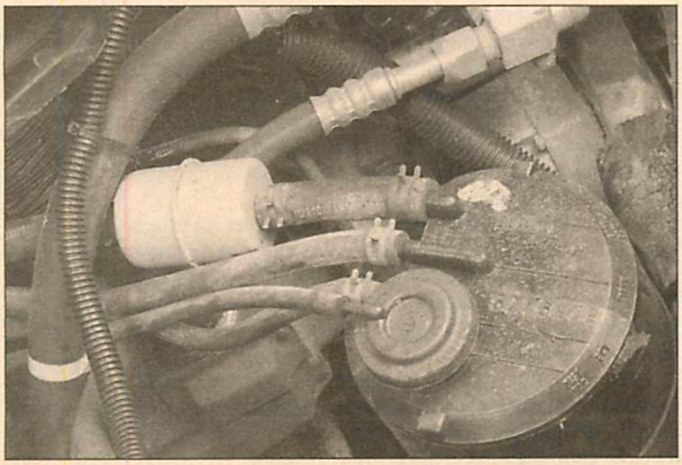
4 Install the plug and tighten it securely.



21.5 With the engine cold, start the engine and look through the snorkel to confirm that the damper door (arrow) is in the closed position



22.2 With the engine and exhaust pipe cold, try moving the heat riser valve - It should move freely



23.2 Check the evaporative emissions control canister and the hose connections for cracks and damage

20 Seat belt check (every 7500 miles or 6 months)

1 Check the seat belts, buckles, latch plates and guide loops for any obvious damage or signs of wear.
2 On later models, make sure the seat belt reminder light comes on when the key is turned on.
3 The seat belts are designed to lock up during a sudden stop or impact, yet allow free movement during normal driving. The retractors should hold the belt against your chest while driving and rewind the belt when the buckle is unlatched.
4 If any of the above checks reveal problems with the seat belt system, replace parts as necessary.

21 Thermostatically controlled air cleaner check (every 15,000 miles or 12 months)

Refer to illustration 21.5

1 Some engines are equipped with a thermostatically controlled air cleaner which draws air to the carburetor from different locations, depending upon engine temperature.
2 This is a visual check. If access is limited, a small mirror may have to be used.
3 Open the hood and locate the damper door inside the air cleaner assembly. It is inside the long snorkel of the metal air cleaner housing.
4 If there is a flexible air duct attached to the end of the snorkel, leading to an area behind the grille, disconnect it at the snorkel. This will enable you to look through the end of the snorkel and see the damper inside.
5 The check should be done when the engine is cold. Start the engine and look through the snorkel at the damper, which should move to a closed position **(see illustration)**. With the damper closed, air cannot enter through the end of the snorkel, but instead enters the air cleaner through the flexible duct attached to the exhaust manifold and the heat stove passage.
6 As the engine warms up to operating temperature, the damper should open to allow air through the snorkel end. Depending on outside temperature, this may take 10 to 15 minutes. To speed up this check you can reconnect the snorkel air duct, drive the vehicle, then check to see if the damper is completely open.

22 Exhaust control valve (heat riser) lubrication and check (every 15,000 miles or 12 months)

Refer to illustration 22.2

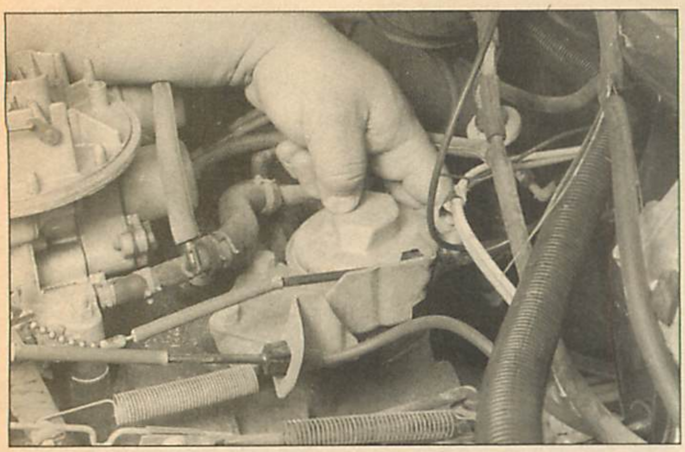
1 Most V8 engines covered by this manual are equipped with an exhaust heat control valve (heat riser), located between the junction of the exhaust manifold and the exhaust pipe. When the engine is cold, this valve redirects hot exhaust gases to the intake manifold for increased fuel vaporization and better low speed driveability.
2 With the engine cold to prevent burns, press on the butterfly actuator lever to make sure it opens and closes freely **(see illustration)**. If the action isn't smooth, lubricate it by applying heat-valve lubricant to the lever shaft.
3 Again with the engine cold, start the engine and watch the heat riser. Upon starting, the weight should move to the closed position. As the engine warms to normal operating temperature, the weight should move the valve to the open position, allowing a free flow of exhaust through the tailpipe. Since it could take several minutes for the system to heat up, you could mark the cold weight position, drive the vehicle, and then check the weight.

23 Evaporative emissions control system check (every 15,000 miles or 12 months)

Refer to illustration 23.2

1 The function of the evaporative emissions control system is to draw fuel vapors from the gas tank and fuel system, store them in a charcoal canister and route them to the intake manifold during normal engine operation.
2 The most common symptom of a fault in the evaporative emissions system is a strong fuel odor in the engine compartment. If a fuel odor is detected, inspect the charcoal canister, located in the front of the engine compartment **(see illustration)**. Check the canister and all hoses for damage and deterioration.
3 The evaporative emissions control system is explained in more detail in Chapter 6.

1



24.2 The diaphragm in the EGR valve (which can be reached through the holes in the underside of the valve) should move easily with finger pressure

24 Exhaust Gas Recirculation (EGR) system check (every 15,000 miles or 12 months)

Refer to illustration 24.2

1 The EGR valve is usually located on the intake manifold, adjacent to the carburetor. Most of the time when a problem develops in this emissions system, it's due to a stuck or corroded EGR valve.

2 With the engine cold, to prevent burns, push on the EGR valve diaphragm. Using moderate pressure, you should be able to push the diaphragm up into the housing **(see illustration)**.

3 If the diaphragm doesn't move or is hard to move, replace the EGR valve with a new one. If in doubt about the condition of the valve, compare the free movement of your EGR valve with a new valve.

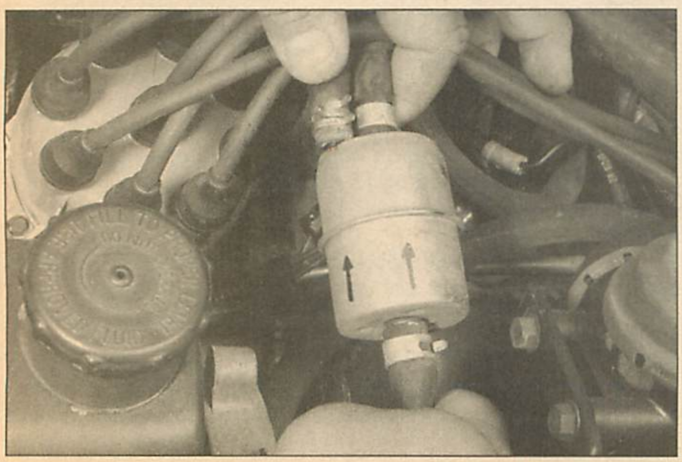
4 Refer to Chapter 6 for more information on the EGR system.

25 Carburetor choke check (every 15,000 miles or 12 months)

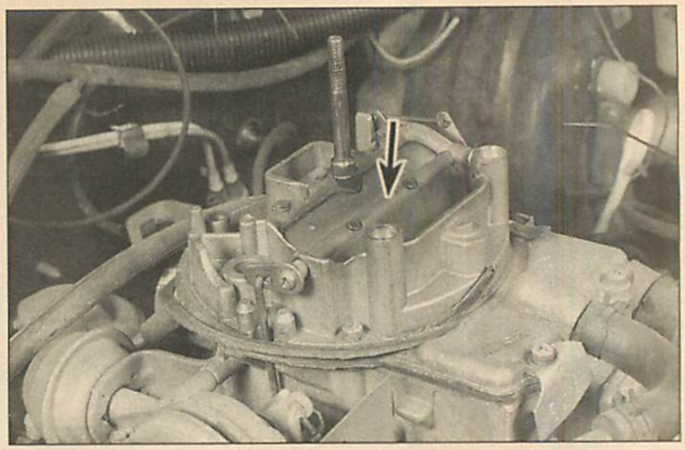
Refer to illustration 25.3

1 The choke operates when the engine is cold, and thus this check can only be performed before the vehicle has been started for the day.

2 Open the hood and remove the top plate of the air cleaner assembly. It is usually held in place by a wing nut at the center. If any vacuum hoses must be disconnected, make sure you tag the hoses for reinstallation in their original positions. Place the top plate and wing nut aside, out of the way of moving engine components.



26.3 Use pliers to remove the hose clamps - always install the filter with the directional arrow pointed towards the carburetor



25.3 The carburetor choke plate (arrow) is visible after removing the air cleaner top plate

3 Look at the center of the air cleaner housing. You will notice a flat plate (arrow) at the carburetor opening **(see illustration)**.

4 Press the accelerator pedal to the floor. The plate should close completely. Start the engine while you watch the plate at the carburetor. **Warning:** *Do not position your face directly over the carburetor, as the engine could backfire, causing serious burns.* When the engine starts, the choke plate should open slightly.

5 Allow the engine to continue running at an idle speed. As the engine warms up to operating temperature, the plate should slowly open, allowing more cold air to enter through the top of the carburetor.

6 After a few minutes, the choke plate should be fully open to the vertical position. Press quickly on the accelerator to make sure the fast idle cam disengages.

7 You will notice that the engine speed corresponds with the plate opening. With the plate fully closed, the engine should run at a fast idle speed. As the plate opens and the throttle is moved to disengage the fast idle cam, the engine speed will decrease.

26 Fuel filter replacement (every 15,000 miles or 12 months)

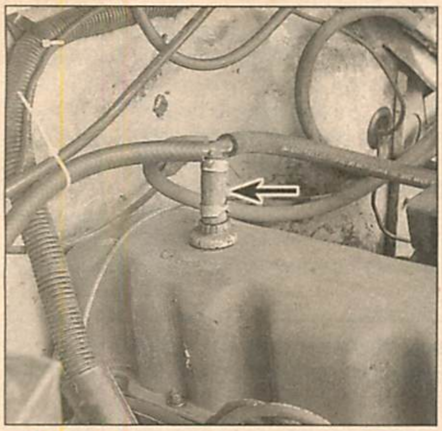
Refer to illustration 26.3

Warning: *Gasoline is extremely flammable, so take extra precautions when you work on any part of the fuel system. Don't smoke or allow open flames or bare light bulbs near the work area, and don't work in a garage where a natural gas-type appliance (such as a water heater or clothes dryer) with a pilot light is present. Since gasoline is carcinogenic, wear latex gloves when there's a possibility of being exposed to fuel, and, if you spill any fuel on your skin, rinse it off immediately with soap and water. Mop up any spills immediately and do not store fuel-soaked rags where they could ignite. When you perform any kind of work on the fuel system, wear safety glasses and have a Class B Type fire extinguisher on hand.*

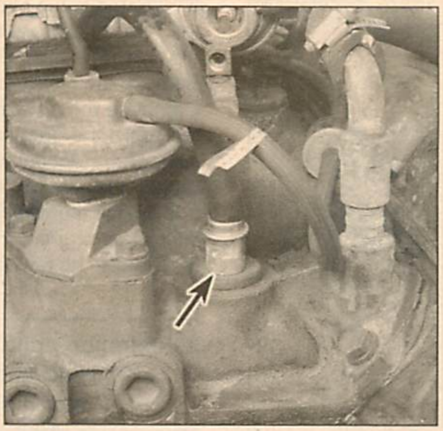
1 Fuel filters often become clogged due to excessive dirt or foreign material in the fuel system and must be replaced according to the maintenance interval suggestions.

2 Considering the volatile nature of gasoline, precautions should be exercised when a fuel filter is replaced. The job should be done with the engine cold or after sitting at least three hours. Be prepared to immediately clean up any spilled gasoline. In addition, you need to obtain a replacement filter for your specific vehicle.

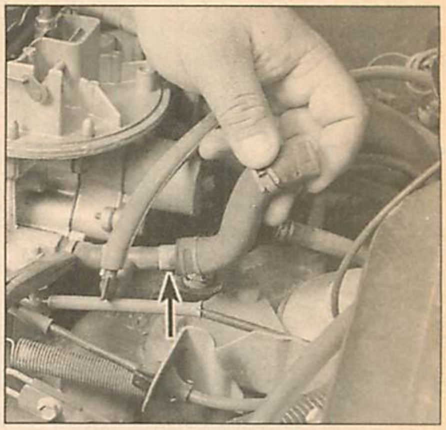
3 The fuel filter is located in-line between the carburetor and the fuel pump, It is secured in place by rubber hoses and hose clamps **(see illustration)**. Remove the fuel filler cap to relieve any residual pressure inside the tank. Release the clamps on the rubber hoses, then wrap a rag around the filter to catch escaping fuel. Slowly remove the filter from the hoses. Use caution, as the gasoline may be under pressure.



27.1a On six-cylinder models the PCV valve (arrow) is located in the valve cover



27.1b On early V8 models, the PCV valve is located at the rear of the intake manifold



27.2 With the engine running, put your finger over the end of the PCV hose; you should feel vacuum - on later V8 models the PCV valve (arrow) is located inline behind the carburetor

4 Replace the filter with an exact duplicate. Install the new fuel filter with the directional arrow pointed towards the carburetor **(see illustration 26.3)**. Also replace the hose clamps if they appear weak or distorted.

5 Tighten all clamps, then start the vehicle and check the filter and surrounding area for leaks.

27 Positive Crankcase Ventilation (PCV) valve check and replacement (every 15,000 miles or 12 months)

Refer to illustrations 27.1a, 27.1b and 27.2

1 On six-cylinder models the PCV valve is located in the valve cover. On V8 models the PCV valve is located at the rear of the intake manifold **(see illustrations)**. On later V8 models, an inline PCV valve is used **(see illustration 27.2)**.

2 With the engine idling at normal operating temperature, pull the valve (with hose attached) from the valve cover or intake manifold **(see illustration)**.

3 Place your finger over the valve opening or hose. If there's no vacuum, check for a plugged hose, manifold port, or the valve itself. Replace any plugged or deteriorated hoses.

4 Turn off the engine and shake the PCV valve, listening for a rattle. If the valve doesn't rattle, replace it with a new one.

5 To replace the valve, pull it from the end of the hose, noting its installed position.

6 When purchasing a replacement PCV valve, make sure it's for your particular vehicle and engine size. Compare the old valve with the new one to make sure they're the same.

7 Push the valve into the end of the hose until it's seated.

8 Inspect all rubber hoses and grommets for damage and hardening. Replace them, if necessary.

9 Press the PCV valve and hose securely into position.

28 Air filter and PCV filter replacement (every 15,000 miles or 12 months)

Refer to illustrations 28.2, 28.4, 28.6 and 28.7

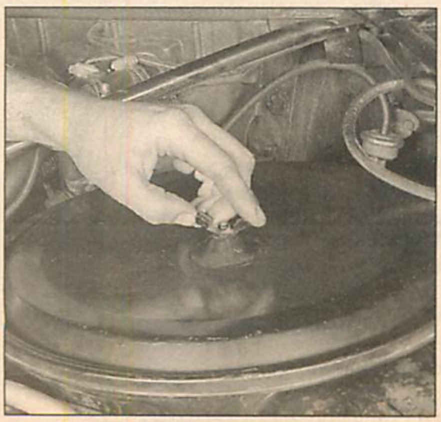
1 At the specified intervals, the air filter and (if equipped) PCV filter should be replaced with new ones. The engine air cleaner also supplies filtered air to the PCV system.

2 The filter is located on top of the carburetor and is replaced by unscrewing the wing nut from the top of the filter housing and lifting off the cover **(see illustration)**.

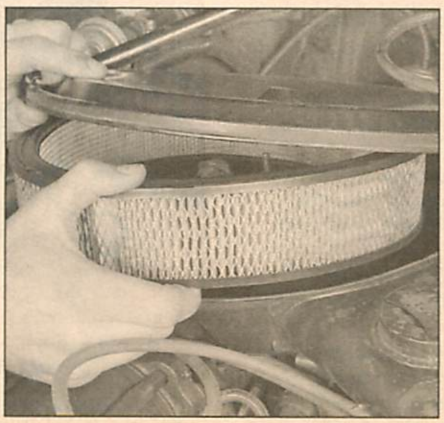
3 While the top cover is off, be careful not to drop anything down into the carburetor or air cleaner assembly.

4 Lift the air filter element out of the housing **(see illustration)** and wipe out the inside of the air cleaner housing with a clean rag.

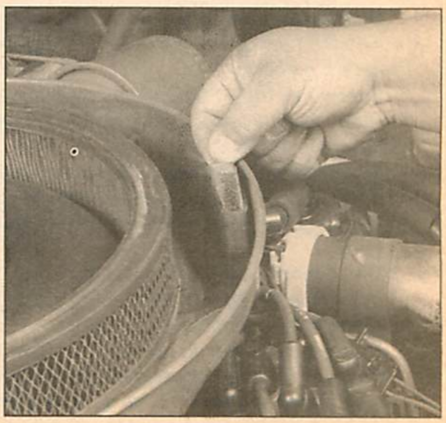
5 On six-cylinder models the PCV filter is also located inside the air cleaner housing. Remove the top cover and air filter as previously described, then locate the PCV filter on the inside of the housing.



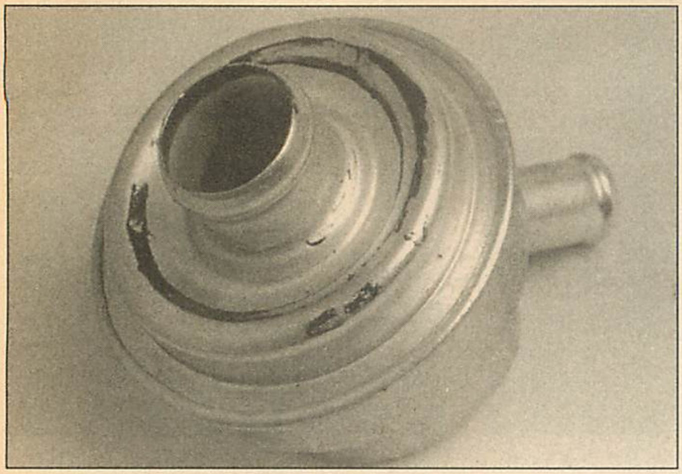
28.2 The first step in removing the air filter is unscrewing the wing nut on the housing



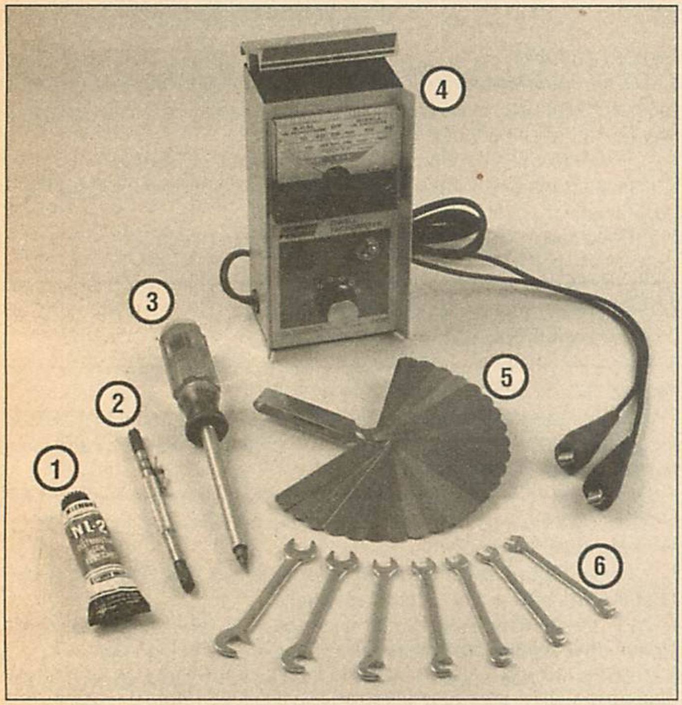
28.4 After setting the top cover aside, the filter element can be lifted out of the housing



28.6 The PCV filter on six-cylinder models is located in the air cleaner housing



28.7 Clean the PCV filter on V8 models by applying air pressure through the filler tube opening (arrow)



29.1 Tools and materials needed for ignition point replacement and dwell angle adjustment

1 ***Distributor cam lube*** *- Sometimes this special lubricant comes with the new points; however, it's a good idea to buy a tube and have it on hand*
2 ***Screw starter*** *- This tool has special claws which hold the screw securely as it's started, which helps prevent accidental dropping of the screw*
3 ***Magnetic screwdriver*** *- Serves the same purpose as 2 above. If you don't have one of these special screwdrivers, you risk dropping the point mounting screws down into the distributor body*
4 ***Dwell meter*** *- A dwell meter is the only accurate way to determine the point setting (gap). Connect the meter according to the instructions supplied with it.*
5 ***Blade-type feeler gauges*** *- These are required to set the initial point gap (space between the points when they are open)*
6 ***Ignition wrenches*** *- These special wrenches are made to work within the tight confines of the distributor. Specifically, they are needed to loosen the nut/bolt which secures the leads to the points*

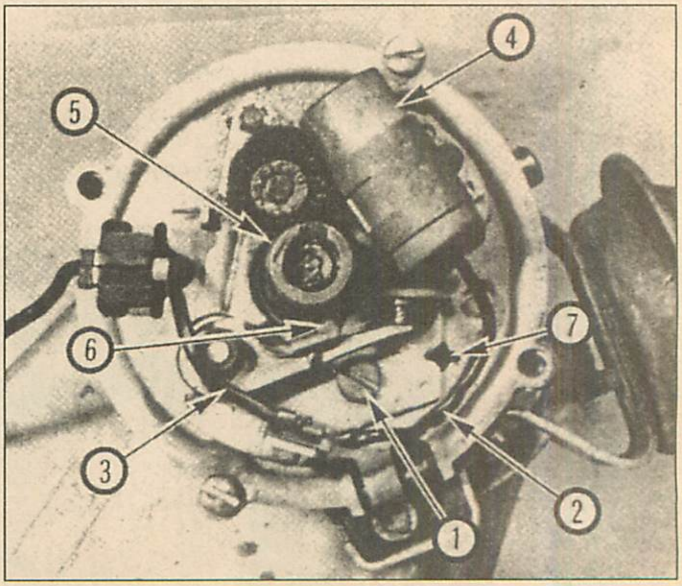
6 Remove the old filter **(see illustration)**.
7 On V8 models the PCV filter is located in the oil filler cap. This type of filter doesn't require replacement but it can be cleaned. Remove the oil filler cap and wash it thoroughly with cleaning solvent. Complete the cleaning process by applying light air pressure through the filler tube opening in the cap **(see illustration)**. **Warning:** *Always wear eye protection when using compressed air!* If the filter has deteriorated, the filler cap must be replaced.
8 Install the new PCV filter and the new air filter. Make sure the air filter seats properly in the bottom of the housing.
9 Install the top cover and any hoses which were disconnected.

29 Ignition point check, replacement and adjustment (1973 and earlier models) (every 15,000 miles or 12 months)

Refer to illustrations 29.1, 29.2a, 29.2b, 29.6a, 29.6b, 29.8, 29.15, 29.16a, 29.16b and 29.23

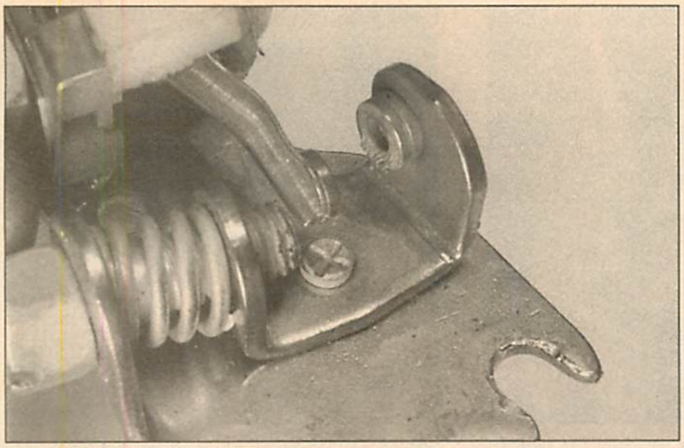
Check and replacement

1 The ignition points must be replaced at regular intervals on vehicles not equipped with electronic ignition. Occasionally the rubbing block will wear enough to require adjustment of the points. It's also possible to clean and dress them with a fine file, but replacement is recommended since they are relatively accessible and very inexpensive. Several special tools are required for this procedure **(see illustration)**.
2 After removing the distributor cap and rotor (see Section 31), the ignition points are plainly visible **(see illustration)**. They can be examined by gently prying them open to reveal the condition of the contact surfaces **(see illustration)**. If they're rough, pitted, covered with oil or burned, they should be replaced, along with the condenser. **Caution:** *This procedure requires the removal of small screws which can easily fall down into the distributor. To retrieve them, the distributor would have to be removed and disassembled. Use a magnetic or spring-loaded screwdriver and be extra careful.*
3 If not already done, remove the distributor cap by positioning a screwdriver in the slotted head of each latch. Press down on the latch and rotate it 1/2-turn to release the cap from the distributor body. On six-cylinder models simply remove the distributor cap hold down



29.2a Typical ignition point components

1 *Point mounting screw*
2 *Condenser lead wire*
3 *Primary lead wire*
4 *Condenser*
5 *Point cam*
6 *Point rubbing block*
7 *Point gap/dwell adjustment slot*



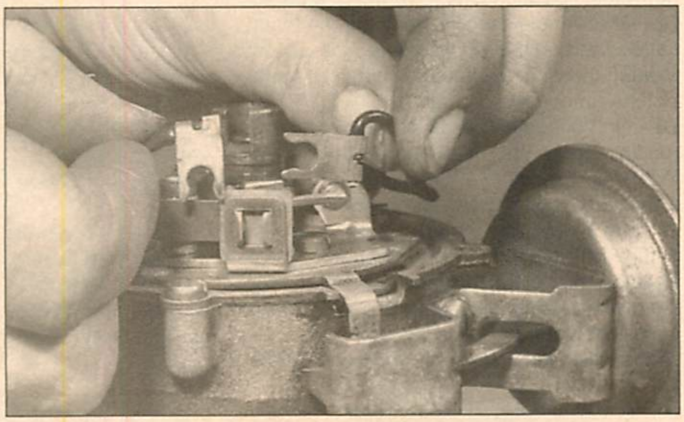
29.2b Although it is possible to restore ignition points that are pitted, burned and corroded (as shown here), they should be replaced

screws.

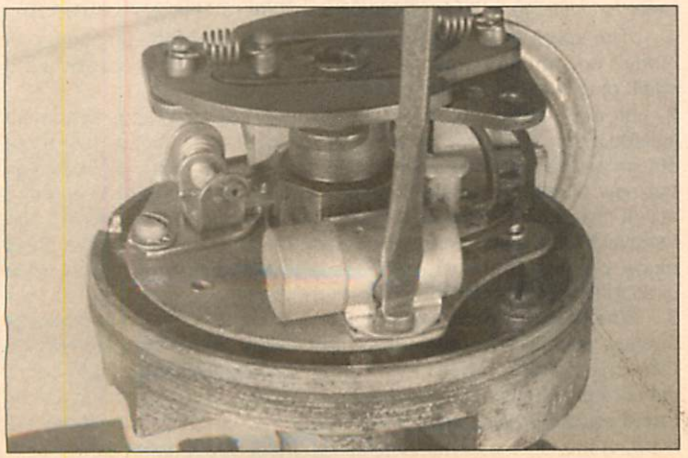
4 Position the cap (with the spark plug wires still attached) out of the way. Use a length of wire to hold it out of the way, if necessary.

5 Remove the rotor, which is held in place with two screws on V8 models. Six-cylinder models require grasping the rotor with one hand and pulling straight up on the rotor to remove it.

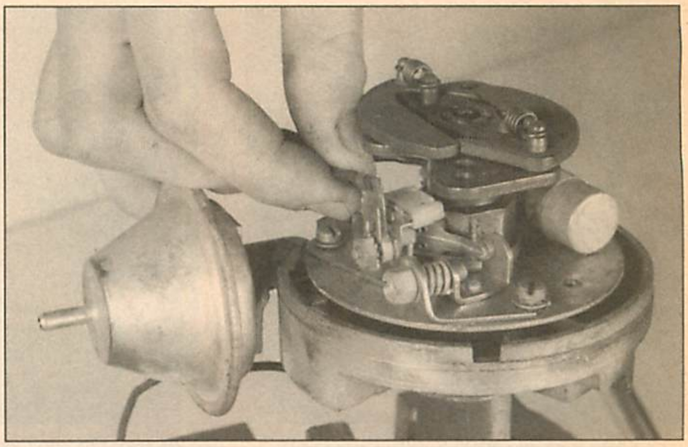
6 Note how they are routed, then disconnect the primary and condenser wire leads from the points **(see illustrations)**. The wires may be



29.6b On six-cylinder models, the wires can simply be pulled off the points (pliers may be required) - pull only on the terminals, not the wires



29.8 The condenser is attached to the breaker plate *by a single screw*



29.6a Loosen the nut and disconnect the primary and condenser wires from the points

attached with a small nut (which should be loosened, but not removed), a small screw or by a spring-loaded terminal.

7 Loosen the screws which secure the ignition points to the breaker plate, but don't completely remove the screws (most ignition point sets have slots at these locations). Slide the points out of the distributor.

8 The condenser can now be removed from the breaker plate. Loosen the mounting strap screw and slide the condenser out or completely remove the condenser and strap **(see illustration)**. If you remove both the condenser and strap, be careful not to drop the mounting screw down into the distributor body.

9 Before installing the new points and condenser, clean the breaker plate and the cam on the distributor shaft to remove all dirt, dust and oil.

10 Apply a small amount of distributor cam lube (usually supplied with the new points, but also available separately) to the cam lobes.

11 Position the new condenser and tighten the mounting strap screw securely.

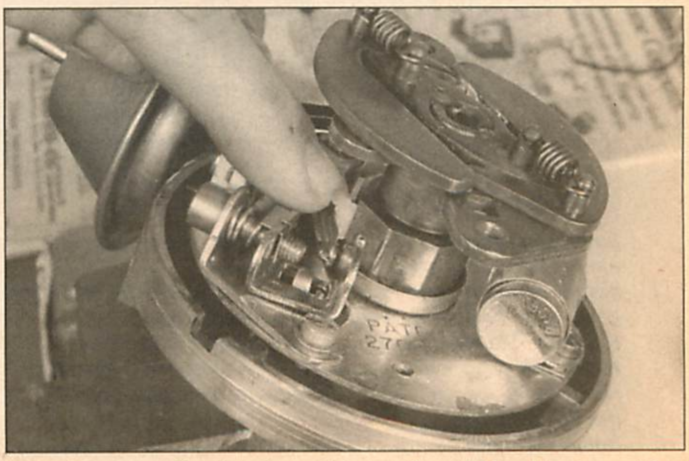
12 Slide the new point set into place and make sure the protrusions on the breaker plate fit into the holes in the point base (to properly position the point set), then tighten the screws securely.

13 Attach the primary and condenser wires to the new points. Make sure the wires are routed so they don't interfere with breaker plate or advance weight movement.

Adjustment

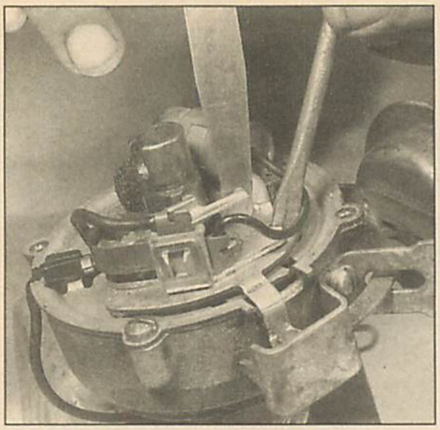
14 Although the final dwell angle will be adjusted later, make the initial gap adjustment now, which will allow the engine to be started.

15 Make sure that the point rubbing block is resting on one of the high points of the cam **(see illustration)**. If it isn't, rotate the crankshaft with a breaker bar and socket attached to the large bolt that holds the

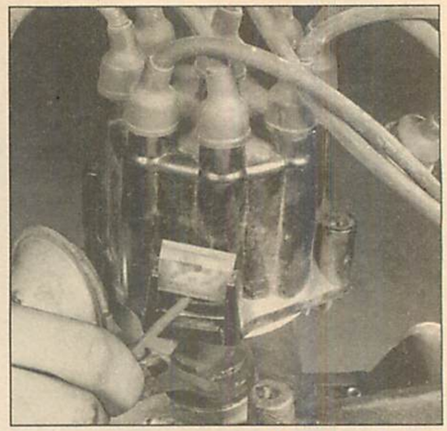


29.15 Before adjusting the point gap, the rubbing block must be resting on one of the cam lobes (which will open the points)

29.16a On V8 models with the points open, insert a 0.016-inch thick feeler gauge and turn the adjustment screw with a 1/8-inch Allen wrench



29.16b On six-cylinder models the point gap/dwell angle is adjusted by inserting a screwdriver into the slot between the breaker plate and the point base - twist the screwdriver until the desired point gap/dwell angle is achieved



29.23 On V8 models, an Allen wrench can be inserted into the adjustment screw socket and turned to adjust the point dwell

vibration damper in place.

16 With the rubbing block on a cam high point (points open), insert a 0.016-inch feeler gauge between the contact surfaces. On V8 models use an Allen wrench to turn the adjustment screw until the point gap is equal to the thickness of the feeler gauge. On six-cylinder models insert a screwdriver into the slot between the breaker plate and the point base to adjust the gap **(see illustrations)**. The gap is correct when a slight amount of drag is felt as the feeler gauge is withdrawn.

17 Inspect and install the rotor and distributor cap as described in (Section 31)

18 Whenever new ignition points are installed or the original points are cleaned, the dwell angle must be checked and adjusted. Precise adjustment of the dwell angle requires an instrument called a dwell meter. Combination tach/dwell meters are commonly available at reasonable cost from auto parts stores.

19 If a dwell meter is not available, the initial adjustment described above will be sufficient until a competent automotive repair facility can adjust the dwell angle for you.

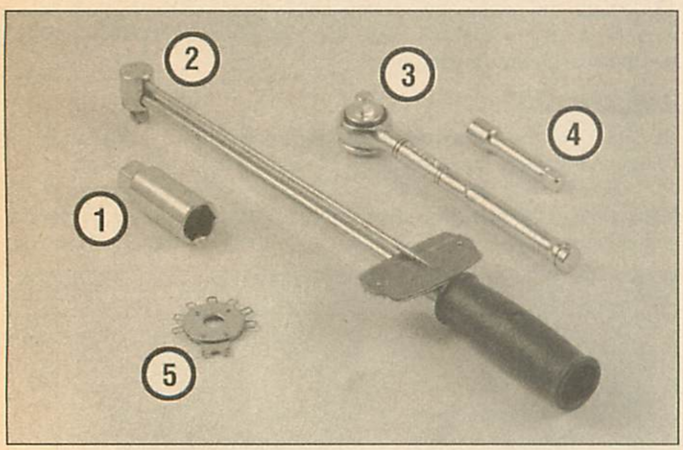
20 Hook the dwell meter up following the manufacturer's instructions.

21 Start the engine and allow it to run at idle until normal operating temperature is reached (the engine must be warm to obtain an accurate reading). Record the dwell reading on the meter. If the reading is not within specifications it will need to be adjusted.

22 Dwell angle specifications can be found in this Chapter's Specifications and on the VECI label or tune-up decal in the engine compartment. If there's a discrepancy between the two, assume the VECI label or tune-up decal is correct.

23 On V8 models the dwell angle can be adjusted while the engine is running. Raise the metal door in the distributor cap and insert a 1/8-inch Allen wrench into the adjustment screw socket **(see illustration)**. Adjust the dwell angle to the specifications.

24 On six-cylinder models the dwell angle must be adjusted with the engine off as described above in step 16 **(see illustration 29.16b)**. Readjust the point gap, install the distributor cap and rotor then recheck the dwell meter reading. repeat this process until the meter reading is as specified. **Note:** *Opening the point gap will decrease the dwell reading while closing the point gap will increase the dwell reading.*



30.2 Tools required for changing spark plugs

1 **Spark plug socket** - *This will have special padding inside to protect the spark plug's porcelain insulator*
2 **Torque wrench** - *Although not mandatory, using this tool is the best way to ensure the plugs are tightened properly*
3 **Ratchet** - *Standard hand tool to fit the spark plug socket*
4 **Extension** - *Depending on model and accessories, you may need special extensions and universal joints to reach one or more of the plugs*
5 **Spark plug gap gauge** - *This gauge for checking the gap comes in a variety of styles. Make sure the gap for your engine is included*

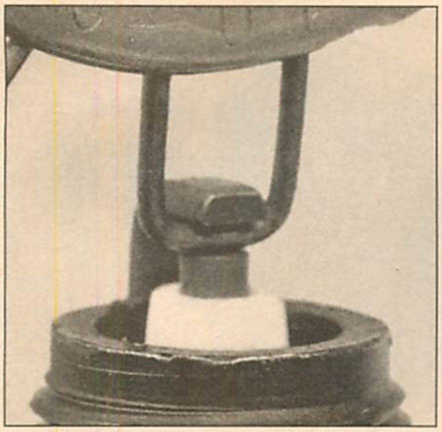
30 Spark plug replacement (every 15,000 miles or 12 months)

Refer to illustrations 30.2, 30.5a, 30.5b, 30.6a, 30.6b, 30.9 and 30.10

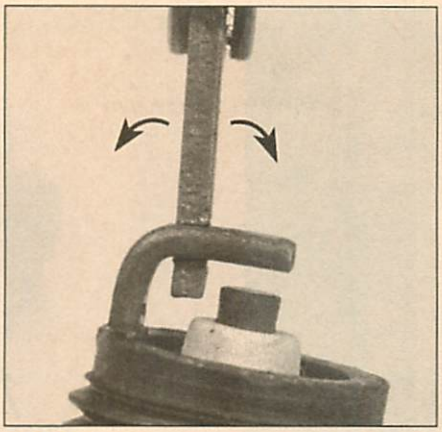
1 The spark plugs are located on both sides of the engine on V8 models and on the passenger side on six-cylinder models. Label each spark plug wire before proceeding any further.

2 In most cases, the tools necessary for spark plug replacement include a spark plug socket which fits onto a ratchet (spark plug sockets are padded inside to prevent damage to the porcelain insulators on the new plugs), various extensions and a gap gauge to check and adjust the gaps on the new plugs **(see illustration)**. A special plug wire removal tool is available for separating the wire boots from the spark plugs, but it isn't absolutely necessary. A torque wrench should be used to tighten the new plugs.

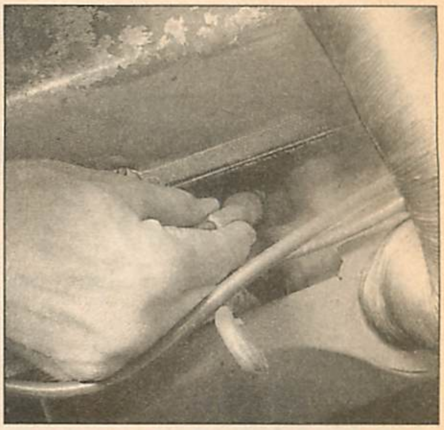
3 The best approach when replacing the spark plugs is to purchase the new ones in advance, adjust them to the proper gap and replace them one at a time. When buying the new spark plugs, be sure to obtain the correct plug type for your particular engine. This information can be found on the *Emission Control Information* label located under the hood, in the factory owner's manual and this Chapter's Specifications. If differences exist between the plug specified on the emissions label and in the owner's manual, assume that the emissions label is correct.



30.5a Spark plug manufacturers recommend using a wire type gauge when checking the gap - if the wire does not slide between the electrodes with a slight drag, adjustment is required



30.5b To change the gap, bend the *side* electrode only, as indicated by the arrows, and be very careful not to crack or chip the porcelain insulator surrounding the center electrode



30.6a When removing the spark plug wires, pull only on the boot and use a twisting, pulling motion

4 Allow the engine to cool completely before attempting to remove any of the plugs. While you're waiting for the engine to cool, check the new plugs for defects and adjust the gaps.

5 The gap is checked by inserting the proper thickness gauge between the electrodes at the tip of the plug **(see illustration)**. The gap between the electrodes should be the same as the one specified on the *Emissions Control Information* label or in this Chapter's Specifications. The wire should just slide between the electrodes with a slight amount of drag. If the gap is incorrect, use the adjuster on the gauge body to bend the curved side electrode slightly until the proper gap is obtained **(see illustration)**. If the side electrode is not exactly over the center electrode, bend it with the adjuster until it is. Check for cracks in the porcelain insulator (if any are found, the plug should not be used).

6 With the engine cool, remove the spark plug wire from one spark plug. Pull only on the boot at the end of the wire - do not pull on the wire **(see illustration)**. A plug wire removal tool should be used if available **(see illustration)**.

7 If compressed air is available, use it to blow any dirt or foreign material away from the spark plug hole. A common bicycle pump will also work. The idea here is to eliminate the possibility of debris falling into the cylinder as the spark plug is removed.

8 Place the spark plug socket over the plug and remove it from the engine by turning it in a counterclockwise direction.

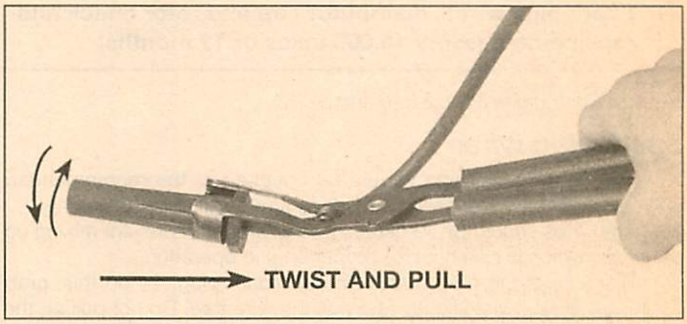
9 Compare the spark plug with the chart on the inside back cover of this manual to get an indication of the general running condition of the engine. Before installing the new plugs, it is a good idea to apply a thin coat of anti-seize compound to the threads **(see illustration)**.

10 Thread one of the new plugs into the hole until you can no longer turn it with your fingers, then tighten it with a torque wrench (if available) or the ratchet. It might be a good idea to slip a short length of rubber hose over the end of the plug to use as a tool to thread it into place **(see illustration)**. The hose will grip the plug well enough to turn it, but will start to slip if the plug begins to cross-thread in the hole - this will prevent damaged threads and the accompanying repair costs.

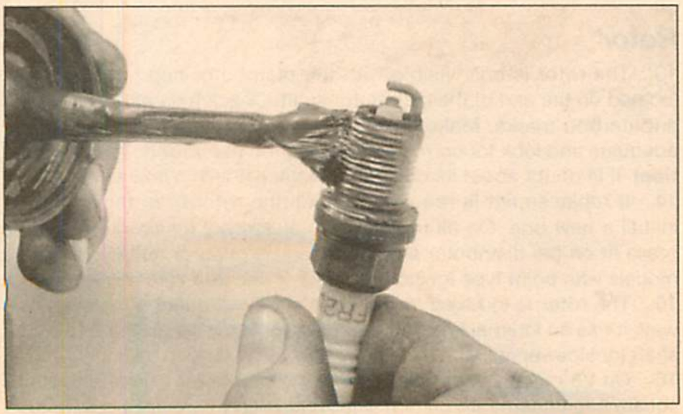
11 Before pushing the spark plug wire onto the end of the plug, inspect it following the procedures outlined in Section 31.

12 Attach the plug wire to the new spark plug, again using a twisting motion on the boot until it's seated on the spark plug.

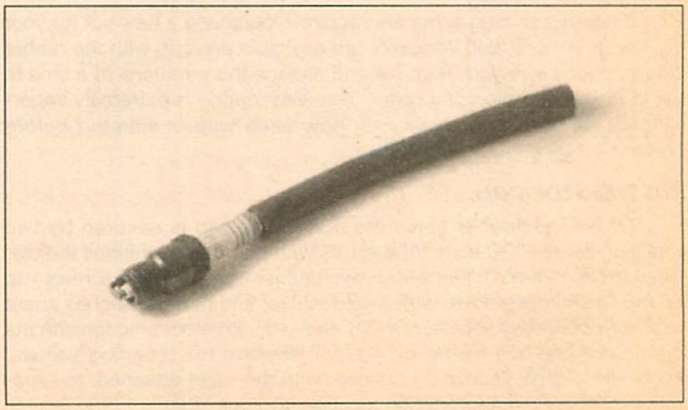
13 Repeat the procedure for the remaining spark plugs, replacing them one at a time to prevent mixing up the spark plug wires.



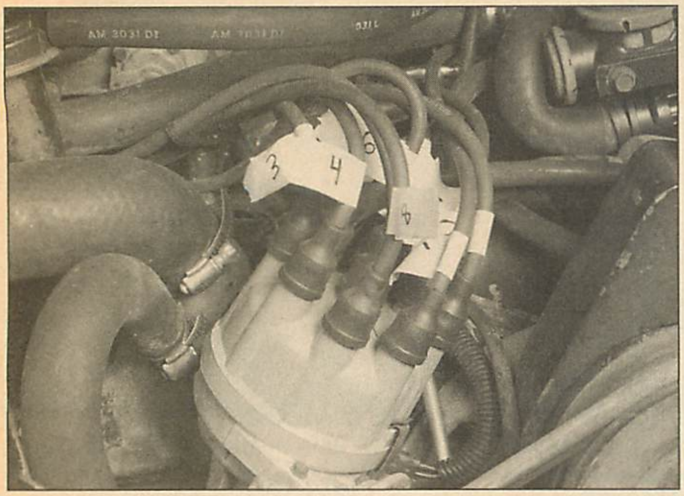
30.6b Using a spark plug boot puller tool like this one will make the job of removing the spark plug boots much easier



30.9 Apply a thin coat of anti-seize compound to the spark plug threads



30.10 A length of 3/8-inch ID rubber hose will save time and prevent damaged threads when installing the spark plugs



31.8 Label each spark plug wire according to the cylinder location and firing order specifications at the front of this Chapter

31 Spark plug wires, distributor cap and rotor check and replacement (every 15,000 miles or 12 months)

Refer to illustrations 31.8, 31.10 and 31.13

Spark plug wires

1 The spark plug wires should be checked at the recommended intervals and whenever new spark plugs are installed in the engine.

2 The wires should be inspected one at a time to prevent mixing up the order, which is essential for proper engine operation.

3 Disconnect the plug wire from one spark plug. To do this, grab the rubber boot, twist slightly and pull the wire free. Do not pull on the wire itself, only on the rubber boot.

4 Check inside the boot for corrosion, which will look like a white crusty powder. Push the wire and boot back onto the end of the spark plug. It should be a tight fit on the plug. If it isn't, remove the wire and use a pair of pliers to carefully crimp the metal connector inside the boot until it fits securely on the end of the spark plug.

5 Using a clean rag, wipe the entire length of the wire to remove any built-up dirt and grease. Once the wire is clean, check for holes, burned areas, cracks and other damage. Don't bend the wire excessively or the conductor inside might break.

6 Disconnect the wire from the distributor cap. Pull the wire straight out of the cap. Pull only on the rubber boot during removal. Check for corrosion and a tight fit in the same manner as the spark plug end. Reattach the wire to the distributor cap.

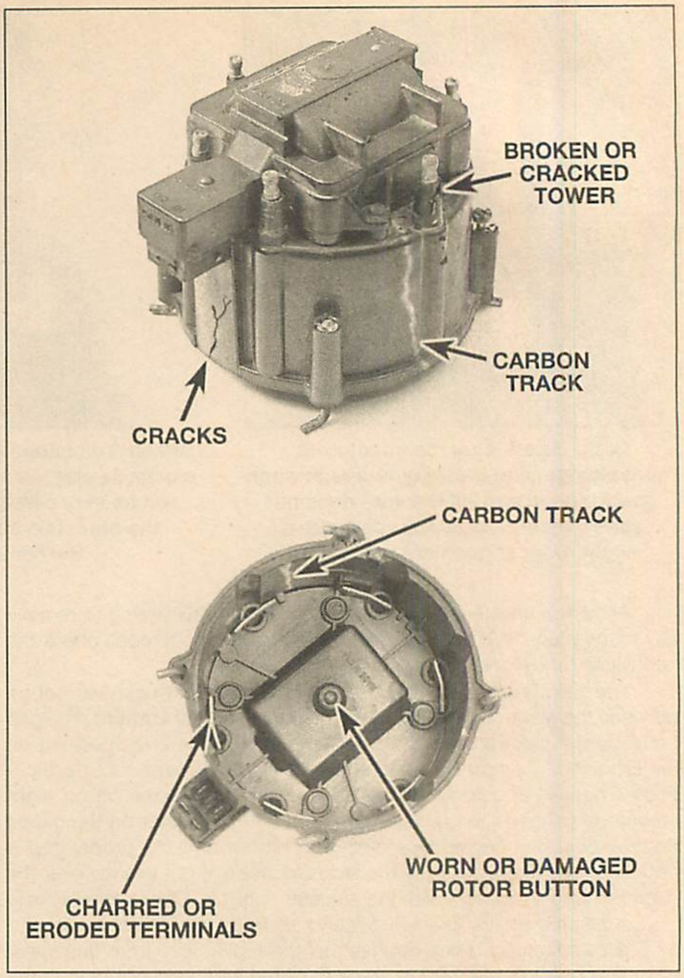
7 Check the remaining spark plug wires one at a time, making sure they are securely fastened at the distributor and the spark plug when the check is complete.

8 If new spark plug wires are required, purchase a new set for your specific engine model. Wire sets are available pre-cut, with the rubber boots already installed. Remove and replace the wires one at a time to avoid mix-ups in the firing order. The wire routing is extremely important, so be sure to note exactly how each wire is situated before removing it **(see illustration)**.

Distributor cap

9 On six-cylinder engines the distributor cap is secured by two retaining screws. On early V8 engines with point type ignitions the distributor cap is held in place with two latches that look like screws - to release them, push down with a screwdriver and turn the latches about a1/2 turn counterclockwise. On V8 engines with electronic ignition the distributor cap is secured by clasps. Remove the retaining screws, latches or clasps. Pull up on the cap, with the wires attached, to separate it from the distributor, then position it to one side.

10 Check the distributor cap for carbon tracks, cracks and other damage. Closely examine the terminals on the inside of the cap for excessive corrosion and damage **(see illustration)**. Slight deposits are normal. Again, if in doubt about the condition of the cap, replace it with a new one.



31.10 Shown here are some of the common defects to look for when inspecting the distributor cap (if in doubt about its condition, install a new one)

11 To replace the cap, simply separate it from the distributor and transfer the spark plug wires, one at a time, to the new cap. Be very careful not to mix up the wires!

12 Reattach the cap to the distributor, then install the retaining screws, latches or clasps to hold it in place. **Note:** *The distributor cap indexes on a notch located in the cap with a peg on the distributor housing and can only be installed one way.*

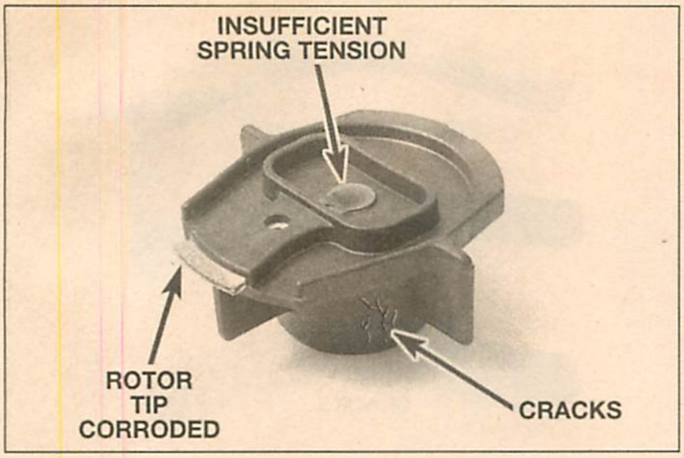
Rotor

13 The rotor is only visible with the distributor cap removed. It is located on the end of the distributor shaft. Check it carefully for cracks and carbon tracks. Make sure the center terminal spring tension is adequate and look for corrosion and wear on the rotor tip **(see illustration)**. If in doubt about its condition, replace it with a new one.

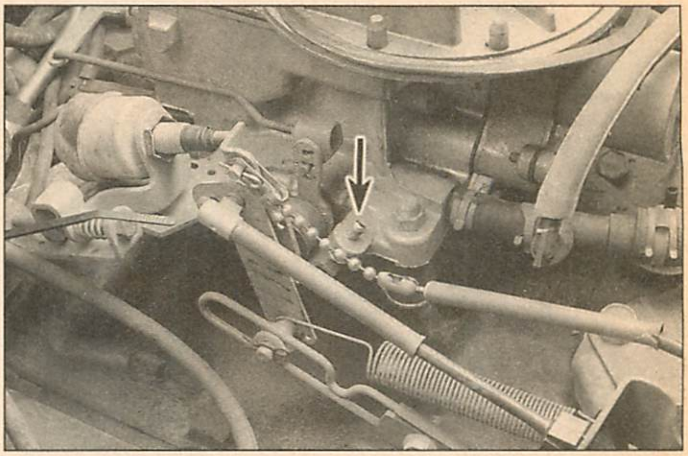
14 If replacement is required, detach the rotor from the shaft and install a new one. On all models with electronic ignition, the rotor is press fit on the distributor shaft and can be pried or pulled off. On V8 models with point type ignition the rotor is secured with two screws.

15 The rotor is indexed to the shaft so it can only be installed one way. It has an internal key that must line up with a slot in the end of the shaft (or vice versa).

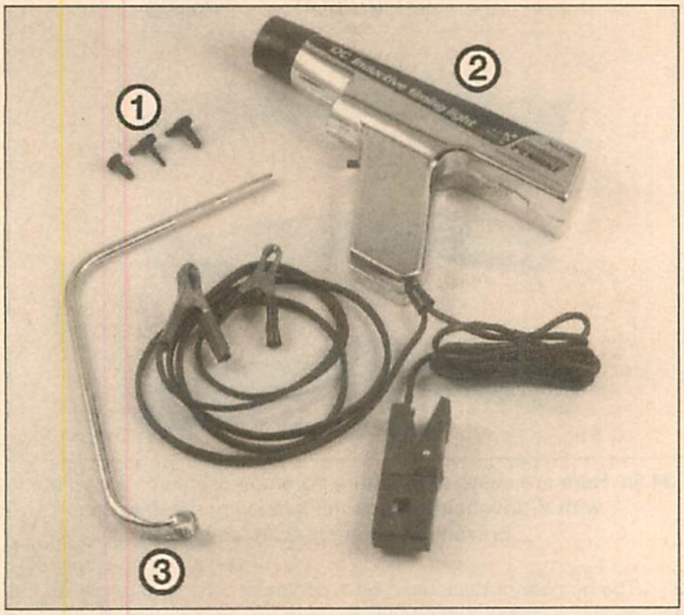
16 On V8 models with point type ignition the rotor is indexed with a square peg underneath on one side and a round peg on the other side, so it will fit on the advance mechanism only one way. Install the rotor and tighten the rotor mounting screws securely.



31.13 The ignition rotor should be checked for wear and corrosion as indicated here (if in doubt about its condition, install a new one)



32.4 The curb idle speed can be adjusted by turning the idle stop screw (arrow) located on the left side of the carburetor



33.3 Tools needed to check and adjust the ignition timing

1 ***Vacuum plugs*** *- Vacuum hoses will, in most cases, have to be disconnected and plugged. Molded plugs in various shapes and sizes are available for this*

2 ***Inductive pick -up timing light*** *- Flashes a bright, concentrated beam of light when the number one spark plug fires. Connect the leads according to the instructions supplied with the light*

3 ***Distributor wrench*** *- On some models, the hold-down bolt for the distributor is difficult to reach and turn with conventional wrenches or sockets. A special wrench like this must be used*

32 Idle speed check and adjustment (every 15,000 miles or 12 months)

Refer to illustration 32.4

1 Engine idle speed is the speed at which the engine operates when no accelerator pedal pressure is applied. The idle speed is critical to the performance of the engine as well as many engine sub-systems.

2 Make sure the parking brake is firmly set and the wheels blocked to prevent the vehicle from rolling. This is especially true if the specifications require the transmission to be in Drive. An assistant inside the vehicle pressing on the brake pedal is the safest method.

3 A hand-held tachometer must be used when adjusting idle speed to get an accurate reading. The exact hook-up for these meters varies with the manufacturer, so follow the particular directions included with the instrument.

4 For most applications, the idle speed is set by turning an adjustment screw located on the left side of the carburetor **(see illustration)**. This screw changes the amount the throttle plate is held open by the throttle linkage. The screw may be on the linkage itself or on the carburetor body.

5 For all applications, the engine must be completely warmed-up to operating temperature, which will automatically render the choke and fast idle inoperative.

6 Once you have located the idle screw, experiment with different length screwdrivers until the adjustment can be easily made without coming into contact with hot or moving engine components.

7 If the air cleaner is removed, the vacuum hose to the snorkel should be plugged.

8 Since the manufacturer recommended many different adjustment procedures over the time period covered by this manual, it would be impractical to cover all types in this Section. Most models have a tune-up decal or Vehicle Emission Control Information (VECI) label located in the engine compartment with instructions for setting idle speed. If no VECI label is found refer to the Specifications Section at the beginning of this Chapter and to the adjustment procedures specified in Chapter 4.

33 Ignition timing check and adjustment (every 15,000 miles or 12 months)

Refer to illustrations 33.3 and 33.6

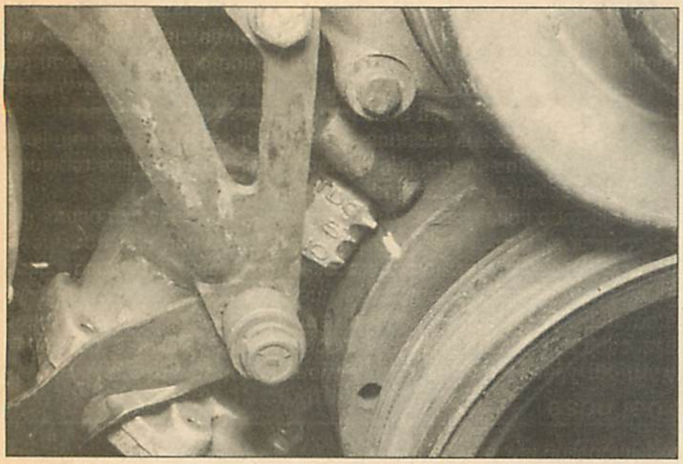
Note: *It is imperative that the procedures included on the tune-up or Vehicle Emissions Control Information (VECI) label be followed when adjusting the ignition timing. The label will include all information concerning preliminary steps to be performed before adjusting the timing, as well as the timing specifications. If no VECI label is found refer to the specifications chart at the beginning of this Chapter.*

1 At the specified intervals, whenever the ignition points have been replaced or the distributor removed, the ignition timing should be checked and adjusted.

2 Various procedures (depending on make and model of the vehicle) must be performed to disable the distributor advance mechanism before attempting to check the timing. Locate the Tune-up or VECI label under the hood and read through and perform all preliminary instructions concerning ignition timing. If no VECI label is found refer to the Specifications Section at the beginning of this Chapter.

3 Before attempting to check the timing some special tools will be needed for this procedure **(see illustration)**.

1



33.6 The ignition timing indicator is located at the front of the engine by the crankshaft pulley

4 Check that the idle speed is as specified (Section 32).On vehicles with breaker point-type ignition, make sure the ignition point dwell angle is correct (see Section 29).

5 Connect a timing light in accordance with the manufacturer's instructions. Generally, the light will be connected to power and ground sources and to the number one spark plug wire (refer to the cylinder location diagram in this Chapter's Specifications).

6 Locate the numbered timing tag on the front cover of the engine **(see illustration)**. It's located just behind the lower crankshaft pulley. Clean it off with solvent if necessary so you can see the numbers and small grooves.

7 Use chalk or paint to mark the groove in the crankshaft pulley.

8 Mark the timing tab in accordance with the number of degrees called for on the VECI label or the tune-up label in the engine compartment. On six-cylinder engines each line on the timing tab represents two degrees. On V8 engines each line on the timing tab represents five degrees. The word Before or the letter "A" indicates advance and the letter "O" indicates Top Dead Center (TDC). As an example for six-cylinder engines, if your vehicle specifications call for eight degrees BTDC (Before Top Dead Center), mark the timing tab four notches before the O.

9 Make sure timing light is clear of all moving engine components, then start the engine and warm it up to normal operating temperature.

10 Aim the flashing timing light at the timing mark by the crankshaft pulley, again being careful not to come in contact with moving parts. The marks should appear to be stationary. If the marks are in alignment, the timing is correct.

11 If the notch on the crankshaft pulley is not aligned with the correct mark on the timing tab, loosen the distributor hold-down bolt and rotate the distributor until the notch is aligned with the correct timing mark.

12 Retighten the hold-down bolt and recheck the timing.

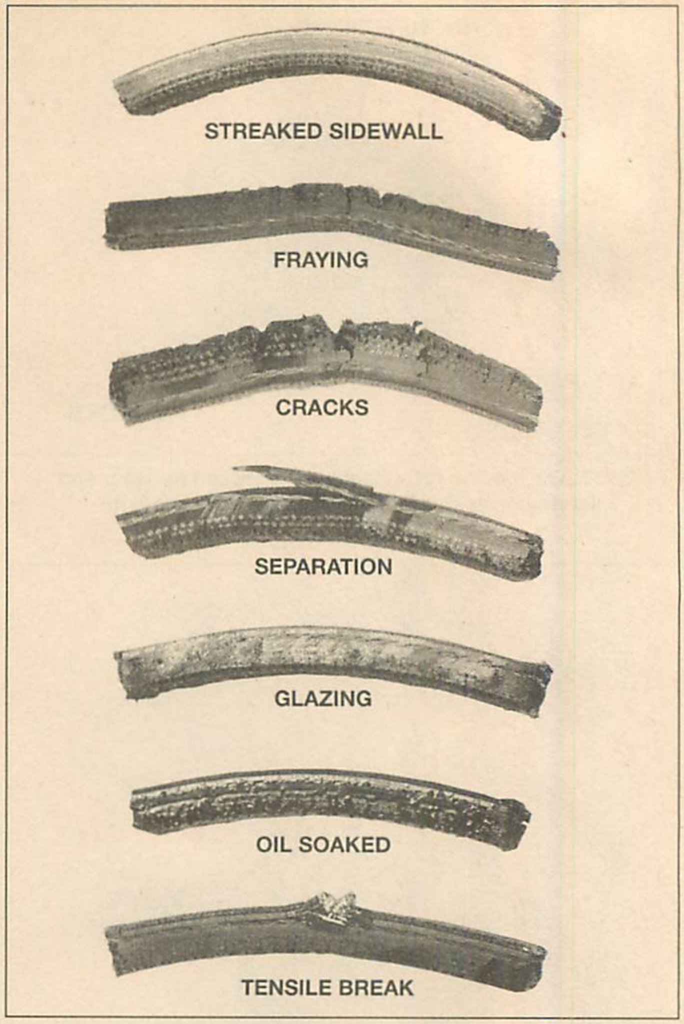
13 Turn off the engine and disconnect the timing light. Reconnect the vacuum advance hose, if removed, and any other components which were disconnected.

34 Drivebelt check, adjustment and replacement (every 15,000 miles or 12 months)

Check

Refer to illustrations 34.3a, 34.3b and 34.4

1 The drivebelts, or V-belts as they are sometimes called, are located at the front of the engine and play an important role in the overall operation of the vehicle and its components. Due to their function and material make-up, the belts are prone to failure after a period of time and should be inspected and adjusted periodically to prevent major engine damage.



34.3a Here are some of the more common problems associated with V-drivebelts (check the belts very carefully to prevent an untimely breakdown)

2 The number of belts used on a particular vehicle depends on the accessories installed. Drivebelts are used to turn the alternator, power steering pump, water pump and air conditioning compressor. Depending on the pulley arrangement, more than one of these components may be driven by a single belt. On some later six-cylinder models, a single serpentine drivebelt is used to drive all the accessories.

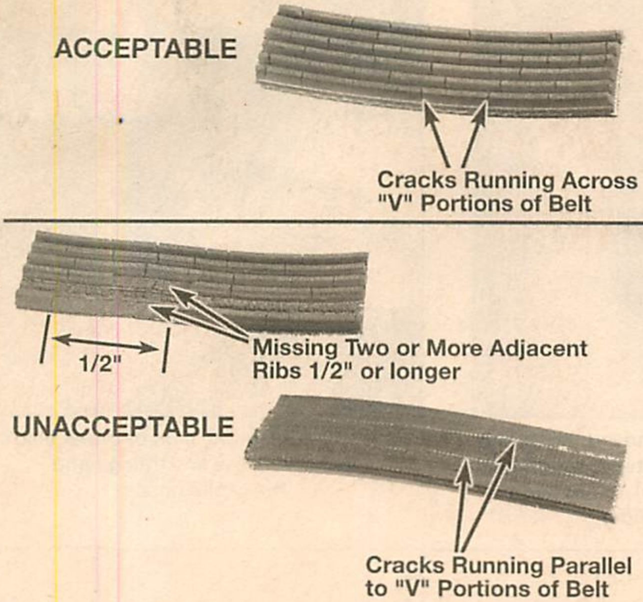
3 With the engine off, open the hood and locate the various belts at the front of the engine. Using your fingers (and a flashlight, if necessary), move along the belts checking for cracks and separation of the belt plies. Also check for fraying and glazing, which gives the belt a shiny appearance **(see illustrations)**. Both sides of each belt should be inspected, which means you will have to twist the belt to check the underside.

4 The tension of each belt is checked by pushing on the belt at a distance halfway between the pulleys. Push firmly with your thumb and see how much the belt moves (deflects) **(see illustration)**. As rule of thumb, if the distance from pulley center-to-pulley center is between 7 and 11 inches, the belt should deflect 1/4-inch. If the belt travels between pulleys spaced 12 to 16 inches apart, the belt should deflect 1/2-inch for a V-belt or 1/4-inch for a serpentine belt.

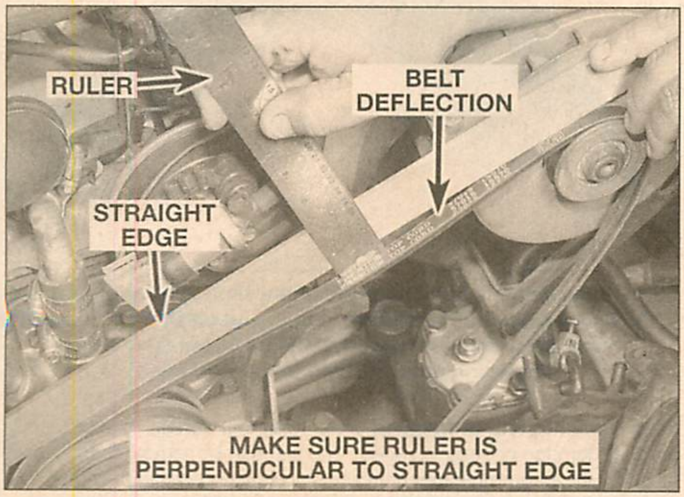
Adjustment

Refer to illustrations 34.6 and 34.8

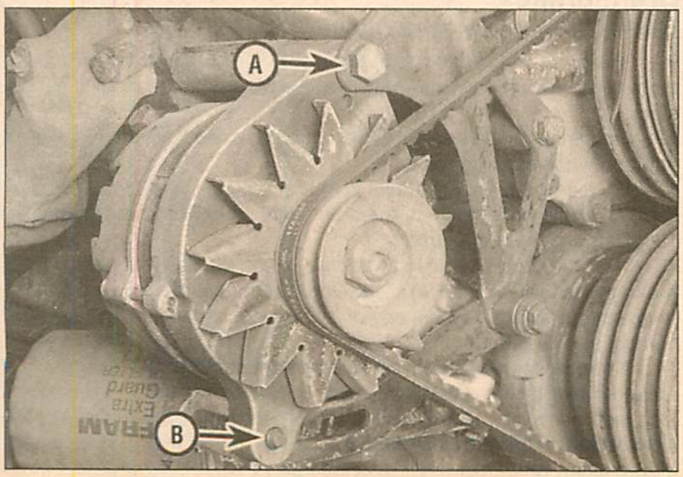
5 If it is necessary to adjust the belt tension, either to make the belt tighter or looser, it is done by moving the belt-driven accessory on the bracket.



34.3b Small cracks in the underside of a serpentine belt are acceptable - lengthwise cracks, or missing pieces are cause for replacement



34.4 Measuring drivebelt deflection with a straightedge and ruler



34.6 Each engine accessory has a pivot bolt (A) and a adjustment bolt (B) which must be loosened to adjust the drive belt

6 For each component there will be an adjusting bolt and a pivot bolt **(see illustration)**. Both bolts must be loosened slightly to enable you to move the component. The serpentine belt is adjusted at the alternator.

7 After the two bolts have been loosened, move the component away from the engine to tighten the belt or toward the engine to loosen the belt. Hold the accessory in position and check the belt tension. If it is correct, tighten the two bolts until just snug, then recheck the tension. If the tension is all right, tighten the bolts.

8 To adjust the power steering drivebelt on some later models, loosen the pivot bolt and insert a 1/2-inch drive ratchet to use as a leverage tool to tension the belt **(see illustration)**.

9 It will often be necessary to use some sort of prybar to move the accessory while the belt is adjusted. If this must be done to gain the proper leverage, be very careful not to damage the component being moved or the part being pried against.

Replacement

10 To replace a belt, follow the above procedures for drivebelt adjustment but slip the belt off the pulleys and remove it. Since belts tend to wear out more or less at the same time, it's a good idea to replace all of them at the same time. Mark each belt and the corresponding pulley grooves so the replacement belts can be installed properly.

11 Take the old belts with you when purchasing new ones in order to make a direct comparison for length, width and design.

12 Adjust the belts as described earlier in this Section.

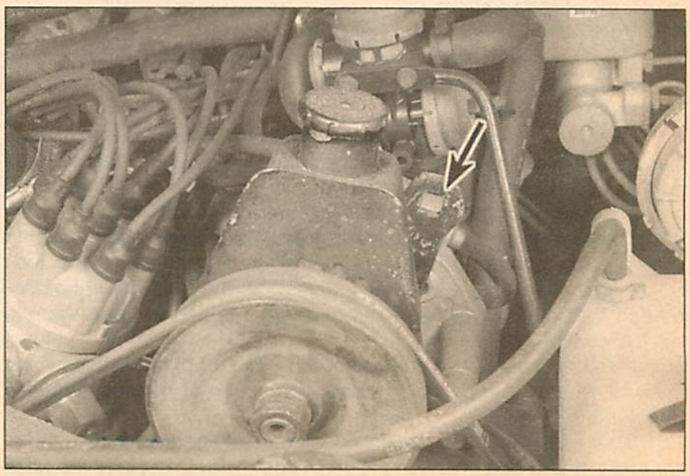
35 Fuel system check (every 15,000 miles or 12 months)

Warning: *Gasoline is extremely flammable, so take extra precautions when working on any part of the fuel system. Don't smoke or allow open flames or bare light bulbs in or near the work area, and don't work in a garage where a natural gas-type appliance (such as a water heater or clothes dryer) with a pilot light is present. Since gasoline is carcinogenic, wear latex gloves when there's a possibility of being exposed to fuel, and, if you spill fuel on your skin, rinse it off immediately with soap and water. Have a Class B fire extinguisher on hand.*

1 The fuel system is most easily checked with the vehicle raised on a hoist so the components underneath the vehicle are readily visible and accessible.

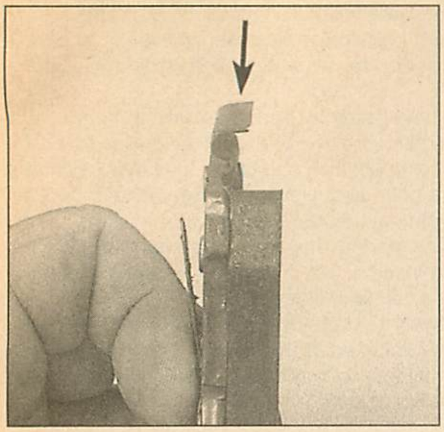
2 If the smell of gasoline is noticed while driving or after the vehicle has been in the sun, the system should be thoroughly inspected immediately.

3 Remove the gas tank cap and check for damage, corrosion and an unbroken sealing imprint on the gasket. Replace the cap with a new one if necessary.

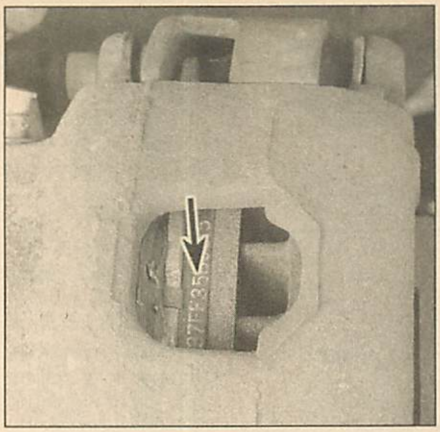


34.8 Insert a 1/2-inch drive ratchet or breaker bar into the square hole (arrow) and pry upward to tension the drivebelt

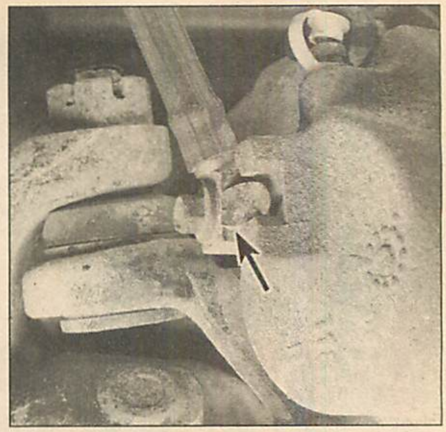
1



36.3 Later model disc brakes may be equipped with wear indicators that contact the disc and make a squealing sound when the pad has worn to its limit



36.5 With the wheels removed, the brake pad lining can be inspected through the caliper window (arrow) and at each end of the caliper



36.7 Check for any sign of brake fluid leakage at the line fittings and the brake hoses

4 With the vehicle raised, inspect the gas tank and filler neck for cracks and other damage. The connection between the filler neck and tank is especially critical. Sometimes a filler neck will leak due to cracks, problems a home mechanic can't repair. **Warning:** *Do not, under any circumstances, try to repair a fuel tank yourself (except rubber components). A welding torch or any open flame can easily cause the fuel vapors to explode if the proper precautions are not taken.*

5 Carefully check all rubber hoses and metal lines leading away from the fuel tank. Check for loose connections, deteriorated hoses, crimped lines and other damage. Follow the lines to the front of the vehicle, carefully inspecting them all the way. Repair or replace damaged sections as necessary.

6 If a fuel odor is still evident after the inspection, refer to Section 23.

36 Brake system check (every 15,000 miles or 12 months)

Note: *For detailed information of the brake system, refer to Chapter 9.*
Warning: *Brake system dust may contain asbestos, which is hazardous to your health. DO NOT blow it out with compressed air, inhale it or use gasoline or solvents to remove it. Use brake system cleaner only.*

1 In addition to the specified intervals, the brakes should be inspected every time the wheels are removed or whenever a defect is suspected. Raise the vehicle and place it securely on jackstands. Remove the wheels (see *Jacking and towing* at the front of the manual, if necessary).

Disc brakes

Refer to illustrations 36.3, 36.5 and 36.7

2 Disc brakes can be checked without removing any parts except the wheels. Extensive disc damage can occur if the pads are not replaced when needed.

3 Later model disc brake pads may have built-in wear indicators **(see illustration)** which make a high-pitched squealing sound when the pads are worn. **Caution:** *Expensive damage to the disc can result if the pads are not replaced soon after the wear indicators start squealing.*

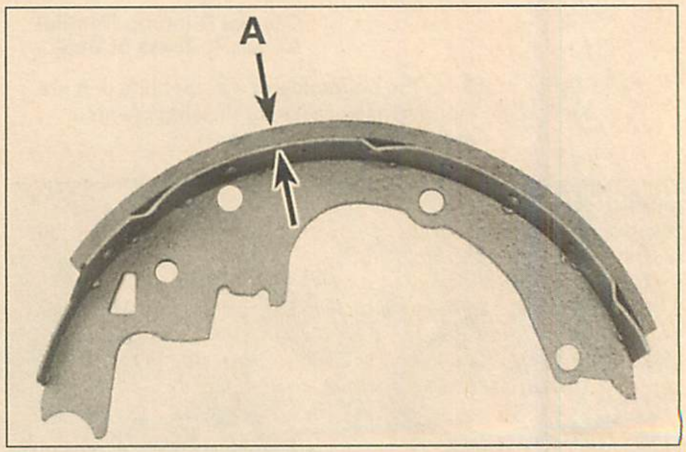
4 The disc brake calipers, which contain the brake pads, have an inner pad and outer pad in each caliper. All pads should be inspected.

5 Each caliper has a "window" to inspect the pads **(see illustration)**. If the pad material has worn to about 1/8-inch thick or less, the pads should be replaced.

6 If you're unsure about the exact thickness of the remaining lining material, remove the pads for further inspection or replacement (see Chapter 9).

7 Before installing the wheels, check for leakage and/or damage at the brake hoses and connections **(see illustration)**. Replace the hose or fittings as necessary, (see Chapter 9).

8 Check the condition of the brake disc. Look for score marks,



36.14 If the lining is bonded to the brake shoe, measure the lining thickness from the outer surface to the metal shoe, as shown here; if the lining is riveted to the shoe, measure from the lining outer surface to the rivet head

deep scratches and overheated areas (they will appear blue or discolored). If damage or wear is noted, the disc can be removed and resurfaced by an automotive machine shop or replaced with a new one. See Chapter 9 for more detailed inspection and repair procedures.

Drum brakes

Refer to illustrations 36.14 and 36.16

9 Raise the vehicle and support it securely on jackstands. Remove the wheels (see *Jacking and towing* at the front of the manual, if necessary).

10 On earlier models with front drum brakes see Section 39 for front hub and wheel bearing removal.

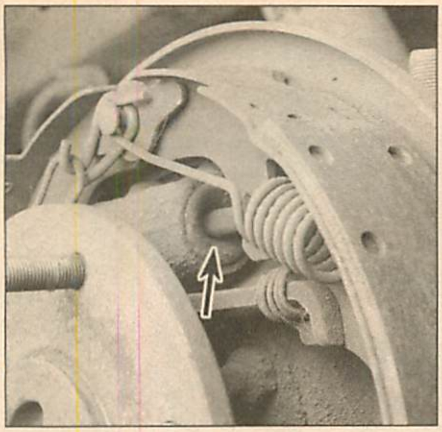
11 On rear drum brakes, make sure the parking brake is off then proceed to tap on the outside of the drum with a rubber mallet to loosen it.

12 Remove the brake drums.

13 With the drums removed, carefully clean the brake assembly with brake system cleaner. **Warning:** *Don't blow the dust out with compressed air and don't inhale any of it (it may contain asbestos, which is harmful to your health).*

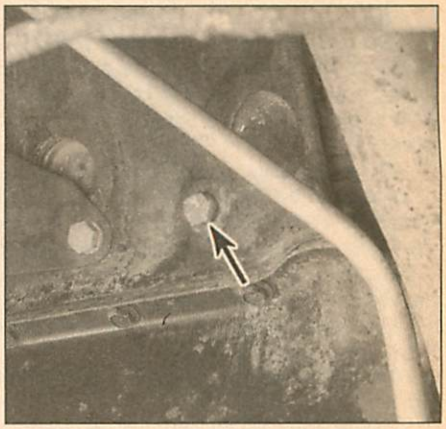
14 Note the thickness of the lining material on both front and rear brake shoes. If the material has worn away to within 1/8-inch of the recessed rivets or metal backing, the shoes should be replaced **(see illustration)**. The shoes should also be replaced if they're cracked, glazed (shiny areas), or covered with brake fluid.

15 Make sure all the brake assembly springs are connected and in good condition.



36.16 Check for fluid leakage at both ends of the wheel cylinder dust covers (arrow)

38.3 The radiator drain plug (arrow) is located at the bottom of the radiator



38.4a The block drain plugs (arrow) are generally located about one to two inches above the oil pan rail

16 Check the brake components for signs of fluid leakage. With your finger or a small screwdriver, carefully pry back the rubber cups on the wheel cylinder located at the top of the brake shoes **(see illustration)**. Any leakage here is an indication that the wheel cylinders should be overhauled immediately (see Chapter 9). Also, check all hoses and connections for signs of leakage.

17 Wipe the inside of the drum with a clean rag and denatured alcohol or brake cleaner. Again, be careful not to breathe the dangerous asbestos dust.

18 Check the inside of the drum for cracks, score marks, deep scratches and "hard spots" which will appear as small discolored areas. If imperfections cannot be removed with fine emery cloth, the drum must be taken to an automotive machine shop for resurfacing.

19 Repeat the procedure for the remaining wheel. If the inspection reveals that all parts are in good condition, reinstall the brake drums, install the wheels and lower the vehicle to the ground.

Parking brake

20 The parking brake is operated by a foot pedal and locks the rear brake system. The easiest, and perhaps most obvious, method of periodically checking the operation of the parking brake assembly is to park the vehicle on a steep hill with the parking brake set and the transmission in Neutral (be sure to stay in the vehicle during this check!). If the parking brake cannot prevent the vehicle from rolling, it needs service (see Chapter 9).

37 Clutch linkage check and adjustment (every 15,000 miles or 12 months)

1 Clutch pedal freeplay will change over time due to normal clutch disc and linkage wear.

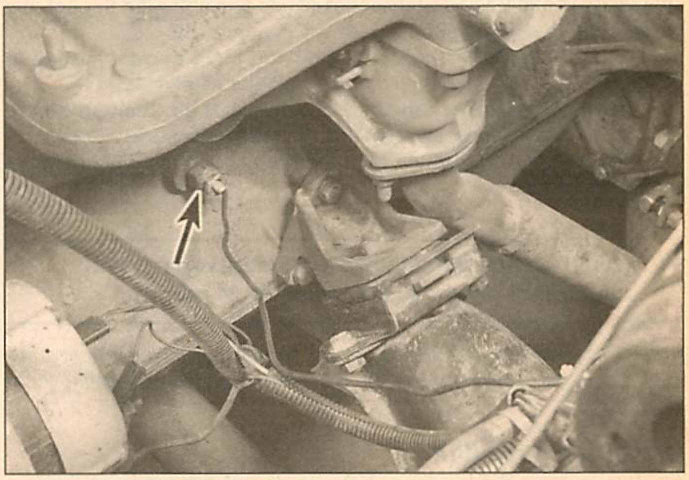
2 Clutch pedal freeplay adjustment is an important maintenance item. Excessive freeplay can result in hard shifting and excessive transmission wear. Insufficient freeplay can result in clutch slippage and premature clutch wear.

3 For check and adjustment procedures (see Chapter 8).

38 Cooling system servicing (draining, flushing and refilling) (every 30,000 miles or 24 months)

Refer to illustrations 38.3, 38.4a and 38.4b

Warning: *Do not allow antifreeze to come in contact with your skin or painted surfaces of the vehicle. Rinse off spills immediately with plenty of water. Antifreeze is highly toxic if ingested. Never leave antifreeze lying around in an open container or in puddles on the floor; children and pets are attracted by it's sweet smell and may drink it. Check with local authorities about disposing of used antifreeze. Many communities have collection centers which will see that antifreeze is disposed of safely.*



38.4b Some six-cylinder models may require removing the coolant temperature switch (arrow) to drain the block

1 Periodically, the cooling system should be drained, flushed and refilled to replenish the antifreeze mixture and prevent formation of rust and corrosion, which can impair the performance of the cooling system and cause engine damage. When the cooling system is serviced, all hoses and the radiator cap should be checked and replaced if necessary.

2 Apply the parking brake and block the wheels. **Warning:** *If the vehicle has just been driven, wait several hours to allow the engine to cool down before beginning this procedure.*

3 Move a large container under the radiator drain to catch the coolant. The radiator drain plug is located on the side of the lower tank of the radiator **(see illustration)**. Attach a 3/8-inch diameter hose to the drain fitting (if possible) to direct the coolant into the container, then open the drain fitting) (a pair of pliers may be required to turn it).

4 Remove the radiator cap and allow the radiator to drain, then, move the container under the engine block drain plugs. Engine block drain plugs are generally located on each side of the block one to two inches above the oil pan rail on V8 engines. On six-cylinder engines the block drain plugs are located on the drivers side - a coolant temperature switch may replace the block drain plug depending on the model year of the vehicle **(see illustrations)**. Remove the plugs or switches and allow the coolant in the block to drain. **Note:** *Frequently, the coolant will not drain from the block after the plug is removed. This is due to a rust layer that has built up behind the plug. Insert a Phillips screwdriver into the hole to break the rust barrier.*

5 While the coolant is draining, check the condition of the radiator hoses, heater hoses and clamps (refer to Section 10 if necessary).

6 Replace any damaged clamps or hoses.
7 Once the system is completely drained, flush the radiator with fresh water from a garden hose until it runs clear at the drain. The flushing action of the water will remove sediments from the radiator but will not remove rust and scale from the engine and cooling tube surfaces.
8 These deposits can be removed with a chemical cleaner. Follow the procedure outlined in the manufacturer's instructions. If the radiator is severely corroded, damaged or leaking, it should be removed (see Chapter 3) and taken to a radiator repair shop.
9 Remove the overflow hose from the coolant reservoir and flush the reservoir with clean water, then reconnect the hose.
10 Close and tighten the radiator drain fitting. Install and tighten the block drain plugs.
11 Place the heater temperature control in the maximum heat position.
12 Slowly add new coolant (a 50/50 mixture of water and antifreeze) to the radiator until it's full. Add coolant to the reservoir up to the lower mark.
13 Leave the radiator cap off and run the engine in a well-ventilated area until the thermostat opens (coolant will begin flowing through the radiator and the upper radiator hose will become hot).
14 Turn the engine off and let it cool. Add more coolant mixture to bring the level back up to the lip on the radiator filler neck.
15 Squeeze the upper radiator hose to expel air, then add more coolant mixture if necessary. Replace the radiator cap.
16 Start the engine, allow it to reach normal operating temperature and check for leaks.

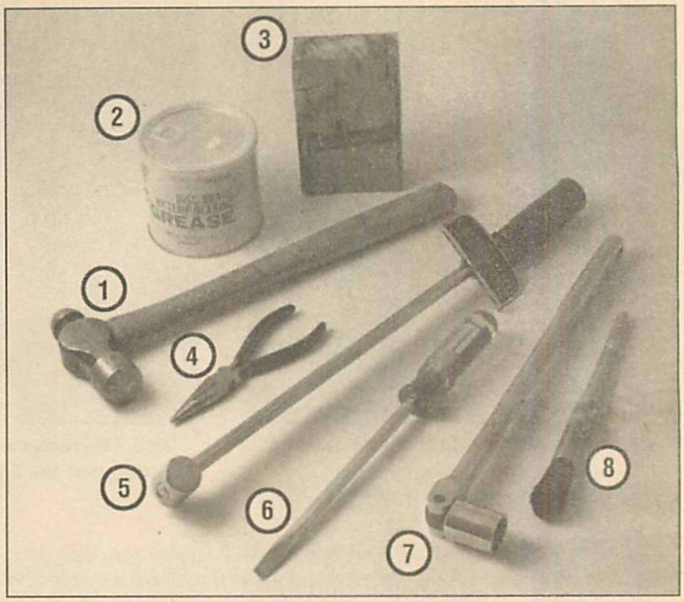
39 Front hub and wheel bearing check, repack and adjustment (every 30,000 miles or 24 months)

Note: *This procedure requires a special socket (available at most automotive parts stores) to remove the inner and outer wheel bearing locking nuts.*

Check and repack

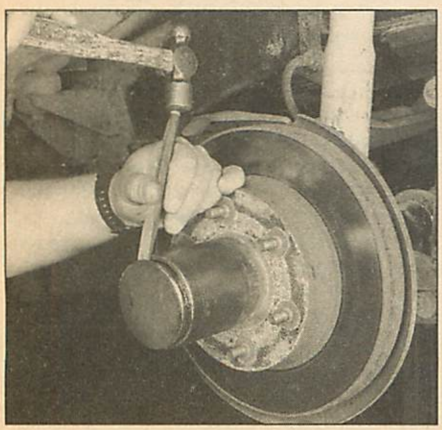
Refer to illustrations 39.1, 39.6a, 39.6b, 39.7a, 39.7b, 39.7c, 39.8, 39.9a, 39.9b, 39.10, 39.12 and 39.16

1 In most cases the front wheel bearings will not need servicing until the brake shoes or pads are changed. However, the bearings should be checked whenever the front of the vehicle is raised for any reason. Several items, including a torque wrench and special grease, are required for this procedure **(see illustration)**.
2 With the vehicle securely supported on jackstands, spin each wheel and check for noise, rolling resistance and freeplay.
3 Grasp the top of each tire with one hand and the bottom with the other. Move the wheel in and out on the spindle. If there's any noticeable movement, the bearings should be checked and then repacked with grease, or replaced if necessary.
4 Remove the wheel.
5 On models with disc brakes, fabricate a wood block which can be slid between the brake pads to keep them separated, remove the caliper (see Chapter 9) and hang it out of the way on a piece of wire.

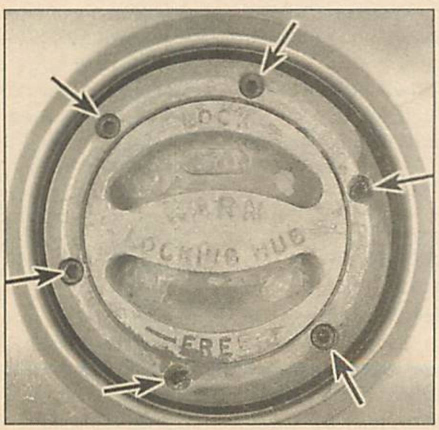


39.1 Tools and materials needed for front wheel bearing maintenance

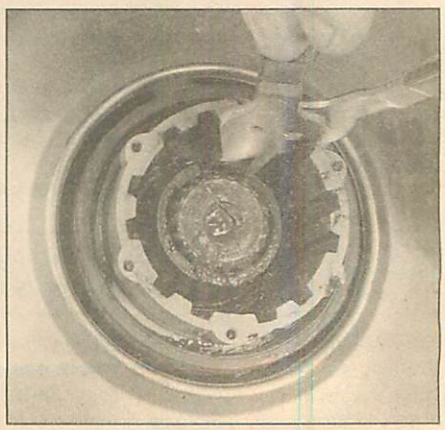
1 ***Hammer*** *- A common hammer will do just fine*
2 ***Grease*** *- High-temperature grease that is formulated specially for front wheel bearings should be used*
3 ***Wood block*** *- If you have a scrap piece of 2x4, it can be used to drive the new seal into the hub*
4 ***Needle-nose pliers*** *- Used to straighten and remove the cotter pin in the spindle*
5 ***Torque wrench*** *- This is very important in this procedure; if the bearing is too tight, the wheel won't turn freely - if it's too loose, the wheel will "wobble" on the spindle. Either way, it could mean extensive damage*
6 ***Screwdriver*** *- Used to remove the seal from the hub (a long screwdriver is preferred)*
7 ***Socket/breaker bar*** *- Needed to loosen the nut on the spindle if it's extremely tight*
8 ***Brush*** *- Together with some clean solvent, this will be used to remove old grease from the hub and spindle*



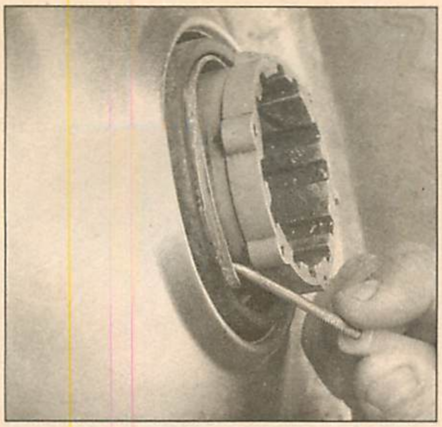
39.6a Remove the dust cap on vehicles without manual locking hubs



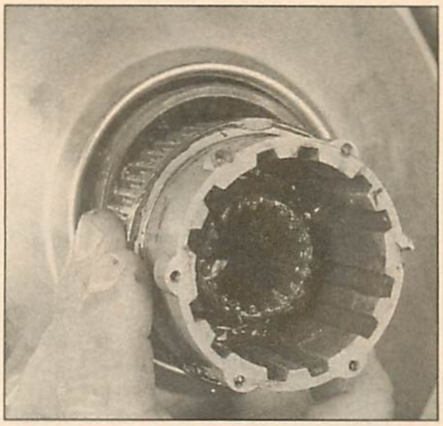
39.6b Remove the six Allen-head bolts securing the hub body on vehicles with manual locking hubs



39.7a Remove the inner snap-ring from the axle shaft . . .

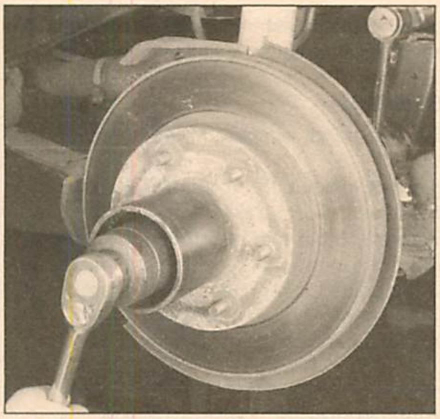


39.7b . . . remove the outer snap-ring securing the hub clutch . . .

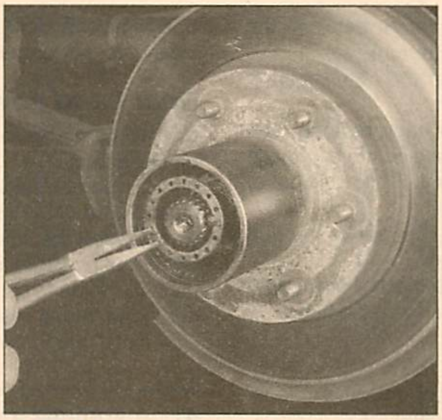


39.7c . . . pull the hub clutch assembly from the brake disc/drum

39.8 On vehicles without manual locking hubs, detach the inner snap-ring from the axle shaft and remove the drive hub and spring



39.9a Remove the wheel bearing outer locknut with the locknut removal socket (available at automotive parts stores)



39.9b Remove the locating washer and using the special socket, remove the inner locknut

39.10 Pull the disc or brake drum assembly out slightly, then push it back in to disengage the outer wheel bearing and cup

6 Remove the dust cap on vehicles without manual locking hubs. On vehicles with manual locking hubs, detach the six Allen-head screws securing the hub and remove the hub body **(see illustrations)**.

7 On vehicles equipped with manual locking hubs, remove the inner and outer snap-rings then remove the front hub clutch assembly **(see illustrations)**. **Note:** *The front drive hubs consist of two sub assemblies, the hub body and the hub clutch assembly - DO NOT attempt to disassemble the sub assemblies.*

8 On vehicles without manual locking hubs, remove the inner snap-ring **(see illustration)**, then remove the drive hub and spring.

9 Using a special locknut removal socket, remove the outer locknut, locating washer and inner locknut **(see illustrations)**.

10 Pull the disc or brake drum assembly out slightly, then push it back in. This should force the outer bearing and cup off the spindle so it can be removed **(see illustration)**.

11 Pull the disc or brake drum off the spindle.

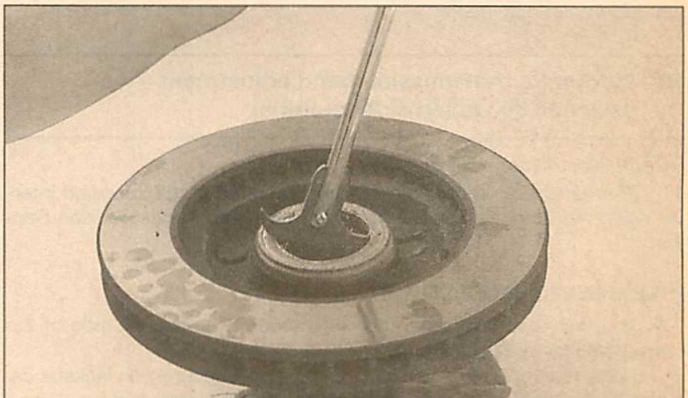
12 Use a screwdriver or a seal puller tool to pry the seal out of the rear of the brake disc or drum **(see illustration)**. Note how the seal is installed.

13 Remove the inner wheel bearing from the disc or brake drum.

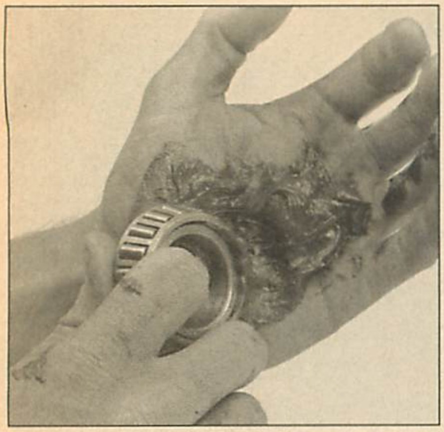
14 Use solvent to remove all traces of the old grease from the bearings, hub and spindle. A small brush may prove helpful; however make sure no bristles from the brush embed themselves inside the bearing rollers. Allow the parts to air dry.

15 Carefully inspect the bearings for cracks, heat discoloration, worn rollers, etc. Check the bearing races inside the hub for wear and damage. If the bearing races are defective, drive the bearing race out of the hub using a brass drift. Drive the new race into the hub using the appropriate size bearing driver (inexpensive bearing driver sets are available at most automotive parts stores). Note that the bearings and races are replaced as matched sets; used bearings should never be installed on new races.

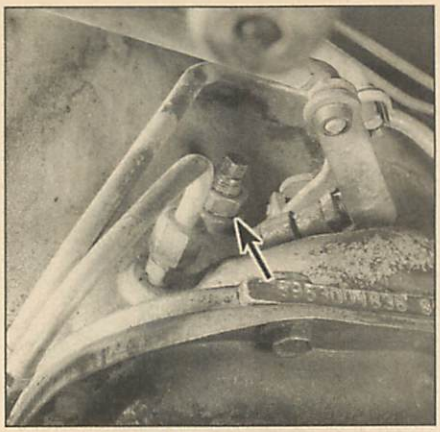
16 Use only high-temperature front wheel bearing grease to pack the bearings. Inexpensive bearing packing tools are available at automotive parts stores, but not entirely necessary. If one is not available, pack the



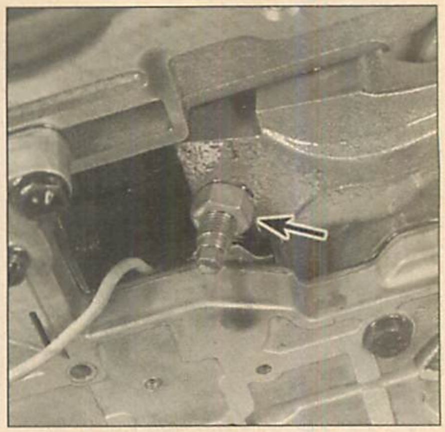
39.12 Use a screwdriver or seal removal tool to pry out the grease seal



39.16 If a bearing packing tool is not available, work grease into the bearing rollers by pressing it against the palm of your hand



40.2 Location of the front band adjusting screw (arrow)



40.7 Location of the rear band adjusting screw (arrow)

grease by hand completely into the bearings, forcing it between the rollers, cone and cage from the back side **(see illustration)**.

17 Apply a thin coat of grease to the spindle at the outer bearing seat, inner bearing seat, shoulder and seal seat.

18 Place a small quantity of grease inboard of each bearing race inside the hub. Using your finger, form a dam at these points to provide extra grease availability and to keep thinned grease from flowing out of the bearing.

19 Place the grease-packed inner bearing into the rear of the hub and put a little more grease outboard of the bearing.

20 Place a new seal over the inner bearing and tap the seal evenly into place with a hammer and block of wood until it's flush with the hub.

Adjustment

21 Carefully place the brake disc/drum assembly onto the spindle and push the grease-packed outer bearing into position.

22 Install the inner locknut with the locating peg facing outward. Then tighten the inner locknut to 50 ft-lbs while rotating the brake disc or drum to seat the bearings.

23 Back off the inner locknut 1/8-turn while rotating the brake disc or drum.

24 Install the locating washer, seating the inner locknut locating peg into one of the holes. If the peg does not align with a hole, back the nut off to the next nearest hole. Install the outer locknut and tighten it to a minimum of 50 ft-lbs.

25 The remainder of the installation is the reverse of removal. **Note:** *Lightly grease the internal components of the manual locking hub assembly with chassis grease. DO NOT pack the hubs full of grease or poor operation may occur.*

40 Automatic transmission band adjustment (every 30,000 miles or 24 months)

Refer to illustrations 40.2 and 40.7

1 The transmission bands should be adjusted at the specified interval when the transmission fluid and filter are being replaced (see Section 41).

Front band (kickdown)

2 The front band adjusting screw is located on the left side of the transmission **(see illustration)**.

3 Raise the front of the vehicle and support it securely on jackstands.

4 Loosen the adjusting screw locknut approximately five turns, then loosen the adjusting screw several turns. Make sure the adjusting screw turns freely, with no binding; lubricate it with penetrating oil if necessary.

5 Tighten the adjusting screw to the torque listed in this Chapter's Specifications, then back it off the number of turns listed in the Specifications. Hold the screw at the adjustment point, then tighten the locknut to the torque listed in this Chapter's Specifications.

Rear band (low-reverse)

6 To gain access to the rear band, remove the transmission fluid pan (see Section 41).

7 Loosen the adjusting screw locknut approximately five turns **(see illustration)**. Make sure the adjusting screw turns freely in the lever.

8 Tighten the adjusting screw to the torque listed in this Chapter's Specifications, then back it off the number of turns listed in the Specifications. Hold the screw at the adjustment point, then tighten the locknut to the torque listed in this Chapter's Specifications.

9 Install the transmission fluid pan.

41 Automatic transmission fluid and filter change (every 30,000 miles or 24 months)

Refer to illustrations 41.6, 41.9, 41.10a, 41.10b and 41.12

1 At the specified intervals, the transmission fluid should be drained and replaced. Since the fluid will remain hot long after driving, perform this procedure only after the engine has cooled down completely. On 1980 and later models, the manufacturer also recommends adjusting the transmission bands at this time, since this procedure requires removing the fluid pan (see Section 40).

2 Before beginning work, purchase the specified transmission fluid (see *Recommended lubricants and fluids* at the front of this Chapter) and a new filter.

3 Other tools necessary for this job include a floor jack, jackstands to support the vehicle in a raised position, a drain pan capable of holding at least eight pints, newspapers and clean rags.

4 Raise the vehicle and support it securely on jackstands.

5 Place the drain pan underneath the transmission pan. Remove the rear and side pan mounting bolts, but only loosen the front pan bolts approximately four turns.

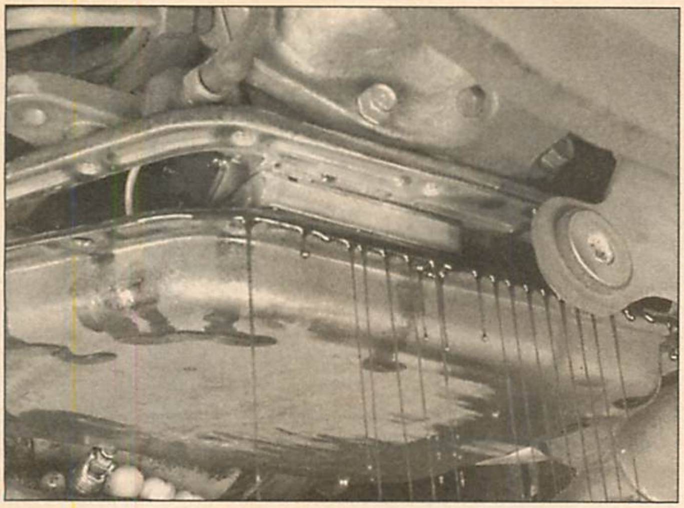
6 Carefully pry the transmission pan loose with a screwdriver, allowing the fluid to drain **(see illustration)**.

7 Remove the remaining bolts, pan and gasket. Carefully clean the gasket surface of the transmission to remove all traces of the old gasket and sealant.

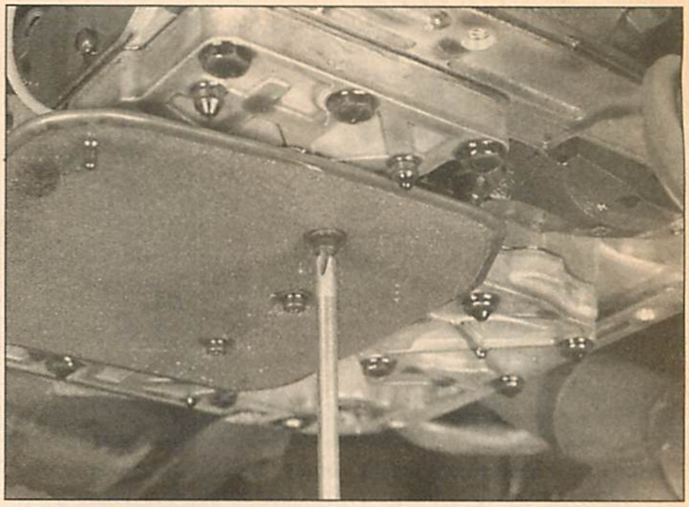
8 Drain the fluid from the transmission pan, clean the pan with solvent and dry it with compressed air, if available.

9 Remove the filter retaining screws from the valve body and remove the filter **(see illustration)**.

10 Thoroughly inspecting the bottom of the *pan, the filter* and the fluid. Although normally bright red, transmission fluid may turn dark red or brown during normal use. If you find the fluid very dark colored, or if it smells burned, it usually *indicates* the transmission has been



41.6 With the front bolts in place but loose, pull the rear of the pan down to drain the transmission fluid



41.9 Remove the filter screws using a Phillips head screwdriver

1

overheated. If you find small pieces of metal or clutch material in the pan or filter, it indicates wear or damage have occurred to the internal parts or clutches **(see illustrations)**. If you have any concerns about the condition of your transmission based on what you find in the fluid, pan and filter, it's a good idea to take your vehicle to your dealer or a transmission shop for further evaluation.

11 Use a gasket scraper to remove any traces of old gasket material remaining on the transmission case and valve body. **Note:** *Be very careful not to gouge the delicate aluminum gasket surface on the valve body.* Install a new filter and gasket.

12 Make sure the gasket surface on the transmission pan is clean, then install the magnet (if equipped) and a new gasket on the pan **(see illustration)**. Place the pan against the transmission and, working around the pan, tighten each bolt a little at a time to the torque listed in this Chapter's Specifications.

13 Lower the vehicle and add approximately three quarts of the specified type of automatic transmission fluid through the filler tube (see Section 6).

14 With the transmission in Park and the parking brake set, start the engine.

15 Move the gear selector through each range and back to Park. Check the fluid level and add fluid, if necessary, until the level is within the correct range on the dipstick.

16 Check under the vehicle for leaks during the first few trips. Check the fluid level again when the transmission is hot (see Section 6).

42 Manual transmission lubricant change (every 30,000 miles or 24 months)

1 Raise the vehicle and support it securely on jackstands.

2 Move a drain pan, rags, newspapers and wrenches under the transmission.

3 Remove the transmission drain plug at the bottom of the case and allow the lubricant to drain into the pan **(see illustration 17.2)**.

4 After the lubricant has drained completely, reinstall the plug and tighten it securely.

5 Remove the fill plug from the side of the transmission case. Using a hand pump, syringe or funnel, fill the transmission with the specified lubricant until it is level with the lower edge of the filler hole. Reinstall the fill plug and tighten it securely.

6 Lower the vehicle.

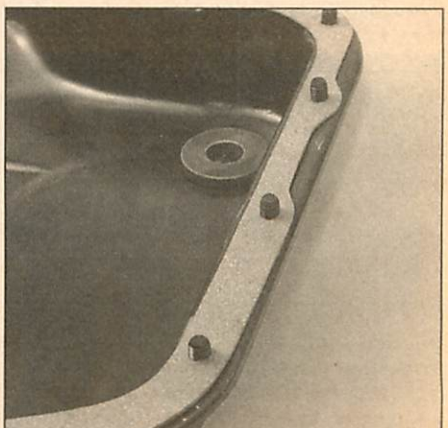
7 Drive the vehicle for a short distance, then check the drain and fill plugs for leakage.

43 Transfer case lubricant change (every 30,000 miles or 24 months)

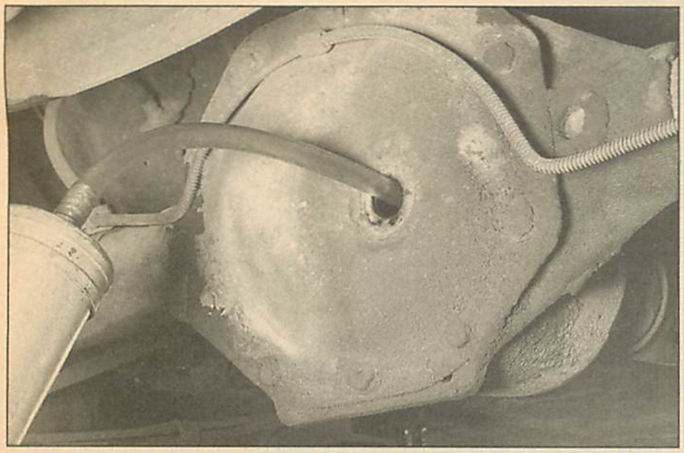
1 Drive the vehicle for at least 15 minutes to warm the lubricant in the case. Perform this warm-up procedure with 4WD engaged, if

41.10a Metal flakes found at the bottom of the pan *could be a sign of internal* transmission damage

41.10b Inspect the filter for pieces of metal or clutch material (arrow)



41.12 Place a new gasket in position on the pan and install the bolts to hold the gasket in place



44.6 This is the easiest way to remove the lubricant - work the end of the hose to the bottom of the differential housing and draw out the old lubricant with a suction pump

possible. Use all gears, including Reverse, to ensure the lubricant is sufficiently warm to drain completely.

2 Raise the vehicle and support it securely on jackstands.

3 Remove the drain plug from the lower part of the case and allow the old lubricant to drain completely **(see illustrations 18.1a and 18.1b)**.

4 After the lubricant has drained completely, reinstall the plug and tighten it securely

5 Remove the filler plug from the case

6 Fill the case with the specified lubricant until it is level with the lower edge of the filler hole.

7 Install the filler plug and tighten it securely.

8 Drive the vehicle for a short distance and recheck the lubricant level. In some instances a small amount of additional lubricant will have to be added.

44 Differential lubricant change (every 30,000 miles or 24 months)

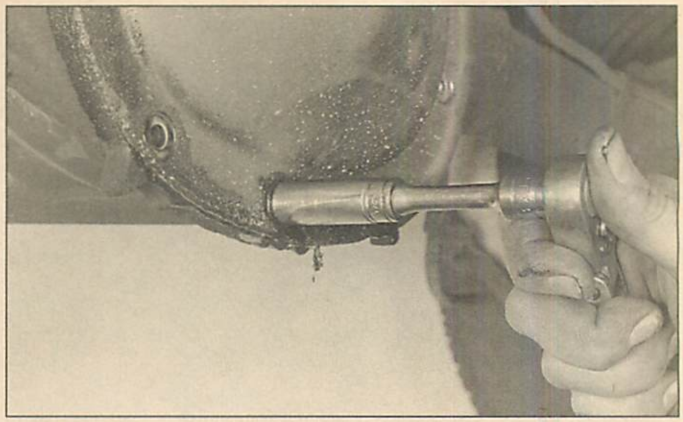
Drain

Refer to illustration 44.6, 44.8a, 44.8b, 44.8c and 44.10

1 This procedure should be performed after the vehicle has been driven so the lubricant will be warm and therefore flow out of the differential more easily.

2 Raise the vehicle and support it securely on jackstands.

3 The easiest way to drain the differential is to remove the lubricant through the filler plug hole with a suction pump. If the differential cover gasket is leaking, it will be necessary to remove the cover to drain the lubricant (which will also allow you to inspect the differential.



44.8a Remove the bolts from the lower edge of the cover . . .

Changing the lubricant with a suction pump

4 Remove the filler plug from the differential (see Section 19).

5 Insert the flexible hose.

6 Work the hose down to the bottom of the differential housing and pump the lubricant out **(see illustration)**.

Changing lubricant by removing the cover

7 Move a drain pan, rags, newspapers and wrenches under the vehicle.

8 Remove the bolts on the lower half of the cover. Loosen the bolts on the upper half and use them to loosely retain the cover. Allow the oil to drain into the pan, then completely remove the cover **(see illustrations)**.

9 Using a lint-free rag, clean the inside of the cover and the accessible areas of the differential housing. As this is done, check for chipped gears and metal particles in the lubricant, indicating that the differential should be more thoroughly inspected and/or repaired.

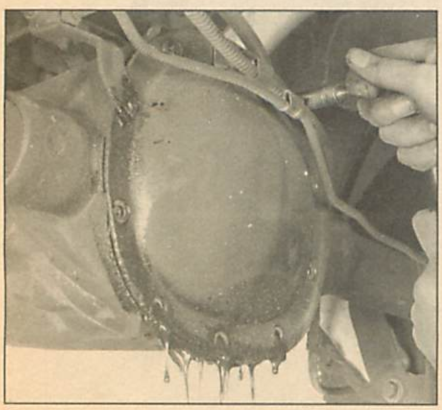
10 Thoroughly clean the gasket mating surfaces of the differential housing and the cover plate. Use a gasket scraper or putty knife to remove all traces of the old gasket **(see illustration)**.

11 Apply a thin layer of RTV sealant to the cover flange, then press a new gasket into position on the cover. Make sure the bolt holes align properly.

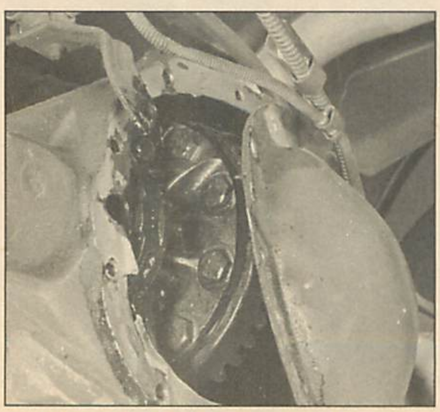
Refill

12 Use a hand pump, syringe or funnel to fill the differential housing with the specified lubricant until it's level with the bottom of the filler plug hole.

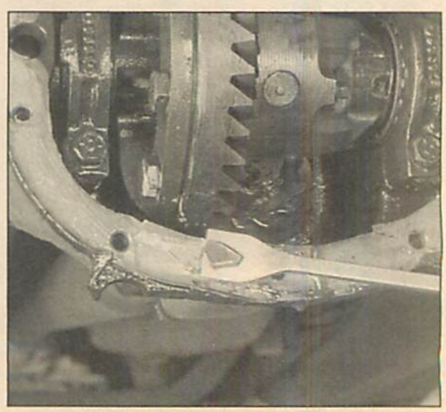
13 Install the fill plug and tighten it securely.



44.8b . . . then loosen the top bolts, allowing the lubricant drain



44.8c After the lubricant has drained, remove the bolts and the cover



44.10 Carefully scrape the old gasket material off to ensure a leak-free seal

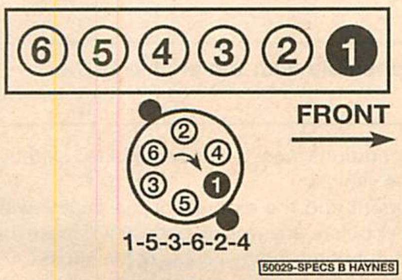
Chapter 2 Part A
Inline six-cylinder engine

Contents

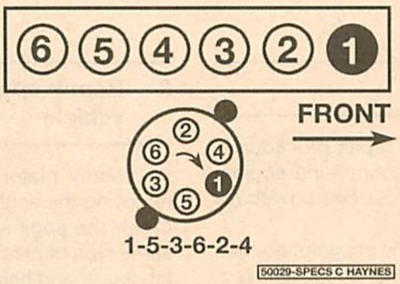
Specifications

General

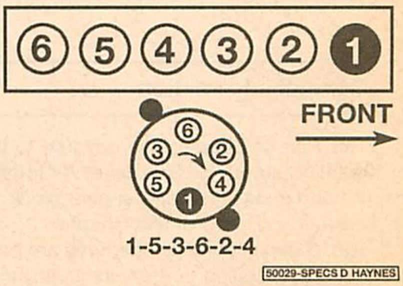
Displacement	258 cubic inches (4.2 liters)
Cylinder numbers (front-to-rear)	1-2-3-4-5-6
Firing order	1-5-3-6-2-4



1972 thru 1974



1975 thru 1977



1978 thru 1988

Cylinder location and distributor rotation

Camshaft

Lobe lift (intake and exhaust)	
1972 through 1974	0.254 inch
1975 through 1977	0.232 inch
1978	
1 bbl. carburetor	0.232 inch
2 bbl. carburetor	0.248 inch
1979 through 1981	0.248 inch
1982 and later	0.253 inch
Journal diameter	
No. 1	2.029 to 2.030 inches
No. 2	2.019 to 2.020 inches
No. 3	2.009 to 2.010 inches
No. 4	1.999 to 2.000 inches
Journal-to-bearing (oil) clearance	0.001 to 0.003 inch
Endplay	None

Torque specifications

	Ft-lbs (unless otherwise indicated)
Camshaft sprocket bolt	45 to 55
Crankshaft pulley-to-vibration damper bolts	20
Cylinder head bolts	
1972	85
1973 through 1980	105
1981 and later	85
Flywheel/driveplate bolts	105
Intake manifold bolts/nuts	23
Exhaust manifold bolts/nuts	23
Oil pan mounting bolts	
1/4-inch bolts	84 in-lbs
5/16-inch bolts	132 in-lbs
Oil pump mounting bolts	
Short bolt	120 in-lbs
Long bolt	17
Rear main bearing cap bolts	80
Rocker arm pivot bolts	19
Rocker arm shaft bolts	21
Timing chain cover-to-block	
Bolts	62 in-lbs
Studs	16
Valve cover-to-cylinder head bolts	
1972 through 1980	50 in-lbs
1981 and later	28 in-lbs
Vibration damper center bolt (lubricated)	
1972 through 1976	55
1977 and later	80
Engine mounts bolts	33

1 General information

This Part of Chapter 2 is devoted to in-vehicle repair procedures for the inline six-cylinder engine. All information concerning engine removal and installation and engine block and cylinder head overhaul can be found in Part C of this Chapter.

The following repair procedures are based on the assumption that the engine is installed in the vehicle. If the engine has been removed from the vehicle and mounted on a stand, many of the Steps outlined in this Part of Chapter 2 will not apply.

The Specifications included in this Part of Chapter 2 apply only to the procedures contained in this Part. Part C of Chapter 2 contains the Specifications necessary for cylinder head and engine block rebuilding.

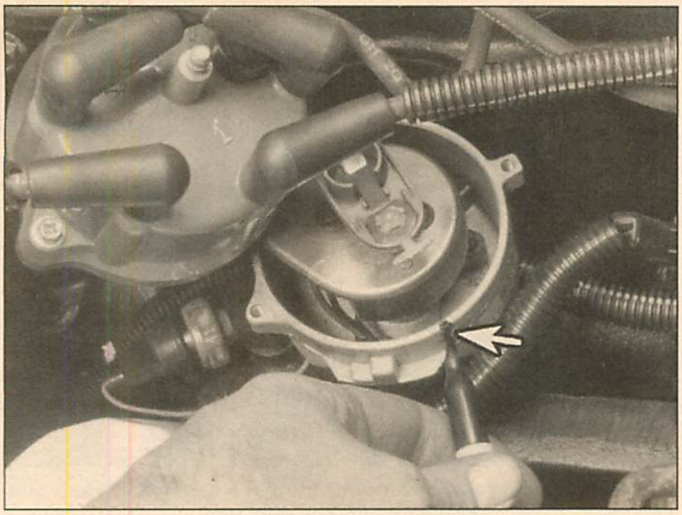
2 Repair operations possible with the engine in the vehicle

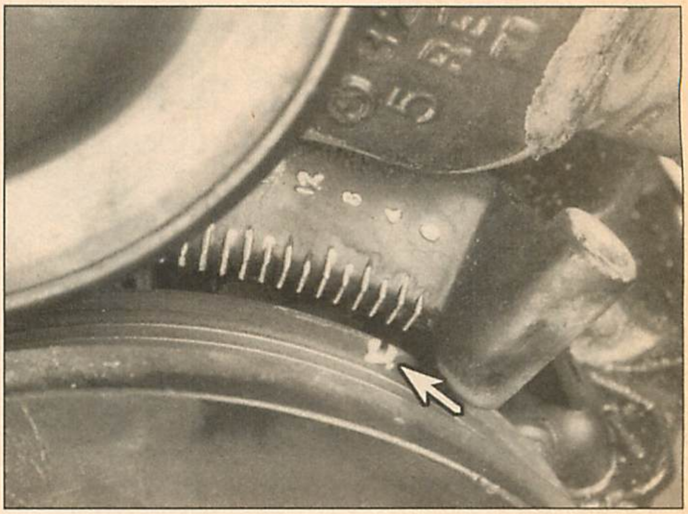
Many major repair operations can be accomplished without removing the engine from the vehicle.

Clean the engine compartment and the exterior of the engine with some type of pressure washer before any work is done. It will make the job easier and help keep dirt out of the internal areas of the engine.

Remove the hood, if necessary, to improve access to the engine as repairs are performed (refer to Chapter 11 if necessary).

If vacuum, exhaust, oil or coolant leaks develop, indicating a need for gasket or seal replacement, the repairs can generally be made with the engine in the vehicle. The intake gasket, timing cover gasket, oil pan gasket, crankshaft oil seals and cylinder head gasket are all


3.6 Mark the distributor body, directly beneath the number 1 terminal


3.8 Align the notch on the vibration damper with the "O" on the timing indicator scale

accessible with the engine in place.

Exterior engine components, such as the intake and exhaust manifolds, the oil pan (and the oil pump), the water pump, the starter motor, the alternator, the distributor and the fuel system components can be removed for repair with the engine in place.

Since the cylinder head can be removed without pulling the engine, valve component servicing can also be accomplished with the engine in the vehicle. Replacement of the camshaft and timing chain and sprockets is also possible with the engine in the vehicle.

In extreme cases caused by a lack of necessary equipment, repair or replacement of piston rings, pistons, connecting rods and rod bearings is possible with the engine in the vehicle. However, this practice is not recommended because of the cleaning and preparation work that must be done to the components involved.

3 Top Dead Center (TDC) for number one piston - locating

Refer to illustrations 3.6 and 3.8

Note: *The following procedure is based on the assumption that the distributor is correctly installed. If you are trying to locate TDC to install the distributor correctly, piston position must be determined by feeling for compression at the number one spark plug hole, then aligning the ignition timing marks as described in Step 8.*

1 Top Dead Center (TDC) is the highest point in the cylinder that each piston reaches as it travels up-and-down when the crankshaft turns. Each piston reaches TDC on the compression stroke and again on the exhaust stroke, but TDC generally refers to piston position on the compression stroke.

2 Positioning the piston(s) at TDC is an essential part of many procedures such as rocker arm removal, camshaft and timing chain/sprocket removal and distributor removal.

3 Before beginning this procedure, be sure to place the transmission in Neutral and apply the parking brake or block the rear wheels. Also, remove the spark plugs (see Chapter 1) and disable the ignition system. Detach the coil wire from the center terminal of the distributor cap and ground it on the block with a jumper wire.

4 In order to bring any piston to TDC, the crankshaft must be turned using one of the methods outlined below. When looking at the front of the engine, normal crankshaft rotation is clockwise.

a) *The preferred method is to turn the crankshaft with a socket and ratchet attached to the bolt threaded into the front of the crankshaft.*

b) *A remote starter switch, which may save some time, can also be used. Follow the instructions included with the switch. Once the piston is close to TDC, use a socket and ratchet, as described in the previous paragraph.*

c) *If an assistant is available to turn the ignition switch to the Start position in short bursts, you can get the piston close to TDC without a remote starter switch. Make sure your assistant is out of the vehicle, away from the ignition switch, then use a socket and ratchet (as described in Paragraph a) to complete the procedure.*

5 Note the position of the terminal for the number one spark plug wire on the distributor cap. If the terminal isn't marked, follow the plug wire from the number one cylinder spark plug to the cap.

6 Use a felt-tip pen or chalk to make a mark on the distributor body directly under the terminal **(see illustration)**.

7 Detach the cap from the distributor and set it aside (see Chapter 1 if necessary).

8 Turn the crankshaft (see Step 4 above) until the notch in the crankshaft pulley is aligned with the 0 on the timing plate (located at the front of the engine) **(see illustration)**.

9 Look at the distributor rotor - it should be pointing directly at the mark you made on the distributor body. If it is, go to Step 12.

10 If the rotor is 180 degrees off, the number one piston is at TDC on the exhaust stroke. Go to Step 11.

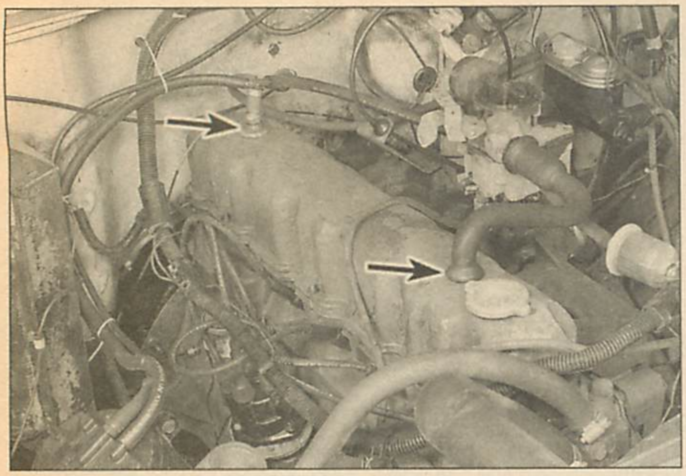
11 To get the piston to TDC on the compression stroke, turn the crankshaft one complete turn (360 degrees) clockwise. The rotor should now be pointing at the mark on the distributor. When the rotor is pointing at the number one spark plug wire terminal in the distributor cap and the ignition timing marks are aligned, the number one piston is at TDC on the compression stroke.

12 After the number one piston has been positioned at TDC on the compression stroke, TDC for any of the remaining pistons can be located by turning the crankshaft 120 degrees and following the firing order. Mark the remaining spark plug wire terminal locations on the distributor body just like you did for the number one terminal, then number the marks to correspond with the cylinder numbers. For instance, the next cylinder in the firing order after number 1 is 5. To reach TDC for number 5, turn the engine (from number 1 TDC) 120 more degrees clockwise (viewed from the front) and the rotor should now point at the terminal for cylinder number 5.

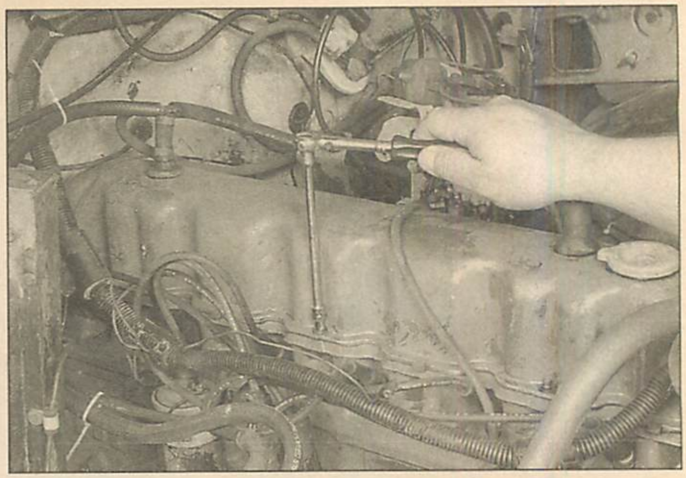
4 Valve cover - removal and installation

Refer to illustrations 4.2, 4.3 and 4.5

1 Refer to Chapter 4 and remove the air cleaner.



4.2 Remove the PCV hoses (arrows) from the valve cover



4.3 Remove the valve cover bolts (note the location of any studs or wiring harness retainers)

2 Remove the crankcase breather tube and hose from the valve cover **(see illustration)**.

3 Remove the valve cover retaining bolts and lift the cover off. If the cover is stuck, tap on it gently with a soft-face mallet **(see illustration)**. Do not pry on the gasket flange. **Note:** *Some models may use a traditional gasket, while others use RTV sealant.*

4 Clean the sealing surfaces, removing any traces of oil with lacquer thinner or acetone and a clean rag.

5 Position a new gasket to the cover or apply a bead of RTV sealant **(see illustration)**.

6 Install the cover and bolts before the sealant cures (5 to 10 minutes). Tighten the bolts to the torque listed in this Chapter's Specifications. Do not overtighten, or the gasket flange may become distorted and cause an oil leak.

7 Reinstall the crankcase breather hose, and run the engine to check for oil leaks.

5 Rocker arms and pushrods - removal, inspection and installation

1972 and 1974 models

Refer to illustration 5.3

1 Early six-cylinder engines were equipped with rocker arms mounted on a common shaft. On these models, remove the valve cover, then remove the six bolts retaining the rocker shaft assembly to the cylinder head.

2 Number all of the rocker arms and the spacers on the shaft before disassembly. To remove the rocker arms for inspection or replacement, drive out the roll pin (at either end of the shaft) and remove the wave-washer.

3 Remove and clean the rocker arms, spacers and the oil deflector, and inspect for signs of wear, scoring, chipping or galling **(see illustration)**. If any of these conditions exist, replace the rocker arm and shaft assembly as a unit. **Note:** *Smooth shiny spots on the shaft indicate normal wear, grooves or wear into the shaft are signs of abnormal wear.*

4 Lube the shaft with moly-based grease and assemble the components in the proper order, making sure the oil holes in the rocker shaft are pointing down toward the cylinder head. When all of the components are in place, reinstall the last wave-washer and drive in the roll pin.

1973 models and 1975 and later models

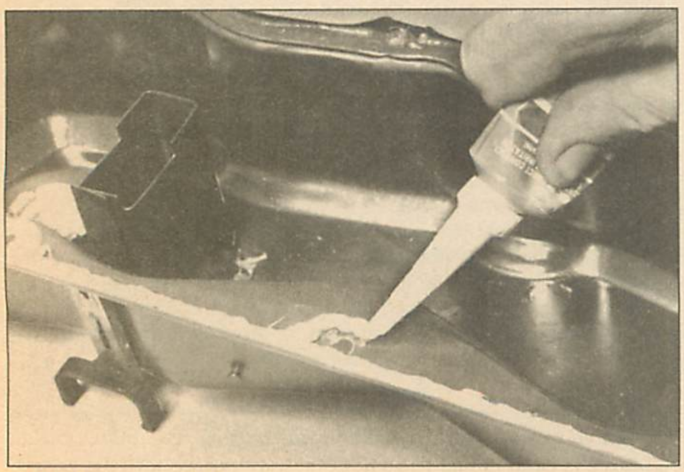
Refer to illustrations 5.6, 5.7 and 5.8

Removal

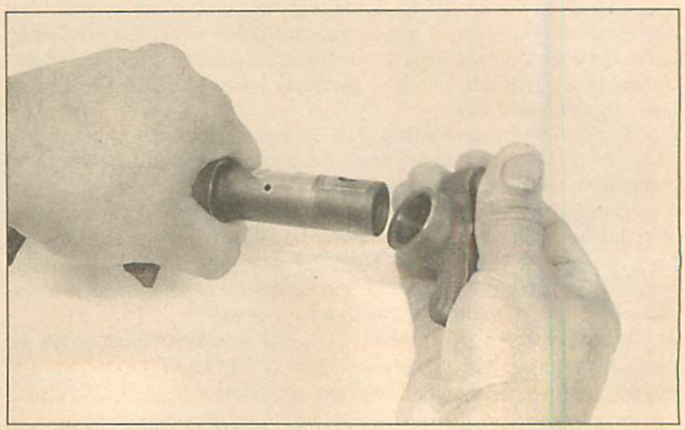
5 Remove the valve cover (see Section 4).

6 Beginning at the front of the cylinder head, loosen and remove the rocker arm mounting bolts in pairs **(see illustration)**. Alternate between each of the bolts on a pair, loosening each one in 1/4-turn increments until they can be removed by hand.

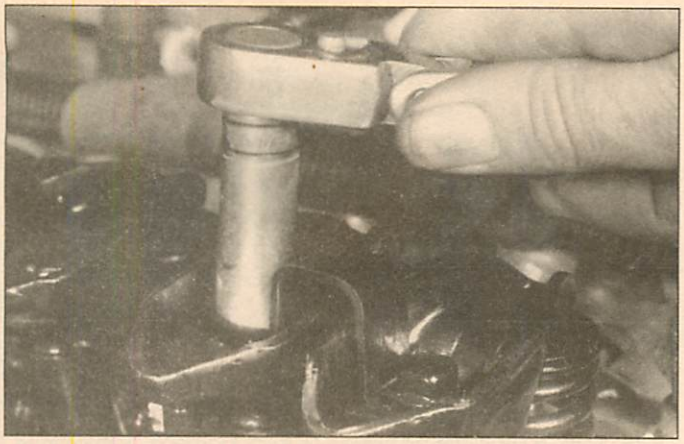
7 Remove the rocker arms, bridges and fulcrums **(see illustration)** and store them with their respective mounting bolts. Store each set of rocker arm components separately in a marked plastic bag to ensure



5 When using RTV sealant, apply a bead around the perimeter of the valve cover and around the bolt holes



5.3 Clean and inspect the rockers and shaft for signs of wear - shiny spots are normal



5.6 Loosen each bolt in 1/4-turn increments, alternating between the intake and exhaust rocker arm

they are reinstalled in their original locations.

8 Remove the pushrods and store them separately to make sure they don't get mixed up during installation **(see illustration)**.

Inspection

9 Check each rocker arm for wear, cracks and other damage, especially where the pushrods and valve stems contact the rocker arm faces. Check the fulcrum seat in each rocker arm and the fulcrum faces. Look for galling, stress cracks and unusual wear patterns. If the rocker arms are worn or damaged, replace them with new ones and install new fulcrums as well.

10 Make sure the oil hole at the pushrod end of each rocker arm is open.

11 Inspect the pushrods for cracks and excessive wear at the ends. Roll each pushrod across a piece of plate glass to see if it's bent (if it wobbles, it's bent).

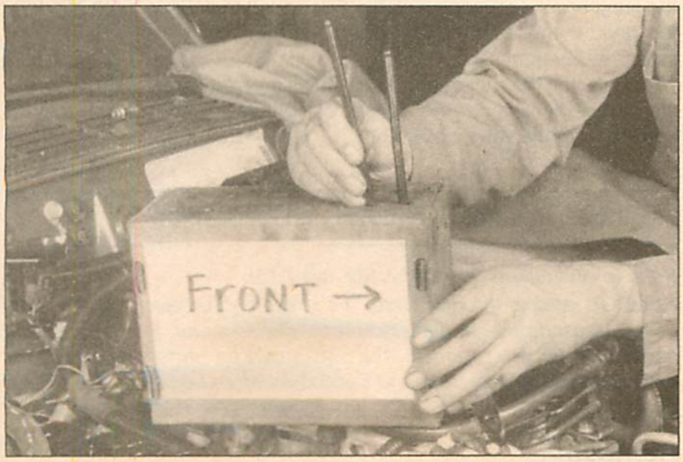
Installation

12 Lubricate the lower end of each pushrod with clean engine oil or moly-base grease and install it in its original location. Make sure each pushrod seats completely in the lifter socket.

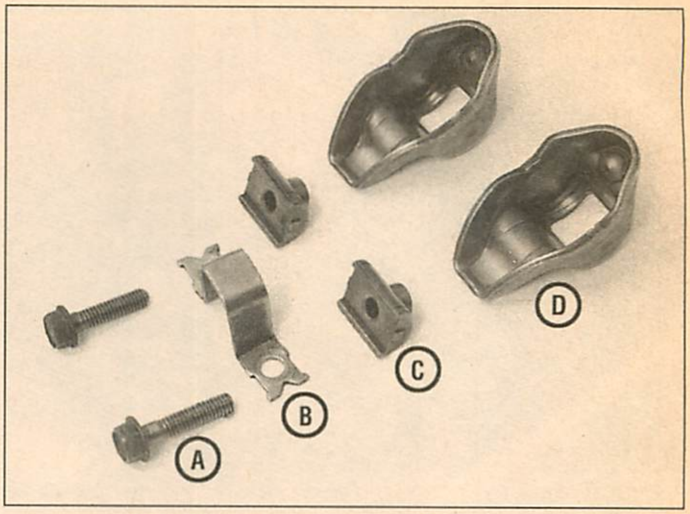
13 Bring the number one piston to Top Dead Center (TDC) on the compression stroke (see Section 3).

14 Apply moly-base grease or engine assembly lube to the ends of the valve stems and the upper ends of the pushrods before placing the rocker arms in position.

15 Apply moly-base grease or engine assembly lube to the fulcrums



5.8 Store the pushrods in a box like this to ensure reinstallation in the same location



5.7 Bridged-type rocker arm components

A	*Bolt*	*C*	*Fulcrum*
B	*Bridge*	*D*	*Rocker arm*

to prevent damage to the mating surfaces before engine oil pressure builds up. Install the rocker arms, fulcrums, bridges and bolts in their original locations. Tighten the bolts to the torque listed in this Chapter's Specifications. **Note:** *Tighten each pair of bolts in 1/4-turn increments), alternating between intake and exhaust rocker arms until final torque is reached.*

16 Install the valve cover (see Section 4).

17 Start the engine, listen for unusual valvetrain noises and check for oil leaks.

6 Valve spring, retainer and seals - replacement

Refer to illustrations 6.5, 6.7 and 6.16

Note: *Broken valve springs and defective valve stem seals can be replaced without removing the cylinder head. Two special tools and a compressed-air source are normally required to perform this operation, so read through this Section carefully and rent or buy the tools before beginning the job.*

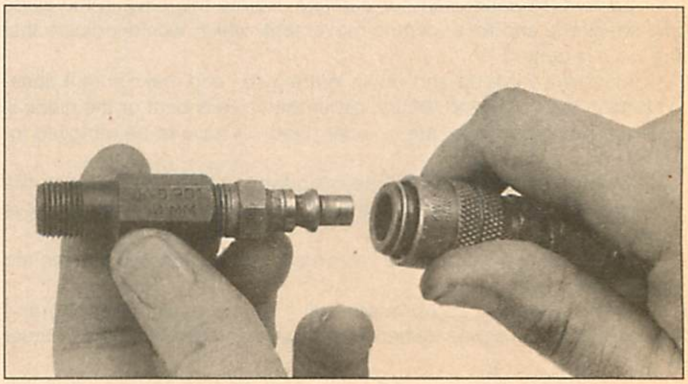
1 Remove the valve cover (see Section 4).

2 Remove the spark plugs (see Chapter 1).

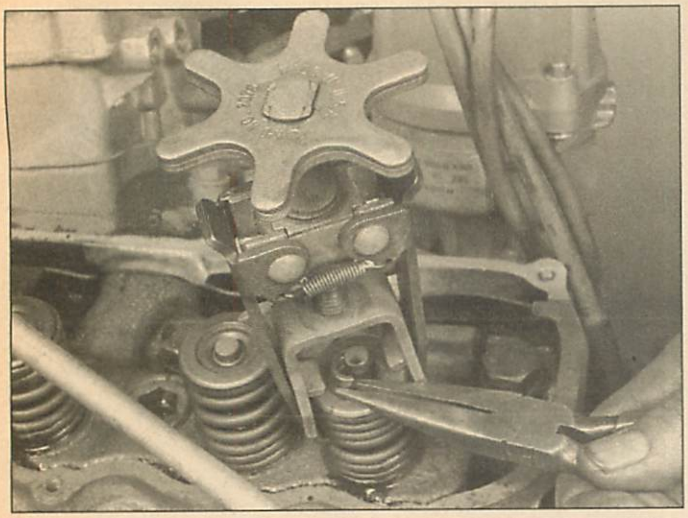
3 Turn the crankshaft until the number one piston is at top dead center on the compression stroke (see Section 3).

4 Remove the rocker arms for the defective springs or seals.

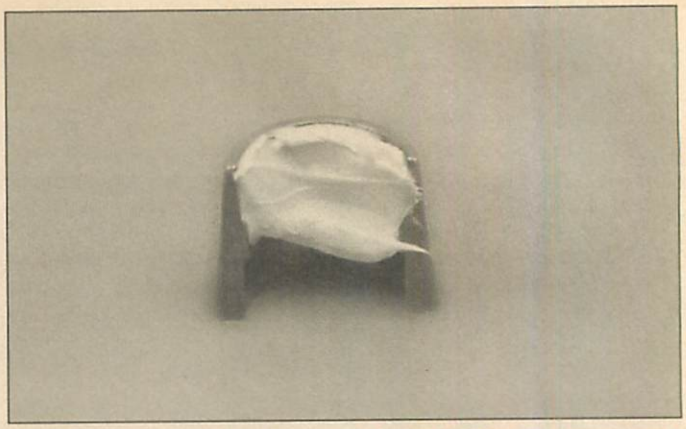
5 Thread an adapter into the spark plug hole and connect an air hose from a compressed air source to it **(see illustration)**. Most auto



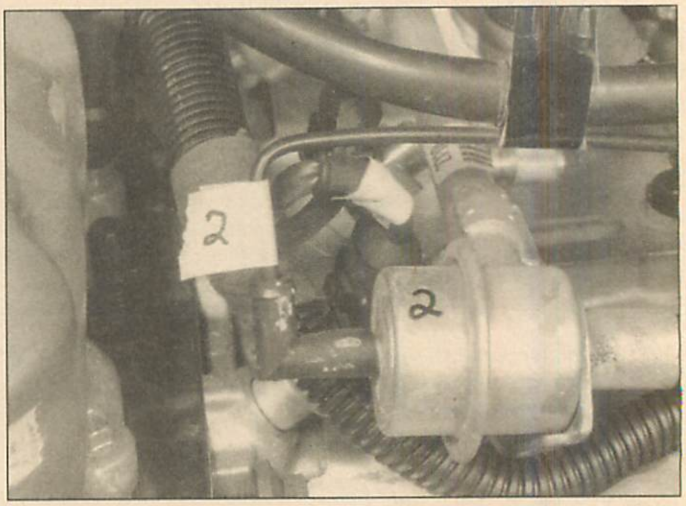
6.5 This is what the air hose adapter that threads into the spark plug hole looks like - they're commonly available in auto parts stores



6.7 Use s clamp-type valve spring compressor to compress the spring and remove the keepers with a small magnet or needle-nose pliers



6.16 Apply a small dab of grease to each keeper as shown here before installation - it'll hold them in place on the valve stem as the spring is released



7.5 Label and disconnect all vacuum and electrical connectors on the intake manifold

parts stores can supply the air hose adapter. **Note:** *Many cylinder compression gauges utilize a screw-in fitting that may work with your air hose quick-disconnect fitting.*

6 Apply compressed air to the cylinder. The valves should be held in place by the air pressure. **Warning:** *If the cylinder isn't exactly at TDC, air pressure may cause the engine to rotate. Do not leave a socket or wrench on the balancer bolt; damage or personal injury may result.*

7 Stuff shop rags into the cylinder head holes around the valves to prevent parts and tools from falling into the engine, then use a valve-spring compressor to compress the spring. Remove the keepers with small needle-nose pliers or a magnet **(see illustration)**. **Note:** *Several different types of tools are available for compressing the valve springs with the cylinder head in place. One type, shown here, grips the lower spring coils and presses on the retainer as the knob is turned, while the lever-type utilizes the rocker arm bolt for leverage. Both types work very well, although the lever type is usually less expensive.*

8 Remove the valve spring and retainer (intake valve) or rotator (exhaust valve). **Note:** *If the valve faces or seats are in poor condition, leaks may prevent the air pressure from retaining the valves - if so, the cylinder head will have to be removed for additional repair.*

9 Remove the old valve stem seals. **Caution:** *Use pliers to pull the old seal from the top of the valve guide, but do not nick or scratch the valve stem in the process.*

10 Wrap a rubber band or tape around the top of the valve stem so the valve doesn't fall into the combustion chamber, then release the air pressure.

11 Inspect the valve stem for damage. Rotate the valve in the guide and check the end for eccentric movement, which would indicate that the valve is bent.

12 Move the valve up-and-down in the guide and make sure it doesn't bind. If the valve stem binds, either the valve is bent or the guide is damaged. In either case, the cylinder head will have to be removed for repair.

13 Reapply air pressure to the cylinder to retain the valve in the closed position, then remove the tape or rubber band from the valve stem.

14 Install the new seal on the valve stem and push it down to the top of the valve guide.

15 With the spring compressor still in place over the spring and retainer, place the spring back over the valve and seat it on the cylinder head.

16 Position the keepers in the valve stem groove. Apply a small dab of grease to the inside of each keeper to hold it in place if necessary **(see illustration)**. Remove the pressure from the spring tool and make sure the keepers are seated. **Warning:** *The spring exerts considerable pressure, be certain the keepers are properly located in the valve stem grooves before releasing the spring compressor.*

17 Disconnect the air hose and remove the adapter from the spark plug hole.

18 Repeat the above procedure on the remaining cylinders, following the firing order sequence (see the Specifications). Bring each piston to top dead center on the compression stroke before applying air pressure (see Section 3).

19 Reinstall the rocker arm assemblies and the valve cover.

20 Start the engine, then check for oil leaks and unusual sounds coming from the valve cover area.

7 Intake manifold - removal and installation

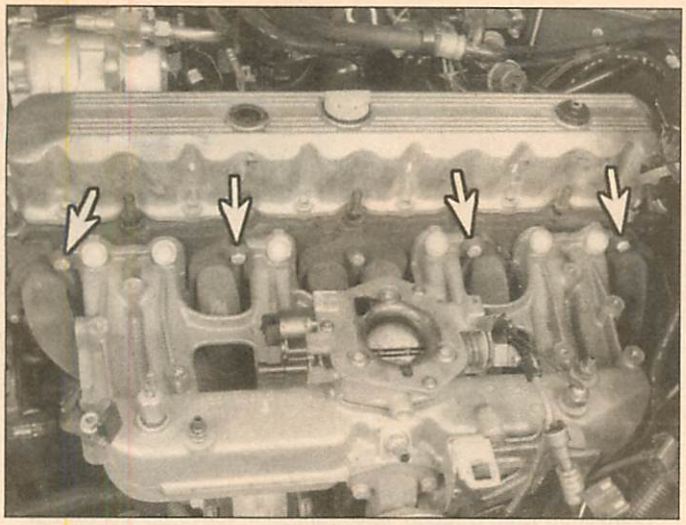
Refer to illustrations 7.5, 7.9, 7.15a and 7.15b

Note: *On models through 1980, the intake and exhaust manifolds are bolted to each other and are best removed as a unit, then separated if necessary. On later models, the intake can be removed without the exhaust. Read this Section and Section 8 before beginning the procedure.*

Removal

1 Disconnect the negative cable from the battery.

2 Remove the air cleaner assembly and the accelerator cable (see Chapter 4).



7.9 Remove the intake manifold bolts (arrows) - if any are studs, mark their location for reinstallation

3 On automatic transmission equipped models, disconnect the transmission line pressure (TV) cable (see Chapter 7 Part B).
4 Detach the cruise control cable, if equipped.
5 Label and disconnect all vacuum and electrical connectors on the intake manifold **(see illustration)**.
6 Relieve the fuel pressure and then disconnect the fuel supply line and return line (if equipped) from the carburetor (see Chapter 4). Cap the open ends.
7 Loosen the drivebelts (see Chapter 1).
8 Remove the power steering pump and bracket from the intake manifold and set it aside without disconnecting the hoses. Be sure to leave the pump in an upright position so fluid won't spill.
9 Remove the intake manifold bolts **(see illustration)**. On 1980 and earlier models remove the exhaust manifold bolts and exhaust pipe connection (see Section 8) and separate the intake manifold and exhaust manifold as a unit, then separate the manifolds **(see illustrations 8.1a and 8.1b)**.
10 On 1981 and later models, remove the EGR tube from the intake manifold (see Chapter 6). Pull the manifold (both manifolds on earlier models) away from the engine slightly to disengage it from the locating dowels in the cylinder head, then lift the manifold(s) out of the engine compartment.

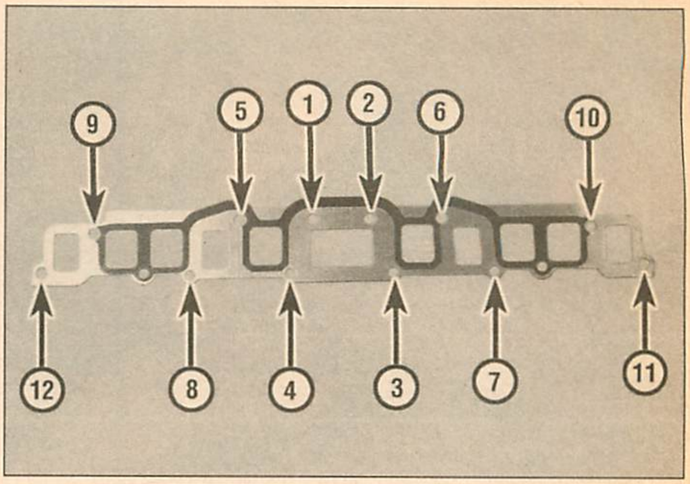
Installation

11 Thoroughly clean the gasket mating surfaces, removing all traces of old gasket material.
12 If the manifold is being replaced, make sure all the fittings, senders, etc. are transferred to the replacement manifold.
13 Position a new intake gasket on the cylinder head, using the locating dowels to hold it in place and position the intake manifold loosely on the cylinder head.
14 Install the EGR tube (if equipped) between the manifolds, but don't tighten the fittings yet.
15 Install the manifold retaining bolts and tighten all fasteners in sequence **(see illustrations)** to the torque listed in this Chapter's Specifications. Tighten the EGR tube fittings securely (if equipped).
16 Reinstall the remaining parts in the reverse order of removal.
17 Run the engine and check for leaks.

8 Exhaust manifold - removal and installation

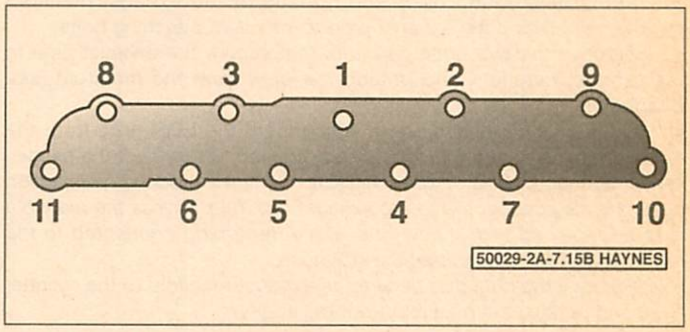
Refer to illustrations 8.1a and 8.1b

Warning: *Allow the engine to cool completely before beginning this procedure.*



7.15a Intake and exhaust manifold bolt tightening sequence - 1980 and earlier models

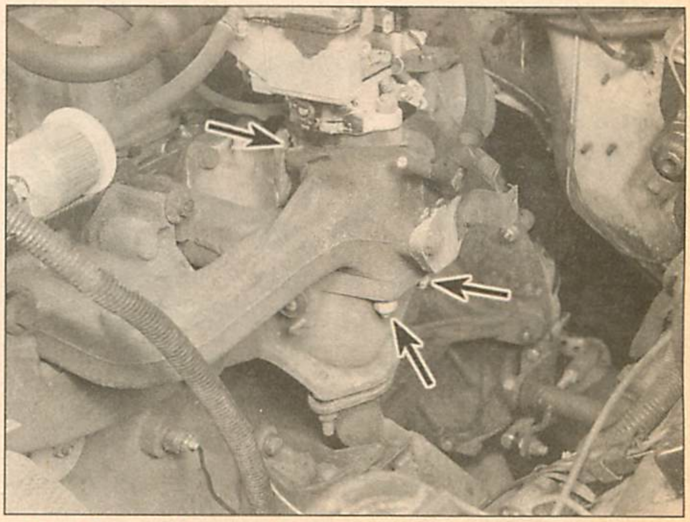
2A



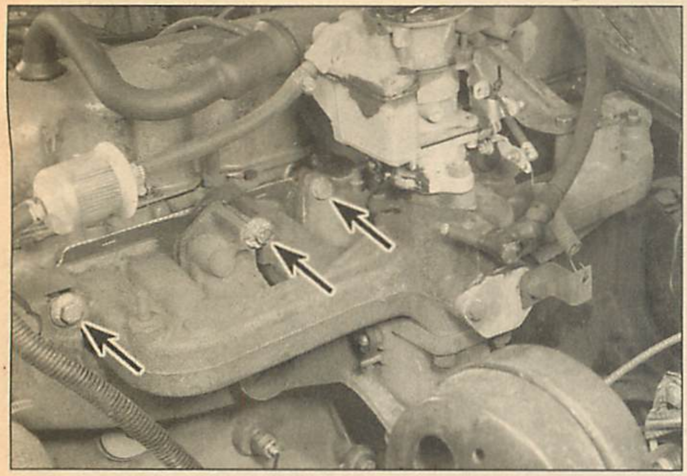
7.15b Intake and exhaust manifold bolt tightening sequence - 1981 and later models

Removal

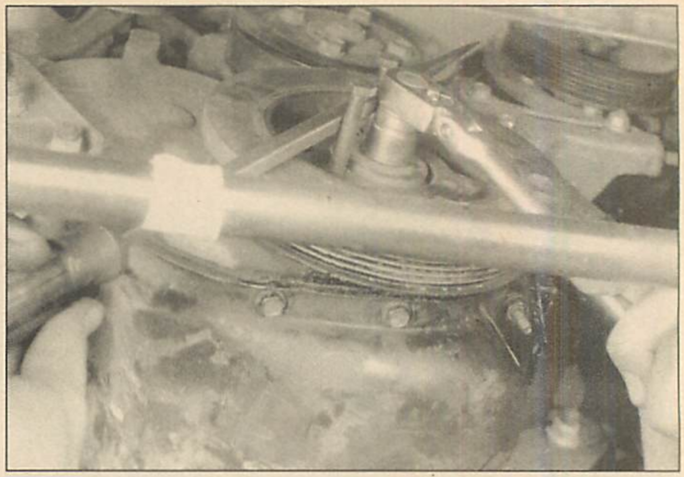
1 Remove the intake manifold (see Section 7). On 1980 and earlier models, remove both intake and exhaust manifolds as a unit, then separate them **(see illustrations)**. **Note:** *Apply penetrating oil on the bolts retaining the two manifolds together and let it soak in before attempting to remove these bolts.*



8.1a Four nuts (arrows indicate three, one more is behind the carburetor) must be removed to separate the intake and exhaust manifolds on early models



8.1b Remove all of the intake/exhaust manifold bolts and nuts (arrows indicate three bolts in view)



9.7 Install two bolts in the damper and use them to keep the crankshaft from rotating while removing the large center bolt

2 Apply penetrating oil to the threads of the exhaust manifold attaching studs and the exhaust pipe-to-manifold attaching bolts.

3 Remove the two bolts and nuts that secure the exhaust pipe to the exhaust manifold and detach the pipe from the manifold (see Chapter 4).

4 On 1981 and later models, disconnect the EGR tube from the exhaust manifold, and on models so equipped, disconnect the oxygen sensor connector (see Chapter 4). **Note:** *On some models, Air Injection pipes are also connected to the exhaust manifold. Unless the manifold is to be replaced with a new one, leave the tubing connected to the manifold and just disconnect the AIR hose.*

5 Remove the nuts that secure the exhaust manifold to the cylinder head and remove the manifold from the engine.

Installation

6 If there was evidence of an exhaust leak at the manifold-to-cylinder head surface (noise or gray/brown stains), check the manifold for warpage and replace it if necessary. There are no gaskets used on the exhaust manifold-to-cylinder head surface, but the earlier models use an asbestos gasket at the intake/exhaust manifold junction. Replace the gasket before reinstalling the manifolds as a set.

7 Slide the manifold over the studs, and install the attaching nuts on the studs finger tight.

8 Reinstall the intake manifold (see Section 7) and tighten all fasteners, in the sequence shown **(see illustration 7.15)**, to the torque listed in this Chapter's Specifications.

9 Reconnect the exhaust pipe, EGR and oxygen sensor if equipped, then run the engine and check for leaks.

9 Crankshaft front oil seal - removal and installation

Removal

Refer to illustrations 9.7, 9.8 and 9.10

1 Disconnect the negative cable from the battery.

2 Raise the front of the vehicle and support it securely on jackstands.

3 Remove the splash pan which is mounted below the front of the engine.

4 Remove the drivebelts (see Chapter 1).

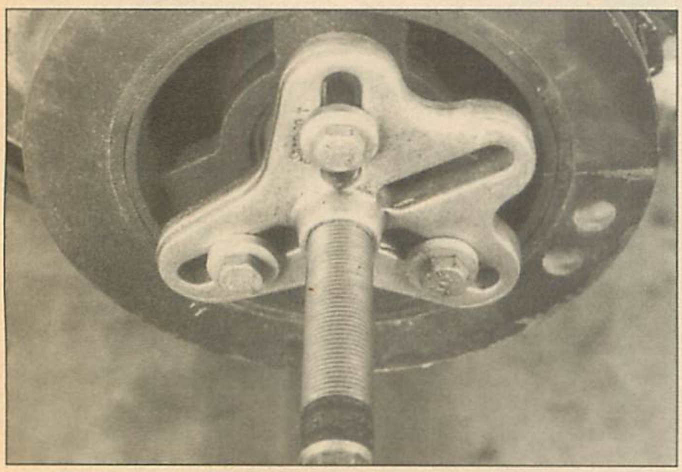
5 Remove the radiator and cooling fan as described in Chapter 3.

6 Unbolt the drivebelt pulley from the damper.

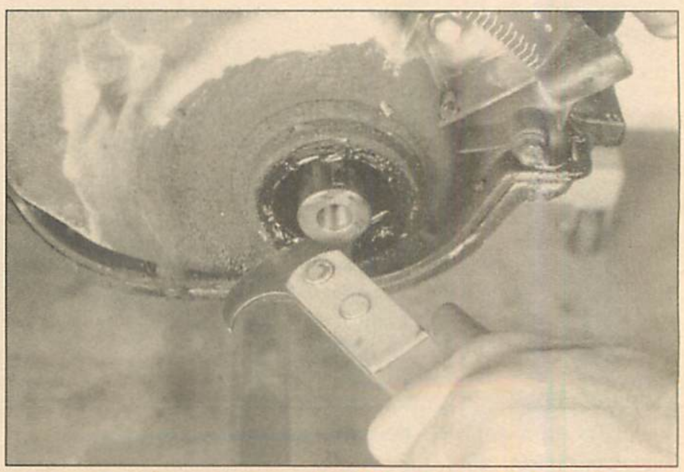
7 Remove the vibration damper retaining bolt and washer. **Note:** *To prevent the crankshaft from rotating, place two 5/16 x 1-1/2-inch long bolts into the damper holes and hold a pry bar between them* **(see illustration).** *Rotate the crankshaft until the bar contacts the frame.*

8 Using a vibration damper removal tool **(see illustration)**, pull the damper off the crankshaft.

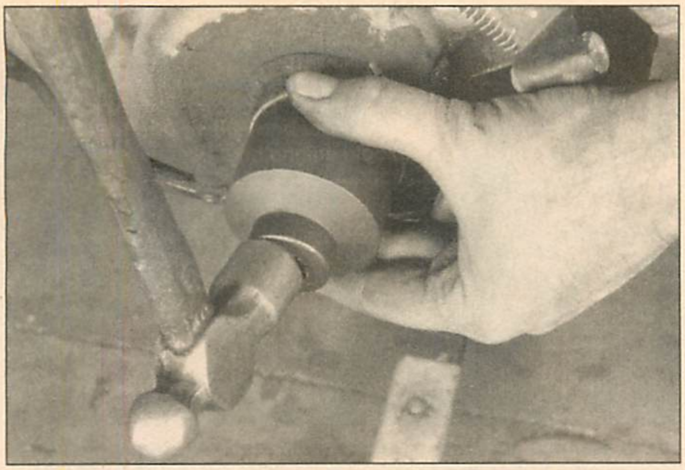
9 Clean and inspect the area on the center hub of the damper



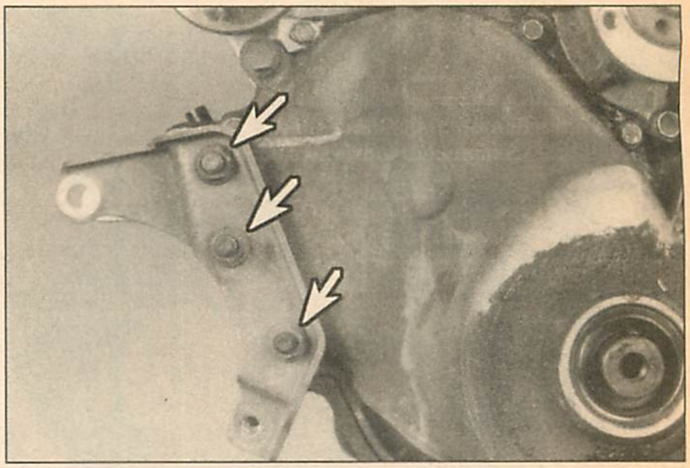
9.8 Use a vibration-damper puller that bolts to the center hub such as this one - do not use a gear puller with jaws gripping the outer ring; it could damage the damper



9.10 Pry the old seal out with a seal removal tool (shown here) or a screwdriver with tape over the tip to prevent scratching the crankshaft



9.11 Gently drive the new seal into place with a hammer and large socket



10.4 Once the alternator has been removed, remove the bracket retaining nuts (arrows), then unbolt the timing chain cover

where the front oil seal rides. Minor imperfections can be cleaned up with fine emery cloth. If there is a groove worn in the hub, replace the vibration damper or have a special sleeve (available at automotive parts stores) installed on the hub to restore the surface.

10 Carefully pry the oil seal out of the timing chain cover with a seal removal tool or screwdriver **(see illustration)**. Don't scratch the cover bore or damage the crankshaft in the process (if the crankshaft is damaged the new seal will leak).

Installation

Refer to illustration 9.11

11 Clean the bore in the cover and coat the outer edge of the new seal with engine oil or multi-purpose grease. Using a socket with an outside diameter slightly smaller than the outside diameter of the seal, carefully drive the new seal into place with a hammer **(see illustration)**. If a socket isn't available, a short section of large-diameter pipe will work. Check the seal after installation to be sure that the spring didn't pop out of place.

12 Apply clean engine oil to the seal contact surface of the damper hub.

13 Align the key slot of the vibration damper hub with the crankshaft key and tap the damper onto the crankshaft with a soft-face mallet.

14 Install the vibration damper bolt and tighten it to the torque listed in this Chapter's Specifications.

15 Reinstall the pulley, drivebelts and fan assembly.

16 Run the engine and check for leaks.

10 Timing chain, cover and sprockets - removal and installation

Removal

Refer to illustrations 10.4, 10.7, 10.9, 10.12 and 10.13

1 Disconnect the negative cable from the battery. Refer to Section 3 and position the engine on TDC for number 1 cylinder.

2 Remove the fan, fan shroud, and water pump pulley (see Chapter 3).

3 Remove the vibration damper (see Section 9).

4 Unbolt the alternator (see Chapter 5) and the alternator bracket assembly **(see illustration)**.

5 Remove the oil pan-to-timing chain cover bolts and timing chain cover-to-engine block bolts.

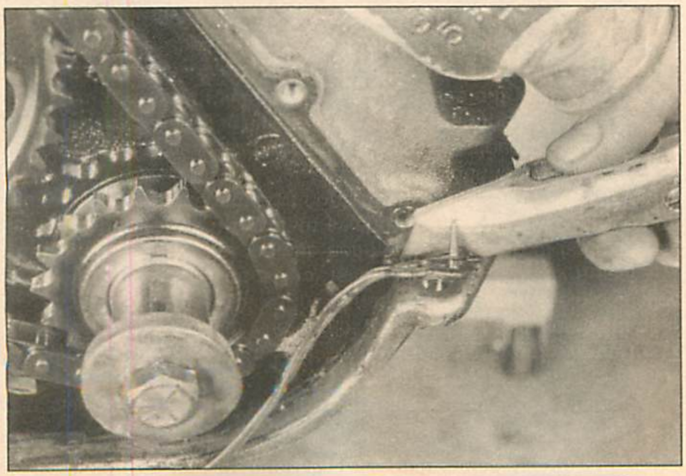
6 Separate the timing chain cover from the engine. If necessary, tap on it gently with a soft-face mallet to break the seal. Temporarily stuff a rag into the oil pan opening to prevent entry of debris.

7 Cut off the oil pan side gasket end tabs flush with the front face of the engine block **(see illustration)**. Save the cut-off gasket tabs for reference later.

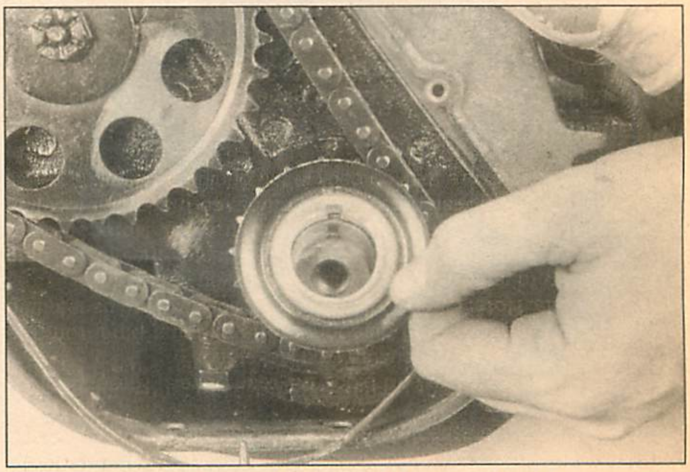
8 Clean the mating surfaces of the timing chain cover, oil pan and engine block, removing all traces of oil and old gasket material.

Timing chain inspection

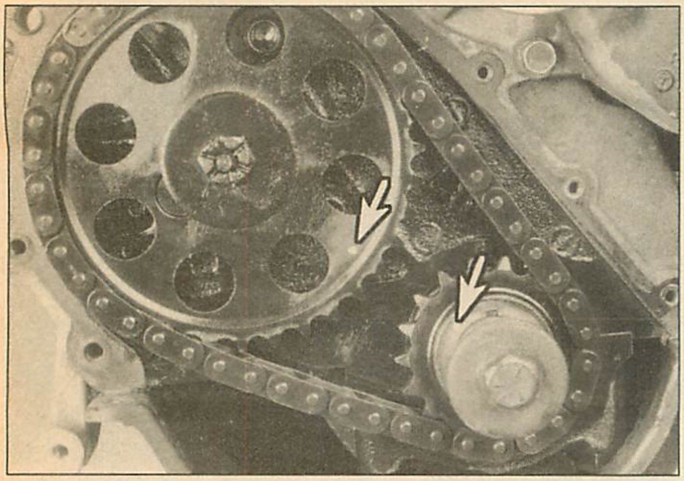
9 Slip the oil slinger off the crankshaft **(see illustration)** and reinstall



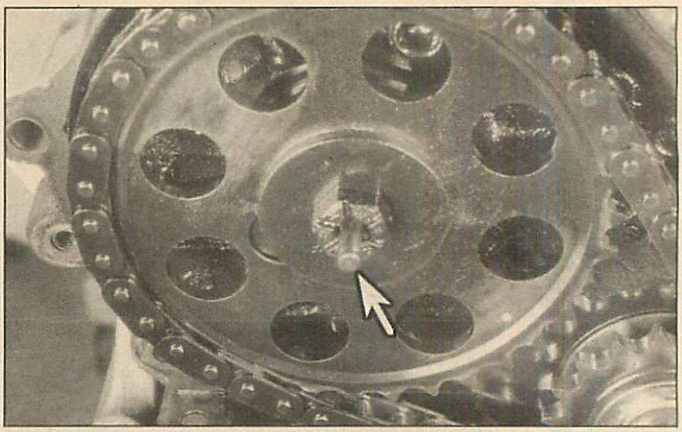
10.7 Cut off the gasket end tabs at both sides where the oil pan and engine block meet



10.9 Slip the oil slinger off the crankshaft, note that the cupped side faces away from the engine



10.12 With the number 1 piston at TDC, the timing chain sprocket index dots (arrows) are directly opposite each other



10.13 Remove the thrust pin and spring (arrow) if equipped, then remove the bolt in the center of the camshaft sprocket - insert a large screwdriver through one of the holes in the sprocket to hold the camshaft

the vibration damper bolt. Using this bolt, rotate the crankshaft clockwise just enough to take up the slack on one side of the chain.

10 Establish a reference point on the block. Move the slack side of the chain toward the center of the engine and make a mark on the block to indicate maximum inward deflection. The difference between the two measurements is the deflection.

11 If the deflection exceeds 3/4-inch, replace the timing chain and sprockets.

12 Align the sprocket timing marks **(see illustration)**.

13 Remove the camshaft sprocket retaining bolt and washer **(see illustration)**. **Note:** *Some models may have a spring-loaded thrust pin at the center of the bolt. Remove the pin and spring.*

14 Pull the crankshaft sprocket, camshaft sprocket and timing chain off as an assembly. **Caution:** *Do not turn the crankshaft or camshaft while the timing chain is removed.*

Installation

Refer to illustrations 10.15a, 10.15b and 10.23

15 Be sure the crankshaft key is still pointing up. Note the locations of the locating dowel on the camshaft and the corresponding hole in the cam sprocket **(see illustrations)**.

16 Pre-assemble the timing chain, crankshaft sprocket and camshaft sprocket with the timing marks aligned and facing out. Slip the assembly onto the engine in such a way that a line drawn through the timing marks will also pass through the centers of the sprockets **(see illustration 10.12)**.

17 Install the camshaft sprocket bolt and washer and tighten it to the torque listed in this Chapter's Specifications. Reinstall the thrust pin and spring, if equipped.

18 Install the crankshaft oil slinger on the crankshaft with the cupped side facing out.

19 Apply RTV sealant to both sides of the new timing chain cover-to-engine block gasket and position the gasket on the engine.

20 Using the end tabs you cut off as guides, trim the replacement oil pan side gasket ends to the appropriate sizes. Apply RTV sealant to the gasket ends and install them on the exposed portions of the oil pan side rails.

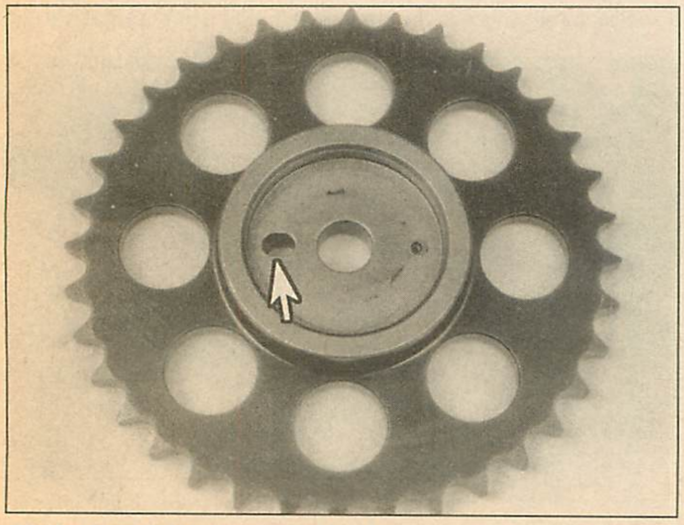
21 Using RTV sealant, generously coat the timing chain cover end tab recesses of the new timing chain cover-to-oil pan seal. Position the seal on the timing chain cover. Apply engine oil to the seal-to-oil pan contact surface.

22 Position the timing chain cover on the engine block.

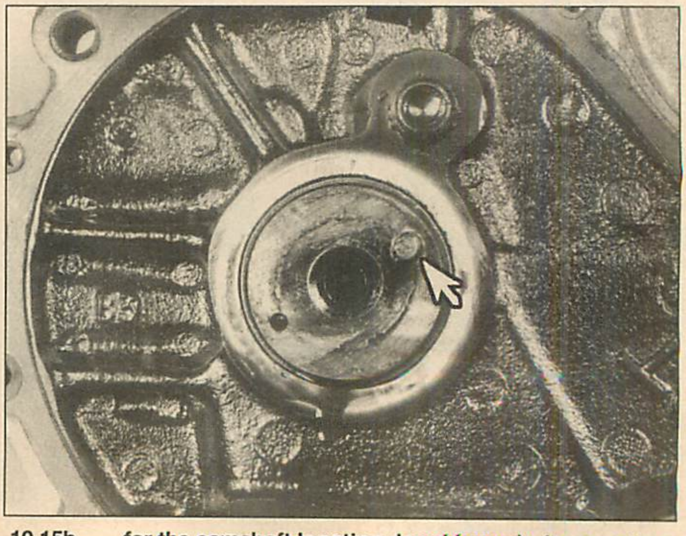
23 Use the vibration damper to center the timing chain cover **(see illustration)**. Be sure the old oil seal (not the new one) is in place, as it may be damaged.

24 Install the timing chain cover-to-block and oil pan-to-cover bolts and tighten them to the torque listed in this Chapter's Specifications.

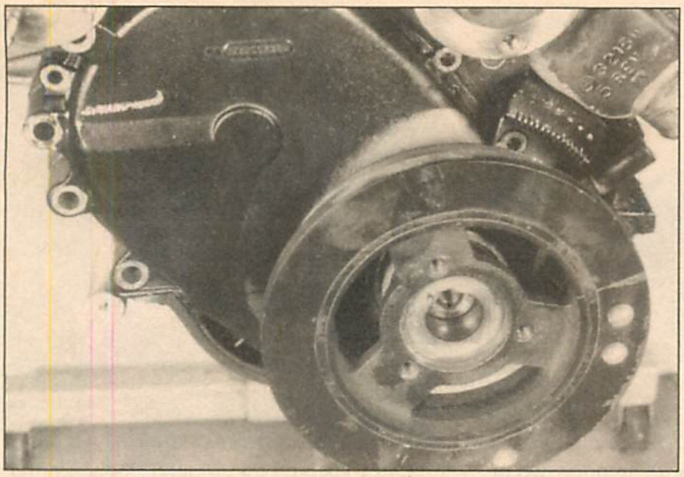
25 Remove the damper and install a new front seal (see Section 9).



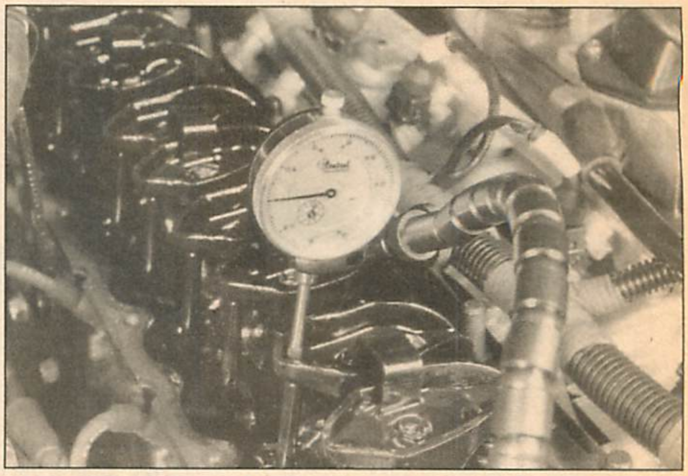
10.15a Note that the engine side of the camshaft sprocket has a hole (arrow) . . .



10.15b . . . for the camshaft locating dowel (arrow) - be sure they are aligned properly during installation



10.23 Temporarily reinstall the damper far enough to center the crankshaft in the timing cover seal before tightening the cover bolts



11.1 When checking the camshaft lobe lift, the dial indicator plunger must be positioned directly above the pushrod

26 With the key inserted in the crankshaft, reinstall the vibration damper as described in Section 9.

27 Reinstall the remaining components in the reverse order of removal.

28 Run the engine and check for oil leaks.

11 Camshaft and lifters - removal, inspection and installation

Camshaft lobe lift check

Refer to illustration 11.1

1 The extent of camshaft wear can be determined by measuring the lobe lift. This procedure does not involve removing the camshaft. With the battery disconnected, the valve cover off and the engine positioned at TDC for number 1 cylinder, mount a dial indicator with the needle contacting the rocker arm directly above the number 1 intake pushrod **(see illustration).**

2 Zero the dial indicator, then rotate the engine by hand while watching the dial. Watch for the highest point reached before the needle stops and starts to turn back again. Record this measurement and check the remainder of the camshaft lobes in the same manner. If any lobe measures 0.005-inch less than that listed in this Chapter's Specifications, the camshaft (and lifters) should be replaced.

Removal

Refer to illustrations 11.9 and 11.11

3 Remove the radiator, fan and fan shroud (see Chapter 3).

4 On models equipped with air conditioning, unbolt the condenser assembly WITHOUT disconnecting the refrigerant lines (see Chapter 3). Set the condenser aside. It may be necessary to remove the battery case (see Chapter 5).

5 Label and then remove the spark plug wires from the spark plugs.

6 Remove the distributor (see Chapter 5).

7 Remove the front bumper and/or grille as necessary (see Chapter 11).

8 Remove the cylinder head (see Section 12).

9 Remove the valve lifters **(see illustration).** Arrange to store them in order so they can be reinstalled in their original locations.

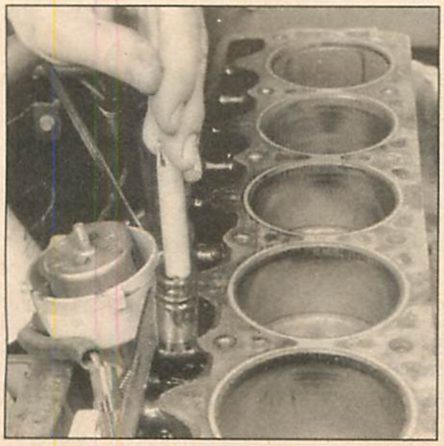
10 Remove the timing chain and sprockets (see Section 10).

11 Carefully withdraw the camshaft from the engine block. Temporarily install a long bolt of the same thread as the sprocket bolt to use as a handle. Support the cam so the lobes don't nick or gouge the bearings as it's withdrawn **(see illustration).**

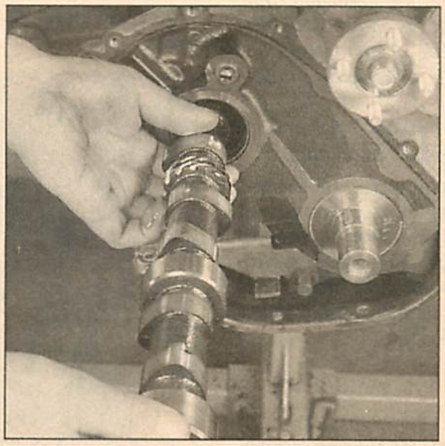
Inspection

Refer to illustrations 11.12a, 11.12b, 11.12c, 11.13a, 11.13b and 11.13c

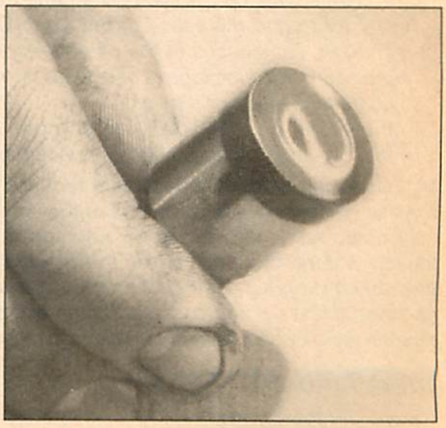
12 Clean the lifters and examine them for signs of wear, scuffing, score marks or wear **(see illustrations).**



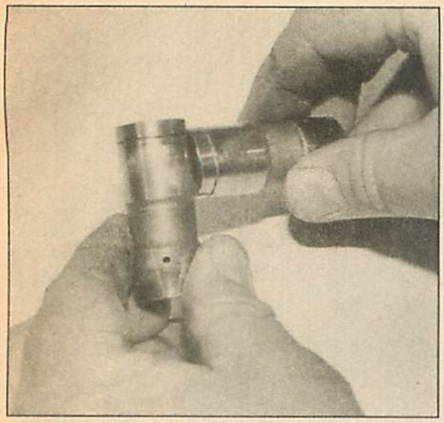
11.9 Remove the lifters with a magnetic pick-up tool (shown here) or a special lifter-removal tool



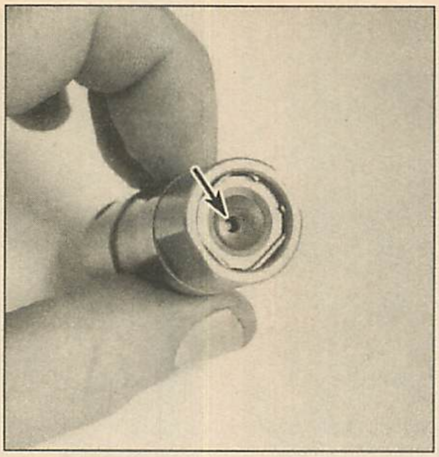
11.11 Support the camshaft near the block and withdraw it carefully to avoid nicking the lobes, journals or bearings



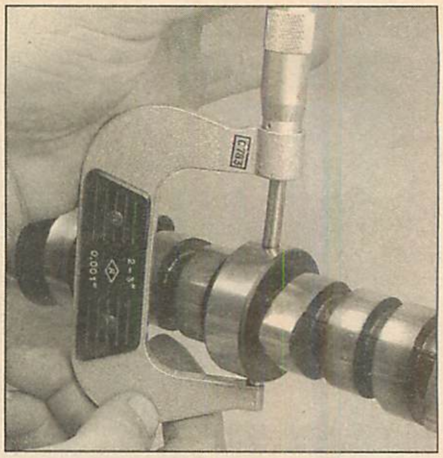
11.12a If the bottom (foot) of any lifter is worn concave (shown here), scratched or galled, replace the entire set of lifters and the camshaft



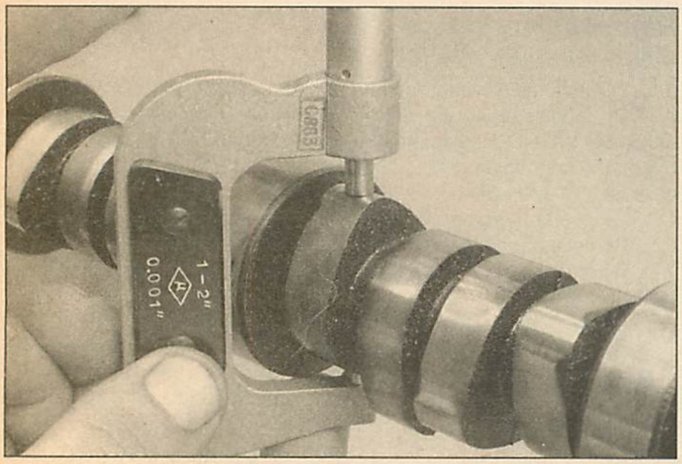
11.12b The side of another lifter can be used as a straightedge to check for wear - the lifter should be slightly convex, if it appears flat, it's worn and must be replaced



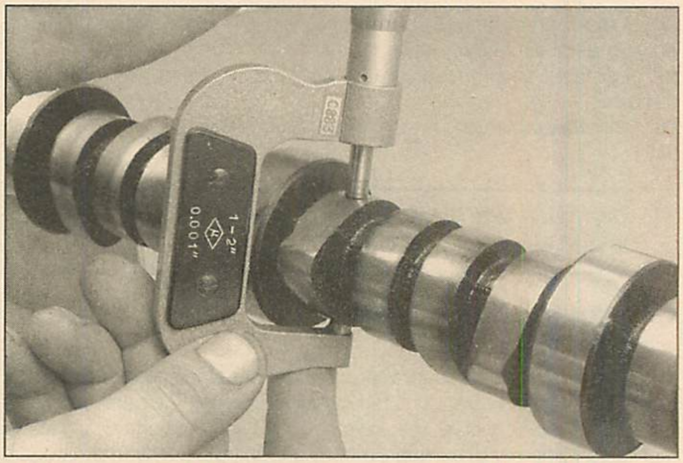
11.12c Check the pushrod seat (arrow) in the top of each lifter for damage or wear



11.13a Using a micrometer, measure the camshaft journals and compare the measurements to Specifications



11.13b Measure the camshaft lobes at their greatest dimension . . .



11.13c . . . and subtract the measurements of the lobe diameter at their smallest dimension to obtain the lobe lift specification

13 Inspect the camshaft for signs of wear. Use a micrometer to measure the lobes and journals and compare the results to this Chapter's Specifications **(see illustrations)**. Check the cam lobes for wear:

a) *Check the toe and ramp areas of each cam lobe for score marks and uneven wear. Also check for flaking and pitting.*
b) *If there's wear on the toe or the ramp, replace the camshaft, but first try to find the cause of the wear. Check the lifters, look for abrasive substances in the oil and inspect the oil pump and oil passages for blockage. Lobe wear is usually caused by inadequate lubrication or dirty oil.*
c) *If the lobe wear is 0.005-inch or more than the lobe lift listed in this Chapter's Specifications, replace the camshaft and lifters.*

14 Camshaft bearing replacement requires special tools and expertise that place it outside the scope of the home mechanic. Remove the engine and take the block to an automotive machine shop to ensure the job is done correctly. **Note:** *If the camshaft sprocket appears to have been rubbing against the timing chain cover, first check the camshaft thrust pin and spring and then examine the oil pressure relief holes in the rear cam journal to make sure they are open.*

Installation

Refer to illustration 11.15

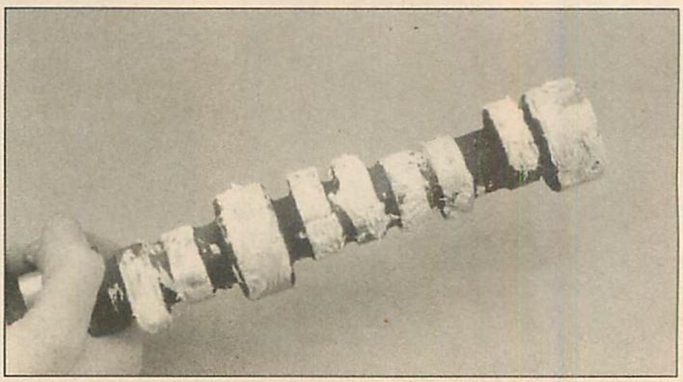
15 Lubricate the camshaft journals and lobes with moly-base grease or engine assembly lube **(see illustration)**.

16 Slide the camshaft into the engine. Support the cam near the block and be careful not to scrape or nick the bearings.

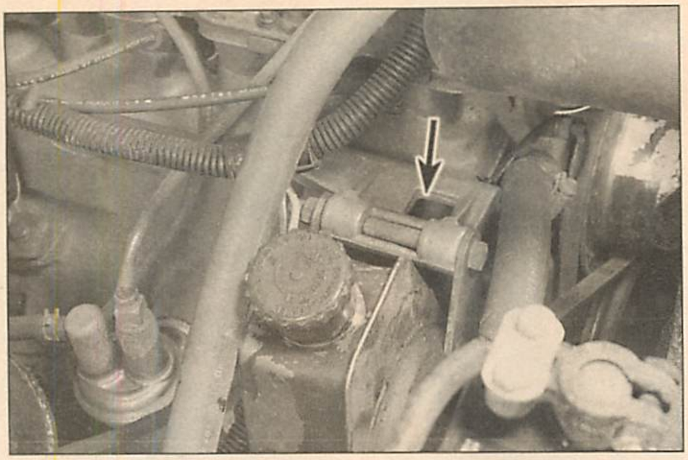
17 The rest of the installation procedure is the reverse of removal.

18 Before starting and running the engine, change the oil and filter (see Chapter 1).

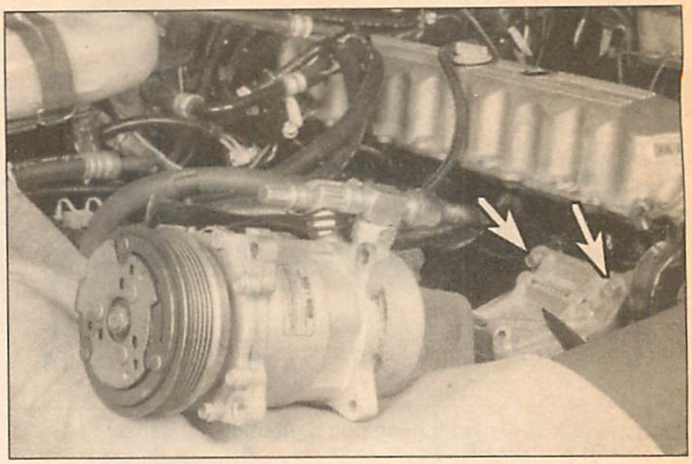
19 If a new camshaft and lifters have been installed, run the engine for 15 to 20 minutes at a high idle (1200 to 1500 rpm) to "break-in" the components, but do not allow the engine to overheat. After breaking-in a new valvetrain, it is important to change the oil and filter after 300 miles.



11.15 Be sure to apply moly-base grease or engine assembly lube to the cam lobes and bearing journals before installing the camshaft



12.6 Unbolt the power steering pump without disconnecting the hoses, then remove the bracket (arrow) from the cylinder head



12.10 Set the air conditioning compressor aside with the refrigerant lines still attached - then remove the upper bracket bolts (arrows)

12 Cylinder head - removal and installation

Refer to illustrations 12.6, 12.10, 12.14, 12.18 and 12.21

Caution: *Allow the engine to cool completely before following this procedure.*

Removal

1 Disconnect the negative cable from the battery.

2 Drain the coolant from the radiator and the engine block (see Chapter 1).

3 Remove the air cleaner assembly (see Chapter 4).

4 Remove the valve cover (see Section 4).

5 Remove the rocker arms and pushrods (see Section 5).

6 Unbolt the power steering pump bracket (if equipped) and set the pump aside without disconnecting the hoses **(see illustration).** Leave the pump upright so fluid doesn't spill.

7 Remove the intake and exhaust manifolds (see Sections 7 and 8).

Models equipped with air-conditioning

8 Remove the bracket on the cylinder head that supports the idler pulley for the air conditioning compressor drivebelt (see Chapter 1).

9 Loosen the alternator drivebelt and remove the alternator bracket-to-cylinder head mounting bolt.

10 Disconnect the wiring harness connector and unbolt the air conditioning compressor (see Chapter 3) without disconnecting the refrigerant hoses. Set the compressor aside and remove the upper two bolts from the bracket **(see illustration).**

All models

11 Label the spark plug wires and remove the distributor cap with the wires attached to it. Remove the spark plugs as described in Chapter 1.

12 Disconnect the wire from the temperature sending unit, which is located at the top left rear corner of the cylinder head. Also disconnect the battery ground cable, if it's attached to the cylinder head.

13 Remove the ignition coil and bracket assembly (see Chapter 5).

14 Remove the heater hose bracket, if equipped **(see illustration).**

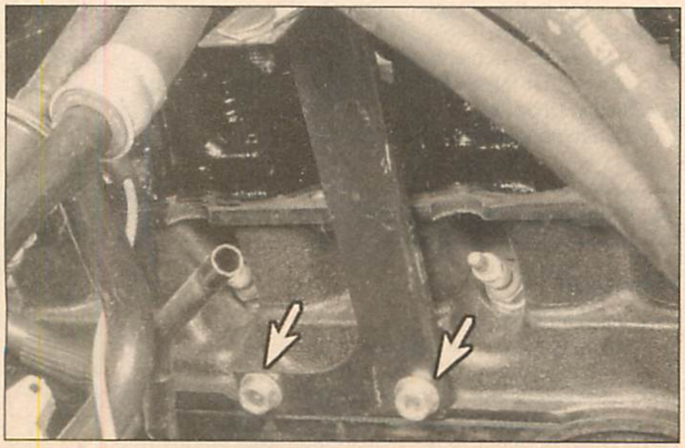
15 Remove the cylinder head bolts and lift the cylinder head off the engine. If the cylinder head sticks to the engine, insert a prybar into an exhaust port and pry gently to break the seal. **Note:** *Use tape or a rubber band to secure bolt number 14* **(see illustration 12.21)** *up and remove it with the cylinder head.*

16 Thoroughly clean the gasket mating surfaces, removing all traces of old gasket material. Stuff shop towels into each cylinder so material doesn't fall in.

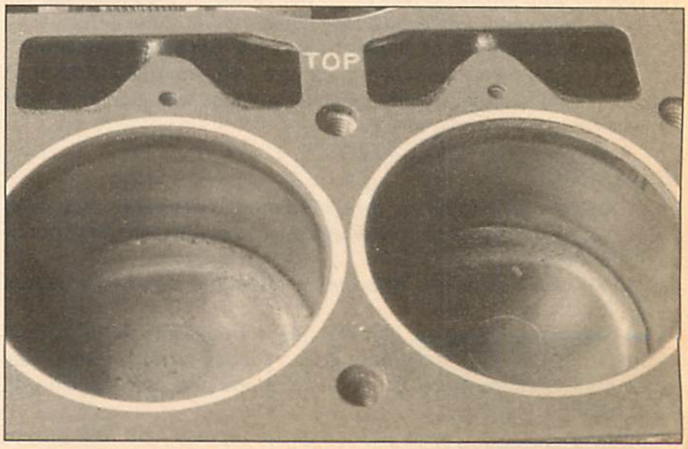
17 Inspect the cylinder head for cracks and warpage. See Chapter 2, Part C, for cylinder head servicing information. If you are replacing the cylinder head, be sure to transfer all fittings, etc. to the new cylinder head.

Installation

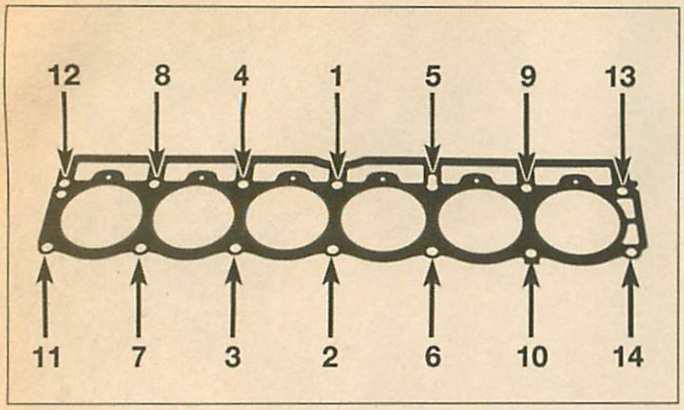
18 If you're installing a metal cylinder head gasket, apply an even coat of gasket sealing compound such as K&W Copper-Coat, or equivalent, to both sides of the gasket. If you're installing a composition gasket, do not use sealant. In any case, follow the gasket set man-



12.14 Remove the two bolts (arrows) to disconnect the heater hose bracket from the cylinder head



12.18 Install the cylinder head gasket with the TOP mark facing up



12.21 Cylinder head bolt tightening sequence

ufacturer's instructions. Position the new cylinder head gasket on the engine block with the word TOP facing up **(see illustration)**.

19 Insert cylinder head bolt number 14 **(see illustration 12.21)** into it's location on the cylinder head and use tape or a rubber band to secure it up so the threads don't protrude below the gasket surface. Install the cylinder head on the engine block and remove the tape or rubber band from bolt number 14.

20 Coat the threads of bolt number 11 **(see illustration 12.21)** with Loctite 592 sealant, or equivalent, and install the cylinder head bolts.

21 Tighten the cylinder head bolts in sequence **(see illustration)** to the torque value listed in this Chapter's Specifications.

22 Reinstall the remaining components in the reverse order of removal.

23 Add coolant and run the engine, checking for coolant or oil leaks.

13 Oil pan - removal and installation

Refer to illustrations 13.6 and 13.8

Removal

1 Disconnect the negative cable from the battery.

2 Raise the vehicle and support it securely on jackstands.

3 Remove the skid plate from under the front of the engine, if equipped.

4 Drain the oil and replace the oil filter (see Chapter 1).

5 Remove the starter motor (see Chapter 5).

6 Mark the locations of any oil pan mounting studs **(see illustration)**.

7 Remove the oil pan mounting bolts/studs and carefully separate the pan from the engine block. If the pan sticks to the block, tap the side of the pan gently with a soft-face mallet.

8 Remove the oil pan by sliding it out to the rear **(see illustration)**.

9 Thoroughly clean the mating surfaces, removing all traces of oil and old gasket material. Finally, clean all surfaces with lacquer thinner or acetone.

Installation

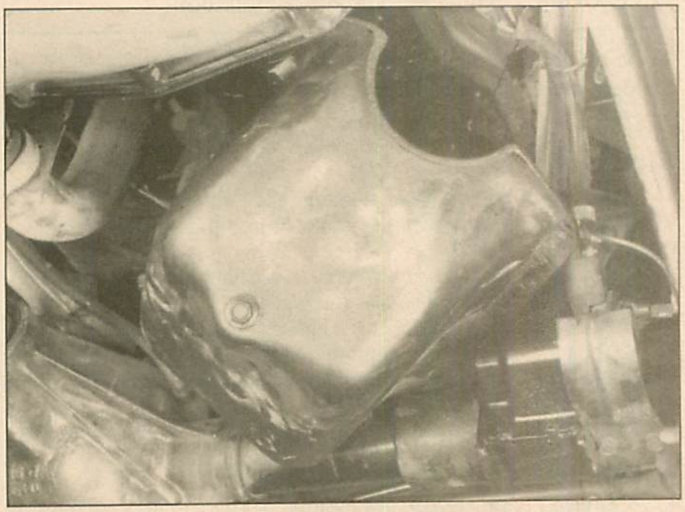
10 Check the oil pan flange for distortion and warpage. Straighten the flange by placing the distorted area on a block of wood and pounding it flat with a hammer.

11 Using gasket adhesive, glue the new front pan seal to the bottom of the timing chain cover.

12 Using gasket adhesive, glue the new side gaskets to the bottom of the block, making sure the front ends interlock with the rubber seal at the front. Coat the areas where the front and side gaskets join with RTV sealant.

13 Coat the inside curved surface of the replacement rear gasket (where it contacts the bearing cap) with a little liquid soap, to allow the gasket to slide into the groove in the rear main bearing cap without tearing. Apply RTV where the side gaskets join the rear rubber seal.

13.6 Mark the locations of the studs with paint to ensure proper reassembly



13.8 Slide and angle the oil pan out to the rear, clearing the axle and the bellhousing

14 Apply RTV sealant to the curved front and rear sealing sections of the oil pan and reinstall the pan over the studs, being careful not to dislodge any of the gaskets during installation. Tighten the bolts to the torque listed in this Chapter's Specifications, working from the center out in several steps.

15 Reinstall the remaining parts in the reverse order of removal.

16 Check that the drain plug is tight and then add the amount of oil specified in Chapter 1.

17 Run the engine and check for oil leaks.

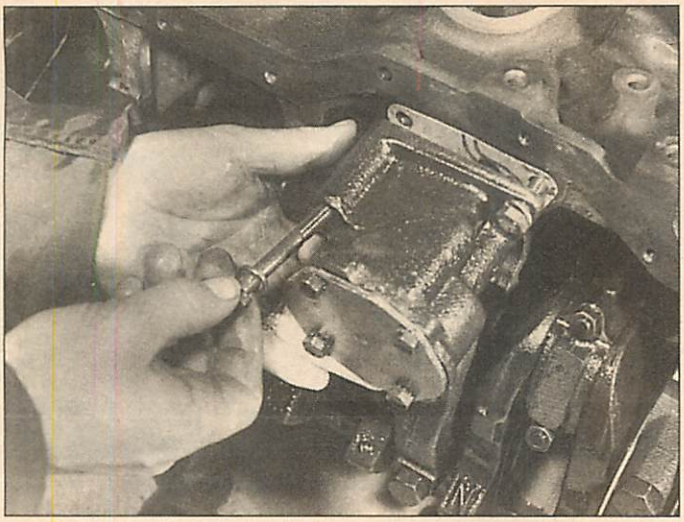
14 Oil pump - removal and installation

Removal

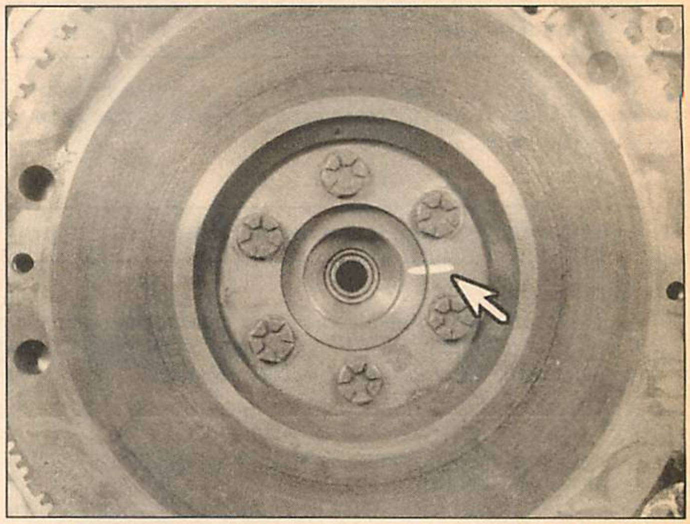
Refer to illustration 14.2

1 Remove the oil pan (see Section 13).

2 While supporting the oil pump, remove the oil pump-to-block bolts and pull the pump and pickup carefully out from under the vehicle **(see illustration)**. **Caution:** *Do not disturb the relationship of the pickup tube to the oil pump body. If the pickup tube is bent or turned, the seal between them may be broken and the pump/pickup should be replaced.*



14.2 Remove the two oil pump-to-block mounting bolts and lower the oil pump assembly from the engine



15.3 Before removing the flywheel, index it to the crankshaft with paint marks (arrow)

3 Lower the pump and pickup screen assembly from the vehicle and clean the gasket surfaces.

Installation

4 If the pump is defective, do not attempt to repair or rebuild it, install a new unit. Prime the pump by pouring clean motor oil into the pickup tube, while turning the pump shaft by hand.
5 Position the pump on the engine with a new gasket and turn the shaft so that the gear tang mates with the slot on the lower end of the distributor drive. If it doesn't, pull it off and turn the tang until it is aligned.
6 Install the mounting bolts and tighten them to the torque listed in this Chapter's Specifications.
7 Install the oil pan and add oil.
8 Run the engine and check for oil pressure and leaks.

15 Flywheel/driveplate - removal and installation

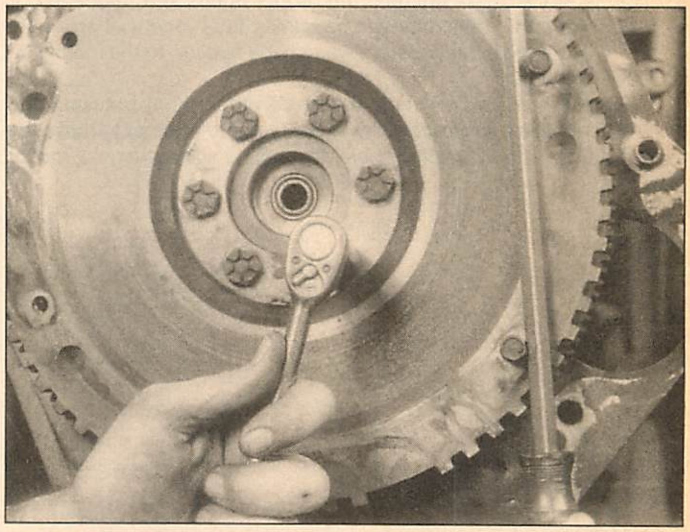
Removal

Refer to illustrations 15.3 and 15.4

1 Raise the vehicle and support it securely on jackstands, then refer to Chapter 7 and remove the transmission. Support the engine by using a floorjack under the oil pan, with a block of wood between the jack and the pan.
2 If you're working on a model equipped with a manual transmission, remove the pressure plate and clutch disc (see Chapter 8). Now is a good time to check/replace the clutch components and pilot bearing.
3 Use paint or a center punch to make alignment marks on the flywheel/driveplate and crankshaft to ensure correct alignment during reinstallation **(see illustration)**.
4 Remove the bolts that secure the flywheel/driveplate to the crankshaft. If the crankshaft turns, hold the flywheel/driveplate with a prybar or wedge a screwdriver into the ring gear teeth **(see illustration)**.
5 Remove the flywheel/driveplate from the crankshaft. If you're removing a flywheel, be careful because it's fairly heavy. Be sure to support it while removing the last bolt. **Caution:** *The teeth may be sharp, wear gloves or use rags to protect your hands.*

Inspection

6 Clean the flywheel to remove grease and oil. Inspect the surface for cracks, rivet grooves, burned areas and score marks. Light scoring



15.4 To prevent to flywheel from turning, hold a pry bar against two clutch bolts (shown) or wedge a large screwdriver into the flywheel ring-gear teeth

can be removed with emery cloth. Check for cracked and broken ring gear teeth. **Note:** *On automatic transmission-equipped vehicles, the ring gear teeth are part of the torque converter. Check the condition of the teeth before reassembly.* Lay the flywheel on a flat surface and use a straightedge to check for warpage. If any defects are evident, take the flywheel to an automotive machine shop to have it resurfaced. Clean and inspect the mating surfaces of the flywheel/driveplate and the crankshaft.

Installation

7 Position the flywheel/driveplate against the crankshaft. Align the marks made during removal. Note that some models have an alignment dowel or staggered bolt holes to ensure correct installation. Before installing the bolts, apply thread-locking compound to the threads.
8 Wedge a screwdriver in the ring gear teeth to keep the flywheel/driveplate from turning as you tighten the bolts to the torque listed in this Chapter's Specifications. Follow a criss-cross pattern and work up to the final torque in three or four steps.
9 The remainder of installation is the reverse of the removal procedure.

16 Rear main oil seal - replacement

The procedure for replacement of the rear main seal in six-cylinder engines is identical to the procedures for the V8 engine. Refer to Part B of this Chapter.

17 Engine mounts - check and replacement

Refer to illustration 17.7

1 Engine mounts seldom require attention, but broken or deteriorated mounts should be replaced immediately or the added strain placed on the driveline components may cause damage.

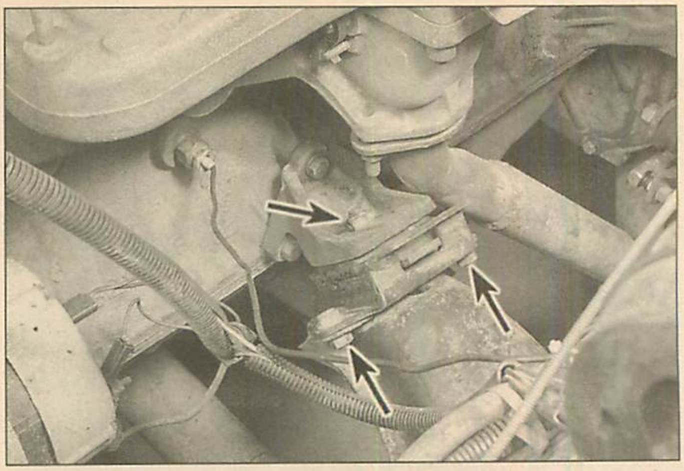
Check

2 During the check, the engine must be raised slightly to remove the weight from the mounts.

3 Raise the vehicle and support it securely on jackstands, then position a jack under the engine oil pan. Place a large block of wood between the jack head and the oil pan, then carefully raise the engine just enough to take the weight off the mounts.

4 Check the mounts to see if the rubber is cracked, hardened or separated from the metal plates. Sometimes the rubber will split right down the center. Rubber preservative may be applied to the mounts to slow deterioration.

5 Check for relative movement between the mount brackets and the engine or (use a large screwdriver or pry bar to attempt to move the mounts). If movement is noted, lower the engine and tighten the mount fasteners.



17.7 Typical engine mount bolt locations (arrows)

Replacement

6 Disconnect the cable from the negative battery terminal. Raise the vehicle and support it securely on jackstands.

7 Remove the insulator-to-engine-bracket stud nut **(see illustration)**.

8 Place a jack and wood block under the crankshaft pulley and raise the engine slightly. Unbolt the insulator from the chassis bracket and remove the insulator.

9 Installation is the reverse of removal. Tighten the engine mount nuts to the torque listed in this Chapter's Specifications.

Chapter 2 Part B
V8 engines

Contents

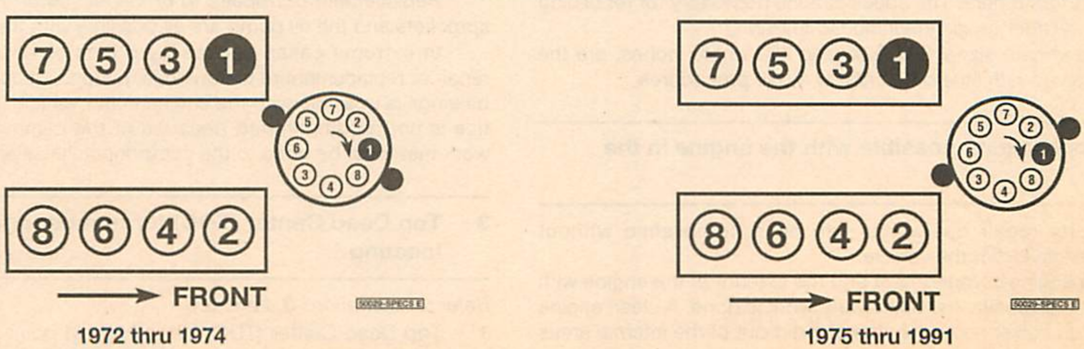
Specifications

General

Firing order	1-8-4-3-6-5-7-2
Cylinder numbers (front-to-rear)	
Left (driver's) side	1-3-5-7
Right side	2-4-6-8
Bore and stroke	
304 cubic inch	3.75 x 3.44 inches
360 cubic inch	4.08 x 3.44 inches
401 cubic inch	4.165 x 3.68 inches
Distributor rotation (viewed from above)	Clockwise
Minimum compression	120 to 140 psi
Maximum variation between cylinders	30 psi
Oil pressure	
Idle	13 psi
1600 rpm	37 to 75 psi

Camshaft

Journal diameter	
Journal number 1	2.1195 to 2.1205 inches
Journal number 2	2.0895 to 2.0905 inches
Journal number 3	2.0595 to 2.0605 inches
Journal number 4	2.0295 to 2.0305 inches
Journal number 5	1.9995 to 2.0005 inches
End play (engine operating)	Zero
Lobe lift	
304 and 360	0.266 inch
401	0.286 inch



Cylinder location and distributor rotation

Oil pump

Gear-to-body clearance	0.0005 to 0.0025 inch
Gear end clearance	0.004 to 0.008 inch

Torque specifications*

	Ft-lbs (unless otherwise indicated)
Camshaft sprocket bolt	30
Cylinder head bolts	110
Engine mount-insulator to frame nuts	
1972 through 1979	33
1980 through 1988	37
1989 and later	33
Engine mount insulator to block nuts	
1972 through 1979	33
1980 through 1988	35
1989 and later	33
Exhaust manifold bolts	
1972 and 1973	32
1974 through 1978	25
1979 and later	
Center 2 bolts	25
Outer 4 bolts	15
Flywheel/driveplate bolts	105
Front cover bolts	25
Intake manifold bolts	43
Oil pan bolts	
1/4-inch bolts	84 in-lbs
5/16-inch bolts	132 in-lbs
Oil pump cover bolts	55 in-lbs
Rocker arm bolts	
1972 and 1973	21
1974 and later	19
Main bearing cap bolts	100
Pulley-to-damper bolts	23
Valve cover bolts	50 in-lbs
Vibration damper-to-crankshaft bolt	
1972 through 1976	55
1977 and later	90

***Note:** *Refer to Part C for additional specifications*

1 General information

This Part of Chapter 2 is devoted to in-vehicle repair procedures for the AMC/Jeep V8 engines. All information concerning engine removal and installation and engine block and cylinder head overhaul can be found in Part C of this Chapter.

Since the repair procedures included in this Part are based on the assumption that the engine is still installed in the vehicle, if they are being used during a complete engine overhaul (with the engine already out of the vehicle and on a stand) many of the steps included here will not apply.

The specifications included in this Part of Chapter 2 apply only to the procedures found here. The specifications necessary for rebuilding the block and cylinder heads are included in Part C.

The three engine sizes, 304, 360 and 401 cubic inches, are the same engine family with little difference in repair procedures.

2 Repair operations possible with the engine in the vehicle

Many major repair operations can be accomplished without removing the engine from the vehicle.

Clean the engine compartment and the exterior of the engine with some type of pressure washer before any work is done. A clean engine will make the job easier and will help keep dirt out of the internal areas of the engine.

Depending on the components involved, it may be a good idea to remove the hood to improve access to the engine as repairs are performed (refer to Chapter 11 if necessary).

If oil or coolant leaks develop, indicating a need for gasket or seal replacement, the repairs can generally be made with the engine in the vehicle. The oil pan gasket, the cylinder head gaskets, intake and exhaust manifold gaskets, front cover gaskets and the crankshaft oil seals are all accessible with the engine in place.

Exterior engine components, such as the water pump, the starter motor, the alternator, the distributor and the carburetor, as well as the intake and exhaust manifolds, can be removed for repair with the engine in place.

Since the cylinder heads can be removed without pulling the engine, valve component servicing can also be accomplished with the engine in the vehicle.

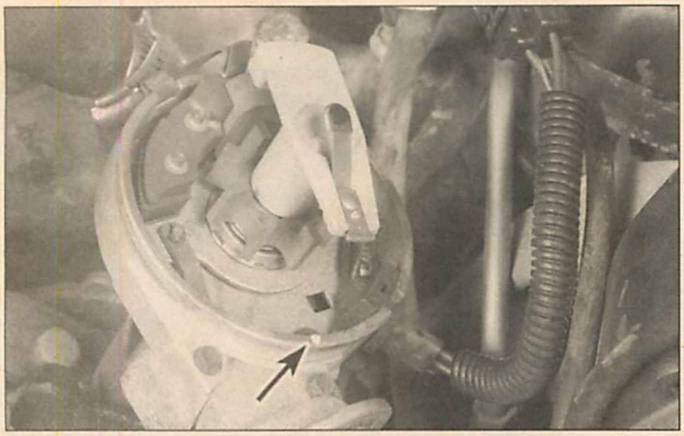
Replacement of, repairs to or inspection of the timing chain and sprockets and the oil pump are all possible with the engine in place.

In extreme cases caused by a lack of necessary equipment, repair or replacement of piston rings, pistons, connecting rods and rod bearings is possible with the engine in the vehicle. However, this practice is not recommended because of the cleaning and preparation work that must be done to the components involved.

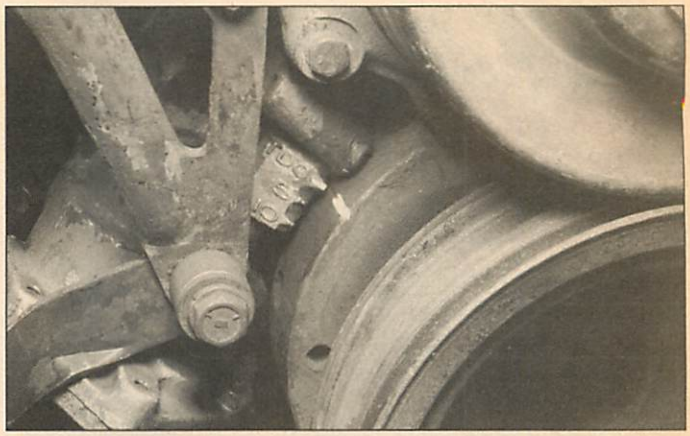
3 Top Dead Center (TDC) for number one piston - locating

Refer to illustrations 3.4 and 3.6

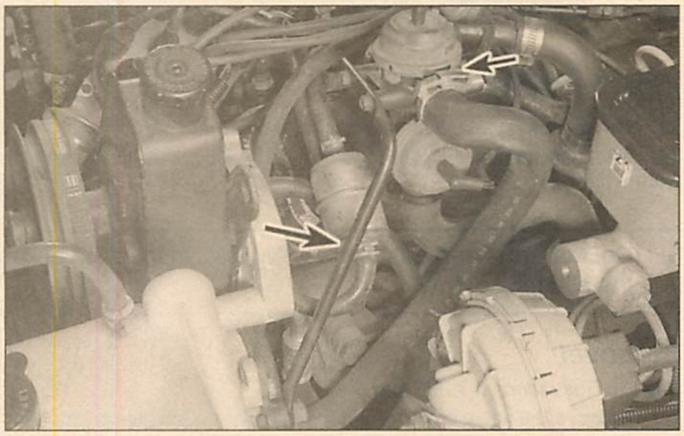
1 Top Dead Center (TDC) is the highest point in the cylinder that each piston reaches as it travels up the cylinder bore. Each piston reaches TDC on the compression stroke and again on the exhaust stroke, but TDC generally refers to piston position on the compression



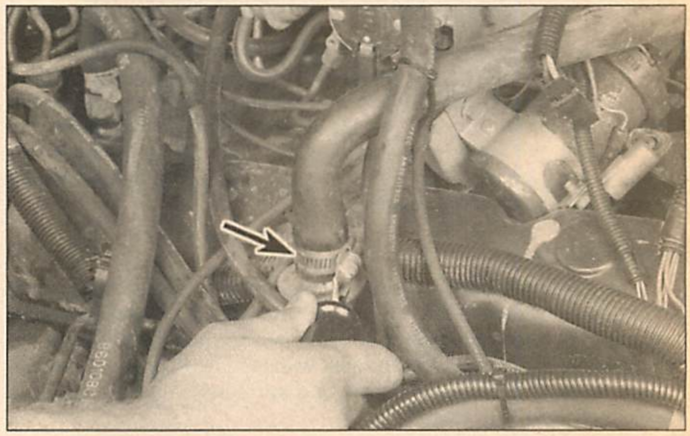
3.4 Mark the base of the distributor below the number one spark plug terminal (arrows)



3.6 Align the groove on the damper with the "0" or "TDC" mark on the front cover



4.3 Disconnect the hoses to the diverter valve (larger arrow) and unbolt the brace (small arrow) to move it out of the way for valve cover removal



4.4 Disconnect the AIR hose (arrow) when removing the right valve cover

stroke. The timing marks are referenced to the number one piston at TDC on the compression stroke.

2 Positioning the pistons at TDC is an essential part of many procedures such as camshaft removal, timing chain replacement and distributor removal.

3 In order to bring any piston to TDC, the crankshaft must be turned using one of the methods outlined below. When looking at the front of the engine, normal crankshaft rotation is clockwise. **Warning:** *Before beginning this procedure, be sure to place the transmission in Neutral and disable the ignition system by disconnecting the coil wire from the distributor cap and grounding it on the engine block.*

a) *The preferred method is to turn the crankshaft with a large socket and breaker bar attached to the large bolt that is threaded into the front of the crankshaft.*

b) *A remote starter switch, which may save some time, can also be used. Attach the switch leads to the S (switch) and B (battery) terminals on the starter solenoid. Once the piston is close to TDC, use a socket and breaker bar as described in the previous paragraph.*

c) *If an assistant is available to turn the ignition switch to the Start position in short bursts, you can get the piston close to TDC without a remote starter switch. Use a socket and breaker bar as described in Paragraph (a) to complete the procedure.*

4 Scribe or paint a small mark on the distributor body directly below the number one spark plug wire terminal in the distributor cap **(see illustration)**.

5 Remove the distributor cap as described in Chapter 1.

6 Turn the crankshaft (see Step 3 above) until the line on the vibration damper is aligned with the zero or "TDC" mark on the timing indicator **(see illustration)**.

7 The rotor should now be pointing directly at the mark on the distributor. If it is 180-degrees off, the piston is at TDC on the exhaust stroke.

8 If the rotor is 180-degrees off, turn the crankshaft one complete turn (360-degrees) clockwise. The rotor should now be pointing at the mark. When the rotor is pointing at the number-one spark plug wire terminal in the distributor cap (which is indicated by the mark on the distributor body) and the timing marks are aligned, the number one piston is at TDC on the compression stroke.

9 After the number one piston has been positioned at TDC on the compression stroke, TDC for any of the remaining cylinders can located by rotating the engine in the normal direction of rotation until the rotor is pointing to the spark plug wire terminal in the distributor cap for the piston you wish to bring to TDC.

4 Valve covers - removal and installation

Removal

Refer to illustrations 4.3, 4.4 and 4.6

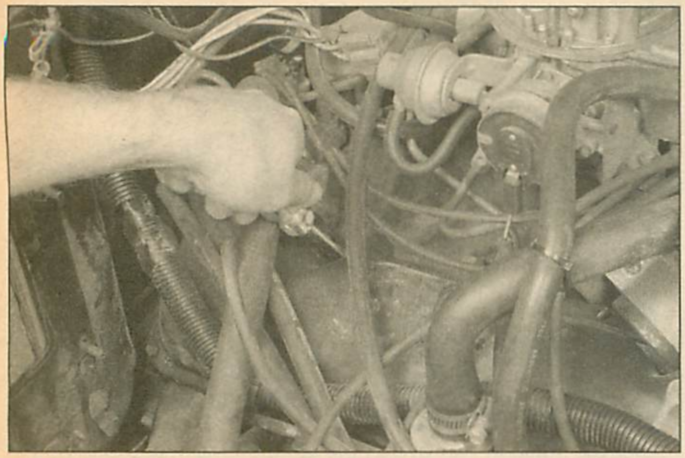
1 Disconnect the battery cable from the negative battery terminal.

2 Remove the air cleaner assembly (see Chapter 4).

3 Detach any air injection (AIR) system components that are in the way, if equipped (see Chapter 6). The diverter valve will have to be relocated if you're removing the left valve cover **(see illustration)**.

4 Remove the AIR hose for clearance to remove the right valve cover **(see illustration)**.

5 Label the spark plug wires and position the brackets/wires out of the way.



4.6 Remove the valve cover mounting bolts - some fasteners are studs, mark their location with paint before removal

6 Remove the valve cover mounting bolts **(see illustration)**.

7 Remove the valve cover. **Note:** *If the cover is stuck to the cylinder head, bump the cover with a block of wood and a hammer to release it. If it still will not come loose, try to slip a flexible putty knife between the cylinder head and cover to break the seal. Don't pry at the cover-to-cylinder head joint, as damage to the sealing surface and cover flange will result and oil leaks will develop.*

Installation

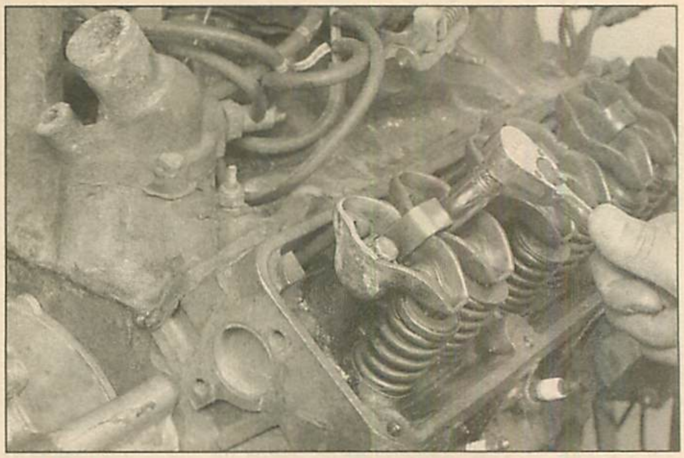
8 The mating surfaces of each cylinder head and valve cover must be perfectly clean when the covers are installed. Use a gasket scraper to remove all traces of sealant or old gasket material, then wipe the mating surfaces with a cloth saturated with lacquer thinner or acetone. If there is sealant or oil on the mating surfaces when the cover is installed, oil leaks may develop.

9 Make sure any threaded holes are clean. Run a tap into them to remove corrosion and restore damaged threads.

10 Mate the new gaskets to the valve covers engaging the tabs into the slots in the valve cover. Use gasket adhesive to retain the gasket on the valve cover if necessary. **Note:** *On many later models, RTV sealant is used instead of a gasket. Apply a uniform bead of RTV sealant around the perimeter of the valve cover and around the bolt holes. Allow it to set up for approximately five minutes before installing the cover.*

11 Carefully position the cover on the cylinder head and install the nuts/bolts.

12 Tighten the bolts/nuts in three steps to the torque listed in this



5.2 Alternate between the intake and exhaust rocker arms, loosening each bolt 1/4-turn at a time until they can be removed by hand

Chapter's Specifications. **Caution:** *DON'T over-tighten the valve cover fasteners.*

13 The remaining installation steps are the reverse of removal.

14 Start the engine and check carefully for oil leaks as the engine warms up.

5 Rocker arms and pushrods - removal, inspection and installation

Removal

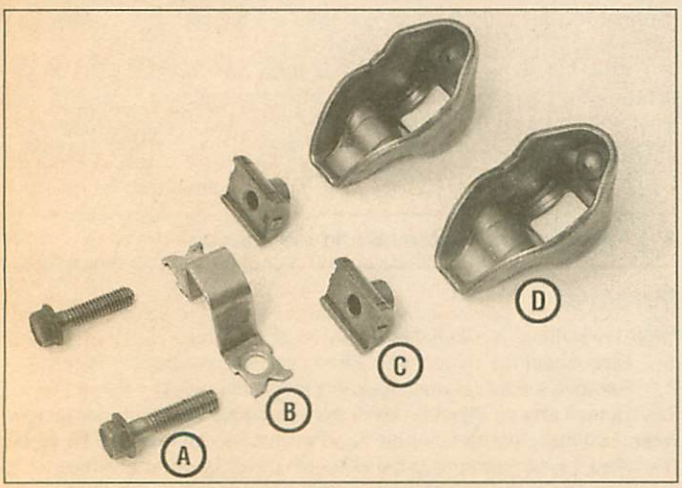
Refer to illustrations 5.2, 5.3 and 5.4

1 Remove the valve covers from the cylinder heads (see Section 4).

2 Beginning at the front of the cylinder head, loosen and remove the rocker arm mounting bolts in pairs **(see illustration)**. Alternate between each of the bolts on a pair, loosening each one a little at a time.

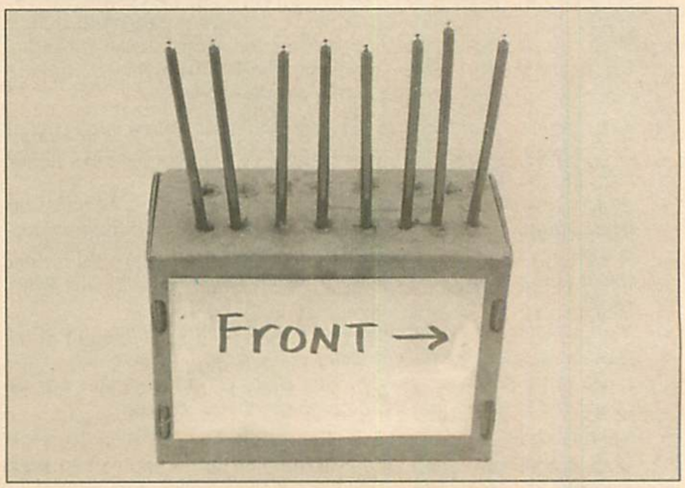
3 Remove the rocker arms, bridges and fulcrums **(see illustration)** and store them with their respective mounting bolts. Store each set of rocker arm components separately in a marked plastic bag to ensure they are reinstalled in their original locations.

4 Remove the pushrods and store them separately to make sure they don't get mixed up during installation **(see illustration)**. **Caution:** *All valve train components must go back in their original position. Organize and store the parts in a way that they won't get mixed up.*

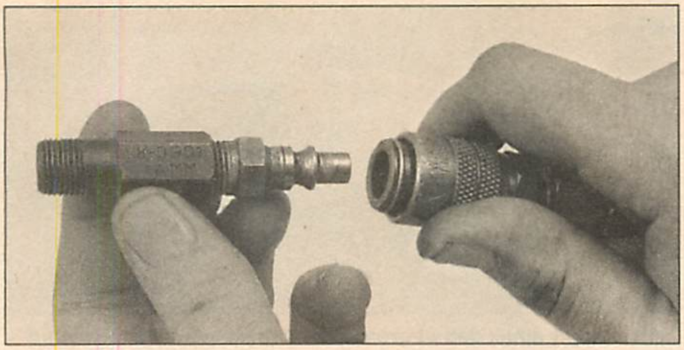


5.3 Rocker arm components

A Bolt
B Bridge
C Fulcrum
D Rocker arm



5.4 A perforated cardboard box can be used to store the pushrods to ensure that they're reinstalled in their original locations - note the label indicating the front of the engine



6.5 This is what the air hose adapter that fits into the spark plug hole looks like - they're commonly available from auto parts stores

Inspection

5 Check each rocker arm for wear, cracks and other damage, especially where the pushrods and valve stems contact the rocker arm faces. Also check the rocker-arm fulcrums for wear. **Note:** *Keep in mind that there is no valve adjustment on these engines, so excessive wear or damage in the valve train can easily result in excessive valve clearance, which in turn will cause valve "tapping" or "clattering" noises when the engine is running.*

6 Inspect the pushrods for cracks and excessive wear at the ends. Roll each pushrod across a flat surface such as a plate of glass to see if it is bent (if it wobbles, it is bent). Replace the pushrods if any of these conditions are present.

Installation

7 Lubricate the lower end of each pushrod with clean engine oil or moly-base grease or engine assembly lube and install them in their original locations. Make sure each pushrod seats completely in the lifter socket.

8 Apply moly-base grease or engine assembly lube to the ends of the valve stems and the upper ends of the pushrods before positioning the rocker arms over the studs. Lubricate and replace the fulcrums on their respective rockers and install the bridges and hand-tighten the bolts.

9 Tighten the rocker-arm bolts evenly, in several stages, alternating between the intake and exhaust. Tighten the bolts to the torque listed in this Chapter's Specifications.

10 Refer to Section 4 and install the valve covers. Start the engine, listen for unusual valve train noise and check for oil leaks at the valve cover joints.

6 Valve springs, retainers and seals - replacement

Refer to illustrations 6.5, 6.7, 6.14, 6.15 and 6.17

Note: *Broken valve springs and defective valve stem seals can be replaced without removing the cylinder head. Two special tools and a compressed-air source are normally required to perform this operation, so read through this Section carefully and rent or buy the tools before beginning the job.*

1 Remove the valve covers (see Section 4).

2 Remove the spark plugs (see Chapter 1).

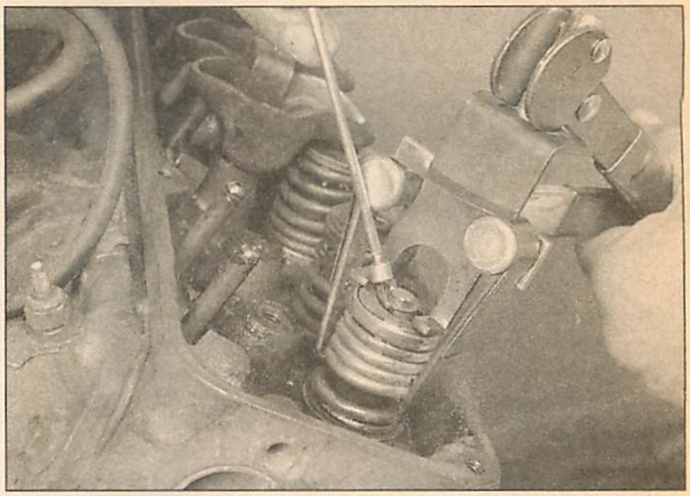
3 Turn the crankshaft until the number one piston is at top dead center on the compression stroke (see Section 3).

4 Remove the rocker arms (see Section 5).

5 Thread an adapter into the spark plug hole and connect an air hose from a compressed air source to it **(see illustration)**. Most auto parts stores can supply the air hose adapter. **Note:** *Many cylinder compression gauges utilize a screw-in fitting that may work with your air hose quick-disconnect fitting.*

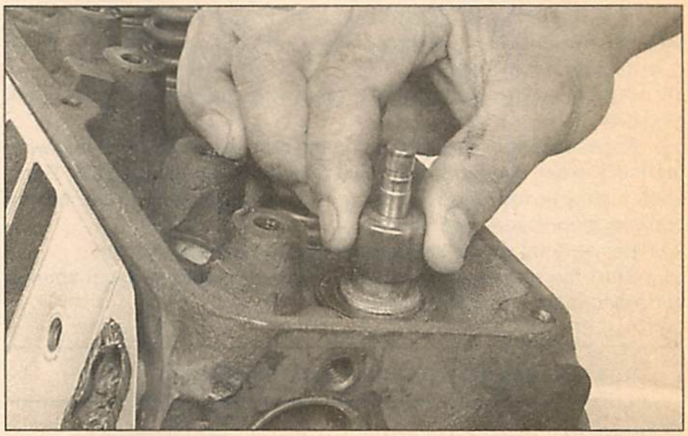
6 Apply compressed air to the cylinder. The valves should be held in place by the air pressure. **Warning:** *If the cylinder isn't exactly at TDC, air pressure may cause the engine to rotate. Do not leave a socket or wrench on the balancer bolt; damage or personal injury may result.*

7 Stuff shop rags into the cylinder head holes around the valves to prevent parts and tools from falling into the engine, then use a valve-spring compressor to compress the spring. Remove the keepers with small needle-nose pliers or a magnet **(see illustration)**. **Note:** *Several different types of tools are available for compressing the valve springs with the cylinder head in place. One type, shown here, grips the lower spring coils and presses on the retainer as the handles are squeezed together, while the lever-type mounts on the rocker arm stud for leverage. Both types work very well, although the lever type is usually less expensive.*



6.7 Once the spring is depressed, the keepers can be removed with a small magnet or needle-nose pliers (a magnet is preferred to prevent dropping the keepers)

2B



6.14 Push the new seal down over the valve guide by hand

8 Remove the valve spring and retainer (intake valve) or rotator (exhaust valve). **Note:** *If air pressure fails to hold the valve in the closed position during this operation the valve face and/or seat is probably damaged. If so, the cylinder head will have to be removed for repair.*

9 Remove the old valve stem seals.

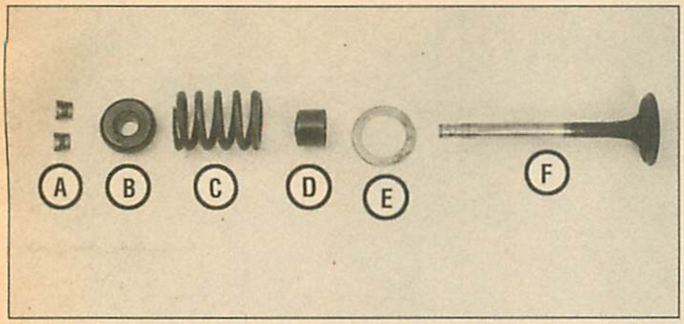
10 Wrap a rubber band or tape around the top of the valve stem so the valve won't fall into the combustion chamber, then release the air pressure.

11 Inspect the valve stem for damage. Rotate the valve in the guide and check the end for eccentric movement, which would indicate that the valve is bent.

12 Move the valve up-and-down in the guide and make sure it doesn't bind. If the valve stem binds, either the valve is bent or the guide is damaged. In either case, the cylinder head will have to be removed for repair.

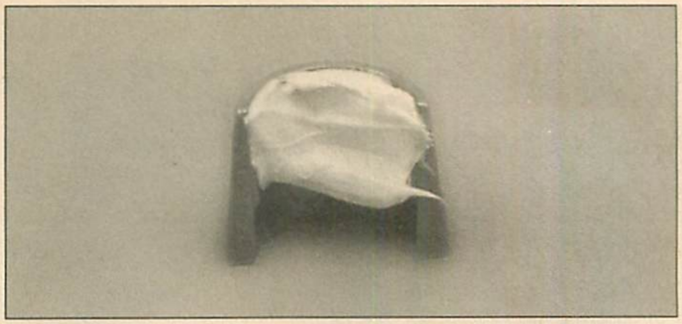
13 Reapply air pressure to the cylinder to retain the valve in the closed position, then remove the tape or rubber band from the valve stem.

14 Push a new valve stem seal down over the valve guide, using the valve stem as a guide, but don't force the seal against the top of the guide **(see illustration)**.



6.15 Valve assembly components

A Keepers
B Retainer/rotator
C Valve spring
D Valve stem seal
E valve spring seat shim
F Valve



6.17 Apply small dab of grease to each keeper as shown here before installation - it'll hold them in place on the valve stem as the spring is released

15 Install the spring and retainer or rotator in position over the valve. If a shim was in place under the spring, replace it **(see illustration)**.

16 Compress the valve spring assembly only enough to install the keepers in the valve stem.

17 Position the keepers in the valve stem groove. Apply a small dab of grease to the inside of each keeper to hold it in place if necessary **(see illustration)**. Remove the pressure from the spring tool and make sure the keepers are seated.

18 Disconnect the air hose and remove the adapter from the spark plug hole.

19 Repeat the above procedure on the remaining cylinders, following the firing order sequence (see this Chapter's Specifications). Bring each piston to top dead center on the compression stroke before applying air pressure (see Section 3).

20 Reinstall the rocker arm assemblies and the valve covers.

21 Start the engine, then check for oil leaks and unusual sounds coming from the valve cover area.

7 Intake manifold - removal and installation

Removal

Refer to illustrations 7.8a and 7.8b

1 Disconnect the battery cable from the negative battery terminal.

2 Drain the cooling system (see Chapter 1).

3 Remove the air cleaner assembly. **Note:** *If you intend to replace the intake manifold, remove the carburetor* (see Chapter 4). Refer to Chapter 5 and remove the ignition coil.

4 Remove the upper mounting bracket for the air conditioning compressor (see Chapter 3). **Caution:** *DO NOT disconnect the refrigerant lines.*

5 Label and disconnect the fuel lines, wiring harness and vacuum hoses connected to the intake manifold or carburetor.

6 Disconnect the upper radiator hose and the heater hose mounted to the rear of the intake manifold (see Chapter 3). On models so equipped, refer to Chapter 6 for disconnecting the EGR valve at the rear of the intake manifold.

7 Disconnect the accelerator linkage (see Chapter 4) and, if equipped, the cruise control linkage. On models with automatic transmissions, disconnect the throttle rod at the carburetor (see Chapter 7B).

8 Loosen the intake manifold mounting bolts **(see illustration)** in 1/4-turn increments until they can be removed by hand. The intake manifold will probably be stuck to the cylinder heads and force may be required to break the gasket seal. A pry bar can be positioned to pry up on a casting projection at the front of the manifold **(see illustration)** to break the gasket bond. **Caution:** *Do not pry between the manifold and the cylinder heads or damage to the gasket-sealing surfaces may result and leaks could develop.*

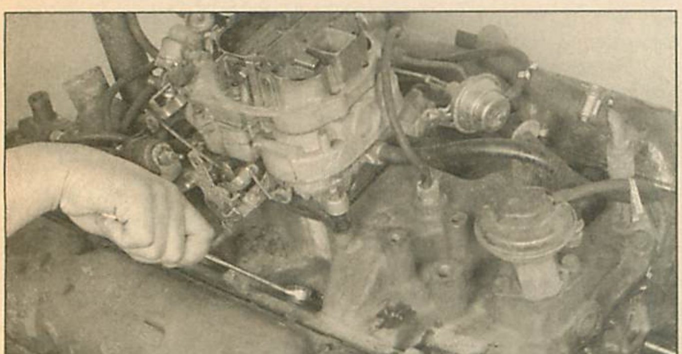
9 Remove the intake manifold. As the manifold is lifted from the engine, be sure to check for and disconnect anything still attached to the manifold.

Installation

Refer to illustrations 7.10, 7.13 and 7.14

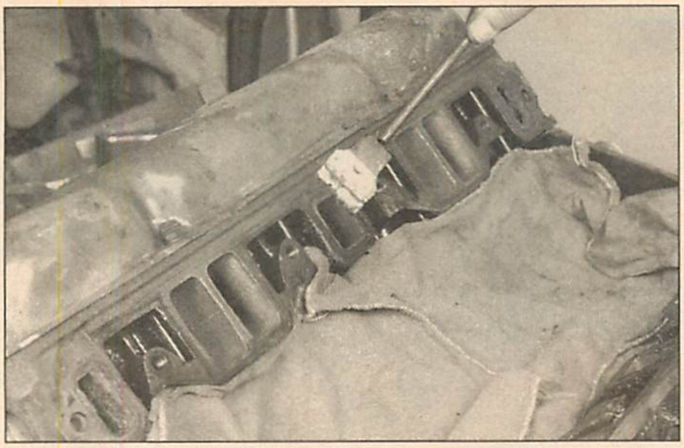
Note: *The mating surfaces of the cylinder heads, block and manifold must be perfectly clean when the manifold is installed. Gasket removal solvents in aerosol cans are available at most auto parts stores and may be helpful when removing old gasket material that is stuck to the cylinder heads and manifold. Be sure to follow the directions printed on the container.*

10 Remove carbon deposits from the exhaust crossover passages. Use a gasket scraper to remove all traces of sealant and old gasket

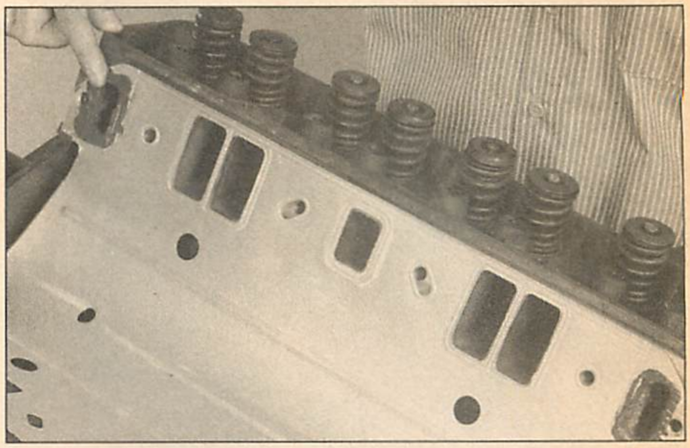


7.8a Remove the intake manifold-to-cylinder head bolts - keep track of any brackets that may be located under the bolts

7.8b Pry up on a casting protrusion, if necessary (arrow)



7.10 Cover the lifter valley with rags while scraping the old gasket material from the cylinder heads



7.13 Install the metal gasket, hooking it on the rear dowels first, then lowering the gasket until the front dowels are engaged - apply RTV around the front and rear water-passages

material, then wipe the mating surfaces with a cloth saturated with lacquer thinner or acetone **(see illustration)**. If there is old sealant or oil on the mating surfaces when the manifold is installed, oil or vacuum leaks may develop. Cover the lifter valley with shop rags to keep debris out of the engine. Use a vacuum cleaner to remove any gasket material that falls into the intake ports.

11 Use a tap of the correct size to chase the threads in the bolt holes, then use compressed air (if available) to remove the debris from the holes. **Warning:** *Wear safety glasses or a face shield to protect your eyes when using compressed air.*

12 Apply a thin coat of RTV sealant to both sides of the water ports of the new metal gasket.

13 Position the metal gasket onto the rear dowel pins on the cylinder heads, then lower the gasket carefully until the front dowels are engaged **(see illustration)**.

14 Clean the front and rear end-gasket surfaces on the block with acetone or lacquer thinner. Glue the new end seals to the block with quick-drying cement, then apply a thin coat of RTV sealant to the manifold side of the seals and a small bead in the four corners where the end seals meet the metal gasket. A thick bead of RTV can also be used instead of an end seal, but the manifold must be installed before the RTV cures **(see illustration)**.

15 Carefully set the manifold in place. **Caution:** *Do not disturb the gaskets and DO NOT move the manifold fore-and-aft after it contacts the front and rear seals or the gaskets will be pushed out of place and you may not notice the problem until you see the oil leak.*

16 Install the intake manifold bolts and hand tighten them. Then tighten the bolts in several steps, starting with the center bolts and working towards the ends. to the torque listed in this Chapter's Specifications. Do not over-tighten the bolts or the gaskets may leak.

17 The remaining installation steps are the reverse of removal. Change the engine oil and filter, and add coolant. Start the engine and check carefully for oil, vacuum and coolant leaks at the intake manifold joints. Refer to Chapter 2C for vacuum leak detection procedures, if necessary.

2B

8 Exhaust manifolds - removal and installation

Removal

Refer to illustrations 8.4 and 8.8

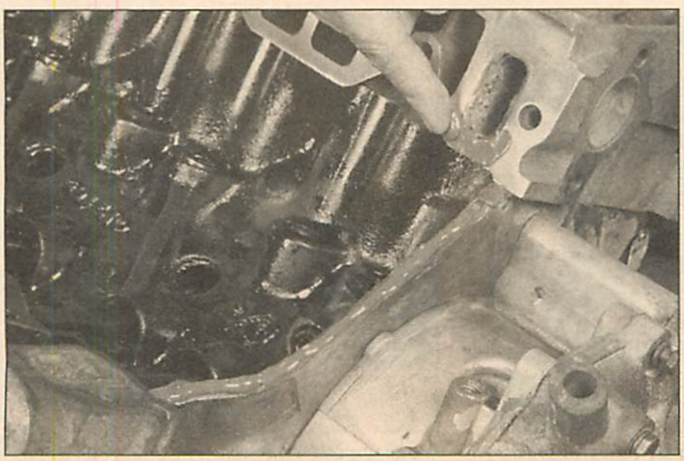
Warning: *Allow the engine to cool completely before performing this procedure.*

1 Disconnect the battery cable from the negative battery terminal.

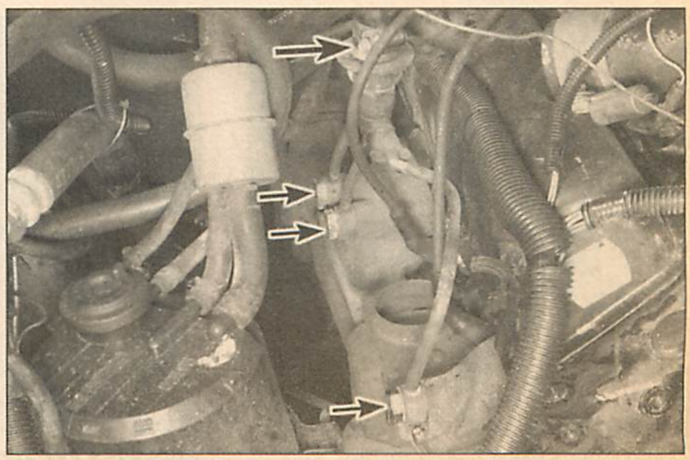
2 Disconnect the spark plug wires and remove the spark plugs (see Chapter 1). If there is any danger of mixing the plug wires up, it's recommended that they be labeled with pieces of numbered tape.

3 Remove the air cleaner assembly. Remove the heated-air duct for access to the right manifold.

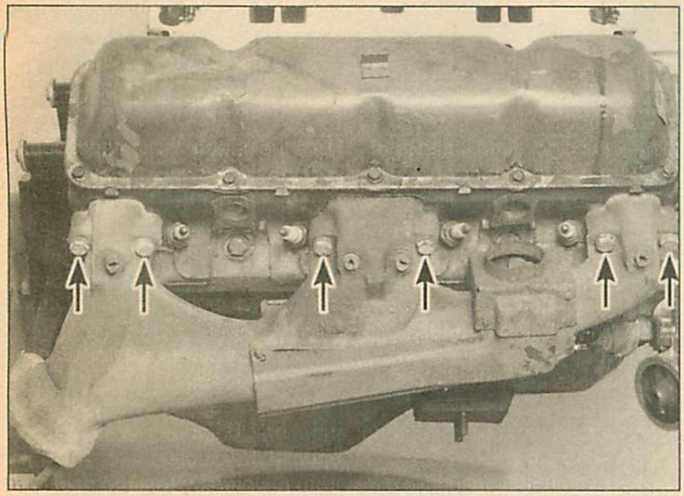
4 If the manifold is to be replaced, disconnect the AIR pipes (if equipped) attached to each manifold. If the manifold is to be reused, simply disconnect the AIR hose from the check valve and leave the pipes connected to the manifold **(see illustration)**. **Note:** *Soak the fasteners with penetrating oil before attempting to unbolt the AIR pipes.*



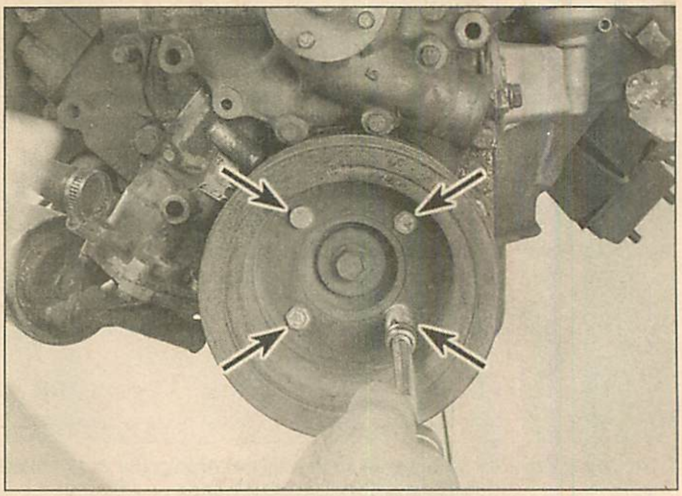
7.14 If no end seals are supplied in your gasket set ,apply a bead of RTV sealant across the block sealing surface



8.4 Either disconnect the AIR hose from the check valve (large arrow) or unbolt the air injection tubes (smaller arrows, three are visible here)



8.8 Mark the location of studs and spacers (if used), then remove the exhaust manifold bolts (arrows)



9.2 Remove the crankshaft pulley bolts (arrows)

5 On the left side, remove the nut retaining the metal AIR pipe, then pull the pipe clear of the manifold. **Note:** *It will be easier to work on the left exhaust manifold if the hoses to the diverter valve are disconnected and the diverter-valve assembly is moved out of the way* **(see illustration 4.3)**.

6 Set the parking brake and block the rear wheels. Raise the front of the vehicle and support it securely on jackstands.

7 Refer to Chapter 4 and disconnect the exhaust pipe from the manifold outlets. **Note:** *Often a short period of soaking with penetrating oil is necessary to remove frozen exhaust attaching nuts/bolts.*

8 Loosen the outer fasteners first, then the center ones to separate the manifold from the cylinder head **(see illustration)**. **Note:** *Some of the exhaust manifold fasteners may be studs, so mark their location before removal to ensure they go back in the original location.*

Installation

9 Installation is the reverse of the removal procedure. Clean the manifold and cylinder head gasket surfaces and check the manifold heat-control valve for ease of operation. If the valve is stuck, free it with penetrating oil or replace it.

10 Install the manifolds with new gaskets. Tighten the fasteners to the torque listed in this Chapter's Specifications. Work from the center to the ends and approach the final torque in three steps.

11 Apply anti-seize compound to the exhaust manifold-to-exhaust pipe bolts and tighten them securely. Also apply anti-seize to the EGR fittings and AIR pipe fasteners.

9 Crankshaft front oil seal - replacement

Refer to illustrations 9.2, 9.3, 9.4, 9.5, 9.8 and 9.9

1 Remove the drivebelt(s) see Chapter 1).

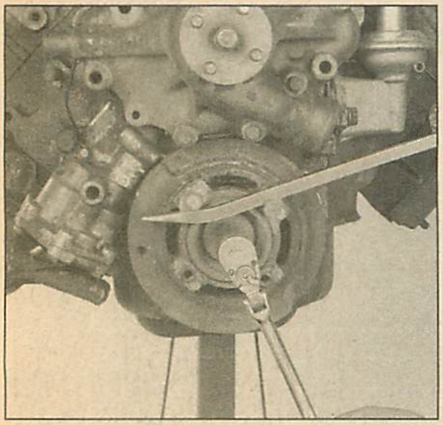
2 Remove the bolts **(see illustration)** and separate the crankshaft pulley from the vibration damper.

3 Remove the large vibration damper bolt **(see illustration)**. To keep the crankshaft from turning, temporarily reinstall two of the pulley bolts and place a pry bar between them.

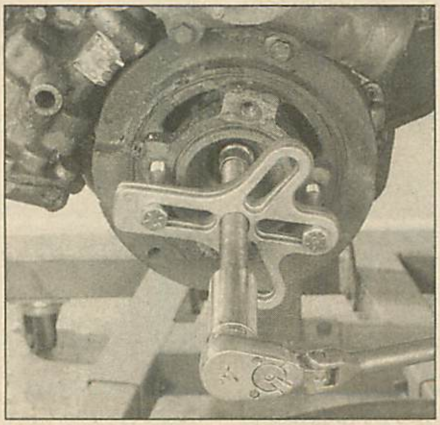
4 Use a vibration-damper puller (commonly available from auto parts stores) to detach the vibration damper **(see illustration)**. **Caution:** *Do not use a puller with jaws that grip the outer edge of the damper. The puller must be the bolt-on type that utilizes bolts to apply force to the damper hub only.*

5 On 1972 through 1977 models, the front seal can only be replaced with the front cover removed from the engine (it installs from the rear). On later models, the seal can be replaced with the cover installed, although replacement is usually easier with the cover removed. If the seal is being replaced with the front cover removed (see Section 10 for cover removal), support the cover on top of two blocks of wood and drive the seal out with a hammer and punch **(see illustration)**. **Caution:** *Be careful not to scratch, gouge or distort the area that the seal fits into or a leak will develop.* On early models the seal must be driven out from the front, and from the back on later models.

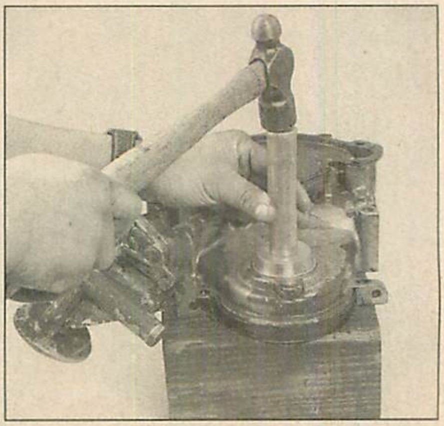
6 If the seal is being removed while the cover is still attached to the engine, carefully pry the seal out of the cover with a seal puller or a



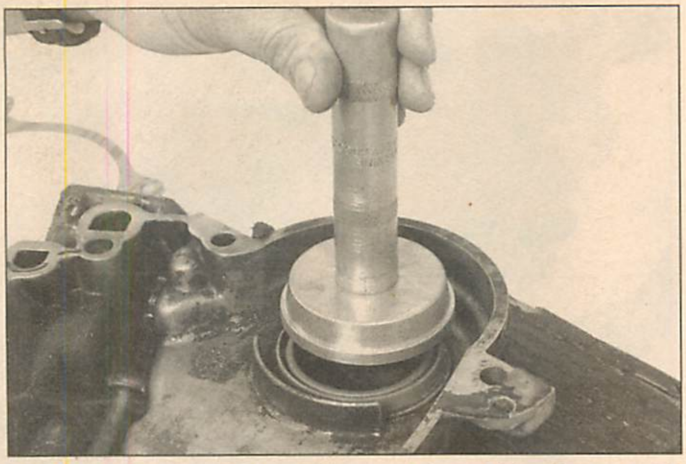
9.3 Remove the center damper bolt



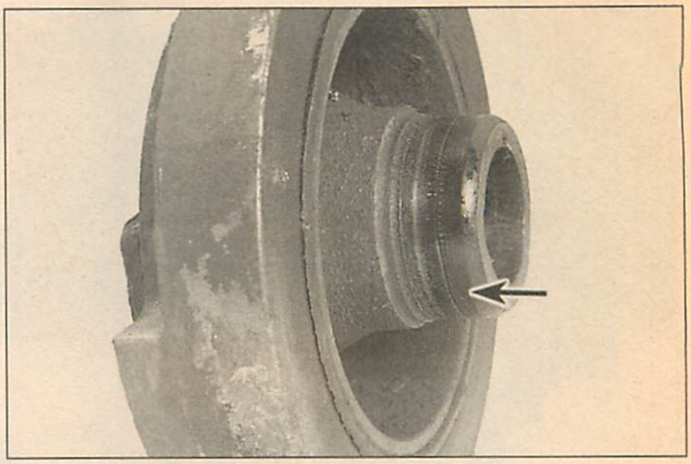
9.4 Use a bolt-type puller to remove the vibration damper



9.5 On 1972 through 1977 models, drive the seal out from the front, using a punch or a seal-driver as shown (on later models, the seal is driven out from the back)



9.8 Use a seal driver or large-diameter pipe to drive the new seal into the cover - on this early cover the seal is driven in from the backside, later models must be driven in from the front



9.9 If the sealing surface of the damper hub has a wear groove from contact with the seal (arrow), repair sleeves may be available from auto parts stores

large screwdriver. **Caution:** *Be careful not to scratch, gouge or distort the area that the seal fits into or a leak will develop.*

7 Clean the seal bore to remove any old seal material and corrosion. Position the new seal in the bore with the seal lip (usually the side with the spring) facing IN (toward the inside of the engine). A small amount of oil applied to the outer edge of the new seal will make installation easier, but don't overdo it!

8 After either method of seal removal is complete and the new seal is ready to be installed, drive the seal into the bore with a large socket and hammer until it's completely seated **(see illustration)**. Select a socket that's the same outside diameter as the seal and make sure the new seal is pressed into place until it bottoms against the cover flange.

9 Check the seal contact surface of the damper **(see illustration)**. If the surface has been grooved from long-time contact with the seal, there may be a press-on sleeve available to put a new surface on the damper for the seal to ride on. This sleeve is pressed into place with a hammer and a block of wood. These sleeves are commonly available for most engines from auto parts stores.

10 Lubricate the seal lips with engine oil and reinstall the vibration damper.

11 The remainder of installation is the reverse of removal.

10 Front cover, timing chain and sprockets - removal, inspection and installation

Timing chain check (with front cover on engine)

Note: *This procedure will allow you to check the amount of slack in the timing chain without removing the front cover from the engine.*

1 Disconnect the negative battery cable from the battery.

2 Place the engine at TDC (Top Dead Center) for cylinder number one (see Section 3).

3 Keeping the piston on the compression stroke, place the number one piston about 30-degrees before TDC (BTDC).

4 Remove the distributor cap (see Chapter 1).

5 You must rotate the crankshaft very slowly by hand for accuracy on this check, so get a 1/2-inch drive breaker bar, extension and correct-size socket to use on the large bolt in the center of the crankshaft pulley.

6 Turn the crankshaft clockwise until the number one piston is at TDC. This will take up the slack on the left side of the timing chain.

7 Mark the position of the distributor rotor on the distributor housing **(see illustration 3.4)**.

8 Slowly turn the crankshaft counterclockwise until the slightest movement is seen at the distributor rotor. Stop and note how far the number one piston has moved away from the TDC mark by looking at the ignition timing indicator on the front cover.

9 If the mark has moved more than 10 degrees, the timing chain is probably worn excessively. Remove the front cover for a more accurate check.

Cover removal

Refer to illustration 10.18

10 Remove the drivebelts (see Chapter 1).

11 Remove the water pump (see Chapter 3).

12 Remove the fuel pump and cap the lines (see Chapter 4).

13 Remove the crankshaft pulley and damper (see Section 9).

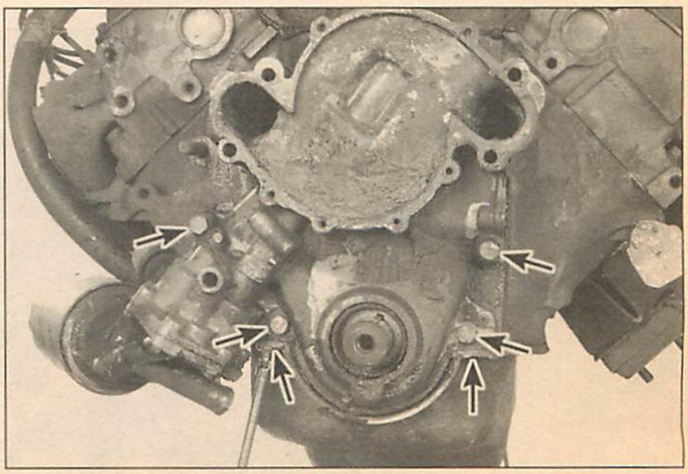
14 On models equipped with air conditioning, unbolt and set aside the air conditioning compressor, without disconnecting the refrigerant lines (see Chapter 3). **Warning:** *The air conditioning system is under high pressure. Do not loosen any components unless the system has been discharged and the refrigerant recovered by a dealer or air conditioning repair facility. Always wear eye protection when disconnecting air conditioning system fittings.*

15 Refer to Chapter 5 and remove the alternator, alternator mounting bracket and the distributor.

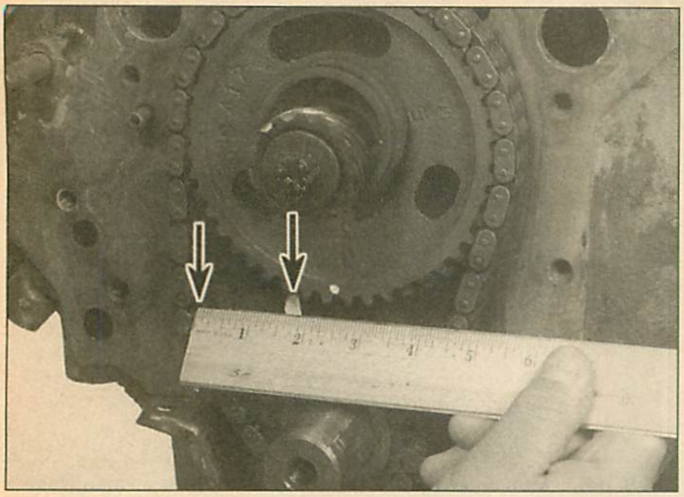
16 Refer to Chapter 6 and unbolt and set aside the AIR pump, if equipped.

17 Remove the front oil pan bolts that thread into the front cover - they're accessed from below.

18 Remove the remaining front cover mounting bolts and separate the front cover from the block and oil pan **(see illustration)**. The cover may be stuck; if so, use a putty knife to break the gasket seal. Do not



10.18 Front cover bolt hole locations (arrows) - bottom two arrows indicate the two front oil pan bolts that must be removed to remove front cover



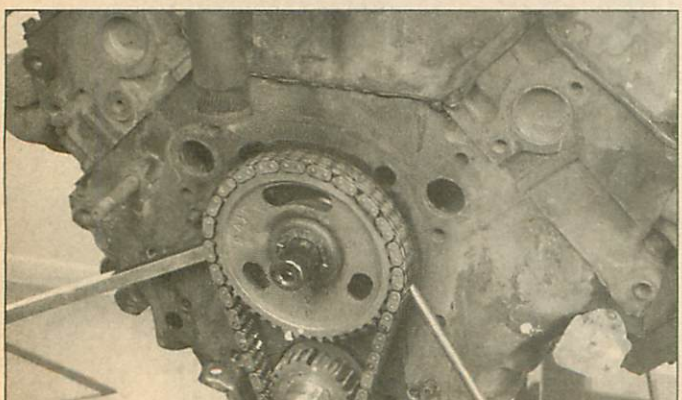
10.20 Position a ruler over the chain to measure slack - push the chain to the center of the engine and make a mark (right arrow); then push the chain outward, make a mark (left arrow) and measure the distance between the marks

use a pry tool in the cover-to-block sealing area or the soft aluminum of the cover could be damaged, causing a potential oil leak. Pull the cover forward until it clears the dowel pins on the block. **Note:** *Note the location of the various front cover and water pump bolts, there are several different length bolts and they must be installed in their original locations.*
19 Remove the oil slinger, if equipped, from the end of the crankshaft. Note how it's installed so you can reinstall it the same way on reassembly. It's a good idea to replace the crankshaft front seal at this time (see Section 9).

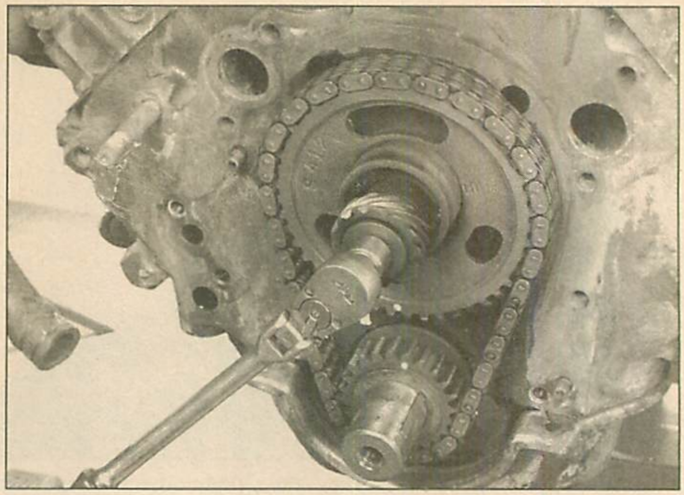
Timing chain and gear inspection (front cover removed from engine)

Refer to illustration 10.20

20 Attach a socket and torque wrench to the camshaft sprocket bolt and apply force in the normal direction of crankshaft rotation until all slack is taken up on the right side of the timing chain. Now push the slack side of the chain inward and make a mark on the block, then pull the chain outward and measure the amount of chain movement with a ruler **(see illustration)**. If it exceeds 7/8-inch, a new timing chain will be required. **Note:** *Whenever a new timing chain is required, the entire set (chain, camshaft and crankshaft sprockets) must be replaced as an assembly.*
21 Inspect the camshaft and crankshaft sprockets for damage or wear.



10.23 Pry off the camshaft sprocket with two screwdrivers



10.22 Remove the camshaft sprocket bolt and washer, then slide the distributor drive gear and fuel pump eccentric from the end of the camshaft

Timing chain removal

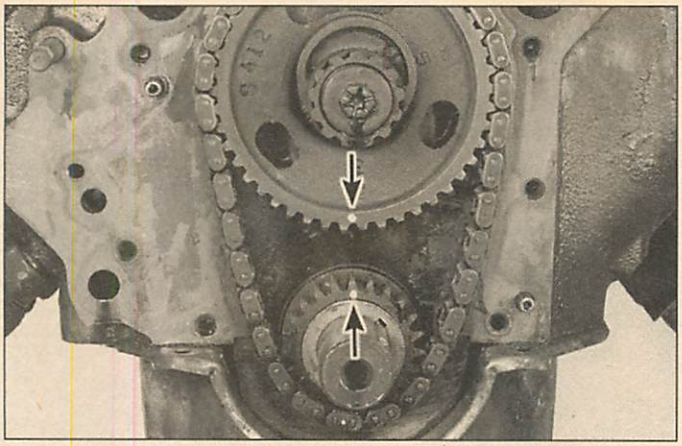
Refer to illustrations 10.22 and 10.23

22 Be sure the timing marks are aligned **(see illustration 10.28)**. Remove the bolt from the camshaft sprocket, then detach the distributor drive gear and fuel pump eccentric **(see illustration)**. If necessary, insert a prybar through one of the camshaft sprocket holes to prevent the camshaft from turning.
23 Remove the camshaft sprocket with the timing chain, use two screwdrivers to lever the sprocket off the camshaft, if necessary **(see illustration)**.
24 The crankshaft sprocket can be removed with a two or three-jaw puller or by using two screwdrivers, but be careful not to damage the threads in the end of the crankshaft. **Note:** *If the front cover oil seal has been leaking, refer to Section 9 and install a new one.*

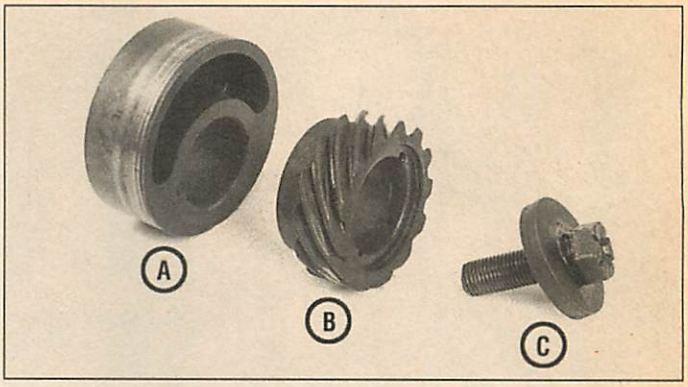
Installation

Refer to illustrations 10.28, 10.29a, 10.29b, 10.30, 10.32a, 10.32b and 10.33

Note: *Timing chains must be replaced as a set with the camshaft and crankshaft sprockets. Never install a new chain on used sprockets.*
25 Use a gasket scraper to remove all traces of old gasket material and sealant from the cover and engine block. Stuff a shop rag into the opening at the front of the oil pan to keep debris out of the engine. Clean any sealant residue from the front of the oil pan and wipe the pan, cover and block sealing surfaces with a cloth saturated with lacquer thinner or acetone.
26 Align the keyway in the crankshaft sprocket with the Woodruff key and press the sprocket onto the crankshaft with the vibration damper bolt, several washers and a large socket; or tap it gently into place with a large socket or section of pipe until it is completely seated. **Caution:** *If resistance is encountered, do not hammer the sprocket onto the crankshaft. It may eventually move onto the shaft, but it may be cracked in the process and fail later, causing extensive engine damage.*
27 If necessary, rotate the crankshaft until the timing mark on the crankshaft sprocket is in the 12 o'clock position.
28 Loop the new chain over the camshaft sprocket and rotate the sprocket until the timing mark is at the 6 o'clock position. Mesh the chain with the crankshaft sprocket and position the camshaft sprocket on the camshaft. If necessary, rotate the camshaft until the keyways align. When the chain is installed, the timing marks MUST align as shown **(see illustration)**.
29 Apply a thread-locking compound to the camshaft sprocket bolt threads, then install the fuel pump eccentric and distributor drive gear and tighten the bolt to the torque listed in this Chapter's Specifications. **Note:** *The fuel pump eccentric is stamped on the back to indicate which side faces the camshaft* **(see illustrations)**.



10.28 Proper alignment of camshaft and crankshaft timing marks (arrows)



10.29a Proper assembly order of the fuel pump eccentric and distributor drive gear

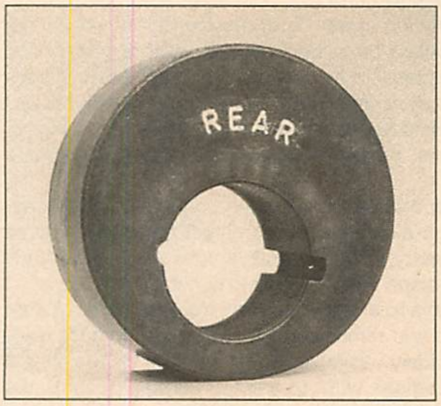
A Fuel pump eccentric
B Distributor drive gear
C Camshaft bolt and washer

30 Lubricate the chain with clean engine oil, and reinstall the oil slinger over the end of the crankshaft with the cupped side facing out **(see illustration)**.

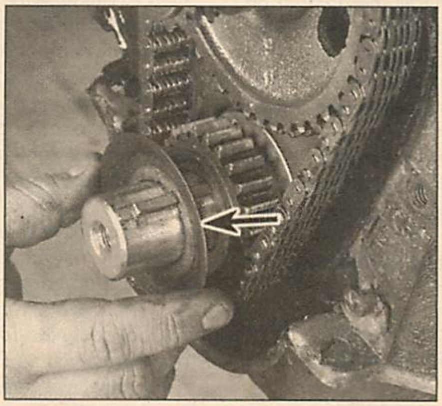
31 Using a utility knife or single-edged razor blade, trim off the front portion of the oil pan gasket at the point where it meets the engine block. Cover the exposed inside area of the oil pan with a rag, then clean all traces of gasket material off the area where the gasket was removed.

32 Attach the new rubber semi-circular seal to the front cover. Using gasket adhesive, install the front oil pan gasket sections (usually included in a front cover gasket set) to the cover and trim them to fit **(see illustrations)**. Apply a dab of RTV sealant to the area where cork gasket fits into the rubber seal.

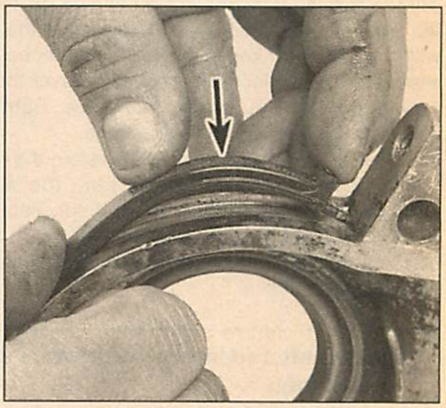
33 Install the front cover gasket to the engine block. Apply a dab of RTV sealant at the oil pan-to-block junctions **(see illustration)**. Also apply RTV sealant to both sides of the new cover gasket around the water passages.



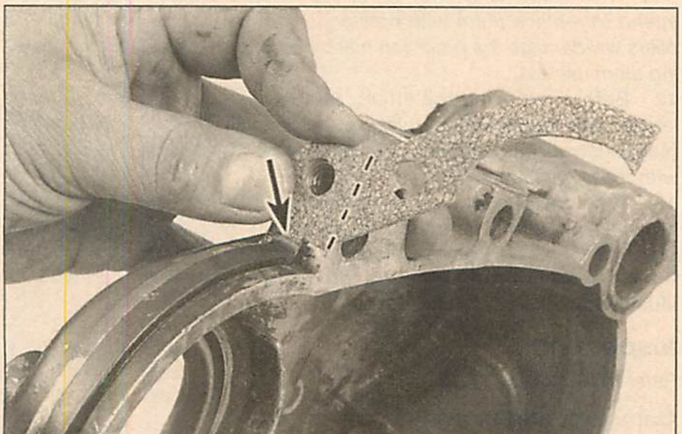
10.29b The fuel pump eccentric must be installed with the REAR-stamped side facing the camshaft



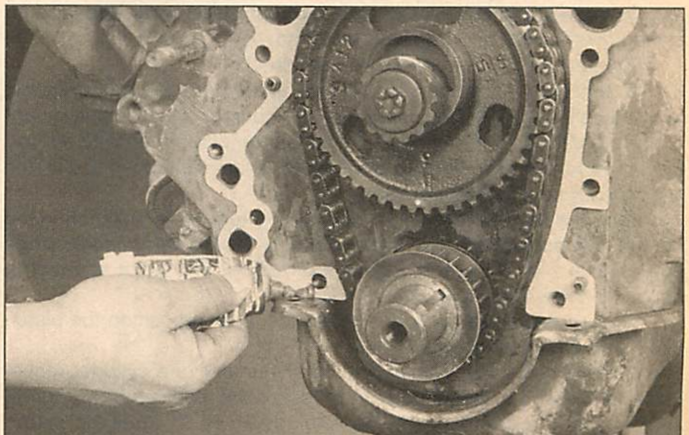
10.30 When reinstalling the oil slinger, remember the concave portion faces OUT



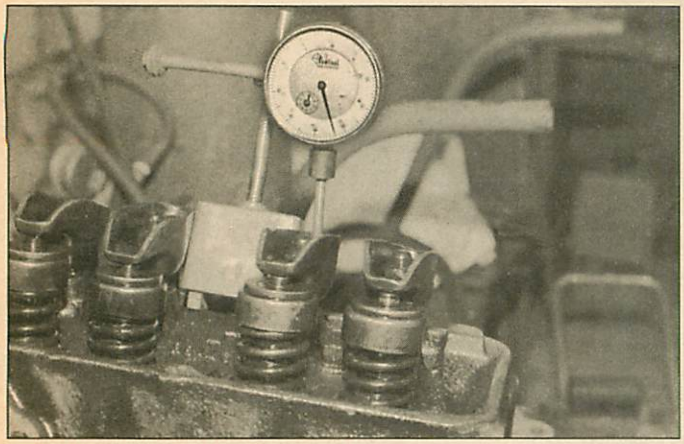
10.32a Clean the groove in the bottom of the front cover and press in the new rubber seal (arrow), seating it firmly and evenly



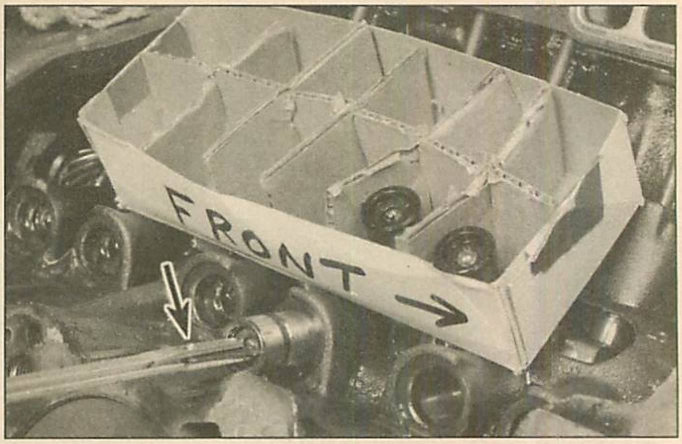
10.32b Install the of oil pan gasket sections and trim them to fit the front cover (dotted line) - attach the gaskets to the cover with gasket adhesive and apply a dab of RTV where the gaskets meet the rubber seal (arrow)



10.33 Place the front cover gasket the block and apply a bead RTV sealant to the oil pan-to-block junctions



11.3 When checking the camshaft lobe lift, the dial indicator plunger must be positioned directly above and in-line with the pushrod



11.12 The lifters in an engine that has accumulated many miles may have to be removed with a special tool (arrow) - store them in an organized manner to make sure they're reinstalled in their original locations

34 Install the cover, pushing down on the oil pan with the cover until the cover engages block dowel pins. **Note:** *It may be necessary to loosen or remove several of the front oil pan bolts to allow the oil pan to flex down enough to install the cover.*
35 Install the cover bolts, including the two oil pan bolts. Tighten the cover bolts to the torque listed in this Chapter's Specifications.
36 Lubricate the oil seal contact surface of the vibration damper hub with moly-base grease or clean engine oil, then install the damper on the end of the crankshaft. The keyway in the damper must be aligned with the Woodruff key in the crankshaft nose. If the damper cannot be seated by hand, slip the large washer over the bolt, install the bolt and tighten it to pull the damper into place. Tighten the bolt to the torque listed in this Chapter's Specifications.
37 The remaining installation steps are the reverse of removal. When installing the distributor, make sure the distributor shaft properly engages the oil pump drive shaft. If necessary use a long screwdriver to pre-position the oil pump driveshaft.
38 Add coolant and check the oil level. Run the engine and check for oil and coolant leaks.

11 Camshaft and lifters - removal, inspection and installation

Camshaft lobe lift check

Refer to illustration 11.3

1 In order to determine the extent of cam lobe wear, the lobe lift should be checked prior to camshaft removal.
2 Remove the valve covers (see Section 4).
3 Position the number one cylinder at TDC on the compression stroke (see Section 3). Beginning with the number one cylinder, mount a dial indicator on the engine and position the plunger against the top of the first rocker arm. The plunger should be directly above and in-line with the pushrod **(see illustration)**.
4 Zero the dial indicator, then very slowly turn the crankshaft in the normal direction of rotation (clockwise) until the indicator needle stops and begins to move in the opposite direction. The point at which it stops indicates maximum cam lobe lift.
5 Record this figure for future reference, then reposition the piston at TDC on the compression stroke.
6 Move the dial indicator to the other number one cylinder rocker arm and repeat the check. Be sure to record the results for each valve.
7 Repeat the check for the remaining valves. Since each piston must be at TDC on the compression stroke for this procedure, work from cylinder-to-cylinder following the firing order sequence (see this Chapter's Specifications for the firing order). For instance, after checking the number one cylinder rocker arms, turn the engine slowly until the distributor's rotor points to the secondary terminal for the next cylinder in the firing order.
8 Compare the results to the lobe lift specifications in this Chapter's Specifications. If the lobe lift is 0.005 inch less than specified, cam lobe wear has occurred and a new camshaft should be installed.

Removal

Refer to illustrations 11.12 and 11.13

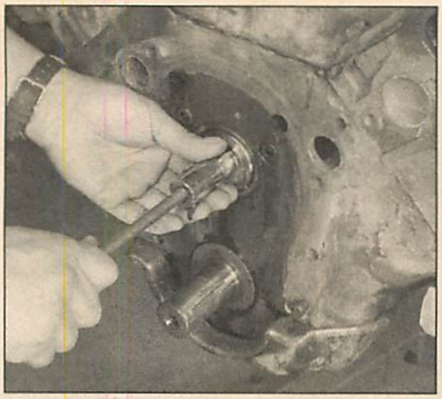
Warning: *The air conditioning system is under high pressure. Do not loosen any components unless the system has been discharged and the refrigerant recovered by a dealer or air conditioning repair facility. Always wear eye protection when disconnecting air conditioning system fittings.*
9 Refer to the appropriate Sections and remove the intake manifold, valve covers, rocker arms, pushrods, front cover, timing chain and camshaft sprocket.
10 Remove the radiator and air conditioning condenser (see Chapter 3). To provide enough clearance for camshaft removal on some models, it may be necessary to unbolt and remove the vertical hood latch support bar and perhaps the grille (see Chapter 11).
11 There are several ways to extract the lifters from the bores. A special tool designed to grip and remove lifters is manufactured by many tool companies and is widely available, but it may not be required in every case. On newer engines without a lot of varnish buildup, the lifters can often be removed with a small magnet or even with your fingers. A machinist's scribe with a bent end can be used to pull the lifters out by positioning the point under the retainer ring inside the top of each lifter. **Caution:** *Do not use pliers to remove the lifters unless you intend to replace them with new ones (along with the camshaft). The pliers will damage the precision machined and hardened lifters, rendering them useless.*
12 Before removing the lifters, arrange to store them in a clearly labeled box to ensure that they are reinstalled in their original locations **(see illustration)**. **Caution:** *Do not attempt to withdraw the camshaft with the lifters in place.*
13 Thread a long bolt into the camshaft sprocket bolt hole to use as a handle when removing the camshaft from the block. Carefully withdraw the camshaft from the block. Support the cam near the block so the lobes do not nick or gouge the bearings as it is withdrawn **(see illustration)**.

Inspection

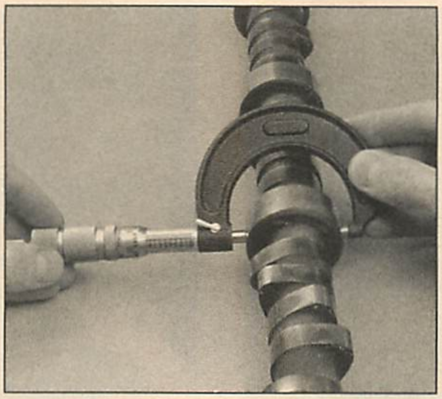
Refer to illustration 11.15

Camshaft and bearings

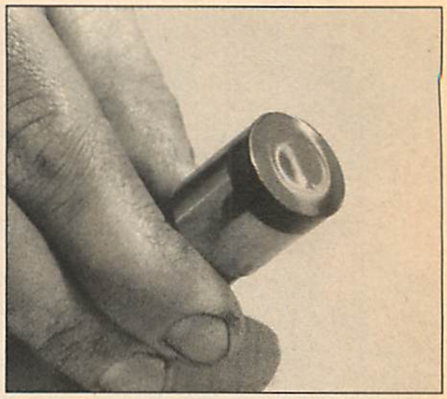
14 After the camshaft has been removed from the engine, cleaned with solvent and dried, inspect the bearing journals for uneven wear, pitting and evidence of seizure. If the journals are damaged, the bearing inserts in the block are probably damaged as well. Both the camshaft and bearings will have to be replaced. **Note:** *Camshaft bearing*



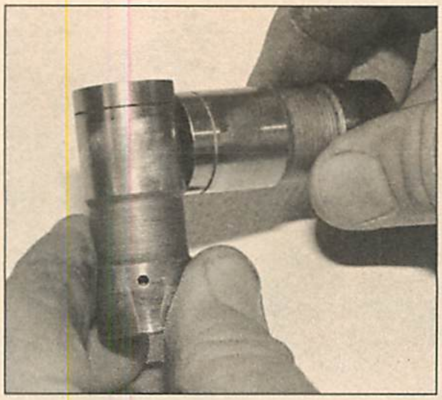
11.13 Thread a long bolt into the camshaft sprocket bolt hole to use as a handle - as the camshaft is being removed, support it near the block so the lobes do not nick the bearings



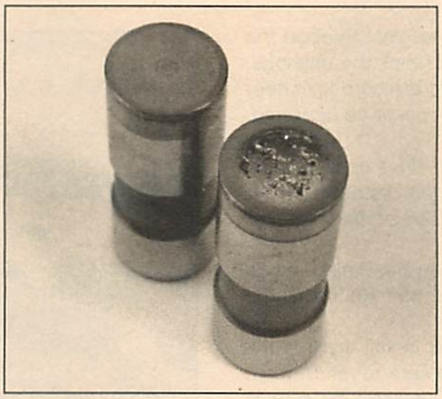
11.15 Check the diameter of each camshaft bearing journal to pinpoint excessive wear and out-of-round conditions



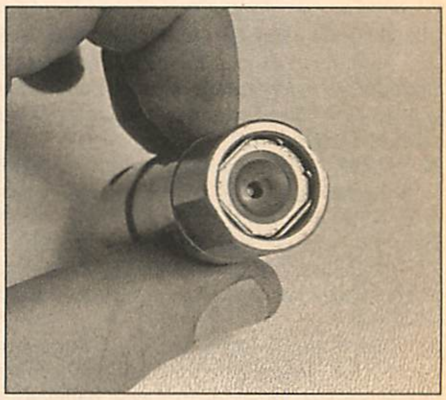
11.18a If the bottom of any lifter is worn concave, scratched or galled, replace the entire set with new lifters



11.18b The foot of each lifter should be slightly convex - the side of another lifter can be used as a straightedge to check it; if it appears flat, it is worn and must not be reused



11.18c If the lifters are pitted or rough, they shouldn't be reused



11.18d Check the pushrod seat in the top of each lifter for wear

replacement requires special tools and expertise that place it beyond the scope of the average home mechanic. The tool for bearing removal/installation is available at stores that carry automotive tools, possibly even found at a tool rental business. It is advisable though, if the bearings are bad, that the engine should be removed and the block taken to an automotive machine shop to ensure that the job is done correctly.

15 Measure the bearing journals with a micrometer to determine if they are excessively worn or out-of-round **(see illustration)**. Refer to the camshaft inspection procedures in Chapter 2A for lobe measurement procedures.

16 Check the camshaft lobes for heat discoloration, score marks, chipped areas, pitting and uneven wear. If the lobes are in good condition and if the lobe lift measurements are as specified in this Chapter's Specifications, the camshaft can be reused.

Lifters

Refer to illustrations 11.18a, 11.18b, 11.18c and 11.18d

Note: *Some engines are fitted with 0.008 inch oversize lifters at the factory. These may be identified by a 3/8-inch, diamond-shaped stamp on the top pad at the front of the engine and a flat ground on the outside surface of each oversize lifter bore.*

17 Clean the lifters with solvent and dry them thoroughly without mixing them up.

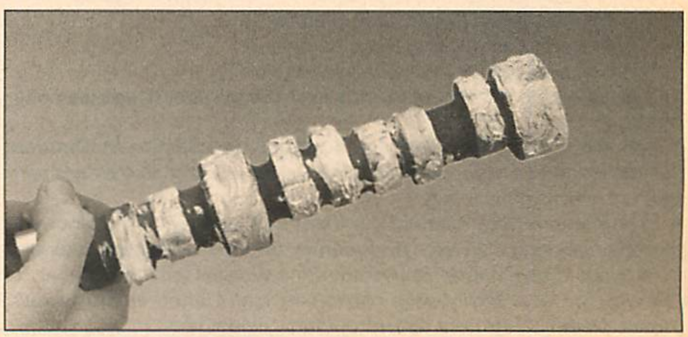
18 Check each lifter wall, pushrod seat and foot for scuffing, score marks and uneven wear. Each lifter foot (the surface that rides on the cam lobe) must be slightly convex, although this can be difficult to determine by eye. If the base of the lifter is concave, the lifters and camshaft must be replaced. If the lifter walls are damaged or worn (which is not very likely), inspect the lifter bores in the engine block as well. If the pushrod seats are worn, check the pushrod ends **(see illustrations)**.

19 If new lifters are being installed, a new camshaft must also be installed. If a new camshaft is installed, then use new lifters as well. Never install used lifters unless the original camshaft is used and the lifters can be installed in their original locations.

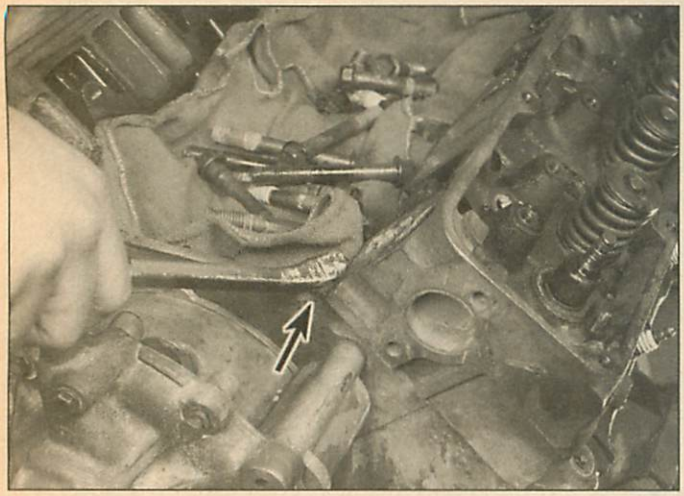
Installation

Refer to illustration 11.20

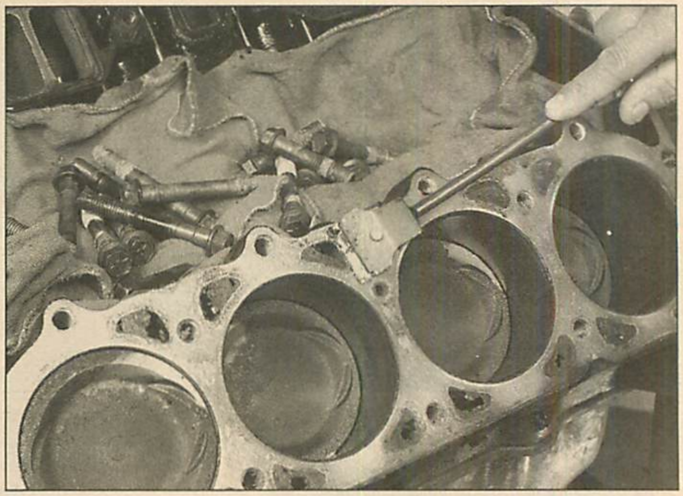
20 Lubricate the camshaft bearing journals and cam lobes with moly-base grease or engine assembly lube **(see illustration)**.



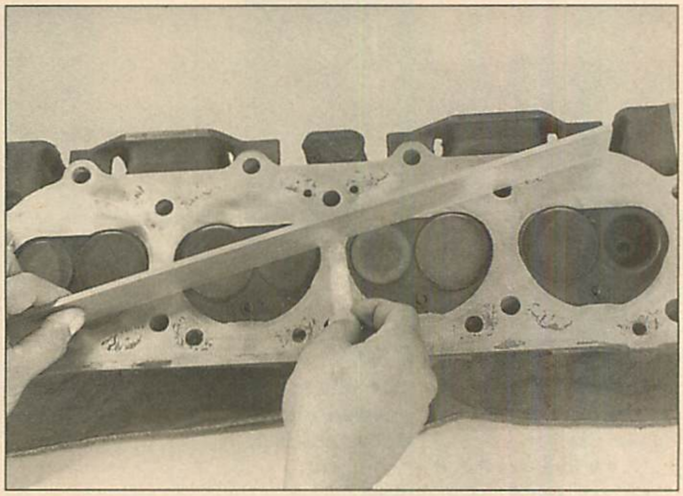
11.20 Be sure to apply moly-based grease or engine assembly lube to the cam lobes and bearing journals before installing the camshaft



12.9 Pry on a casting protrusion to break the cylinder head loose



12.12 Remove all traces of old gasket material, from both the cylinder head and the block



12.13 Check the cylinder head for warpage by trying to slip a feeler gauge under the straightedge - try this lengthwise and diagonally on the cylinder head

21 Slide the camshaft slowly and gently into the engine. Support the cam near the block and be careful not to scrape or nick the bearings. **Caution:** *Do not install the camshaft any farther into the bore than necessary or the camshaft plug at the back of the block could be loosened, causing a large oil leak.*

22 Install the fuel pump eccentric and distributor drive gear, making sure the camshaft washer fits into the recess in the distributor drive gear. **Note:** *The fuel pump eccentric is marked REAR on the side that faces the camshaft* **(see illustration 10.29b)**.

23 Install the timing chain and sprockets, aligning the timing marks on the crankshaft and camshaft sprockets (see Section 10). Install the oil slinger.

24 Lubricate the lifters with clean engine oil and install them in the block. If the original lifters are being reinstalled, be sure to return them to their original locations. If a new camshaft was installed, be sure to install new lifters as well.

25 The remaining installation steps are the reverse of removal.

26 Change the oil and install a new oil filter (see Chapter 1).

27 Start the engine, check for oil pressure and leaks and adjust the ignition timing. **Caution:** *Do not run the engine above a fast idle until all the hydraulic lifters have filled with oil and become quiet again.*

28 If a new camshaft and lifters have been installed, the engine should be brought to operating temperature and run at a fast idle for 15 to 20 minutes to "break in" the components. Then change the oil and filter once more.

12 Cylinder heads - removal and installation

Removal

Refer to illustration 12.9

1 Drain the cooling system (see Chapter 1).

2 Remove the valve covers (see Section 4).

3 Remove the intake manifold (see Section 7).

4 Detach both exhaust manifolds from the cylinder heads (see Section 8).

5 Remove the rocker arms and pushrods (see Section 5). **Caution:** *As mentioned in Section 5, keep all the parts in order so they are reinstalled in the same location.*

6 Before removing the right cylinder head, remove of the air conditioning compressor WITHOUT disconnecting the refrigerant lines and set it aside (see Chapter 3). Remove the alternator (see Chapter 5). Remove the air conditioning compressor and alternator brackets. Unbolt the vehicle ground cable from the cylinder head.

7 Before removing the left cylinder head, remove of the power steering pump WITHOUT disconnecting the hoses and set the pump aside (see Chapter 10). Remove the AIR pump (see Chapter 6). Remove the power steering pump and AIR pump brackets.

8 Loosen the cylinder head bolts in 1/4-turn increments following the reverse of the tightening sequence **(see illustration 12.16)** until they can be removed by hand.

9 Lift the cylinder heads off the engine. If resistance is felt, do not pry between the cylinder head and block as damage to the mating surfaces will result. To dislodge the cylinder head, place a wood block against the end of the cylinder head and strike it with a hammer, or pry up on a casting protrusion **(see illustration)**. Store the cylinder heads on wood blocks to prevent damage to the gasket sealing surfaces.

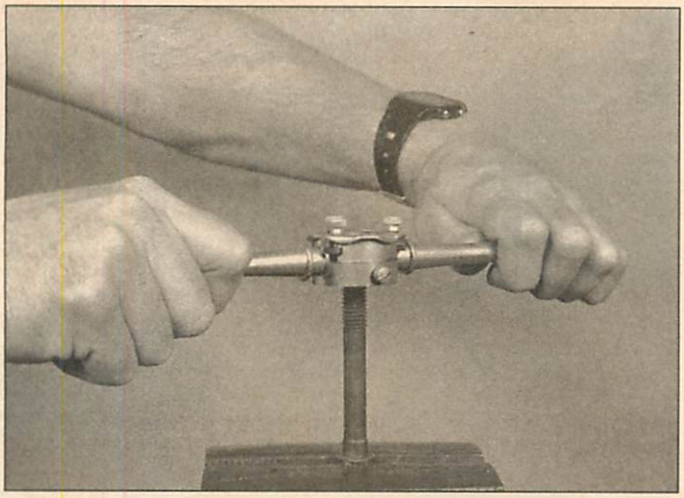
10 Cylinder head disassembly and inspection procedures are covered in detail in Chapter 2, Part C.

Installation

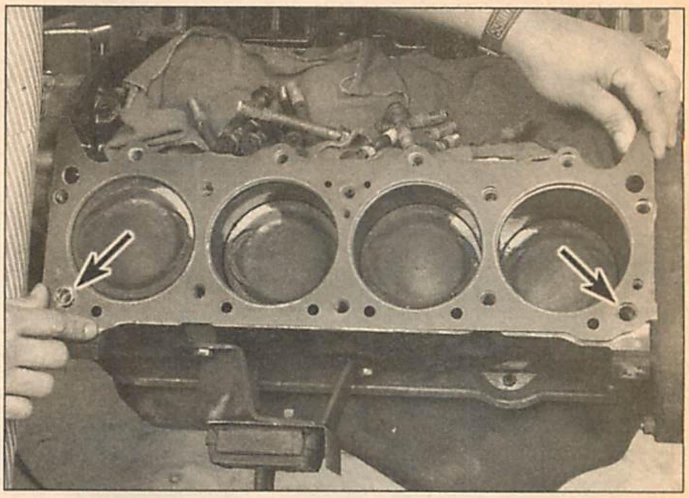
Refer to illustrations 12.12, 12.13, 12.14, 12.15a, 12.15b and 12.17

11 The mating surfaces of the cylinder heads and block must be perfectly clean when the cylinder heads are installed. Gasket removal solvents are available at auto parts stores and may prove helpful.

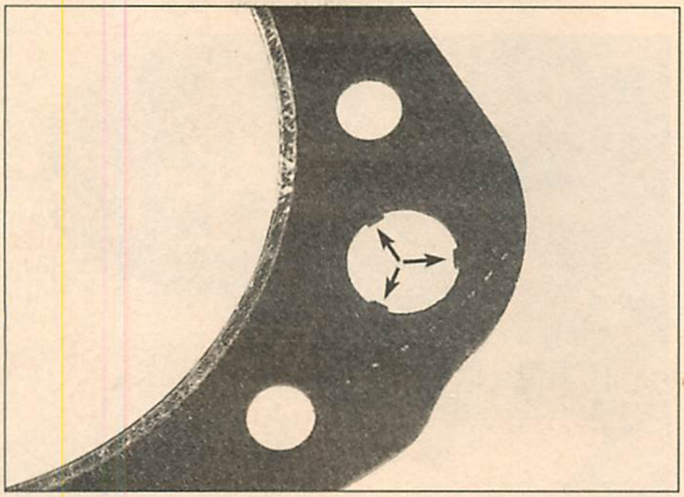
12 Use a gasket scraper to remove all traces of carbon and old gasket material **(see illustration)**, then wipe the mating surfaces with a cloth saturated with lacquer thinner or acetone. If there is oil on the mating surfaces when the cylinder heads are installed, the gaskets may not seal correctly and leaks may develop. When working on the block, cover the lifter valley with shop rags to keep debris out of the



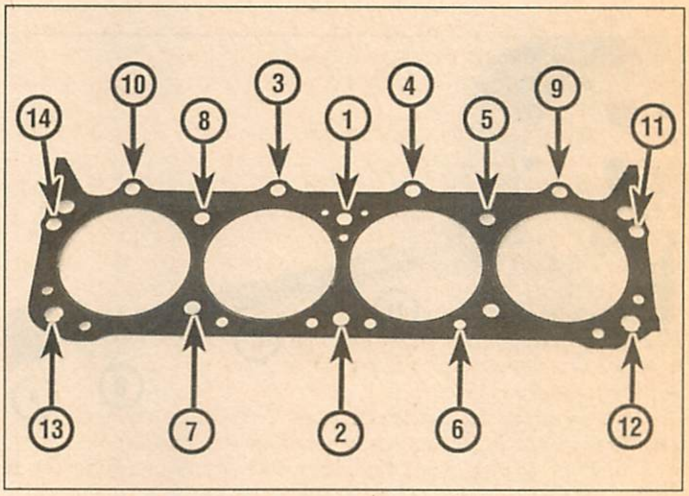
12.14 A die should be used to remove sealant and corrosion from the bolt threads prior to installation



12.15a Align the new gasket over the dowels (arrows) - the gaskets should be marked with TOP or UP on one side



12.15b For engines with 1/2-inch cylinder head bolts (most late model engines), trim these three tabs (with an Xacto knife or single edged razor blade) from the dowel holes in the cylinder head gaskets



12.17 Cylinder head bolt tightening sequence

engine. Use a vacuum cleaner to remove any debris that falls into the cylinders.

13 Check the block and cylinder head mating surfaces for nicks, deep scratches and other damage. If damage is slight, it can be removed with emery cloth. If it is excessive, machining may be the only alternative. Check the cylinder head for warpage by placing a straightedge across the cylinder head surface and trying to insert a feeler gauge between the straightedge and the cylinder head surface **(see illustration)**. See the Specifications for the maximum clearance allowed and use a feeler gauge of that thickness. If the cylinder head is warped beyond Specifications, it must be machined at a machine shop.

14 Use a tap of the correct size to chase the threads in the cylinder head bolt holes in the block. Mount each bolt in a vise and run a die down the threads to remove corrosion and restore the threads **(see illustration)**. Dirt, corrosion, sealant and damaged threads will affect torque readings.

15 If you're using original style metal gaskets, coat both sides of the gasket with a non-hardening sealant such as K&W Copper-coat, or equivalent. Most aftermarket composition gaskets do not require sealant, refer to the instructions supplied with the gasket set for more information. Position the new gaskets over the dowels in the block, with the markings facing up **(see illustration)**. **Note :** *Both 7/16-inch and 1/2-inch sized cylinder head bolts have been used on these engines. Aftermarket replacement cylinder head gaskets will fit both bolt sizes, but for later models with 1/2-inch bolts, trim off the tabs inside the dowel holes* **(see illustration)**.

16 Carefully position the cylinder heads on the block without disturbing the gaskets.

17 Install the bolts in their original locations and tighten them finger tight. Following the recommended sequence **(see illustration)**, tighten the bolts in several steps to the torque listed in this Chapter's Specifications. **Note:** *On the left cylinder head only, coat the threads of bolt number 7 with non-hardening sealant because it is exposed to coolant in the block.*

18 The remaining installation steps are the reverse of removal.

19 Add coolant and change the oil and filter (see Chapter 1). Start the engine, set the ignition timing and check the engine for proper operation and coolant or oil leaks.

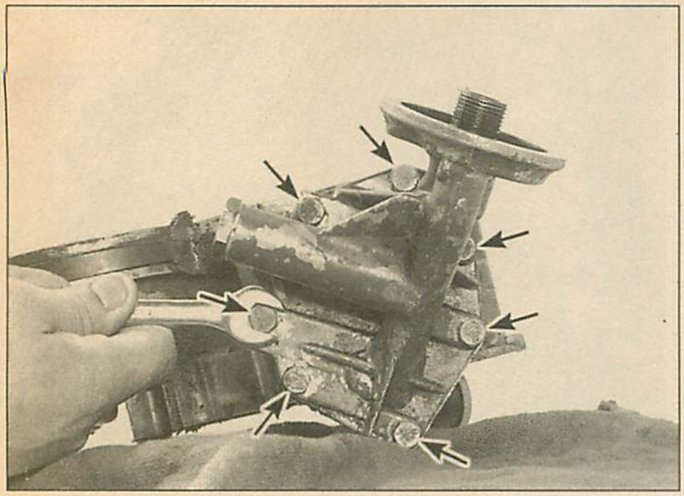
13 Oil pump - removal, inspection and installation

Removal

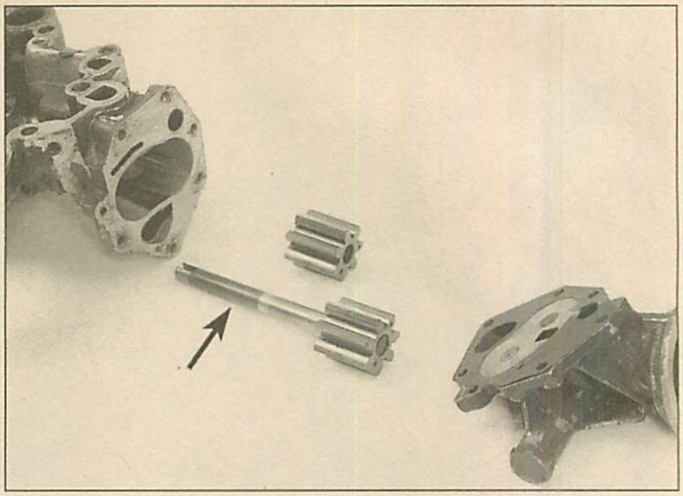
Refer to illustrations 13.2a and 13.2b

Note: *The "body" of the oil pump is an integral part of the front cover. The oil pump cover and gears can be removed and replaced in-vehicle or with the front cover removed from the engine.*

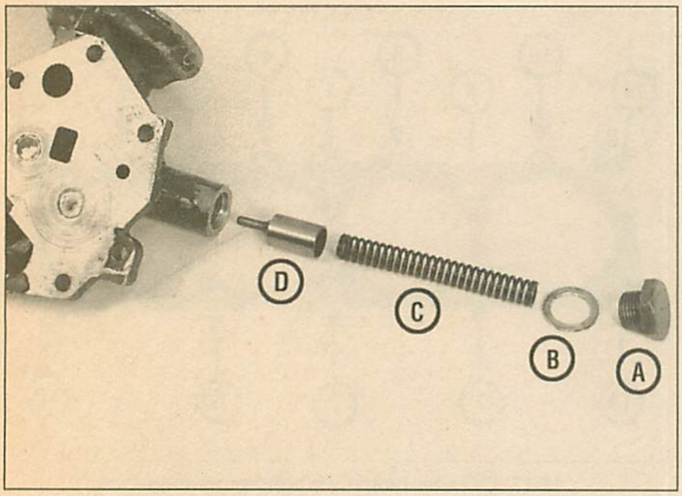
1 Remove the oil filter (see Chapter 1).



13.2a Remove the bolts (arrows) retaining the oil pump to the front cover

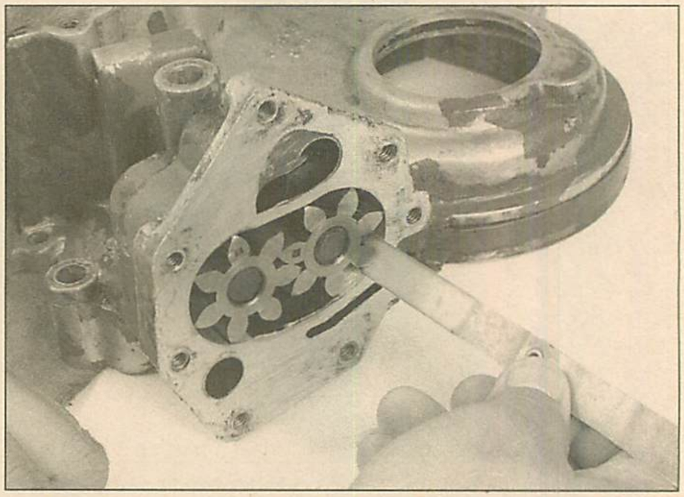


13.2b Remove the oil pump gears from the housing for inspection - the drive gear shaft (arrow) is slotted and engages the distributor shaft



13.4 Oil pump pressure relief valve components

A Pressure relief cap
B Copper sealing ring
C Oil pressure relief spring
D Oil pressure relief valve



13.8a Check the clearance between the oil pump gear tips and the pump body

2 Remove the bolts attaching the oil pump cover assembly to the front cover **(see illustration)**. Remove the oil pump cover assembly and slide the oil pump gears out of the body **(see illustration)**.

Inspection

Refer to illustrations, 13.4, 13.8a, 13.8b and 13.9

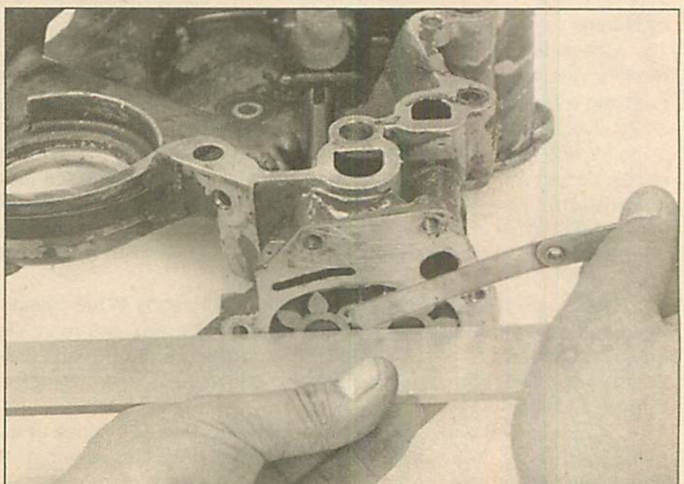
3 Clean the gears with solvent and inspect them for wear and scoring. If the gears are worn or damaged, replace them as a set. Inspect the pump body cavity and cover for wear or scoring. If the pump body is damaged the entire front cover will have to be replaced.

4 Unscrew the oil pressure relief valve cap, spring and valve **(see illustration)**. Do not remove the oil filter bypass valve and spring, as they are staked in place.

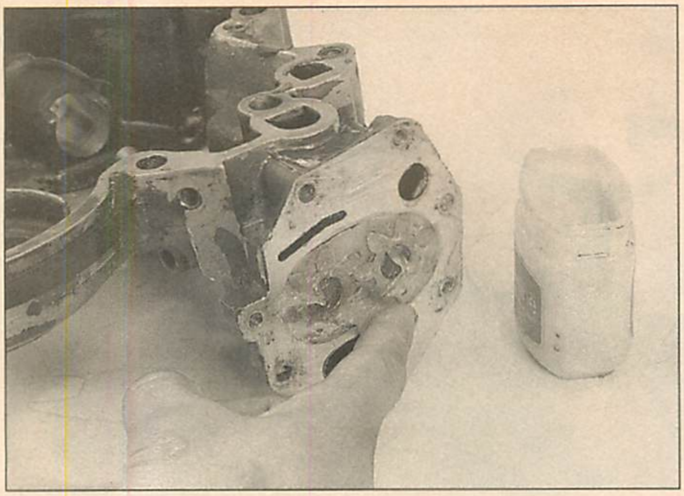
5 Wash the parts with solvent and inspect the relief valve for wear and scoring. Check to make sure the relief valve spring is not collapsed or worn on its side. Any relief valve spring which is questionable should be replaced with a new one.

6 Check the relief valve in its bore in the oil pump cover. It should easily slide into the bore, any side-to-side movement is unacceptable. The valve and/or cover should be replaced if damaged or worn.

7 Lubricate the pressure relief valve and spring, and install it in the bore of the oil pump case. Install the cap and gasket, and tighten the cap securely.



13.8b With the straightedge positioned across the cavity, measure the clearance between the straightedge and the gears (gear end clearance)



13.9 Pack the inside of the pump cavity and gears with petroleum jelly at final assembly - DO NOT substitute any other lubricant for petroleum jelly

8 Install the gears into the pump body and using feeler gauges, check the clearance between the tips of the gear teeth and the pump body **(see illustration)**. Now, lay a straightedge across the cavity and measure the end clearance between the gears and the straightedge **(see illustration)**. Make this measurement while pushing the gears upward into the front cover. If the gears are found to be worn, replace them as a set. If the pump body is worn, the front cover must be replaced (see Section 10), in which case a new set of gears would also be installed.

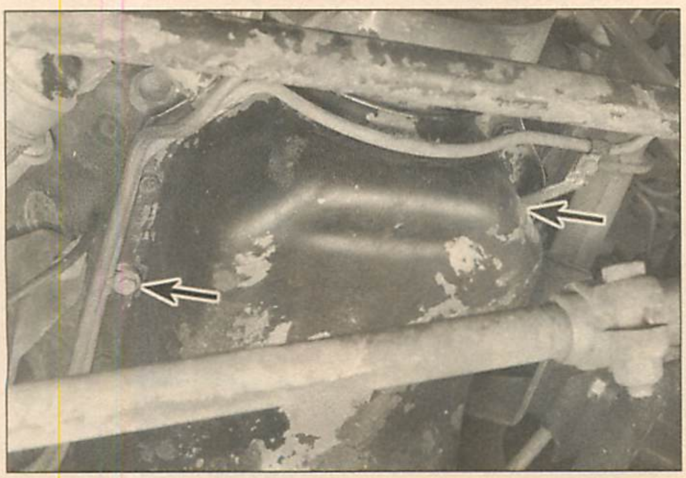
Installation

Refer to illustration 13.9

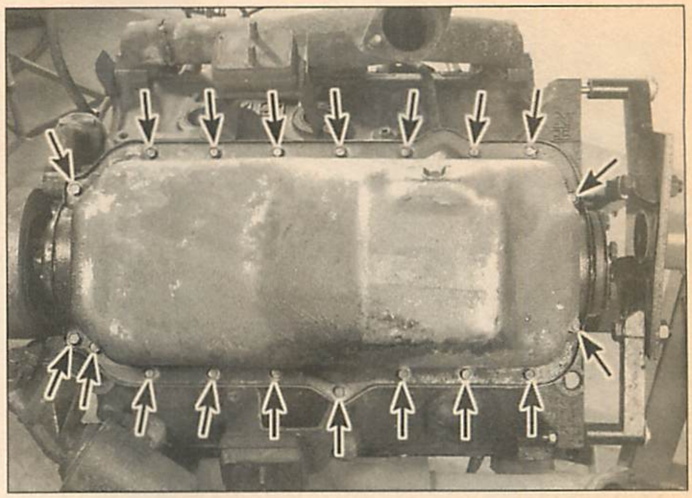
9 If the condition of the pump is satisfactory at this point, install the gears. If the front cover is installed on the engine, make sure that the oil pump drive shaft properly engages the distributor shaft. Pack petroleum jelly into every cavity of the gear pocket and between the teeth of the gears **(see illustration)**. The pump may not prime when the engine is started if the pump is not completely packed with the petroleum jelly.

10 Install the pump cover with a new gasket and tighten the bolts to the torque listed in this Chapter's Specifications.

11 Install a new oil filter, check the oil level and add if necessary. Pay close attention to the oil pressure gauge or warning light during the initial startup. Shut off the engine and inspect all work if a lack of pressure is indicated.



14.6b Mark the location of transmission cooler lines brackets (arrows), retained by oil pan bolts



14.6a Remove the bolts (arrows) around the perimeter of the oil pan (typical)

2B

14 Oil pan - removal and installation

Removal

Refer to illustrations 14.6a and 14.6b

1 Disconnect the battery cable from the negative battery terminal. Raise the vehicle and support it securely on jackstands (see Chapter 1). **Note:** *Extra clearance for oil pan removal is provided if the jackstands are placed under the frame, rather than the front axle, allowing the front axle to hang down as far as possible.*

2 Drain the engine oil and replace the oil filter (see Chapter 1). Remove the engine oil dipstick.

3 Remove the starter (see Chapter 5).

4 On some models, the exhaust pipe may have to be disconnected from the manifold and lowered for additional clearance (see Chapter 4).

5 Depending on the model, it may be necessary to raise the engine slightly to provide additional clearance. If necessary, remove the engine mount-to-bracket nuts, position a hydraulic jack under the vibration damper (use a wood block between the jack head and damper) and raise the engine. Watch for interference in the engine compartment as you raise the engine.

6 Remove the oil pan bolts **(see illustration)**, then lower the pan from the engine. If the pan sticks to the engine, strike the pan with a rubber mallet to break the gasket seal. **Caution:** *Before using force on the oil pan, be sure all the bolts have been removed.* At this point, the oil pan is free from the engine; you can very carefully slide it down and out to the rear. **Note:** *On some models the steel transmission cooling lines have clamps that attach to oil pan bolts or studs. Pry the lines aside slightly to access the bolts/nuts for removal* **(see illustration)**.

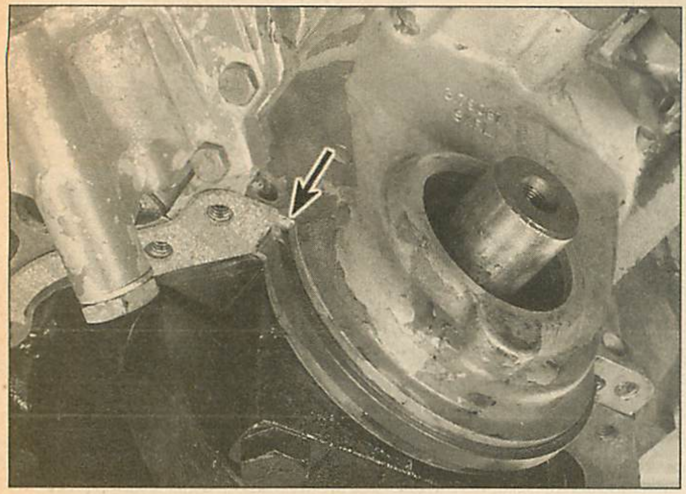
Installation

Refer to illustration 14.9

7 Clean the oil pan with solvent and dry thoroughly.

8 Thoroughly clean the mounting surfaces of the oil pan and engine block of old gasket material and sealant. If the oil pan is distorted at the bolt-hole areas, straighten the flange by supporting it from below on a 1x4 wood block and tapping the bolt holes with the rounded end of a ball-peen hammer. Wipe the gasket surfaces clean with a rag soaked in lacquer thinner or acetone. Remove the rubber front seal from the bottom of the front cover, and the rear rubber seal from the rear main bearing cap, and clean the grooves.

9 Install the side-rail gaskets on the engine. Attach them to the block with gasket adhesive. Press the rubber end seals into the grooves in the front cover and rear main bearing cap. Apply a bead of RTV sealant in the four corners where the side-rail gaskets meet the front and rear rubber gaskets **(see illustration)**.



14.9 Press the rubber front end seal into the groove in the front cover and apply RTV sealant to the corners (arrow) where it contacts the side gaskets - apply sealant to the same locations on the rear end seal

10 Lift the pan into position, be careful not to disturb the gaskets. Install four bolts finger-tight to retain the pan to the block while the remainder of the fasteners are started.

11 When all the bolts are in place, tighten the bolts to the torque listed in this Chapter's Specifications, starting at the ends and alternating from side-to-side towards the center.

12 The remainder of the installation procedure is the reverse of removal.

13 Add the proper type and quantity of oil (see Chapter 1), start the engine and check for leaks before placing the vehicle back in service.

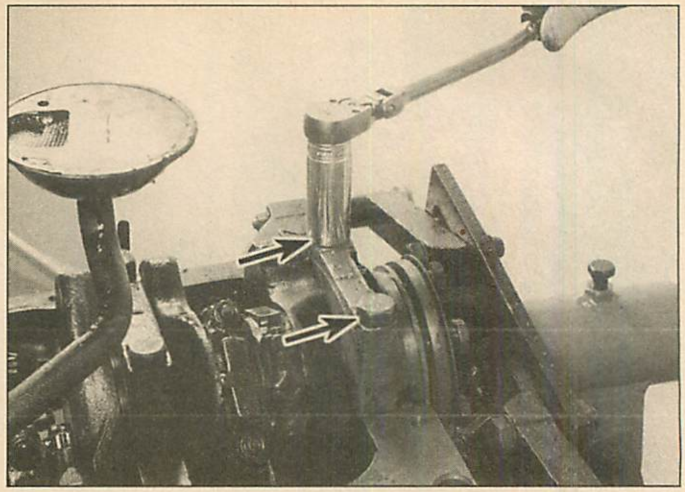
15 Rear main oil seal - replacement

Refer to illustrations 15.2, 15.4a, 15.4b and 15.7

Note: *If you're installing a new seal during a complete engine overhaul, ignore the steps in this procedure that concern removal of external parts. Also, since the crankshaft is already removed, it's not necessary to use any special tools to remove the upper seal half; remove and install the upper seal half the same way as the lower seal half. The following procedure illustrates replacing the rear main seal with the engine in the vehicle.*

1 Drain the oil (see Chapter 1) and remove the oil pan (see Section 14).

2 Remove the bolts and detach the rear main bearing cap from the engine **(see illustration)**.



15.2 Remove the bolts (arrows) and detach the rear main bearing cap from the engine

3 Loosen all of the main bearing cap bolts slightly, but do not remove them.

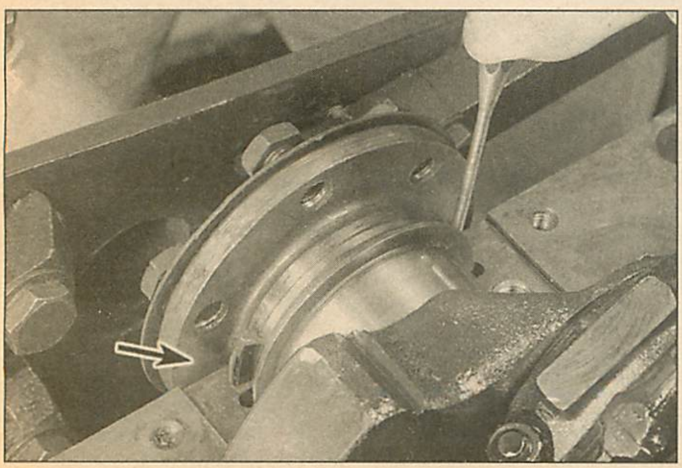
4 Remove the upper half of the rear seal (in the engine block) by tapping in one end of the seal with a small brass punch, being careful not to damage the crankshaft. When the opposite side begins to protrude, pull the seal out with needle-nose pliers **(see illustrations)**. Clean the bearing cap and engine block surfaces carefully to degrease them and remove any sealant.

5 Lightly oil the lip of the new upper seal with engine oil and lightly coat the outer circumference of the seal with liquid soap.

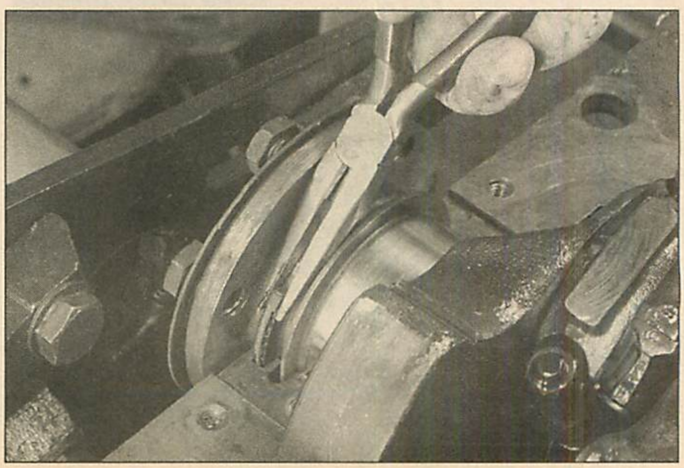
6 Rotate the upper seal half into cylinder block with the paint stripe toward the rear (the seal lip must face toward the front of the engine). **Caution:** *Hold your thumb firmly against the outside diameter of the seal as you're rotating it into place. This will prevent the seal outside diameter from being shaved from contact with the sharp edge of the engine block. If the seal is damaged on installation, it may cause an oil leak.* When the seal is installed completely, press on both ends to seat it evenly in the block.

7 Place the lower seal half in the bearing cap or seal retainer with the lip facing the front of the engine. Apply a small amount of RTV sealant on the top and bottom of the outside "legs" of the lower seal half. Before installing the main cap, apply a very small bead of RTV along the chamfered edges of the main cap where it meets the block **(see illustration)**. **Caution:** *Do not allow any RTV sealant to get on the machined mating surfaces of the block or cap.*

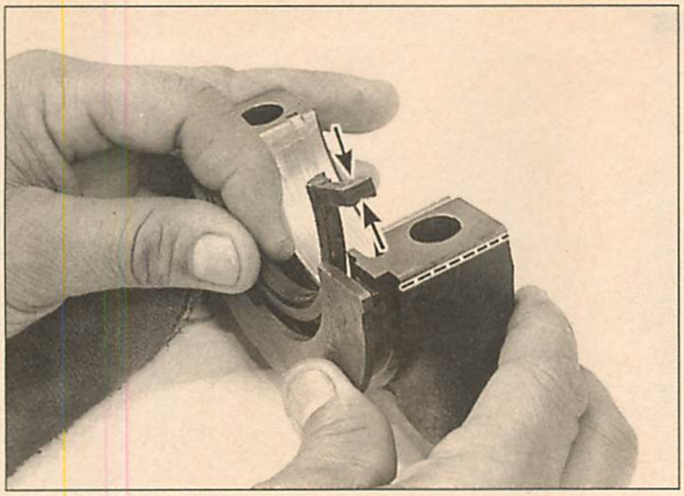
8 Install the rear main bearing cap and tighten all the main bearing



15.4a Drive one side of the upper seal half into the block until the other side protrudes (arrow)



15.4b When the other side protrudes enough, pull the seal out with needle-nose pliers



15.7 Install the lower half of the rear main seal into the bearing cap. Apply a small amount of RTV sealant to the top and bottom of the ends (small arrows) and a very small bead of RTV sealant along the chamfered edges of the cap (dotted line)

cap bolts to the torque listed in this Chapter's Specifications.

9 Refer to Section 14 and install the oil pan.

10 The remainder of installation is the reverse of removal. Add the proper type and quantity of oil (see Chapter 1), start the engine and check for leaks before placing the vehicle back in service.

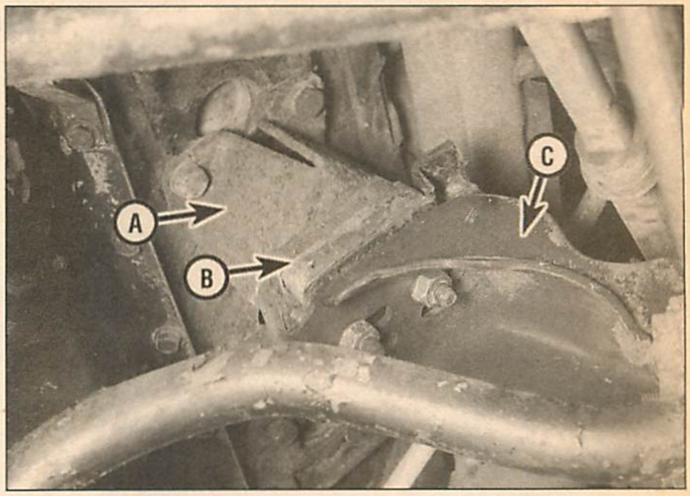
16 Flywheel/driveplate - removal and installation

The procedure for removal, inspection and replacement of the flywheel/driveplate on V8 engines is essentially the same as the six-cylinder engine. Refer to Chapter 2 Part A for the procedure.

17 Engine mounts - check and replacement

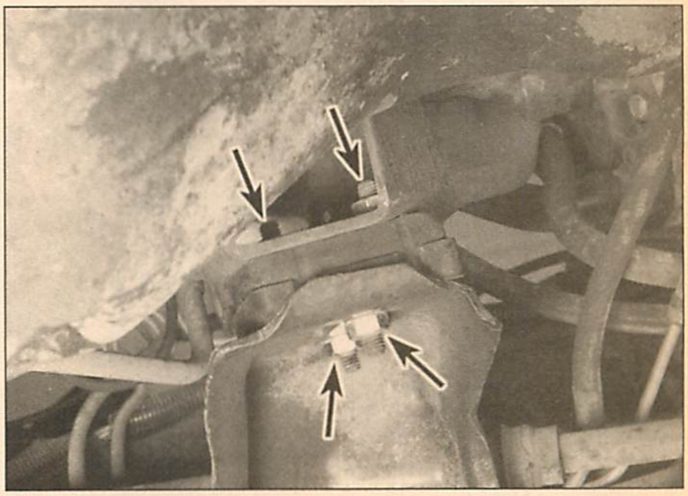
Refer to illustrations 17.1a and 17.1b

Engine mount inspection and replacement procedures for V8 engines are identical to those for the six-cylinder engine. Refer to Chapter 2, Part A for the procedure, but see the illustrations in this Section.



17.1a Typical V8 engine mount components

A Engine bracket
B Insulator
C Chassis bracket



17.1b Remove the nuts from the insulator studs at the engine bracket (upper arrows) and chassis bracket (lower arrows), support the engine with a jack and replace the insulator

Notes

2C

Chapter 2 Part C
General engine overhaul procedures

Contents

Specifications

Inline six-cylinder engine

General

Displacement	258 cubic inches (4.2 liters)
Oil pressure	30 to 70 psi above 2000 rpm
Cylinder compression	120 to 150 psi minimum; no more than 30 psi variation among cylinders

Cylinder block

Cylinder bore diameter (standard)	3.7501 to 3.7533 inches
Taper and out-of-round limit	0.001 inch
Block deck warpage limit	0.002 inch per six inches (0.008 inch overall)

Pistons and rings

Piston-to-cylinder bore clearance	
Desired	0.0012 to 0.0013 inch
Allowable	0.0009 to 0.0017 inch
Piston ring side clearance	
Compression rings	0.0017 to 0.0032 inch
Oil ring (steel rails)	0.001 to 0.008 inch
Piston ring end gap	
Compression rings	0.010 to 0.020 inch
Oil ring (steel rails)	0.015 to 0.055 inch

Crankshaft and connecting rods

Crankshaft main journal	
Diameter (standard)	2.4986 to 2.5001 inches
Out-of-round/taper limit	0.0005 inch
Main bearing oil clearance	
Allowed	0.001 to 0.003 inch
Preferred	0.0015 to 0.0025 inch
Crankshaft connecting rod journal	
Diameter	2.0934 to 2.0955 inches
Taper limit and out-of-round limit	0.001 inch
Standard bearing oil clearance	
Allowed	0.0010 to 0.0025 inch
Preferred	0.0015 to 0.0020 inch
Connecting rod side clearance	
1972 through 1980	0.005 to 0.014 inch
1981 and later	0.010 to 0.019 inch
Crankshaft endplay	0.0015 to 0.0065 inch

Cylinder head and valve train

Head gasket surface warpage limit	0.002 inch per six inches (0.006 inch overall)
Valve stem diameter (standard)	0.3715 to 0.3725 inch
Valve stem-to-guide clearance (standard)	0.001 to 0.003 inch
Valve spring free length (approximate)	
1972 through 1977	
Intake	2.234 inches
Exhaust (with rotators)	2.000 inches
1978 and later (intake and exhaust)	1.99 inches
Valve spring installed height (approximate)	
1972 through 1977	1-13/16 inches
1978	
Intake	1-25/32 inches
Exhaust	1-13/16 inches
1979 through 1981	
Intake	1-25/32 inches
Exhaust	1-5/8 inches
1982 and later (intake and exhaust)	1-25/32 inches
Valve seat width	0.040 to 0.060 inch

304, 360 and 401 cubic-inch V8 engines

General

Oil pressure	
Idle	13 psi
1600 rpm	37 to 75 psi
Cylinder compression	100 to 140 psi minimum; no more than 30 psi variation among cylinders

Cylinder block

Cylinder bore diameter	
304	3.7502 to 3.7534 inches
360	4.0799 to 4.0831 inches
401	4.1650 inches
Taper limit	0.005 inch
Out-of-round limit	0.003 inch
Block deck warpage limit	0.002 inch per six inches (0.008 inch overall)

Pistons and rings

Piston-to-cylinder bore clearance	
304 and 401	0.0010 to 0.0018 inch
360	0.0012 to 0.0020 inch
Piston ring side clearance	
304	
Top compression ring	0.0015 to 0.0035 inch
Second compression ring	0.0015 to 0.0030 inch
Oil control ring	0.0011 to 0.0080 inch
360 and 401	
Top compression ring	0.0015 to 0.0030 inch
Second compression ring	0.0015 to 0.0035 inch
Oil control ring	0.000 to 0.007 inch
Piston ring end gap	
Compression rings	0.010 to 0.020 inch
Oil ring (steel rails)	
304	0.010 to 0.025 inch
360	0.015 to 0.045 inch
401	0.015 to 0.055 inch

Crankshaft and connecting rods

Main journal diameter	
Journals 1 through 4	2.7474 to 2.7489 inches
Rear main journal	2.7464 to 2.7479 inch
Main bearing oil clearance	
Journals 1 through 4	0.001 to 0.003 inch
Rear main journal	0.002 to 0.004 inch
Connecting rod journal	
Diameter	
304 and 360	2.0934 to 2.0955 inches
401	2.2464 to 2.2485 inches
Taper/out-of-round limits	0.0005 inch
Connecting rod bearing oil clearance	0.001 to 0.003 inch
Connecting rod side clearance	0.006 to 0.018 inch
Crankshaft endplay	0.003 to 0.008 inch

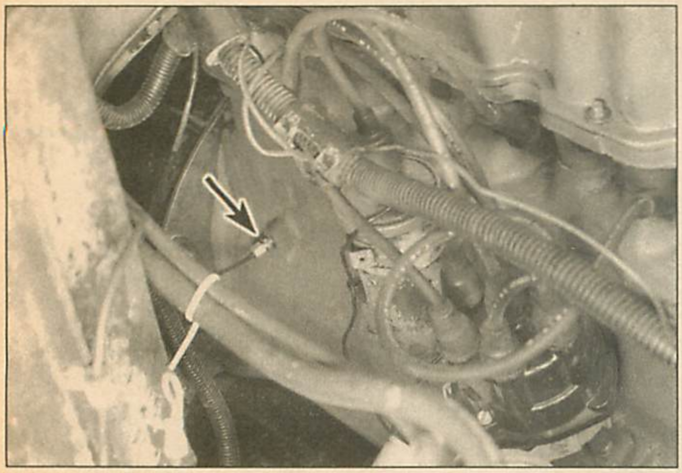
Cylinder head and valve train

Head gasket surface warpage limit	0.002 inch per six inches (0.008 inch overall)
Valve stem diameter (standard)	0.3715 to 0.3725 inch
Valve stem-to-guide clearance	0.001 to 0.003 inch
Valve spring free length (approximate)	
1974	
Intake	2.20 inches
Exhaust (with rotators)	2.00 inches
1975 to 1978 (intake and exhaust)	2.20 inches
1979 and later (intake and exhaust)	1.99 inches
Valve spring installed height (approximate)	
1972 to 1978	1-13/16 inches
1979 and later	1-25/32 inches
Valve seat width	0.040 to 0.060 inch

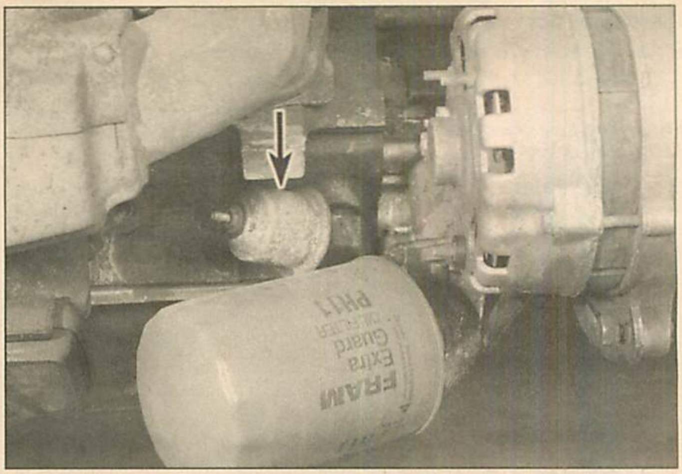
Torque specifications*	Ft-lbs
Main bearing cap bolts	
Six-cylinder engines	80
V8 engines	100
Connecting rod cap nuts	
Six-cylinder engines	33
V8 engines	
304 and 360	33
401	39

*Note: *Refer to either Part A or Part B for additional specifications.*

2C



3.4a On inline six-cylinder engines, the sending unit (arrow) is screwed into the block on the right side, near the bellhousing flange



3.4b The oil pressure sending unit (arrow) on V8 engines is located on the right-front of the block, near the oil filter

1 General information

Included in this portion of Chapter 2 are the general overhaul procedures for cylinder heads and internal engine components. The information ranges from advice concerning preparation for an overhaul and the purchase of replacement parts to detailed, step-by-step procedures covering removal and installation of internal engine components and the inspection of parts.

The following Sections have been written based on the assumption that the engine has been removed from the vehicle. For information concerning in-vehicle engine repair, as well as removal and installation of the external components necessary for the overhaul, see Parts A and B of this Chapter and Section 8 of this Part.

The Specifications included here in Part C are only those necessary for the inspection and overhaul procedures which follow. Refer to Parts A and B for additional specifications.

2 Engine removal - methods and precautions

If you have decided that an engine must be removed for overhaul or major repair work, several preliminary steps should be taken.

Locating a suitable work area is extremely important. A shop is, of course, the most desirable place to work. Adequate work space, along with storage space for the vehicle, will be needed. If a shop or garage is not available, at the very least a flat, level, clean work surface made of concrete or asphalt is required.

Cleaning the engine compartment and engine before beginning the removal procedure will help keep tools clean and organized.

An engine hoist or A-frame will be needed. Make sure that the equipment is rated in excess of the combined weight of the engine and its accessories. Safety is of primary importance, considering the potential hazards involved in lifting the engine out of the vehicle.

If the engine is being removed by a novice, a helper should be available. Advice and aid from someone more experienced would also be helpful. There are many instances when one person cannot simultaneously perform all of the operations required when lifting the engine out of the vehicle.

Plan the operation ahead of time. Arrange for or obtain all of the tools and equipment you will need prior to beginning the job. Some of the equipment necessary to perform engine removal and installation safely and with relative ease are (in addition to an engine hoist) a heavy duty floor jack, complete sets of wrenches and sockets as described in the front of this manual, wooden blocks and plenty of rags and cleaning solvent for mopping up spilled oil, coolant and gasoline. If the hoist is to be rented, make sure that you arrange for it in advance and perform beforehand all of the operations possible without it. This will save you money and time.

Plan for the vehicle to be out of use for a considerable amount of time. A machine shop will be required to perform some of the work which the do-it-yourselfer cannot accomplish due to a lack of special equipment. These shops often have a busy schedule, so it would be wise to consult them before removing the engine in order to accurately estimate the amount of time required to rebuild or repair components that may need work.

Always use extreme caution when removing and installing the engine. Serious injury can result from careless actions. Plan ahead, take your time and a job of this nature, although major, can be accomplished successfully.

3 Engine overhaul - general information

Refer to illustrations 3.4a, 3.4b and 3.4c

It is not always easy to determine when, or if, an engine should be completely overhauled, as a number of factors must be considered.

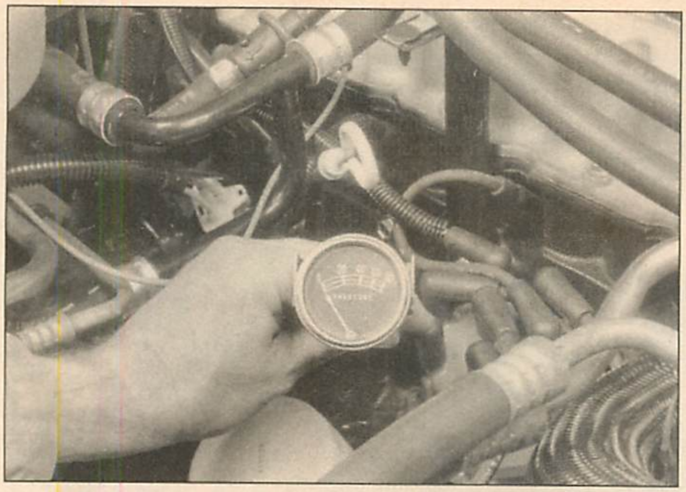
High mileage is not necessarily an indication that an overhaul is needed, while low mileage does not preclude the need for an overhaul. Frequency of servicing is probably the most important consideration. An engine that has had regular and frequent oil and filter changes, as well as other required maintenance, will most likely give many thousands of miles of reliable service. Conversely, a neglected engine may require an overhaul very early in its life.

Excessive oil consumption is an indication that piston rings and/or valve guides are in need of attention. Make sure that oil leaks are not responsible before deciding that the rings and/or guides are bad. Test the cylinder compression (see Section 4) or have a leakdown test performed by an experienced tune-up mechanic to determine the extent of the work required.

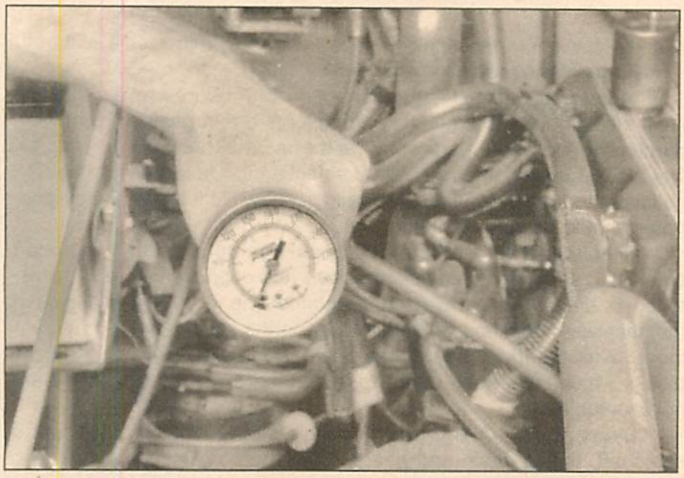
If the engine is making obvious knocking or rumbling noises, the connecting rod and/or main bearings are probably at fault. To accurately test oil pressure, temporarily connect a mechanical oil pressure gauge in place of the oil pressure sending unit **(see illustrations)**. Compare the reading to the pressure listed in this Chapter's Specifications. If the pressure is extremely low, the bearings and/or oil pump are probably worn out.

Loss of power, rough running, excessive valve train noise and high fuel consumption rates may also point to the need for an overhaul, especially if they are all present at the same time. If a complete tune-up does not remedy the situation, major mechanical work is the only solution.

An engine overhaul involves restoring the internal parts to the specifications of a new engine. During an overhaul, the piston rings are replaced and the cylinder walls are reconditioned (rebored and/or honed). If a re-bore is done, new pistons are required. The main bearings, connecting rod bearings and camshaft bearings are generally



3.4c Unscrew the oil pressure sending unit and install a pressure gauge in its place



4.4 A compression gauge with a threaded fitting for the spark plug hole is preferred over the type that requires hand pressure to maintain the seal - be sure to open the throttle valve as far as possible during the compression check

replaced with new ones and, if necessary, the crankshaft may be reground to restore the journals. Generally, the valves are serviced as well, since they are usually in less-than-perfect condition at this point. While the engine is being overhauled, other components, such as the distributor, starter and alternator, can be rebuilt as well. The end result should be a like-new engine that will give many thousands of trouble-free miles. **Note:** *Critical cooling system components such as the hoses, the drivebelts, the thermostat and the water pump MUST be replaced with new parts when an engine is overhauled. Some professional engine rebuilders will not guarantee their rebuilt short-blocks or long-blocks unless the customer has the radiator reconditioned at a radiator shop. The radiator should be professionally cleaned. If in doubt, replace it with a new one.*

Before beginning the engine overhaul, read through the entire procedure to familiarize yourself with the scope and requirements of the job. Overhauling an engine is not difficult if you take your time and follow all procedures carefully. But it is time consuming. Plan on the vehicle being tied up for a minimum of two weeks, especially if parts must be taken to an automotive machine shop for repair or reconditioning. Check on availability of parts and make sure that any necessary special tools and equipment are obtained in advance. Most work can be done with typical hand tools, although a number of precision measuring tools are required for inspecting parts to determine if they must be replaced. Often an automotive machine shop will handle the inspection of parts and offer advice concerning reconditioning and replacement. **Note:** *Always wait until the engine has been completely disassembled and all components, especially the engine block, have been inspected before deciding what service and repair operations must be performed by an automotive machine shop.* Since the block's condition will be the major factor to consider when determining whether to overhaul the original engine or buy a rebuilt one, never purchase parts or have machine work done on other components until the block has been thoroughly inspected. As a general rule, time is the primary cost of an overhaul, so it does not pay to install worn or sub-standard parts.

As a final note, to ensure maximum life and minimum trouble from a rebuilt engine, everything must be assembled with care in a spotlessly clean environment.

4 Compression check

Refer to illustration 4.4

1 A compression check will tell you what mechanical condition the pistons, rings, valves and head gaskets of your engine are in. Specifically, it can tell you if the compression is down due to leakage caused by worn piston rings, defective valves and seats or a blown head gasket. **Note:** *The engine must be at normal operating temperature for this check and the battery must be fully charged.*

2 Begin by cleaning the area around the spark plugs before you remove them (compressed air works best for this). **Warning:** *Always wear eye protection when using compressed air!* This will prevent dirt from getting into the cylinders as the compression check is being done. Remove all of the spark plugs from the engine.

3 Block the throttle wide open and disconnect the primary wires from the coil.

4 With the compression gauge threaded in the number one spark plug hole, crank the engine over at least four compression strokes and watch the gauge **(see illustration)**. The compression should build up quickly in a healthy engine. Low compression on the first stroke, followed by gradually increasing pressure on successive strokes, indicates worn piston rings. A low compression reading on the first stroke, which does not build up during successive strokes, indicates leaking valves or a blown head gasket (a cracked head could also be the cause). Record the highest gauge reading obtained.

5 Repeat the procedure for the remaining cylinders and compare the results to the Specifications.

6 Add some engine oil (about three squirts from a plunger-type oil can) to each cylinder, through the spark plug hole, and repeat the test.

7 If the compression increases after the oil is added, the piston rings are definitely worn. If the compression does not increase significantly, the leakage is occurring at the valves or head gasket. Leakage past the valves may be caused by burned valve seats and/or faces or warped, cracked or bent valves.

8 If two adjacent cylinders have equally low compression, there is a strong possibility that the head gasket between them is blown. The appearance of coolant in the combustion chambers or the oil would verify this condition. Generally, coolant will cause the oil on the dipstick to look light-colored (milky).

9 If the compression is unusually high, the combustion chambers are probably coated with carbon deposits. If that is the case, the cylinder heads should be removed and decarbonized.

10 If compression is way down or varies greatly between cylinders, it would be a good idea to have a leak-down test performed by an automotive repair shop. This test will pinpoint exactly where the leakage is occurring and how severe it is.

5 Vacuum gauge diagnostic checks

Refer to illustration 5.4

A vacuum gauge provides valuable information about what is going on in the engine at a low cost. You can check for worn rings or cylinder walls, leaking head or intake manifold gaskets, incorrect carburetor adjustments, restricted exhaust, stuck or burned valves, weak valve springs, improper ignition or valve timing and ignition problems.

Unfortunately, vacuum gauge readings are easy to misinterpret, so they should be used in conjunction with other tests to confirm the diagnosis.

Both the gauge readings and the rate of needle movement are important for accurate interpretation. Most gauges measure vacuum in inches of mercury (in-Hg). As vacuum increases (or atmospheric pressure decreases), the reading will increase. Also, for every 1,000-foot increase in elevation above sea level, the gauge readings will decrease about one inch of mercury.

Connect the vacuum gauge directly to intake manifold vacuum, not to ported (carburetor) vacuum **(see illustration)**. Be sure no hoses are left disconnected during the test or false readings will result.

Before you begin the test, allow the engine to warm up completely. Block the wheels and set the parking brake. With the transmission in Park, start the engine and allow it to run at normal idle speed. **Warning:** *Carefully inspect the fan blades for cracks or damage before starting the engine. Keep your hands and the vacuum tester clear of the fan and do not stand in front of the vehicle or in line with the fan when the engine is running.*

Read the vacuum gauge; an average, healthy engine should normally produce about 17 to 22 inches of vacuum with a fairly steady needle. Refer to the following vacuum gauge readings and what they indicate about the engines condition:

1 A low, steady reading usually indicates a leaking gasket between the intake manifold and carburetor or throttle body, a leaky vacuum hose, late ignition timing or incorrect camshaft timing. Check ignition timing with a timing light and eliminate all other possible causes, utilizing the tests provided in this Chapter before you remove the timing chain cover to check the timing marks.

2 If the reading is three to eight inches below normal and it fluctuates at that low reading, suspect an intake manifold gasket leak at an intake port.

3 If the needle has regular drops of about two to four inches at a steady rate, the valves are probably leaking. Perform a compression or leak-down test to confirm this.

4 An irregular drop or down-flick of the needle can be caused by a sticking valve or an ignition misfire. Perform a compression or leak-down test and read the spark plugs.

5 A rapid vibration of about four inches-Hg vibration at idle combined with exhaust smoke indicates worn valve guides. Perform a leak-down test to confirm this. If the rapid vibration occurs with an increase in engine speed, check for a leaking intake manifold gasket or head gasket, weak valve springs, burned valves or ignition misfire.

6 A slight fluctuation, say one inch up and down, may mean ignition problems. Check all the usual tune-up items and, if necessary, run the engine on an ignition analyzer.

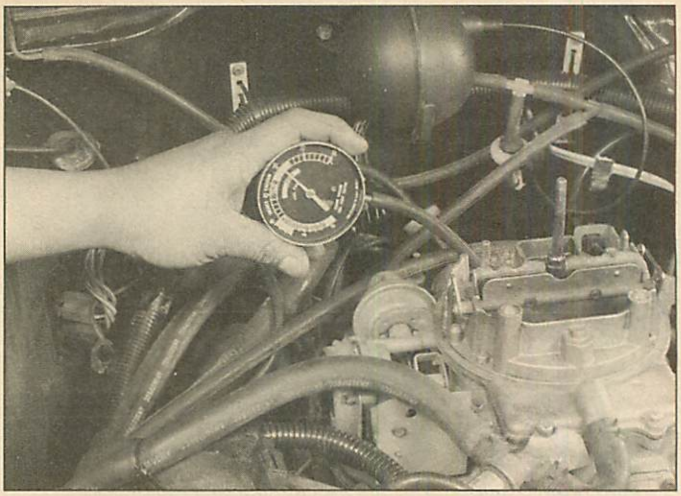
7 If there is a large fluctuation, perform a compression or leak-down test to look for a weak or dead cylinder or a blown head gasket.

8 If the needle moves slowly through a wide range, check for a clogged PCV system, incorrect idle fuel mixture, carburetor/throttle body or intake manifold gasket leaks.

9 Check for a slow return after revving the engine by quickly snapping the throttle open until the engine reaches about 2,500 rpm and let it shut. Normally the reading should drop to near zero, rise above normal idle reading (about 5 in-Hg over) and then return to the previous idle reading. If the vacuum returns slowly and doesn't peak when the throttle is snapped shut, the rings may be worn. If there is a long delay, look for a restricted exhaust system (often the muffler or catalytic converter). An easy way to check this is to temporarily disconnect the exhaust ahead of the suspected part and re-test.

6 Engine rebuilding alternatives

The do-it-yourselfer is faced with a number of options when performing an engine overhaul. The decision to replace the engine block, piston/connecting rod assemblies and crankshaft depends on a number of factors, with the number one consideration being the condition of the block. Other considerations are cost, access to machine shop facilities, parts availability, time required to complete the project and the extent of prior mechanical experience on the part of the do-it-yourselfer.



5.4 A simple vacuum gauge connected to manifold vacuum can tell you a lot about an engine's condition

Some of the rebuilding alternatives include:

Individual parts - If the inspection procedures reveal that the engine block and most engine components are in reusable condition, purchasing individual parts may be the most economical alternative. The block, crankshaft and piston/connecting rod assemblies should all be inspected carefully. Even if the block shows little wear, the cylinder bores should be surface honed.

Crankshaft kit - This rebuild package consists of a reground crankshaft and a matched set of pistons and connecting rods. The pistons will already be installed on the connecting rods. Piston rings and the necessary bearings will be included in the kit. These kits are commonly available for standard-size cylinder bores, as well as for engine blocks which have been bored to a standard oversize. These kits are not assembled.

Short block - A short block consists of an engine block with a camshaft, timing chain and gears, crankshaft and piston/connecting rod assemblies already installed. All new bearings are incorporated and all clearances will be correct. The existing cylinder head(s), valve train components and external parts can be bolted to the short block with little or no machine shop work necessary.

Long block - A long block consists of a short block plus an oil pump, cylinder head(s) and valve train components. All components are installed with new bearings, seals and gaskets incorporated throughout. The installation of manifolds and external parts is all that is necessary.

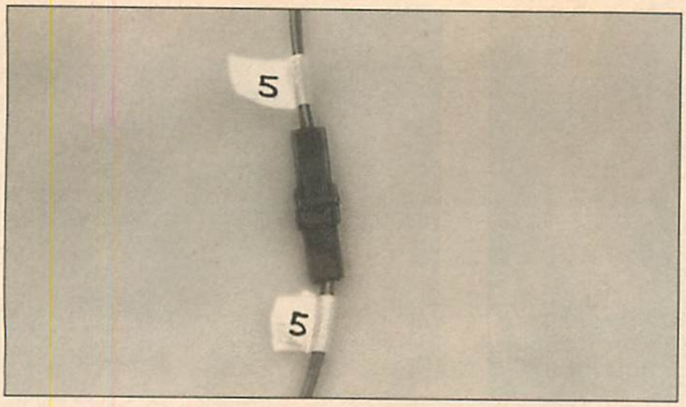
Give careful thought to which alternative is best for you and discuss the situation with local automotive machine shops, auto parts dealers or parts store counter people before ordering or purchasing replacement parts.

7 Engine - removal and installation

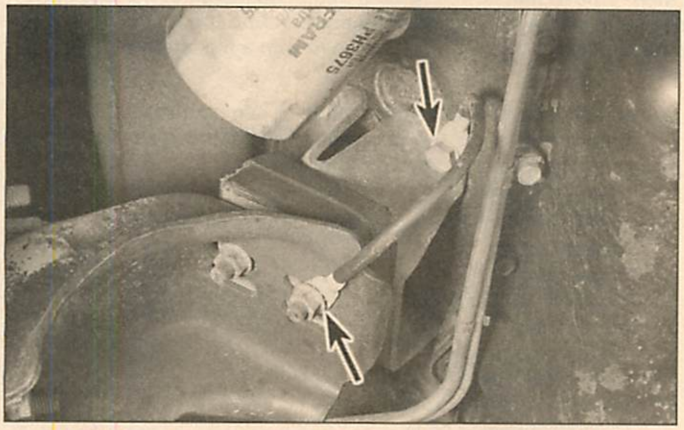
Refer to illustrations 7.10 and 7.23

Warning: *Gasoline is extremely flammable, so take extra precautions when disconnecting any part of the fuel system. Don't smoke or allow open flames or bare light bulbs in or near the work area and don't work in a garage where a natural gas appliance (such as a clothes dryer or water heater) is installed. If you spill gasoline on your skin, rinse it off immediately. Have a fire extinguisher rated for gasoline fires handy and know how to use it! Also, the air conditioning system is under high pressure - have a dealer service department or service station discharge the system and recapture the refrigerant before disconnecting any of the hoses or fittings.*

Note: *Read through the following steps carefully and familiarize yourself with the procedure before beginning work.*



7.10 Label each wire before disconnecting the connector



7.23 Remove the ground strap (arrows) connecting the frame to the engine - on most models it is attached at one of the engine mounts

Removal

1 On air-conditioned models, inspect the compressor mounting to determine if the compressor can be unbolted and moved aside without disconnecting the refrigerant lines (see Chapter 3). If this is not possible, have the system discharged by a dealer or service station (see the **Warning** at the beginning of this Section).
2 Remove the hood (see Chapter 11).
3 Remove the air cleaner assembly and all hoses connected to it (see Chapter 4).
4 Drain the cooling system and remove the drivebelts (see Chapter 1). **Note:** *Mark all the accessory drivebelts with markers to indicate which components they drive, i.e. alternator, air conditioning compressor, power steering pump, and also number the belts to indicate which order they go onto the pulleys. This will eliminate confusion on reassembly, which might be days or weeks later.*
5 Remove the radiator, shroud and fan (see Chapter 3).
6 Detach the radiator and heater hoses from the engine.
7 Disconnect the accelerator cable (see Chapter 4) and throttle rod (automatic transmission only - see Chapter 7B) from the carburetor.
8 Remove the power steering pump and brackets (if equipped) without disconnecting the hoses and tie it out of the way (see Chapter 10).
9 Remove the alternator (see Chapter 5).
10 Label and disconnect all wires from the engine **(see illustration)**. Masking tape and/or a touch-up paint applicator work well for marking items. **Note:** *Take instant photos or sketch the locations of components and brackets to help with reassembly.*
11 Disconnect the fuel lines at the engine (see Chapter 4) and plug the lines to prevent fuel loss.
12 Label and detach all vacuum lines from the intake manifold.
13 Raise the vehicle and support it securely on jackstands.
14 Drain the engine oil (see Chapter 1).
15 Refer to Chapter 4 and disconnect the exhaust pipe(s) from the exhaust manifold(s).
16 Support the transmission with a floor jack or use a length of chain to keep it in place when the engine is separated for removal. **Note:** *On automatic-transmission models, unbolt the transmission dipstick tube from the cylinder head, but leave it attached to the transmission.*
17 On some early models, the heater core/blower motor housing on the firewall must be removed for clearance (see Chapter 3).
18 Disconnect the wires from the starter solenoid and remove the starter (see Chapter 5).
19 Remove the flywheel or torque converter inspection cover (see Chapter 7B).
20 If equipped with an automatic transmission, remove the torque converter-to-driveplate bolts (see Chapter 7B). In order to turn the engine to reach all the bolts, use a socket and breaker bar on the bolt in the front end of the crankshaft to turn the driveplate to the needed positions.
21 Remove the transmission-to-engine bolts.
22 Attach an engine hoist to the engine and raise the engine slightly to remove the weight from the engine mounts.
23 Remove the engine mount bolts or stud nuts (see Chapter 2A or 2B). On most models, disconnect the ground strap connected to one of the engine mounts **(see illustration)**.
24 Lift the engine slightly and separate the engine from the transmission. Carefully work it forward to separate it from the transmission. If you're working on a vehicle with an automatic transmission, be sure the torque converter stays in the transmission (clamp a pair of locking pliers to the housing to keep the converter from sliding out). If you're working on a vehicle with a manual transmission, the input shaft must be completely disengaged from the clutch.
25 Check to make sure everything is disconnected, then lift the engine out of the vehicle. The engine will probably need to be tilted and/or maneuvered as it's lifted out, so have an assistant handy. **Warning:** *Do not place any part of your body under the engine when it is supported only by a hoist or other lifting device.*
26 Remove the flywheel/driveplate and mount the engine on an engine stand or set the engine on the floor and support it so it doesn't tip over. Then disconnect the engine hoist.

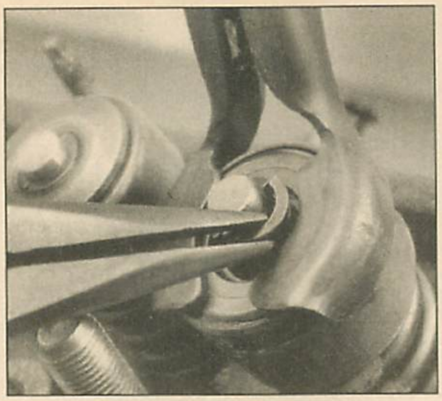
Installation

27 Check the engine mounts. If they're worn or damaged, replace them.
28 On manual transmission models, inspect the clutch components (see Chapter 8). On automatic models, inspect the converter seal and bushing.
29 Apply a dab of grease to the pilot bushing on manual transmission models, or to the torque converter hub on automatic transmission models.
30 Attach the hoist to the engine and carefully lower the engine into the engine compartment.
31 Carefully guide the engine into place. Follow the procedure outlined in Chapter 7 for transmission attachment. **Caution:** *Do not use the bolts to force the engine and transmission into alignment. It may crack or damage major components.*
32 Align the engine to the engine mounts. Install the nuts or bolts and tighten them securely. **Note:** *If it was detached from the engine, reconnect the automatic transmission dipstick to the engine.*
33 Reinstall the remaining components in the reverse order of removal.
34 Add coolant, oil, power steering and transmission fluid as needed (see Chapter 1).
35 Run the engine and check for proper operation and leaks. Shut off the engine and recheck fluid levels. See Section 25 for procedures to break-in a new engine.

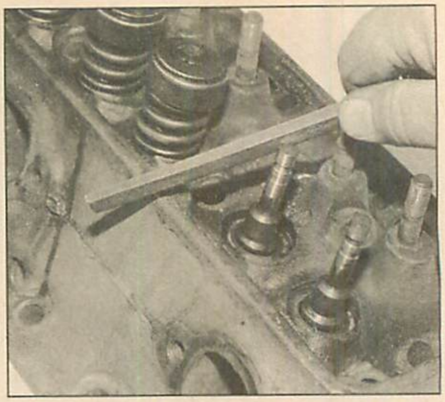
8 Engine overhaul - disassembly sequence

1 It is much easier to disassemble and work on the engine if it is mounted on a portable engine stand. These stands can often be rented quite cheaply from an equipment rental yard. Before the engine is mounted on a stand, the flywheel/driveplate should be removed from

9.2 A small plastic bag, with an appropriate label, can be used to store the valve train components so they can be kept together and reinstalled in the original position



9.3a Use a valve spring compressor to compress the spring, then remove the keepers from the valve stem with a magnet or needle-nose pliers



9.3b If the valve won't pull through the guide, deburr the edge of the stem end and the area around the top of the keeper groove with a file or whetstone

the engine (refer to Chapter 2A or 2B).

2 If a stand is not available, it is possible to disassemble the engine with it blocked up on a sturdy workbench or on the floor. Be extra careful not to tip or drop the engine when working without a stand.

3 If you are going to obtain a rebuilt engine, all external components must come off first, to be transferred to the replacement engine, just as they will if you are doing a complete engine overhaul yourself. These include:

Alternator and brackets
Emissions control components
Distributor, spark plug wires and spark plugs
Thermostat and housing cover
Water pump
Carburetor
Intake/exhaust manifolds
Oil pump assembly
Engine mounts
Clutch and flywheel/driveplate

Note: *When removing the external components from the engine, pay close attention to details that may be helpful or important during installation. Note the installed position of gaskets, seals, spacers, pins, washers, bolts and other small items.*

4 If you are obtaining a short-block, which consists of the engine block, crankshaft, pistons and connecting rods all assembled, then the cylinder heads, oil pan and oil pump will have to be removed as well. See *Engine rebuilding alternatives* for additional information regarding the different possibilities to be considered.

5 If you are planning a complete overhaul, the engine must be disassembled and the internal components removed in the general following order:

Valve cover(s)
Intake and exhaust manifolds
Rocker arms and pushrods
Cylinder head(s)
Valve lifters
Oil pan
Oil pump
Fuel pump
Timing chain cover
Timing chain and sprockets
Camshaft
Piston/connecting rod assemblies
Crankshaft and main bearings

6 Critical cooling system components such as the hoses, the drivebelts, the thermostat and the water pump MUST be replaced with new parts when an engine is overhauled. If you are buying a rebuilt engine or short-block, some rebuilders will not guarantee their engines unless you have proof that the radiator has been professionally cleaned. Also, new components should be used in the oil pump housing.

7 Before beginning the disassembly and overhaul procedures, make sure the following items are available:

Common hand tools
Small cardboard boxes or plastic bags for storing parts
Gasket scraper
Ridge reamer
Vibration damper puller
Micrometers
Telescoping gauges
Dial indicator set
Valve spring compressor
Cylinder surfacing hone
Piston ring groove cleaning tool
Electric drill motor
Tap and die set
Wire brushes
Oil gallery brushes
Cleaning solvent

9 Cylinder head - disassembly

Refer to illustrations 9.2, 9.3a and 9.3b

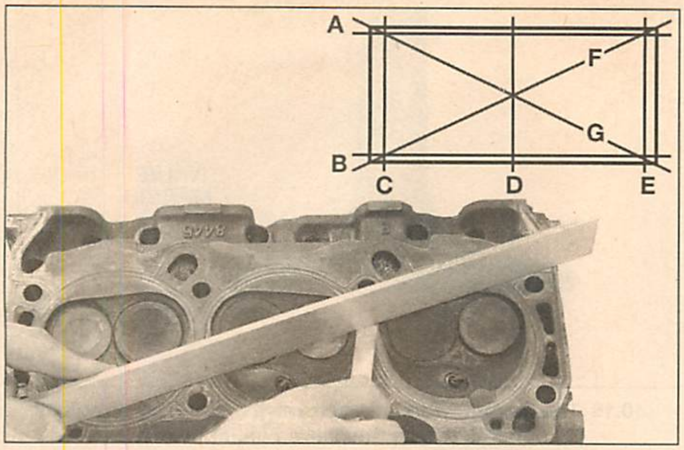
Note: *New and rebuilt cylinder heads are commonly available for most engines at dealerships and auto parts stores. Due to the fact that some specialized tools are necessary for the disassembly and inspection procedures, and replacement parts may not be readily available, it may be more practical and economical for the home mechanic to purchase replacement cylinder heads rather than taking the time to disassemble, inspect and recondition the originals.*

1 Cylinder head disassembly involves removal of the intake and exhaust valves and related components. If they are still in place, remove the rocker arms. Label the parts or store them separately so they can be reinstalled in their original locations.

2 Before the valves are removed, arrange to label and store them, along with their related components, so they can be kept separate and reinstalled in the same valve guides they are removed from **(see illustration)**.

3 Compress the springs on the first valve with a spring compressor and remove the keepers **(see illustration)**. Carefully release the valve spring compressor and remove the retainer and (if used) rotators, the shield, the springs and the spring seat or shims (if used). Rotators are generally used only on the exhaust valves. Remove the oil seal(s) from the valve stem and the umbrella-type seal from over the guide boss (if used), then pull the valve from the head. If the valve binds in the guide (won't pull through), push it back into the head and deburr the area around the keeper groove with a fine file or whetstone **(see illustration)**.

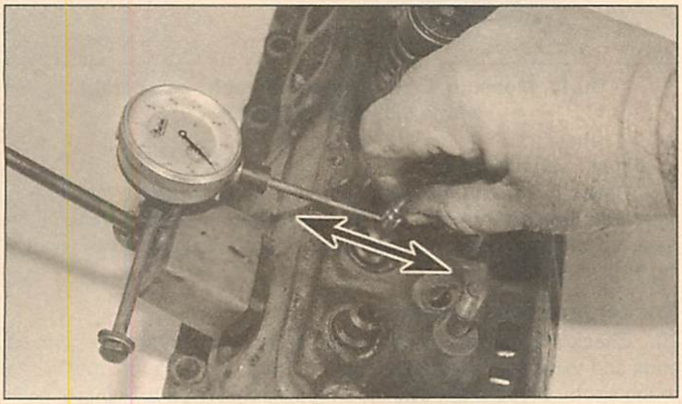
4 Repeat the procedure for the remaining valves. Remember to



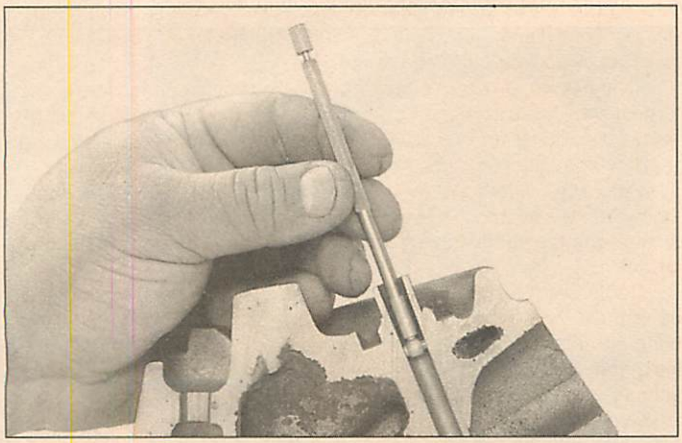
10.12 Check the cylinder head gasket surface for warpage by trying to slip a feeler gauge under the straightedge (see this Chapter's Specifications for the maximum warpage allowed and use a feeler gauge of that thickness) - check straight across and diagonally

keep all the parts for each valve together so they can be reinstalled in the same locations.

5 Once the valves and related components have been removed and stored in an organized manner, the head should be thoroughly cleaned and inspected. If a complete engine overhaul is being done, finish the engine disassembly procedures before beginning the cylinder head cleaning and inspection process.



10.14a A dial indicator can be used to determine the valve stem-to-guide clearance - move the valve stem as indicated by the arrows



10.14b A machinist's small-hole gauge can be used to check valve guide wear - expand it until it meets the guide, then measure it with a micrometer - measure at the top, middle and bottom of the guide

10 Cylinder head - cleaning and inspection

1 Thorough cleaning of the cylinder heads and related valve train components, followed by a detailed inspection, will enable you to decide how much valve service work must be done during the engine overhaul.

Cleaning

2 Scrape away all traces of old gasket material and sealing compound from the head gasket, intake manifold and exhaust manifold sealing surfaces. Be very careful not to gouge the cylinder head. Special gasket-removal solvents, which soften gaskets and make removal much easier, are available at auto parts stores.

3 Remove any built-up scale from the coolant passages.

4 Run a stiff wire brush through the various holes to remove any deposits that may have formed in them.

5 Run an appropriate-size tap into each of the threaded holes to remove any corrosion and thread sealant that may be present. If compressed air is available, use it to clear the holes of debris produced by this operation.

6 Check the condition of the spark plug threads.

7 Clean the cylinder head with solvent and dry it thoroughly. Compressed air will speed the drying process and ensure that all holes and recessed areas are clean. **Note:** *Decarbonizing chemicals are available and may prove very useful when cleaning cylinder heads and valve train components. They are very caustic and should be used with caution. Be sure to follow the instructions on the container.*

8 Clean the rocker arms, shafts (1972 and 1974 six-cylinder engines only) and pushrods with solvent and dry them thoroughly (don't mix them up during the cleaning process). Compressed air will speed the drying process and can be used to clean out the oil passages.

9 Clean all the valve springs, shields, keepers and retainers (or rotators) with solvent and dry them thoroughly. Do the components from one valve at a time to avoid mixing up the parts.

10 Scrape off any heavy deposits that may have formed on the valves, then use a wire brush mounted in a drill motor to remove deposits from the valve heads and stems. Again, make sure the valves do not get mixed up.

Inspection

Cylinder head

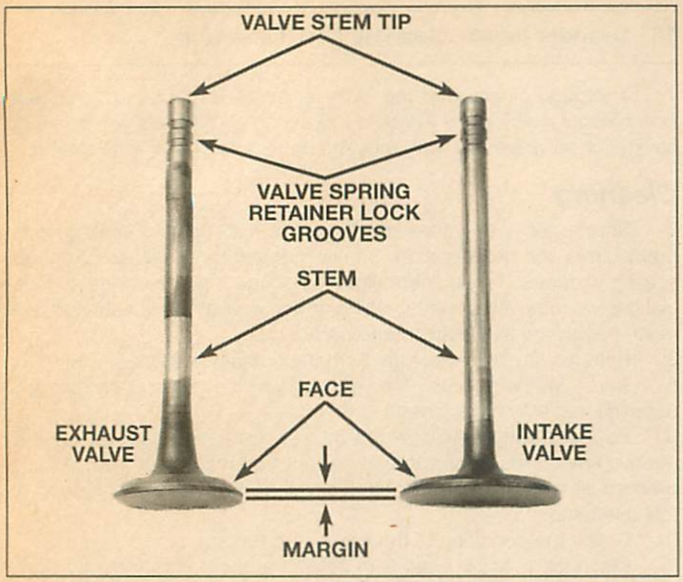
Refer to illustrations 10.12, 10.14a and 10.14b

11 Inspect the head very carefully for cracks, evidence of coolant leakage and other damage. If cracks are found, a new cylinder head should be obtained.

12 Using a straightedge and feeler gauge, check the head gasket mating surface for warpage **(see illustration)**. If the warpage exceeds the limit specified in this Chapter's Specifications, it can be resurfaced at an automotive machine shop.

13 Examine the valve seats in each of the combustion chambers. If they are pitted, cracked or burned, the head will require valve service with special equipment that is beyond the scope of most home mechanics, especially from an equipment stand point.

14 Check the valve stem-to-guide clearance by measuring the lateral movement of the valve stem with a dial indicator attached securely to the head **(see illustration)**. The valve must be in the guide and approximately 1/16-inch off the seat. The total valve stem movement indicated by the gauge needle must be divided by two to obtain the actual clearance. After this is done, if there is still some doubt regarding the condition of the valve guides they should be checked by an automotive machine shop (the cost should be minimal). The guide dimensions can also be checked with a small-hole gauge, which can detect taper in the guide **(see illustration)**. When using a small-hole gauge or telescoping snap gauge, put the gauge down to the middle portion of the guide (where wear should be minimal) and tighten the gauge. Move the gauge up and down and if the guide isn't worn the feel of the gauge should stay the same all the way. Loose areas indicate wear. If they are worn, they can often be restored at a machine shop or replaced with new guides.



10.15 Check for valve wear at the points shown here

Valves

Refer to illustrations 10.15 and 10.16

15 Carefully inspect each valve face for uneven wear, deformation, cracks, pits and burned spots **(see illustration)**. Check the valve stem for scuffing and galling and the neck for cracks. Rotate the valve and check for any obvious indication that it is bent. Look for pits and excessive wear on the end of the stem. The presence of any of these conditions indicates the need for valve service by an automotive machine shop.

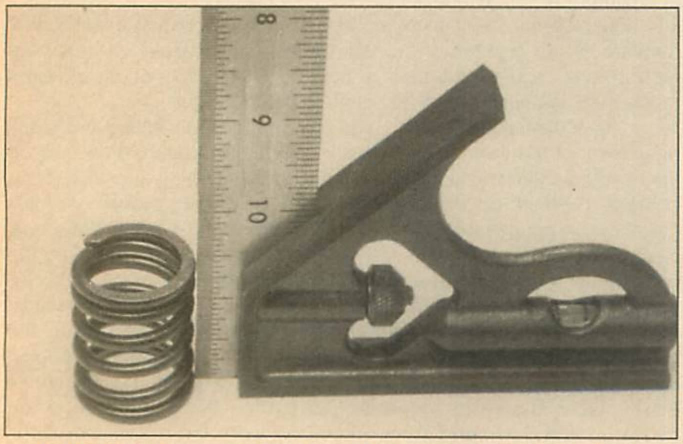
16 Measure the margin width on each valve. Any valve with a margin that is narrower than 0.047 (3/64) inch should be discarded and replaced with a new one **(see illustration)**.

Valve components

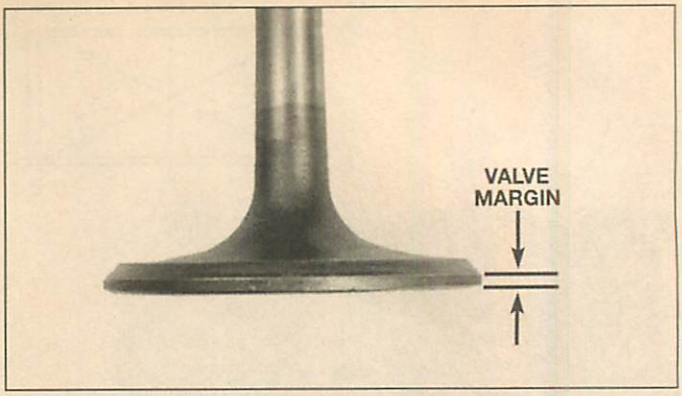
Refer to illustrations 10.17, 10.18 and 10.19

17 Check each valve spring for wear (on the ends) and pits. Measure the free length and compare it to the Specifications in this Chapter **(see illustration)**. Any springs that are shorter than specified have sagged and should not be reused. The tension of all springs should be checked with a special fixture before deciding that they are suitable for use in a rebuilt engine (take the springs to an automotive machine shop for this check).

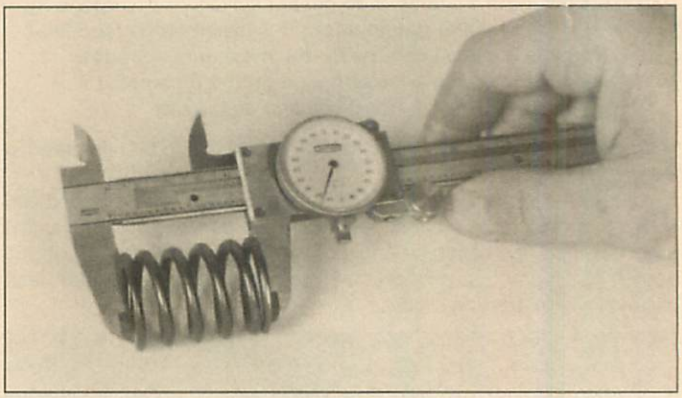
18 Stand each spring on a flat surface and check it for squareness **(see illustration)**. If any of the springs are distorted or sagged, replace all of them with new parts.



10.18 Check each valve spring for squareness - if it is bent, it should be replaced



10.16 The margin width on each valve must be as specified (if no margin exists, the valve cannot be reused)



10.17 Measure the free length of each valve spring with a dial or vernier caliper

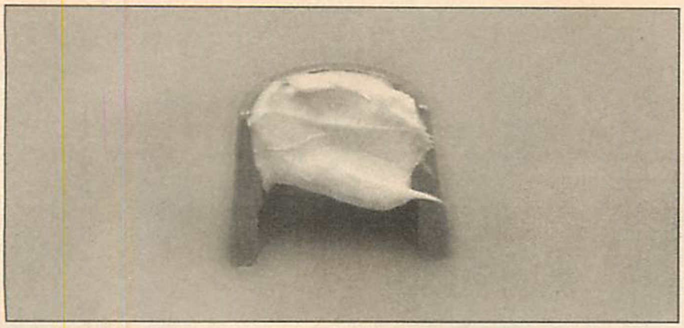
19 Check the spring retainers (or rotators) and keepers for obvious wear **(see illustration)** and cracks. Any questionable parts should be replaced with new ones, as extensive damage will occur if they fail during engine operation.

Rocker arm components

20 Check the rocker arm faces (the areas that contact the pushrod ends and valve stems) for pits, wear, galling, cracks, score marks and rough spots. On early six-cylinder engines, check the rocker arm pivot contact areas and shafts. See Section 5 of Part A of this Chapter for checks of the rocker-shaft system.

21 Inspect the pushrod ends for scuffing and excessive wear. Roll

10.19 The exhaust valve rotators can be checked by turning the inner and outer sections in opposite directions to feel for smooth movement and excessive play



12.6 Apply a small dab of grease to each keeper as shown here before installation - it'll hold them in place on the valve stem as the spring is released

each pushrod on a flat surface, such as plate glass, to determine if it is bent.

22 Check the rocker arm bolt holes in the cylinder heads for damaged threads.

23 Any damaged or excessively worn parts must be replaced with new ones.

24 If the inspection process indicates that the valve components are in generally poor condition and worn beyond the limits specified in this Chapter, which is usually the case in an engine that is being overhauled, reassemble the valves in the cylinder head and refer to Section 11 for valve servicing recommendations.

11 Valves - servicing

1 Because of the complex nature or the job and the special tools and equipment needed, servicing of the valves, the valve seats and the valve guides (commonly known as a "valve job") is best left to a professional.

2 The home mechanic can remove and disassemble the cylinder heads, do the initial cleaning and inspection, then reassemble and deliver the cylinder heads to a dealer service department or an automotive machine shop for the actual valve servicing.

3 The dealer service department, or automotive machine shop, will remove the valves and springs, recondition or replace the valves and valve seats, recondition the valve guides, check and replace the valve springs, spring retainers or rotators and keepers (as necessary), replace the valve seals with new ones, reassemble the valve components and make sure the installed spring height is correct. The cylinder head gasket surface will also be resurfaced if it is warped.

4 After the valve job has been performed by a professional, the head will be in like-new condition. When the head is returned, be sure to clean it again before installation on the engine to remove any metal particles and abrasive grit that may still be present from the valve service or head resurfacing operations. Use compressed air, if available, to blow out all the oil holes and passages.

12 Cylinder head - reassembly

Refer to illustrations 12.6, and 12.8

1 Regardless of whether or not the cylinder heads were sent to an automotive machine shop for valve servicing, make sure they are clean before beginning reassembly.

2 If the cylinder heads were sent out for valve servicing, the valves and related components will already be in place. Begin the reassembly procedure with Step 8.

3 Beginning at one end of the head, lubricate and install the first valve. Apply moly-base grease or clean engine oil to the valve stem.

4 Different types of valve stem oil seals are used on the intake and exhaust. On some applications, an umbrella type seal which extends down over the valve guide boss is used over the valve stem.

5 Drop the spring seat or shim(s), if used, over the valve guide and set the valve spring and retainer (or rotator) in place.

6 Compress the springs with a valve spring compressor. Position the keepers in the upper groove, then slowly release the compressor and make sure the keepers seat properly. Apply a small dab of grease to each keeper to hold it in place if necessary **(see illustration)**.

7 Repeat the procedure for the remaining valves. Be sure to return the components to their original locations - do not mix them up!

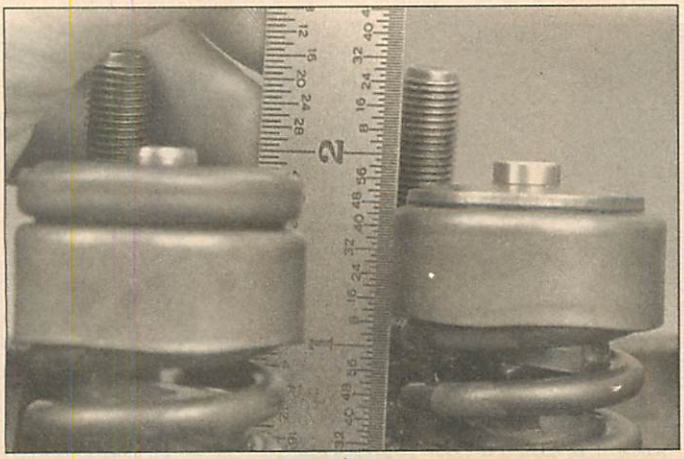
8 Check the installed valve spring height with a ruler graduated in 1/32-inch increments **(see illustration)** or a dial caliper. If the cylinder heads were sent out for service work, the installed height should be correct (but don't automatically assume that it is). The measurement is taken from the top of each spring seat or shim(s) to the bottom of the retainer/rotator. If the height is greater than listed in this Chapter's specifications, shims can be added under the springs to correct it. **Caution:** *Do not, under any circumstances, shim the springs to the point where the installed height is less than specified. A condition called "coil bind" will be caused when the spring is compressed.*

13 Piston/connecting rod assembly - removal

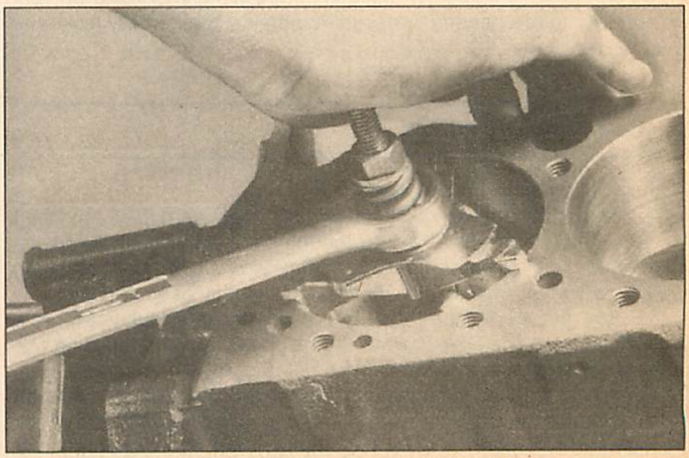
Refer to illustrations 13.1, 13.3, 13.4 and 13.5

Note: *Prior to removing the piston/connecting rod assemblies, remove the cylinder head(s), the oil pan and the oil pump, if it is mounted in the crankcase, and the oil pump pickup screen assembly by referring to the appropriate Sections in Chapter 2, Part A or Part B.*

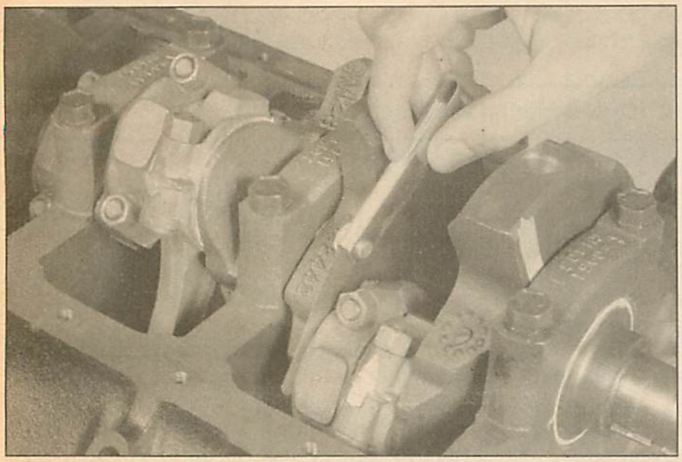
1 Completely remove the ridge at the top of each cylinder with a ridge reaming tool **(see illustration)**. Follow the manufacturer's instructions provided with the tool. Failure to remove the ridge before attempting to remove the piston/connecting rod assemblies will result in piston breakage.



12.8 Valve spring installed height is the distance from the spring seat to the top of the spring (not including the retainer or rotator)



13.1 A ridge reamer is required to remove the ridge from the top of each cylinder - do this before removing the pistons!



13.3 Check the connecting rod side clearance (endplay) with a feeler gauge as shown here

2 After the cylinder ridges have been removed, turn the engine upside-down so the crankshaft is facing up.

3 Before the connecting rods are removed, check the endplay (side clearance) with a feeler gauge. Slide the feeler gauge between the first connecting rod and the crankshaft throw until the play is removed **(see illustration)**. The endplay is equal to the thickness of the feeler gauge. If the endplay exceeds the service limit listed in this Chapter's Specifications, new connecting rods will be required. If new rods (or a new crankshaft) are installed, the endplay may fall under the specified minimum. If it does, the rods will have to be machined to restore it - consult an automotive machine shop for advice if necessary. Repeat the procedure for the remaining connecting rods.

4 Check the connecting rods and caps for identification marks **(see illustration)**. If they are not plainly marked, use a small center-punch to make the appropriate number of indentations on each rod and cap.

5 Loosen each of the connecting rod cap nuts 1/2-turn at a time until they can be removed by hand. Remove the number one connecting rod cap and bearing insert. Do not drop the bearing insert out of the cap. Slip a short length of plastic or rubber hose over each connecting rod cap bolt to protect the crankshaft journal and cylinder wall when the piston is removed **(see illustration)**. Push the connecting rod/piston assembly out through the top of the engine. Use a wooden hammer handle to push on the upper bearing insert in the connecting rod. If resistance is felt, double-check to make sure that all of the ridge was removed from the cylinder.

6 Repeat the procedure for the remaining cylinders. After removal, reassemble the connecting rod caps and bearing inserts in their respective connecting rods and install the cap nuts finger tight. Leaving the old bearing inserts in place until reassembly will help prevent the connecting rod bearing surfaces from being accidentally nicked or gouged.

14 Crankshaft - removal

Refer to illustrations 14.2, 14.3 and 14.4

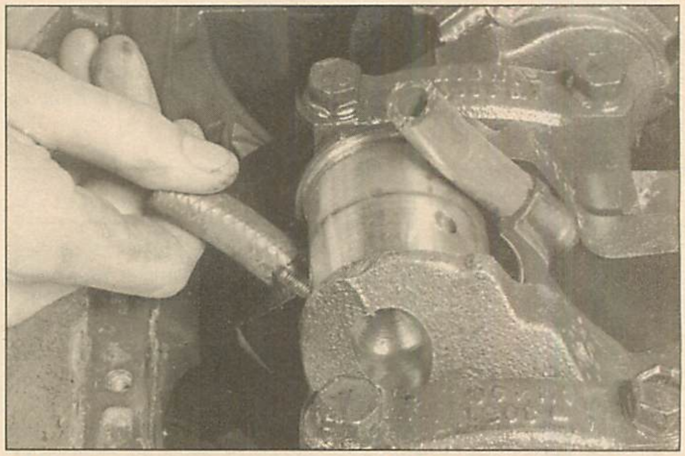
Note: *The crankshaft can be removed only after the engine has been removed from the vehicle. It is assumed that the flywheel or driveplate, vibration damper or crankshaft pulley, timing chain, oil pan, oil pump and piston/connecting rod assemblies have already been removed.*

1 Before the crankshaft is removed, check the endplay. Mount a dial indicator with the stem in line with the crankshaft and touching one of the crank throws or the end of the crank.

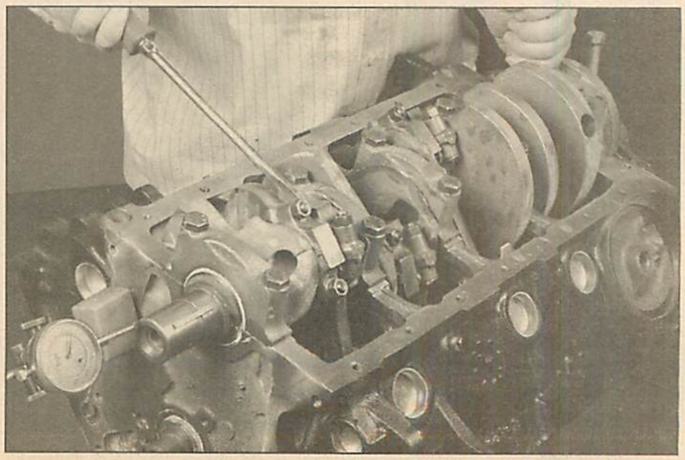
2 Push the crankshaft all the way to the rear and zero the dial indicator. Next, pry the crankshaft to the front as far as possible and check the reading on the dial indicator **(see illustration)**. The distance that it moves is the endplay. If it is greater than the maximum listed in this Chapter's Specifications, check the crankshaft thrust surfaces for wear. If no wear is evident, new main bearings should correct the endplay.

3 If a dial indicator is not available, a feeler gauge can be used. Gently pry or push the crankshaft all the way to the front of the engine. Slip the feeler gauge between the crankshaft and the front face of the thrust main bearing to determine the clearance **(see illustration)**.

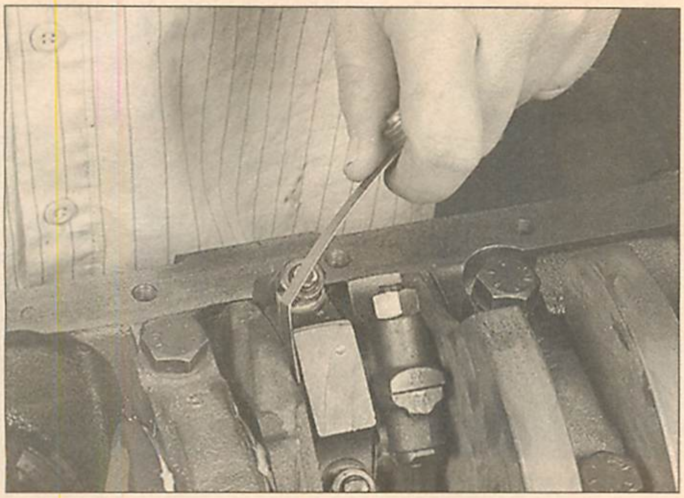
13.4 The connecting rods should be marked with numbers at the parting line of each rod and cap - the number corresponds to the engine cylinder number - on reassembly, be sure the numbers are on the same side, facing each other, as shown



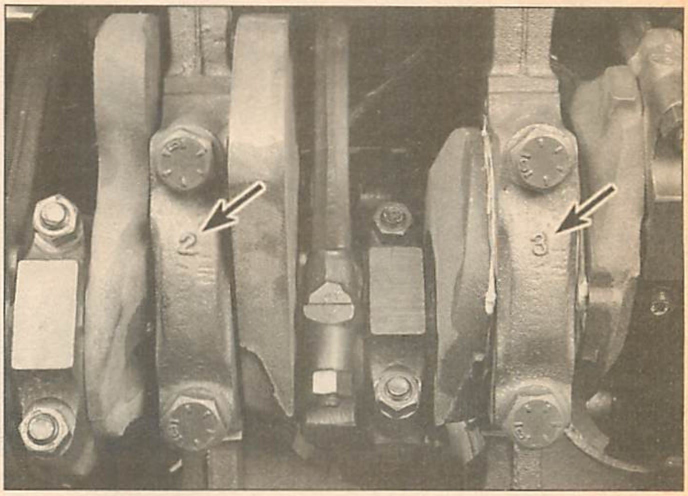
13.5 To prevent damage to the crankshaft journals and cylinder walls, slip sections of rubber hose over the rod bolts before removing the piston/rod assemblies



14.2 Checking crankshaft endplay with a dial indicator



14.3 Checking crankshaft endplay with a feeler gauge



14.4 The main bearing caps are marked to indicate their locations (arrows) - they should be numbered consecutively from the front of the engine to the rear, and have arrows to indicate which way faces the front of the engine

4 Check the main bearing caps to see if they are marked to indicate their locations. They should be numbered consecutively from the front of the engine to the rear **(see illustration)**. If they aren't, mark them with number stamping dies or a center-punch.

5 Loosen each of the main bearing cap bolts 1/4-turn at a time each, until they can be removed by hand.

6 Gently tap the caps with a soft-face hammer, then separate them from the engine block. If necessary, use the bolts as levers to remove the caps. Try not to drop the bearing inserts if they come out with the caps.

7 Carefully lift the crankshaft out of the engine. It is a good idea to have an assistant available, since the crankshaft is quite heavy. With the bearing inserts in place in the engine block and main bearing caps, return the caps to their respective locations on the engine block and tighten the bolts finger tight.

15 Engine block - cleaning

Refer to illustrations 15.1a, 15.1b, 15.4, 15.8 and 15.10

1 Using the wide end of a punch tap in on the outer edge of the core plug to turn the plug sideways in the bore. Then, using a pair of pliers, pull the core plug from the engine block **(see illustrations)**. Don't worry about the condition of the old core plugs as they are being removed because they will be replaced on reassembly with new plugs.

2 Using a gasket scraper, remove all traces of gasket material from the engine block.

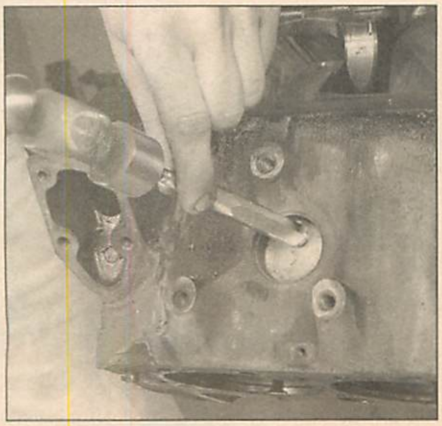
3 Remove the main bearing caps or cap assembly and separate the bearing inserts from the caps and the engine block. Tag the bearings, indicating which cylinder they were removed from and whether they were in the cap or the block, then set them aside.

4 Remove all of the threaded oil gallery plugs from the block **(see illustration)**. The plugs are usually very tight - they may have to be drilled out and the holes retapped. If drilled out or damaged during removal, use new plugs when the engine is reassembled.

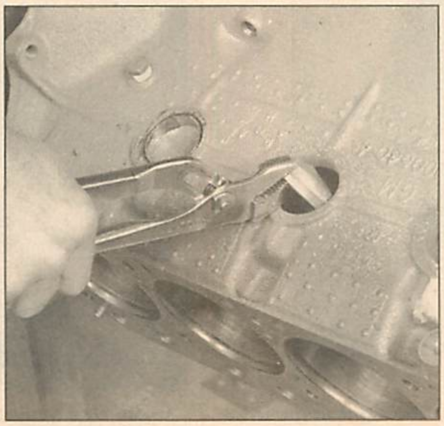
5 If the engine is extremely dirty it should be taken to an automotive machine shop to be steam cleaned or hot tanked.

6 After the block is returned, clean all oil holes and oil galleries one more time. Brushes specifically designed for this purpose are available at most auto parts stores. Flush the passages with warm water until the water runs clear, dry the block thoroughly and wipe all machined surfaces with a light, rust preventive oil. If you have access to compressed air, use it to speed the drying process and to blow out all the oil holes and galleries. **Warning:** *Wear eye protection when using compressed air!*

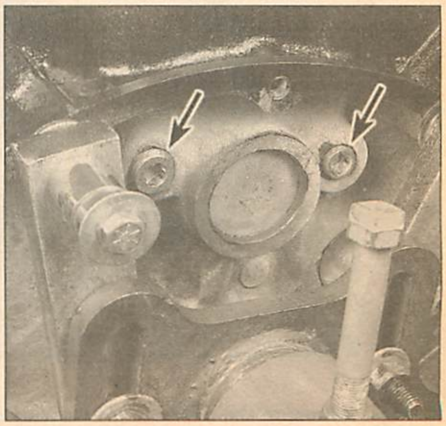
7 If the block isn't extremely dirty or sludged up, you can do an adequate cleaning job with hot soapy water and a stiff brush. Take plenty of time and do a thorough job. Regardless of the cleaning method used, be sure to clean all oil holes and galleries very thoroughly, dry the block completely and coat all machined surfaces with light oil.



15.1a A hammer and a large punch can be used to knock the core plugs sideways in their bores

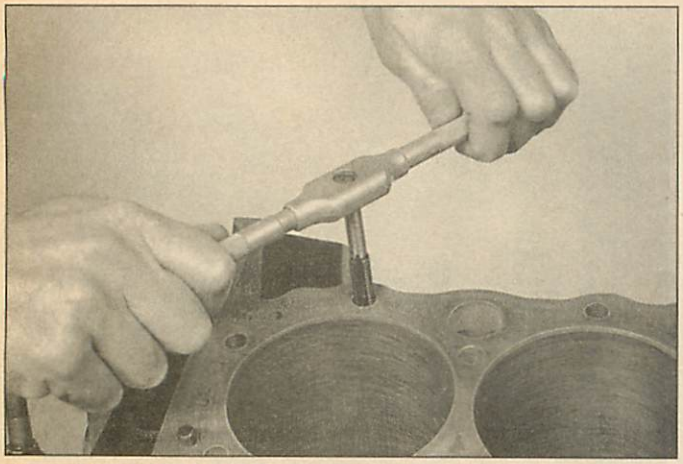


15.1b Pull the core plugs from the block with pliers



15.4 Remove all the oil gallery plugs/bolts (arrows) to more thoroughly clean all debris from the oiling system (typical galley plugs shown)

2C



15.8 All bolt holes in the block - particularly the main bearing cap and head bolt holes - should be cleaned and restored with a tap (be sure to remove debris from the holes after this is done)

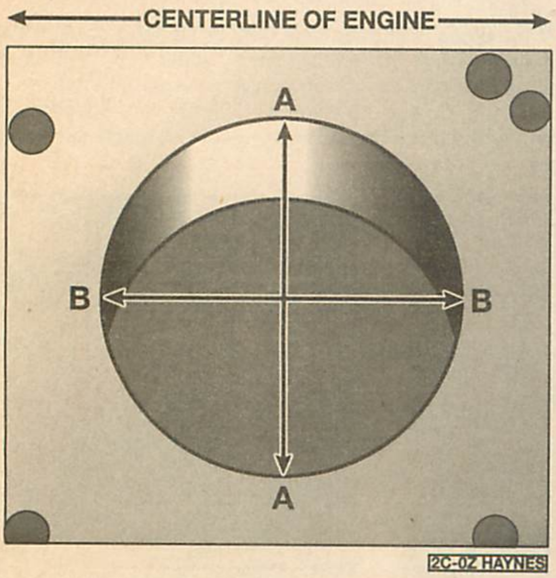
8 The threaded holes in the block must be clean to ensure accurate torque readings during reassembly. Run the proper size tap into each of the holes to remove rust, corrosion, thread sealant or sludge and restore damaged threads **(see illustration)**. If possible, use compressed air to clear the holes of debris produced by this operation. Now is a good time to clean the threads on the head bolts and the main bearing cap bolts as well.

9 Reinstall the main bearing caps and tighten the bolts finger tight.

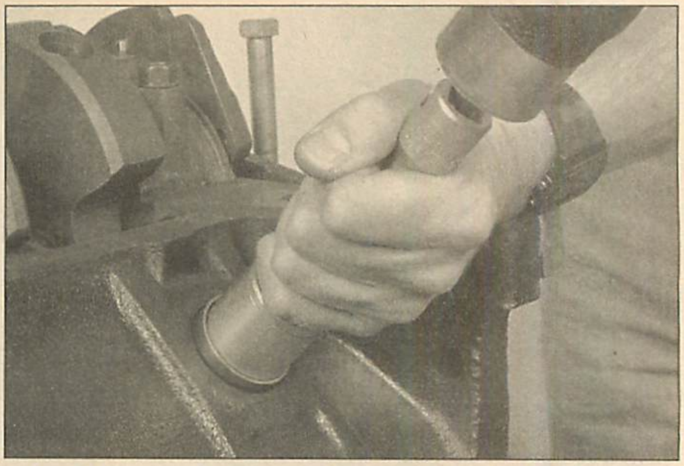
10 After coating the sealing surfaces of the new core plugs with Permatex no. 2 sealant, install them in the engine block **(see illustration)**. Make sure they're driven in straight or leakage could result. Special tools are available for this purpose, but a large socket, with an outside diameter that will just slip into the core plug, a 1/2-inch drive extension and a hammer will work just as well.

11 Apply non-hardening sealant (such as Permatex no. 2 or Teflon tape) to the new oil gallery plugs and thread them into the holes in the block. Make sure they're tightened securely.

12 If the engine isn't going to be reassembled right away, cover it with a large plastic trash bag to keep it clean.



16.4a Measure the diameter of each cylinder at a right angle to the engine centerline (A), and parallel to engine centerline (B) - out-of-round is the difference between A and B; taper is the difference between A and B at the top of the cylinder and A and B at the bottom of the cylinder



15.10 A large socket on an extension can be used to drive the new core plugs into the bores

16 Engine block - inspection

Refer to illustrations 16.4a, 16.4b, 16.4c, 16.11a and 16.11b

1 Before the block is inspected, it should be cleaned (see Section 15).

2 Visually check the block for cracks, rust and corrosion. Look for stripped threads in the threaded holes. It's also a good idea to have the block checked for hidden cracks by an automotive machine shop that has the special equipment to do this type of work. If defects are found, have the block repaired, if possible, or replaced.

3 Check the cylinder bores for scuffing and scoring.

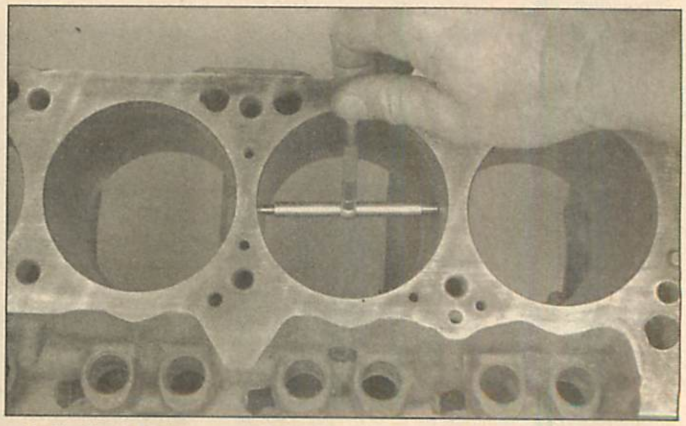
4 Check the cylinders for taper and out-of-round conditions as follows **(see illustrations)**:

5 Measure the diameter of each cylinder at the top (just under the ridge area), center and bottom of the cylinder bore, parallel to the crankshaft axis.

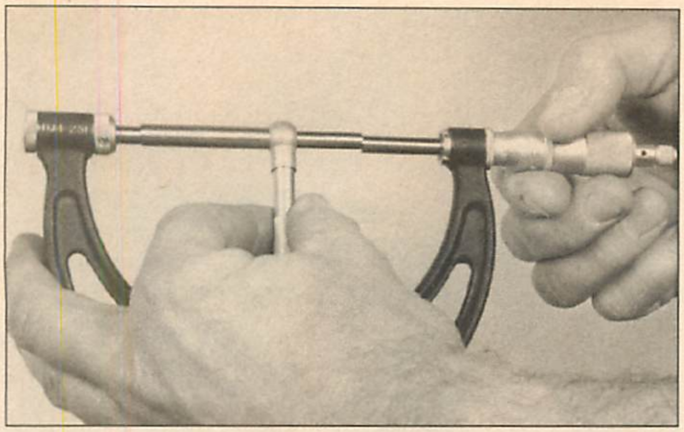
6 Next measure each cylinder's diameter at the same three locations perpendicular to the crankshaft axis.

7 The taper of the cylinder is the difference between the bore diameter at the top of the cylinder and the diameter at the bottom. The out-of-round specification of the cylinder bore is the difference between the parallel and perpendicular readings. Compare your results to those listed in this Chapter's Specifications.

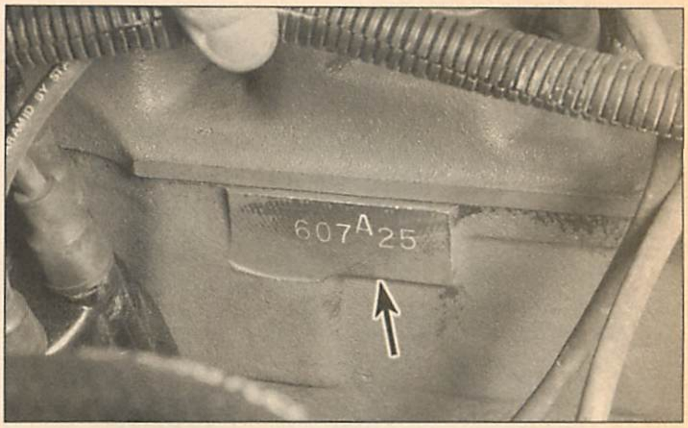
8 If the cylinder walls are badly scuffed or scored, or if they're out-of-round or tapered beyond the specified limits, have the engine block rebored and honed at an automotive machine shop.



16.4b Use a telescoping gauge to measure the bore - the ability to "feel" when it is at the correct point will be developed over time, so work slowly and repeat the check until you're satisfied the bore measurement is accurate



16.4c The gauge is then measured with a micrometer to determine the bore size



16.11a On six-cylinder engines, the engine oversize/undersize code is stamped into a pad (arrow) between the distributor and the ignition coil on the right side of the engine

9 If a rebore is done, new pistons and rings will be required.
10 Using a precision straightedge and feeler gauge, check the block deck (the surface that mates with the cylinder head(s) for distortion as you did with the cylinder head(s) **(see illustration 10.12)**. If it's distorted beyond the specified limit, it can be resurfaced by an automotive machine shop.
11 If the cylinders are in reasonably good condition and not worn to the outside of the limits, and if the piston-to-cylinder clearances can be maintained, then they don't have to be rebored. Honing is all that's necessary (see Section 17). **Note:** *Some engines may have been manufactured with oversize or undersize components. The letter code indicating this is stamped on the engine* **(see illustrations)**. *The letter codes are:*

a) B - all cylinder bores 0.010-inch oversize
b) M - all crankshaft main journals 0.010-inch undersize
c) P - all connecting rod journals 0.010-inch undersize
d) C - all camshaft bearing bores 0.010-inch oversize.

17 Cylinder honing

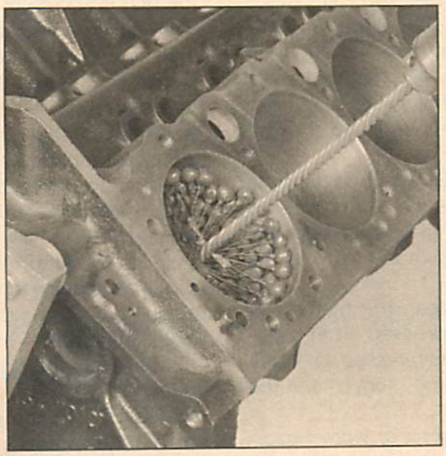
Refer to illustrations 17.3a and 17.3b

1 Prior to engine reassembly, the cylinder bores must be honed so the new piston rings will seat correctly and provide the best possible combustion chamber seal. **Note:** *If you do not have the tools or do not want to tackle the honing operation, most automotive machine shops will do it for a reasonable fee.*
2 Before honing the cylinders, install the main bearing caps and tighten the bolts to the specified torque.
3 Two types of cylinder hones are commonly available - the flex hone or "bottle brush" type and the more traditional surfacing hone with spring-loaded stones. Both will do the job, but for the less experienced mechanic the "bottle brush" hone will probably be easier to use. You will also need plenty of light oil or honing oil, some rags and an electric drill motor. Proceed as follows:

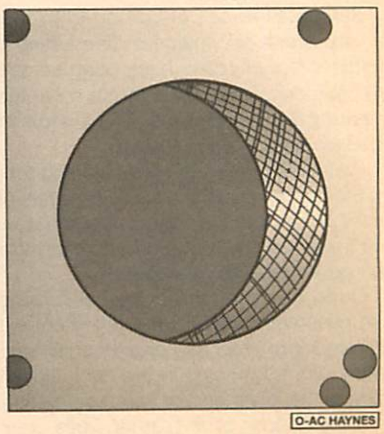
a) Mount the hone in the drill motor, compress the stones and slip it into the first cylinder **(see illustration)**.
b) Lubricate the cylinder with plenty of oil, turn on the drill and move the hone up-and-down in the cylinder at a pace which will produce a fine crosshatch pattern on the cylinder walls. Ideally, the crosshatch lines should intersect at approximately a 60-degree angle **(see illustrations)**. *Be sure to use plenty of lubricant and do not take off any more material than is absolutely necessary to produce the desired finish.* **Note:** *Piston ring manufacturers may specify a smaller crosshatch angle than the traditional 60-degrees, typically 45-degrees, so read and follow any instructions printed on the piston ring packages.*
c) Do not withdraw the hone from the cylinder while it is running. Instead, shut off the drill and continue moving the hone up-and-down in the cylinder until it comes to a complete stop, then compress the stones and withdraw the hone. If you are using a "bottle brush" type hone, stop the drill motor, then turn the chuck in the normal direction of rotation while withdrawing the hone from the cylinder.
d) Wipe the oil out of the cylinder and repeat the procedure for the remaining cylinders.

2C

16.11b On V8 engines, the code is stamped into this data plate (arrow) riveted to the front of the right valve cover



17.3a A "bottle brush" hone will produce better results if you've never honed cylinders before



17.3b The cylinder hone should leave a smooth, crosshatch pattern with the lines intersecting at approximately a 60-degree angle

18.4a The piston ring grooves can be cleaned with a special tool, as shown here . . .

18.4b . . . or a section of a broken ring

4 After the honing job is complete, chamfer the top edges of the cylinder bores with a small file so the rings will not catch when the pistons are installed. Be very careful not to nick the cylinder walls with the end of the file.

5 The entire engine block must be washed again very thoroughly with warm, soapy water to remove all traces of the abrasive grit produced during the honing operation. **Note:** *The bores can be considered clean when a white cloth - dampened with clean engine oil - used to wipe down the bores does not pick up any more honing residue, which will show up as gray areas on the cloth. Be sure to run a brush through all oil holes and galleries and flush them with running water.*

6 After rinsing, dry the block and apply a coat of light rust-preventive oil to all machined surfaces. Wrap the block in a plastic trash bag to keep it clean and set it aside until reassembly.

18 Piston/connecting rod assembly - inspection

Refer to illustrations 18.4a, 18.4b, 18.10 and 18.11

1 Before the inspection process can be carried out, the piston/connecting rod assemblies must be cleaned and the original piston rings removed from the pistons. **Note:** *Always use new piston rings when the engine is reassembled.*

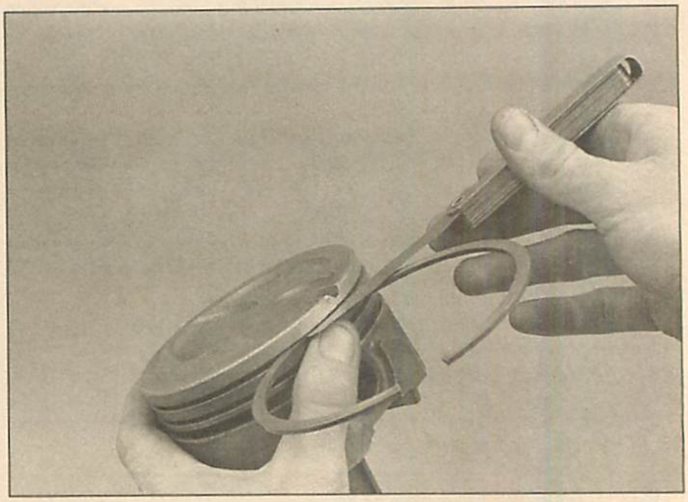
2 Using a piston ring installation tool, carefully remove the rings from the pistons. Be careful not to nick or gouge the pistons in the process.

3 Scrape all traces of carbon from the top of the piston. A hand-held wire brush or a piece of fine emery cloth can be used once the majority of the deposits have been scraped away. Do not, under any circumstances, use a wire brush mounted in a drill motor to remove deposits from the pistons. The piston material is soft and may be eroded away by the wire brush.

4 Use a piston ring groove-cleaning tool to remove carbon deposits from the ring grooves. If a tool isn't available, a piece broken off an old ring will do the job. Be very careful to remove only the carbon deposits - don't remove any metal and do not nick or scratch the sides of the ring grooves **(see illustrations)**.

5 Once the deposits have been removed, clean the piston/rod assemblies with solvent and dry them with compressed air (if available). **Warning:** *Wear eye protection when using compressed air!* Make sure the oil return holes in the back sides of the ring grooves and the oil hole in the lower end of each rod are clear.

6 If the pistons and cylinder walls aren't damaged or worn excessively, and if the engine block is not rebored, new pistons won't be necessary. Normal piston wear appears as even vertical wear on the piston thrust surfaces and slight looseness of the top ring in its groove. New piston rings, however, should always be used when an engine is rebuilt.



18.10 Check the ring side clearance with a feeler gauge at several points around the groove

7 Carefully inspect each piston for cracks around the skirt, at the pin bosses and at the ring lands.

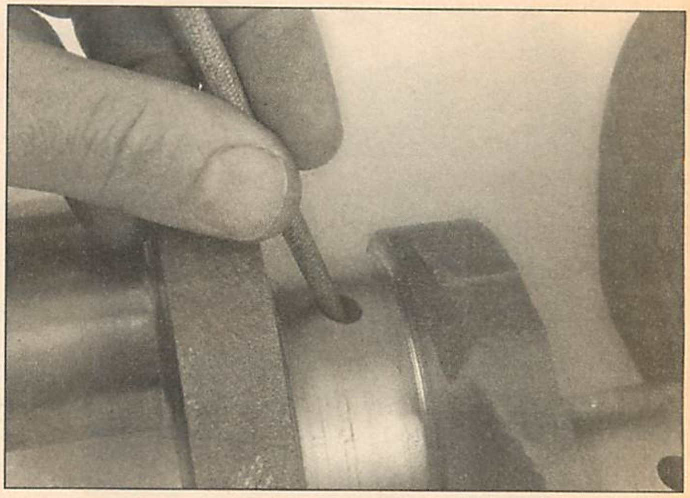
8 Look for scoring and scuffing on the thrust faces of the skirt, holes in the piston crown and burned areas at the edge of the crown. If the skirt is scored or scuffed, the engine may have been suffering from overheating and/or abnormal combustion, which caused excessively high operating temperatures. The cooling and lubrication systems should be checked thoroughly. A hole in the piston crown is an indication that abnormal combustion (preignition) was occurring. Burned areas at the edge of the piston crown are usually evidence of spark knock (detonation). If any of the above problems exist, the causes must be corrected or the damage will occur again. The causes may include intake air leaks, incorrect fuel/air mixture, incorrect ignition timing and EGR system malfunctions.

9 Corrosion of the piston, in the form of small pits, indicates that coolant is leaking into the combustion chamber and/or the crankcase. Again, the cause must be corrected or the problem may persist in the rebuilt engine.

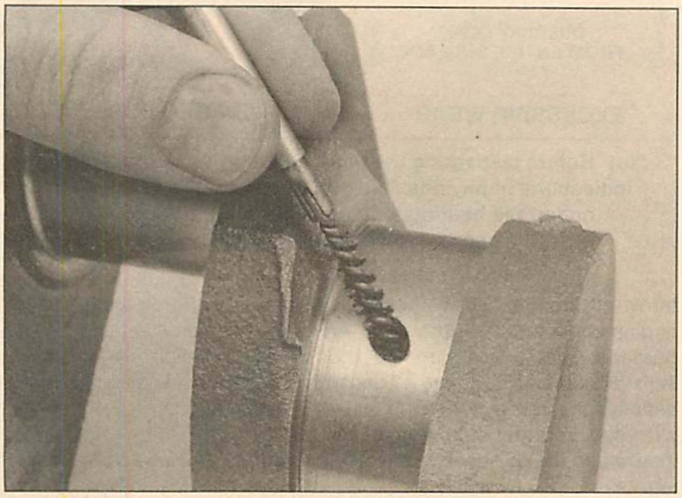
10 Measure the piston ring side clearance by laying a new piston ring in each ring groove and slipping a feeler gauge in beside it **(see illustration)**. Check the clearance at three or four locations around each groove. Be sure to use the correct ring for each groove - they are different. If the side clearance is greater than specified, new pistons will have to be used.

11 Check the piston-to-bore clearance by measuring the bore (see Section 16) and the piston diameter. Make sure the pistons and bores

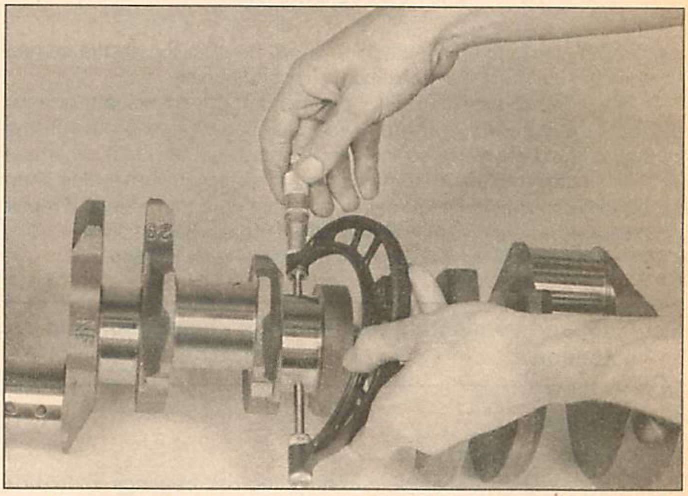
18.11 Measure the piston in line with the piston pin, and at 90 degrees to the pin



19.1 The oil holes should be chamfered so sharp edges don't gouge or scratch the new bearings



19.2 Use a wire or stiff plastic bristle brush to clean the oil passages in the crankshaft - flush the passages out with solvent



19.5 Measure the diameter of each crankshaft journal at several points to detect taper and out-of-round conditions

are correctly matched. Measure the piston across the skirt, at a 90-degree angle to the piston pin, the specified distance down from the top of the piston or the lower edge of the oil ring groove **(see illustration)**. Subtract the piston diameter from the bore diameter to obtain the clearance. If it's greater than specified, the block will have to be rebored and new pistons and rings installed.

12 Check the piston-to-rod clearance by twisting the piston and rod in opposite directions. Any noticeable play indicates excessive wear, which must be corrected. The piston/connecting rod assemblies should be taken to an automotive machine shop to have the pistons and rods re-sized and new pins installed.

13 If the pistons must be removed from the connecting rods for any reason, they should be taken to an automotive machine shop. While they are there have the connecting rods checked for bend and twist, since automotive machine shops have special equipment for this purpose. **Note:** *Unless new pistons and/or connecting rods must be installed, do not disassemble the pistons and connecting rods.*

14 Check the connecting rods for cracks and other damage. Temporarily remove the rod caps, lift out the old bearing inserts, wipe the rod and cap bearing surfaces clean and inspect them for nicks, gouges and scratches. After checking the rods, replace the old bearings, slip the caps into place and tighten the nuts finger tight. **Note:** *If the engine is being rebuilt because of a connecting rod knock, be sure to check with an automotive machine shop on the possibility of re-sizing either the small or large end of the rod. If this isn't possible, install new rods.*

19 Crankshaft - inspection

Refer to illustrations 19.1, 19.2, 19.5 and 19.7

1 Remove all burrs from the crankshaft oil holes with a stone, file or scraper **(see illustration)**.

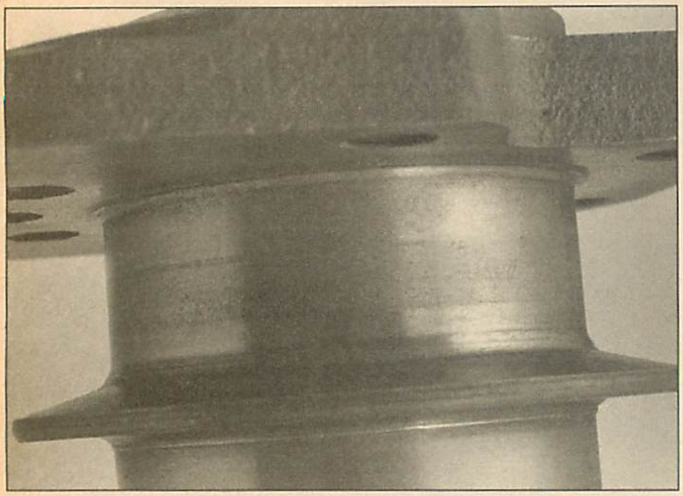
2 Clean the crankshaft with solvent and dry it with compressed air (if available). Be sure to clean the oil holes with a stiff brush and flush them with solvent **(see illustration)**.

3 Check the main and connecting rod bearing journals for uneven wear, scoring, pits and cracks.

4 Check the rest of the crankshaft for cracks and other damage. It should be magnafluxed to reveal hidden cracks - an automotive machine shop will handle the procedure.

5 Using a micrometer, measure the diameter of the main and connecting rod journals and compare the results to the Specifications **(see illustration)**. By measuring the diameter at a number of points around each journal's circumference, you'll be able to determine whether or not the journal is out-of-round. Take the measurement at each end of the journal, near the crank throws, to determine if the journal is tapered. Crankshaft runout should be checked also, but large V-blocks and a dial indicator are needed to do it correctly. If you don't have the equipment, have a machine shop check the runout.

6 If the crankshaft journals are damaged, tapered, out-of-round or worn beyond the limits given in the Specifications, have the crankshaft



19.7 If the seals have worn grooves in the crankshaft journals, or if the seal contact surfaces are nicked or scratched, the new seals will leak

reground by an automotive machine shop. Be sure to use the correct size bearing inserts if the crankshaft is reconditioned.

7 Check the oil seal journals at each end of the crankshaft for wear and damage **(see illustration)**. If the seal has worn a groove in the journal, or if it's nicked or scratched, the new seal may leak when the engine is reassembled. In some cases, an automotive machine shop may be able to repair the journal by pressing on a thin sleeve. If repair isn't feasible, a new or different crankshaft should be installed.

8 Examine the main and rod bearing inserts (see Section 20).

20 Main and connecting rod bearings - inspection and selection

Inspection

Refer to illustration 20.1

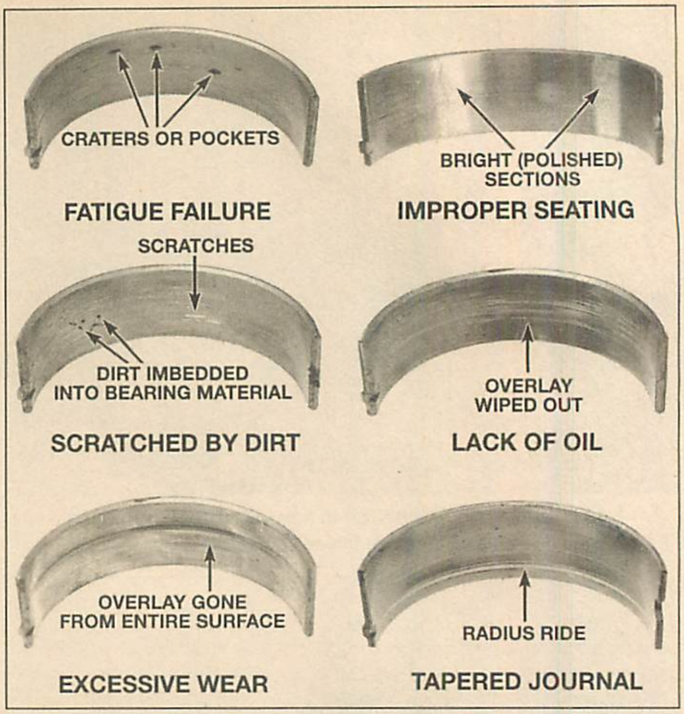
1 Even though the main and connecting rod bearings should be replaced with new ones during the engine overhaul, the old bearings should be retained for close examination, as they may reveal valuable information about the condition of the engine **(see illustration)**.

2 Bearing failure occurs because of lack of lubrication, the presence of dirt or other foreign particles, overloading the engine and corrosion. Regardless of the cause of bearing failure, it must be corrected before the engine is reassembled to prevent it from happening again.

3 When examining the bearings, remove them from the engine block, the main bearing caps, the connecting rods and the rod caps and lay them out on a clean surface in the same general position as their location in the engine. This will enable you to match any bearing problems with the corresponding crankshaft journal.

4 Dirt and other foreign particles get into the engine in a variety of ways. It may be left in the engine during assembly, or it may pass through filters or the PCV system. It may get into the oil, and from there into the bearings. Metal chips from machining operations and normal engine wear are often present. Abrasives are sometimes left in engine components after reconditioning, especially when parts are not thoroughly cleaned using the proper cleaning methods. Whatever the source, these foreign objects often end up embedded in the soft bearing material and are easily recognized. Large particles will not embed in the bearing and will score or gouge the bearing and journal. The best prevention for this cause of bearing failure is to clean all parts thoroughly and keep everything spotlessly clean during engine assembly. Frequent and regular engine oil and filter changes are also recommended.

5 Lack of lubrication (or lubrication breakdown) has a number of interrelated causes. Excessive heat (which thins the oil), overloading (which squeezes the oil from the bearing face) and oil leakage or



20.1 Before discarding the used bearings, examine them for indications of any possible problems with the crankshaft, noting the bearing location it came from. Here are some typical bearing failures

throw-off (from excessive bearing clearances, worn oil pump or high engine speeds) all contribute to lubrication breakdown. Blocked oil passages, which usually are the result of misaligned oil holes in a bearing shell, will also oil starve a bearing and destroy it. When lack of lubrication is the cause of bearing failure, the bearing material is wiped or extruded from the steel backing of the bearing. Temperatures may increase to the point where the steel backing turns blue from overheating.

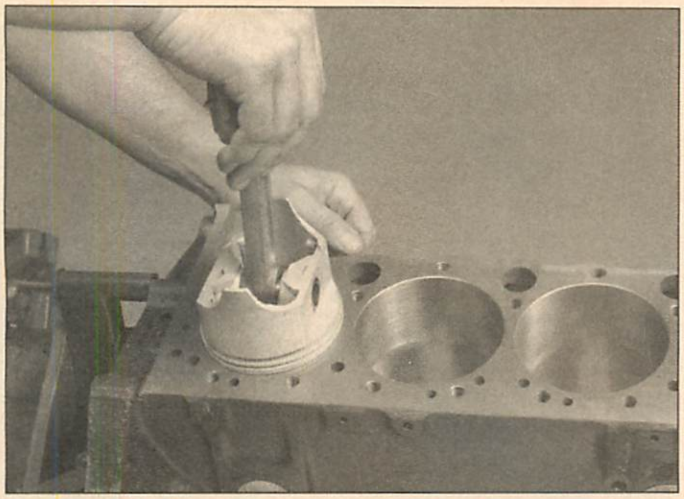
6 Driving habits can have a definite effect on bearing life. Low speed operation in too high a gear (lugging the engine) puts very high loads on bearings, which tends to squeeze out the oil film. These loads cause the bearings to flex, which produces fine cracks in the bearing face (fatigue failure). Eventually the bearing material will loosen in pieces and tear away from the steel backing. Short trip driving leads to corrosion of bearings because insufficient engine heat is produced to drive off the condensed water and corrosive gases. These products collect in the engine oil, forming acid and sludge. As the oil is carried to the engine bearings, the acid attacks and corrodes the bearing material.

7 Incorrect bearing installation during engine assembly will lead to bearing failure as well. Tight fitting bearings leave insufficient bearing oil clearance and will result in oil starvation. Dirt or foreign particles trapped behind a bearing insert result in high spots on the bearing which lead to failure.

8 If a new or original crankshaft is installed, the size of each journal should be indicated by a color coded mark on the adjacent counterweight cheek, toward the rear end of the crankshaft. The bearing inserts are color coded on the edge of the insert. The accompanying charts should be consulted to determine the correct bearings. **Caution:** *Always check the bearing oil clearance with Plastigage during final installation of the crankshaft and piston/connecting rod assemblies.*

9 If necessary to achieve the desired oil clearance, different size upper and lower bearing inserts may be used on the same journal, but the size difference must never exceed 0.001-inch. **Caution:** *The odd size inserts, if used, must all be placed in the same locations - i.e. all in the caps or all in the block/rod.*

10 If a reground crankshaft is used, the automotive machine shop or parts store will supply the correct size bearing inserts.



22.3 When checking piston ring end gap, the ring must be square in the cylinder bore (this is done by pushing the ring down with the top of a piston as shown)

11 Remember, the oil clearance is the final judge when selecting new bearing sizes for either main or rod bearings. If you have any questions or are unsure which bearings to use, get help from a dealer parts or service department or other parts supplier. **Note:** *Some engines have factory oversized or undersized components,* see Section 16.

Crankshaft main bearing selection chart

Main bearing journal	Upper insert	Lower insert
Yellow - standard	Yellow - standard	Yellow - standard
Orange - 0.0005-inch undersize	Black - 0.001-inch undersize	Black - 0.001-inch undersize
Black - 0.001-inch undersize	Red - 0.010-inch undersize	Green - 0.002-inch undersize
Green - 0.0015-inch undersize	-	Red - 0.010-inch undersize
Red - 0.010-inch undersize	-	-

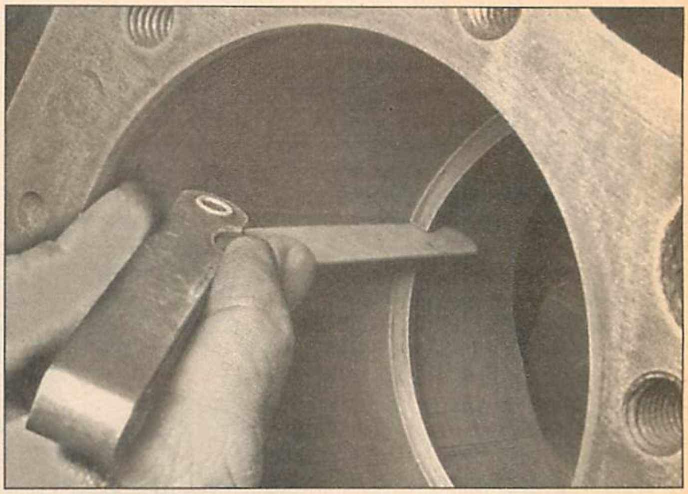
Connecting rod bearing selection chart

Connecting rod journal	Upper insert	Lower insert
Yellow - standard	Yellow - standard	Yellow - standard
Orange - 0.0007-inch undersize	Black - 0.001-inch undersize	Black - 0.001-inch undersize
Black - 0.0014-inch undersize	Red - 0.010-inch undersize	Red - 0.010-inch undersize
Red - 0.010-inch undersize	-	-

21 Engine overhaul - reassembly sequence

1 Before beginning engine reassembly, make sure you have all the necessary new parts, gaskets and seals as well as the following items on hand:

Common hand tools
A torque wrench
Piston ring installation tool
Piston ring compressor
Short lengths of rubber or plastic hose to fit over connecting rod bolts



22.4 With the ring square in the cylinder, measure the ring end gap with a feeler gauge

Plastigage
Feeler gauges
A fine-tooth file
New engine oil
Engine assembly lube or moly-base grease
Gasket sealant
Thread locking compound

2 In order to save time and avoid problems, engine reassembly must be done in the following general order:

Piston rings
Crankshaft and main bearings
Rear main oil seal
Piston/connecting rod assemblies
Camshaft
Timing chain and gears and cover
Lifters
Cylinder head(s), pushrods and rocker arms
Oil pump
Oil pick-up tube
Oil pan
Valve cover(s)
Intake and exhaust manifolds
Flywheel/driveplate

22 Piston rings - installation

Refer to illustrations 22.3, 22.4, 22.5, 22.10a, 22.10b and 22.13

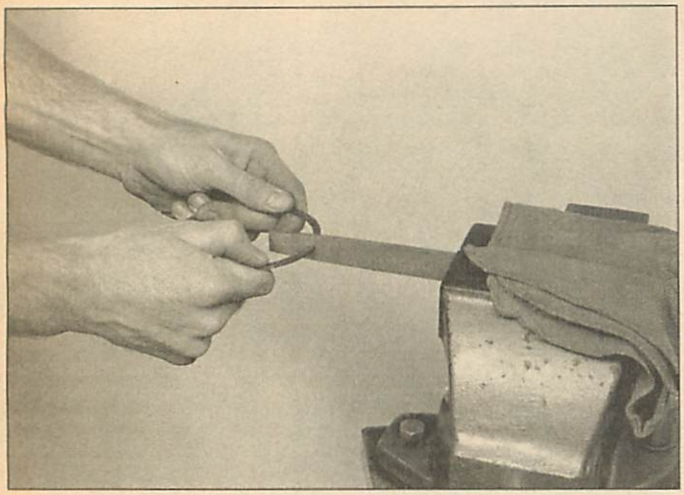
1 Before installing the new piston rings, the ring end gaps must be checked. It's assumed that the piston ring side clearance has been checked and verified correct (see Section 22).

2 Lay out the piston/connecting rod assemblies and the new ring sets so the ring sets will be matched with the same piston and cylinder during the end gap measurement and engine assembly.

3 Insert the top (number one) ring into the first cylinder and square it up with the cylinder walls by pushing it in with the top of the piston **(see illustration)**. The ring should be near the bottom of the cylinder, at the lower limit of ring travel.

4 To measure the end gap, slip feeler gauges between the ends of the ring until a gauge equal to the gap width is found **(see illustration)**. The feeler gauge should slide between the ring ends with a slight amount of drag. Compare the measurement to this Chapter's Specifications. If the gap is larger or smaller than specified, double-check to make sure you have the correct rings before proceeding.

5 If the gap is too small, it must be enlarged or the ring ends may come in contact with each other during engine operation, which can cause serious damage to the engine. The end gap can be increased by



22.5 If the end gap is too small, clamp a file in a vise and file the ring ends by pushing the ring over the file toward the vise - after filing to correct size, deburr the ring ends with fine emery cloth or a whetstone

filing the ring ends very carefully with a fine file. Mount the file in a vise equipped with soft jaws, slip the ring over the file with the ends contacting the file face and slowly move the ring to remove material from the ends **(see illustration)**. **Caution:** *When performing this operation, file only from the outside in.*

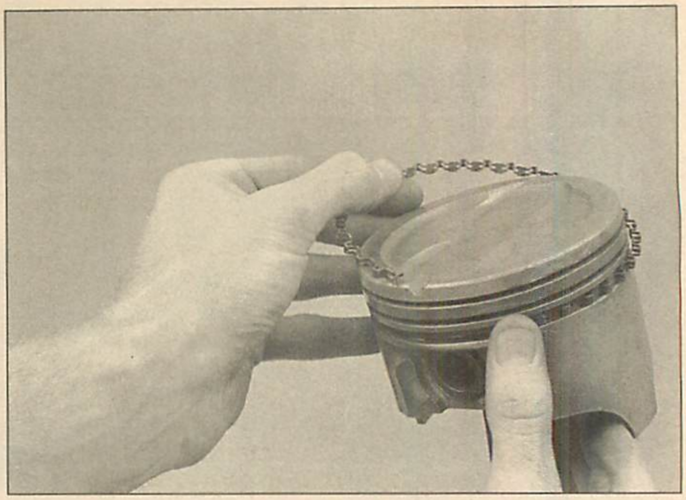
6 Excess end gap is not critical unless it is greater than 0.040-inch. Again, double-check to make sure you have the correct rings for your engine.

7 Repeat the procedure for the rest of the rings. Remember to keep rings, pistons and cylinders matched up.

8 Repeat the procedure for each ring that will be installed in the first cylinder and for each ring in the remaining cylinders. Remember to keep rings, pistons and cylinders matched up.

9 Once the ring end gaps have been checked/corrected, the rings can be installed on the pistons.

10 The oil control ring (lowest one on the piston) is usually installed first. It's composed of three separate components. Slip the spacer/expander into the groove **(see illustration)**. If an anti-rotation tang is used, make sure it's inserted into the drilled hole in the ring groove. Next, install the lower side rail. Don't use a piston ring installation tool on the oil ring side rails, as they may be damaged. Instead, place one end of the side rail into the groove between the spacer/expander and the ring land, hold it firmly in place and slide a finger around the piston while pushing the rail into the groove **(see illustration)**. Next, install the upper side rail in the same manner.



22.10a Installing the spacer/expander in the oil control ring groove . .

11 After the three oil ring components have been installed, check to make sure that both the upper and lower side rails can be turned smoothly in the ring groove.

12 The number two (middle) ring is installed next. It's usually stamped with a mark which must face up, toward the top of the piston. **Note:** *Always follow the instructions printed on the ring package or box - different manufacturers may require different approaches. Do not mix up the top and middle rings, as they have different cross sections.*

13 Use a piston ring installation tool and make sure the identification mark is facing the top of the piston, then slip the ring into the middle groove on the piston. Don't expand the ring any more than necessary to slide it over the piston **(see illustration)**.

14 Install the number one (top) ring in the same manner. Make sure the mark is facing up. Be careful not to confuse the number one and number two rings.

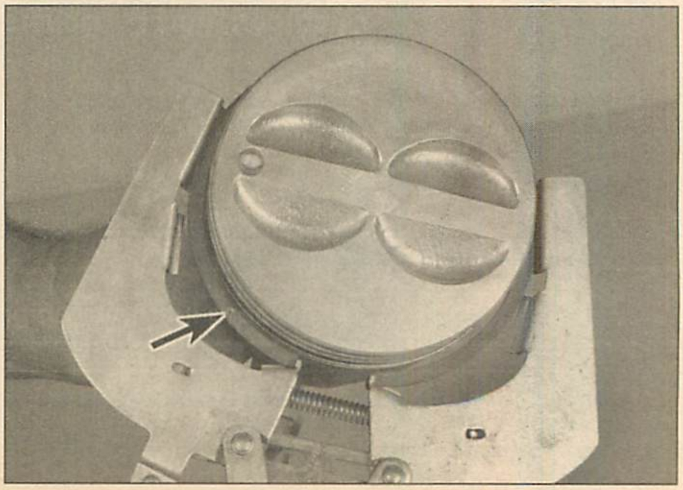
15 Repeat the procedure for the remaining pistons and rings.

23 Crankshaft - installation and main bearing oil clearance check

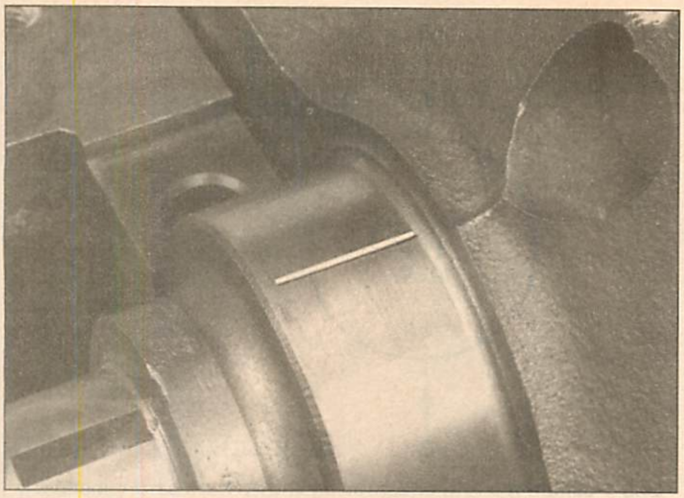
1 Crankshaft installation is the first major step in engine reassembly. It's assumed at this point that the engine block and crankshaft have been cleaned, inspected and repaired or reconditioned.

2 Position the engine with the bottom facing up.

22.10b . . . followed by the side rails - DO NOT use a piston ring installation tool when installing the oil ring side rails



22.13 Installing the compression rings with a ring expander - the mark (arrow) must face up



23.10 Lay the Plastigage strips (arrow) on the main bearing journals, parallel to the crankshaft centerline

23.14 Compare the width of the crushed Plastigage to the scale on the envelope to determine the main bearing oil clearance (always take the measurement at the widest point of the Plastigage); be sure to use the correct scale - standard and metric ones are included

3 Remove the main bearing cap bolts and lift out the caps. Lay the caps out in the proper order to ensure correct installation.

4 If they're still in place, remove the old bearing inserts from the block and the main bearing caps. Wipe the main bearing surfaces of the block and caps with a clean, lint-free cloth. They must be kept spotlessly clean!

Main bearing oil clearance check

Refer to illustrations 23.10 and 23.14

5 Clean the back sides of the new main bearing inserts and lay the bearing half with the oil groove and hole in each main bearing saddle in the block (on all engines covered by this manual, the bearings with oil holes go in the block and those without oil holes go in the caps). Lay the other bearing half from each bearing set in the corresponding main bearing cap. Make sure the tab on each bearing insert fits into the recess in the block or cap. Also, the oil holes in the block must line up with the oil holes in the bearing insert. **Caution:** *Do not hammer the bearings into place and don't nick or gouge the bearing faces. No lubrication should be used at this time.*

6 The thrust bearings must be installed in the number three main bearing saddle.

7 Clean the faces of the bearings in the block and the crankshaft main bearing journals with a clean, lint-free cloth. Check or clean the oil holes in the crankshaft, as any dirt here can go only one way - straight through the new bearings.

8 Once you're certain the crankshaft is clean, carefully lay it in position in the main bearings. No lubricant should be used at this time.

9 Before the crankshaft can be permanently installed, the main bearing oil clearance must be checked.

10 Trim several pieces of the appropriate size Plastigage (they must be slightly shorter than the width of the main bearings) and place one piece on each crankshaft main bearing journal, parallel with the journal axis **(see illustration)**.

11 Clean the faces of the bearings in the caps and install the caps in their respective positions (don't mix them up) with the arrows pointing toward the front of the engine. Don't disturb the Plastigage. Apply a light coat of oil to the bolt threads and the under sides of the bolt heads, then install them.

12 Working from the center out, tighten the main bearing cap bolts, in three steps, to the torque listed in this Chapter's Specifications. Don't rotate the crankshaft at any time during this operation!

13 Remove the bolts and carefully lift off the main bearing caps. Keep them in order. Don't disturb the Plastigage or rotate the crankshaft. If any of the main bearing caps are difficult to remove, tap them gently from side-to-side with a soft-face hammer to loosen them.

14 Compare the width of the crushed Plastigage on each journal to the scale printed on the Plastigage envelope to obtain the main bearing oil clearance **(see illustration)**. Check the Specifications to make sure it's correct.

15 If the clearance is not as specified, the bearing inserts may be the wrong size which means different ones will be required. Before deciding that different inserts are needed, make sure that no dirt or oil was between the bearing inserts and the caps or block when the clearance was measured. If the Plastigage is noticeably wider at one end than the other, the journal may be tapered (see Section 20).

16 Carefully scrape all traces of the Plastigage material off the main bearing journals and/or the bearing faces. Don't nick or scratch the bearing faces.

Final crankshaft installation

17 Carefully lift the crankshaft out of the engine. Clean the bearing faces in the block, then apply a thin, uniform layer of clean moly-base grease or engine assembly lube to each of the bearing surfaces. Coat the thrust washers as well.

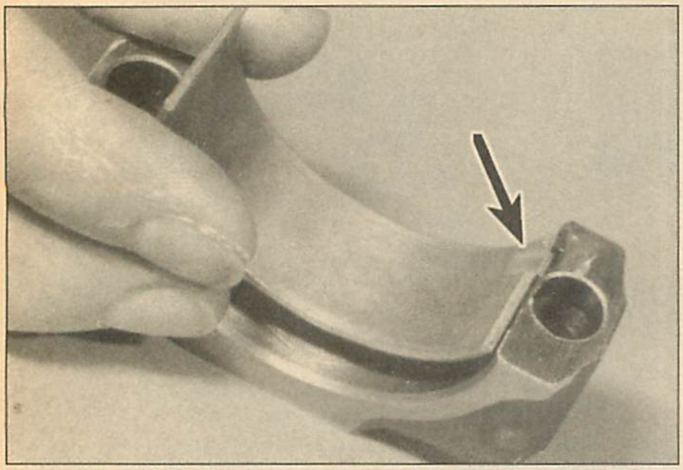
18 Install the rear main oil seal halves into the engine block and rear main bearing cap. It's not necessary to "shoehorn" the upper seal half into the engine - simply press it into place while the crankshaft is removed. Lubricate the crankshaft surfaces that contact the oil seals with moly-base grease, engine assembly lube or clean engine oil. See Chapter 2A, Section 16 for the rear main cap sealing procedure.

19 Make sure the crankshaft journals are clean, then lay the crankshaft back in place in the block. Clean the faces of the bearings in the caps or cap assembly, then apply the same lubricant to them. Install the caps in their respective positions with the arrows pointing toward the front of the engine.

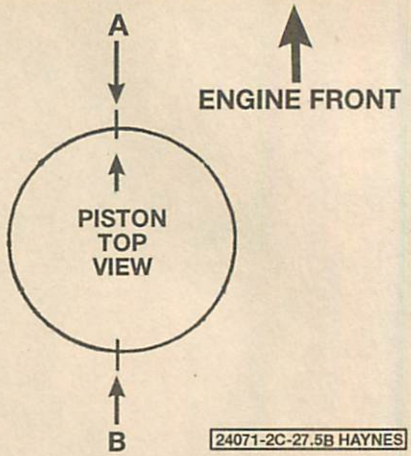
20 Apply a light coat of oil to the bolt threads and the under sides of the bolt heads, then install them. Tighten all except the number three cap to the torque listed in this Chapter's Specifications (work from the center out and approach the final torque in three steps). Tighten the number three cap bolts to 10-to-12 ft-lbs. Tap the ends of the crankshaft forward and backward with a lead or brass hammer to line up the thrust bearings and crankshaft surfaces. Re-tighten all main bearing cap bolts to the specified torque, following the recommended sequence.

21 Rotate the crankshaft a number of times by hand to check for any obvious binding.

22 Check the crankshaft endplay with a feeler gauge or a dial indicator (see Section 14). The endplay should be correct if the crankshaft thrust faces aren't worn or damaged and new bearings have been installed.



24.3 Make sure the bearing tang fits securely into the notch in the rod cap



24.5 Position the ring end gaps as shown here before installing the pistons in the block:

A Top compression ring gap, lower oil control ring gap
B Second compression ring gap, upper oil control ring gap

24 Pistons/connecting rods - installation and rod bearing oil clearance check

Refer to illustrations 24.3, 24.5, 24.9, 24.11, 24.13 and 24.17

1 Before installing the piston/connecting rod assemblies, the cylinder walls must be perfectly clean, the top edge of each cylinder must be chamfered, and the crankshaft must be in place.

2 Remove the cap from the end of the number one connecting rod (refer to the marks made during removal). Remove the original bearing inserts and wipe the bearing surfaces of the connecting rod and cap with a clean, lint-free cloth. They must be kept spotlessly clean.

Connecting rod bearing oil clearance check

3 Clean the back side of the new upper bearing insert, then lay it in place in the connecting rod. Make sure the tab on the bearing fits into the recess in the rod **(see illustration)** so the oil holes align. Don't hammer the bearing insert into place and be very careful not to nick or gouge the bearing face. Don't lubricate the bearing at this time.

4 Clean the back side of the other bearing insert and install it in the rod cap. Again, make sure the tab on the bearing fits into the recess in the cap, and don't apply any lubricant. It's critically important that the mating surfaces of the bearing and connecting rod are perfectly clean and oil free when they're assembled.

5 Position the piston ring gaps at 180-degree intervals around the piston **(see illustration)**.

6 Slip a section of plastic or rubber hose over each connecting rod cap bolt **(see illustration 13.5)**.

7 Lightly lubricate the piston and rings with clean engine oil and attach a piston ring compressor to the piston. Leave the skirt protruding about 1/4-inch to guide the piston into the cylinder. The rings must be compressed until they're flush with the piston.

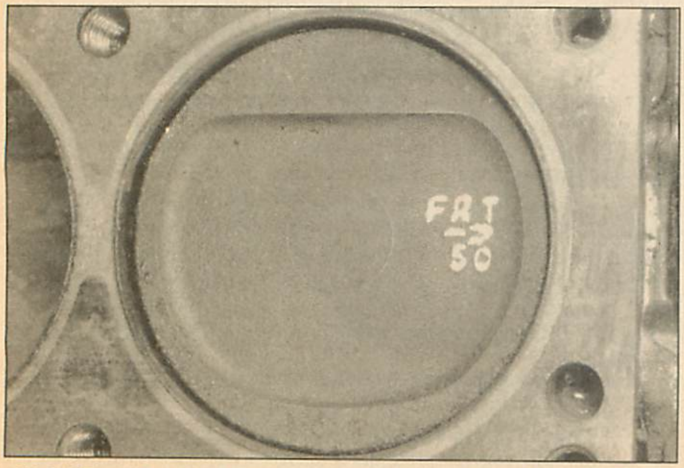
8 Rotate the crankshaft until the number one connecting rod journal is at BDC (bottom dead center) and apply a light coat of engine oil to the cylinder walls.

9 With the mark on top of the piston **(see illustration)** facing the front (timing chain end) of the engine, gently insert the piston/connecting rod assembly into the number one cylinder bore and rest the bottom edge of the ring compressor on the engine block.

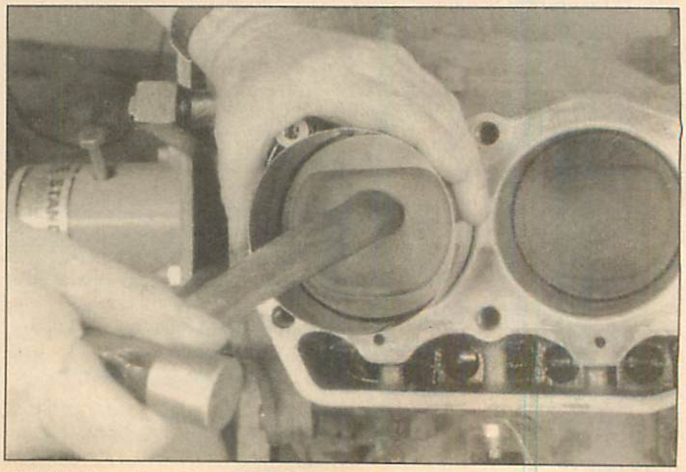
10 Tap the top edge of the ring compressor to make sure it's contacting the block around its entire circumference.

11 Gently tap on the top of the piston with the end of a wooden or plastic hammer handle **(see illustration)** while guiding the end of the connecting rod into place on the crankshaft journal. The piston rings may try to pop out of the ring compressor just before entering the cylinder bore, so keep some pressure on the ring compressor. Work slowly, and if any resistance is felt as the piston enters the cylinder, stop immediately. Find out what's hanging up and fix it before proceeding. Do not, for any reason, force the piston into the cylinder - you might break a ring and/or the piston.

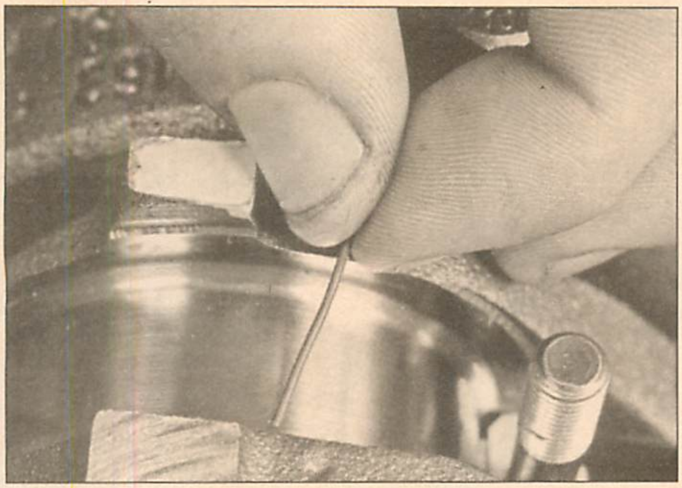
12 Once the piston/connecting rod assembly is installed, the connecting rod bearing oil clearance must be checked before the rod cap is permanently bolted in place.



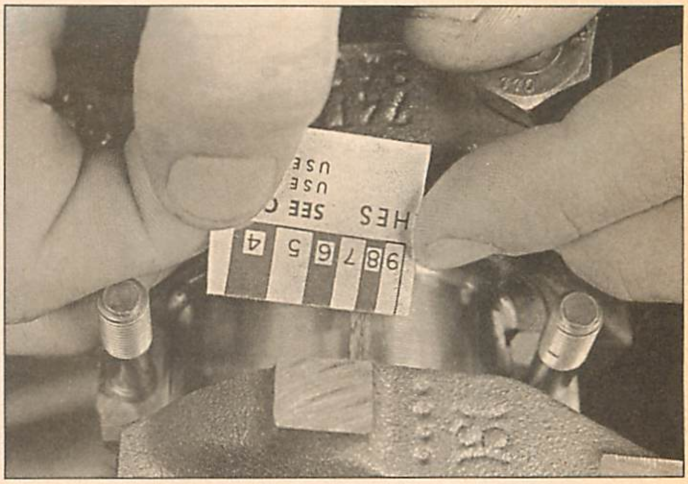
24.9 When installed, the arrow or notch on the piston must face the front of the engine



24.11 The piston can be driven gently into the cylinder bore with the end of a wooden or plastic hammer handle



24.13 Lay the Plastigage strips on each rod bearing journal, parallel to the crankshaft centerline



24.17 Measuring the width of the crushed Plastigage to determine the rod bearing oil clearance (be sure to use the correct scale - standard and metric ones are included)

13 Cut a piece of the appropriate size Plastigage slightly shorter than the width of the connecting rod bearing and lay it in place on the number one connecting rod journal, parallel with the journal axis **(see illustration)**.

14 Clean the connecting rod cap bearing face, remove the protective hoses from the connecting rod bolts and install the rod cap. Make sure the mating mark on the cap is on the same side as the mark on the connecting rod. Check the cap to make sure the front mark is facing the timing chain end of the engine.

15 Apply a light coat of oil to the undersides of the nuts, then install and tighten them to the torque listed in this Chapter's Specifications. Use a thin-wall socket to avoid erroneous torque readings that can result if the socket is wedged between the rod cap and nut. If the socket tends to wedge itself between the nut and the cap, lift up on it slightly until it no longer contacts the cap. Do not rotate the crankshaft at any time during this operation.

16 Remove the nuts and detach the rod cap, being very careful not to disturb the Plastigage.

17 Compare the width of the crushed Plastigage to the scale printed on the Plastigage envelope to obtain the oil clearance **(see illustration)**. Compare it to the Specifications to make sure the clearance is correct.

18 If the clearance is not as specified, the bearing inserts may be the wrong size (which means different ones will be required). Before deciding that different inserts are needed, make sure that no dirt or oil was between the bearing inserts and the connecting rod or cap when the clearance was measured. Also, recheck the journal diameter. If the Plastigage was wider at one end than the other, the journal may be tapered (see Section 20).

Final connecting rod installation

19 Carefully scrape all traces of the Plastigage material off the rod journal and/or bearing face. Be very careful not to scratch the bearing - use your fingernail or the edge of a credit card.

20 Make sure the bearing faces are perfectly clean, then apply a uniform layer of clean moly-base grease or engine assembly lube to both of them. You'll have to push the piston into the cylinder to expose the face of the bearing insert in the connecting rod - be sure to slip the protective hoses over the rod bolts first.

21 Slide the connecting rod back into place on the journal, remove the protective hoses from the rod cap bolts, install the rod cap and tighten the nuts to the torque listed in this Chapter's Specifications.

22 Repeat the entire procedure for the remaining pistons/connecting rods.

23 The important points to remember are:

a) *Keep the back sides of the bearing inserts and the insides of the connecting rods and caps perfectly clean when assembling them.*
b) *Make sure you have the correct piston/rod assembly for each cylinder.*
c) *The arrow/notch on the piston must face the front (timing chain end) of the engine.*
d) *Lubricate the cylinder walls with clean engine oil.*
e) *Lubricate the bearing faces when installing the rod caps after the oil clearance has been checked.*

24 After all the piston/connecting rod assemblies have been properly installed, rotate the crankshaft a number of times by hand to check for any obvious binding.

25 As a final step, the connecting rod side clearance (endplay) must be checked (see Section 13).

26 Compare the measured side clearance to the Specifications to make sure it's correct. If it was correct before disassembly and the original crankshaft and rods were reinstalled, it should still be right. If new rods or a new crankshaft were installed, the side clearance may be inadequate. If so, the rods will have to be removed and taken to an automotive machine shop for re-sizing.

27 The rest of the assembly procedure is the reverse of the removal procedure.

25 Initial start-up and break-in after overhaul

Warning: *Have a fire extinguisher handy when starting the engine for the first time.*

1 Once the engine has been installed in the vehicle, double-check the engine oil and coolant levels. Add one pint of Chrysler Crankcase Conditioner (part no. 4318002) or equivalent.

2 Start the engine. It may take a few moments for the gasoline to reach the carburetor but the engine should start without a great deal of effort.

3 After the engine starts, it should be allowed to warm up to normal operating temperature. While the engine is warming up, make a thorough check for oil and coolant leaks.

4 Shut the engine off and recheck the engine oil and coolant levels.

5 Drive the vehicle to an area with no traffic, accelerate from 30 to 50 mph, then allow the vehicle to slow to 30 mph with the throttle closed. Repeat the procedure 10 or 12 times. This will load the piston rings and cause them to seat properly against the cylinder walls. Check again for oil and coolant leaks.

6 Drive the vehicle gently for the first 500 miles (no sustained high speeds) and keep a constant check on the oil level. It is not unusual for an engine to use oil during the break-in period.

7 At approximately 500 to 600 miles, change the oil and filter.

8 For the next few hundred miles, drive the vehicle normally. Do not pamper it or abuse it.

9 After 2000 miles, change the oil and filter again and consider the engine fully broken in.

Notes

Chapter 3
Cooling, heating and air conditioning systems

Contents

Specifications

General

Coolant capacity	See Chapter 1
Drivebelt tension	See Chapter 1
Radiator pressure cap rating	15 psi
Thermostat opening temperature	195-degrees F

Torque specifications

	Ft-lbs (unless otherwise indicated)
Fan-to-water pump attaching bolts/nuts	18
Viscous fan drive-to-fan blade assembly attaching bolts	18
Thermostat housing bolts	156 in-lbs
Water pump attaching bolts	
Six-cylinder engine	156 in-lbs
V8 engine	
Pump-to-block bolts	25
Pump-to-front cover bolts	48 in-lbs

1 General information

The cooling system consists of a radiator and coolant reserve system, a radiator pressure cap, a thermostat, a four, five or seven blade fan, and a belt-driven water pump.

The radiator cooling fan is mounted on the front of the water pump. There are two types of fans used; one incorporates a fluid drive fan clutch (viscous fan clutch) which saves horsepower and reduces noise, the second is a basic fan with a solid hub attaching to the water pump, often with a spacer between the fan and the water pump. On either type a fan shroud is mounted on the rear of the radiator to direct air flow through the radiator.

The system is pressurized by a spring-loaded radiator cap, which, by maintaining pressure, increases the boiling point of the coolant. If the coolant temperature goes above this increased boiling point, the extra pressure in the system forces the radiator cap valve off its seat and exposes the overflow pipe or hose. The overflow pipe/hose leads to a coolant recovery system. This consists of a plastic reservoir into which the coolant that normally escapes due to expansion is retained. When the engine cools, the excess coolant is drawn back into the radiator by the vacuum created as the system cools, maintaining the system at full capacity. This is a continuous process and provided the level in the reservoir is correctly maintained, it is not necessary to add coolant to the radiator.

Coolant in the left side of the radiator circulates up the lower radiator hose to the water pump, where it is forced through the water passages in the cylinder block. The coolant then travels up into the cylinder head, circulates around the combustion chambers and valve seats, travels out of the cylinder head past the open thermostat into the upper radiator hose and back into the radiator.

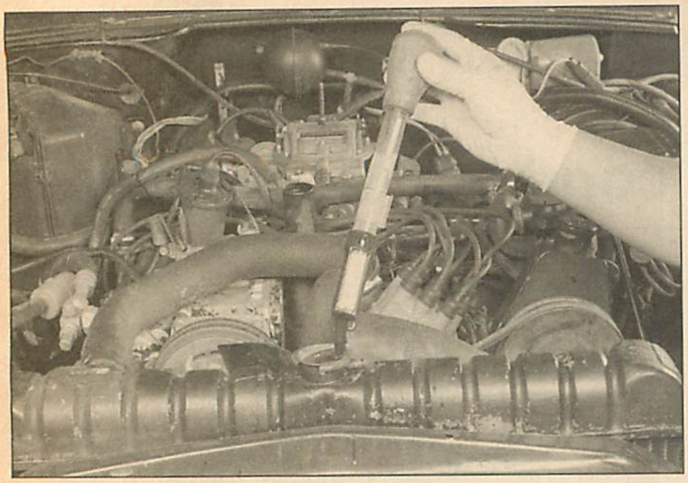
When the engine is cold, the thermostat restricts the circulation of coolant to the engine. When the minimum operating temperature is reached, the thermostat begins to open, allowing coolant to return to the radiator.

Automatic transmission-equipped models have a cooler element incorporated into the radiator to cool the transmission fluid. Some automatic-transmission models also have an auxiliary transmission-oil cooler mounted in front of the radiator, which is cooled by air drawn through the radiator by the fan.

The heating system works by directing air through the heater core mounted in a housing on the engine side of the firewall and then to the interior of the vehicle by a system of ducts. Temperature is controlled by mixing heated air with fresh air, using a system of flapper doors in the ducts, and a blower motor.

Air conditioning is an optional accessory, consisting of an evaporator core located under the dash (with its own blower motor), a condenser in front of the radiator, a receiver-drier in the engine compartment and a belt-driven compressor mounted at the front of the engine.

3



2.6 An inexpensive hydrometer can be used to test the condition of your coolant

2 Antifreeze - general information

Refer to illustration 2.6

Warning: *Do not allow antifreeze to come in contact with your skin or painted surfaces of the vehicle. Rinse off spills immediately with plenty of water. Antifreeze is highly toxic if ingested. Never leave antifreeze lying around in an open container or in puddles on the floor; children and pets are attracted by it's sweet smell and may drink it. Check with local authorities about disposing of used antifreeze. Many communities have collection centers which will see that antifreeze is disposed of safely. Never dump used anti-freeze on the ground or pour it into drains.*

Note: *Non-toxic antifreeze is now manufactured and available at local auto parts stores, but even these types should be disposed of properly.*

The cooling system should be filled with a water/ethylene glycol based antifreeze solution which will prevent freezing down to at least -20-degrees F (even lower in cold climates). It also provides protection against corrosion and increases the coolant boiling point.

The cooling system should be drained, flushed and refilled at least every other year (see Chapter 1). The use of antifreeze solutions for periods of longer than two years is likely to cause damage and encourage the formation of rust and scale in the system.

Before adding antifreeze to the system, check all hose connections. Antifreeze can leak through very minute openings.

The exact mixture of antifreeze to water which you should use depends on the relative weather conditions. The mixture should contain at least 50-percent antifreeze, but should never contain more than 70-percent antifreeze. Consult the mixture ratio chart on the antifreeze container before adding coolant. Hydrometers are available at most automotive parts stores to test the coolant **(see illustration)**. Use antifreeze which meets the vehicle manufacturer's specifications.

3 Thermostat - check and replacement

Warning: *The engine must be completely cool before beginning this procedure.*

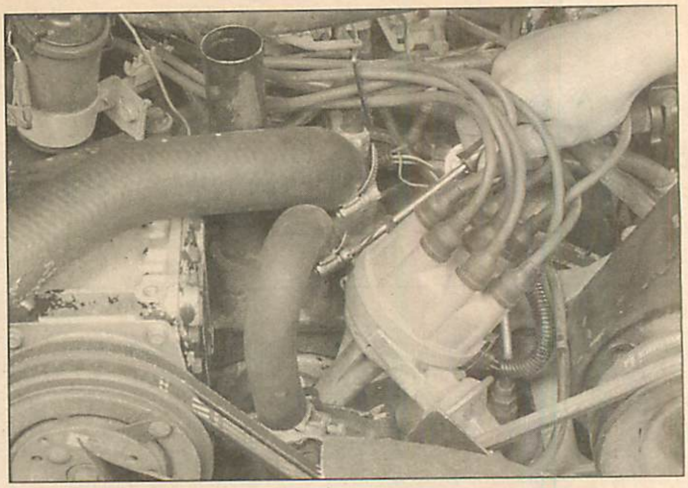
Note: *Don't drive the vehicle without a thermostat! The computer (if equipped) may stay in open loop and emissions and fuel economy will suffer.*

Check

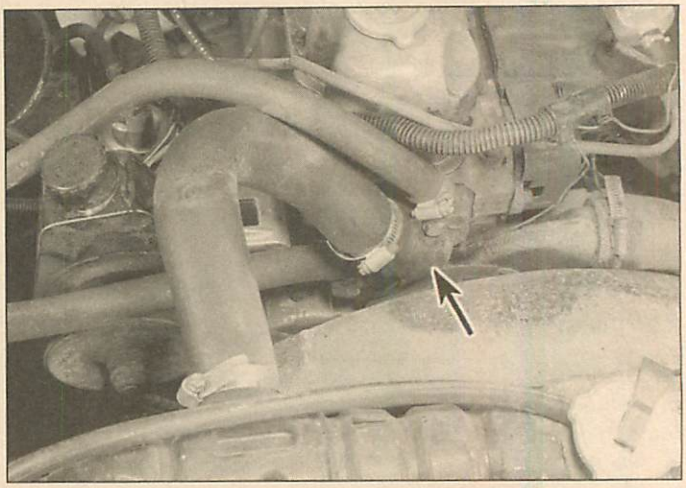
1 Before condemning the thermostat, check the coolant level, drivebelt tension and temperature gauge (or light) operation.

2 If the engine takes a long time to warm up, the thermostat is probably stuck open. Replace the thermostat.

3 If the engine runs hot, check the temperature of the upper radiator hose. If the hose isn't hot, the thermostat is probably stuck shut. Replace the thermostat.



3.7a Loosen the clamp and disconnect both the bypass hose and radiator hose from the thermostat cover (V8 models)



3.7b The thermostat housing (arrow) on six-cylinder models is located at the front of the cylinder head - disconnect both the radiator and heater hoses

4 If the upper radiator hose is hot, it means the coolant is circulating and the thermostat is open. Refer to the *Troubleshooting* section for the cause of overheating.

5 If an engine has been overheated, you may find damage such as leaking head gaskets, scuffed pistons and warped or cracked cylinder heads.

Replacement

Refer to illustrations 3.7a, 3.7b, 3.8 and 3.11

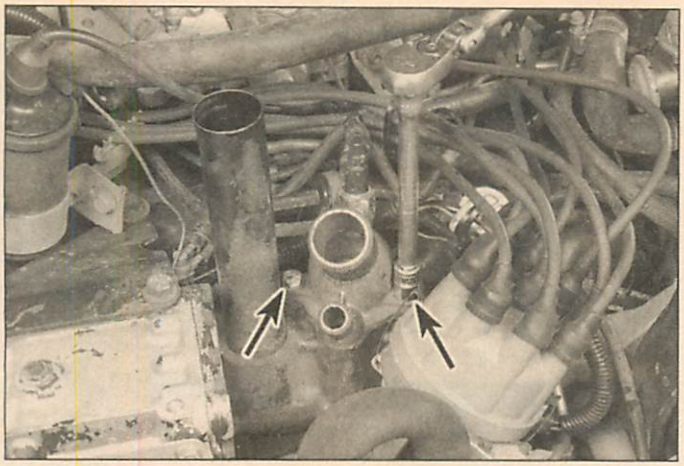
6 Drain coolant (about 1 gallon) from the radiator, until the coolant level is below the thermostat housing.

7 Disconnect the bypass hose (heater hose on six-cylinder engines) and upper radiator hose from the thermostat cover **(see illustrations)**.

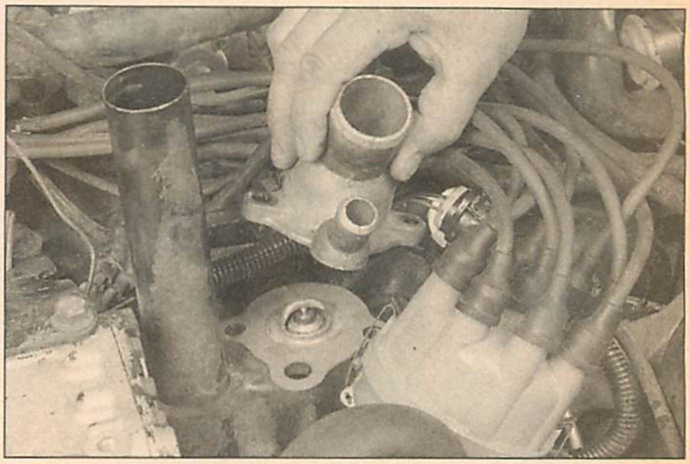
8 Remove the bolts and lift the cover off **(see illustration)**. It may be necessary to tap the cover with a soft-face hammer to break the gasket seal.

9 Note how it's installed, then remove the thermostat. Be sure to use a replacement thermostat with the correct opening temperature (see this Chapter's Specifications).

10 Use a scraper or putty knife to remove all traces of old gasket material and sealant from the mating surfaces. **Caution:** *Be careful not to gouge or damage the gasket surfaces, because a leak could develop*



3.8 Remove the bolts (arrows) and lift the thermostat cover off



3.11 Install the new thermostat with the spring toward the engine, place the new gasket over the thermostat and install the cover

after assembly. Make sure no gasket material falls into the coolant passages; it is a good idea to stuff a rag in the passage. Wipe the mating surfaces with a rag saturated with lacquer thinner or acetone.

11 Install the thermostat and make sure the correct end faces out - the spring is directed toward the engine **(see illustration)**.

12 Apply a thin coat of RTV sealant to both sides of the new gasket and position it on the engine side, over the thermostat, and make sure the gasket holes line up with the bolt holes in the housing.

13 Carefully position the cover and install the bolts. Tighten them to the torque listed in this Chapter's Specifications - do not over-tighten the bolts or the cover may crack or become distorted.

14 Reattach the radiator hose to the cover and tighten the clamp - now may be a good time to check and replace the hoses and clamps (see Chapter 1).

15 Refer to Chapter 1 and refill the system, then run the engine and check carefully for leaks.

16 Repeat steps 1 through 4 to be sure the repairs corrected the previous problem(s).

4 Engine cooling fan and clutch - check, removal and installation

Warning: *Keep hands, tools and clothing away from the fan. To avoid injury or damage DO NOT operate the engine with a damaged fan. Do not attempt to repair fan blades - replace a damaged fan with a new one.*

Check

Viscous clutch models only

1 Symptoms of failure of the fan clutch are continuous noisy operation, looseness leading to vibration and evidence of silicone fluid leaks.

2 Rock the fan back and forth by hand to check for excessive bearing play.

3 With the engine cold, turn the blades by hand. The fan should turn freely.

4 Visually inspect for substantial fluid leakage from the clutch assembly, a deformed bi-metal spring or grease leakage from the cooling fan bearing. If any of these conditions exist, replace the fan clutch.

5 When the engine is warmed up, turn off the ignition switch and disconnect the cable from the negative battery terminal. Turn the fan by hand. Some resistance should be felt. If the fan turns easily, replace the fan clutch.

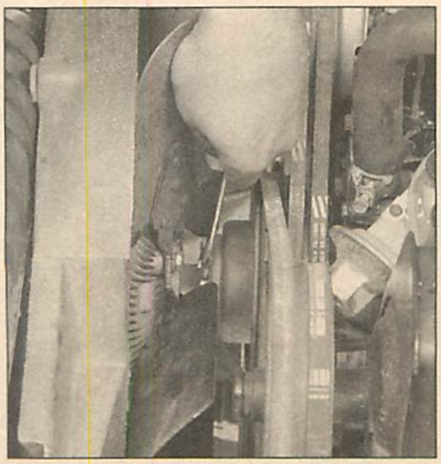
Removal and installation

Refer to illustrations 4.7a, 4.7b, 4.8 and 4.9

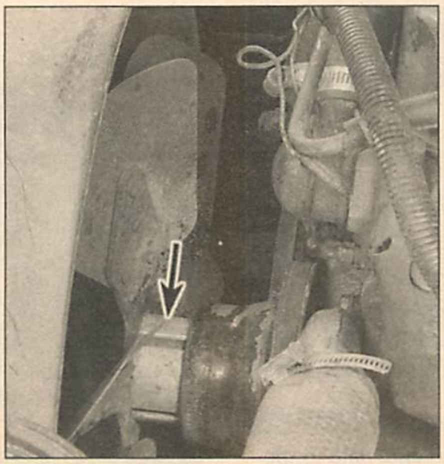
6 Loosen the drivebelt tension (see Chapter 1).

7 Remove the fan assembly-to-water pump hub bolts **(see illustrations). Note:** *If the engine has a non-viscous fan there will be a spacer used. Be careful not to lose it once removed.*

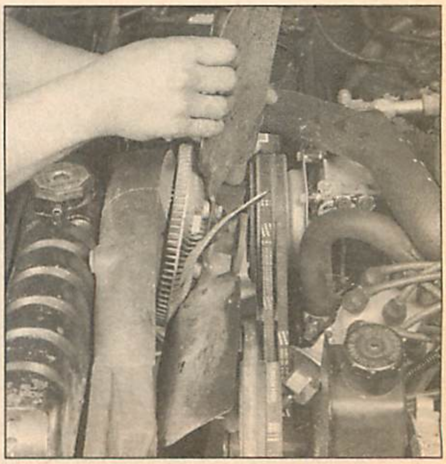
8 The fan and fan clutch should remain bolted together until they are removed. The fan assembly can be angled up and out without removing the fan shroud **(see illustration)**.



4.7a Remove the fan-assembly-to-water pump hub bolts

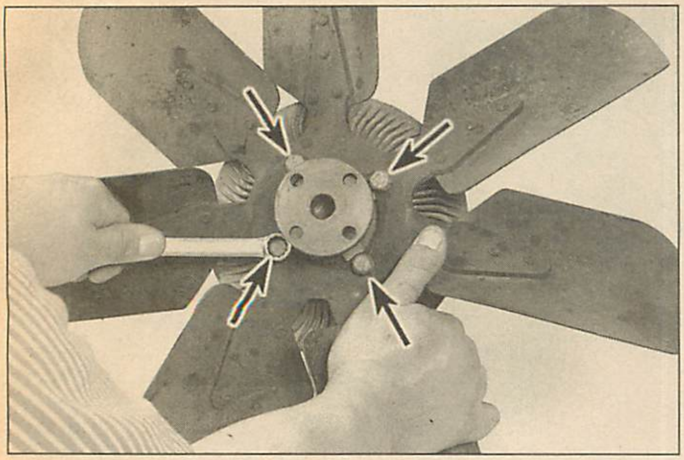


4.7b A spacer is used between the fan and water pump pulley on models not equipped with air-conditioning

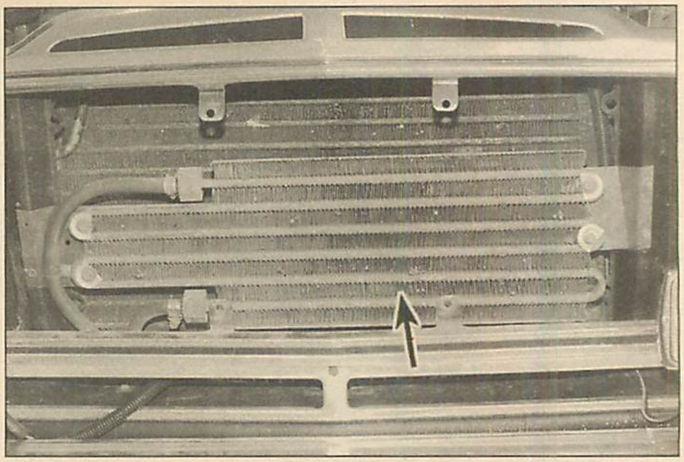


4.8 Angle the fan assembly out, making sure you don't hit the radiator core with the fan blades

3



4.9 Remove the fan-to-fan clutch mounting bolts (arrows)



5.1 Remove the grille to access the auxiliary transmission cooler (arrow)

9 The fan clutch (if equipped) can be unbolted from the fan blade assembly for replacement **(see illustration)**. **Caution:** *To prevent silicone fluid from draining from the clutch assembly, DO NOT place the drive unit in a position with the rear of the shaft pointing down. Store the clutch either front down, or prop it up vertically as installed on an engine.*

10 Some six-cylinder models may be equipped with a serpentine belt instead of standard V-belts. On these models, the fan, clutch and water pump are designed for *reverse* rotation. If your fan and clutch are stamped REVERSE, replace them only with components that are similarly marked.

11 Installation is the reverse of removal.

5 Transmission auxiliary oil cooler - removal and installation

Refer to illustrations 5.1 and 5.4

1 Some models will have an auxiliary oil cooler for transmission fluid, mounted behind the grille and in front of the radiator and air-conditioning condenser **(see illustration)**. Air flowing through the grille cools the transmission fluid. The transmission pump circulates the fluid through the bottom radiator tank, through the auxiliary cooler and back to the transmission.

2 For best efficiency, the auxiliary transmission cooler (like the radiator and condenser), should be kept clean of dirt, mud, leaves or other debris. Use a brush to clean its front surface of loose dirt, then spray the engine side of the radiator with a high-pressure hose (aiming the spray toward the front of the vehicle) to drive out remaining dirt.

3 To remove the cooler, first remove the grille (see Chapter 11).

4 Disconnect the rubber hoses from the right-side of the cooler and plug them to prevent loss of transmission fluid **(see illustration)**. Have a few rags handy under the cooler to catch any leakage.

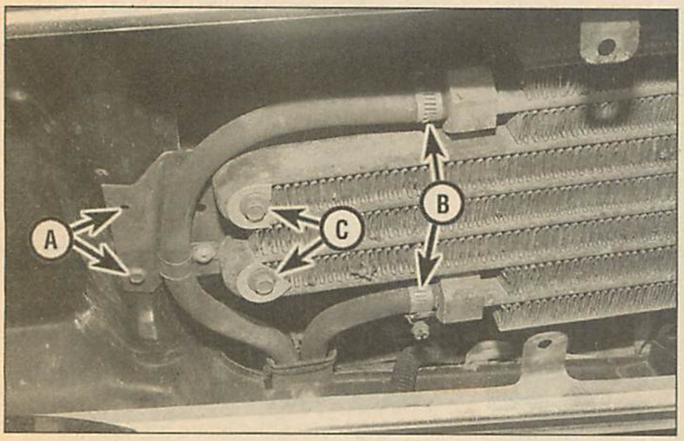
5 The cooler is retained by a bracket at each end. To remove the cooler from the vehicle, remove the four screws holding the brackets to the body. If the cooler is to be replaced, unbolt the brackets from the cooler (two bolts and nuts at each end) and attach the brackets to the new cooler **(see illustration 5.4)**.

6 Inspect the rubber hoses for fraying or cracks before reinstalling the cooler. **Warning:** *If the vehicle's transmission is being replaced or rebuilt, the cooler unit should be thoroughly flushed with solvent, otherwise any debris from the failed transmission may remain in the cooler and could affect the new transmission.*

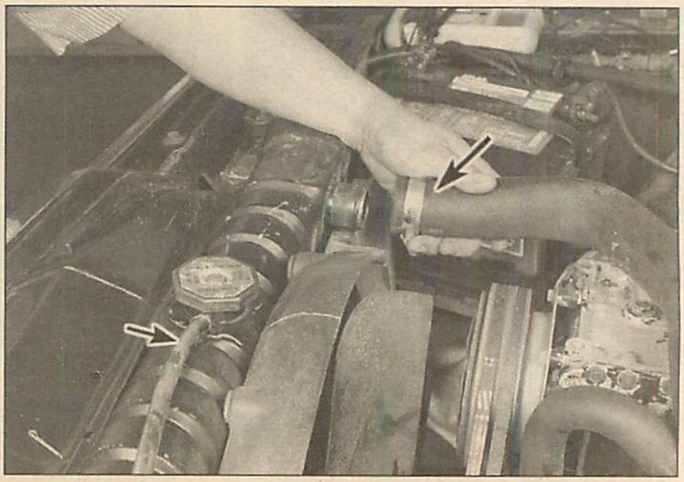
7 Installation is the reverse of the removal procedure. After installing the cooler, be sure to check the transmission fluid level and add fluid if necessary.

6 Radiator and coolant reservoir - removal and installation

Warning: *The engine must be completely cool before beginning this procedure.*

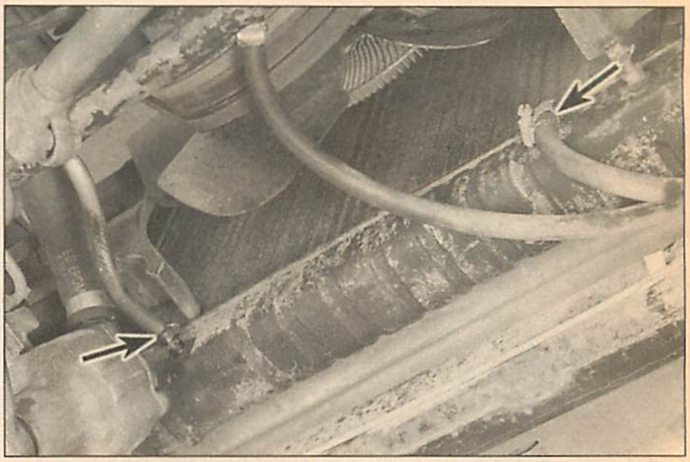


5.4 The cooler is retained by a bracket at each end, held to the body with screws (A) - disconnect the hoses (B) and remove the screws - the bolts (C) are only removed if a new cooler is being installed on the old brackets



6.2a Disconnect the overflow hose (small arrow) and the upper radiator hose (large arrow) from the radiator

6.2b Loosen the clamp on the lower radiator hose and pull the hose (arrow) from the left side of the radiator



6.3 Disconnect and plug the two transmission fluid lines (arrows) at the bottom of the radiator

Radiator

Refer to illustrations 6.2a, 6.2b, 6.3 and 6.4

1 Disconnect the cable from the negative battery terminal.

2 Drain the cooling system as described in Chapter 1, then disconnect the overflow hose and the upper and lower radiator hoses from the radiator **(see illustrations)**. Refer to the coolant **Warning** in Section 2.

3 Remove the cooler lines from the radiator, if equipped **(see illustration)** - be careful not to damage the lines or fittings. Plug the ends of the disconnected lines to prevent leakage and stop dirt from entering the system. Have a drain pan ready to catch any spills.

4 Remove the four bolts holding the fan shroud and lay it against the engine, over the fan and away from the radiator **(see illustration)**. The bolts retaining the fan shroud also retain the radiator to the body.

5 Lift the radiator from the engine compartment. Take care not to contact the fan blades.

6 Prior to installation of the radiator, replace any damaged hose clamps and radiator hoses.

7 Radiator installation is the reverse of removal.

8 After installation, fill the system with the proper mixture of antifreeze, and also check the automatic transmission fluid level, if equipped (see Chapter 1).

Coolant reservoir

Refer to illustration 6.9

9 Remove the coolant overflow hose from the reservoir, remove the screws and detach the reservoir **(see illustration)**.

10 Prior to installation make sure the reservoir is clean and free of debris which could be drawn into the radiator. Wash the inside and outside of the reservoir with soapy water and a brush if necessary, then rinse thoroughly. After cleaning, the reservoir coolant level will be easier to read.

11 Installation is the reverse of removal.

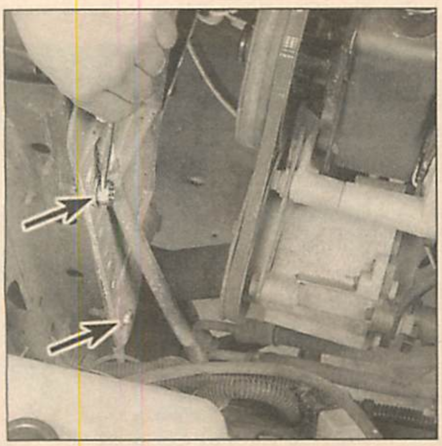
7 Water pump - check

Refer to illustration 7.2

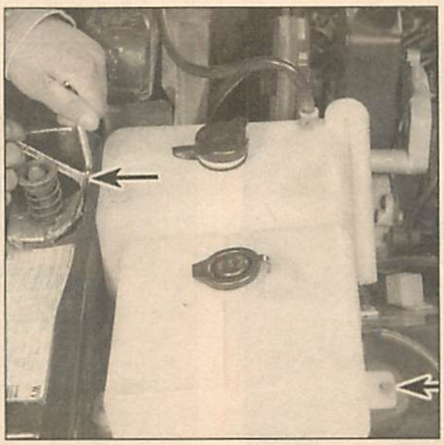
1 Water pump failure can cause overheating and serious damage to the engine. There are three ways to check the operation of the water pump while it is installed on the engine. If any one of the following quick-checks indicates water pump problems, it should be replaced immediately.

2 A seal protects the water pump impeller shaft bearing from contamination by engine coolant. If this seal fails, a weep hole in the water pump snout will leak coolant **(see illustration)**. An inspection mirror can be used to look at the underside of the pump. If the weep hole is leaking, shaft bearing failure will follow. Replace the water pump immediately. **Note:** *A small amount of discoloration is normal around the weep hole, but the presence of brown residue or dripping water indicates pump replacement is required.*

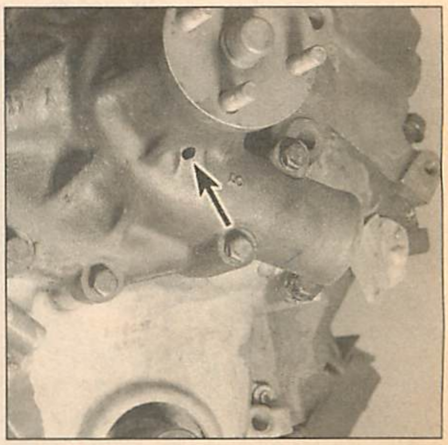
3 Besides contamination by coolant after a seal failure, the water



6.4 Remove the fan shroud/radiator mounting bolts (arrows)

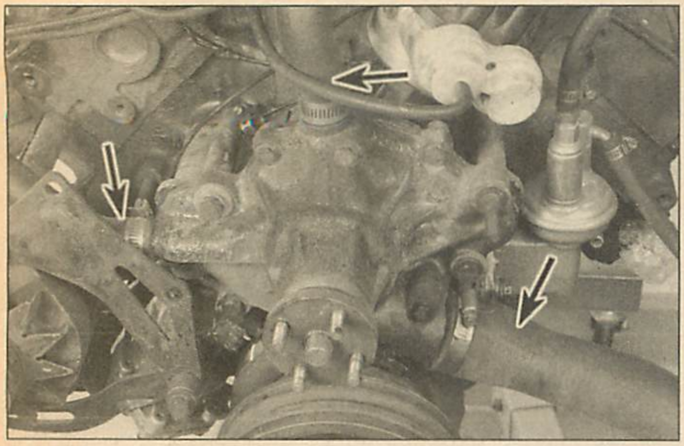


6.9 Typical coolant reservoir tank mounting screws (arrows) - on some models the tank is mounted on the firewall

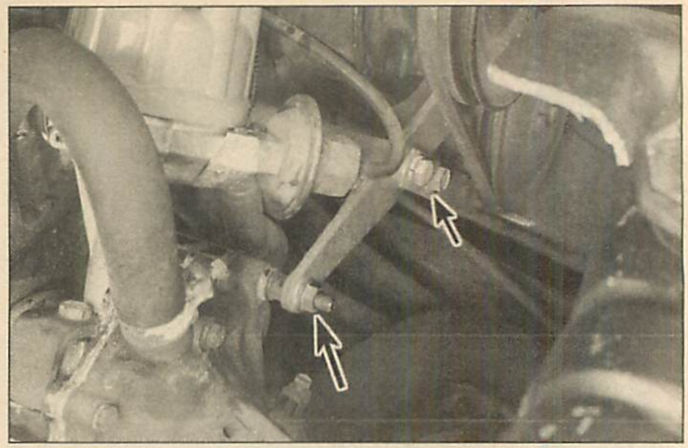


7.2 Check the weep hole (arrow) for leakage

3



8.4 Detach the coolant hoses (arrows) from the water pump

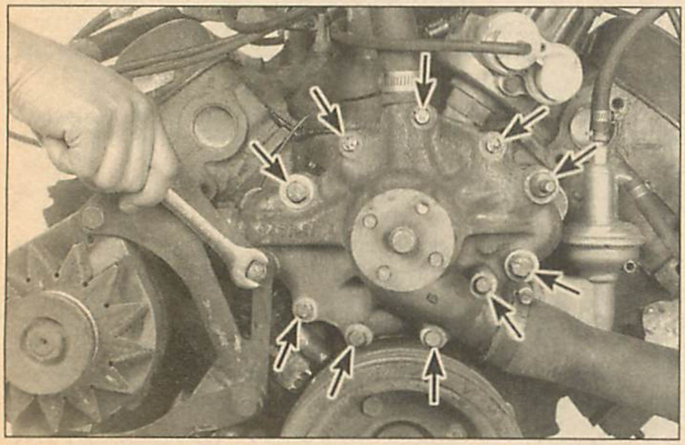


8.5 Remove the mounting bolts (small arrow) of the power steering pump bracket, then remove the nut (large arrow) and pull the bracket forward enough to clear the stud

pump impeller shaft bearing can also be prematurely worn out by an improperly-tensioned drivebelt. When the bearing wears out, it emits a high pitched squealing sound. If such a noise is coming from the water pump during engine operation, the shaft bearing has failed - replace the water pump immediately. **Note:** *Do not confuse belt noise with bearing noise.*

4 To identify excessive bearing wear before the bearing actually fails, grasp the water pump pulley (with the belt removed) and try to force it up-and-down or from side-to-side. If the pulley can be moved either horizontally or vertically, the bearing is nearing the end of its service life. Replace the water pump. Don't mistake drivebelt slippage, which causes a squealing sound, for water pump bearing failure.

5 It is possible for a water pump to be bad, even if it doesn't howl or leak water. Sometimes the fins on the back of the impeller can corrode away until the pump is no longer effective. The only way to check for this is to remove the pump for examination.



8.6a Remove the water pump mounting bolts (arrows) - V8 models

8 Water pump - removal and installation

Removal

Refer to illustrations 8.4, 8.5, 8.6a, 8.6b and 8.6c

1 Disconnect the cable from the negative battery terminal.

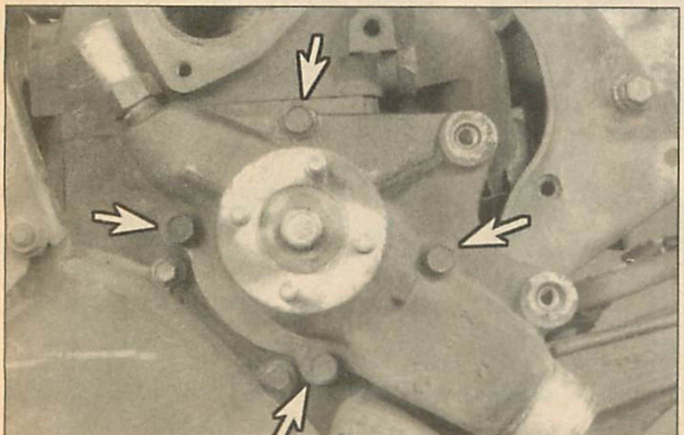
2 Drain the coolant and remove the drivebelts (see Chapter 1).

3 Remove the fan and shroud assembly (see Section 4) and water pump pulley.

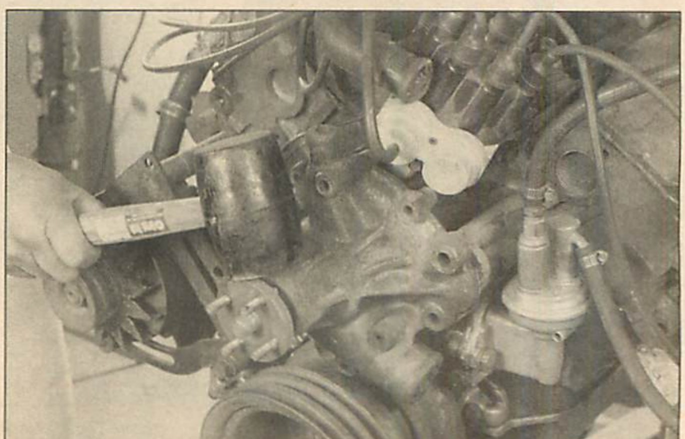
4 Detach the coolant hoses from the water pump **(see illustration)**.

5 On most models the air conditioning compressor (if equipped), alternator, power steering and air pump brackets are attached to bolts or studs at the water pump. Unbolt the accessory units to allow the brackets to be moved forward enough to clear the water pump mounting studs **(see illustration)**. **Note:** *Do not disconnect the power steering or air conditioning compressor hoses; unbolt the units and tie them aside. Refer to Section 15 for compressor mount removal.*

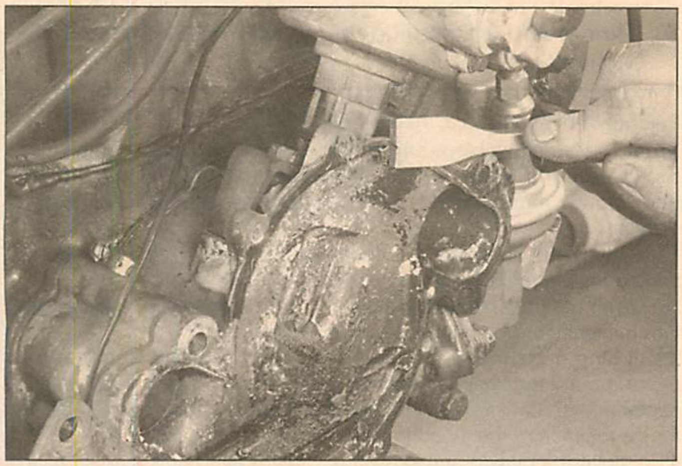
6 Remove the water pump mounting bolts and detach the water



8.6b Water pump mounting bolts (arrows) - six-cylinder models



8.6c If it is difficult to remove, use a soft-face hammer to break the gasket seal



8.7 Remove all traces of old gasket material from the pump and timing cover - use care to avoid gouging the soft aluminum of the timing cover

pump. It may be necessary to tap the pump with a soft-face hammer to break the gasket seal **(see illustrations)**. Inspect the pump's impeller blades on the backside for corrosion. If any fins are missing or badly corroded, replace the pump with a new one. **Caution:** *Some six-cylinder models may be equipped with a serpentine belt instead of standard V-belts. On these models, the fan, clutch and water pump are designed for reverse rotation. If your fan, clutch or water pump are stamped REVERSE, replace them only with components that are similarly marked. Reverse-rotation water pumps are marked REV on the front and R is stamped into the impeller.*

Installation

Refer to illustrations 8.7 and 8.9

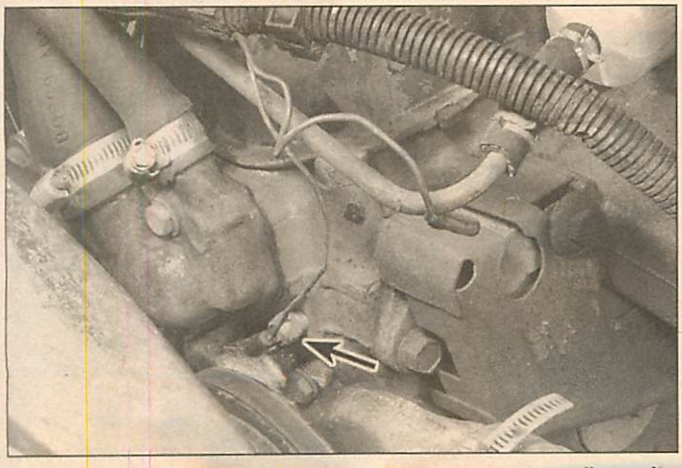
7 Clean the sealing surfaces of all gasket material on both the water pump and front cover **(see illustration)**. Wipe the mating surfaces with a rag saturated with lacquer thinner or acetone.

8 Apply a thin layer of gasket sealant to both sides of the new gasket.

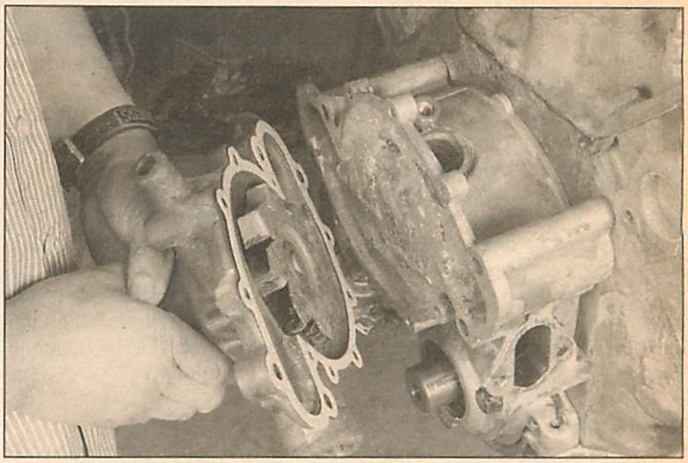
9 Install the gasket on the water pump **(see illustration)**.

10 Place the water pump in position and install the bolts finger tight. Use caution to ensure that the gasket doesn't slip out of position. Remember to replace any mounting brackets secured by the water pump mounting bolts or studs. Tighten the bolts to the torque listed in this Chapter's Specifications.

11 Install the coolant hoses and hose clamps. Tighten the hose clamps securely.



9.1a On six-cylinder models, coolant-temperature sending unit (arrow) is located at the front of the cylinder head, near the thermostat housing



8.9 Coat the gasket with a thin coat of gasket sealant and install the water pump

12 Install the water pump pulley, fan assembly and pulley bolts.

13 Install the drivebelts (see Chapter 1) and tighten the fan/pulley mounting bolts securely.

14 Add coolant to the specified level (see Chapter 1).

15 Reconnect the battery cable to the negative battery terminal.

16 Start the engine and check for the proper coolant level and the water pump and hoses for leaks.

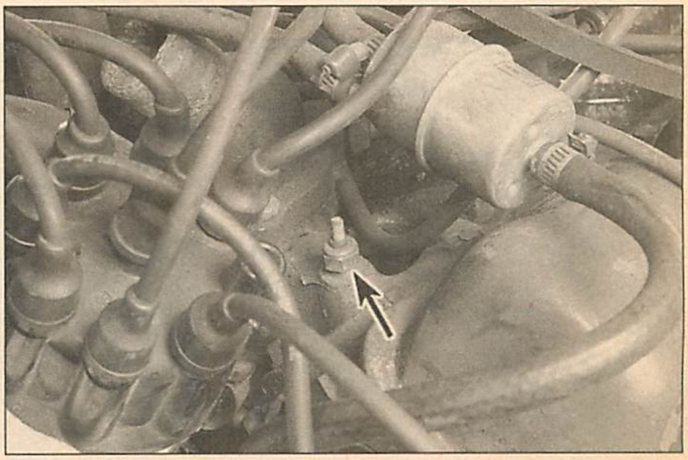
9 Coolant temperature sending unit - check and replacement

Warning: *Wait until the engine is completely cool before beginning this procedure.*

Check

Refer to illustrations 9.1a and 9.1b

1 The coolant temperature indicator system is composed of a temperature gauge mounted in the dash and a coolant temperature sending unit mounted on the engine **(see illustrations)**. Some vehicles have more than one sending unit, but only one is used for the indicator system and the other is used to send temperature information to the computer. **Note:** *When troubleshooting the temperature gauge system, make sure the vehicle's fuel tank is partly full, not empty or totally full, and that the fuel gauge is operating properly. This indicates that the Constant Voltage Regulator (CVR) that supplies 5 volts to the gauges is*



9.1b Coolant temperature sender location (arrow) - V8 models *working properly.*

2 If an overheating indication occurs, check the coolant level in the system and then make sure the wiring between the gauge and the sending unit is secure and all fuses are intact.

3 When the ignition switch is turned on, the gauge should activate. If the gauge hasn't moved when the engine is warmed up, check the instrument fuse on the fuse panel (see Chapter 12).

4 If the gauge doesn't move, pull the wiring connector from the sending unit at the engine and ground the connector to the block. This should make the gauge swing to the HOT reading. If not, the sender, gauge circuit or gauge is faulty.

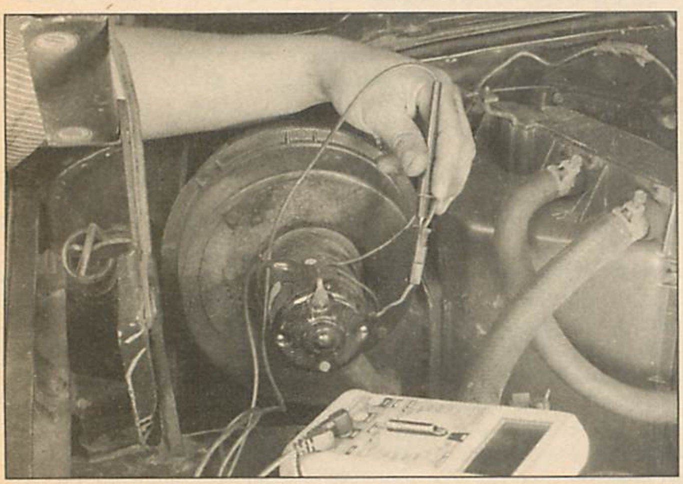
5 To test the gauge (see Chapter 12 for access to the rear of the instrument cluster), attach a ground wire to the sender terminal on the back of the gauge. If the gauge doesn't operate, replace the gauge. If the gauge does work, test the sender wire for continuity.

Replacement

6 Make sure the engine is cool before removing the defective sending unit. There will be some coolant loss as the unit is removed, so be prepared to catch any spills. Refer to the coolant **Warning** in Section 2.

7 Prepare the new sending unit by coating the threads with sealant. Disconnect the electrical connector and simply unscrew the sensor from the engine and install the replacement, then reattach the wire connector.

8 Check the coolant level after the replacement unit has been installed and top off the system, if necessary (see Chapter 1). Check now for proper operation of the gauge and sending unit.



10.3 Connect a voltmeter to the heater blower motor connector and check for voltage at each blower switch position

10 Heater and air conditioning blower motors and circuit - check

Refer to illustrations 10.3, 10.6a, 10.6b, 10.6c and 10.9

Note: *There are two blower motors on air-conditioning-equipped models. One for the heater and another for the air conditioning system. Both blower motors and blower resistors are checked in the same manner.*

1 Check the fuse and all connections in the circuit for looseness and corrosion. Make sure the battery is fully charged.

2 With the transmission in Park and the parking brake securely set, turn the ignition switch to On (engine not running).

3 Using a voltmeter, connect the negative probe to the blower motor ground terminal and backprobe the blower motor electrical connector with the positive probe **(see illustration)**. **Note:** *See Section 11 for the location of the air conditioning blower motor.*

4 Move the blower speed switch through each of its positions and note the voltage readings. Changes in voltage indicate that the motor speeds will also vary as the switch is moved to the different positions.

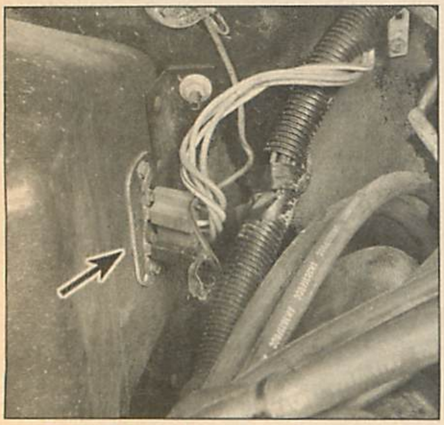
5 If voltage is present at the connector but the blower motor does not operate, disconnect the blower motor connector and apply battery voltage with a fused jumper wire. Also check the blower motor-to-chassis ground wire for corrosion and tightness. If the blower doesn't operate, it is faulty.

6 If there was no voltage present at the blower motor at one or more speeds, and the motor itself tested OK, check the blower motor resistor **(see illustrations)**.

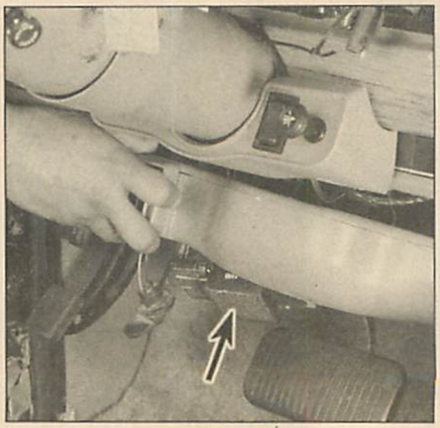
7 Disconnect the electrical connector from the blower motor resistor. Using an ohmmeter, check for continuity through each of the resistor terminals. If there is an open circuit across any two terminals, the resistor is faulty.

8 If the resistor checked good, switch your meter to the voltmeter function, connect the negative probe to a good chassis ground and probe the harness side of the blower resistor connector with the positive probe. With the ignition on, voltage should be present at each of the terminals in the connector as the switch is moved to the different positions (see the wiring diagrams at the end of Chapter 12 for terminal designations and corresponding switch positions). If there is no voltage present in one or more switch positions, the switch, control panel or related wiring is probably faulty.

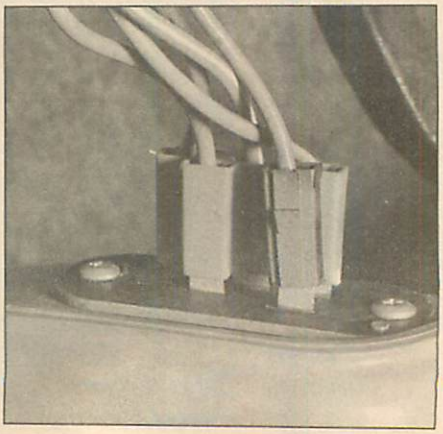
9 To check either of the blower motor speed switches, first remove the heater/air conditioning control panel (see Section 12). Using a voltmeter, check for power at the main feed wire with the ignition switch On (see the wiring diagrams at the end of Chapter 12 for terminal designation and wire color). If there is no power to the blower switch, check the circuit from the fuse box to the control panel (the blower switch mode relay is taped to the wiring harness behind the evaporator housing on later models). If power is available, check for continuity



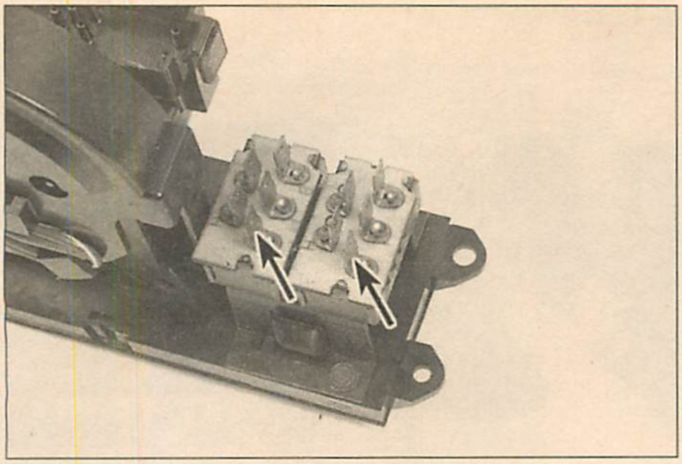
10.6a Blower (heater) motor resistor (arrow) location, at the right side of the firewall, on the heater-core housing



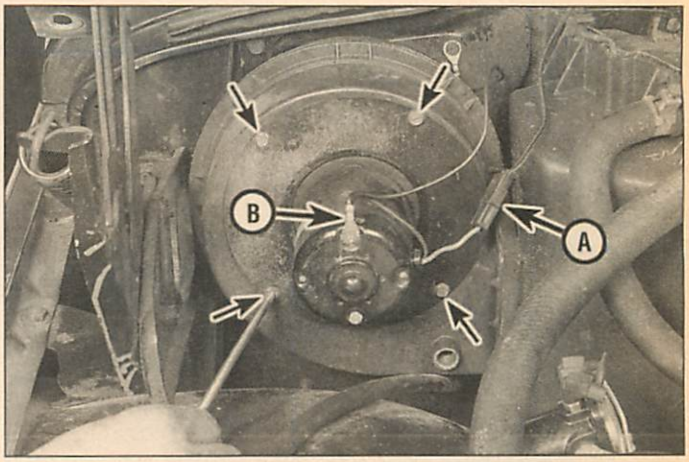
10.6b Lower the air-conditioning duct (arrow) from below the steering column . . .



10.6c . . . to access the air conditioning blower motor resistor located on the back of the air duct



10.9 Check for continuity between the power-in terminal (arrows) and each of the other terminals - at every switch speed, there should be continuity between the power and one other terminal



11.2 Disconnect the power (A) and ground wire (B), then remove the four screws (arrows) retaining the heater blower motor

between the power terminal on the switch and each of the other terminals **(see illustration)**. As each blower speed is selected, there should be one terminal with continuity to the power terminal. If not, replace the switch.

11 Heater and air conditioner blower motors - removal and installation

Note: *There are two blower motors on air conditioning equipped models. One for the heater and another for the air conditioning system.*

Heater blower motor

Refer to illustrations 11.2 and 11.3

1 Disconnect the cable from the negative battery terminal.

2 Disconnect the blower motor electrical connector and ground wire terminal. Remove the four mounting screws and pull out the blower motor and fan assembly **(see illustration)**.

3 If necessary, detach the fan retainer clip from the motor shaft **(see illustration)** and remove the fan from the motor.

4 Installation is the reverse of removal. Connect the wiring and check for proper blower operation.

Air conditioning blower motor

Refer to illustrations 11.6 and 11.8

5 Disconnect the cable from the negative battery terminal.

6 Remove the mounting screws and lower the air conditioning evaporator core housing to access the blower motor attaching screws (it's not necessary to discharge the air conditioner system to remove the blower motor) **(see illustration)**.

7 Disconnect the blower motor electrical connector and ground wire terminal.

8 Remove the blower motor mounting screws and motor clamp **(see illustration)**.

9 Remove the blower motor from the housing.

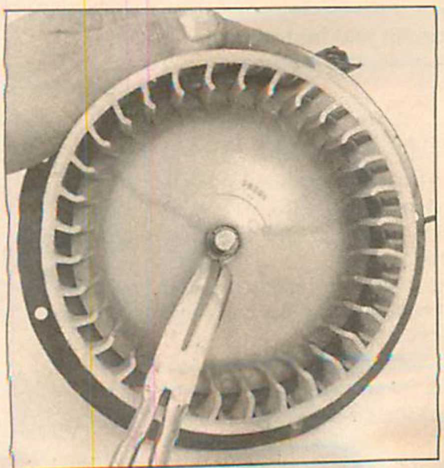
10 Installation is the reverse of removal.

12 Heater and air conditioning control assembly - removal and installation

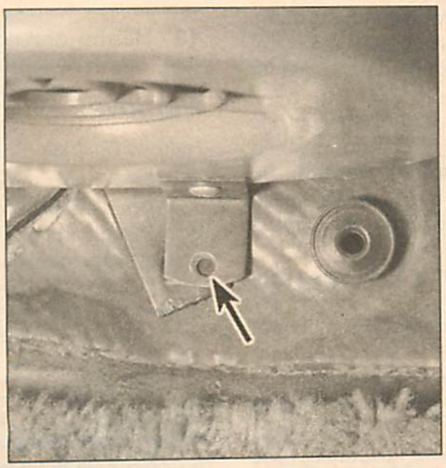
Refer to illustrations 12.3, 12.4, 12.7 and 12.8

1 Disconnect the cable from the negative battery terminal.

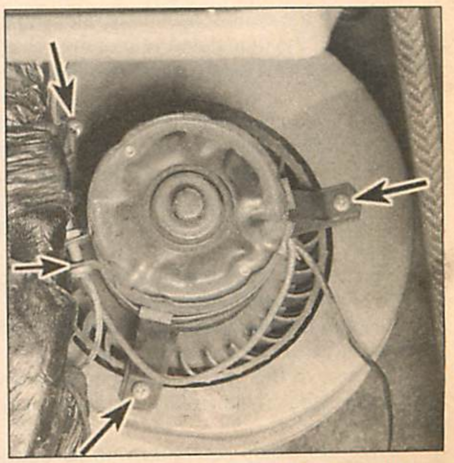
2 Remove the trim bezel that surrounds the heater/air conditioning control assembly (see Chapter 11).



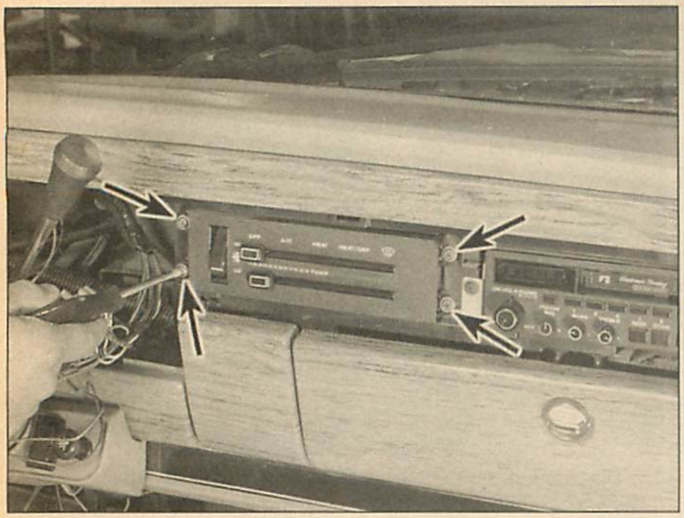
11.3 Remove the fan by squeezing the spring clip together and slipping the fan off the shaft



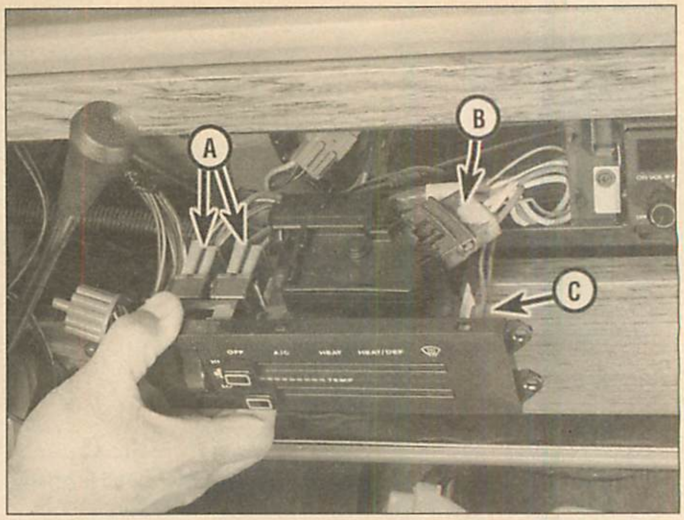
11.6 Remove the six screws securing the evaporator housing to the bottom-right of the dash, then remove this bolt (arrow) at the lower right of the (interior) firewall and lower the housing



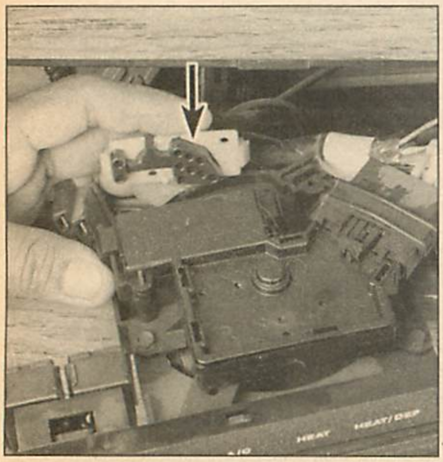
11.8 Remove the mounting screws, loosen the motor clamp (arrows) and remove the motor from the housing



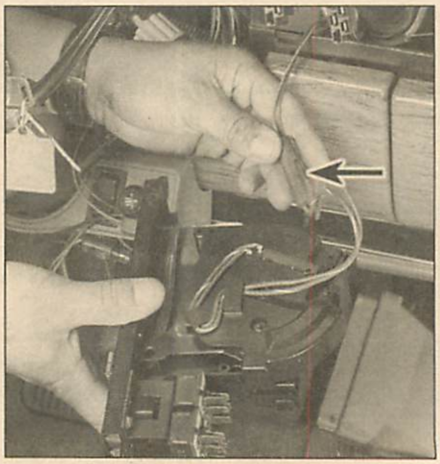
12.3 Remove the four screws (arrows) and pull the control panel out from the instrument panel



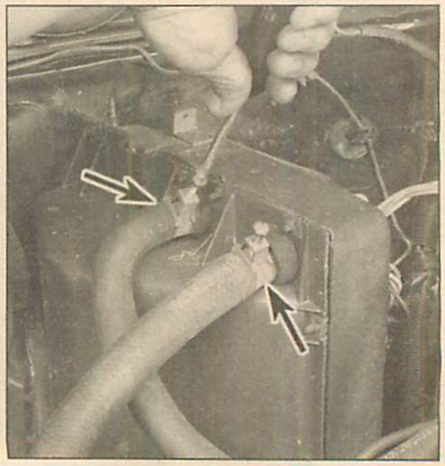
12.4 Disconnect the blower speed switch connectors (A), the main mode control connector (B), and the illumination light connector (C)



12.7 Push in the tabs on either side and disconnect the vacuum connector (arrow)



12.8 Disconnect the thermistor circuit connector (arrow)



13.3 Loosen the hose clamps and disconnect the heater hoses (arrows) from the heater core fittings

3 Remove the control assembly retaining screws **(see illustration)**. Depending on the model and year of the vehicle, the controls may have push buttons and a lever, or just two levers (one for mode and one for temperature).

4 Pull the control assembly out from the dash and disconnect the cables, electrical connections and vacuum lines (on air-conditioned models) from the control assembly **(see illustration)**. **Caution:** *Be careful when removing the vacuum lines to avoid cracking the plastic connectors and causing a vacuum leak (possibly within the control assembly).*

5 Disconnect the connectors for the control panel illumination light and the blower speed switch(es).

6 Release the tab retaining the mode-control cable to the control assembly and pull off the cable "eye".

7 To remove the vacuum connector from the control assembly, depress the tabs on either side while pulling out on the connector **(see illustration)**.

8 On later models equipped with air-conditioning, disconnect the electrical connector to the thermistor **(see illustration)**.

9 To install the control assembly, reverse the removal procedure. **Caution:** *When reconnecting vacuum lines to the control assembly use a very small amount of plain water to make reconnection easier, if necessary. Do not use any other lubricant.*

13 Heater core - removal and installation

Removal

Refer to illustrations 13.3, 13.4, 13.5a, 13.5b, 13.6 and 13.7

1 Disconnect the cable from the negative battery terminal.

2 Drain the cooling system (see Chapter 1).

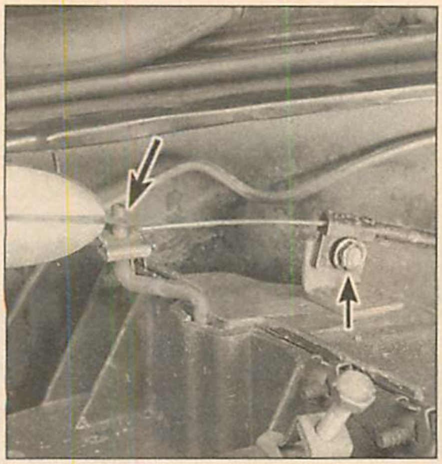
3 Disconnect the heater hoses from the heater core and plug the open fittings **(see illustration)**.

4 Use diagonal pliers to remove the spring clip from the mode-door cable end. Remove the mounting screw and disconnect the cable from the mode door **(see illustration)**.

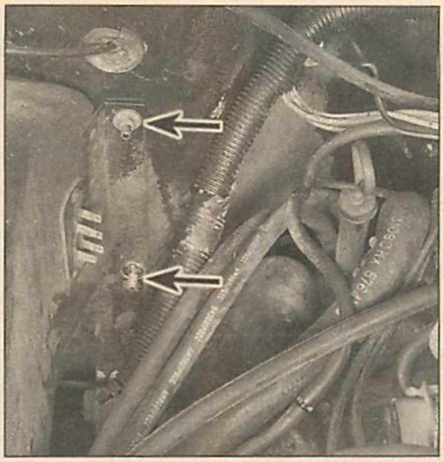
5 Remove the two nuts retaining the left side of the heater housing to the firewall, then remove the two nuts from the studs inside the vehicle, under the right side of the dash **(see illustrations)**. Remove the heater-core/housing assembly from the engine compartment.

6 Remove the screws and separate the two halves of the heater housing, exposing the heater core **(see illustration)**.

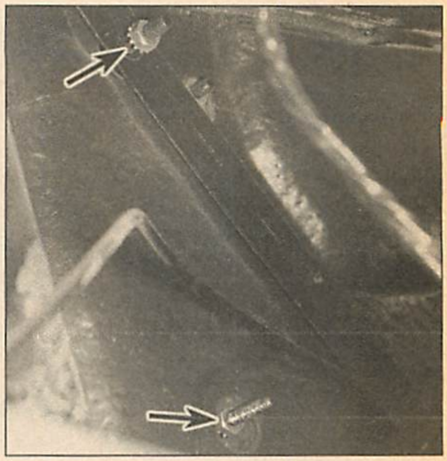
7 Remove the heater core from the housing, noting the location of the sealing material. If the sealing material is in good condition, save it for reuse **(see illustration)**.



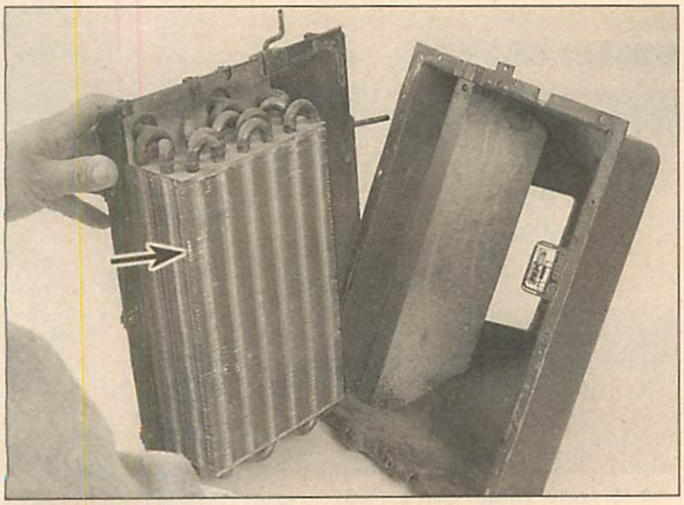
13.4 Pry the retaining clip off the mode door lever (left arrow), remove the cable mounting bracket (right arrow) and disconnect the cable from the mode door



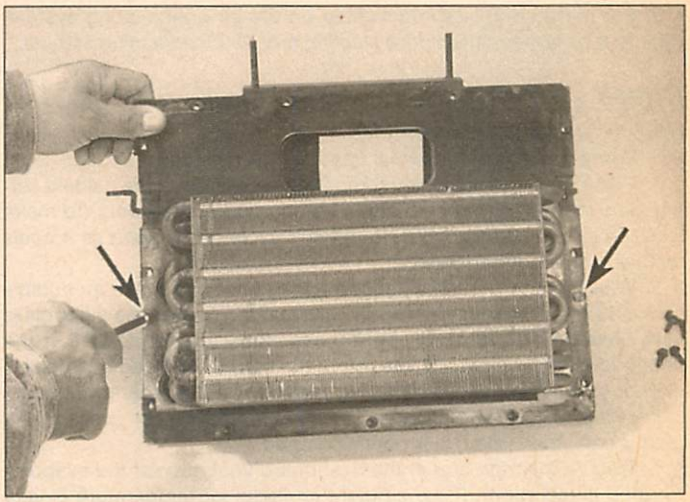
13.5a Remove the two nuts (arrows) on the left side of the heater housing . . .



13.5b . . . and these two nuts inside the vehicle



13.6 Remove the screws and separate the housing, exposing the heater core (arrow)



13.7 Remove the two mounting screws (arrows) and detach the heater core from the housing

Installation

8 Installation is the reverse of removal. Reinstall the sealing material between the heater core and the housing.

9 Refill the cooling system (see Chapter 1).

10 Start the engine and check for proper operation and leaks. Recheck the cooling system level after the engine has reached operating temperature.

14 Air conditioning and heating system - check and maintenance

Warning: *The air conditioning system is under high pressure. DO NOT loosen any fittings or remove any components until after the system has been discharged. Air conditioning refrigerant should be properly discharged into an EPA-approved container at a dealership service department or an automotive air conditioning facility. Always wear eye protection when disconnecting air conditioning system fittings.*

1 The following maintenance steps should be performed on a regular basis to ensure that the air conditioning and heating system continues to operate at peak efficiency.

a) Check the tension of the drivebelt and adjust if necessary (see Chapter 1).

b) Check the condition of the hoses. Look for cracks, hardening and deterioration. Look at potential leak areas for signs of refrigerant oil leaking out. **Warning:** *Do not replace air conditioning hoses until the system has been discharged by a dealership or air conditioning repair facility.*

c) Check the fins of the condenser for leaves, bugs and other foreign material. A soft brush and compressed air can be used to remove them.

d) Check the wire harness for correct routing, broken wires, damaged insulation, etc. Make sure the electrical connectors are clean and tight.

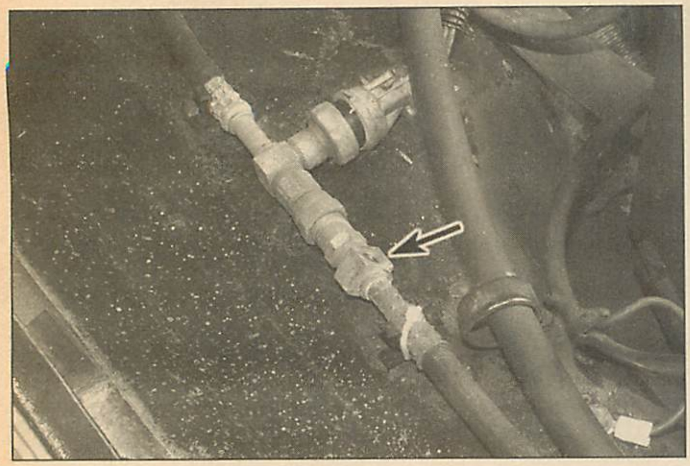
e) Maintain the correct refrigerant charge.

2 The air conditioning system should be run for about 10 minutes at least once a month. This is particularly important during the winter months because long-term non-use can cause hardening of the internal seals.

3 Because of the complexity of the air conditioning system and the special equipment required to effectively work on it, accurate troubleshooting of the system should be left to a certified air conditioning technician.

4 If the air conditioning system doesn't operate at all, check the fuse panel.

5 The most common cause of poor cooling is simply a low system refrigerant charge. If a noticeable drop in cool air output occurs, the



14.8 Observe the sight glass (arrow) on the right fenderwell with the air conditioning ON to check for bubbles in the refrigerant that might indicate a low charge

following quick check will help you determine if the refrigerant level is low. For more complete information on the air conditioning system, refer to the *Haynes Automotive Heating and Air Conditioning Manual*.

Check

Refer to illustrations 14.8 and 14.9

6 Warm the engine to normal operating temperature.

7 Place the air conditioning temperature selector at the coldest setting and the blower at the highest setting. Open the doors (to make sure the air conditioning system doesn't cycle off as soon as it cools the passenger compartment).

8 With the compressor engaged - the clutch will make an audible click and the center of the clutch will rotate - inspect the sight glass **(see illustration)**, located on the passenger-side fenderwell. If the refrigerant looks foamy, it's low. Have the system charged at a dealership or automotive air conditioning facility. If the refrigerant appears clear, the compressor discharge line is warm and the compressor inlet pipe is cool, the system is properly charged.

9 Place a thermometer in the dashboard vent nearest the evaporator **(see illustration)**. If the ambient (outside) air temperature is very high, say 110-degrees F, the duct air temperature may be as high as 60-degrees F, but generally the air conditioning should be 30 to 40-degrees F cooler than the ambient air.

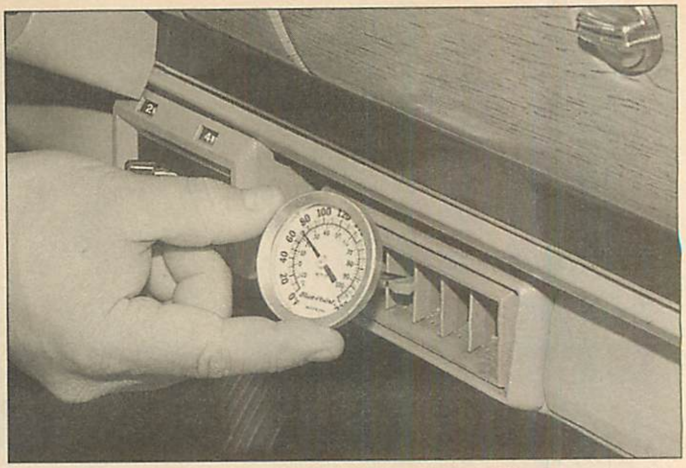
Adding refrigerant

10 Because of Federal regulations enacted by the Environmental Protection Agency, 12-ounce cans of R-12 refrigerant may not be available in your area for home charging of air conditioning systems. If this is the case, it will be necessary to take the vehicle to a licensed air conditioning technician for charging. **Note:** *The R-12 refrigerant used in all vehicles before 1993 is no longer being manufactured, although there are stockpiles available to professional installers at the time of this writing. In the future, R12 refrigerant will become too expensive or unavailable. Consult your air conditioning specialist for "retrofit kits" that allow the use of modern, environmentally-friendly R-134-A refrigerant in older vehicles. For some vehicles, the conversion is simple and inexpensive, but more complicated for others.*

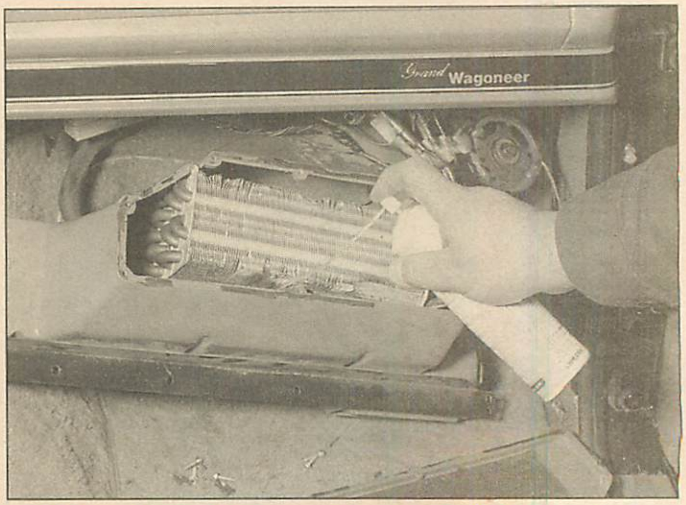
Heating systems

11 If antifreeze vapor or steam is coming through the vents, the heater core is leaking. If you smell a sweet odor when you first turn on the heater, this indicates antifreeze vapor is leaking out of the heater core. Antifreeze can leak out through very tiny pinholes. **Note:** *If it is leaking, replace the heater core with a new one* (see Section 13)*; most radiator shops will not repair a leaking heater core.*

12 If the air coming out of the heater vents isn't hot, the problem



14.9 Insert a thermometer in the center duct while operating the air conditioning system - the output should be 35 to 40-degrees F below the ambient air temperature



14.16 Large spray bottles made for disinfecting automotive air-conditioning systems are available in most auto parts stores - lower the evaporator housing, exposing the evaporator core and spray the disinfectant directly onto the evaporator core

could stem from any of the following causes:

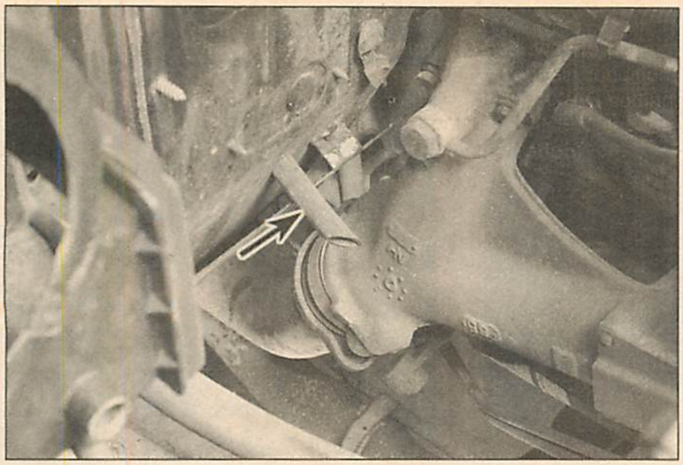
a) *The thermostat is stuck open, preventing the engine coolant from warming up enough to carry heat to the heater core. Replace the thermostat (see Section 3).*
b) *A heater hose is blocked, preventing the flow of coolant through the heater core. Feel both heater hoses at the firewall. They should be hot. If one of them is cold, there is an obstruction in one of the hoses or in the heater core. Detach the hoses and back flush the heater core with a water hose. If the heater core is clear but circulation is impeded, remove the two hoses and flush them out with a water hose.*
c) *If flushing fails to remove the blockage from the heater core, the core must be replaced* (see Section 13).

Eliminating air-conditioner odors

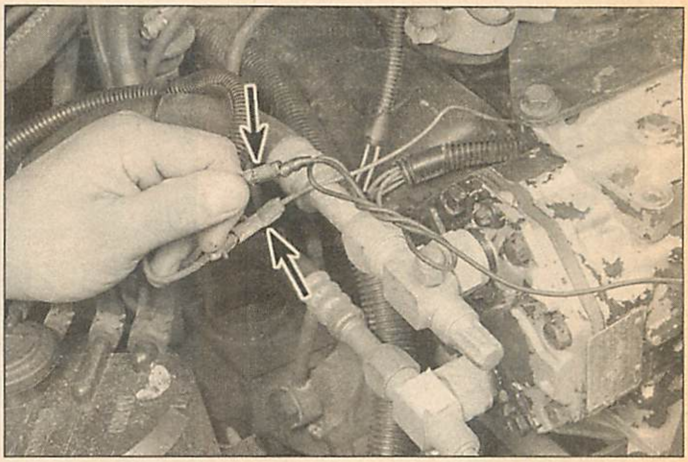
Refer to illustrations 14.16 and 14.17

13 Unpleasant odors that often develop in air-conditioning systems are caused by the growth of a fungus, usually on the surface of the evaporator core. The warm, humid environment there is a perfect breeding ground for mildew to develop.

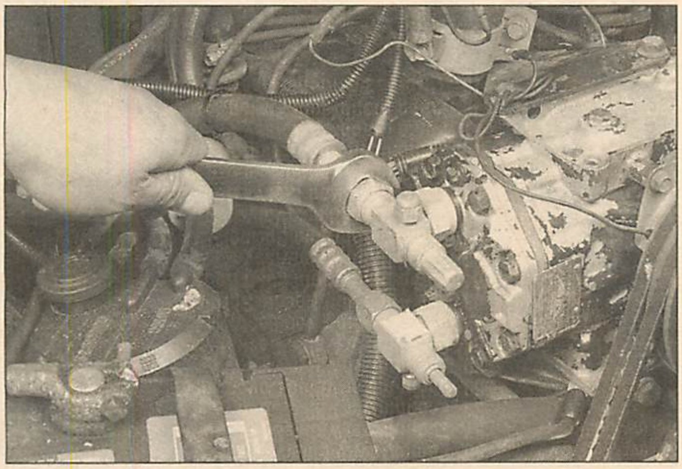
14 The evaporator core on most vehicles is difficult to access, and the dealerships have a lengthy, expensive process for eliminating the



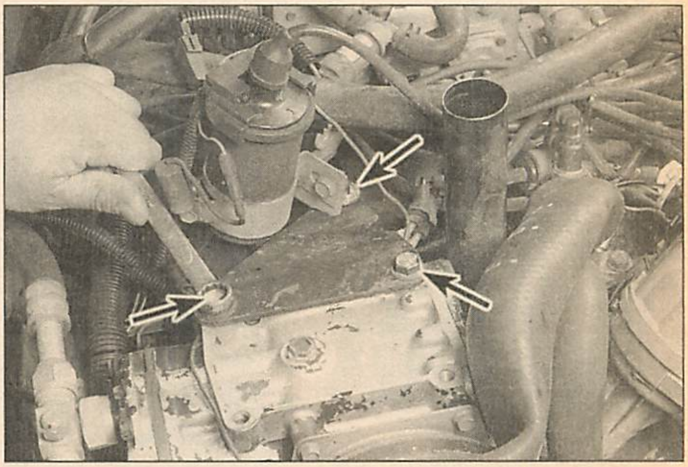
14.17 Check the evaporator housing drain tube (arrow) for obstructions - it's located on the firewall, below the heater core housing



15.3a Disconnect the electrical connectors (arrows) from the air conditioning compressor . . .



15.3b . . . and disconnect the refrigerant lines from the fittings



15.5 Remove these three bolts (arrows) and remove the upper compressor mounting bracket

fungus by opening up the evaporator case and using a powerful disinfectant and rinse on the core until the fungus is gone. You can service your own system at home, but it takes something much stronger than basic household germ-killers or deodorizers.

15 Aerosol disinfectants for automotive air-conditioning systems are available in most automotive parts stores, but remember when shopping for them that the most effective treatments are also the most expensive. The basic procedure for using these sprays is to start by running the system for ten minutes with the blower on its highest speed. Use the highest heat mode to dry out the system and keep the compressor from engaging by disconnecting the wiring connector at the compressor (see Section 15).

16 The disinfectant can usually comes with a long spray hose. Find a point on the evaporator case that would allow direct spray over the entire core and drill a small hole in the plastic housing. **Caution:** *Use a stop if necessary to prevent the drill from going in far enough to damage the core.* Point the nozzle inside the hole and spray, according to the manufacturer's recommendations. After use, close up the small hole with a dab of flexible body sealer. As an alternative, lower the evaporator housing and spray the disinfectant directly onto the evaporator core **(see illustration)**.

17 Once the evaporator has been cleaned, the best way to prevent the mildew from coming back again is to always run your air-conditioning system on the exterior-air source, don't use the MAX/AC setting. The drier outside air keeps the fungus from starting. Also make sure your evaporator housing *drain* tube is clear **(see illustration)**.

15 Air conditioning compressor - removal and installation

Warning: *The air conditioning system is under high pressure. DO NOT loosen any fittings or remove any components until after the system has been discharged. Air conditioning refrigerant should be properly discharged into an EPA-approved container at a dealership service department or an automotive air conditioning repair facility. Always wear eye protection when disconnecting air conditioning system fittings.*

Note: *The receiver/drier* (see Section 16) *should be replaced whenever the compressor is replaced.*

Removal

Refer to illustrations 15.3a, 15.3b, 15.5, 15.6, 15.7, and 15.8

1 Have the air conditioning system discharged (see **Warning** above). Disconnect the cable from the negative battery terminal.

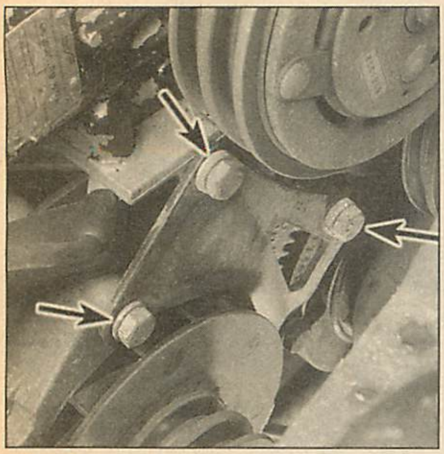
2 Clean the compressor thoroughly around the refrigerant line fittings.

3 Disconnect the electrical connector from the air conditioning compressor. Disconnect the suction and discharge lines from the top of the compressor **(see illustrations)**. Plug the open fittings to prevent the entry of dirt and moisture.

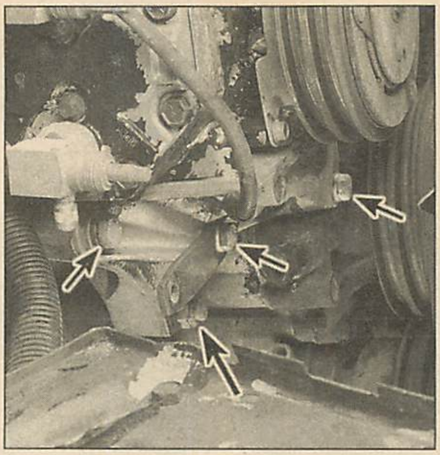
4 Remove the drivebelt(s) (refer to Chapter 1).

5 Remove the upper compressor mounting bracket **(see illustration)**.

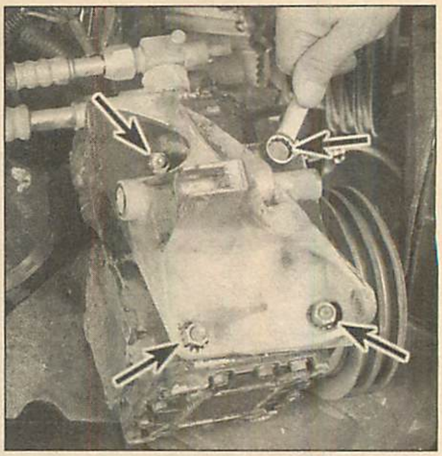
3



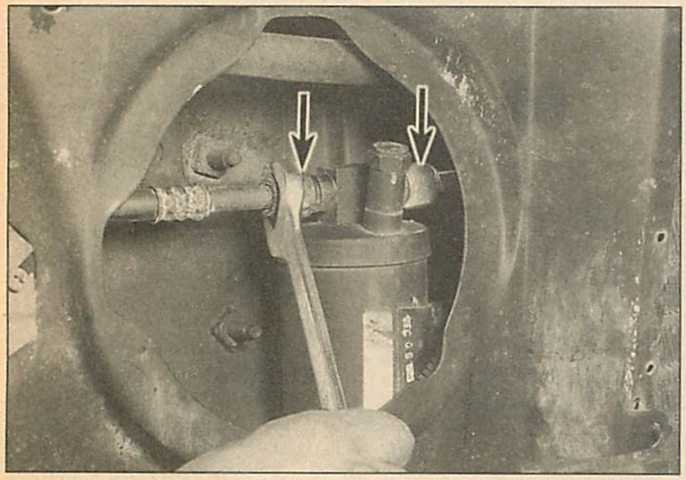
15.6 Remove the alternator bracket bolts (arrows), remove the bracket and position the alternator aside



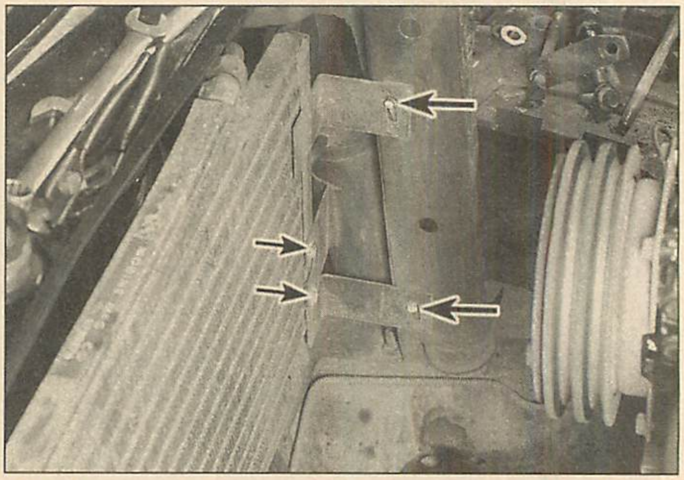
15.7 Remove the compressor mounting bolts (small arrows) and nut (larger arrow)



15.8 Remove the bolts and nuts (arrows) retaining the compressor to the mount



16.2 Remove the refrigerant lines from the receiver-drier (arrows)



16.3 To remove the receiver-drier, remove the screws retaining the bracket to the condenser mounting bracket (small arrows) - to remove the condenser, remove the mounting bolts on each side of the condenser (large arrows)

6 Remove the alternator mounting bracket and position the alternator aside **(see illustration)**.

7 Remove compressor mounting bolts and nut **(see illustration)**. Pull the compressor and mount forward until the mount clears the stud.

8 Remove the compressor and mount assembly from the engine compartment and remove the bolts/nuts retaining the compressor to the mount **(see illustration)**.

Installation

9 If a new compressor is being installed, pour the oil from the old compressor into a graduated container and add that exact amount of new refrigerant oil to the new compressor. Also follow any directions included with the new compressor. **Note:** *Some replacement compressors come with refrigerant oil in them.*

10 Install the lower bracket on the compressor and tighten the nuts and bolts securely.

11 Install the compressor/bracket assembly onto the engine. Install the alternator bracket and alternator, tighten all the fasteners securely.

12 Install the upper compressor mount and the drivebelt(s).

13 Connect the electrical connector to the compressor. Install the refrigerant lines to the fittings, using new O-rings lubricated with clean refrigerant oil, and tighten the nuts securely.

14 Reconnect the cable to the negative battery terminal.

15 Have the system evacuated, recharged and leak tested by a dealership service department or an automotive air conditioning repair facility.

16 Air conditioning receiver/drier - removal and installation

Warning: *The air conditioning system is under high pressure. DO NOT loosen any fittings or remove any components until after the system has been discharged. Air conditioning refrigerant should be properly discharged into an EPA-approved container at a dealership service department or an automotive air conditioning repair facility. Always wear eye protection when disconnecting air conditioning system fittings.*

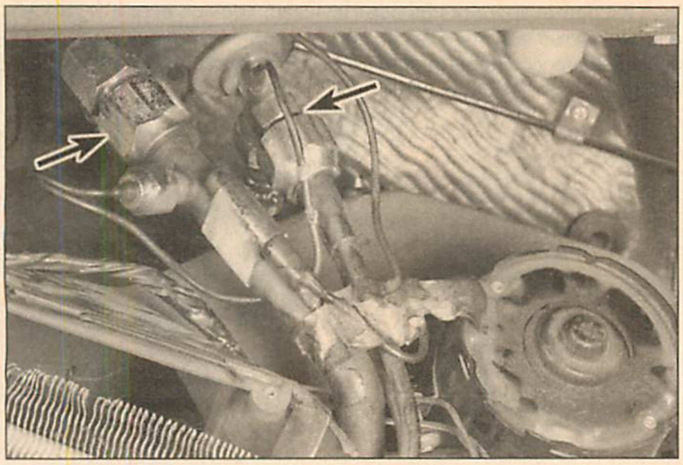
Removal

Refer to illustrations 16.2 and 16.3

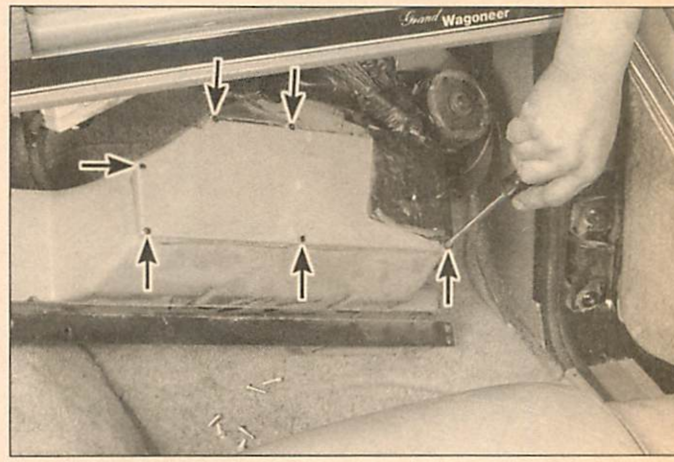
1 Have the air conditioning system discharged (see **Warning** above). Disconnect the cable from the negative battery terminal.

2 Disconnect the refrigerant inlet and outlet lines **(see illustration)**. Cap or plug the open lines immediately to prevent the entry of dirt or moisture. **Note:** *On some models, the receiver-drier is located in the engine compartment, on others (like the one shown here) it is located between the radiator support and the grille, and requires removal of the grille* (see Chapter 11) *and the radiator* (see Section 6) *for access.*

3 Refer to Section 6 and remove the radiator. Remove the two screws retaining the receiver-drier bracket to the condenser and slide the receiver/drier assembly up and out **(see illustration)**.



18.3 Lower the evaporator housing from the instrument panel and pull it back toward the seat as far as you can to access the refrigerant line fittings (arrows)



18.4a Remove the screws (arrows) from the evaporator cover, peel back the insulation and remove the cover

Installation

4 If you are replacing the receiver/drier with a new one, add one ounce of fresh refrigerant oil to the new unit.

5 Place the new receiver/drier into position, install the mounting screws and tighten them securely.

6 Install the refrigerant lines, using clean refrigerant oil on the new O-rings. Tighten the fittings securely.

7 Connect the cable to the negative terminal of the battery.

8 Have the system evacuated, recharged and leak tested by a dealership service department or an automotive air conditioning repair facility.

17 Air conditioning condenser - removal and installation

Warning: *The air conditioning system is under high pressure. DO NOT loosen any fittings or remove any components until after the system has been discharged. Air conditioning refrigerant should be properly discharged into an EPA-approved container at a dealership service department or an automotive air conditioning repair facility. Always wear eye protection when disconnecting air conditioning system fittings.*

Removal

1 Have the air conditioning system discharged (see **Warning** above). Disconnect the cable from the negative battery terminal.

2 Refer to Section 6 and remove the radiator.

3 Disconnect the refrigerant line fittings from the condenser and cap the open fittings to prevent the entry of dirt and moisture. **Caution:** *Always use a back-up wrench on the fittings to avoid damaging the refrigerant line connections.*

4 Disconnect the receiver/drier (see Section 16).

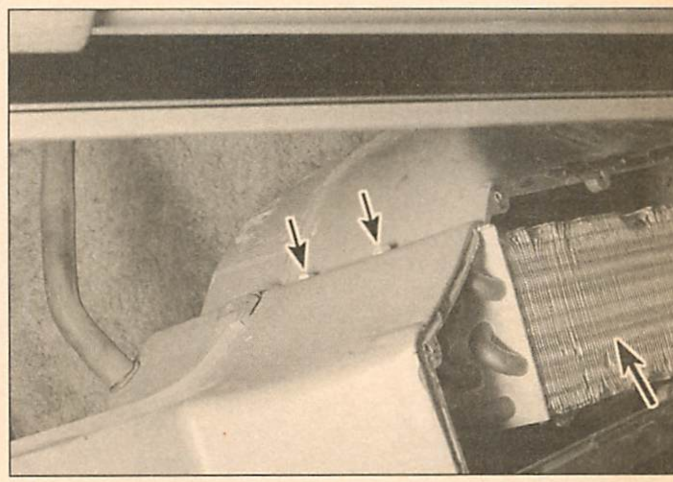
5 Unbolt the condenser from the core support or radiator bracket **(see illustration 16.3)**.

6 Tilt the condenser toward the engine and lift the condenser from the vehicle. **Caution:** *The condenser is made of aluminum - be careful not to damage it during removal.*

Installation

7 Installation is the reverse of removal. Be sure to use new O-rings on the refrigerant line fittings (lubricate the O-rings with clean refrigerant oil). If a new condenser is installed, add one ounce of new refrigerant oil to the system.

8 Have the system evacuated, recharged and leak tested by a dealership service department or an automotive air conditioning repair



18.4b Remove the screws (small arrows) retaining the back cover (two are shown here), remove the back cover and slide the evaporator core (large arrow) from the housing

18 Air conditioning evaporator - removal and installation

Warning: *The air conditioning system is under high pressure. DO NOT loosen any fittings or remove any components until after the system has been discharged. Air conditioning refrigerant should be properly discharged into an EPA-approved container at a dealership service department or an automotive air conditioning repair facility. Always wear eye protection when disconnecting air conditioning system fittings.*

Removal

Refer to illustrations 18.3, 18.4a and 18.4b

1 Have the air conditioning system discharged (see **Warning** above). Disconnect the cable from the negative battery terminal.

2 Refer to Section 11 and lower the evaporator/blower housing from the instrument panel.

3 Disconnect the two refrigerant lines at the evaporator **(see illustration)**. When disconnecting the lines, use a back-up wrench to prevent twisting the tubing. **Note:** *Plug the refrigerant lines immediately to keep moisture out of the system.*

4 Disassemble the evaporator core housing **(see illustrations)**.

5 Remove the hold-down clamps or brackets, then remove the evaporator from the housing.

3

Installation

6 Installation is the reverse of the removal procedure. Use new O-rings on all connections, lubricated with refrigerant oil.

7 If a new evaporator has been installed, add one ounce of refrigerant oil. Have the system evacuated, recharged and leak tested by a dealership service department or an automotive air conditioning repair facility.

Chapter 4
Fuel and exhaust systems

Contents

4

Specifications

Carter YF carburetor

Initial choke plate clearance	
1972	15/64 inch
1973 and later	13/64 inch
Fast idle cam linkage setting	
1972	7/32 inch
1973 through 1975	13/64 inch
1976	3/16 inch
Choke unloader	
1972 through 1975	5/16 inch
1976	9/32 inch
Automatic choke setting	
Standard	1 notch rich
Altitude compensator equipped	2 notches rich
Dashpot setting	
1972	7/64 inch
1973 through 1975	3/32 inch
1976	5/64 inch
Fast idle speed	
1972	2,300 rpm
1973 and later	1,600 rpm
Idle speed	See Chapter 1
Idle drop	
Automatic transmission	25 rpm
Manual transmission	50 rpm

Carter BBD carburetor

- Initial choke plate clearance
  - 1977 and 1978 .... 9/64 inch
  - 1979
    - Manual *transmission*
      - Carburetor number 8229 .... 1/8 inch
      - All others .... 5/32 inch
    - Automatic transmission .... 9/64 inch
  - 1980
    - Carburetor number 8255 .... 9/64 inch
    - All others .... 1/8 inch
  - 1981
    - Carburetor number 8311 .... 1/8 inch
    - All others .... 9/64 inch
  - 1982
    - Carburetor number 8340 .... 5/32 inch
    - Carburetor number 8341,8354, 8355 .... 9/64 inch
    - Carburetor number 8349,8351, 8357 .... 1/8 inch
  - 1983 through 1988 .... 9/64 inch
- Fast idle cam linkage setting
  - 1977 and 1978 .... 3/32 inch
  - 1979
    - Manual transmission
      - Carburetor number 8229 .... 3/32 inch
      - All others .... 7/64 inch
    - Automatic transmission .... 7/64 inch
  - 1980 and 1981 .... 3/32 inch
  - 1982
    - Carburetor number 8340 .... 7/64 inch
    - All others .... 3/32 inch
  - 1983 through 1988 .... 3/32 inch
- Choke unloader .... 9/32 inch
- Automatic choke setting
  - Standard .... 1 notch rich
  - Altitude compensator equipped .... 2 notches rich
- Dashpot setting .... 7/64 inch
- Idle drop
  - Automatic transmission .... 25 rpm
  - Manual transmission .... 50 rpm
- Fast idle speed setting
  - 1977 and 1978 .... 1650 rpm
  - 1979
    - Manual transmission .... 1500 rpm
    - Automatic transmission .... 1600 rpm
  - 1980
    - Carburetor number 8253, 8256 .... 1850 rpm
    - All others .... 1700 rpm
  - 1981
    - Carburetor number 8311, 8312 .... 1700 rpm
    - All others .... 1850 rpm
  - 1982 through 1988 .... Not applicable
- Idle speed .... See Chapter 1

Autolite/Motorcraft 2100 and 2150 carburetors

- Initial choke plate clearance
  - 1972 through 1974
    - Manual transmission .... 9/64 inch
    - Automatic transmission .... 1/8 inch
  - 1975 through 1978 .... 0.136 inch
  - 1979
    - Carburetor number 9RHM2 .... 0.104 inch
    - Carburetor number 9RHA2 .... 0.113 inch
  - 1980
    - Carburetor number ODA2JC, ODM2JC .... 0.120 inch
    - Carburetor number ODM2J .... 0.125 inch
    - Carburetor number ODA2J, ODM2A .... 0.128 inch
  - 1981 through 1985 .... 0.116 inch
  - 1986 through 1991 .... 0.118 inch

Fast idle cam linkage adjustment	
1972	1/8 inch
1973	
Manual transmission	9/64 inch
Automatic transmission	7/64 inch
1974	1/8 inch
1975 through 1978	0.115 inch
1979	
Carburetor number 9RHM2	0.086 inch
Carburetor number 9RHA2	0.093 inch
1980	
Carburetor number ODA2JC, ODM2JC	0.106 inch
All others	0.113 inch
1981 through 1991	0.076 inch
Choke unloader adjustment	
1972	13/64 inch
1973 through 1978	1/4 inch
1979	
Carburetor number 9RHM2	0.348 inch
Carburetor number 9RHA2	0.350 inch
1980 and 1981	0.300 inch
1982 through 1985	0.350 inch
1986 through 1991	0.420 inch
Automatic choke setting	1-1/2 to 2-1/2 notches rich
Dashpot adjustment	5/64 inch
Bowl vent clearance	0.120 inch
Idle speed	See Chapter 1
Fast idle speed	1400 to 1600 rpm

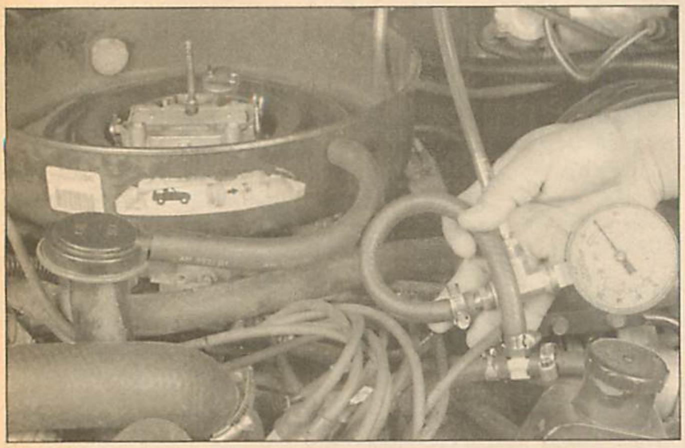
Autolite/Motorcraft 4300 and 4350 carburetors

Initial choke plate clearance	
1972 and 1973	3/16 inch
1974	0.170 inch
1975	0.147 inch
1976 through 1978	
Federal	0.135 inch
California	0.140 inch
Fast idle cam linkage adjustment	
1972 and 1973	5/32 inch
1974	0.160 inch
1975	0.166 inch
1976 through 1978	0.135 inch
Choke unloader adjustment	
1972 and 1973	9/32 inch
1974	0.325 inch
1975 through 1978	0.325 inch
Automatic choke setting	1-1/2 to 2-1/2 notches rich
Dashpot adjustment	9/64 inch
Bowl vent clearance	0.120 inch
Idle speed	See Chapter 1
Fast idle speed	1400 to 1600 rpm

Torque specifications

	Ft-lb
Carburetor-to-intake manifold nuts	16
Fuel pump bolts	16
Exhaust pipe-to-manifold nuts	20

4



2.1 Connect a fuel pressure gauge to a T-fitting and install the assembly between the fuel inlet or filter and the carburetor bowl inlet valve

1 General information

Warning: *Gasoline is extremely flammable, so take extra precautions when you work on any part of the fuel system. Don't smoke or allow open flames or bare light bulbs near the work area, and don't work in a garage where a natural gas-type appliance (such as a water heater or a clothes dryer) with a pilot light is present. Since gasoline is carcinogenic, wear latex gloves when there's a possibility of being exposed to fuel, and, if you spill any fuel on your skin, rinse it off immediately with soap and water. Mop up any spills immediately and do not store fuel-soaked rags where they could ignite. When you perform any kind of work on the fuel system, wear safety glasses and have a Class B type fire extinguisher on hand.*

The fuel system on all models consists of a fuel tank mounted in various locations on the chassis, a mechanically operated fuel pump and a carburetor. A combination of metal and rubber fuel lines are used to connect these components.

These carburetors either use a warm air automatic choke system or an electrically assisted automatic choke system depending upon the year and type of carburetor equipped on the engine. The electric-assist choke system consists of a thermostatic spring and cover (choke assembly), temperature sensing switch and a ceramic heater. At temperatures below 60-degrees, the switch is open and no current is supplied to the ceramic heater located within the thermostatic spring. At temperatures above 60-degrees F, the temperature sensing switch closes and current is supplied to the ceramic heater. As the heater warms, it causes the spring to pull the choke plate open within 1 to 1-1/2 minutes. The warm air choke system uses the same type of thermostatic spring except warm air from the exhaust manifold is routed to and then over the spring through a tube.

The carburetor is either a one, two or four-barrel type, depending on engine displacement and year of production. Later six-cylinder models are equipped with an electronic feedback carburetor. The feedback carburetor is linked with a variety of sensors and output actuators to lower the exhaust emissions.

Here is a list of the various carburetors used on these models:

One-barrel carburetor

Carter YF - 1972 through 1976 six-cylinder engine

Two-barrel carburetors

Carter BBD - 1977 through 1982 six-cylinder engine
Carter BBD (Feedback carburetor) - 1981 through 1988 six-cylinder engine
Autolite/Motorcraft 2100 - 1972 through 1980 V8 engine
Autolite/Motorcraft 2150 - 1977 through 1991 V8 engine

Four-barrel carburetors

Autolite/Motorcraft 4300 - 1973 and 1974 V8 engine
Autolite/Motorcraft 4350 - 1975 through 1978 V8 engine

2.6 Disconnect the fuel line and allow fuel to flow into a graduated beaker or suitable measuring device for 60 seconds to check the fuel volume

The fuel system is interrelated with the emissions control systems on all models produced for sale in the United States. Components of the emissions control systems are described in Chapter 6.

2 Fuel pump - check

Refer to illustrations 2.1 and 2.6

Warning: *Gasoline is extremely flammable, so take extra precautions when you work on any part of the fuel system. See the* **Warning** *in Section 1.*

Note: *It is a good idea to check the fuel pump and lines for any obvious damage or fuel leakage. Also check all hoses from the tank to the pump, particularly the suction hoses at the fuel tank and pump which, if they have are cracked, may not allow fuel to the fuel pump. It is also possible for the fuel pump diaphragm to rupture internally and leak fuel into the crankcase. If you have excess fuel consumption or fuel smell, and you can't find any external leaks, check the condition of the engine oil for any signs of fuel mixing with the oil; the oil level will usually be abnormally high and the oil will be thin and have a fuel smell.*

1 Remove the fuel filler cap to relieve any pressure in the fuel tank. Disconnect the fuel line from the carburetor and install a T-fitting. Connect a fuel pressure gauge to the T-fitting with a section of fuel hose **(see illustration)**.

2 Start the engine and allow it to idle. The pressure on the gauge should be 2-1/2 to 8 psi. It should remain constant and return to zero slowly when the engine is shut off. **Note:** *If the engine will not start, crank the engine until you get a reading on the gauge.*

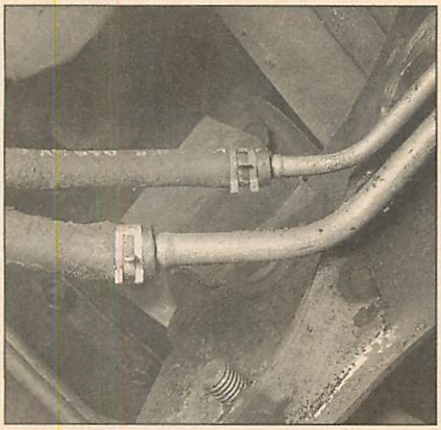
3 An instant pressure drop indicates a faulty outlet valve and the fuel pump must be replaced.

4 If the pressure is too high, check the air vent to see if it is plugged before replacing the pump.

5 If the pressure is too low, be sure the fuel hoses and lines are in good condition and not restricted. Other causes of low fuel pressure could be a clogged fuel filter or a clogged screen on the pickup in the fuel tank.

6 Check fuel pump volume. Disable the ignition system by detaching the primary (low voltage) wires from the ignition coil. Remove the fuel line from the carburetor or fuel filter (pre-filter fuel line) and place a graduated beaker or a substitute measuring device next to the fuel line. Have an assistant crank the engine and allow the fuel to flow into the beaker. Check the amount after 30 seconds **(see illustration)**. The fuel pump should pump at least 1 pint per 30 seconds at 500 rpm (cranking speed).

7 If the fuel pump pressure or volume is less than the specified amount and there are no obvious leaks *or obstructions in the fuel lines*, replace the fuel pump.



3.2 Carefully inspect the fuel lines that extend from the fuel pump and fuel tank to the metal lines attached to the chassis of the vehicle (also check the entire length of the metal lines)

4.7a Remove the clamp that retains the vapor line to the metal line

4.7b Location of the venting line (arrow) at the front of the fuel tank

3 Fuel lines and fittings - repair and replacement

Warning: *Gasoline is extremely flammable, so take extra precautions when you work on any part of the fuel system. See the* **Warning** *in Section 1.*

Inspection

Refer to illustration 3.2

1 Once in a while, you will have to raise the vehicle to service or replace some component (an exhaust pipe hanger, for example). Whenever you work under the vehicle, always inspect the fuel lines and fittings for possible damage or deterioration.

2 Check all hoses and pipes for cracks, kinks, deformation or obstructions **(see illustration).**

3 Make sure all hose and pipe clips attach their associated hoses or pipes securely to the underside of the vehicle.

4 Verify all hose clamps attaching rubber hoses to metal fuel lines or pipes are snug enough to assure a tight fit between the hoses and pipes.

Replacement

5 If you must replace any damaged sections, use hoses approved for use in fuel systems or pipes made from steel only (it's best to use an original-type pipe that's already flared and pre-bent). Do not install substitutes constructed from inferior or inappropriate material, as this could result in a fuel leak and a fire.

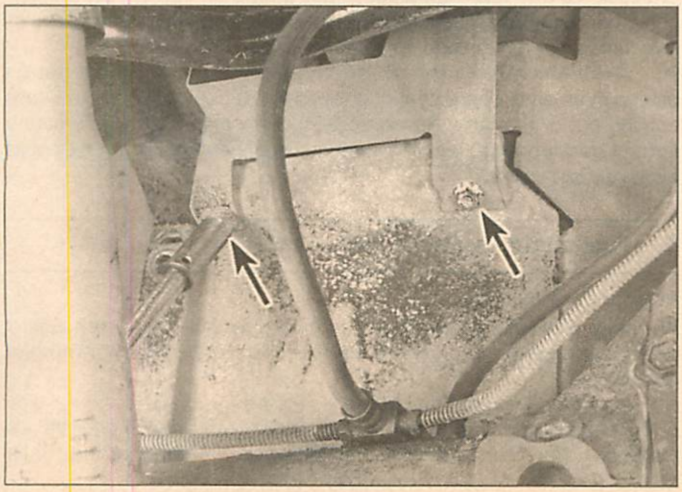
6 Always, before detaching or disassembling any part of the fuel line system, note the routing of all hoses and pipes and the orientation of all clamps and clips to assure that replacement sections are installed in exactly the same manner.

7 Before detaching any part of the fuel system, be sure to relieve the fuel tank pressure by removing the fuel filler cap.

8 Always use new hose clamps after loosening or removing them. 4

9 While you're under the vehicle, it's a good idea to check the following related components:

a) *Check the condition of the fuel filter - make sure that it's not clogged or damaged* (see Chapter 1).
b) *Inspect the evaporative emission control (EVAP) system. Verify that all hoses are attached and in good condition* (see Chapter 6).



4.8 Remove the bolts (arrows) that retain the shield to the fuel tank assembly

4 Fuel tank - removal and installation

Refer to illustrations 4.7a, 4.7b, 4.8, 4.9, 4.10, 4.11, 4.12 and 4.14

Warning: *Gasoline is extremely flammable, so take extra precautions when you work on any part of the fuel system. See the* **Warning** *in Section 1.*

Note: *The following procedure is much easier to perform if the fuel tank is empty. Some fuel tanks may have a drain plug. If the tank does not have a drain plug, drain the fuel into an approved fuel container using a commercially available siphoning kit (NEVER start the siphoning action by mouth) or wait until the fuel tank is nearly empty, if possible.*

1 Remove the fuel tank filler cap to relieve fuel tank pressure.

2 Detach the cable from the negative terminal of the battery.

3 If the tank still has fuel in it, you can drain it at the fuel filler hose after raising the vehicle. If the tank has a drain plug, remove it and allow the fuel to collect in an approved gasoline container.

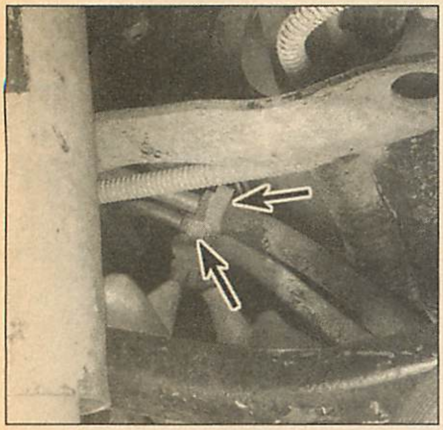
4 Raise the vehicle and place it securely on jackstands.

5 Remove the parking brake cable guides and cables on early models (see Chapter 9). **Note:** *Some models that are equipped with exterior mounted cables must have the cables removed to allow clearance for the fuel tank and shield.*

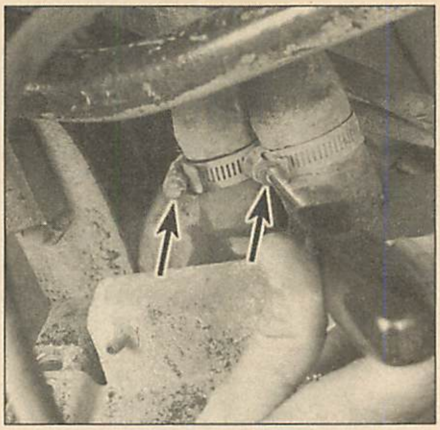
6 On Wagoneer models, remove the rear driveshaft (see Chapter 8).

7 Disconnect the vapor lines from the top of the fuel tank, if equipped **(see illustrations).**

8 Remove the fuel tank shield from the rear of the fuel tank, if equipped **(see illustration).**

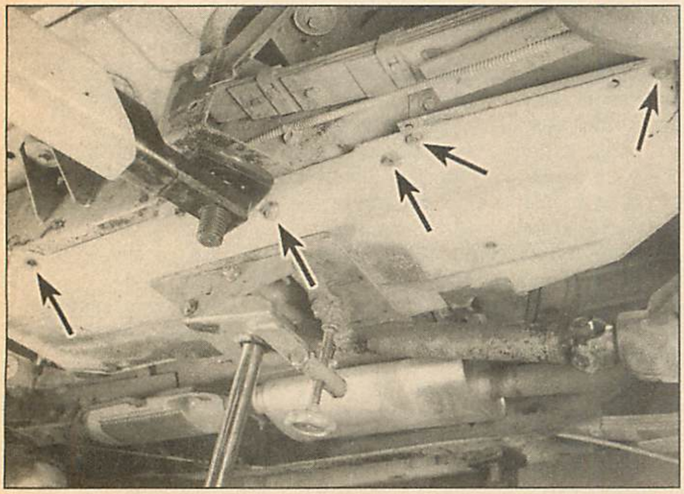


4.9 Loosen the fuel inlet and return line clamps (arrows) and detach the lines

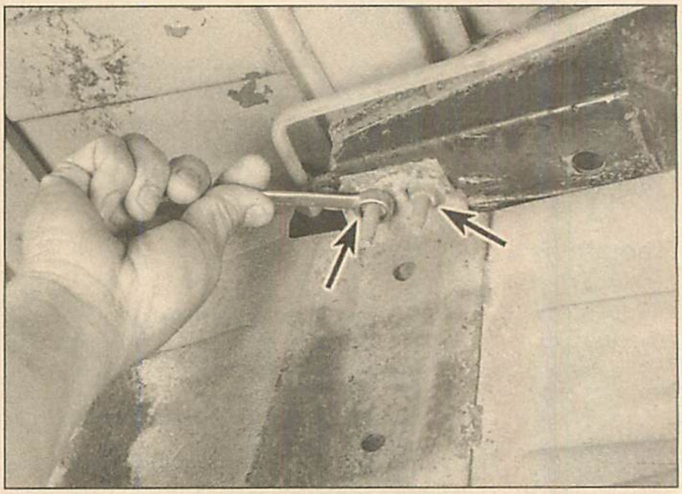


4.10 Loosen the fuel filler hose and the fuel vapor hose clamps (arrows) and detach the hoses

4.11 Disconnect the fuel level sending unit electrical connectors



4.12 Remove the bolts (arrows) from the fuel tank. The shield is an integral part of the fuel tank assembly on this model



4.14 Remove the nuts (arrows) from the fuel tank strap bolts

9 Disconnect the fuel return line and the fuel inlet line **(see illustration). Note:** *The fuel inlet and return lines are different diameters, so reattachment is simple. If you have any doubts, however, clearly label the lines and the fittings. Be sure to plug the hoses to prevent leakage and contamination of the fuel system.*

10 Loosen the hose clamp(s) and detach the fuel filler hose and the vent hose from the tank **(see illustration)**. If there is still fuel in the tank, siphon it out from the fuel feed port. Remember - NEVER start the siphoning action by mouth! Use a siphoning kit, which can be purchased at most automotive parts stores.

11 Disconnect the fuel level sending unit electrical connectors **(see illustration)**.

12 If the fuel tank is equipped with a protective shield, remove the nuts and detach it from the underside of the chassis **(see illustration)**.

13 Support the fuel tank with a floor jack. Position a wood block between the jack head and the fuel tank to protect the tank.

14 Disconnect both fuel tank retaining straps and pivot them down until they are hanging out of the way **(see illustration)**.

15 Lower the tank enough to disconnect the wires and ground strap from the fuel pump/fuel gauge sending unit. Remove the tank from the vehicle.

16 Some models are equipped with an auxiliary fuel tank. Removal of these tanks is similar to the main fuel tank, but instead of being retained by straps, they are retained by bolts around the flange of the tank.

17 Installation is the reverse of removal.

5 Fuel tank cleaning and repair - general information

1 All repairs to the fuel tank or filler neck should be carried out by a professional who has experience in this critical and potentially dangerous work. Even after cleaning and flushing of the fuel system, explosive fumes can remain and ignite during repair of the tank.

2 If the fuel tank is removed from the vehicle, it should not be placed in an area where sparks or open flames could ignite the fumes coming out of the tank. Be especially careful inside garages where a natural gas-type appliance is located, because the pilot light could cause an explosion.

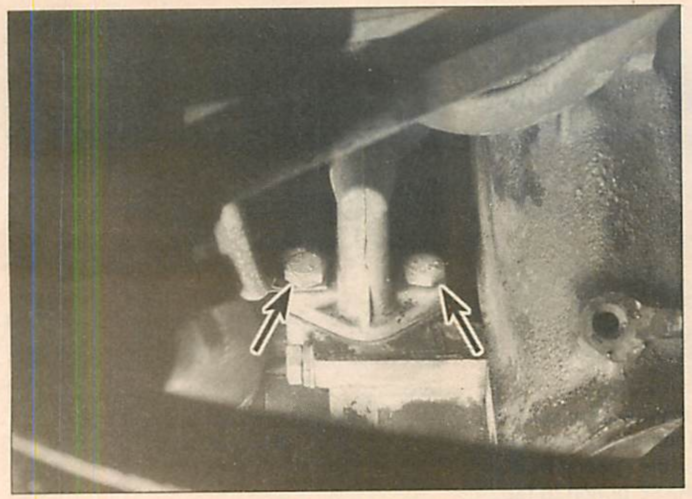
6 Fuel pump - removal and installation

Refer to illustration 6.4

Warning: *Gasoline is extremely flammable, so take extra precautions when you work on any part of the fuel system. See the* **Warning** *in Section 1.*

1 On V8 engines the fuel pump is located on the left (driver's) side of the engine, attached to the front cover. On six-cylinder engines, it's located on the right (passenger's) side of the engine bolted to the engine block.

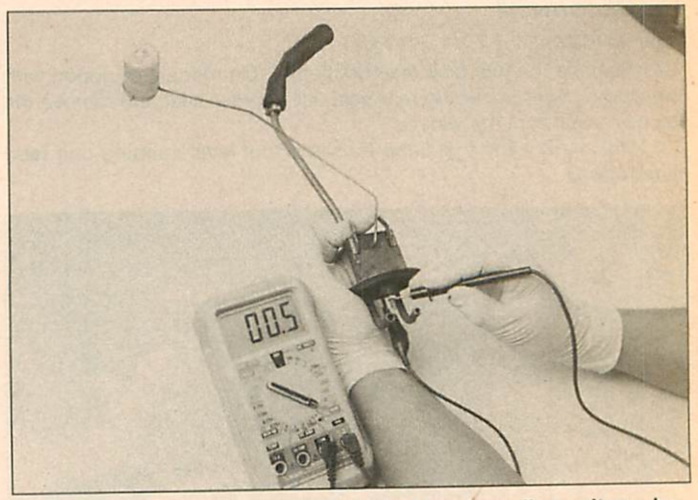
2 Place rags under the fuel pump to catch any gasoline which may be spilled during removal.



6.4 Remove the fuel pump retaining bolts (arrows) (V8 engine shown)

7.5 Remove the retaining screws and lift the fuel level sending unit access cover from the body

7.6 Checking the resistance of the fuel level sending unit in the vehicle



7.8 A more accurate check of the fuel level sending unit can be performed with the assembly on the bench, the ohmmeter probes on the connector and the float positioned on "empty" (bottom) and "full" (top). Check for a smooth change in resistance between these positions

3 Carefully unscrew the fuel line fittings and detach the lines from the pump. A flare-nut wrench along with a back-up wrench should be used on the pressure-side fitting to prevent damage to the line and fittings.
4 Unbolt and remove the fuel pump **(see illustration)**.
5 Before installation, coat both sides of the gasket surface with gasket sealant, position the gasket and fuel pump against the block and install the bolts. Tighten the bolts to the torque listed in this Chapter's Specifications.
6 Attach the lines to the pump and tighten the pressure fitting securely (use a flare-nut wrench, if one is available, to prevent damage to the fittings). Use a new hose clamp on the fuel hose.
7 Run the engine and check for leaks.

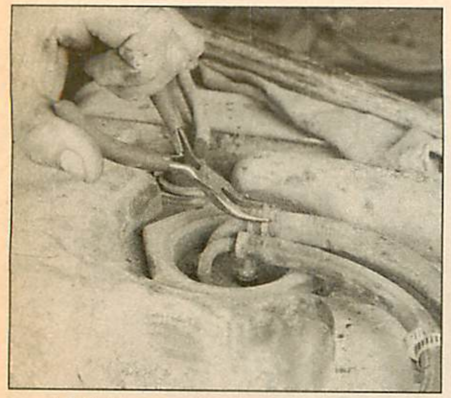
7 Fuel level sending unit - check and replacement

Warning: *Gasoline is extremely flammable, so take extra precautions when you work on any part of the fuel system. See the* **Warning** *in Section 1.*

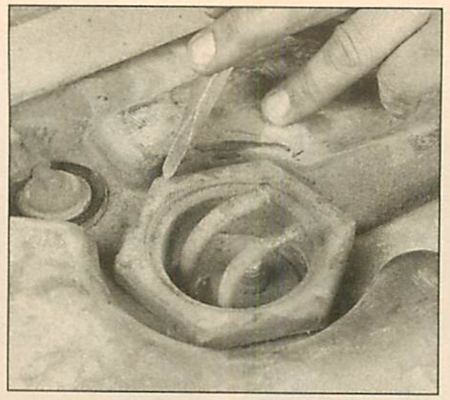
Check

Refer to illustrations 7.5, 7.6 and 7.8

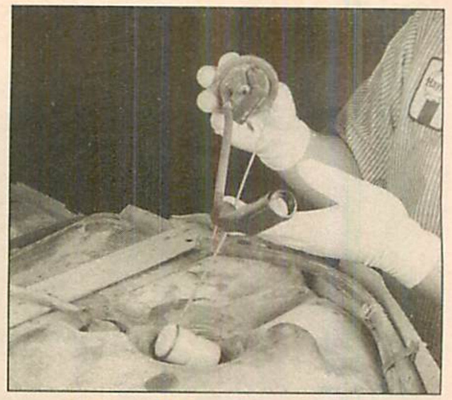
1 Raise the vehicle and support it securely on jackstands.
2 If the fuel level gauge on the instrument panel is malfunctioning, check the operation of the fuel level sending unit. If the fuel level sending unit operates in accordance with the following test, the problem may exist in the gauge or its circuit (see Chapter 12).
3 Before performing any tests on the fuel level sending unit, make sure the sending unit has a good ground electrical connection.
4 Raise the vehicle and support it securely with jackstands.
5 Locate the fuel level sending unit electrical connector. On most models, the connector is located near the back of the fuel tank near the fuel filler hose and the fuel vapor hose. However, some late models are equipped with an access hole under the rear seat or trunk area. Lift the rear seat, remove the retaining screws and remove the access cover plate **(see illustration)**.
6 Position the probes of an ohmmeter probes into the electrical connector **(see illustration)** and check the resistance. Use the 200-ohm or low scale on the ohmmeter.
7 With the fuel tank completely full, the resistance should be approximately 110 ohms. With the tank half full, the resistance should be approximately 55 ohms. With the fuel tank empty, the resistance of the sending unit should be approximately 1 ohm.
8 **Note:** *A more accurate check of the sending unit can be made by removing it (fuel level sending unit or assembly) from the fuel tank and checking its resistance while manually operating the float arm* **(see illustration)**.
9 If the readings are incorrect, replace the sending unit.



7.11 Loosen the fuel line clamps



7.13 Remove the nut using a large socket or, on models with a lock ring, a special tool (if a large socket or the special tool is not available, use a BRASS punch to tap the lock ring counterclockwise)

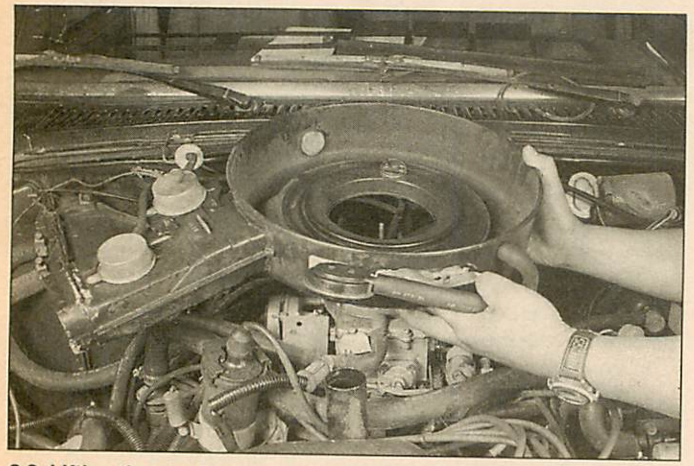


7.14 Lift the sending unit from the fuel tank

Replacement

Refer to illustrations 7. 11, 7.13 and 7.14

10 Remove the fuel tank (see Section 4). On models equipped with an access cover under the rear seat, lift the rear seat and remove the access cover from the vehicle.
11 Disconnect the fuel lines from the fuel level sending unit **(see illustration)**.
12 Disconnect the fuel level sending unit electrical connector from the assembly.
13 Unscrew the lock ring or nut from the tank **(see illustration)**.
14 Lift the sending unit from the tank **(see illustration)**. Carefully angle the sending unit out of the opening without damaging the fuel level float located at the bottom of the assembly.
15 Installation is the reverse of removal. Replace the fuel level sending unit O-ring, if equipped.

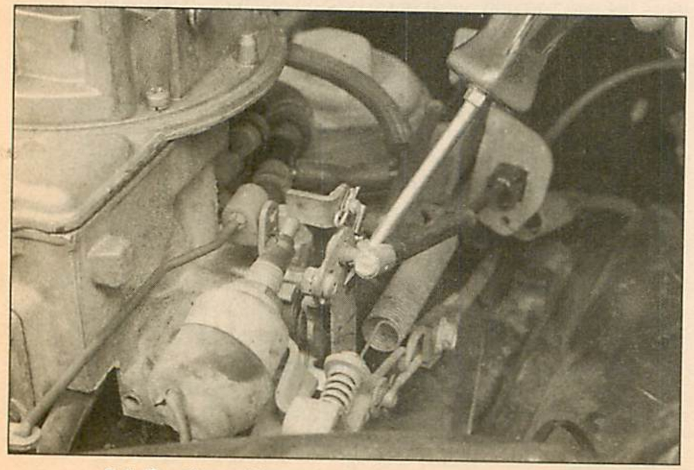


8.3 Lifting the air cleaner assembly from the engine compartment (V8 engine shown)

8 Air cleaner housing - removal and installation

Refer to illustration 8.3

1 Remove the air filter from the air cleaner housing (see Chapter 1, if necessary).
2 Disconnect any vacuum hoses or electrical connectors that would interfere with air cleaner removal and mark them with pieces of numbered tape for reassembly purposes.
3 Lift the air cleaner housing from the engine compartment **(see illustration)**.
4 Installation is the reverse of removal.



9.1 Pry the cable end off the throttle lever stud

9 Accelerator cable - removal and installation

Refer to illustrations 9.1, 9.2 and 9.4

Removal

1 Remove the accelerator cable from the throttle linkage by prying the cable end off the shaft using a small screwdriver **(see illustration)**.
2 Using a pair of needle-nose pliers, press the tabs and release the grommet through the cable bracket **(see illustration)**.
3 Detach the screws and the clips retaining the lower instrument trim panel on the driver's side and remove the trim piece.
4 Pull the cable end out and then up from the accelerator pedal slot **(see illustration)**.
5 To disconnect the cable at the firewall, push the cable grommet through the engine firewall into the engine compartment from inside the passenger compartment.

Installation

6 Installation is the reverse of removal. **Note:** *To prevent possible interference, flexible components (hoses, wires, etc.) must not be routed within two inches of moving parts, unless routing is controlled.*
7 Operate the accelerator pedal and check for any binding condition by completely opening and closing the throttle.
8 If necessary, at the engine compartment side of the firewall, apply sealant around the accelerator cable to prevent water from entering the passenger compartment.

10 Carburetor - diagnosis and overhaul

Warning: *Gasoline is extremely flammable, so take extra precautions when you work on any part of the fuel system. See the* **Warning** *in Section 1.*

Diagnosis

1 A thorough road test and check of carburetor adjustments should be done before any major carburetor service. Specifications for some adjustments are listed on the *Vehicle Emissions Control Information* (VECI) label found in the engine compartment.

2 Carburetor problems usually show up as flooding, hard starting, stalling, severe backfiring and poor acceleration. A carburetor that's leaking fuel and/or covered with wet looking deposits definitely needs attention.

3 Some performance complaints directed at the carburetor are actually a result of loose, out-of-adjustment or malfunctioning engine or electrical components. Others develop when vacuum hoses leak, are disconnected or are incorrectly routed. The proper approach to analyzing carburetor problems should include the following items:

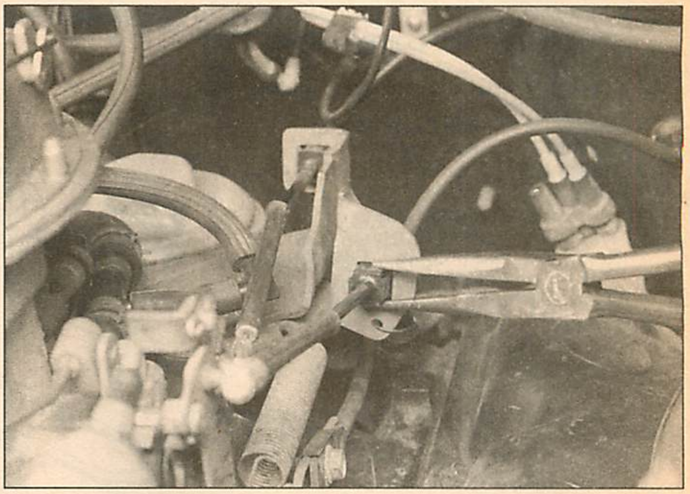
- a) *Inspect all vacuum hoses and actuators for leaks and correct installation* (see Chapters 1 and 6).
- b) *Tighten the intake manifold and carburetor mounting nuts/bolts evenly and securely.*
- c) *Perform a compression test and vacuum test* (see Chapter 2C).
- d) *Clean or replace the spark plugs as necessary* (see Chapter 1).
- e) *Check the spark plug wires* (see Chapter 1).
- f) *Inspect the ignition primary wires.*
- g) *Check the ignition timing (follow the instructions printed on the Emissions Control Information label).*
- h) *Check the fuel pump pressure/volume* (see Section 2).
- i) *Check the heat control valve in the air cleaner for proper operation* (see Chapter 1).
- j) *Check/replace the air filter element* (see Chapter 1).
- k) *Check the PCV system* (see Chapter 6).
- l) *Check/replace the fuel filter* (see Chapter 1). *Also, the strainer in the tank could be restricted.*
- m) *Check for a plugged exhaust system.*
- n) *Check EGR valve operation* (see Chapter 6).
- o) *Check the choke - it should be completely open at normal engine operating temperature* (see Chapter 1).
- p) *Check for fuel leaks and kinked or dented fuel lines* (see Chapters 1 and 4)
- q) *Check accelerator pump operation with the engine off (remove the air cleaner cover and operate the throttle as you look into the carburetor throat - you should see a stream of gasoline enter the carburetor.*
- r) *Check for incorrect fuel or bad gasoline.*
- s) *Check the camshaft lobe lift* (see Chapter 2).
- t) *Have a dealer service department or other repair shop check the electronic engine and carburetor controls.*

4 Diagnosing carburetor problems may require that the engine be started and run with the air cleaner off. While running the engine without the air cleaner, backfires are possible. This situation is likely to occur if the carburetor is malfunctioning, but just the removal of the air cleaner can lean the fuel/air mixture enough to produce an engine backfire. **Warning:** *Do not position any part of your body, especially your face, directly over the carburetor during inspection and servicing procedures. Wear eye protection!*

Overhaul

Refer to illustrations 10.7a, 10.7b, 10.7c and 10.7d

5 Once it's determined that the carburetor needs an overhaul, several options are available. If you're going to attempt to overhaul the carburetor yourself, first obtain a good-quality carburetor rebuild kit (which will include all necessary gaskets, internal parts, instructions and a parts list). You'll also need some special solvent and a means of blowing out the internal passages of the carburetor with air.

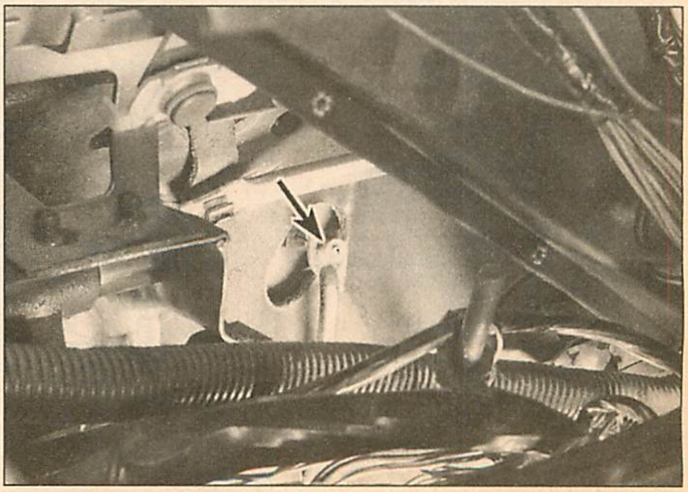


9.2 Squeeze the tabs using needle-nose pliers and separate the grommet from the bracket

6 An alternative is to obtain a new or rebuilt carburetor. They are readily available from dealers and auto parts stores. Make absolutely sure the exchange carburetor is identical to the original. A tag is usually attached to the top of the carburetor or a number is stamped on the float bowl. It will help determine the exact type of carburetor you have. When obtaining a rebuilt carburetor or a rebuild kit, make sure the kit or carburetor matches your application exactly. Seemingly insignificant differences can make a large difference in engine performance.

7 If you choose to overhaul your own carburetor, allow enough time to disassemble it carefully, soak the necessary parts in the cleaning solvent (usually for at least three to four hours or according to the instructions listed on the carburetor cleaner) and reassemble it, which will usually take much longer than disassembly. When disassembling the carburetor, match each part with the illustration in the carburetor kit and lay the parts out in order on a clean work surface. Overhauls by inexperienced mechanics can result in an engine which runs poorly or not at all. To avoid this, use care and patience when disassembling the carburetor so you can reassemble it correctly **(see illustrations)**.

8 Because carburetor designs are constantly modified by the manufacturer in order to meet increasingly more stringent emissions regulations, it isn't feasible to include a step-by-step overhaul of each type. You'll receive a detailed, well illustrated set of instructions with the carburetor overhaul kit.

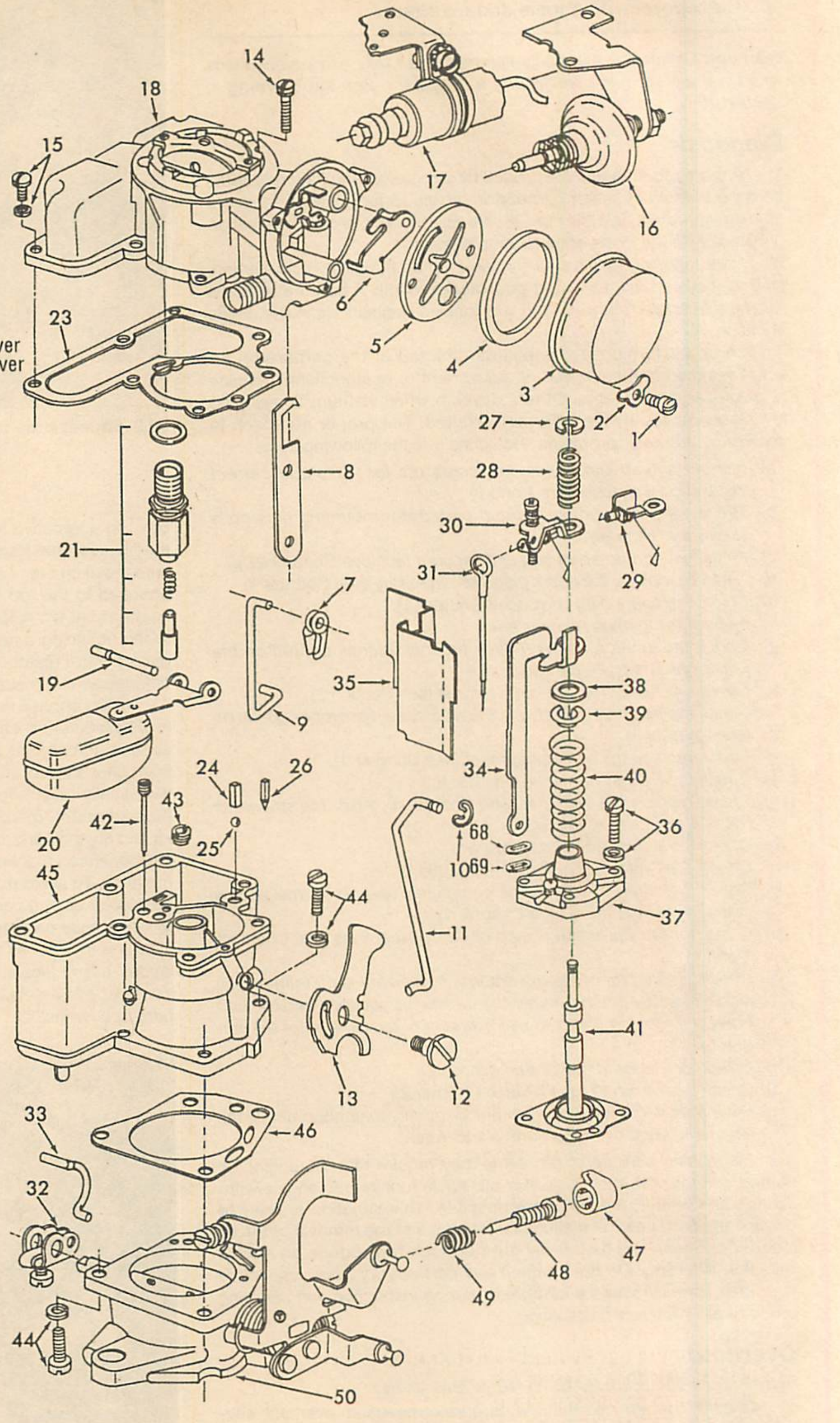


9.4 Disconnect the accelerator cable from the pedal (arrow)

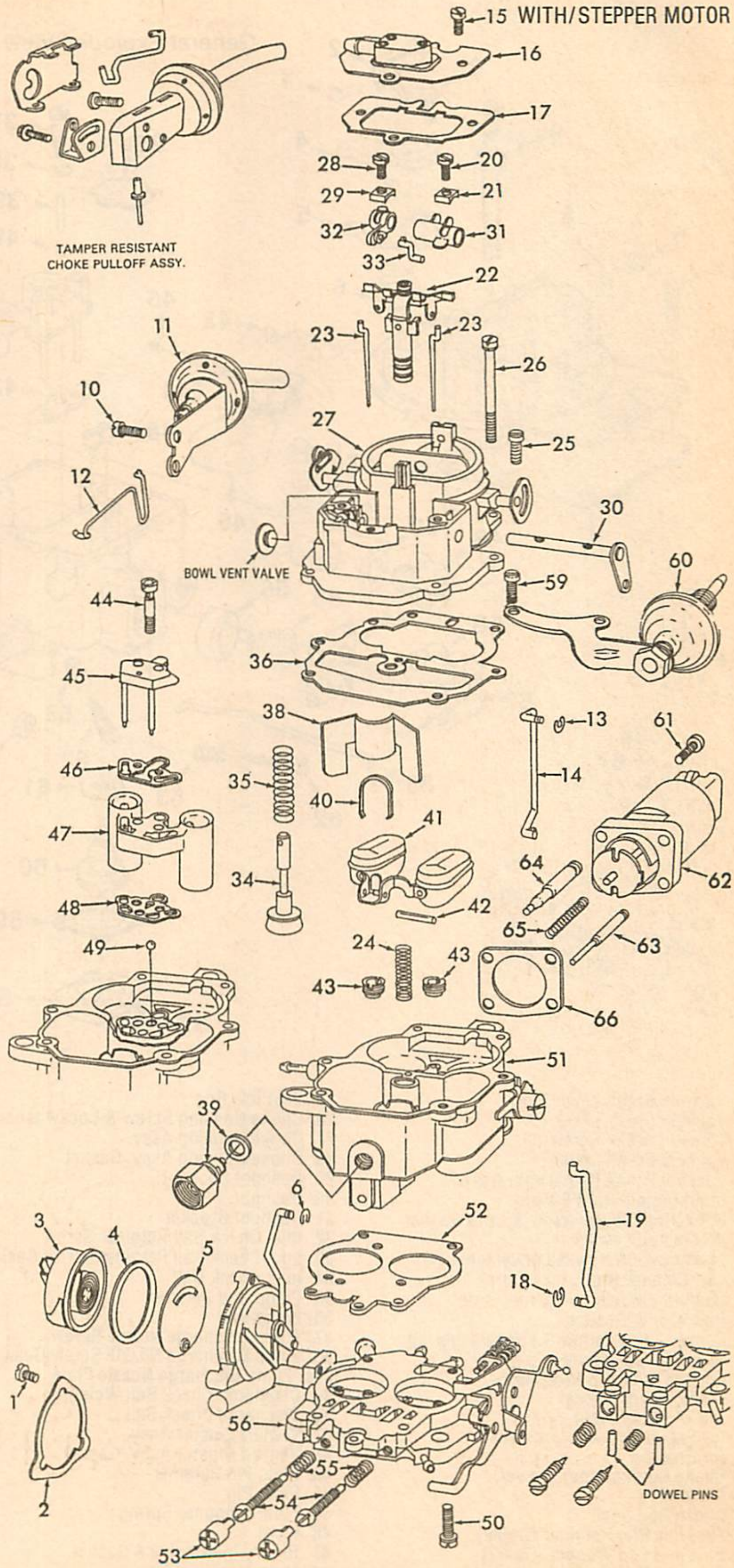
GENERAL EXPLODED VIEW

The general design and parts shown will vary.

1. Screw (3) - Choke Cover *Clamp*
2. Clamp (3) - Choke Cover
3. Choke Cover & Spring
4. Gasket - Choke Cover
5. Baffle Plate - Choke
6. Trip Lever - Choke (Early Models)
7. Retainer - *Fast* Idle Link (Early Models)
8. Link - Fast Idle (Early Models)
9. Rod - Fast Idle (Early Models)
10. Retainer - Fast Idle Rod
11. Rod - Fast Idle
12. Screw - Fast Idle Cam
13. Cam - Fast Idle
14. Screw & Lockwasher (3) - Long - Bowl Cover
15. Screw & Lockwasher (4) - Short - Bowl Cover
16. Dashpot & Bracket - (When Used)
17. Solenoid & Bracket - (When Used)
18. Bowl Cover Assembly
19. Pin - Float
20. Float & Lever Assembly
21. Needle, Seat and Gasket Assembly
22. Screen - Needle Seat (Some Models)
23. Gasket - Bowl Cover
24. Weight - Check Ball
25. Ball - Pump Check
26. Needle - Pump Check (Some Models)
27. Retainer - Upper Pump Spring
28. Spring - Upper Pump
29. Arm Assy. - Metering Rod (Early Models)
30. Arm & Adj. Screw Assy. - Metering Rod
31. Rod - Metering
32. Arm - Throttle Shaft
33. Link - Pump Connector
34. Link - Pump Lifter
35. Baffle Plate - Fuel Bowl (Some Models)
36. Screw & Lockwasher (4) - Pump Housing
37. Pump Housing Assembly
38. Spacer - Pump Stem (Some Models)
39. Retainer - Pump Spring
40. Spring - Pump
41. Pump Diaphragm Assembly
42. Jet - Low Speed
43. Jet - Metering Rod
44. Screw & Lockwasher (3) - Throttle Body
45. Bowl Assembly
46. Gasket - Throttle Body
47. Cap - Idle Limiter
48. Needle - Idle Adjusting
49. Spring - Idle Needle
50. Throttle Body Assembly
51. Rotary Disk Valve Replaces (21) (22)
52. Shaft - Vent Valve
53. Spring - Vent Valve
54. Retainer - Vent Valve
55. Valve - Vent (Rubber)
56. Lever - Vent Valve
57. Plate - Adj. Screw
58. Tube - Pump Passage
59. Spacer - Pump Diaphragm
60. Screw - Vent Operating Lever
61. Lever - Vent Stop
62. Lever - Operating
63. Spring Washer - Operating Lever
64. E-Clip - Spring Washer
65. Arm - Pump Link
66. Link - Pump Connector
67. Rubber Cap
68. RETAINER-LIFTER LINK SEAL
69. SEAL LIFTER LINK



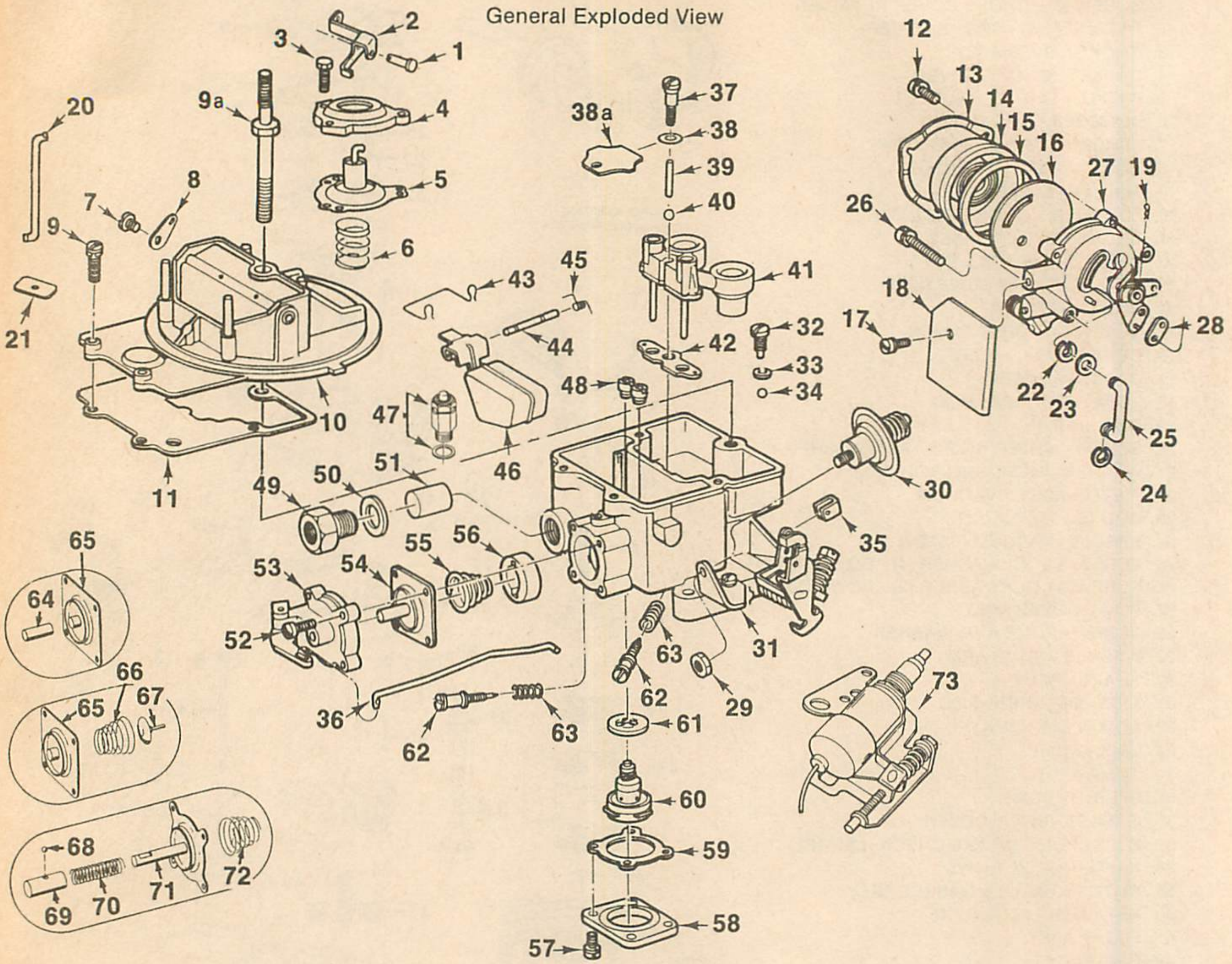
10.7a Exploded view of the Carter YF carburetor



GENERAL EXPLODED VIEW
THE GENERAL DESIGN AND PARTS SHOWN WILL VARY TO INDIVIDUAL UNITS

10.7b Exploded view of the Carter BBD carburetor

1. SCREW (3) - CHOKE COVER RETAINER
2. RETAINER (3) - CHOKE COVER
3. CHOKE COVER ASSY.
4. GASKET - CHOKE COVER
5. BAFFLE - CHOKE HOUSING
6. RETAINER - CHOKE ROD
7. SCREW (2) - CHOKE HOUSING
8. HOUSING ASSY. - CHOKE
9. SEAL - VAC. PASSAGE
10. SCREW (2) - CHOKE PULL OFF
11. CHOKE PULL OFF ASSY.
12. LINK - CHOKE PULL OFF
13. RETAINER - FAST IDLE ROD
14. ROD - FAST IDLE
15. SCREW (3) - DUST COVER
16. COVER ASSY. - DUST
17. GASKET - COVER
18. RETAINER - PUMP ROD
19. ROD - PUMP
20. SCREW - METERING ROD ARM WASHER
21. WASHER - METERING ROD ARM
22. PISTON ASSY. - VACUUM
23. ROD (2) - METERING
24. SPRING - VACUUM PISTON
25. SCREW & LOCKWASHER (4) - BOWL COVER
26. SCREW & LOCKWASHER (2) - BOWL COVER
27. BOWL COVER ASSY.
28. SCREW - PUMP ARM WASHER
29. WASHER - PUMP ARM
30. SHAFT - PUMP
31. ARM - METERING ROD
32. ARM - PUMP LINK
33. LINK - PUMP
34. PUMP ASSY.
35. SPRING - PUMP
36. GASKET - BOWL COVER
37. BALL - PUMP INTAKE CHECK (LARGE)
38. BAFFLE - FUEL BOWL
39. ROTORY VALVE & GASKET ASSY.
40. RETAINER - FLOAT PIN
41. FLOAT ASSY.
42. PIN - FLOAT
43. JET (2) - MAIN
44. SCREW (2) - VENTURI CLUSTER
45. COVER - VENTURI
46. GASKET - VENTURI COVER
47. CLUSTER ASSY. - VENTURI
48. GASKET - VENTURI CLUSTER
49. BALL - PUMP DISC. CHECK (SMALL)
50. SCREW & LOCKWASHER (2) -THROTTLE BODY
51. BOWL ASSY.
52. GASKET - THROTTLE BODY
53. CAP (2) - IDLE LIMITER
54. NEEDLE (2) - IDLE ADJUSTING
55. SPRING (2) - IDLE ADJ. NEEDLE
56. THROTTLE BODY ASSY.
57. SCREW - FAST IDLE
58. CAM - FAST IDLE
59. SCREW & LOCKWASHER (2) - DASH-POT
60. DASH-POT & BRACKET
61. SCREW (4) - STEPPER MOTOR
62. STEPPER MOTOR ASSY.
63. PIN - METERING (MAIN SYSTEM)
64. PIN - METERING (LOW SPEED)
65. SPRING - STEPPER MOTOR
66. GASKET STEPPER MOTOR

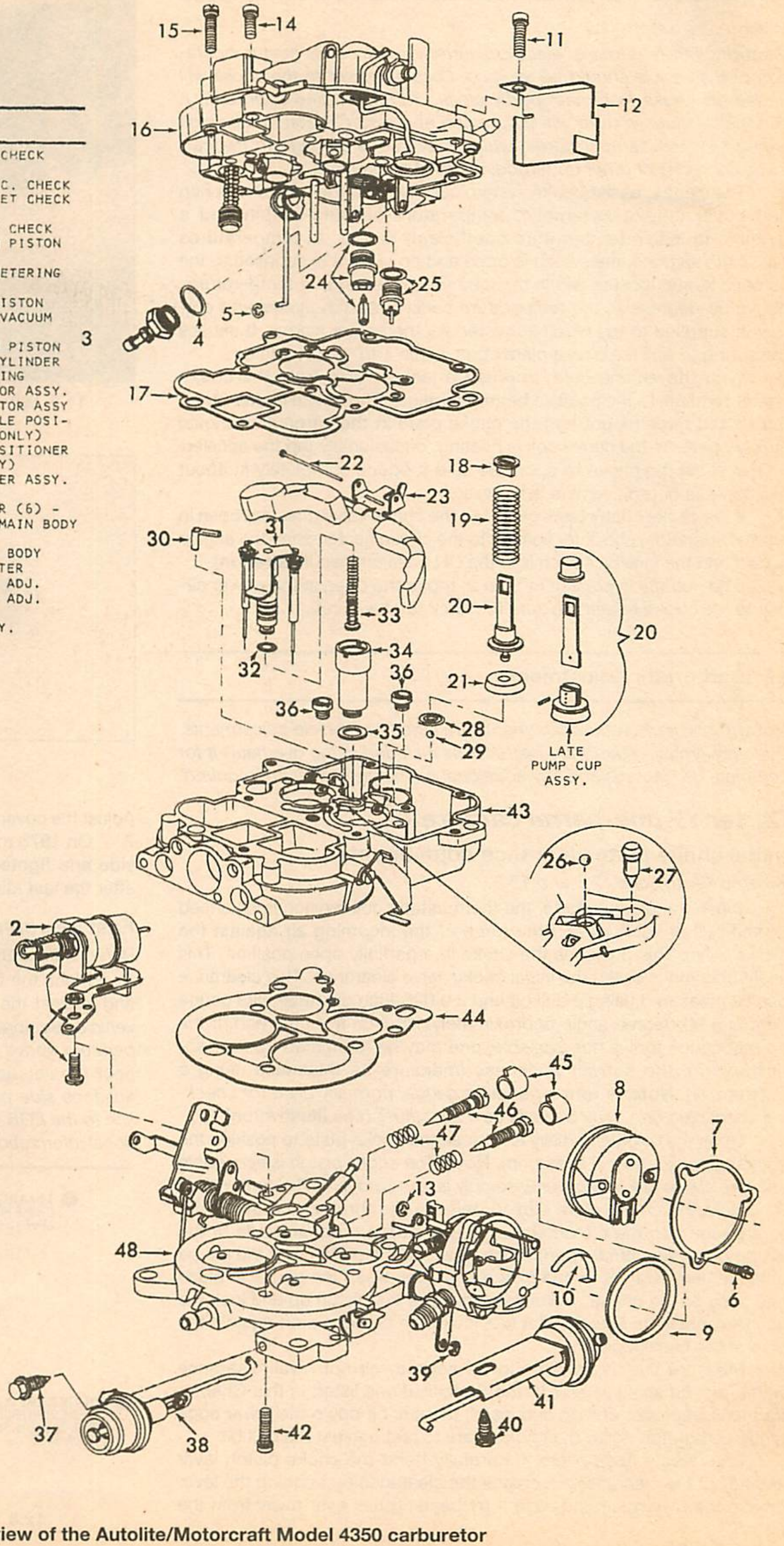


1. Vacuum Break Lever Pin
2. Vacuum Break Lever
3. Vacuum Break Screw (3)
4. Vacuum Break Cover
5. Vacuum Break Diaphragm Assy.
6. Diaphragm Return Spring
7. Choke Rod Lever Screw & Lockwasher
8. Choke Rod Lever
9. Bowl Cover Screw & Lockwasher (4)
9a. Air Cleaner Stud
10. Bowl Cover Assy.
11. Bowl Cover Gasket
12. Choke Clamp Screw & Lockwasher (3)
13. Choke Cover Clamp
14. Choke Cover & Spring Assy.
15. Choke Cover Gasket
16. Choke Baffle Plate
17. Air Shield Screw & Lockwasher
18. Air Shield
19. Choke Rod Retainer (Lower)
20. Choke Rod
21. Choke Rod Seal
22. Fast Idle Rod Retainer (Upper)
23. Fast Idle Rod Washer (Upper)
24. Fast Idle Rod Retainer (Lower)
25. Fast Idle Rod
26. Choke Housing Screw & Lockwasher
27. Choke Housing Assy.
28. Choke Housing Assy. Gasket
29. Dashpot Locknut
30. Dashpot
31. Dashpot Bracket
32. Inlet Check Ball Retainer Screw
33. Inlet Check Ball Retainer Screw Gasket
34. Inlet Check Ball
35. Pump Rod Retainer
36. Pump Rod
37. Pump Discharge Nozzle Screw
38. Pump Discharge Nozzle Screw Gasket
38a. Pump Discharge Nozzle Plate
39. Discharge Check Ball Weight
40. Discharge Check Ball
41. Venturi Cluster Assy.
42. Venturi Cluster Assy. Gasket
43. Float Pin Retainer
44. Float Pin
45. Float Dampner Spring
46. Float
47. Rotory Inlet Valve & Gasket
48. Main Metering Jets
49. Fuel Inlet Fitting
50. Fuel Inlet Fitting Gasket
51. Fuel Inlet Filter Screen
52. Pump Cover Screw & Lockwasher
53. Pump Cover & Lever Assy.
54. Pump Diaphragm Assy.
55. Pump Diaphragm Spring
56. Pump Cavity Filler
57. Economizer Valve Cover Screw & Lockwasher (4)
58. Economizer Valve Cover
59. Economizer Valve Cover Gasket
60. Economizer Valve
61. Economizer Valve Gasket
62. Idle Adjusting Needles
63. Idle Adjusting Needle Springs
64. Pump Diaphragm Push Rod
65. Pump Diaphragm Assy.
66. Pump Diaphragm Spring
67. Pump Inlet Check Valve
68. Pump Push Rod Sleeve Ball
69. Pump Push Rod Sleeve
70. Pump Push Rod Spring
71. Pump Diaphragm Assy.
72. Pump Diaphragm Spring
73. Throttle Positioner Assy.

10.7c Exploded view of the Autolite/Motorcraft Model 2100 carburetor

NOMENCLATURE

REF. NO.		REF. NO.	
1.	SCREW & NUT - THROTTLE POSITIONER	26.	BALL - PUMP VENT CHECK (SMALL)
2.	SOLENOID ASSY. - THROTTLE POSITIONER	27.	NEEDLE - PUMP DISC. CHECK
3.	FITTING - FUEL INLET	28.	RETAINER-PUMP INLET CHECK BALL
4.	GASKET - INLET FITTING	29.	BALL - PUMP INLET CHECK
5.	RETAINER - PUMP LINK	30.	RETAINER - VACUUM PISTON ASSY.
6.	SCREW (3) - CHOKE COVER RETAINER	31.	VACUUM PISTON & METERING ROD ASSY.
7.	RETAINER CLAMP - CHOKE COVER	32.	O-RING - VACUUM PISTON
8.	CHOKE COVER ASSY.	33.	SPRING & GUIDE - VACUUM PISTON
9.	GASKET - CHOKE COVER	34.	CYLINDER - VACUUM PISTON
10.	STOP-CHOKE PISTON (1975)	35.	GASKET - VACUUM CYLINDER
11.	SCREW & LOCKWASHER - SHIELD	36.	JETS - MAIN METERING
12.	SHIELD - CHOKE	37.	SCREW - CHOKE MOTOR ASSY.
13.	RETAINER - CHOKE ROD	38.	CHOKE PULLDOWN MOTOR ASSY
14.	SCREW & LOCKWASHER (8) - UPPER BODY	39.	RETAINER - THROTTLE POSITIONER ROD (JEEP ONLY)
15.	SCREW & LOCKWASHER (1) - UPPER BODY (LONG)	40.	SCREW-THROTTLE POSITIONER BRACKET (JEEP ONLY)
16.	UPPER BODY ASSY.	41.	THROTTLE POSITIONER ASSY. (JEEP ONLY)
17.	GASKET - UPPER BODY	42.	SCREW & LOCKWASHER (6) - THROTTLE BODY TO MAIN BODY
18.	BUSHING - PUMP SPRING (UPPER)	43.	MAIN BODY ASSY.
19.	SPRING - PUMP RETURN	44.	GASKET - THROTTLE BODY
20.	STEM ASSY. - PUMP	45.	CAP (2)-IDLE LIMITER
21.	CUP - PUMP	46.	NEEDLE (2) - IDLE ADJ.
22.	PIN - FLOAT LEVER	47.	SPRING (2) - IDLE ADJ. NEEDLE
23.	FLOAT & LEVER ASSY.	48.	THROTTLE BODY ASSY.
24.	NEEDLE & SEAT ASSY.-PRI.		
25.	NEEDLE & SEAT ASSY.-AUX.		



10.7d Exploded view of the Autolite/Motorcraft Model 4350 carburetor

11 Electric choke heater - testing

Refer to illustration 11.3

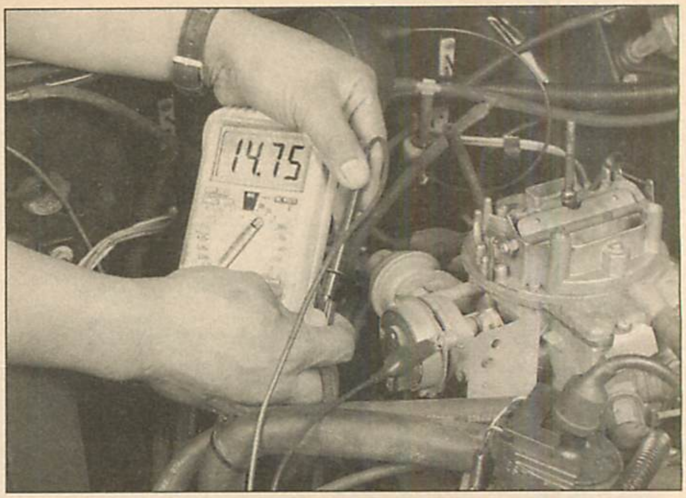
Caution: *If there is loss of electrical current to the choke heater, operation of the vehicle should be avoided. Loss of power to the choke will cause the choke to remain partly closed during engine operation. A very rich air/fuel mixture will be created and result in abnormally high exhaust system temperatures, which may cause damage to the catalytic converter or other underbody parts of the vehicle.*

1 The electric assist choke system consists of a thermostatic spring and cover (choke assembly), temperature sensing switch and a ceramic (positive temperature coefficient) heater. At temperatures below 60-degrees, the switch is open and no current is supplied to the ceramic heater located within the thermostatic spring. At temperatures above 60-degrees F, the temperature sensing switch closes and current is supplied to the ceramic heater. As the heater warms, it causes the spring to pull the choke plate open within 1 to 1-1/2 minutes.

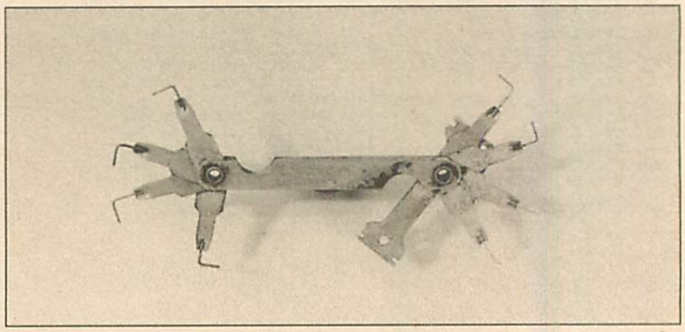
2 With the engine cold, connect a jumper wire from the choke heater terminal to the positive battery terminal. The choke heater housing should become hot and the choke plate in the carburetor should slowly open. As the choke coil is heating, occasionally tap the accelerator to allow the choke to open. Be sure it opens completely in about five minutes or replacement is necessary.

3 If the choke heater tests okay, but the choke valve does not open in normal operation, check for voltage to the choke heater when the engine is cold and the ignition switch is in the ON position **(see illustration).**

4 If no voltage is present in Step 2, repair the open in the power circuit to the choke heater (be sure to check the fuse first).



11.3 With the ignition key ON, check for battery voltage to the choke coil



12.1 Wire-type feeler gauge set

12 Carburetor adjustments

Note: *These carburetor adjustments are strictly in-vehicle adjustments. During overhaul, refer to the instructions included in the overhaul kit for complete procedures and any additional adjustments that are required.*

Carter YF one-barrel carburetor

Initial choke plate clearance adjustment

Refer to illustrations 12.1 and 12.3

1 When the engine starts, the thermostatic coil tension is balanced by the pull of vacuum and the force of the incoming air against the choke valve. This positions the choke in a partially open position. This slight opening is called the initial choke valve clearance. This clearance can be measured using a drill bit and a 0.026-inch diameter wire gauge bent at a 90-degree angle approximately 1/8-inch from the end. If the correct gauge tool is not available, one may be fabricated from a section of wire the correct thickness (measure its thickness using a micrometer). **Note:** *A wire-type feeler gauge, normally used for checking spark plug gap, may be used as a substitute* **(see illustration).**

2 Open the throttle partially and close the choke plate to position the choke piston at the top of its bore. **Note:** *The choke piston is accessible after the choke coil and cover assembly is removed from the carburetor.*

3 Hold the choke plate closed, release the throttle and insert the wire gauge into the piston slot and against the outboard side of the piston bore **(see illustration).** Push down on the piston with the gauge until the bent end enters the piston bore slot. Keep the gauge in place and push on the choke piston lever to move the piston up and lock the gauge in position. This special tool locks the choke piston against the bore at the correct depth.

4 Measure the choke plate lower edge-to-air horn wall clearance with a drill bit shank. Refer to the Specifications listed in this Chapter for the correct size drill bit and install the drill bit down the lower edge of the carburetor. Allow the choke plate to rest against the drill bit.

5 Use needle-nose pliers to carefully bend the choke piston lever and adjust the clearance. Decrease the clearance by bending the lever toward the piston and increase it by bending the lever away from the piston.

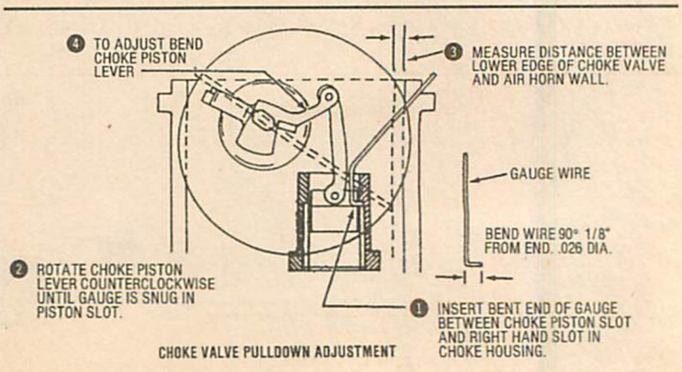
6 Install the choke baffle plate, gasket cover and retaining screws. Adjust the cover to the specified setting and tighten the retaining screws.

7 On 1978 models, turn the cover counterclockwise toward the rich side and tighten one retaining screw. The final adjustment is made after the fast idle cam linkage is adjusted.

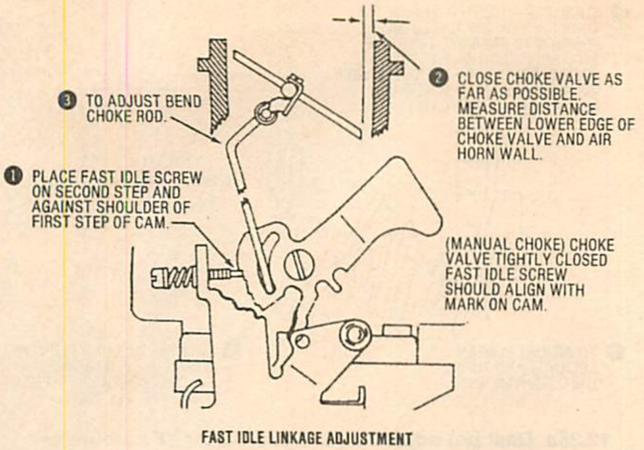
Fast idle cam linkage adjustment

Refer to illustration 12.8

8 Place the fast idle screw on the second step of the fast idle cam and against the shoulder of the high step **(see illustration). Note:** *On vehicles equipped with a spark delay device and with the ambient temperature above 55 degrees F; before setting the fast idle speed, connect the vacuum line directly from the carburetor spark port to the advance side of the distributor. Also, disconnect the vacuum supply line to the EGR valve and plug the line. Consult the VECI label for additional information.*



12.3 Initial choke plate clearance adjustment - Carter YF carburetor



12.8 Fast idle cam linkage adjustment - Carter YF carburetor

9 Check the clearance between the lower edge of the choke plate and the air horn wall using a drill bit shank. Compare this measurement to this Chapter's Specifications.
10 To adjust, bend the choke plate connecting rod until the proper choke plate-to-air horn wall clearance is achieved.

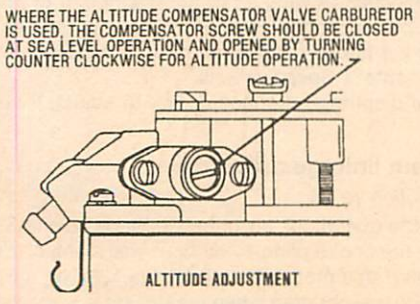
Choke unloader adjustment

Refer to illustration 12.11

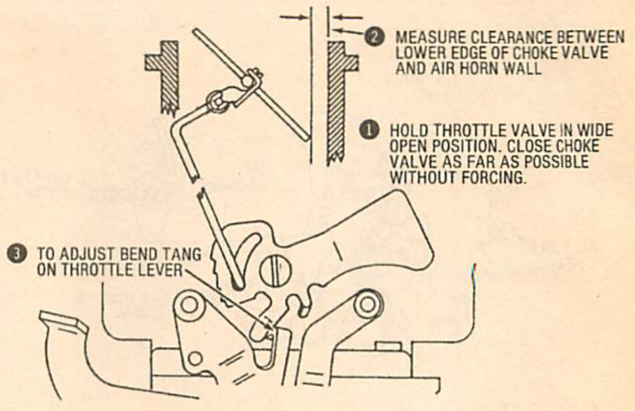
11 Hold the throttle completely open while pushing the choke plate toward the closed position. Measure the clearance between the choke plate lower edge and the air horn wall with a drill bit shank **(see illustration)**. Compare this measurement to the Specifications. **Note:** *Be sure the choke piston adjustment* (see Steps 1 through 7) *is corrected before setting the unloader adjustment.*
12 To adjust, bend the unloader tang which contacts the fast idle cam.
13 After adjustment, operate the throttle to make sure the linkage does not bind.
14 There should be a 0.070-inch clearance between the unloader tang and carburetor body with the throttle completely open after adjustment.

Bowl vent adjustment

15 Disconnect the emissions canister hose from the carburetor and attach a new piece of clean hose to the bowl vent.
16 Place the throttle on the high step of the fast idle cam and blow into the hose. There should be considerable resistance felt, indicating the vent is closed.
17 Move the fast idle cam until the throttle screw drops to the third step of the cam. Blow into the hose to verify that the bowl vent has opened and that pressure is relieved.
18 Repeat the test procedure to verify that the bowl vent is properly adjusted.
19 If no pressure is felt with the throttle on the high step of the cam, the vent is not closing. If the pressure is not released on the third step of the cam, the vent is not opening. Adjust by bending the forked end of the lever.



12.21 Altitude compensator adjustment screw location - Carter YF carburetor



12.11 Unloader adjustment - Carter YF carburetor

Altitude compensator adjustment

Refer to illustration 12.21

20 Some models are equipped with an altitude compensation device which features a compensation circuit that prevents a rich mixture at altitudes above 4,000 feet. The altitude compensator is adjusted manually.
21 When operating the vehicle above 4,000 feet, use a screwdriver to turn the altitude compensator screw counterclockwise approximately 2-1/2 turns to the outer seat position **(see illustration)**.
22 Below 4,000 feet, adjust the screw clockwise to the inner seat position.
23 The screw has two positions; all the way in (low altitude) or all the way out (above 4,000 feet). Do not adjust the screw to any other position.

4

Idle speed and fuel/air mixture adjustment

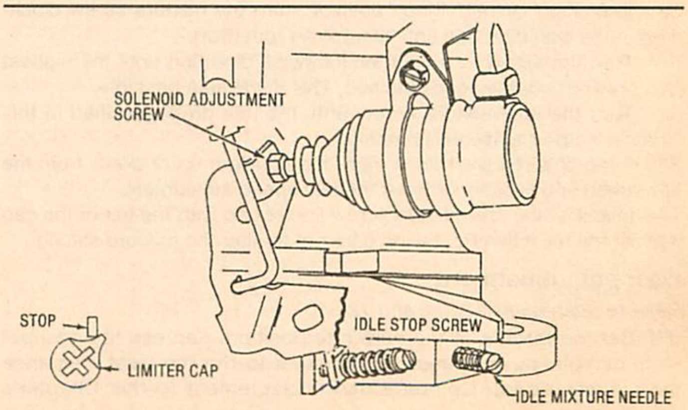
Refer to illustrations 12.26a and 12.26b

24 Prior to idle speed or mixture adjustment the following conditions must exist:

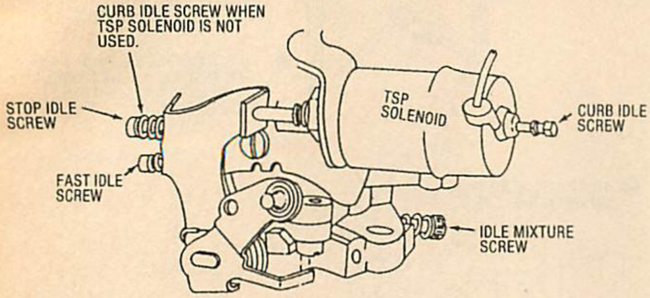
Parking brake securely set
Transmission must be in Drive (automatic) or Neutral (manual)
Engine at normal operating temperature
Air cleaner installed
Adjust idle speed before adjusting the fuel/air mixture

The engine must not be idled for more than three minutes (if the adjustment takes more than three minutes, run the engine for one minute at 2,000 rpm in Neutral)

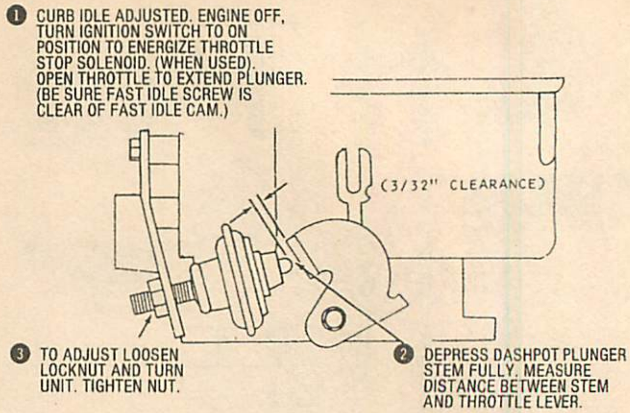
25 Attach a tachometer to the engine, following the manufacturer's instructions.
26 Turn the idle speed adjustment screw to obtain the idle speed listed in the Chapter 1 Specifications **(see illustrations)**.



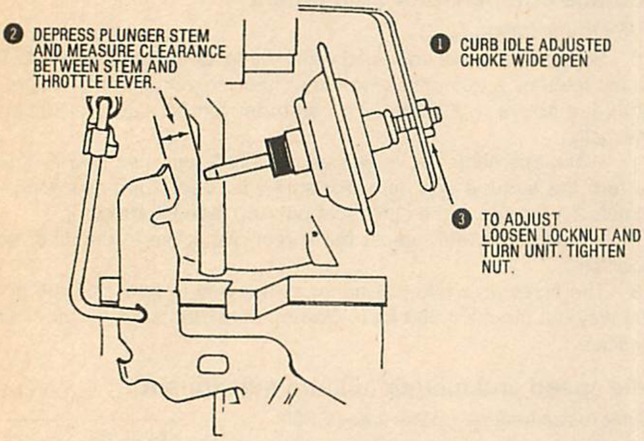
12.26a Idle speed adjustment (stop) screw and idle mixture screw locations - Carter YF carburetor



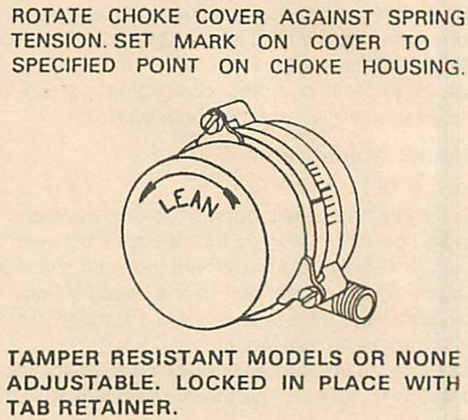
12.26b Curb idle adjustment for carburetors equipped with a throttle positioner - Carter YF carburetor



12.35a Dashpot adjustment - 1975 Carter YF carburetor



12.35b Dashpot adjustment - 1976 and later Carter YF carburetor



12.38 Rotate the choke cover RICH (clockwise) 1/4-turn and tighten - Carter BBD carburetor

27 If the carburetor is equipped with a solenoid, turn the nut on the plunger to obtain the specified idle speed and tighten the locknut (if so equipped). Disconnect the solenoid electrical connector and adjust the carburetor idle speed screw to achieve an idle of 500 rpm, then reconnect the connector.

28 Adjust the idle mixture screw to the full rich stop (counterclockwise), note the position of the screw head slots and remove the plastic limiter caps. This can be accomplished by threading a No. 10 sheet metal screw into the center of the cap.

29 Connect a tachometer and perform the idle speed adjustment procedure described above.

30 Beginning at the full rich position, turn the mixture screw clockwise in the lean direction until there is an rpm drop.

31 Turn the screw in a counterclockwise direction until the highest rpm previously attained is obtained. This is the lean best idle.

32 Turn the idle mixture screw until the idle drop specified in this Chapter's Specifications is reached.

33 If the final reading varies more than 30 rpm up or down from the idle speed specification, repeat the idle speed adjustment.

34 Install a new idle mixture screw limiter cap with the ear of the cap against the full rich stop, taking care not to alter the mixture setting.

Dashpot adjustment

Refer to illustrations 12.35a and 12.35b

35 Set the throttle at the curb idle position, depress the dashpot stem completely and measure the stem-to-throttle lever clearance **(see illustrations)**. Compare this measurement to this Chapter's Specifications.

36 To adjust, loosen the locknut and turn the dashpot until the specified clearance is obtained.

Fast idle adjustment

37 The fast idle adjustment is made with the engine at normal operating temperature, the EGR valve and TCS solenoid disconnected and the fast idle screw contacting the second step and against the shoulder of the high step of the fast idle cam **(see illustration 12.8)**. Turn the fast idle adjustment screw to obtain the specified rpm setting.

Carter BBD two-barrel carburetor

Initial choke plate clearance adjustment

Refer to illustrations 12.38 and 12.42

38 Loosen the cover screws and rotate the choke 1/4-turn in the rich direction **(see illustration)**. Tighten one screw.

39 Open the throttle plate sufficiently to place the fast idle screw on the high step of the cam.

40 Apply 19 inches of vacuum to the diaphragm to pull the plunger against the stop. Refer to the dashpot adjustment (see Steps 59 and 60).

41 Measure the choke plate-to-air horn wall clearance and check it against this Chapter's Specifications.

42 Bend the diaphragm connector link to adjust, if necessary **(see illustration)**.

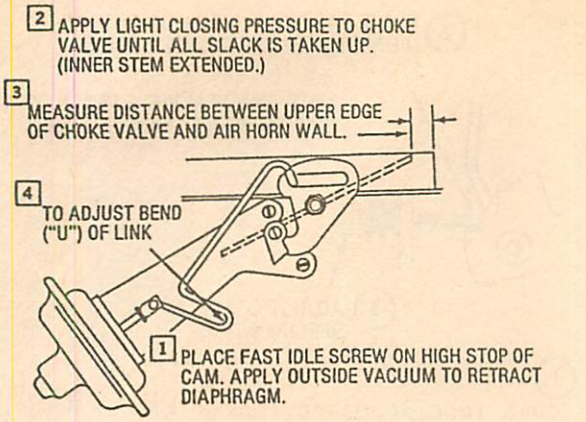
Fast idle cam linkage adjustment

Refer to illustration 12.45

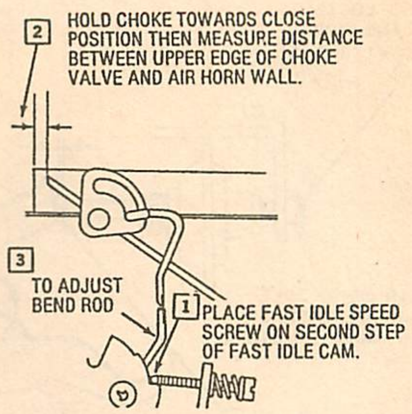
43 Perform the operations described in Steps 38 and 39.

44 Measure the choke plate-to-air horn wall clearance with a drill bit shank. Compare this measurement to this Chapter's Specifications. There should be a slight drag when the drill bit is removed.

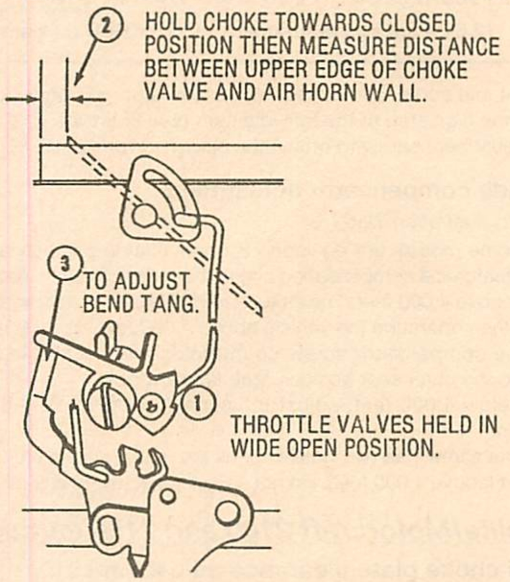
45 To adjust, bend the fast idle connector rod as necessary **(see illustration)**.



12.42 Initial choke plate clearance - Carter BBD carburetor



12.45 Fast idle linkage adjustment - Carter BBD carburetor



12.48 Choke unloader adjustment - Carter BBD carburetor

Choke unloader adjustment

Refer to illustration 12.48

46 With the throttle held in the wide open position, apply light pressure to the choke plate and hold it in place.

47 Measure the choke plate-to-air horn wall clearance with a gauge or drill bit shank. Compare this measurement to this Chapter's Specifications and adjust, if necessary.

48 Adjust by bending the unloader tang, making sure that it operates smoothly after adjustment **(see illustration).**

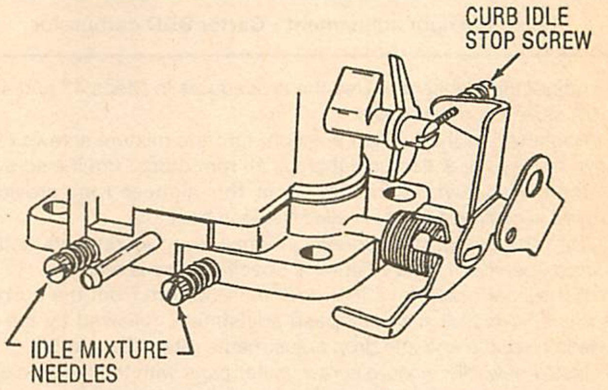
Curb idle speed adjustment

Refer to illustrations 12.50 and 12.51

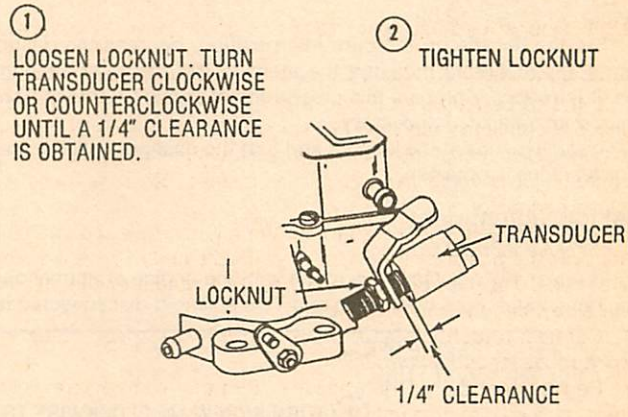
49 Prior to adjusting the curb idle speed, the following conditions must exist: **Note:** *If the vehicle is equipped with a VECI label* (see Chapter 6)*, follow the instructions printed on the label for setting the curb idle speed.*

Transmission in Neutral (manual) or Drive (automatic)
Parking brake securely set
Engine at normal operating temperature
Air cleaner installed
Tachometer properly attached

50 Turn the adjustment screw to attain the idle speed specified in Chapter 1 Specifications or the VECI label **(see illustration).** If the VECI label differs from the Specifications use the information on the label.



12.50 Curb idle speed screw location - Carter BBD carburetor



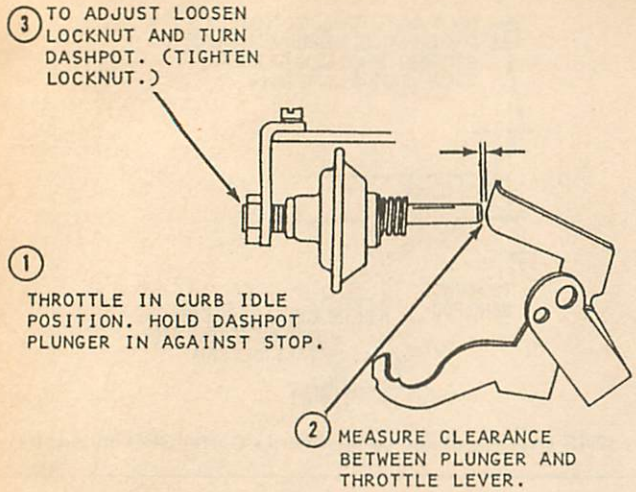
12.51 Throttle positioner (transducer) adjustment - Carter BBD carburetor

51 If the carburetor is equipped with a transducer, turn the nut on the transducer to adjust the idle rpm **(see illustration)**, then tighten the locknut.

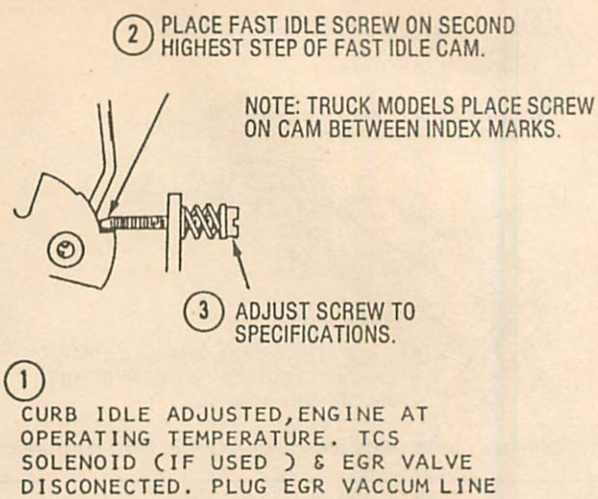
52 Disconnect the transducer electrical connector and adjust the carburetor idle screw to obtain a 500 rpm idle speed. Reconnect the transducer connector.

Mixture adjustment

53 The mixture adjustment preparations are the same as those for curb idle adjustment described in Step 49. Adjust the idle mixture screws to the full rich stop (counterclockwise), note the position of the screw head slots and remove the plastic limiter caps. This can be accomplished by threading a no. 10 sheet metal screw into the center of the cap.



12.59 Dashpot adjustment - Carter BBD carburetor



12.61 Fast idle adjustment - Carter BBD carburetor

54 Adjust the idle speed. Use the procedures in Steps 47 and 48 for transducer-equipped models.

55 Beginning at the full rich position, turn the mixture screws clockwise in the lean direction until there is an rpm drop. Turn the screws in the counterclockwise direction until the highest rpm previously achieved is obtained. This is called the lean best idle.

56 Turn the idle mixture screws in small, even increments until the idle drop specified in this Chapter's Specifications is reached.

57 If the final reading varies more than 30 rpm from the curb idle specification, repeat the idle speed adjustment, followed by the mixture lean best idle and idle drop adjustments (Steps 51 and 52).

58 Install new idle mixture screw limiter caps with the limiter cap ear against the full rich stop. Be careful not to change the mixture settings.

Dashpot adjustment

Refer to illustration 12.59

59 Set the throttle on the curb idle position, depress the dashpot stem completely and measure the stem-to-throttle lever clearance **(see illustration)**. Compare this measurement to this Chapter's Specifications and adjust, if necessary.

60 To adjust, loosen the locknut and turn the dashpot until the specified clearance is obtained.

Fast idle adjustment

Refer to illustration 12.61

61 The fast idle adjustment is made with the engine at normal operating temperature, the EGR valve and TCS solenoid disconnected and the fast idle screw contacting the second step and against the shoulder of the high step of the fast idle cam **(see illustration)**. Turn the fast idle adjustment screw to obtain the specified rpm setting.

Altitude compensator adjustment

Refer to illustration 12.63

62 Some models are equipped with an altitude compensation device which features a compensation circuit that prevents a rich mixture at altitudes above 4,000 feet. The altitude compensator is adjusted manually.

63 When operating the vehicle above 4,000 feet, use a screwdriver to turn the compensator screw counterclockwise approximately 2-1/2 turns to the outer seat position **(see illustration)**.

64 Below 4,000 feet, adjust the screw clockwise to the inner seat position.

65 The screw has two positions; all the way in (low altitude) or all the way out (above 4,000 feet). Do not adjust the screw to any other position.

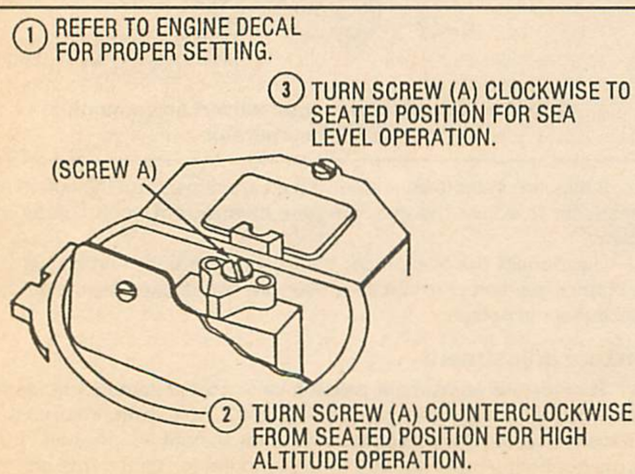
Autolite/Motorcraft 2100 and 2150 carburetors

Initial choke plate clearance adjustment

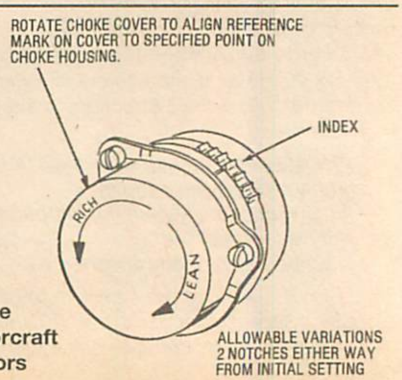
Refer to illustrations 12.66 and 12.69

66 If equipped with a Model 2100, rotate the choke cover 1/4-turn counterclockwise toward the rich side **(see illustration)**. If equipped with a Model 2150 (with altitude compensator) (see Section 14), open the throttle and rotate the choke cover until the choke plate is closed. On all models, tighten one choke cover retaining screw. **Note:** *If the choke is held on by rivets, drill them out with the proper size drill bit and replace them with screws.*

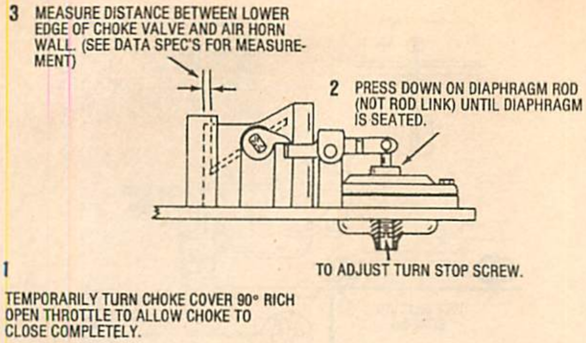
67 If equipped with a Model 2100, disconnect the choke heat inlet tube and align the fast idle speed adjusting screw with the index (second) step of the fast idle cam. If equipped with a Model 2150 (with altitude compensator), close the throttle with the fast idle speed screw on the top step of the fast idle cam and using a hand held vacuum pump,



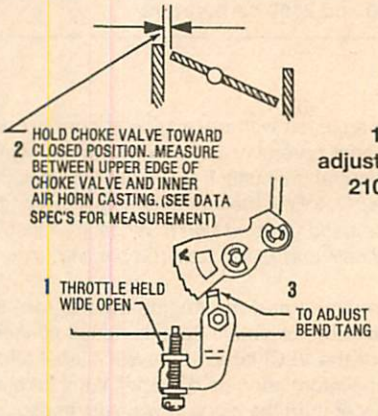
12.63 High altitude adjustment (if equipped) - Carter BBD carburetor



12.66 Automatic choke adjustment - Autolite/Motorcraft 2100 and 2150 carburetors



12.69 Initial choke plate clearance - Autolite/Motorcraft 2100 and 2150 carburetors



12.78 Choke unloader adjustment - Autolite/Motorcraft 2100 and 2150 carburetors

apply vacuum to the choke diaphragm to hold it against the set screw.

68 If equipped with a model 2100, start the engine (without moving the accelerator linkage) and turn the fast idle adjusting screw counterclockwise three full turns.

69 On all models, measure the clearance between the choke plate lower edge and the air horn wall with a drill bit shank **(see illustration)**. Compare this measurement to this Chapter's Specifications and adjust, if necessary.

70 After setting the choke to the specified position, tighten the choke cover screws.

71 If equipped with a Model 2100, adjust by bending the modulator arm. If equipped with a Model 2150 (with altitude compensator), turn the adjustment screw on the back of the diaphragm to attain the specified clearance (see Section 14).

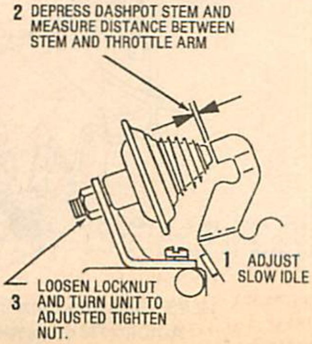
72 Shut off the engine and connect the choke heat tube. Reset the choke cover only after adjusting the fast idle cam linkage.

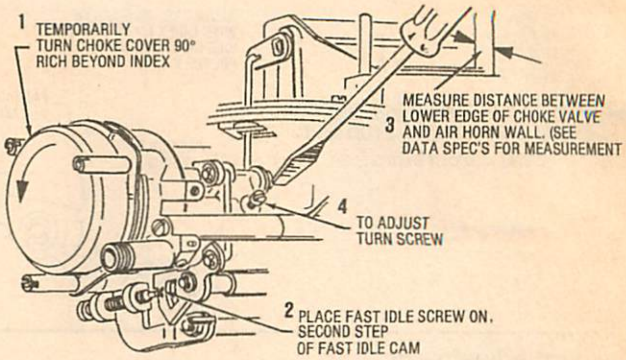
Fast idle cam adjustment

Refer to illustration 12.74

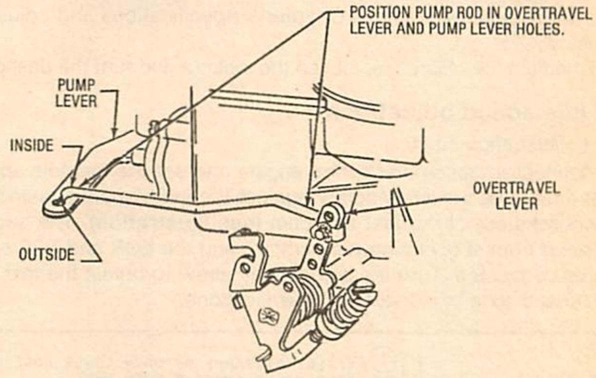
73 Push down on the fast idle cam lever until the fast idle adjusting screw is in contact with the index (second) step and against the shoulder of the high step.

12.84 Dashpot adjustment - Autolite/Motorcraft 2100 and 2150 carburetors





12.74 Fast idle cam linkage adjustment - Autolite/Motorcraft 2100 and 2150 carburetors



12.81 Accelerator pump stroke adjustment - Autolite/Motorcraft 2100 and 2150 carburetors

74 Measure the choke plate lower edge-to-air horn wall clearance **(see illustration)**. Compare it with this Chapter's Specifications and adjust, if necessary.

75 Turn the fast idle cam lever screw to adjust the linkage.

76 Adjust the automatic choke and tighten the retaining screws.

Choke unloader adjustment

Refer to illustration 12.78

77 Hold the throttle completely open with pressure applied on the choke plate toward the closed position.

78 Measure the choke plate lower edge-to-air horn wall clearance **(see illustration)**. Compare it to this Chapter's Specifications and adjust, if necessary.

79 Adjust the clearance by bending the choke unloader tang.

80 After adjustment, open the throttle until the unloader tang is directly below the fast idle cam pivot and check the clearance again. Adjust as necessary and have an assistant push the throttle pedal down. Make sure the throttle linkage opens completely and, if it does not, adjust the throttle cable bracket or remove any excess padding from under the floor mat.

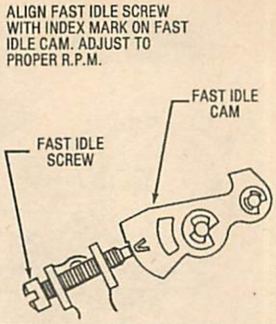
Accelerator pump stroke adjustment

Refer to illustration 12.81

81 The accelerator pump over travel lever has four adjustment holes and the pump lever has two. During normal operation, the pump rod should be in the third hole of the over travel lever and the inboard hole of the pump lever **(see illustration)**.

82 In extremely hot weather the pump rod can be moved to the second hole of the over travel lever and, in very cold weather, to the fourth hole to provide smoother acceleration.

83 Remove the operating rod from the retaining clip to move the rod to a different position on the over travel lever. Move the clip to the desired position, insert the rod and snap the clip over the rod.



12.86 Fast idle speed adjustment - Autolite/Motorcraft 2100 and 2150 carburetors

Dashpot adjustment

Refer to illustration 12.84

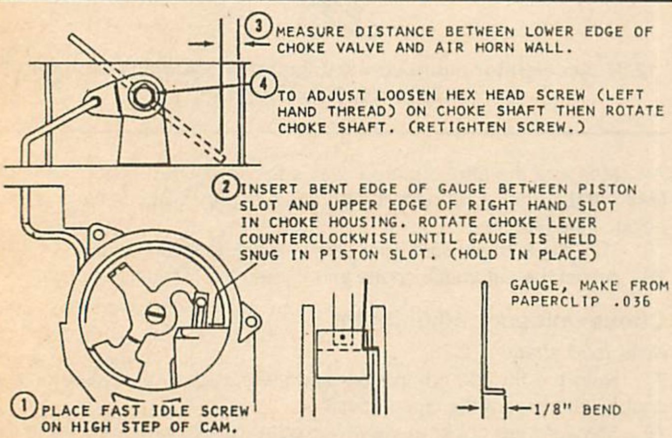
84 With the throttle in the idle position, depress the dashpot stem and measure the stem-to-throttle clearance **(see illustration)**. Compare the measurement to this Chapter's Specifications and adjust, if necessary.

85 To adjust the clearance, loosen the locknut and turn the dashpot.

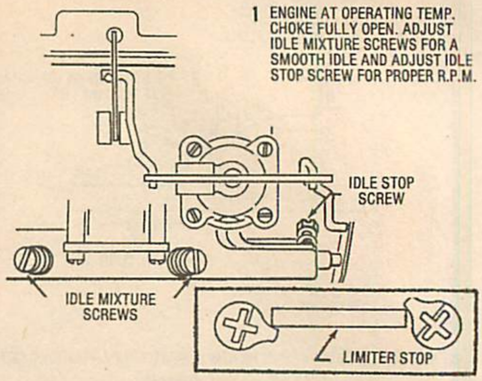
Fast idle speed adjustment

Refer to illustration 12.86

86 Connect a tachometer to the engine and set the fast idle speed with the fast idle adjusting screw against the index mark (located on the second step) of the fast idle cam **(see illustration)**. The engine must be at normal operating temperature and the EGR and TCS solenoids disconnected. Turn the adjustment screw to obtain the fast idle speed specified in this Chapter's Specifications.



12.90a Choke valve clearance adjustment on models without a choke diaphragm - Autolite/Motorcraft 4300 and 4350



12.88 Idle adjustment screw and idle mixture screw locations - Model 2100 and 2150 carburetors

Idle speed adjustment

Refer to illustration 12.88

87 The idle speed must be adjusted with the engine at normal operating temperature, the air cleaner assembly installed and the transmission in Drive (automatic) or Neutral (manual). If the vehicle is equipped with a VECI label (see Chapter 6), follow the instructions printed on the label. **Caution:** *Since the automatic transmission must be in Drive during adjustment, block the wheels and make sure the parking brake is firmly set.*

88 With a tachometer connected and the engine at idle, turn the adjustment screw **(see illustration)** to obtain the idle speed specified in Chapter 1 Specifications or the VECI label. If the VECI label differs from the Specifications use the information on the label. If the carburetor is equipped with a transducer, turn the hex screw on the transducer to adjust the idle speed. Disconnect the electrical connector and then adjust the idle speed screw to obtain an idle of 500 rpm. Reconnect the electrical connector to the transducer.

Mixture adjustment

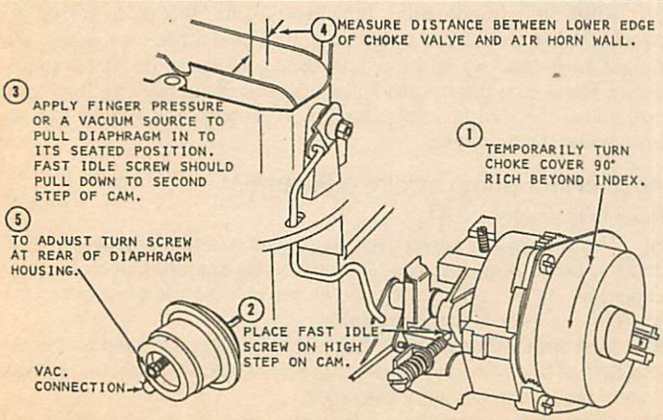
89 The manufacturer recommends that mixture adjustment on these models be accomplished with special infrared exhaust analyzing equipment. Take the vehicle to a properly equipped facility for the adjustment.

Autolite/Motorcraft 4300 and 4350 carburetors

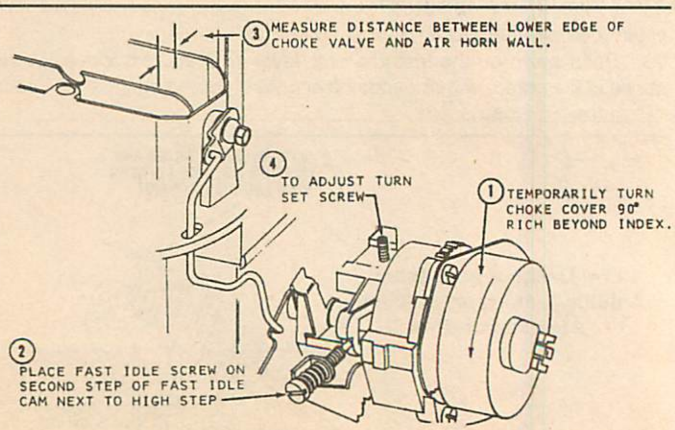
Initial choke plate clearance adjustment

Refer to illustrations 12.90a and 12.90b

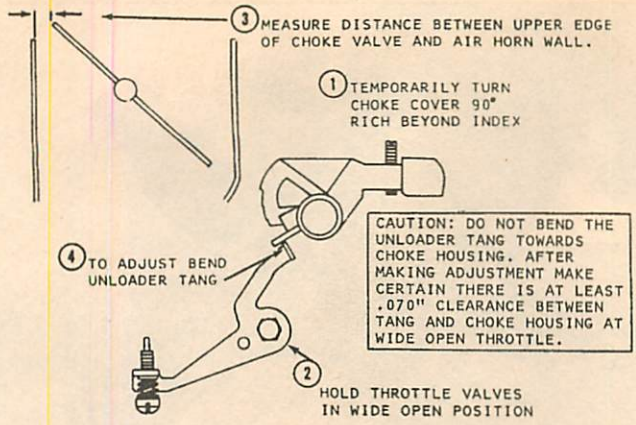
90 On models without a choke diaphragm, place the fast idle screw on the high step cam **(see illustration)**. On models with a choke diaphragm, open the throttle and rotate the choke cover 1/4-turn RICH (counterclockwise) and tighten one choke cover retaining screw **(see illustration)**.



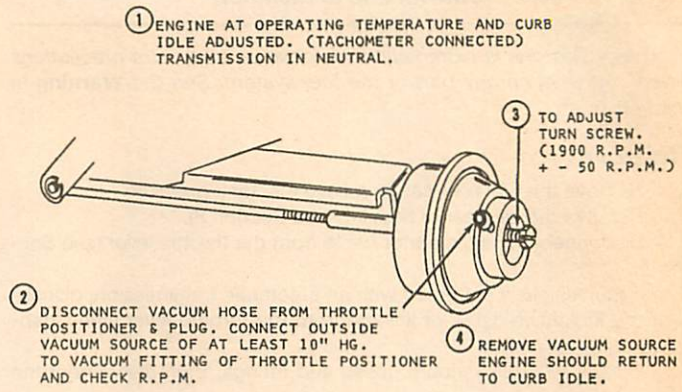
12.90b Choke valve clearance adjustment on models with a choke diaphragm - Autolite/Motorcraft 4300 and 4350



12.95 Fast idle cam linkage adjustment - Autolite/Motorcraft 4300 and 4350



12.100 Choke unloader adjustment - Autolite/Motorcraft 4300 and 4350



12.103 Throttle position adjustment on vacuum modulator systems - Autolite/Motorcraft 4300 and 4350

91 On models without a choke diaphragm, hold the throttle half open with pressure applied on the choke plate toward the closed position. Insert a 0.36 inch wire gauge between the lower edge of the piston and the upper edge of the right hand slot in choke piston housing. Pull the choke shaft lever counterclockwise to lock it in place. On models with a choke diaphragm, align the fast idle speed adjusting screw with the high step of the fast idle cam. Apply vacuum to the diaphragm and observe that the fast idle speed screw pulls down to the second step of the cam.
92 On all models, measure the clearance between the choke plate lower edge and the air horn wall with a drill bit shank. Compare this measurement to this Chapter's Specifications.
93 On models without a choke diaphragm, loosen the choke lever retaining screw (clockwise) located on the choke shaft and make the necessary adjustment. Tighten by turning the retaining screw counterclockwise. On models with a choke diaphragm, after setting the choke to the specified position, tighten the choke cover screws.

Fast idle cam adjustment

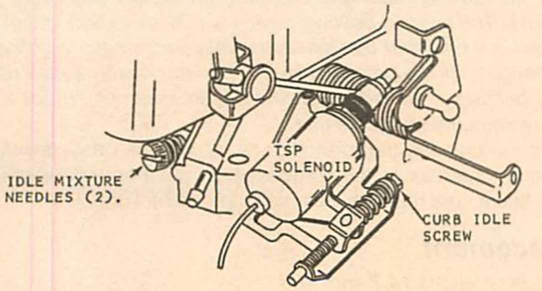
Refer to illustration 12.95

94 Open the throttle and rotate the choke cover 1/4-turn RICH (counterclockwise) and tighten one choke cover retaining screw. Push down on the fast idle cam lever until the fast idle adjusting screw is in contact with the second step and against the shoulder of the high step.
95 Measure the choke plate lower edge-to-air horn wall clearance and compare it with this Chapter's Specifications **(see illustration).**
96 Turn the fast idle cam lever screw to adjust the linkage.
97 Adjust the automatic choke and tighten the retaining screws.

Choke unloader adjustment

Refer to illustration 12.100

98 Open the throttle and rotate the choke cover 1/4-turn RICH (counterclockwise) and tighten one choke cover retaining screw.
99 Hold the throttle completely open with pressure applied on the choke plate toward the closed position.



12.108 Curb idle adjustment - Autolite/Motorcraft 4300 and 4350

100 Measure the choke plate lower edge-to-air horn wall clearance and compare it to this Chapter's Specifications **(see illustration).**
101 Adjust the clearance by bending the choke unloader tang.
102 After adjustment, open the throttle until the unloader tang is directly below the fast idle cam pivot and check the clearance against the Specifications. Adjust as necessary and have an assistant push the throttle pedal down. Make sure the throttle linkage opens completely and, if it does not, adjust the throttle cable bracket or remove any excess padding from under the floor mat.

Throttle modulator adjustment (if equipped)

Refer to illustration 12.103

103 Warm the engine to operating temperature, set the parking brake, block the wheels and place the transmission in Park (automatic) or Neutral (manual). Install a tachometer according to the manufacturers instructions. With the engine idling, disconnect and plug the vacuum hose to the throttle positioner. Install a hand held vacuum pump and apply 10 in-Hg to the throttle positioner **(see illustration).**
104 Turn the adjustment screw until 1850 to 1950 rpm is attained.
105 Remove the vacuum source and observe that the engine returns to curb idle.

Fast idle speed adjustment

106 Warm the engine to operating temperature, set the parking brake, block the wheels and place the transmission in Park (automatic) or Neutral (manual). Install a tachometer according to the manufacturers instructions. Disconnect the EGR and TCS solenoids. Place the fast idle adjusting screw against the second step of the fast idle cam **(see illustration 12.95).** Turn the adjustment screw to obtain the fast idle speed specified in this Chapter's Specifications.

Idle speed adjustment

Refer to illustration 12.108

107 The idle speed must be adjusted with the engine at normal operating temperature, the air cleaner assembly installed and the transmission in Drive (automatic) or Neutral (manual). **Caution:** *Since the automatic transmission must be in Drive during adjustment, make sure the parking brake is firmly set and block the wheels.*
108 With a tachometer connected and the engine at idle, turn the adjustment screw **(see illustration)** to obtain the idle speed specified in Chapter 1 Specifications. If the carburetor is equipped with a solenoid, disconnect the electrical connector to the solenoid and turn the hex screw on the solenoid to adjust the idle speed. Reconnect the wire to the solenoid.

Mixture adjustment

109 The manufacturer recommends that mixture adjustment on these models be accomplished with special infrared exhaust analyzing equipment. Take the vehicle to a properly equipped facility for the adjustment.

13 Carburetor - removal and installation

Warning: *Gasoline is extremely flammable, so take extra precautions when you work on any part of the fuel system. See the* **Warning** *in Section 1.*

Removal

1 Remove the fuel filler cap to relieve fuel tank pressure.
2 Remove the air cleaner housing (see Section 8).
3 Disconnect the accelerator cable from the throttle lever (see Section 9).
4 If the vehicle is equipped with an automatic transmission, disconnect the kickdown cable or linkage from the throttle lever (see Chapter 7).
5 Clearly label all vacuum hoses and fittings, then disconnect the hoses.
6 Disconnect the fuel line from the carburetor.
7 Label the wires and terminals, then disconnect all the electrical connectors.
8 Remove the mounting fasteners and detach the carburetor from the intake manifold. Remove the carburetor mounting gasket. Stuff a rag into the intake manifold openings to prevent debris from entering.

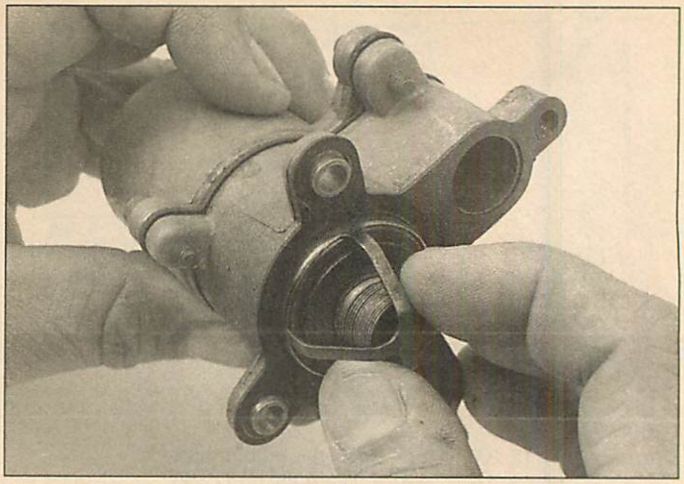
Installation

9 Use a gasket scraper to remove all traces of gasket material and sealant from the intake manifold and the carburetor. Clean the mating surfaces with lacquer thinner or acetone.
10 Place a new gasket on the intake manifold.
11 Position the carburetor on the gasket and install the mounting fasteners.
12 To prevent carburetor distortion or damage, tighten the fasteners in a criss-cross pattern, 1/4-turn at a time to the torque listed in this Chapter's Specifications.
13 The remaining installation steps are the reverse of removal.
14 Check and, if necessary, adjust the idle speed (see Section 12).
15 If the vehicle is equipped with an automatic transmission, refer to Chapter 7B for the kickdown cable or linkage adjustment procedure.
16 Start the engine and check carefully for fuel leaks.

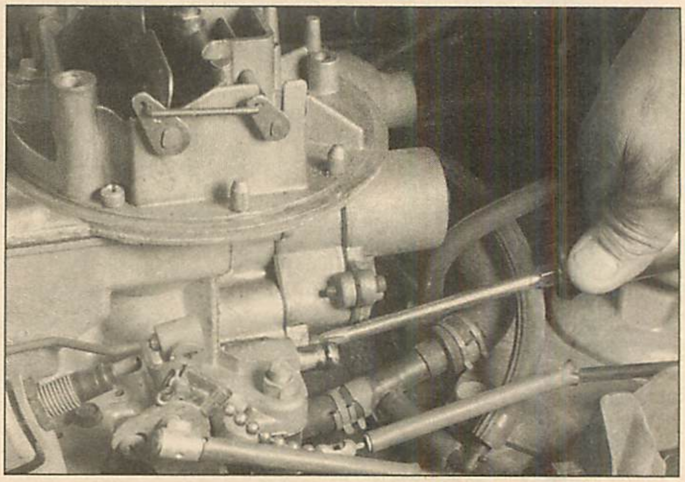
14 Altitude compensation system (Model 2150 carburetor) - general information and check

General information

Note: *Early Model 2100 carburetors are not equipped with the altitude compensation system. Refer to the carburetor adjustments in Section 12 for additional information on adjustments for high altitude applications.*
1 The altitude compensation system circuit on the Model 2150 two-barrel carburetor supplies additional air into the intake system to lean the air/fuel mixture at high altitudes. The compensation circuit parallels the carburetor venturi (main circuit). At the top opening of the compensation circuit, a small choke valve controls the airflow when the main choke is closed. Air flows down through the main body via a passage and into a special plenum chamber next to the main venturi bores. A spring loaded valve regulates the amount of air routed through the plenum chamber into the compensation chamber. To make a clear distinction, the plenum chamber air comes from the carburetor throat and stops before the valve while compensation chamber air is the air sitting directly behind the valve, inside the carburetor. From there, air is routed through two passageways to the venturi (at the throttle valve) into the intake system. The extra air combines to make the fuel/air mixture lean to compensate for the high altitude (low pressure) and rich mixtures.
2 The spring loaded valve is controlled by an aneroid bellows that reacts to the atmospheric pressure. The aneroid expands at high altitudes and pushes the valve stem out and away from the valve seat allowing air to pass into the compensation chamber. At low altitudes the aneroid collapses because of the higher pressures and closes the valve. The aneroid is not adjustable and must be replaced as a unit.



14.4 Make sure the spring has enough tension to keep the chamber closed at normal operating conditions



14.7 Remove the mounting screws from the altitude compensation chamber

Check

Refer to illustration 14.4

Caution: *Do not immerse any of the altitude compensation system components in carburetor cleaner. Carburetor cleaner can damage these specialized components.*
3 Remove the altitude compensation device on the backside of the carburetor **(see illustration 14.7)**.
4 Carefully check the spring tension of the valve assembly **(see illustration)**. The spring should have enough tension to retain the valve against the seat.
5 Separate the compensation chamber from the aneroid bellows assembly **(see illustration 14.8)**. Make sure the rubber seal that surrounds the valve is intact and not leaking. Replace this seal if necessary. **Note:** *The aneroid bellows device is difficult to test in that it must be placed in a chamber that simulates altitude changes (high/low pressure changes). If the part is suspect, replace it with a new unit. The aneroid bellows is sealed inside the piston assembly. In the event of failure, replace the complete unit.*
6 Working on the carburetor body, check the passageways from the plenum chamber to the compensation chamber and then into the venturi. Make sure they are clear with no obstructions.

Replacement

Refer to illustrations 14.7 and 14.8

7 Remove the screws from the altitude compensation chamber **(see illustration)**. Remove the chamber from the carburetor body.

8 Remove the screws from the assembly and separate the aneroid bellows assembly from the compensation chamber **(see illustration)**.

9 Installation is the reverse of removal.

15 Electronic feedback carburetor system - general information, component checks and replacement

General information

1 The electronic feedback carburetor emission system or Computerized Emission Control (CEC) system relies on an electronic signal, which is generated by an exhaust gas oxygen sensor, to control a variety of devices and keep emissions within limits. The CEC system is installed onto 1981 through 1988 six-cylinder engines. The system works in conjunction with a three-way catalyst to control the levels of carbon monoxide, hydrocarbons and oxides of nitrogen. The CEC system also works in conjunction with the computer or MCU (MicroComputer Unit). The two systems share certain sensors and output actuators; therefore, diagnosing the CEC system will require a thorough check of all the feedback carburetor components.

2 The CEC system has a diagnostic system for pinpointing sensor and output actuator problems but it requires a special SCAN tool available only at the dealer service department. Diagnosis of this system will require thorough knowledge of electrical systems and computerized sensors and output actuators. Listed below are checks and removal procedures for many of the components that will help the home mechanic to eliminate possible problems that could easily be remedied before resorting to more intensive electrical testing.

3 The system operates in two modes: open loop and closed loop. When the engine is cold, the air/fuel mixture is controlled by the computer in accordance with a program designed in at the time of production. The air/fuel mixture during this time will be richer to allow for proper engine warm-up. When the engine is at operating temperature, the system operates in closed loop and the air/fuel mixture is varied depending on the information supplied by the exhaust gas oxygen sensor.

4 Here is a list of the various sensors and output actuators involved with these feedback carburetor systems: **Note:** *1983 and earlier models may not have all the components listed.*

Coolant temperature switch
Thermal Electric switch
Oxygen sensor
Vacuum switches
WOT switch
Knock sensor
Stepper motor (fuel control)
Upstream and downstream solenoid (AIR system)
Electronic distributor
Idle relay
Throttle positioner
Positive Crankcase Ventilation (PCV system)

Check and replacement

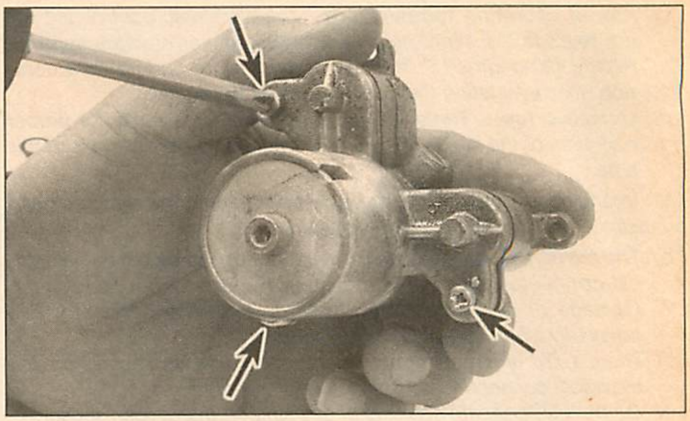
Coolant Temperature switch

General description

5 The coolant temperature switch detects coolant temperature when it is cold and after it has warmed up to operating temperature (approximately 135-degrees F). The coolant temperature switch is located at the rear of the intake manifold. The switch remains open below 135-degrees F. As the engine warms, the coolant temperature switch will close above 135-degrees F.

Check

6 To check the sensor, connect the probes of an ohmmeter to the terminals of the coolant temperature switch while it is completely cold (50 to 80-degrees F). The meter should indicate infinite resistance (open). Next, start the engine and warm it up until the engine reaches normal operating temperature (140 to 200-degrees F). The ohmmeter should read continuity. If the readings are incorrect, replace the switch.



14.8 Remove the mounting screws from the unit (arrows) and separate the aneroid bellows assembly from the altitude compensation assembly

Replacement

Warning: *Wait until the engine is completely cool before performing this procedure.*

7 Before installing the new sensor, wrap the threads with Teflon sealing tape to prevent leakage and thread corrosion.

8 To remove the sensor, unplug the electrical connector, then carefully unscrew the sensor.

9 Install the new sensor as quickly as possible to minimize coolant loss. Check the coolant level and add some, if necessary (see Chapter 1).

Oxygen sensor

Note: *A faulty oxygen sensor is one of the most common causes of high fuel consumption and poor driveability on a vehicle equipped with a feedback carburetor.*

4

General description and check

10 The oxygen sensor, which is located in the exhaust manifold, monitors the oxygen content of the exhaust gas stream. The oxygen content in the exhaust reacts with the oxygen sensor to produce a voltage output which varies from 0.1-volt (high oxygen, lean mixture) to 0.9-volts (low oxygen, rich mixture). The electronic control unit constantly monitors this variable voltage output to determine the ratio of oxygen to fuel in the mixture. The electronic control unit alters the air/fuel mixture ratio by controlling the pulse width (open time) of the mixture control solenoid. A mixture ratio of 14.7 parts air to 1 part fuel is the ideal mixture ratio for minimizing exhaust emissions, thus allowing the catalytic converter to operate at maximum efficiency. It is this ratio of 14.7 to 1 which the electronic control unit and the oxygen sensor attempt to maintain at all times.

11 The oxygen sensor produces no voltage when it is below its normal operating temperature of about 600-degrees F. During this initial period before warm-up, the system operates in open loop mode. If the engine reaches normal operating temperature and/or has been running for two or more minutes, and if the oxygen sensor is producing a steady signal voltage between 0.1 and 0.9-volts, the oxygen sensor is working properly (closed loop).

12 Using a digital multimeter, backprobe the oxygen sensor electrical connector and monitor the voltage as the engine goes from cold to operating temperature. Observe the voltmeter carefully as the voltage values flash between 0.1 to 0.9 volts.

13 The proper operation of the oxygen sensor depends on four conditions:

a) ***Electrical*** *- The low voltages generated by the sensor depend upon good, clean connections which should be checked whenever a malfunction of the sensor is suspected or indicated.*

b) ***Outside air supply*** *- The sensor is designed to allow air circulation to the internal portion of the sensor. Whenever the sensor is removed and installed or replaced, make sure the air passages are not restricted.*

c) ***Proper operating temperature*** *- The electronic control unit will not react to the sensor signal until the sensor reaches approximately 600-degrees F. This factor must be taken into consideration when evaluating the performance of the sensor.*

d) ***Unleaded fuel*** *- The use of unleaded fuel is essential for proper operation of the sensor. Make sure the fuel you are using is of this type.*

14 In addition to observing the above conditions, special care must be taken whenever the sensor is serviced.

a) *The oxygen sensor has a permanently attached pigtail and electrical connector which should not be removed from the sensor. Damage or removal of the pigtail or electrical connector can adversely affect operation of the sensor.*

b) *Grease, dirt and other contaminants should be kept away from the electrical connector and the louvered end of the sensor.*

c) *Do not use cleaning solvents of any kind on the oxygen sensor.*

d) *Do not drop or roughly handle the sensor.*

e) *The silicone boot must be installed in the correct position to prevent the boot from being melted and to allow the sensor to operate properly.*

Replacement

Note: *Because it is installed in the exhaust manifold or pipe, which contracts when cool, the oxygen sensor may be very difficult to loosen when the engine is cold. Rather than risk damage to the sensor (assuming you are planning to reuse it in another manifold or pipe), start and run the engine for a minute or two, then shut it off. Be careful not to burn yourself during the following procedure.*

15 Disconnect the cable from the negative terminal of the battery.

16 Raise the vehicle and place it securely on jackstands.

17 Carefully disconnect the electrical connector from the sensor.

18 Carefully unscrew the sensor from the exhaust manifold. **Caution:** *Excessive force may damage the threads.*

19 Anti-seize compound must be used on the threads of the sensor to facilitate future removal. The threads of new sensors will already be coated with this compound, but if an old sensor is removed and reinstalled, recoat the threads.

20 Install the sensor and tighten it securely.

21 Reconnect the electrical connector of the pigtail lead to the main engine wiring harness.

22 Lower the vehicle and reconnect the cable to the negative terminal of the battery.

Vacuum switches

General description

23 The 4 in-Hg switch (ported vacuum) and the 10 in-Hg switch (adaptive vacuum) are located together on a bracket that is attached to the center dash panel in the engine compartment. The 4 in-Hg vacuum switch is natural color and the 10 in-Hg vacuum switch is green. The 4 in-Hg vacuum switch is controlled by ported vacuum and is normally in the open position when ported vacuum is below 4 in-Hg. When vacuum rises above 4 in-Hg then the switch closes. This indicates to the MCU whether the engine throttle is idling or under hard acceleration. The 10 in-Hg switch is controlled by manifold vacuum. The switch is normally closed when the vacuum is below 10 in-Hg. The switch opens when the engine vacuum exceeds 10 in-Hg which indicates to the computer that a medium throttle conditions exists.

Check

24 Disconnect the vacuum lines from the 4 and 10 in-Hg vacuum switches, install a vacuum gauge to the lines, start the engine and observe the vacuum as the engine goes from idle to wide open throttle. Ported vacuum to the 4 in-Hg switch should vary from low to high (4 to 22 in-Hg) while manifold vacuum should vary from 22 to 5 in-Hg If the proper vacuum signal is not reaching the vacuum switches, check the hoses and manifold for clogging, pinched vacuum lines or incorrectly routed vacuum hoses.

25 Use a hand-held vacuum pump and apply vacuum to the 4 in-Hg switch. Observe that continuity exists when vacuum to the switch reaches 4 in-Hg (closed switch).

26 Use a hand-held vacuum pump, and apply approximately 10 in-Hg of vacuum to the 10 in-Hg switch and observe that continuity does not exist (open switch).

27 If the measurements are incorrect, replace the vacuum switch(es) with a new part.

Replacement

28 Disconnect the harness electrical connector from the vacuum switch.

29 Remove the mounting bolts and lift the vacuum switch from the engine compartment. Installation is the reverse of removal.

Stepper motor

General information

30 The function of the stepper motor is to operate the air metering pins in response to computer air/fuel ratio control commands. The stepper motor is an integral component of the BBD feedback carburetor manufactured by Carter. Because of the variation of the operations of the engine (idle, hard acceleration, deceleration, cruising, etc.), the computer (MCU) provides optimum air/fuel ratio corrections during all phases of the driving cycle by moving the metering pins to allow more or less fuel into the main power jet. The constant electronic variation allows for more complete combustion for better emissions and performance. Refer to the exploded view in Section 10 for the exact location of the stepper motor and metering pins.

Check

31 Maintain an engine speed of 1,500 rpm. Disconnect the stepper motor electrical connector. Average engine speed should increase a minimum of 50 rpm.

32 Reconnect the feedback carburetor stepper motor connector. The engine speed should slowly return to 1,500 rpm. If rpm does not change as specified, there's a problem in the feedback carburetor system, possibly the metering pins, although the oxygen sensor is usually the cause. First check for battery voltage to the stepper motor electrical connector, then check the oxygen sensor. If the oxygen sensor is OK and all connections are OK, the fuel metering pintle is probably bad.

Replacement

33 Disconnect the cable from the negative battery terminal.

34 Disconnect the electrical connector from the stepper motor.

35 Use an open end wrench and remove the stepper motor from the carburetor body.

36 Installation is the reverse of removal.

Wide Open Throttle (WOT) switch

General description

37 The WOT switch is attached to the base of the carburetor by a mounting bracket. When the throttle is wide open, the switch contacts a cam that closes contact. This electrical signal indicates to the MCU that the throttle is wide open. This setting uses different fuel and vacuum characteristics that must be corrected for emissions and power performance.

Check

38 To check the WOT switch, install an ohmmeter and observe that continuity changes as the throttle valve reaches approximately 15 degrees from wide open throttle. If there is no change in the continuity, the switch is defective. **Note:** *Be careful when backprobing the electrical connector. Do not damage the wiring harness or pull on any connectors to make clean contact. Be sure the probes are placed in the correct position.*

Replacement

39 Detach the cable from the negative terminal of the battery.

40 Unplug the wire harness electrical connector from the WOT connector.

41 Remove the WOT connector bracket retaining screw and detach the bracket and connector from the carburetor body.

Thermal electric switch

General information

42 The thermal electric switch is located inside the air cleaner. This sensor detects air temperature and relays the information to the MCU. On cold engine start-up, the thermal electric switch indicates cold air temperatures inside the air cleaner and the computer corrects the fuel mixture rich. When the temperature rises above 65-degrees F, the switch indicates warm temperatures to the MCU.

Check

43 Disconnect the thermal electric switch connector and using an ohmmeter, probe the terminals.
44 Below 50-degrees F the meter should indicate a closed circuit. Above 65-degrees F the meter should indicate an open circuit.
45 If the switch continuity isn't as specified, replace the switch

Replacement

46 Detach the cable from the negative terminal of the battery.
47 Unplug the wire harness electrical connector from the switch connector.
48 Remove the air cleaner top cover and detach the switch retaining clip.
49 Installation is the reverse of removal.

Knock sensor

General Description

50 The knock sensor detects any changes in combustion chamber detonation or knock. The knock sensor is constructed of piezoelectric crystal transducer and it is located near the carburetor base in the front of the intake manifold. The special material is sensitive to any vibration consequently causing slight oscillations from the knock sensor. This generates a voltage signal signaling the computer that that there is excess vibration present. The computer in turns selectively retards timing to allow less detonation.

Check

51 Install a timing light to the manufacturer's specifications. Observe the ignition timing mark while lightly tapping the engine block directly next to the knock sensor with a ball-peen hammer or similar tool. The ignition timing mark should noticeably retard with each tap.

Replacement

52 Disconnect the harness connector for the knock sensor and remove the assembly from the intake manifold.
53 Installation is the reverse of removal.

Altitude jumper wire

54 The altitude jumper wire is taped on the CEC wire harness in the engine compartment. This jumper wire indicates to the computer if the vehicle was originally designed to operated at altitudes above 4,000 feet. This jumper wire is not present on a vehicle originally designed to operated at low altitudes. In the event a low altitude vehicle is to be operated at high altitudes, remove the tape from the harness connector and install the altitude jumper wire to the ground terminals next to the ignition coil. There are additional engine ground connections on this eyelet screw but there is room to add more. **Note:** *Altitude adjustments on vehicles operating over 4,000 feet require other modifications. Carburetion, ignition timing, vacuum harness routing changes and the altitude jumper wire are necessary. Consult the VECI label and the dealer service department for more information.*

Micro Computer Unit (MCU)

General Information

55 The MCU assembly is the "brain" of the electronic control system. This computer processes and calibrates information it receives from the sensors to control the output actuators. This computer receives information from the coolant temperature switch, thermal electric switch, oxygen sensor, knock sensor, WOT switch and distributor. The information is used by the processor to activate various engine control systems such as air/fuel ratio, PCV flow, spark advance, canister purge and air injection for exhaust emissions control. The MCU is located in the engine compartment on 1983 and earlier models and in the passenger compartment on 1984 and later models.

Replacement

56 Locate the MCU. Disconnect the electrical connector from the MCU.
57 Remove the bolts from the bracket and lift out the MCU.

Idle relay

General information

58 This relay is used by the MCU to control the throttle positioning device attached to the carburetor. When the relay is energized, power is diverted to the throttle positioner which depresses the throttle lever increasing engine rpm. Refer to the BBD carburetor adjustments in Section 12 for additional information and testing procedures for the throttle positioner and idle circuit.

Check

59 Have the relay checked by a dealer service department or other properly equipped repair facility.

Ignition module

60 See Chapter 5 for information on the ignition module.

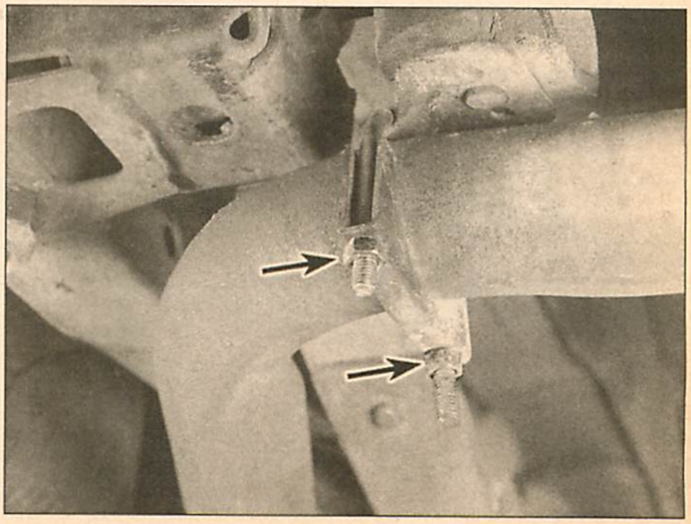
16 Exhaust system servicing - general information

Refer to illustration 16.1

Warning: *Inspection and repair of exhaust system components should be done only after enough time has elapsed after driving the vehicle to allow the system components to cool completely. Also, when working under the vehicle, make sure it is securely supported on jackstands.*

1 The exhaust system consists of the exhaust manifold(s), the catalytic converter, the muffler, the tailpipe and all connecting pipes, brackets, hangers and clamps. The exhaust system is attached to the body with mounting brackets **(see illustration)** and rubber hangers. If any of the parts are improperly installed, excessive noise and vibration will be transmitted to the body.

2 Conduct regular inspections of the exhaust system to keep it safe and quiet. Look for any damaged or bent parts, open seams, holes, loose connections, excessive corrosion or other defects which could allow exhaust fumes to enter the vehicle. Deteriorated exhaust system components should not be repaired; they should be replaced with new parts.



16.1 Be sure to apply penetrating spray to the exhaust system bolts before attempting to remove them

3 If the exhaust system components are extremely corroded or rusted together, welding equipment will probably be required to remove them. The convenient way to accomplish this is to have a muffler repair shop remove the corroded sections with a cutting torch. If, however, you want to save money by doing it yourself (and you don't have a welding outfit with a cutting torch), simply cut off the old components with a hacksaw. If you have compressed air, special pneumatic cutting chisels can also be used. If you do decide to tackle the job at home, be sure to wear safety goggles to protect your eyes from metal chips and work gloves to protect your hands.

4 Here are some simple guidelines to follow when repairing the exhaust system:

a) Work from the back to the front when removing exhaust system components.

b) Apply penetrating oil to the exhaust system component fasteners to make them easier to remove.

c) Use new gaskets, hangers and clamps when installing exhaust system components.

d) Apply anti-seize compound to the threads of all exhaust system fasteners during reassembly.

e) Be sure to allow sufficient clearance between newly installed parts and all points on the underbody to avoid overheating the floor pan and possibly damaging the interior carpet and insulation. Pay particularly close attention to the catalytic converter and heat shield.

Chapter 5
Engine electrical systems

Contents

Specifications

Ignition system

Ballast resistor or resistor wire	
Points-type system	
Six-cylinder engine	1.8 ohms
V8 engine	1.35 ohms
Breakerless Inductive Discharge (BID) system	
Six-cylinder engine	1.8 ohms
V8 engine	1.35 ohms
Solid State Ignition (SSI) system	1.35 ohms
Ignition coil-to-distributor cap wire resistance	
SSI system	500 ohms per inch (maximum)
BID system	5,000 ohms per foot (maximum)
Ignition coil resistance (at 75 degrees F)	
Points-type system	
Primary resistance	1.0 to 2.0 ohms
Secondary resistance	7.0 to 13.0 K-ohms
Breakerless Induction Discharge (BID) system	
1974 and 1975	
Primary resistance	1.0 to 2.0 ohms
Secondary resistance	8.0 to 12.0 K-ohms
1976	
Primary resistance	1.0 to 2.0 ohms
Secondary resistance	9.0 to 15.0 K-ohms
1977	
Primary resistance	1.25 to 1.40 ohms
Secondary resistance	9.0 to 15.0 K-ohms
Solid State Ignition (SSI) system	
Primary resistance	1.13 to 1.23 ohms
Secondary resistance	7.7 to 9.3 K-ohms
Ignition pick-up coil resistance (at 75 degrees F)	
BID system	1.6 to 2.4 ohms
SSI system	400 to 800 ohms
Sensor air gap (BID system)	0.050 inch

Charging system

Alternator output voltage	
14.1 to 15.3 volts @ 0 to 50-degrees F	
13.7 to 14.9 volts @ 50 to 100-degrees F	
13.4 to 14.4 volts @ 100 to 150-degrees F	
13.0 to 14.1 volts @ 150 to 200-degrees F	
Alternator brush length	
New	1/2 inch
Minimum	1/4 inch

Starting system

Cold cranking voltage	9.6 volts minimum
Starter brush length	
New	1/2 inch
Minimum	1/4 inch

1 General information

The engine electrical systems include all ignition, charging and starting components. Because of their engine-related functions, these components are considered separately from chassis electrical devices like the lights, instruments, etc.

Be very careful when working on the engine electrical components. They are easily damaged if checked, connected or handled improperly. The alternator is driven by an engine drivebelt which could cause serious injury if your hands, hair or clothes become entangled in it with the engine running. Both the starter and alternator are connected directly to the battery and could arc or even cause a fire if mishandled, overloaded or shorted out.

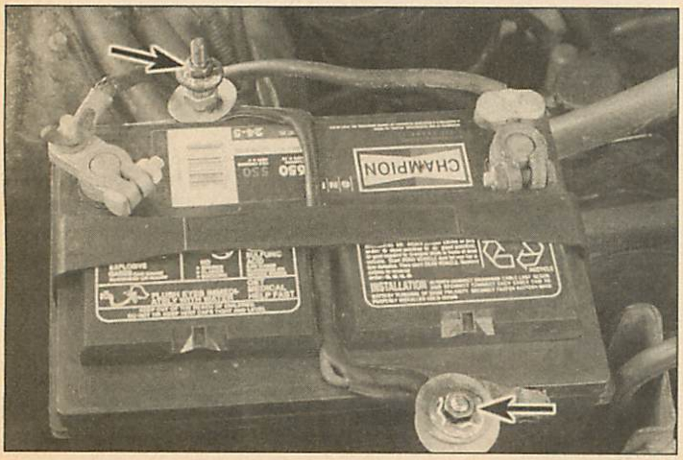
Never leave the ignition switch on for long periods of time with the engine off. Don't disconnect the battery cables while the engine is running. Correct polarity must be maintained when connecting battery cables from another source, such as another vehicle, during jump starting. Always disconnect the negative cable first and hook it up last or the battery may be shorted by the tool being used to loosen the cable clamps.

Additional safety related information on the engine electrical systems can be found in *Safety first* near the front of this manual. It should be referred to before beginning any operation included in this Chapter.

2 Battery - removal and installation

Refer to illustration 2.2

1 Disconnect both cables from the battery terminals. **Caution:** *Always disconnect the negative cable first and hook it up last or the battery may be shorted by the tool being used to loosen the cable clamps.*



2.2 Detach the battery cables (negative first, then positive) then remove the nut and bolt from the battery hold-down clamp (arrows)

2 Remove the battery hold-down clamp **(see illustration)**.

3 Lift out the battery. Use the special straps that attach to the battery posts (available at most automotive parts stores), lifting and moving the battery is much easier if you use them.

4 Installation is the reverse of removal.

3 Battery - emergency jump starting

Refer to the *Booster battery (jump) starting* procedure at the front of this manual.

4 Battery cables - check and replacement

1 Periodically inspect the entire length of each battery cable for damage, cracked or burned insulation and corrosion. Poor battery cable connections can cause starting problems and decreased engine performance.

2 Check the cable-to-terminal connections at the ends of the cables for cracks, loose wire strands and corrosion. The presence of white, fluffy deposits under the insulation at the cable terminal connection is a sign that the cable is corroded and should be replaced. Check the terminals for distortion, missing mounting bolts and corrosion.

3 When replacing the cables, always disconnect the negative cable first and hook it up last or the battery may be shorted by the tool used to loosen the cable clamps. Even if only the positive cable is being replaced, be sure to disconnect the negative cable from the battery first.

4 Disconnect and remove the cable. Make sure the replacement cable is the same length and diameter.

5 Clean the threads of the relay or ground connection with a wire brush to remove rust and corrosion. Apply a light coat of petroleum jelly to the threads to prevent future corrosion.

6 Attach the cable to the relay or ground connection and tighten the mounting nut/bolt securely.

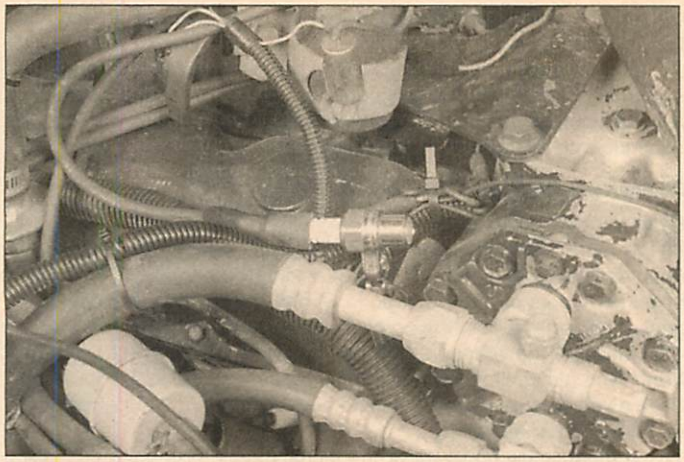
7 Before connecting the new cable to the battery, make sure that it reaches the battery post without having to be stretched. Clean the battery posts thoroughly and apply a light coat of petroleum jelly to prevent corrosion.

8 Connect the positive cable first, followed by the negative cable.

5 Ignition system - general information

1 The ignition system is designed to ignite the fuel/air charge entering each cylinder at just the right moment. It does this by producing a high voltage spark between the electrodes of each spark plug.

2 The types of ignition systems installed on these vehicles evolved



6.1 To use a calibrated ignition tester, simply disconnect a spark plug wire, connect it to the tester, clip the tester to a convenient ground and operate the starter - if there is enough power to fire the plug, sparks will be visible between the electrode tip and the tester body

through the years to accommodate more strict emissions standards adopted by the major automotive manufacturers. Some of the changes in the ignition systems overlapped in certain years and others changed with certain models while some did not. Here is a general listing of the various systems.

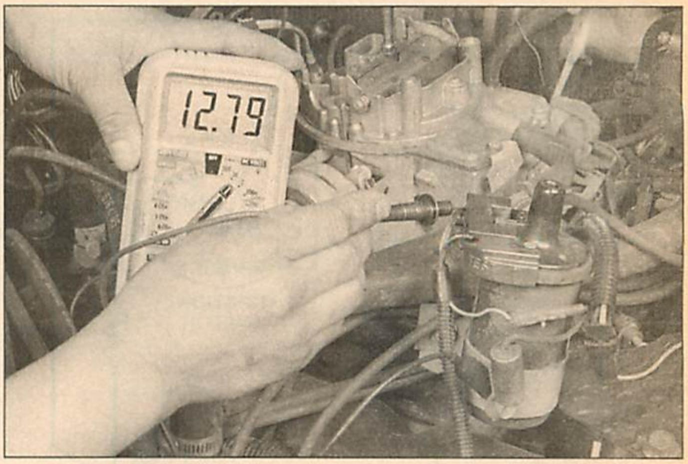
Breaker-points type ignition system

3 This ignition system controls the ignition spark using the conventional points and condenser arrangement and timing is controlled by mechanical advance components. This system is installed on 1972 through 1974 models only. 1972 models are equipped with a ballast resistor while later models are equipped with a resistor wire between the ignition switch and the ignition coil. Both types of resistors stabilize primary voltage and current for uniform secondary voltage capabilities at all engine speeds.

Electronic ignition systems

4 Electronic (breakerless) ignition systems include the Breakerless Inductive Discharge (BID) system and the Solid State Ignition (SSI) system. The BID system is equipped on these models from 1974 through 1977. SSI systems are used from 1978 through 1991. The BID system uses a conventional distributor, an electronic control unit (ignition module), sensor and trigger wheel. The distributor uses centrifugal weights to advance the timing along with a vacuum advance unit. The ignition module is mounted on the engine compartment firewall and it is sealed to prevent damage from weather and vibration. A resistance wire from the ignition switch to the coil is used to protect it from voltage surges, reverse polarity or current overloads. The distributor is equipped with a sensor coil and a trigger wheel that rotates with engine rpm. The sensor receives alternating current signals from the ignition module. This signal collapses when the trigger wheel tooth passes the sensor. This voltage signal is interpreted by the ignition module, switching power to the ignition coil off and sending a secondary voltage spike to the cylinder.

5 The SSI ignition system on later models contains many of the same type components as the BID system. These ignition systems are a solid state electronic design consisting of an ignition module, coil, distributor, the spark plug wires and the spark plugs. SSI systems can easily be identified by the 4-wire and 2-wire connectors on the ignition module. Engines that are equipped with the CEC feedback system use a computer or MicroComputer Unit (MCU) to control ignition spark and timing advance and retard. The coil primary circuit is controlled by an amplifier module. When the ignition is switched on, the ignition primary circuit is energized. When the distributor armature "teeth" or "spokes" approach the magnetic coil assembly, a voltage is induced which signals the amplifier to turn off the coil primary current. A timing circuit in the amplifier module turns the coil current back on after the coil field has collapsed. When it's on, current flows from the battery through the ignition switch, the coil primary winding, the amplifier module and then to ground. When the current is interrupted, the magnetic field in the ignition coil collapses, inducing a high voltage in the coil secondary windings. The voltage is conducted to the distributor where the rotor directs it to the appropriate spark plug. This process is repeated continuously.



6.6 Check for battery voltage on the primary (+) coil terminal with the ignition key on

6 Ignition system - check

Warning: *Because of the high voltage generated by the ignition system, extreme care should be taken whenever an operation is performed involving ignition components. This not only includes the coil, distributor and spark plug wires, but related components such as spark plug connectors, tachometer and other test equipment.*

All ignition systems

Refer to illustrations 6.1 and 6.6

1 If the engine will not start even though it turns over, check for spark at the spark plug by installing a calibrated ignition system tester to one of the spark plug wires **(see illustration)**. **Note:** *The tool is available at most auto parts stores. Be sure to get the correct tool for your particular ignition system (breaker-type [points] or breakerless-type [electronic]).*

2 Connect the clip on the tester to a ground such as a metal bracket or valve cover bolt, crank the engine and watch the end of the tester for bright blue, well defined sparks.

3 If sparks occur, sufficient voltage is reaching the plugs to fire the engine. However the plugs themselves may be fouled, so remove and check them as described in Chapter 1 or replace them with new ones.

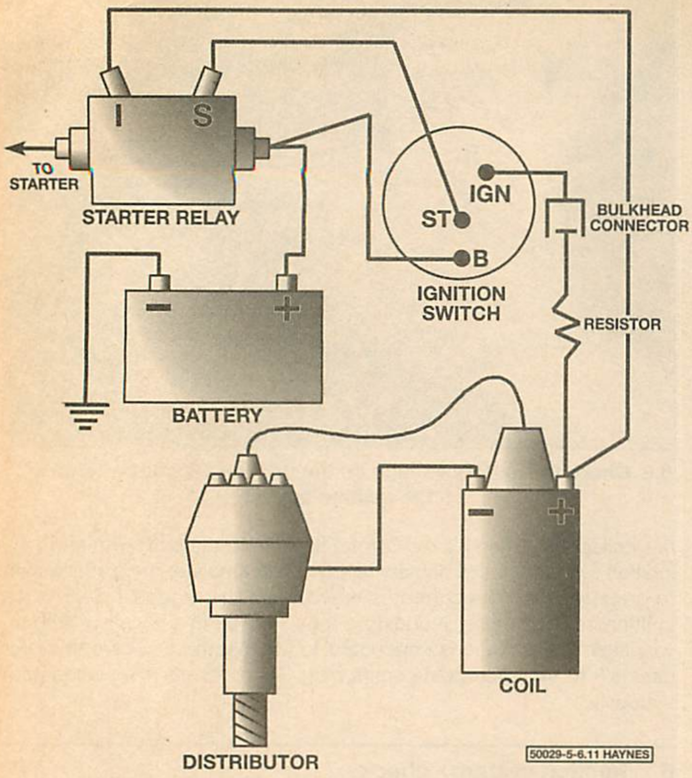
4 If no sparks occur, detach the coil secondary wire from the distributor cap, connect the tester to the coil wire and repeat the test.

5 If sparks occur, the distributor cap, rotor, spark plug wires or spark plugs may be defective. Remove the distributor cap and check the cap, rotor and spark plug wires as described in Chapter 1. Replace defective parts as necessary. If moisture is present in the distributor cap, use WD-40 or something similar to dry out the cap and rotor, then reinstall the cap and repeat the spark test at the spark plug wire.

6 If no sparks occur at the coil wire, check the primary wire connections at the coil to make sure they are clean and tight. Check for voltage to the ignition coil **(see illustration)**. If the voltage at the coil is less than the battery voltage, it will be necessary to find the source of the extra circuit resistance. Refer to the electrical schematics at the end of Chapter 12.

7 The coil-to-cap wire may be defective, check the resistance with an ohmmeter and compare it to the Specifications. Make any necessary repairs and repeat the test.

8 If the engine cranks and starts but will not continue to run, check



6.11 Schematic of an ignition points system

the resistor wire or ballast resistor for the correct resistance (see Section 7).

9 If there's still no spark, the ignition coil, module (electronic ignition systems) or other internal components may be defective. Check the resistance of the ignition coil (see Section 8). If the ignition coil is good, continue with the ignition system diagnosis.

Breaker-points type ignition system

Refer to illustration 6.11

10 If there is still no spark (see Step 1), check the ignition points (refer to Chapter 1). If the points appear to be in good condition (no pits or burned spots on the point surface) and the primary wires are connected correctly, adjust the points as described in Chapter 1.

11 Measure the voltage at the points with a voltmeter **(see illustration)**. With the ignition ON (engine not running), the points should produce a voltmeter reading of at least 10.5 volts. If not, the battery must be recharged or replaced.

12 If there is still no spark at the plugs, check for a ground or open circuit in the distributor/points circuit. There may be a damaged points terminal causing the ignition voltage to become shorted or diminished.

13 Check the ballast resistor or resistor wire for the proper resistance (see Section 7).

Electronic ignition systems

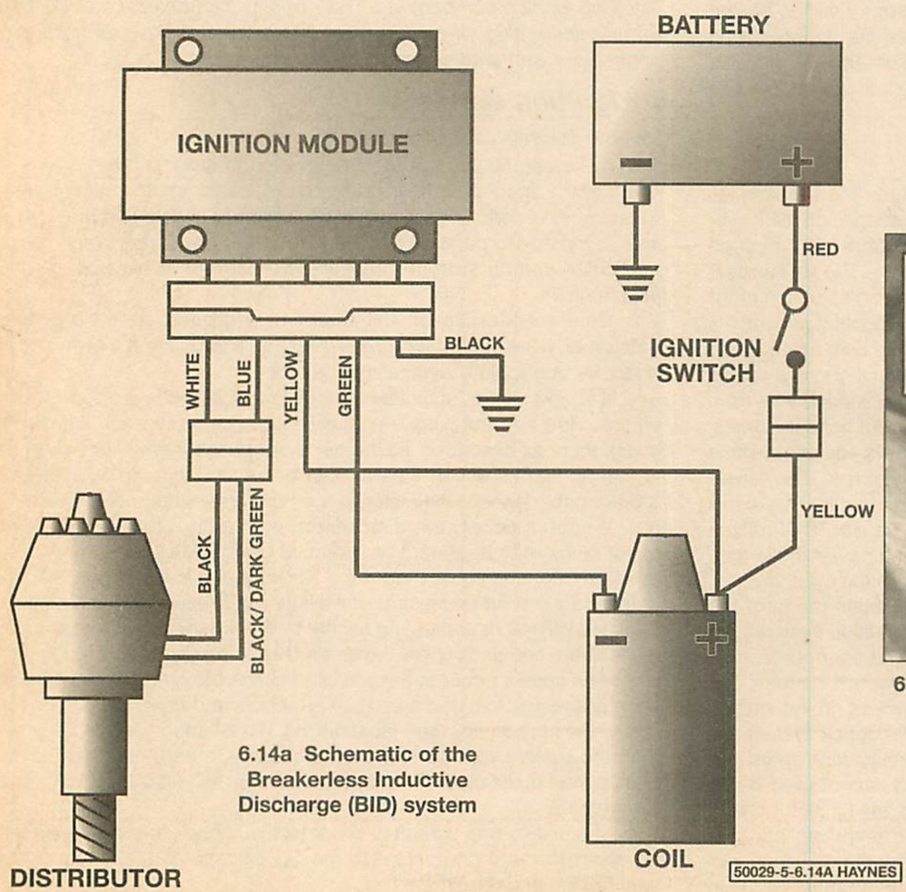
Refer to illustrations 6.14a, 6.14b, 6.14c, 6.14d and 6.15

14 Check for battery voltage to the ignition module:

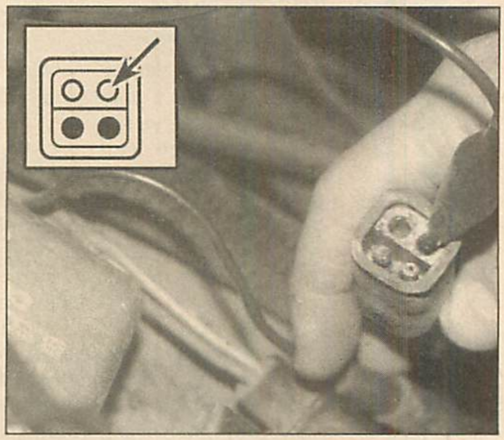
a) *On BID systems, check the yellow wire at the ignition module connector* **(see illustrations)**.

b) *On SSI systems, check the red/white (early models) or yellow wire (later models) at the ignition module 4-terminal connector* **(see illustrations)**.

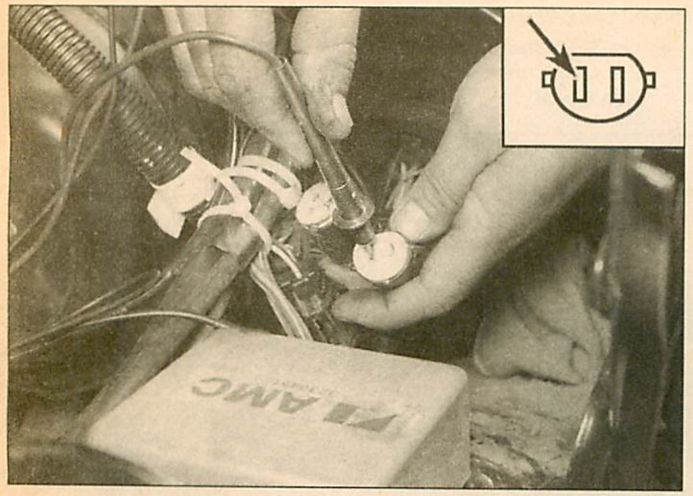
If battery voltage does not exist, check the circuit from the battery, to



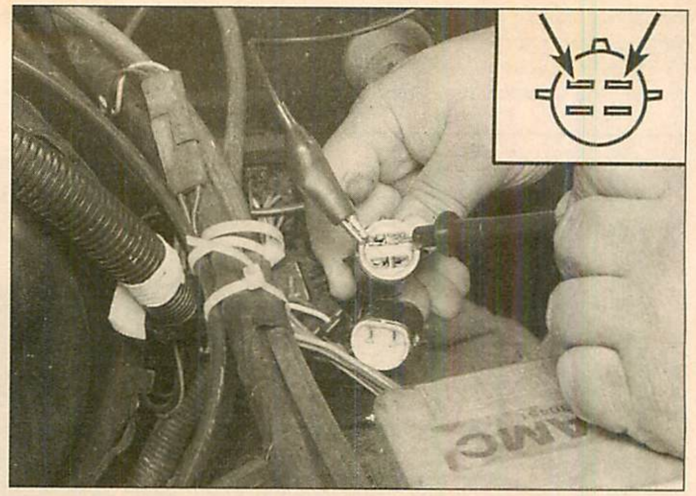
6.14a Schematic of the Breakerless Inductive Discharge (BID) system



6.14b Check for battery voltage to the ignition module (BID system shown)



6.14d Check for battery voltage to the ignition module (SSI system shown)



6.15 Working on the harness side of the module connector, check the pick-up coil resistance

b) On SSI systems, check the resistance between the purple wire and the orange wire (early models) or the blue wire and white wire (later models). It should be 400 to 800 ohms **(see illustration)**.

If the resistance is incorrect, replace the pick-up coil (see Section 12).

Note: *Make sure the connector for the harness is secure and snug. It is very important that the electrical connector for the pick-up coil is making good contact. Use silicon dielectric grease inside the terminal connector.*

16 If all the checks are correct and there is still no spark, replace the ignition module (see Section 11).

7 Ballast resistor or resistor wire - check and replacement

Note 1: *1972 models use a ballast resistor mounted on the firewall, while 1973 and later models use a special ignition resistance wire installed into the wiring harness between the ignition key and the ignition coil. The ballast resistor or resistor wire, reduces the voltage to the ignition coil when the engine is running. Because resistor wire it is rated at a specified resistance, do not replace it with ordinary wire that is not rated for the correct resistance, or damage to the coil will result. Replace it only with the manufacturer's specified resistor wire. When a new resistor wire is installed, the old one must be isolated from the system.*

Note 2: *The main symptom of a defective ballast resistor or resistor wire occurs at starting. The engine will start but quickly stall. In the declining stage, the engine will start but run very rough.*

Check

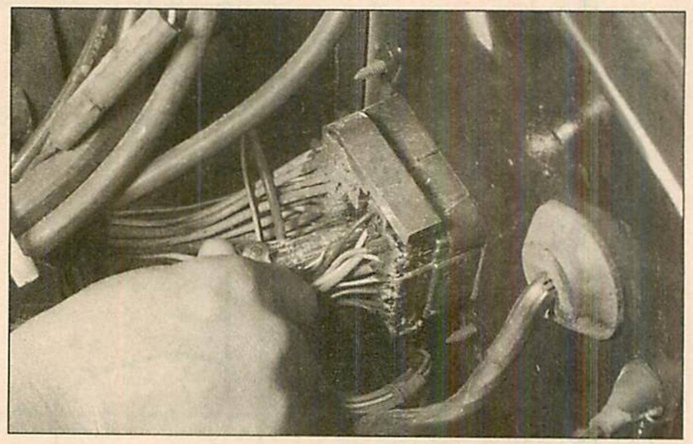
Refer to illustrations 7.1

1 Isolate the ballast resistor or resistor wire and check the resistance while separated from the ignition circuit:

A) On 1972 models, disconnect the electrical connectors from the ballast resistor and check the resistance across the resistor.

B) On 1973 and later models, disconnect the bulkhead connector **(see illustration)**. *Remove the connector from the primary (+) terminal of the ignition coil and measure the resistance from the ignition feed terminal on the wiring harness side of bulkhead connector (red/white wire on early models and yellow wire on later models) to the ignition coil connector.*

2 Compare the measured resistance with this Chapter's Specifications. If the resistance of the ballast resistor or resistor wire is not within 0.05 ohms of the specification, replace the ballast resistor or resistor wire.



7.1 Remove the center bolt and separate the bulkhead connector from the firewall

Replacement

Note: *It may be necessary to replace the resistor wire with a used part supplied from a local salvage yard. The dealer provides a replacement, but it is necessary to replace the entire engine compartment wiring harness.*

3 On 1972 models, detach the ballast resistor from the firewall and install a new resistor.

4 On 1973 and later models, disconnect the bulkhead connector from the engine compartment firewall and separate the resistor wire from the remainder of the wiring harness.

5 Install the new resistor wire in place of the old wire.

6 Make sure all other electrical connectors are secure and corrosion-free.

8 Ignition coil - check and replacement

Check

Refer to illustrations 8.4 and 8.5

1 Disconnect the primary wires and the secondary (high-tension) wire from the coil. Mark the wires and terminals with pieces of numbered tape, if necessary.

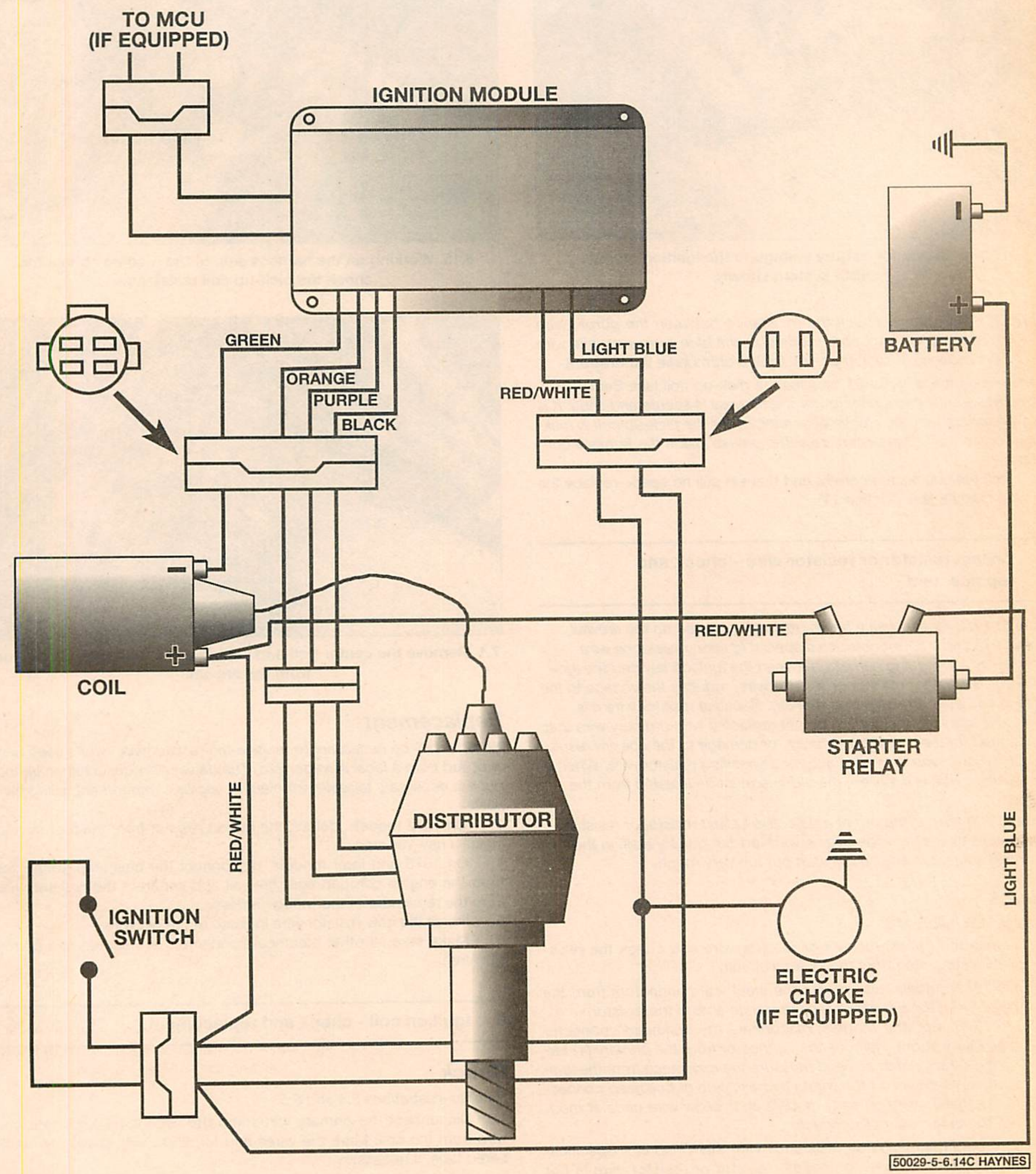
2 Clean the outer case and check it for cracks and other damage.

3 Inspect the coil primary terminals and the coil tower terminal for corrosion. Clean them with a wire brush if any corrosion is found.

the ignition switch, the coil and the ignition module. **Note:** *Refer to the wiring diagrams at the end of Chapter 12 for additional information.*

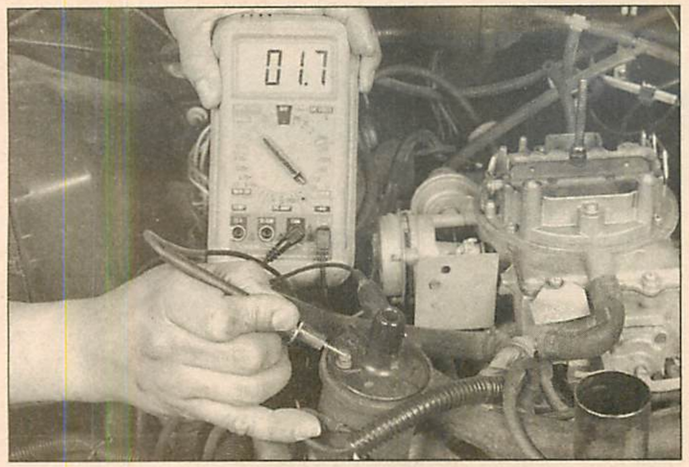
15 If battery voltage exists, check the pick-up coil resistance. Disconnect the electrical connector to the distributor and using an ohmmeter, check the resistance:

a) On BID systems, check the resistance between the black wire and black/dark green wire. It should be 1.6 to 2.4 ohms **(see illustration 6.14a)**.

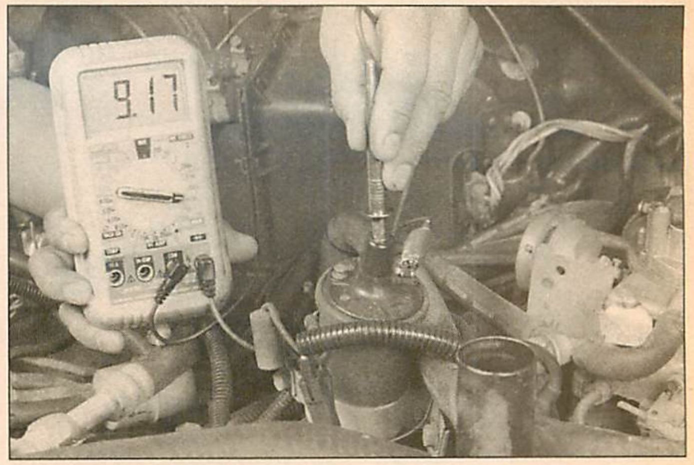


6.14c Schematic of the Solid State Ignition (SSI) system

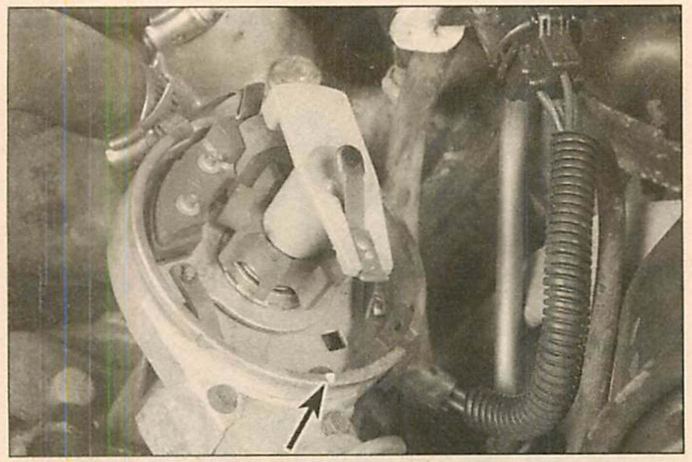
5



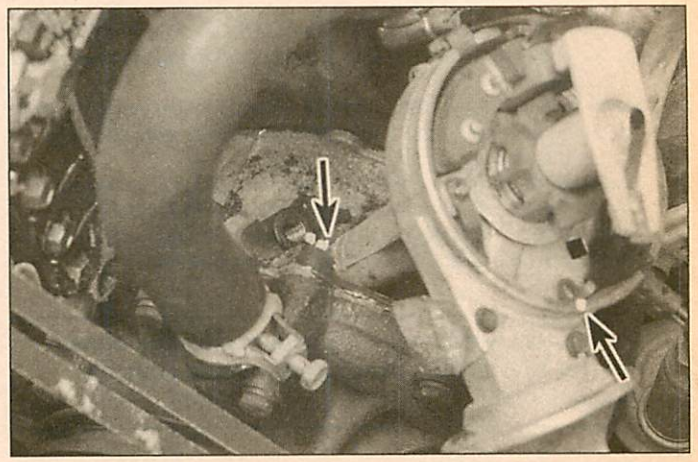
8.4 Checking the coil primary resistance



8.5 Checking the coil secondary resistance



9.5a Make a mark on the perimeter of the distributor body inline with the rotor tip (arrow)



9.5b Mark the base of the distributor and the engine block to clearly define the position of the distributor (arrow). It will be necessary to remove the hold-down clamp to gain access to a suitable location for the paint mark

4 Check the coil primary resistance by attaching the leads of an ohmmeter to the primary terminals **(see illustration)**. Compare the measured resistance to this Chapter's Specifications.
5 Check the coil secondary resistance by attaching one of the ohmmeter leads to one of the primary terminals and the other ohmmeter lead to the coil high-tension terminal **(see illustration)**.
6 Compare the measured resistance to the Specifications listed in this Chapter.
7 If the measured resistances are not as specified, the coil is defective and should be replaced with a new one.
8 It is essential for proper ignition system operation that all coil terminals and wire leads to be kept clean, tight and dry.

Replacement

9 Detach the cable from the negative terminal of the battery.
10 Detach the wires from the primary terminals on the coil (some coils have a single electrical connector for the primary wires).
11 Remove the coil secondary lead.
12 Remove the bracket bolts and detach the coil.
13 Installation is the reverse of removal.

9 Distributor - removal and installation

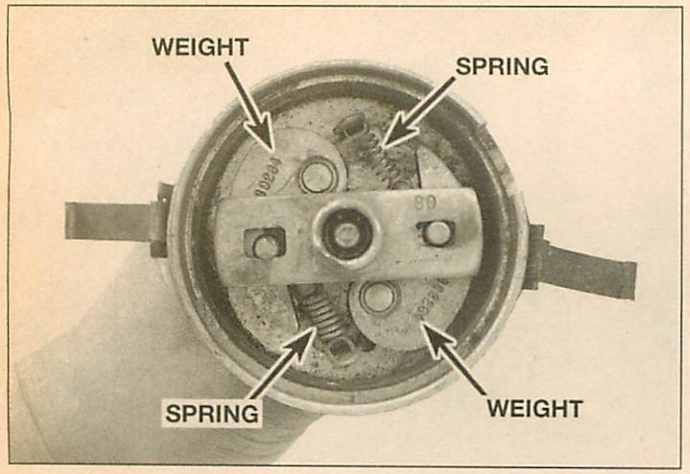
Removal

Refer to illustrations 9.5a and 9.5b

1 Disconnect the primary lead from the coil.
2 Disconnect the electrical connector for the module. Follow the wires as they exit the distributor to find the connector.
3 Note the raised "1" on the distributor cap. This marks the location for the number one cylinder spark plug wire terminal.
4 Remove the distributor cap (see Chapter 1) and turn the engine over until the rotor is pointing toward the number one spark plug terminal (see the TDC locating procedure in Chapter 2).
5 Make a mark on the edge of the distributor base directly below the rotor tip and in line with it **(see illustration)**. Also, mark the distributor base and the engine block to ensure that the distributor is installed correctly **(see illustration)**.
6 Remove the distributor hold-down bolt and clamp, then pull the distributor straight up to remove it. **Caution:** *DO NOT turn the engine while the distributor is removed, or the alignment marks will be useless.*

Installation

7 Insert the distributor into the engine in exactly the same relationship to the block that it was in when removed.
8 To mesh the helical gears on the camshaft and the distributor, it may be necessary to turn the rotor slightly. If the distributor doesn't seat completely, the hex shaped recess in the lower end of the distributor shaft is not mating properly with the oil pump shaft. Recheck the alignment marks between the distributor base and the block to verify that the distributor is in the same position it was in before removal. Also check the rotor to see if it's aligned with the mark you made on the edge of the distributor base. **Note:** *If the crankshaft has been*



10.1 Typical centrifugal advance weight and spring assembly

moved while the distributor is out, locate Top Dead Center (TDC) for the number one piston (see Chapter 2) *and position the distributor and rotor accordingly.*
9 Place the hold-down clamp in position and loosely install the bolt.
10 Install the distributor cap and tighten the cap screws securely.
11 Plug in the module electrical connector.
12 Reattach the spark plug wires to the spark plugs (if removed).
13 Connect the cable to the negative terminal of the battery.
14 Check and, if necessary, adjust the ignition timing (refer to Chapter 1) and tighten the distributor hold-down bolt securely.

10 Distributor centrifugal and vacuum advance system - general information, check and vacuum advance replacement

General information

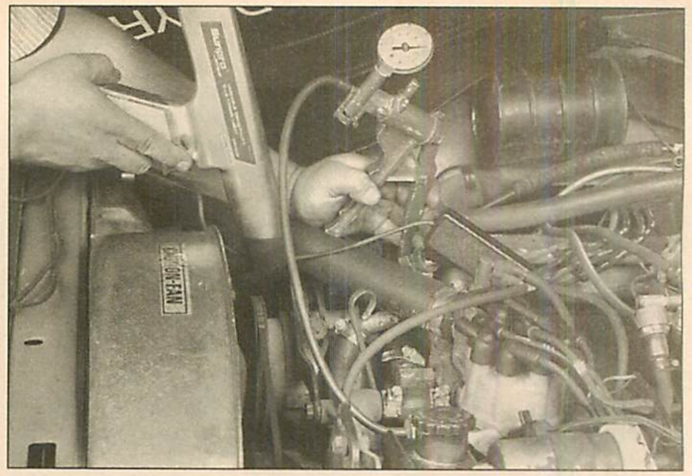
Refer to illustration 10.1

1 To provide the proper spark timing during different engine speeds and throttle openings, most distributors are equipped with a vacuum advance and a centrifugal advance mechanism **(see illustration)**. The vacuum advance unit governs ignition timing according to engine load, while the centrifugal advance unit governs ignition timing according to engine speed. Some models are equipped with a dual diaphragm vacuum advance unit that provides for additional timing retard during engine cranking to aid in starting and also reduce emissions during idle and coast down.
2 The centrifugal advance weights and springs may stick, wear out or become defective after years of service. The vacuum advance diaphragm may rupture, rendering the unit inoperative. Both the vacuum advance and the centrifugal advance systems can be tested using the timing light method. After the initial test to determine its working capabilities, the different systems must be checked separately.

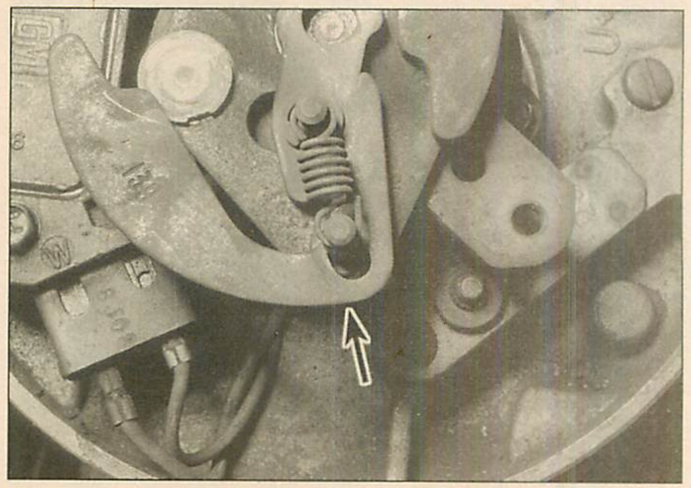
Check

Refer to illustration 10.5

3 Connect a timing light according to the manufacturers instructions. Disconnect the vacuum line to the vacuum advance and start the engine. **Caution:** *Make sure the timing light leads are clear of all moving components before starting the engine.*
4 Observe the timing mark while slowly increasing the engine speed to 4,000 rpm. The timing mark should advance smoothly and without any hesitations or sudden movements. If the timing mark jumps erratically, stop the engine, remove the distributor cap and check the centrifugal weights for binding, missing or defective parts (see Step 7).
5 To check the operation of the vacuum advance unit, connect a



10.5 Observe the timing mark with the timing light while applying vacuum to the vacuum advance unit with a hand-held vacuum pump. There should be a noticeable increase in timing advance as vacuum is applied



10.7 An example of a worn centrifugal advance weight - note the elongated hole

hand-held vacuum pump to the vacuum advance unit. Start the engine and maintain a steady 1,200 rpm. Apply vacuum while observing the timing mark with the timing light **(see illustration)**.
6 When vacuum is applied, the timing mark should advance quickly and completely. Most systems will advance the timing approximately 35 degrees (centrifugal and vacuum advance) at wide open throttle. If it doesn't, see Step 9.

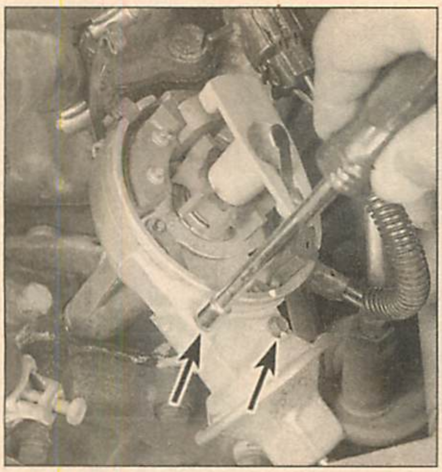
Centrifugal advance check

Refer to illustration 10.7

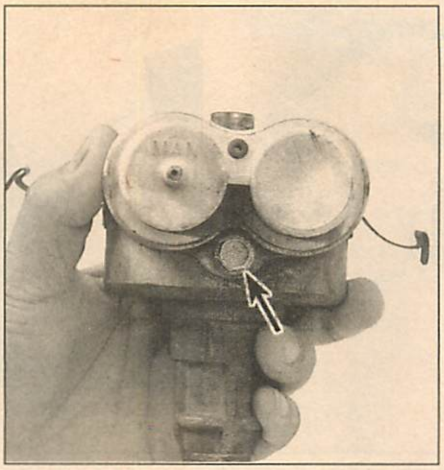
7 With the ignition OFF, and the distributor cap removed from the distributor, carefully check all the components of the centrifugal advance system. Check the condition of the springs and weights and the pin connections **(see illustration)**. Try oiling the weights and springs with a spray penetrant. Repeat the test several more times until the centrifugal advance operates properly.
8 If the centrifugal advance components are worn beyond repair, replace the distributor with a rebuilt unit.

Vacuum advance check

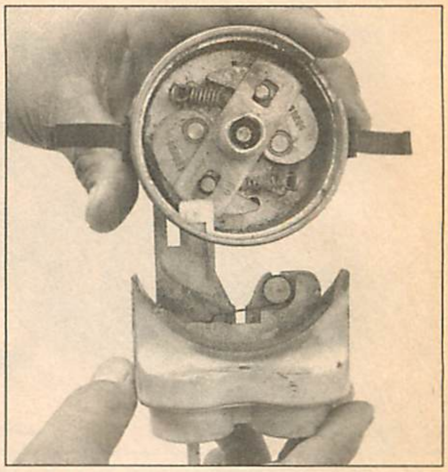
9 The diaphragm assembly is attached to the distributor breaker plate. A vacuum line attaches the diaphragm housing to a ported vacuum source. As vacuum changes from idle to acceleration through deceleration and back to idle, the timing changes accordingly.



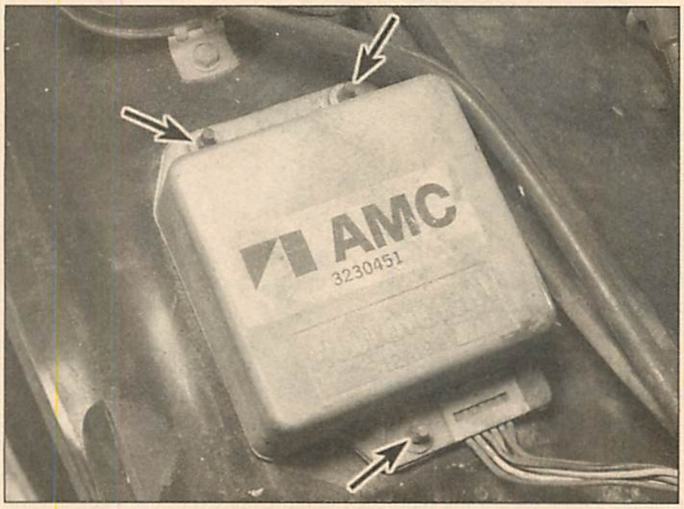
10.14 Remove the screws (arrows) that retain the vacuum advance unit to the distributor (SSI system distributor)



10.15a Remove the screw (arrow) retaining the vacuum advance unit to the distributor body (BID system distributor)



10.15b Separate the vacuum advance from the distributor (BID system distributor)



11.4 Typical ignition module mounting screw locations (arrows)

10 With the engine OFF, check the condition of the vacuum hose from the distributor to the vacuum source. Make sure the hose is properly connected and not broken, split or cracked.

11 Disconnect and plug the vacuum hose to the distributor. Connect a vacuum pump to the vacuum diaphragm and apply between 15 to 20 in-Hg. to the advance unit.

12 Make sure the vacuum advance diaphragm holds vacuum. If the vacuum bleeds down, replace the unit with a new vacuum advance.

Vacuum advance replacement

Refer to illustration 10.14, 10.15a and 10.15b

13 Remove the distributor cap and the vacuum line to the advance unit.

14 If equipped with a SSI system distributor, remove the two screws that retain the vacuum advance unit to the distributor body **(see illustration)**. On V8 models, remove the clip that retains the vacuum advance link to the base plate **(see illustration 12.14)**. Disconnect the vacuum advance lever from the base plate and remove the unit from the distributor body.

15 If equipped with a BID system distributor, remove the pick-up coil assembly from the distributor (see Section 12). Remove the vacuum advance retaining screw, washer and guide and slide the advance unit from the distributor body **(see illustrations)**.

16 Installation is the reverse of removal.

11 Ignition module - check and replacement

Note: *An intermittent no-start condition on certain models of the SSI ignition system may be attributed to the ignition module. If the engine starts then immediately stalls, or if the engine fails to start after shut off, the ignition module may be defective. If your vehicle exhibits these conditions and you suspect the ignition module, tap the module with a rubber mallet or apply heat to the module using a heat gun or lamp. If the engine then starts, the ignition module is defective.*

Check

1 The ignition module is a delicate electronic component that requires expensive electronic equipment to properly diagnosis. Without this equipment, the only effective method of diagnosing a defective ignition module is the process of elimination. Eliminate the basic components of the ignition system as possible sources of the ignition problem. Start by performing the ignition system checks described in Section 6. Check for battery voltage to the ignition module with the ignition key ON (engine not running). Next, check the, ignition coil, pick-up coil and circuits from the distributor to the module. If no problems are found with the ignition system components or circuits, replace the ignition module.

Replacement

Refer to illustrations 11.4

2 Detach the cable from the negative terminal of the battery.

3 Disconnect the electrical connectors.

4 Remove the mounting screws **(see illustration)** and detach the module.

5 Installation is the reverse of removal.

12 Pick-up coil replacement

Note: *Follow the ignition system checks described in Section 6 to determine if the pick-up coil is defective.*

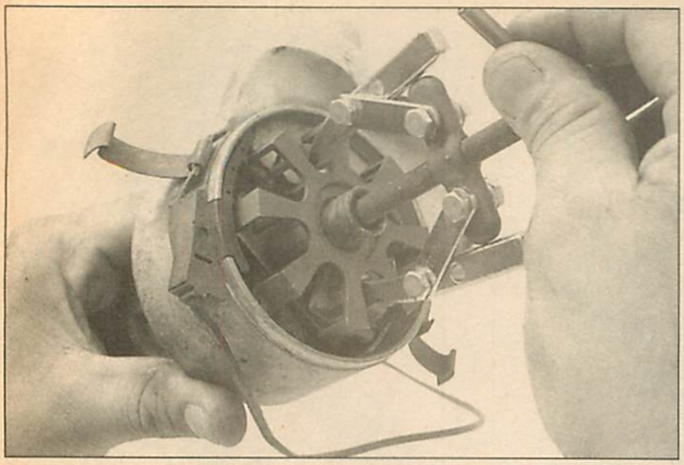
Breakerless Inductive Discharge (BID) ignition system

Refer to illustrations 12.3, 12.4, 12.5, 12.6, 12.7a, 12.7b and 12.10

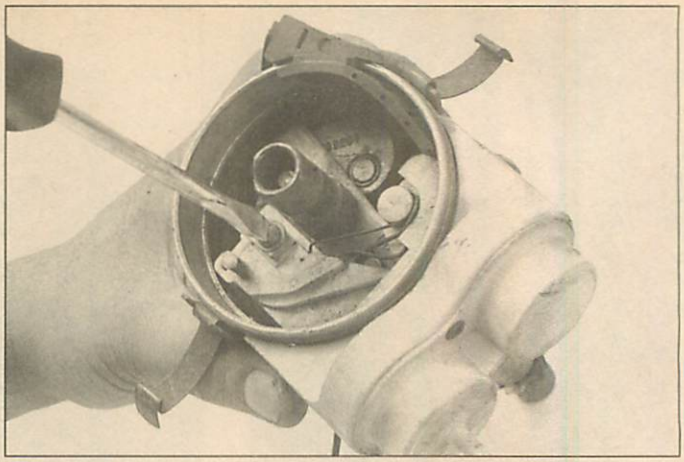
1 Pick-up coil replacement can be accomplished with the distributor installed in the engine or removed, if necessary (see Section 9).

2 Remove the distributor cap, rotor and dust cap.

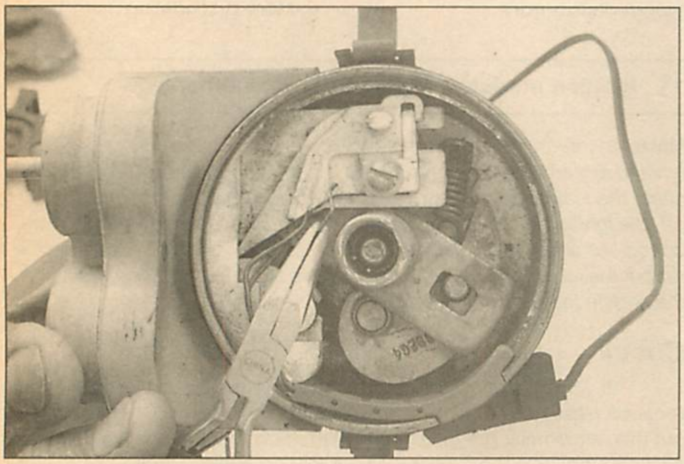
3 Using a small gear puller, remove the trigger wheel. Make sure the



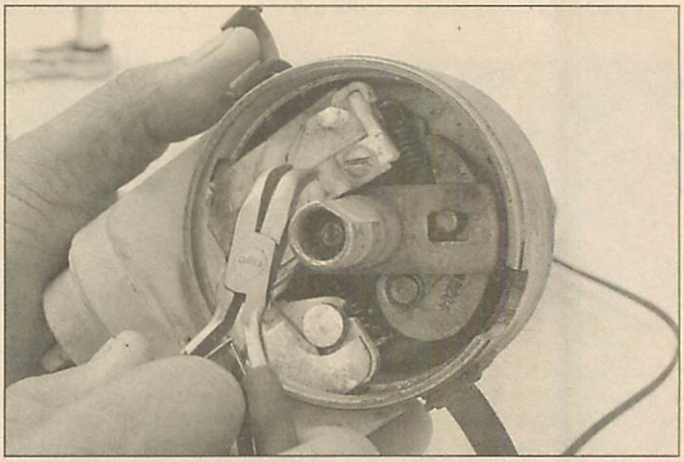
12.3 Use a small puller to separate the trigger wheel from the distributor (BID system distributor)



12.4 Loosen the pick-up coil assembly screw 3 turns



12.5 Lift the spring from the pivot pin



12.6 Use a needlenose pliers to separate the pick-up coil assembly from the distributor

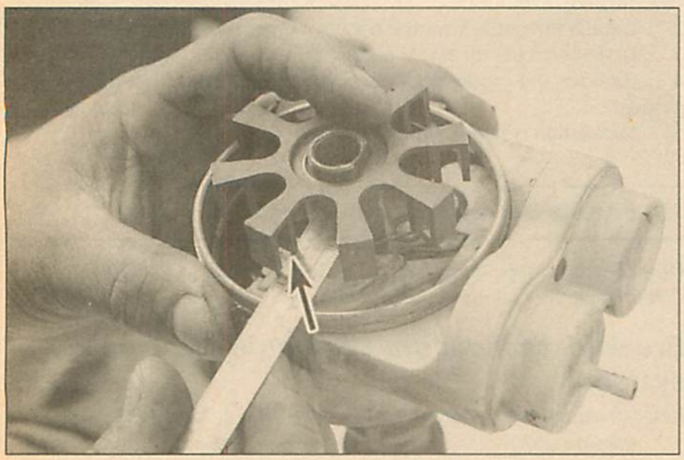
jaws of the puller grip the inner shoulder of the trigger wheel securely **(see illustration)**.

4 Loosen the ignition pick-up coil assembly screw approximately three turns **(see illustration)**.

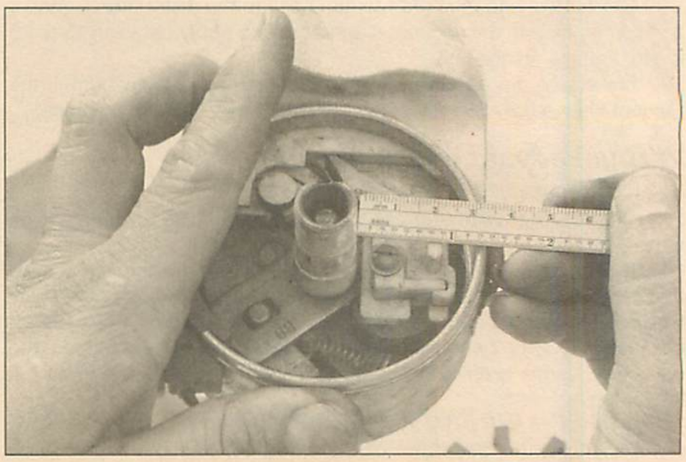
5 Remove the pick-up lead grommet and pull the leads out of the slot around the spring pivot pin. Lift the pick-up spring and release it, making sure it clears the lead as it is removed from the bracket **(see illustration)**.

6 Use a pair of needlenose pliers to lift the pick-up coil assembly from the distributor **(see illustration)**.

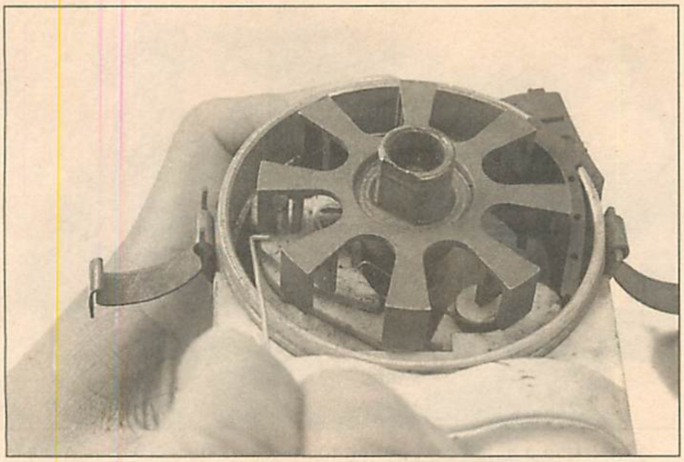
7 To install the pick-up coil, place it on the bracket, making sure the sensor core is centered properly between the trigger wheel arms. Mea-



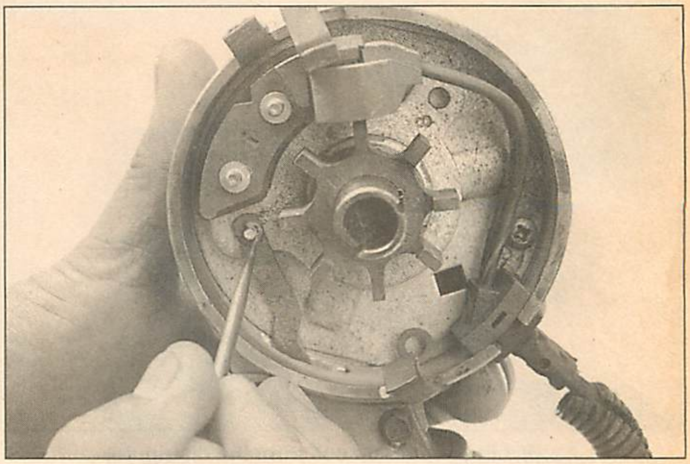
12.7a Place the trigger wheel on the distributor shaft and measure the distance from the shaft to the inner arm of the trigger wheel



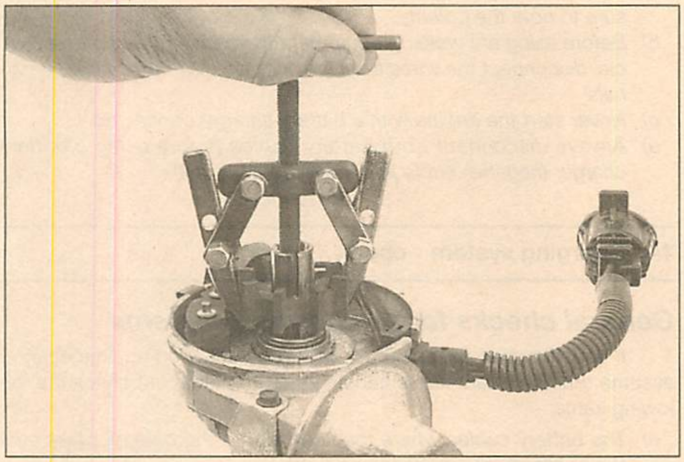
12.7b Take the previous measurement and add 1/16 inch to obtain the exact location of the sensor core



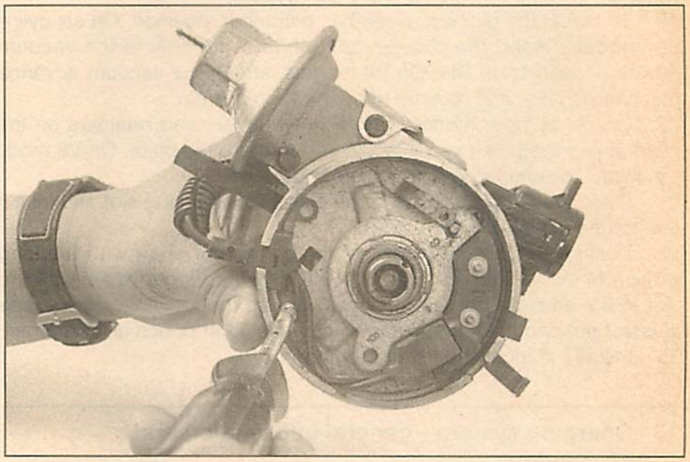
12.10 Use a 0.050-inch wire gauge to check the clearance between the trigger wheel and the pick-up coil sensor



12.14 Remove the clip and lift the vacuum advance lever from the pick-up coil (SSI system distributor)



12.15 Use a small puller to remove the trigger wheel from the distributor shaft



12.16 Remove the pick-up coil retaining screws from the base plate

sure the distance from the distributor shaft to the inside arm on the trigger wheel **(see illustration)**. Add 1/16 inch to this measurement and adjust the locating pin accordingly **(see illustration)**. Tighten the assembly screw to secure the position of the locating pin. The locating pin and screw assembly is used to center the pick-up coil assembly and sensor core on the distributor base plate.

8 Place the spring into position and route the leads around the spring pivot pin. Install the lead grommet in the distributor and make sure the leads are positioned so they will not contact the trigger wheel.

9 Set the trigger wheel in position and make sure that the sensor core is positioned in the center of the trigger wheel arms so they don't contact the sensor core.

10 Use a deep socket to press the trigger wheel into place and tap it into position. Bend a 0.050-inch wire (usually included with the new part) and check the trigger wheel-to-pick-up base clearance **(see illustration)**. The trigger wheel should just touch the gauge in the installed position. **Caution:** *If the proper clearance is not maintained the trigger wheel will immediately damage the pick-up coil sensor when the engine is started.*

11 Add five drops of light engine oil to the felt wick at the top of the yoke and install the dust shield, rotor and cap.

Solid State Ignition (SSI) system

Refer to illustrations 12.14, 12.15, 12.,16, 12.17, 12.18 and 12.22

12 Pick-up coil replacement can be accomplished with the distributor installed in the engine or removed, if necessary (see Section 9).

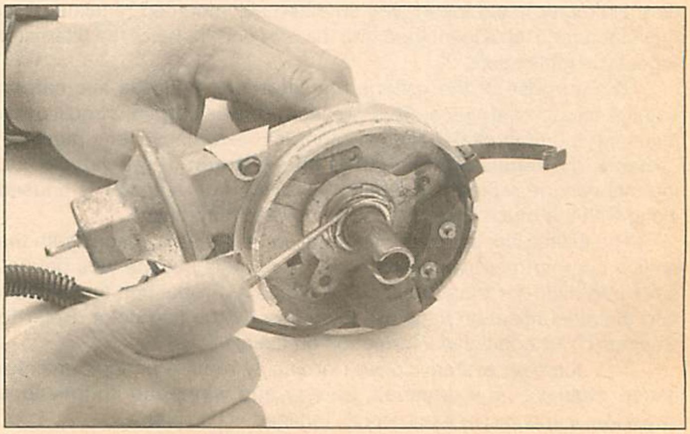
13 Remove the distributor cap and rotor.

14 Disconnect the vacuum advance lever from the pick-up coil assembly and position the lever aside **(see illustration)**.

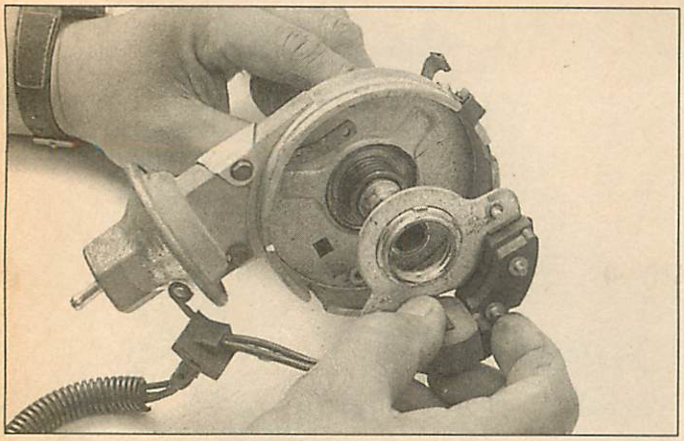
15 Remove the trigger wheel. This can be done with a small gear puller **(see illustration)** or by prying up on the trigger wheel with two screwdrivers. Remove the locating pin from the trigger wheel.

16 Remove the pick-up coil retaining screws from the base plate **(see illustration)**.

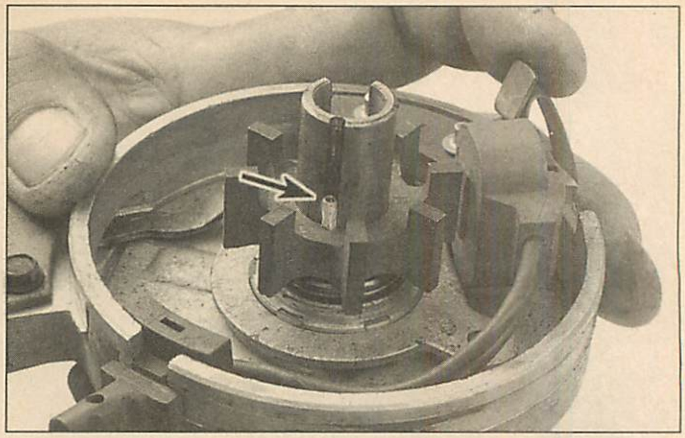
17 On V8 models, remove the snap-ring which retains the pick-up coil to the distributor shaft **(see illustration)**.



12.17 On V8 models, remove the snap-ring from the distributor shaft



12.18 Lift the pick-up coil from the distributor



12.22 Use a small drift punch to install the locating pin in the distributor shaft and trigger wheel groove (arrow)

18 Remove the harness tab ground screw and separate the pick-up assembly from the distributor **(see illustration).**

19 To install the pick-up assembly, place it in position. On six cylinder models, insert the pick-up coil pin into the hole in the vacuum advance mechanism link. On V8 models, attach the vacuum advance mechanism lever and retainer to the pick-up coil pin.

20 On six cylinder models, install the washers and retainers on the pivot pin so the pick-up coil is secured to the base plate. On V8 models, install the snap-ring on the distributor shaft.

21 Place the wiring harness in the distributor housing slot and install the ground screw through the tab.

22 Position the trigger wheel on the distributor shaft with the long portion of the teeth facing up. After aligning the trigger wheel with the slot in the shaft, insert the retaining pin into the locating groove **(see illustration)** and tap it into place with a small drift punch and hammer.

23 Install the rotor and distributor cap.

13 Charging system - general information and precautions

The charging system includes the alternator, either an internal or an external voltage regulator, a charge indicator or warning light, the battery, a fusible link and the wiring between all the components. The charging system supplies electrical power for the ignition system, the lights, the accessories, etc. The alternator is driven by a drivebelt at the front of the engine.

1972 models are equipped with a Motorola alternator with an externally mounted voltage regulator. 1973 and later models are equipped with either a Delco or Motorcraft alternator. The Delco alternator is equipped with an internal voltage regulator while the Motorcraft alternator is equipped with an externally mounted regulator. The manufacturer's label is molded into the rear end frame of the alternator for easy identification.

The purpose of the voltage regulator is to limit the alternator's voltage to a preset value. This prevents power surges, circuit overloads, etc., during peak voltage output. On external voltage regulator systems, the regulator is mounted on the apron of the vehicle. On internal voltage regulator systems, a solid state regulator is housed along with the brush assembly inside the alternator itself.

The fusible link is a short length of insulated wire integral with the engine compartment wiring harness. The link is several wire gauges smaller in diameter than the circuit it protects. Production fusible links and their identification flags are identified by the flag color. Refer to Chapter 12 for additional information on fusible links.

The charging system doesn't ordinarily require periodic maintenance. However, the drivebelt, battery and wires and connections should be inspected at the intervals outlined in Chapter 1.

Be very careful when making electrical circuit connections to a vehicle equipped with an alternator and note the following:

- *a) When reconnecting wires to the alternator from the battery, be sure to note the polarity.*
- *b) Before using arc welding equipment to repair any part of the vehicle, disconnect the wires from the alternator and the battery terminals.*
- *c) Never start the engine with a battery charger connected.*
- *d) Always disconnect both battery cables before using a battery charger (negative cable first, positive cable last).*

14 Charging system - check

General checks for all charging systems

1 If a malfunction occurs in the charging circuit, do not immediately assume that the alternator is causing the problem. First check the following items:

- *a) The battery cables where they connect to the battery. Make sure the connections are clean and tight.*
- *b) The battery electrolyte specific gravity. If it is low, charge the battery.*
- *c) Check the external alternator wiring and connections.*
- *d) Check the drivebelt condition and tension* (see Chapter 1).
- *e) Check the alternator mounting bolts for tightness.*
- *f) Run the engine and check the alternator for abnormal noise.*

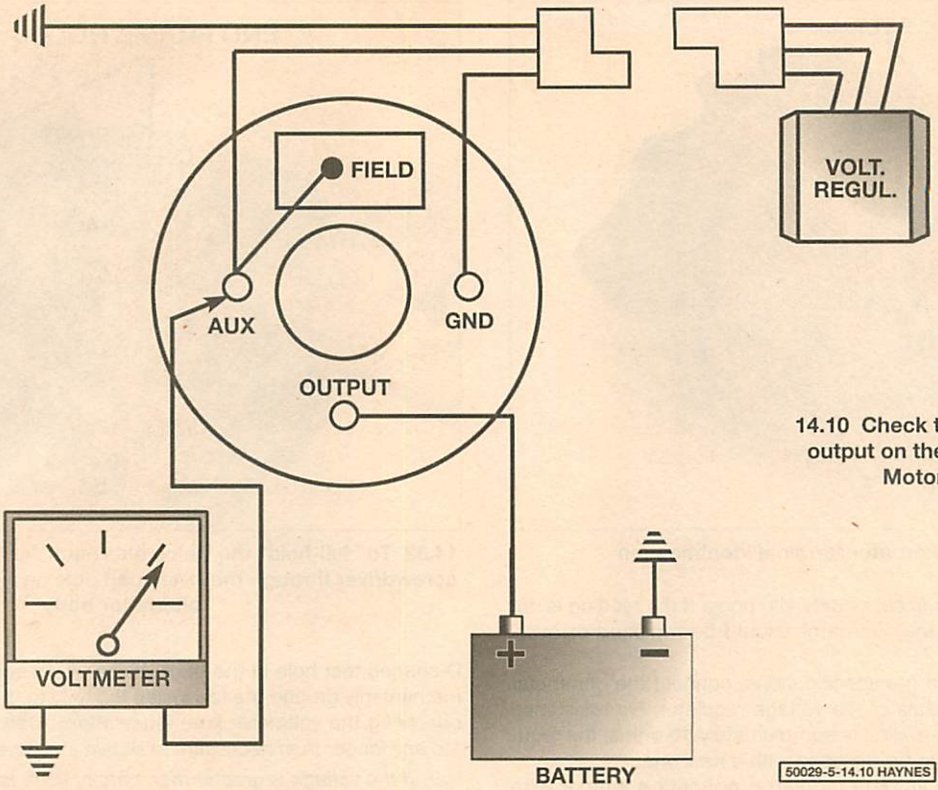
2 Using a voltmeter, check the battery voltage with the engine off. It should be approximately 12-volts.

3 Start the engine and check the battery voltage again. It should now be approximately 13 to 15-volts.

4 If the indicated voltage reading is more than the specified charging voltage, the system is overcharging. Usually, the cause of an overcharging condition is a defective voltage regulator. If the indicated voltage is less than battery voltage, the problem may be the rectifier assembly, brush assembly, the stator or rotor assemblies.

5 Due to the special equipment necessary to test or service the alternator, it is recommended that if a fault is suspected, the home mechanic check the charging system with the proper equipment. The following procedures will aid the home mechanic with diagnosis and repair of simple charging system problems. In the event the charging system requires more in depth diagnosis and repair, take the vehicle to a qualified auto electric shop or dealer service department.

6 Some models are equipped with an ammeter on the instrument panel that indicates charge or discharge condition. With all electrical equipment switched ON, and the engine idling, the gauge needle may show a discharge condition. At fast idle or normal driving speeds the needle should stay on the charge side of the gauge, with the charged state of the battery determining just how far over (the lower the battery state of charge, the farther the needle should swing toward the charge side).



14.10 Check the alternator charging output on the AUX terminal on the Motorola alternator

7 Some models are equipped with a voltmeter on the instrument panel that indicates battery voltage with the key on and engine off, and alternator output when the engine is running.
8 The charge light on the instrument panel illuminates with the key on and engine not running, and should go out after the engine starts running.
9 If the gauge does not show a charge when it should or the alternator light (if equipped) remains on, there is a fault in the system. Before inspecting the brushes or replacing the alternator, the battery condition, alternator belt tension and electrical cable connections should be checked.

Motorola alternator

Refer to illustration 14.10

10 Disconnect the field connector and connect a jumper wire between the auxiliary and field terminals **(see illustration)**. Connect a voltmeter to the auxiliary terminal, start the engine and allow it to idle.
11 If the output is more than 13 volts but less than 15 volts, the alternator is operating properly.
12 If the output is 12 volts or less, the alternator should be replaced with a new or rebuilt unit.
13 If the voltage rises to 15 or 16 volts, the regulator is faulty and should be replaced with a new one (see Section 17).

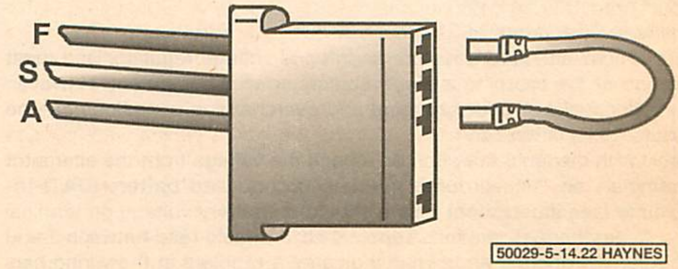
Motorcraft alternator

14 Connect a voltmeter to the battery with the voltmeter positive lead on the positive post and the negative lead on the negative post.
15 Apply a load to the system by turning on the headlights and the heater or air conditioner blower motor.
16 Start the engine and slowly increase the speed to approximately 2,000 rpm.
17 When the voltage stabilizes, compare the reading to the alternator output voltage in this Chapter's Specifications. If the reading is within the specified range, the alternator (and charging system) is operating properly. If the reading is high, the system is overcharging and if it is low, it is undercharging. Proceed with the appropriate checks to verify the conditions and locate the fault.

Undercharging

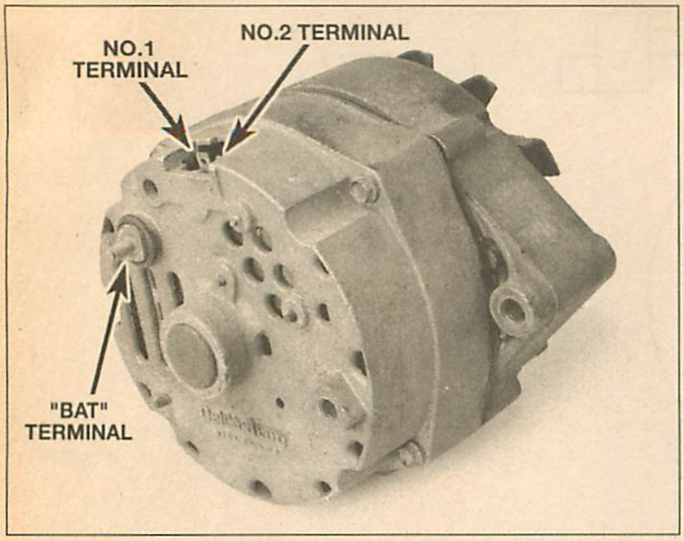
Refer to illustration 14.22

18 If the system is undercharging, turn off the engine and accessories and note the battery voltage at the battery terminals using a voltmeter.
19 Start the engine, turn on all the electrical accessories and slowly increase the engine speed to approximately 2,000 rpm.
20 Note the voltage reading and compare it to the one taken in Step 17. If the reading has increased at least 0.5 volt, the charging system is operating properly. If the increase is less than 0.5 volt, the system is undercharging.
21 If the test indicates undercharging, turn the ignition switch on and check for battery voltage at the voltage regulator S terminal. If there is no voltage, or if it is less than that of the battery, check the yellow wire for an open circuit and for a faulty connection at the regulator or the starter solenoid. Refer to the wiring diagrams at the end of Chapter 12 for additional information.
22 If no fault is found, disconnect the voltage regulator wires and connect one lead of an ohmmeter to the F terminal and the other to a good ground **(see illustration)**. The ohmmeter should indicate 4 to 250 ohms. Less than 4 ohms indicates a short, while more than 250 ohms

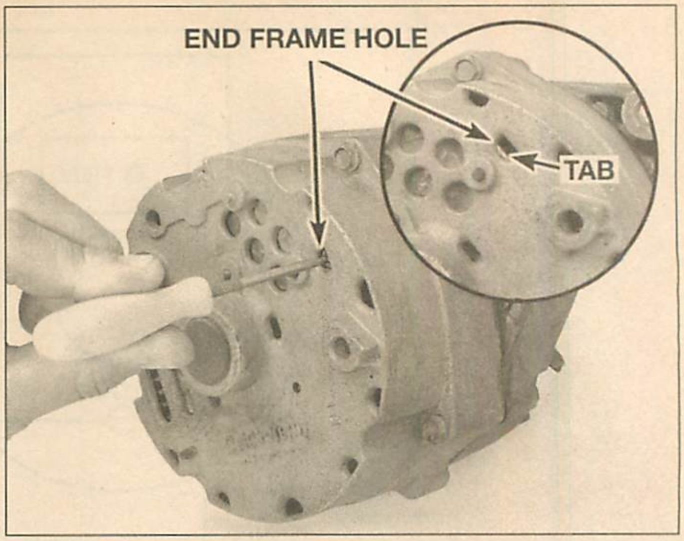


14.22 Motorcraft voltage regulator connector details

5



14.31 Delco alternator terminal identification



14.32 To "full-field" the Delco alternator for testing, insert a small screwdriver through the D-shaped hole and ground the tab to the alternator body

indicates an open, dirty brushes, or dirty slip rings. If the reading is not within the specifications, the alternator should be replaced or overhauled.

23 If the reading is within the specifications, connect the ohmmeter between the I and F terminals of the voltage regulator. No resistance should be indicated. If the reading is approximately 10 ohms, the regulator is damaged and should be replaced with a new one.

24 To further check the voltage regulator, connect a jumper wire between the A and F terminals of the plug **(see illustration 14.22)**, then repeat the tests in Steps 15 through 17. If undercharging is indicated, replace the voltage regulator.

25 If the output is within the specifications, disconnect the jumper wire, leaving the voltage regulator connector unplugged. Disconnect the wiring harness from the alternator field (FLD) terminal and connect a jumper wire between the battery (BAT) and FLD terminals.

26 Repeat the tests in Steps 18 through 20. If the output is within the specifications, there is a fault in the wiring harness and it should be replaced. If the output is low, there is a defect in the alternator and it should be replaced or overhauled.

Overcharging

27 Connect a voltmeter positive lead to the positive battery post and the negative lead to the negative post. With all electrical accessories turned off, note the voltmeter reading.

28 Start the engine and slowly increase the speed to approximately 1,500 rpm. The voltage should increase no more than 2 volts over the battery voltage noted in the previous Step. If it increases more than 2 volts, an overcharging condition is indicated.

29 Disconnect the voltage regulator connector and repeat the test. If the voltage is within the specified range, the regulator is faulty and must be replaced with a new one. If the voltage reading is still high, the alternator wiring harness has a short and should be replaced.

Delco alternator

Refer to illustrations 14.31 and 14.32

30 These alternators feature an integral voltage regulator and most testing of the charging system requires special equipment. However, simple checks of undercharging and overcharging conditions can be made with a voltmeter.

31 With the ignition switch on, check the voltage from the alternator terminals no. 1-to-ground, no. 2-to-ground and battery (BAT)-to-ground **(see illustration)**. There should be battery voltage on terminal no. 2 and the BAT terminal. Terminal no. 1 should read between 2 and 4 volts. An open in any circuit indicates a problem in the wiring harness. If the terminal no. 2 circuit is not open and an obvious overcharge condition exists, there is a fault in the alternator.

32 Connect a voltmeter to the BAT terminal and ground. Locate the D-shaped test hole in the back of the alternator. Start the engine and momentarily ground the tab inside the hole to the alternator body while observing the voltmeter **(see illustration)**. **Caution:** *Don't ground the tab any longer than necessary to obtain a voltmeter reading.*

a) If the voltage is greater than battery voltage and an undercharging condition exists, replace the voltage regulator.

b) If the voltage is battery voltage or lower, overhaul or replace the alternator.

15 Alternator - removal and installation

Refer to illustrations 15.3

1 Detach the cable from the negative terminal of the battery.

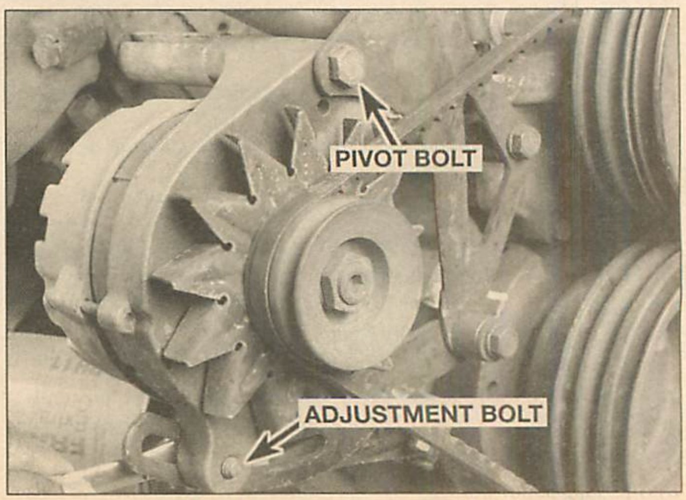
2 Disconnect the electrical connectors from the alternator.

3 Loosen the alternator bolts **(see illustration)** and detach the drivebelt.

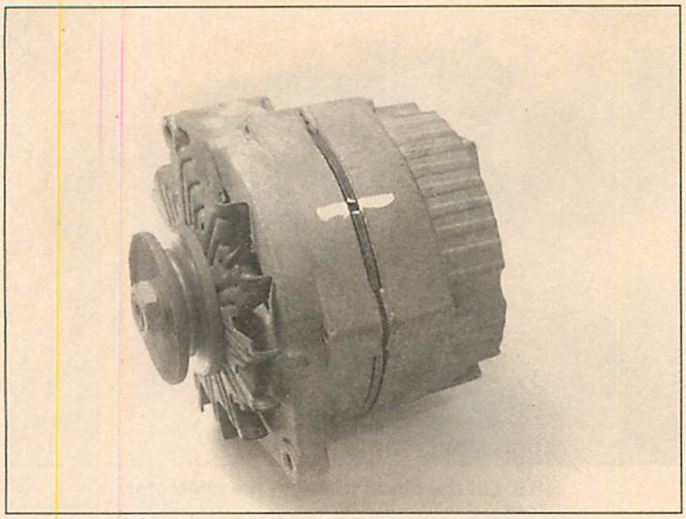
4 Remove the adjustment and pivot bolts and separate the alternator from the engine.

5 Installation is the reverse of removal.

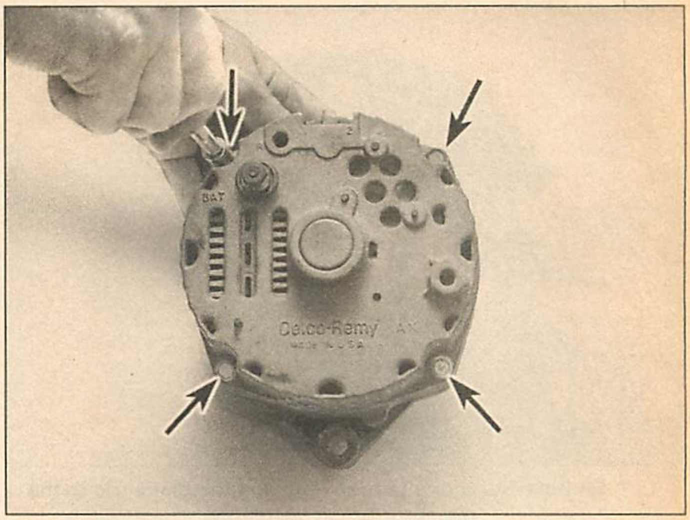
6 After the alternator is installed, adjust the drivebelt tension (see Chapter 1).



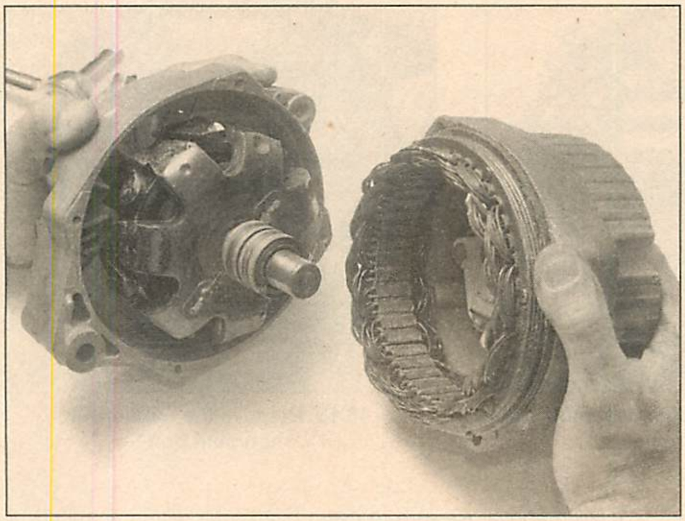
15.3 Alternator mounting details



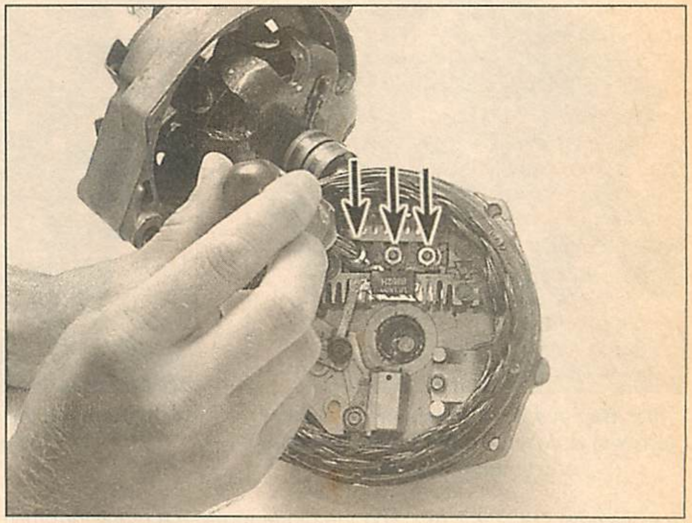
16.2 Paint an alignment mark on the alternator body between each end frame



16.3 Remove the bolts (arrows) securing the rear end frame to the drive end frame



16.4 Separate the two end frames



16.5 Remove the three nuts (arrows) retaining the stator windings to the rectifier bridge

16 Alternator components - check and replacement

Note: *Internal replacement parts for alternators may not be readily available. Check the availability of replacement parts before proceeding.*

Delco alternator

Refer to illustrations 16.2, 16.3, 16.4, 16.5, 16.6, 16.7, 16.8, 16.9, 16.10, 16.13, 16.14a, 16.14b, 16.14c, 16.14e, 16.15a, 16.15b, 16.16a, 16.16b, 16.17a, 16.17b and 16.17c

1 Remove the alternator and (see Section 15) and place it on a clean workbench.

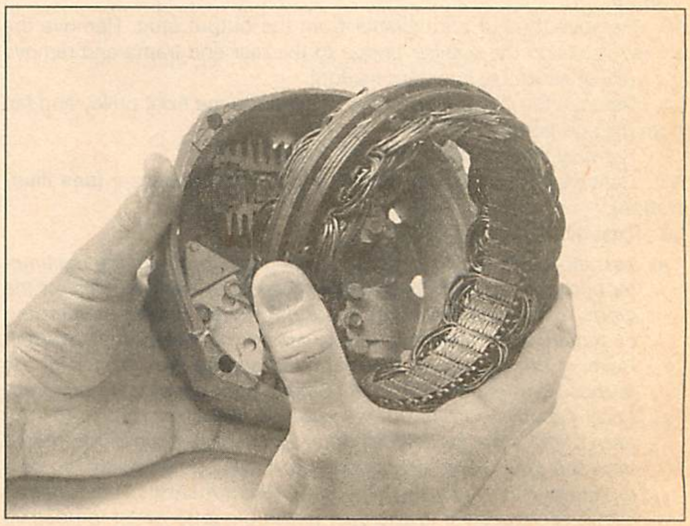
2 Paint an alignment mark on each side of the end frame to insure the correct assembly **(see illustration).**

3 Remove the four bolts that secure the two end frames together **(see illustration).**

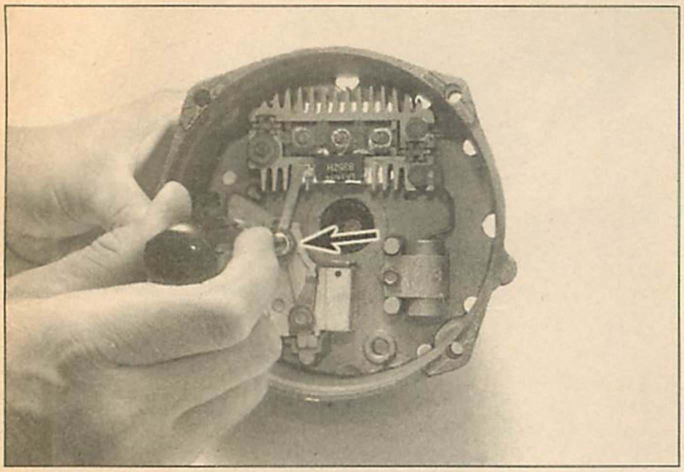
4 Separate the two end frames. The rotor will remain in the drive end frame while the stator will remain in the rear end frame **(see illustration).**

5 Remove the three nuts retaining the stator windings to the rectifier bridge **(see illustration).**

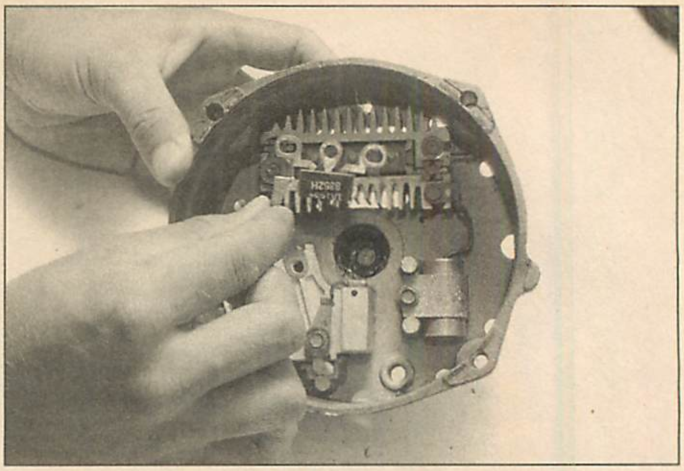
6 Remove the stator from the end frame **(see illustration).**



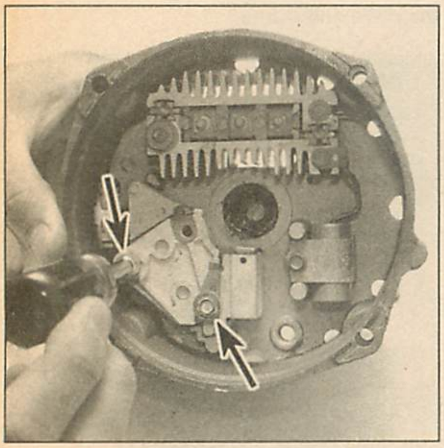
16.6 Separate the stator from the end frame



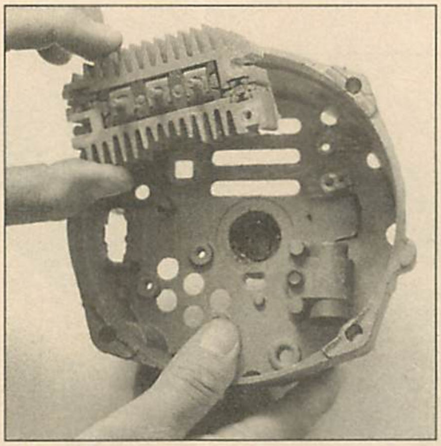
16.7 Remove the screw (arrow) retaining the diode trio to the regulator/brush assembly



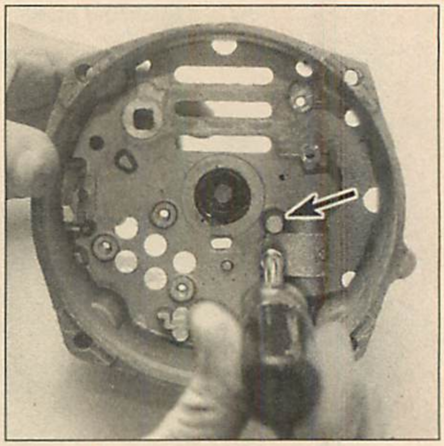
16.8 Lift the diode trio from the alternator



16.9 Remove the two remaining screws (arrows) and remove the brush assembly and voltage regulator



16.10 Remove the rectifier assembly from the end frame



16.13 Remove the condenser mounting bolt

7 Remove the screw retaining the diode trio to the regulator/brush assembly **(see illustration)**.

8 Lift the diode trio from the alternator assembly **(see illustration)**.

9 Remove the brush assembly and the voltage regulator **(see illustration)**.

10 Remove the nut and washer from the output stud. Remove the screws retaining the rectifier bridge to the rear end frame and remove the rectifier assembly **(see illustration)**.

11 Remove the nut and washer and separate the front pulley and fan from the end frame.

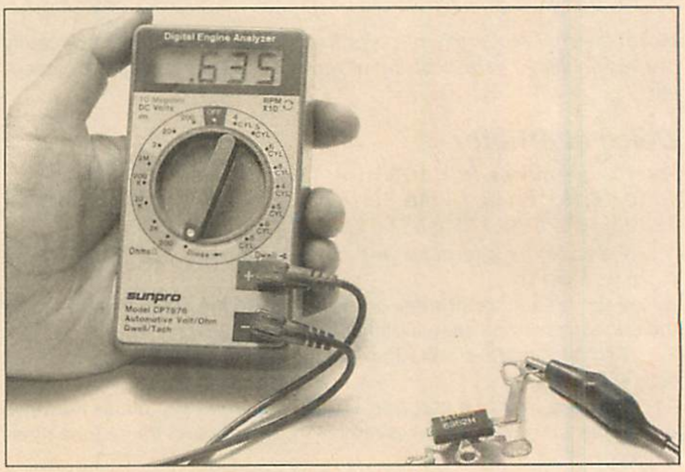
12 Remove the rotor from the end frame.

13 Remove the condenser mounting bolt and condenser **(see illustration)**.

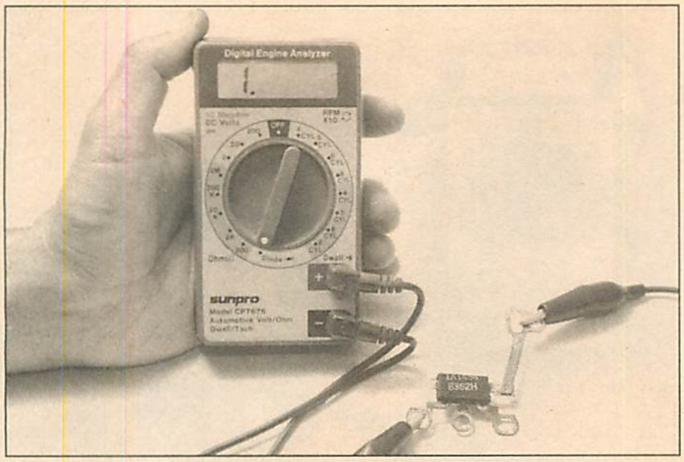
14 Test the diodes as follows:

a) *Test the diode trio by installing the negative probe of the multimeter onto the leg and the positive probe onto each terminal of the diode trio. Using the diode testing function on the multimeter, continuity should exist in one position only* **(see illustrations)**. *Reverse the polarity of the test by changing the position of the probes. Continuity should NOT exist. This checks the unidirectional capability of the operating diode. Next, repeat this test for each of the other two diodes (total six checks). Each diode should have the exact same characteristics. It will be necessary to use a multimeter that includes a diode check function. This function allows slight current application to the diode to assist in opening the voltage gate.*

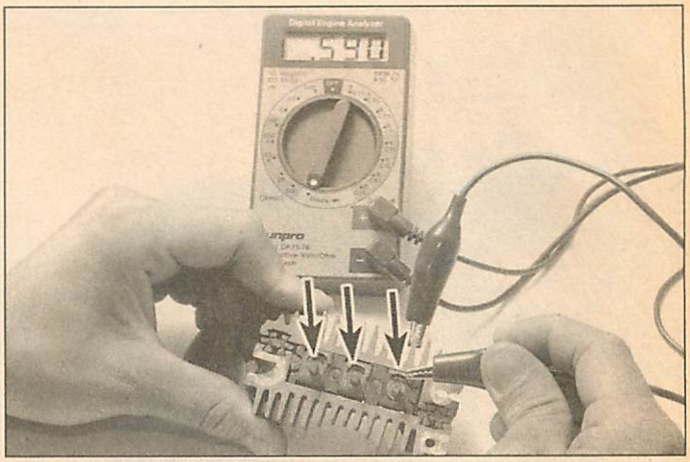
b) *To test the rectifier assembly, follow the exact same procedure as detailed above. Be sure to use a multimeter with a diode check function. Use a screwdriver to lift the tabs off the contact surface to separate the negative and positive diode rectifiers. Make sure the tabs do not touch the posts, the heat sinks or each other. Install the multimeter probes on the tabs and the cooling fins on*



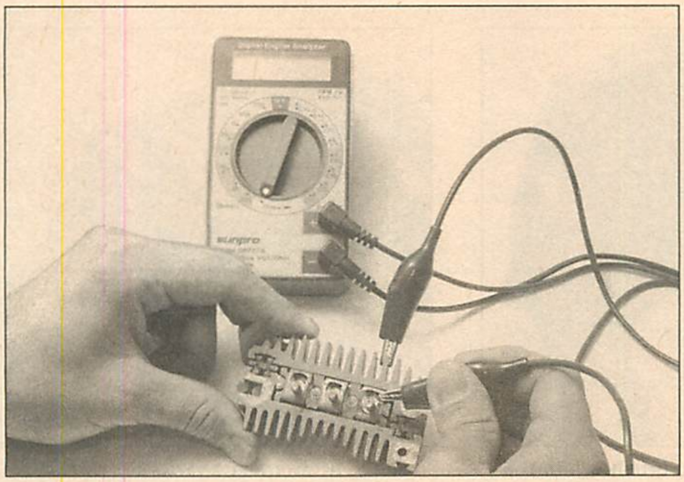
16.14a To test the diode trio, install the negative probe on the extension leg and the positive probe onto each diode (in turn). Continuity should exist through each diode



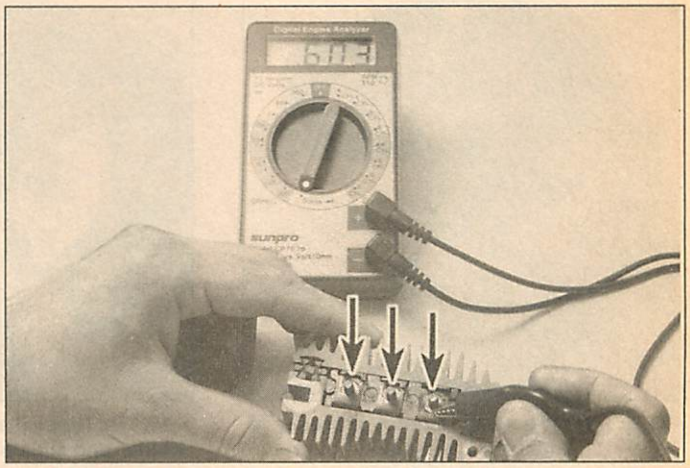
16.14b Reverse the probes to check the continuity in the other direction. The diode should allow continuity in one direction only



16.14c To test the three diodes (arrows) on the top side of the rectifier bridge, install the positive probe onto the cooling fin and touch the negative probe to each metal tab. Continuity should exist through each diode



16.14d Reverse the probes to check the continuity in the other direction. Continuity should NOT exist. The rectifier bridge diodes should allow continuity in one direction only

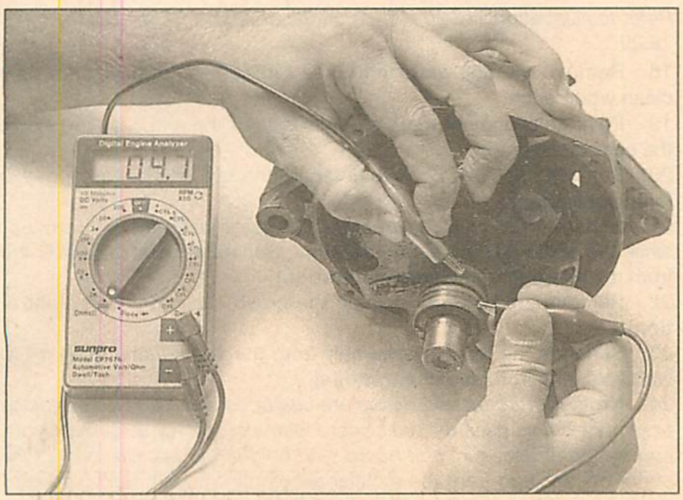


16.14e Test the three diodes (arrows) on the bottom row in the same manner

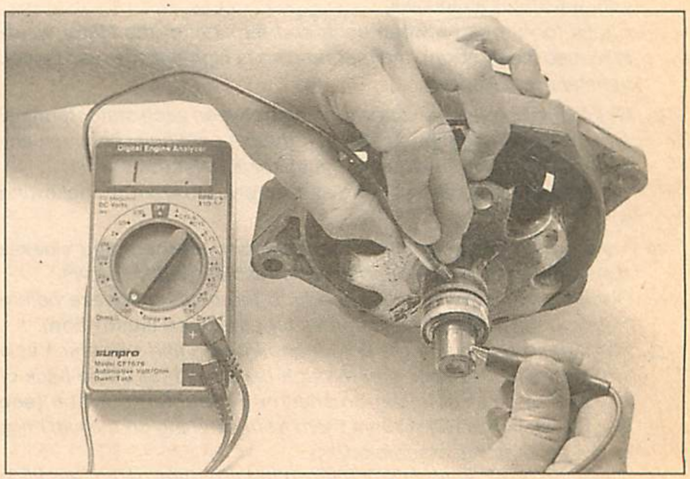
one side of the rectifier, then the other, to obtain results **(see illustrations)**. *If the test results are incorrect for any one of the diodes, replace the complete unit.*

15 Test the rotor as follows:

a) *Check for an opening between the two slip rings* **(see illustration)**. *There should be 1 to 5 ohms resistance between the slip rings.*

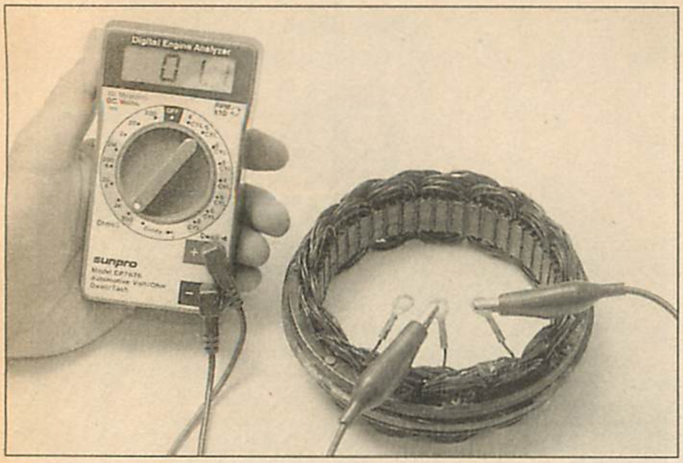


16.15a To test the rotor, check for an open between the two slip rings. There should be 1 to 5 ohms resistance

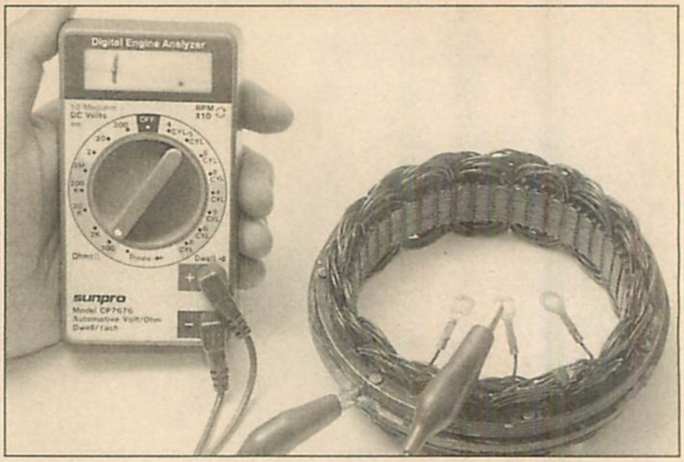


16.15b Check the rotor slips rings and the rotor for possible grounds. Continuity should NOT exist between the slip ring and the shaft or frame

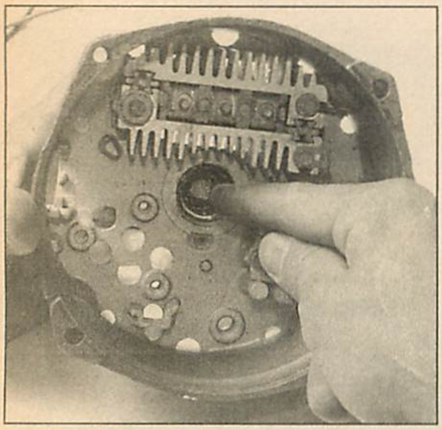
5



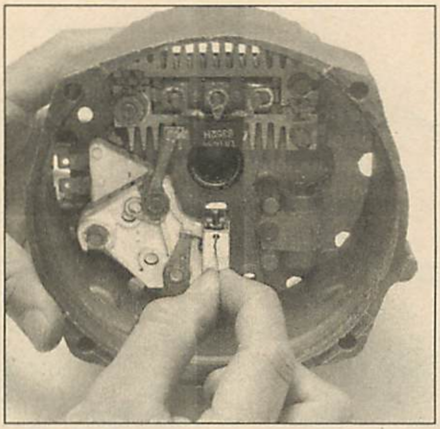
16.16a To test the stator, check for opens between each end terminal of the stator windings. Continuity should exist between all terminals



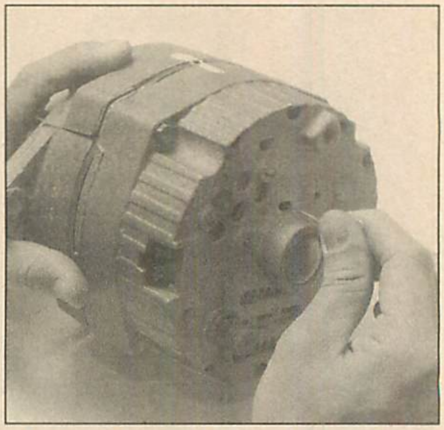
16.16b Also, check for a grounded stator winding to the end frame. Continuity should not exist between any terminal and the frame



16.17a Apply a small amount of grease to the bearing surface



16.17b Press the two brushes into the holder and slide a paper clip through the eyelet to keep the brushes in the holder assembly



16.17c After the alternator is completely assembled, remove the wire or paper clip to release the brushes

b) *Check for grounds between each slip ring and the rotor* **(see illustration)**. *There should be no continuity (infinite resistance) between the rotor and either slip ring. If the rotor fails either test, or if the slip rings are excessively worn, the rotor is defective.*

16 Test the stator as follows:

a) *Check for opens between each end terminal of the stator windings* **(see illustration)**. *If either reading is high (infinite resistance), the stator is defective.*

b) *Check for a grounded stator winding between each stator terminal and the frame* **(see illustration)**. *If there's continuity between any stator winding and the frame, the stator is defective.*

17 Reassembly is a reversal of disassembly. Observe the following points:

a) *Take great care to position the insulating washers and sleeves correctly on the rectifier bridge and brush assembly screws.*

b) *Place a small amount of grease onto the bearing surface before installing the alternator end frames together* **(see illustration)**.

c) *Press the brushes into the holder and insert a stiff wire (such as a straightened-out paper clip) through the small hole in the back of the alternator to hold the brushes in a retracted position* **(see illustration)**. *This will prevent them from catching on the slip rings as the alternator is assembled.*

d) *Clean the brush contact surfaces on the slip rings before installing the end frame.*

e) *Make sure that the marks on the rear end frame and drive end frame (which were made before disassembly) are in alignment.*

f) *Tighten the pulley nut securely.*

g) *Remove the wire or paper clip from the end frame to permit the brushes to release onto the slip rings* **(see illustration)**.

Motorcraft alternator

Refer to illustrations 16.20, 16.21, 16.22, 16.23a, 16.23b, 16.25 and 16.29

18 Remove the alternator and (see Section 15) and place it on a clean workbench.

19 Paint an alignment mark on each side of the end frame to insure the correct assembly.

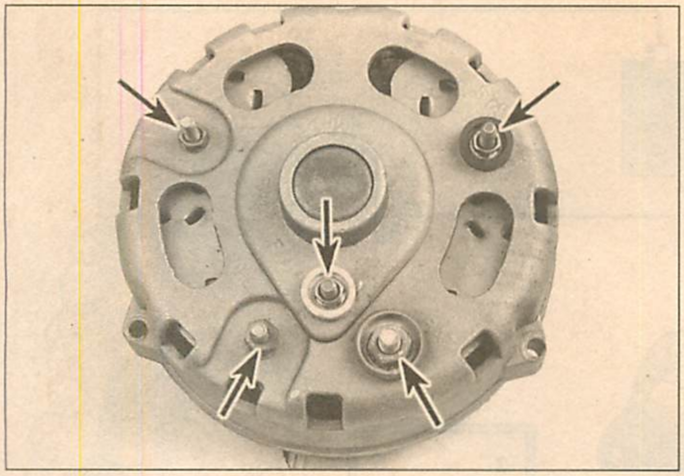
20 Remove the three bolts that secure the two end frames together **(see illustration)**.

21 Separate the two end frames. The rotor will remain in one half while the stator will remain in the other. Separate the stator assembly from the rear end frame **(see illustration)**.

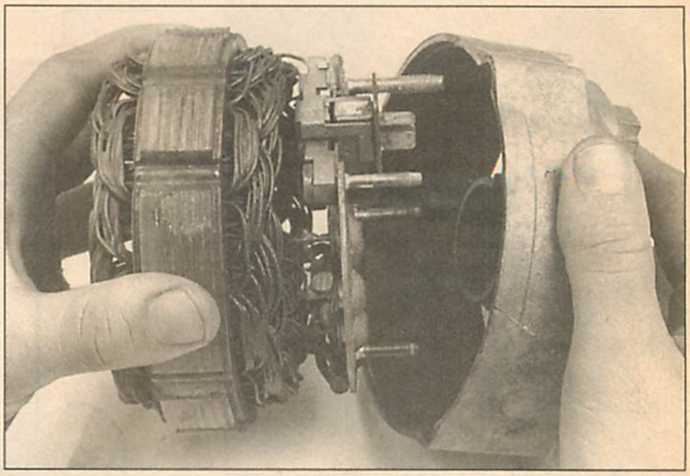
22 Remove the screws retaining the brush assembly **(see illustration)**.

23 Separate the rectifier assembly from the stator leads using a 100 watt soldering iron **(see illustrations)**.

24 **Note:** *Motorcraft alternators are equipped with two types of diode assemblies. One uses a circuit board with exposed or separate diodes and the other uses a circuit board with built-in diodes.* Disconnect the stator neutral lead from the rectifier assembly with exposed diodes by turning the stator terminal clockwise 1/4 turn to unlock. Disconnect the stator neutral lead from the rectifier assembly with built-in diodes by pressing stator terminal straight out of the rectifier assembly.

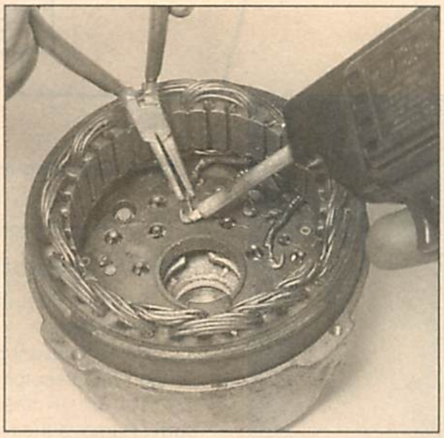


16.20 Remove the three bolts from the rear end frame (Motorcraft alternator shown)

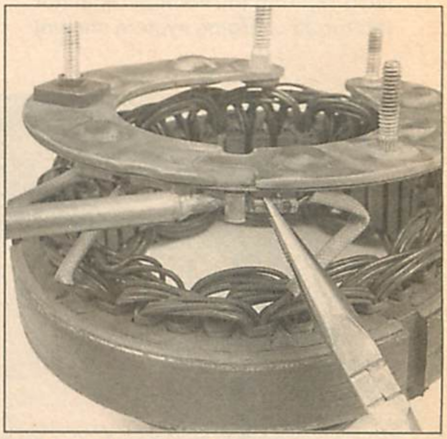


16.21 Separate the stator assembly from the rear end frame

16.22 Remove the brush holder mounting screws (arrows)



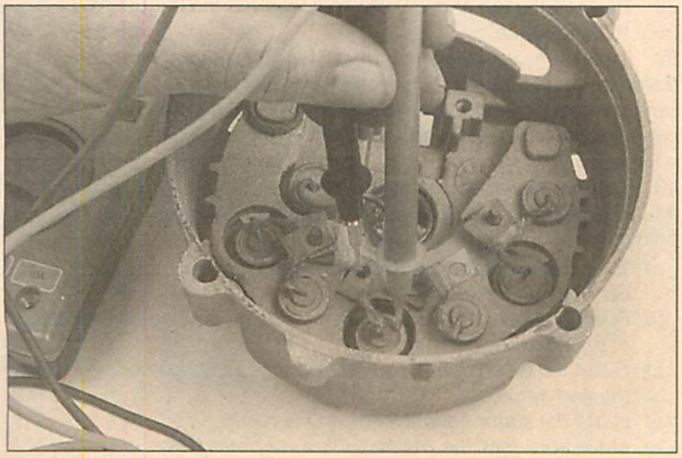
16.23a Unsolder the rectifier leads from the stator



16.23b Unsolder the rectifier assembly from the stator after removing the stator from the end frame

25 Lift the diode assembly from the alternator.

a) *If equipped with exposed diodes, test the diodes by connecting an ohmmeter between each diode terminal and the diode case, then reverse the ohmmeter leads. There should be continuity in one way but not the other. If the readings are the same, replace the diode.*



16.25 On models with exposed diodes, test the diodes by connecting an ohmmeter between the diode terminal and the diode case - continuity should exist one way but not the other

b) *If equipped with built-in diodes, have them tested at an alternator repair shop or dealer service department.*

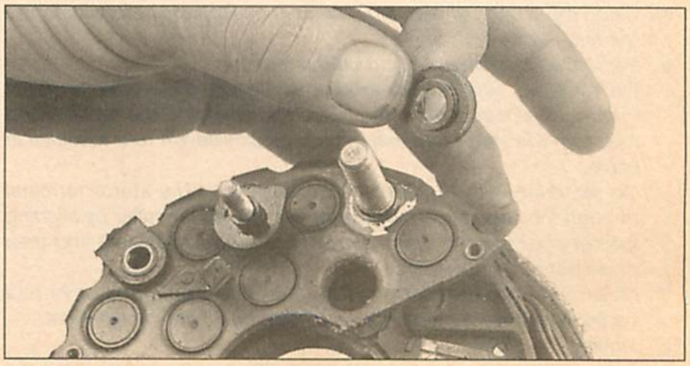
26 Remove the nut and washer and separate the front pulley and fan from the end frame.

27 Test the rotor by referring to Step 15.

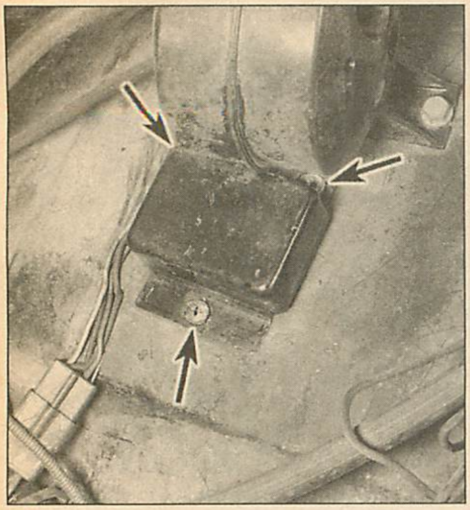
28 Test the stator by referring to Step 16.

29 Reassembly is a reversal of disassembly. Observe the following points:

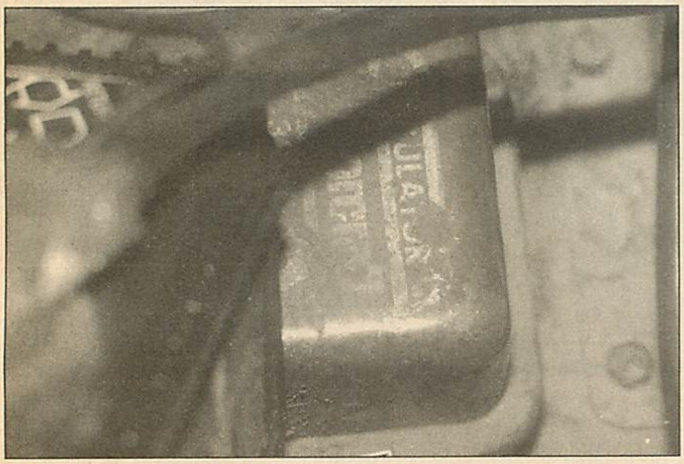
a) *Take great care to position the insulating washers and sleeves correctly on the rectifier bridge and brush assembly screws* **(see illustration)**.



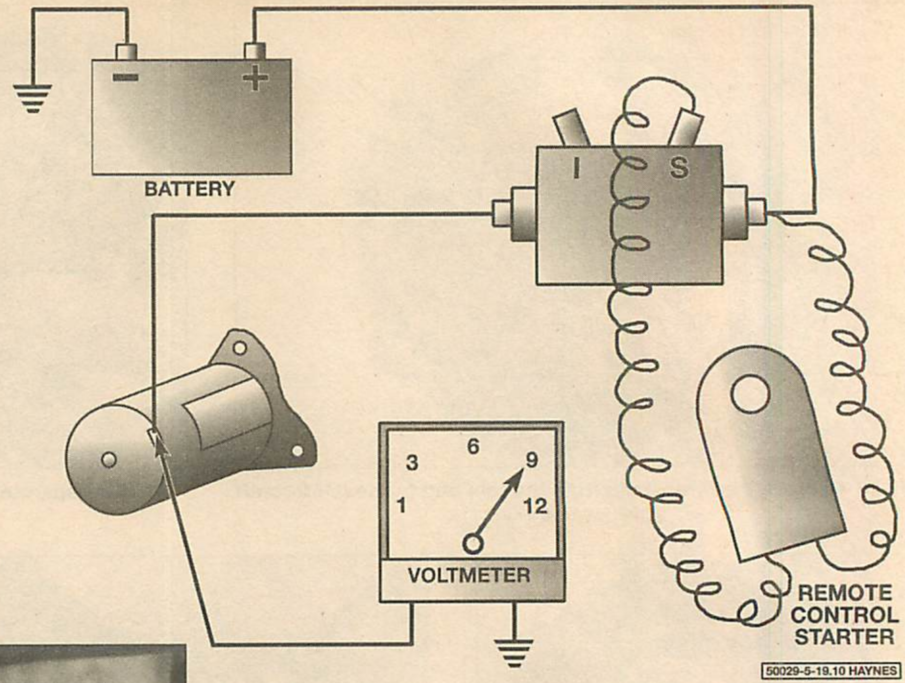
16.29 Install the insulating washers on the rectifier screws



17.2a Remove the mounting screws (arrows) from the voltage regulator (Motorola charging system shown)



17.2b The voltage regulator is mounted directly behind the battery, if equipped with a Motorcraft charging system



19.10 Cranking circuit check for the relay type starting system (1972 through 1988 models)

- b) *Place a small amount of grease onto the bearing surface before installing the alternator halves together.*
- c) *Press the brushes into the holder and insert a stiff wire (such as a straightened-out paper clip) into the brush holder assembly and position the brush holder assembly in the end frame. Be sure a small section of the paper clip extends through the opening at the back of the alternator so that the paper clip can be removed after the alternator is assembled.*
- d) *Clean the brush contact surfaces on the slip rings before installing the end frame.*
- e) *Install the stator neutral lead on the rectifier:*
  On rectifiers with exposed diodes, insert the stator terminal through the neutral lead, the dished washer and the rectifier and then turn the stator terminal counterclockwise 1/4 turn to lock it in place.
  On rectifiers with the built-in diodes, insert the stator terminal through the neutral lead, insulating washer and rectifier by aligning the serrations of the stator terminal to the rectifier hole and then press terminal into rectifier.
- f) *Make sure that the marks on the rear end frame and drive end frame (which were made before disassembly) are in alignment.*
- g) *Tighten the pulley nut securely.*
- h) *Remove the wire or paper clip from the end frame to permit the brushes to release onto the slip rings.*

Motorola alternator

30 Remove the alternator and (see Section 15) and place it on a clean workbench.

31 Paint an alignment mark on each side of the end frame to insure the correct assembly.

32 The brush assembly is mounted on the rear of the alternator body. Remove the mounting screws and insulating washers and separate the brush assembly from the alternator.

33 If the brushes appear to be worn or oil soaked, replace them with new parts.

34 Remove the four bolts that secure the two end frames together.

35 Separate the two end frames. The rotor will remain in one half while the stator will remain in the other half.

36 Separate the rectifier assembly from the stator leads by removing the four nuts and insulating washers from the positive plate studs.

37 Lift the diode assembly from the alternator assembly. Test the diode assembly as shown in Step 25.

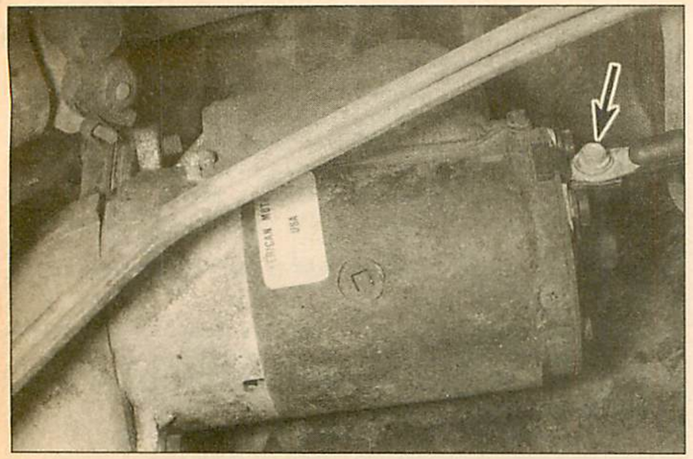
38 Remove the nut and washer and separate the front pulley and fan from the end frame.

39 Test the rotor by referring to Step 15. **Note:** *The rotor can be tested in the end frame. If the rotor must be removed, it will be necessary to remove the lock washer through the opening in the front housing near the rotor shaft and end frame using a special tool (Jeep tool no. J-21157).*

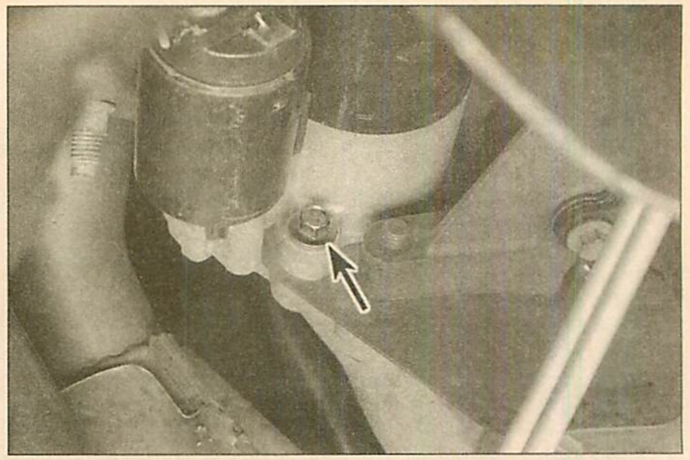
40 Test the stator by referring to Step 16.

41 Reassembly is a reversal of disassembly. Observe the following points:

- a) *Take great care to position the insulating washers and sleeves correctly on the rectifier bridge.*
- b) *Place a small amount of grease onto the bearing surface before assembling the alternator.*
- c) *Clean the brush contact surfaces on the slip rings before installing the end frame.*
- d) *Install the stator neutral leads on the rectifier.*
- e) *Make sure that the marks on the rear end frame and drive end frame (which were made before disassembly) are in alignment.*
- f) *Tighten the pulley nut securely.*
- g) *Install the brush holder onto the rear of the alternator.*



20.3 Remove the starter terminal connector



20.10 Remove the starter/solenoid assembly bolts (arrow) and separate the assembly from the transmission bellhousing. The top bolts are hidden from view

d) 0.3-volt with the voltmeter negative lead connected to the negative terminal of the battery and the positive lead connected to the engine ground.

20 Starter motor - removal and installation

1972 through 1988 models

Refer to illustration 20.3

1 Detach the cable from the negative terminal of the battery.
2 Raise the vehicle and support it securely on jackstands.
3 Disconnect the large cable from the terminal on the starter motor **(see illustration)**.
4 Remove the starter motor mounting bolts and detach the starter from the engine.
5 If necessary, turn the wheels to one side to provide removal access.
6 Installation is the reverse of removal.

1989 through 1991 models

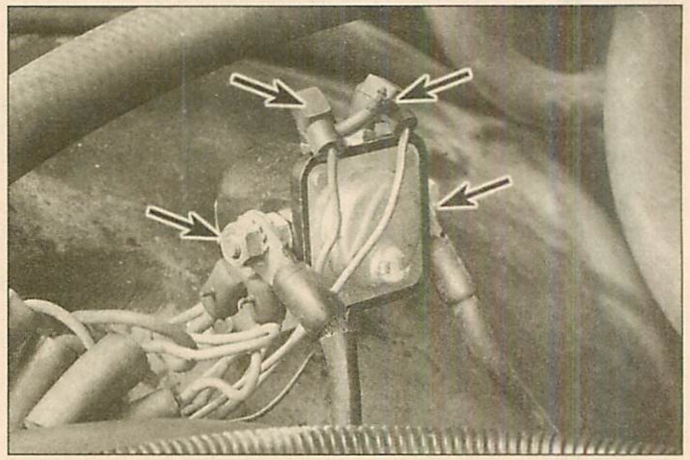
Refer to illustration 20.10

7 Detach the cable from the negative terminal of the battery.
8 Raise the vehicle and support it securely on jackstands.
9 Disconnect the large cable from the terminal on the starter motor and the solenoid terminal connections.
10 Remove the starter motor mounting bolts **(see illustration)** and detach the starter from the engine.
11 If necessary, turn the wheels to one side to provide removal access.
12 Installation is the reverse of removal.

21 Starter relay (1972 through 1988 models) - removal and installation

Refer to illustration 21.2

1 Detach the cable from the negative terminal of the battery.
2 Label the wires and the terminals then disconnect the Neutral safety switch wire, the battery cable, the fusible link and the starter cable from the relay terminals **(see illustration)**.



21.2 To remove the starter relay, detach the neutral safety switch wire, the fusible link, the battery positive lead and the starter motor leads (arrows), then remove the relay mounting bracket bolts

3 Remove the mounting bolts and detach the relay.
4 Installation is the reverse of removal.

22 Starter solenoid (1989 through 1991 models) - removal and installation

1 Detach the cable from the negative terminal of the battery.
2 Remove the starter/solenoid assembly from the vehicle (see Section 20).
3 Remove the solenoid terminal nut and disconnect the brush holder connecting wire.
4 Remove the solenoid screws and remove the starter solenoid and plunger.
5 Installation is the reverse of removal.

17 External voltage regulator - replacement

Refer to illustration 17.2a and 17.2b

1 Detach the cable from the negative terminal of the battery.
2 Locate the voltage regulator in the engine compartment **(see illustrations)**.
3 If necessary, remove the battery or air cleaner duct to gain access to the voltage regulator.
4 Disconnect the electrical connector from the voltage regulator.
5 Remove the regulator mounting bolts.
6 Remove the regulator.
7 Installation is the reverse of removal.

18 Starting system - general information and precautions

1 The function of the starting system is to turn the engine over fast enough to start. The system is composed of the starter motor, starter relay, battery, switch and connecting wires.
2 Turning the ignition key to the Start position actuates the starter relay through the starter control circuit. The starter relay then connects the battery to the starter. The battery supplies the electrical energy to the starter motor, which does the actual work of cranking the engine.
3 Early models (1972 through 1988) are equipped with an external relay mounted on the fenderwell along with a starter unit to engage the starter motor with the flywheel while later models (1989 through 1991) are equipped with a starter/solenoid assembly that is mounted to the transmission bellhousing.
4 All vehicles are equipped with a Neutral Start switch in the starter control circuit, which prevents operation of the starter unless the shift lever is in Neutral or Park.
5 Never operate the starter motor for more than 15 seconds at a time without pausing to allow it to cool for at least two minutes. Excessive cranking can cause overheating, which can seriously damage the starter.

19 Starter motor and circuit - check

Note: *Before diagnosing starter problems, make sure the battery is fully charged.*

General check

1 If the starter motor doesn't turn at all when the switch is operated, make sure the shift lever is in Neutral or Park.
2 Make sure the battery is charged and that all cables at the battery and starter relay/solenoid terminals are secure.
3 If the starter motor spins but the engine doesn't turn over, then the drive assembly in the starter motor is slipping and the starter motor must be replaced (see Section 20).
4 If, when the switch is actuated, the starter motor doesn't operate at all but the starter relay/solenoid operates (clicks), then the problem lies with either the battery, the starter relay/solenoid contacts or the starter motor connections.
5 If the starter relay/solenoid doesn't click when the ignition switch is actuated, either the starter relay/solenoid circuit is open or the relay/solenoid itself is defective. Check the starter relay/solenoid circuit (see the wiring diagrams at the end of Chapter 12) or replace the relay or solenoid (see Section 21).
6 To check the starter relay/solenoid circuit, remove the push-on connector from the relay/solenoid wire. Make sure that the connection is clean and secure and the relay bracket is grounded. If the connections are good, check the operation of the relay/solenoid with a jumper wire. To do this, place the transmission in Park. Remove the push-on connector from the relay/solenoid. Connect a jumper wire between the battery positive terminal and the exposed terminal on the relay/solenoid. If the starter motor now operates, the starter relay/solenoid is okay. The problem is in the ignition switch, Neutral start switch or in the starting circuit wiring (look for open or loose connections).
7 If the starter motor still doesn't operate, replace the starter relay/solenoid (see Section 21 and 22).
8 If the starter motor cranks the engine at an abnormally slow speed, first make sure the battery is fully charged and all terminal connections are clean and tight. Also check the connections at the starter relay/solenoid and battery ground. Eyelet terminals should not be easily rotated by hand. Also check for a short to ground. If the engine is partially seized, or has the wrong viscosity oil in it, it will crank slowly.

Starter cranking circuit test (relay type starter)

Refer to illustration 19.10 and 19.13

Note: *To determine the location of excessive resistance in the starter circuit, perform the following simple series of tests.*

9 Disconnect the ignition coil wire from the distributor cap and ground it on the engine.
10 Connect a remote control starter switch from the battery terminal of the starter relay/solenoid to the S terminal of the relay/solenoid **(see illustration)**.
11 Connect a voltmeter positive lead to the starter motor terminal of the starter relay/solenoid, then connect the negative lead to ground.
12 Actuate the ignition switch and record the voltmeter reading as soon as a steady figure is indicated. Do not allow the starter motor to turn for more than 15 seconds at a time. A reading of 9-volts or more, with the starter motor turning at normal cranking speed, is normal. If the reading is 9-volts or more but the cranking speed is slow, the motor is faulty. If the reading is less than 9-volts and the cranking speed is slow, the relay/solenoid contacts are probably burned.
13 Install a voltmeter positive probe to the positive battery terminal and the negative probe to the starter relay **(see illustration)**.
14 Operate the ignition switch and record the voltmeter reading as soon as a steady figure is indicated. Don't allow the starter motor to turn for more than 15 seconds at a time.
15 The voltage drop in the circuit will be indicated by the voltmeter (place the voltmeter on the low or 0-to-2 volt range). The maximum allowable voltage drop should be:

a) 0.5-volt with the voltmeter negative lead connected to the starter terminal and the positive lead connected to the battery positive terminal.
b) 0.1-volt with the voltmeter negative lead connected to the starter relay/solenoid (battery side) and the positive lead connected to the positive terminal of the battery.
c) 0.3-volt with the voltmeter negative lead connected to the starter relay (starter side) and the positive lead connected to the positive terminal of the battery. **Note:** *This particular test will not apply for starter/solenoid assemblies equipped on later models.*

19.13 Checking voltage drop across the battery positive (+) terminal to the relay. Voltage drop (while the starter is cranking) should not exceed 0.1 volts

Chapter 6
Emissions and engine control systems

Contents

1 General information

Refer to illustrations 1.1a, 1.1b, 1.7a and 1.7b

To prevent pollution of the atmosphere from incompletely burned and evaporating gases, and to maintain good driveability and fuel economy, a number of emission control systems are incorporated **(see illustrations)**. They include the:

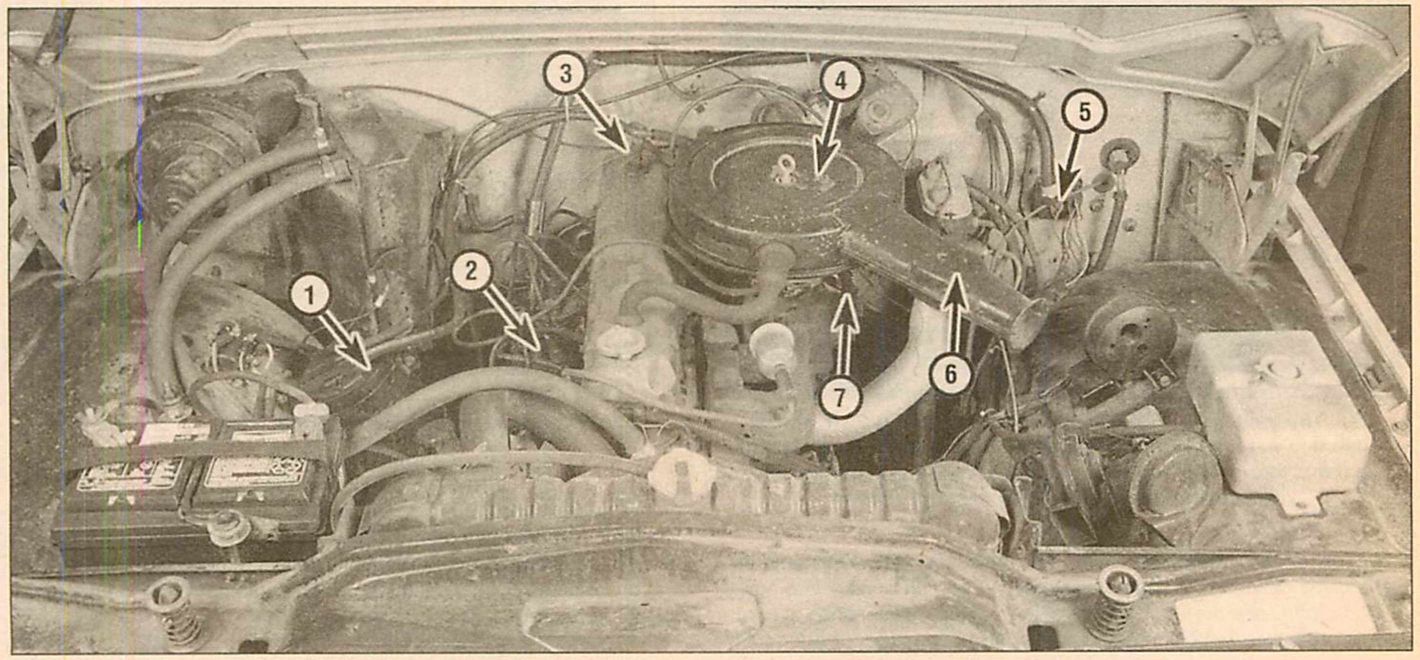
Air Injection Reactor (AIR) system
Automatic choke system
Catalytic converter
Computerized Emission Control (CEC) system (6-cylinder engines)
Evaporative Emission Control (EVAP) system
Exhaust Gas Recirculation (EGR) system
Feedback carburetor (Carter BBD)
Positive Crankcase Ventilation (PCV) system
Spark control system
Thermostatically Controlled Air Cleaner (THERMAC) system
Vacuum throttle modulating system

All of these systems are linked, directly or indirectly, to the emission control system.

The Sections in this Chapter include general descriptions, checking procedures within the scope of the home mechanic and component replacement procedures (when possible). **Note:** *See Chapter 4 for information on carburetor-related emissions control systems.*

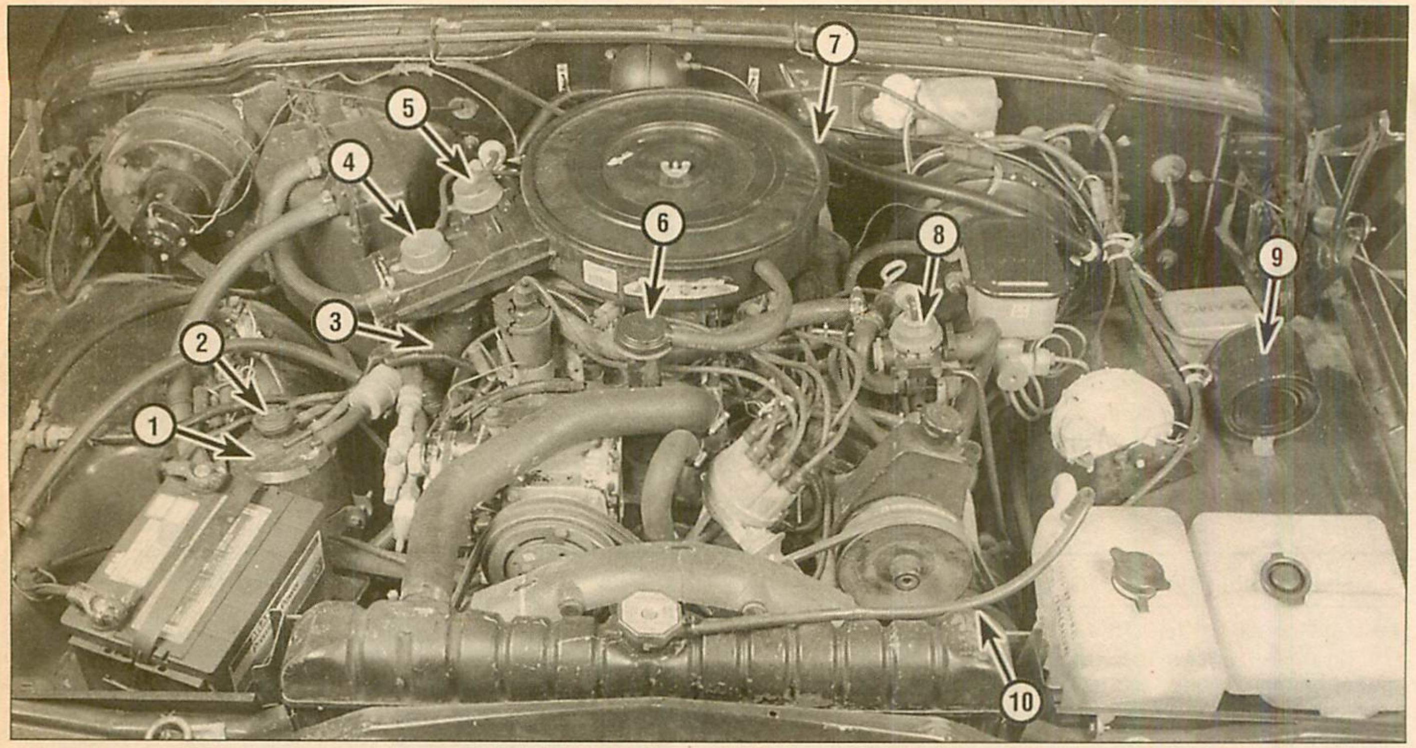
Before assuming that an emissions control system is malfunctioning, check the fuel and ignition systems carefully. The diagnosis of some emission control devices requires specialized tools, equipment and training. If checking and servicing become too difficult or if a procedure is beyond your ability, consult a dealer service department. Remember, the most frequent cause of emissions problems is simply a loose or broken vacuum hose or wire, so always check the hose and wiring connections first.

6



1.1a Emission and engine control system component locations - six cylinder engine (1974 model shown)

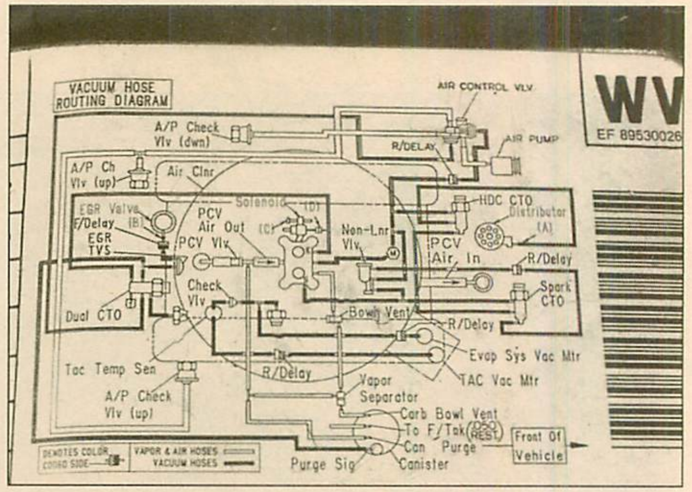
1. *Charcoal canister*
2. *Distributor*
3. *PCV valve*
4. *Air cleaner assembly*
5. *Bulkhead connector*
6. *THERMAC system air valve (inside snorkel)*
7. *Carburetor choke*



1.1b Emission and engine control system component locations - V8 engine (1986 360 cu. in. engine shown)

1. *Charcoal canister*
2. *Purge control valve*
3. *Warm air duct (from exhaust manifold)*
4. *Vacuum motor (trap door)*
5. *Vacuum motor (warm air heat valve)*
6. *Crankcase breather*
7. *EGR valve (behind air cleaner)*
8. *Combination air bypass/air control valve*
9. *Vacuum canister*
10. *Air pump*

1.7a The Vehicle Emission Control Information (VECI) label is located in the engine compartment on the radiator support and contains information on the emission devices on your vehicle, vacuum line routing, etc. (1974 model shown)

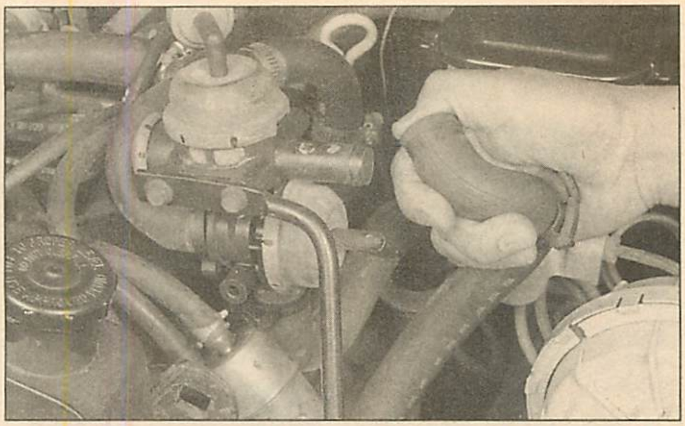


1.7b Typical vacuum schematic (1986 360 cu. in. V8 engine)

This doesn't mean, however, that emission control systems are particularly difficult to maintain and repair. You can quickly and easily perform many checks and do most of the regular maintenance at home with common tune-up and hand tools. **Note:** *Because of a federally mandated extended warranty which covers the emission control system components, check with your dealer about warranty coverage before working on any emissions-related systems. Once the warranty has expired, you may wish to perform some of the component checks and/or replacement procedures in this Chapter to save money.*

Pay close attention to any special precautions outlined in this Chapter. It should be noted that the illustrations of the various systems may not exactly match the system installed on the vehicle you're working on because of changes made by the manufacturer during production or from year-to-year.

A Vehicle Emissions Control Information (VECI) label is located in the engine compartment **(see illustrations)**. This label contains important emissions specifications and adjustment information, as well as a vacuum hose schematic with emissions components identified. When servicing the engine or emissions systems, the VECI label in your particular vehicle should always be checked for up-to-date information.



2.6 Testing airflow from the pump outlet hose. Airflow should increase as rpm increases

2 Air Injection Reactor (AIR) system

General description

1 The air injection reactor system or "air guard" system reduces carbon monoxide and hydrocarbon content in the exhaust gases by injecting fresh air into the hot exhaust gases leaving the exhaust ports. When fresh air is mixed with hot exhaust gases, oxidation is increased, reducing the concentration of hydrocarbons and carbon monoxide and converting them into harmless carbon dioxide and water.

2 The air injection system is composed of an air pump, diverter (bypass) valve, check valve, air injection manifold, a CTO (coolant temperature override), and connecting hoses. The air pump is driven by a belt from the crankshaft and supplies air to the exhaust manifold(s). The check valve prevents the reverse flow of exhaust gases into the system. The diverter valve directs the air from the pump into the manifold(s) or vents it into the atmosphere, depending on the engine operating conditions. Some later models with three-way catalytic converters use a dual air input system to inject air downstream into the converter mixing chamber. **Note:** *Some six-cylinder engines use a Pulse Air system which performs this function by using the positive and negative pulsations of the exhaust instead of an air pump to introduce the air.*

3 The Pulse Air system consists of an air injection reed check valve, which opens and closes due to exhaust system pulsations, an air control valve, air switch solenoid, vacuum storage tank and micro computer unit (MCU), which switches the air upstream or downstream, and associated hoses. This system is part of the feedback carburetor system.

Check

Air supply pump

Refer to illustration 2.6

4 Check and adjust the drivebelt tension (see Chapter 1).

5 Disconnect the air supply hose at the air bypass valve inlet.

6 The pump is operating satisfactorily if airflow is felt at the pump outlet with the engine running at idle, increasing as the engine speed is increased **(see illustration)**. **Caution:** *Some models are equipped with an air pump with a centrifugal fan type air filter located behind the drive pulley. If the engine is to be cleaned with a high pressure steam cleaner, be sure to cover the air pump to prevent the entry of water.*

7 If the air pump doesn't pass the above test, replace it with a new or rebuilt unit.

Diverter valve

Refer to illustrations 2.10a, 2.10b and 2.13

8 With the engine running at idle, disconnect the hose from the diverter valve outlet.

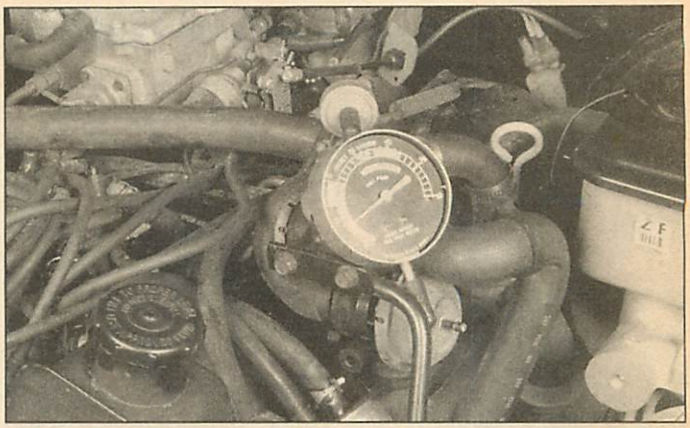
9 Remove the vacuum hose from the port and remove or bypass any restrictors or delay valves in the vacuum hose.

10 Verify that vacuum is present in the vacuum hose **(see illustrations)**. **Note:** *Some models are equipped with CTO valves that regulates vacuum to the diverter valve when the engine is cold. With the engine temperatures below 160-degrees F, vacuum should be available to the diverter valve and once the engine is warmed up to operating temperatures (above 160-degrees F), the vacuum should not be present. Refer to* Section 5 *for information on testing these specialized valves.*

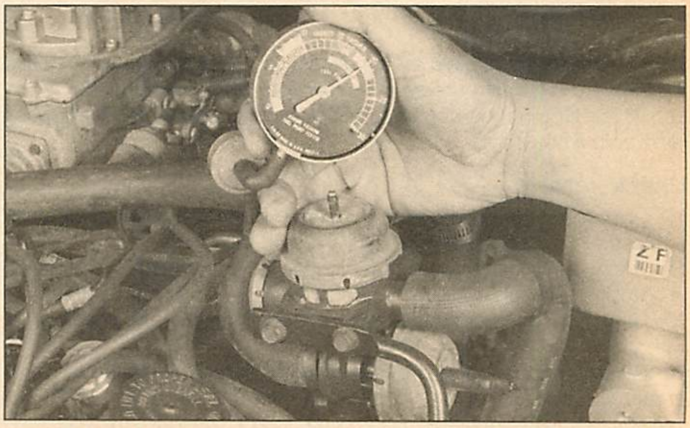
11 Reconnect the vacuum hose to the port.

12 With the engine running at approximately 1,500 rpm, the air pump supply air should be felt or heard at the air bypass valve outlet.

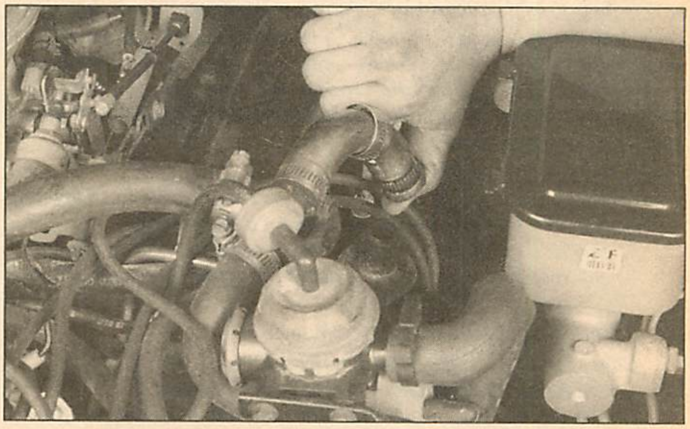
13 With the engine running at approximately 1,500 rpm, disconnect the vacuum hose. Air at the valve outlet **(see illustration)** should be



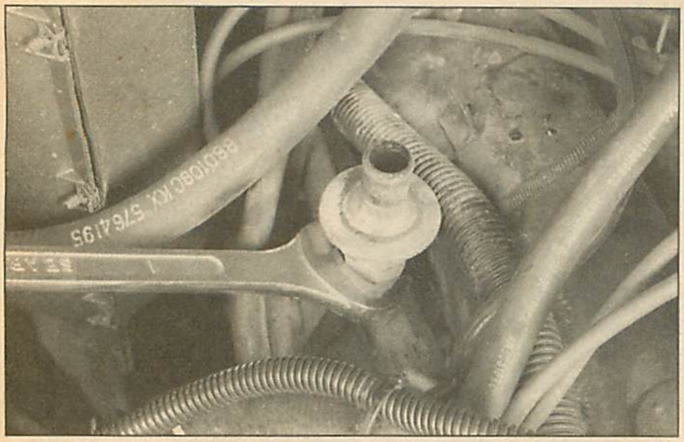
2.10a With the engine idling, check for a vacuum signal to the diverter valve. The 1986 California system uses a combination air bypass/air control valve to regulate airflow and to control airflow at cold/warm temperatures



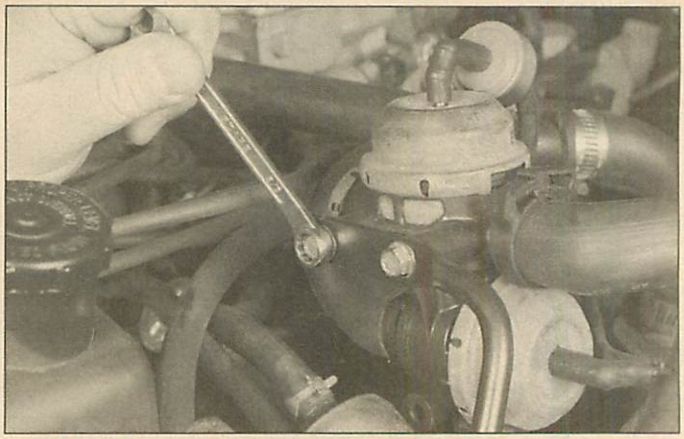
2.10b Checking for vacuum to the air control (combination) valve



2.13 After the engine has warmed to operating temperature, check for the presence of air from the pump to the check valve



2.26a Remove the check valve from the air injection manifold using an open end wrench



2.26b Remove the bolts from the bracket and remove the combination air bypass/air control valve from the engine (1986 V8 engine shown)

decreased or shut off and air pump supply air should be felt or heard at the silencer ports.

14 Reconnect all hoses.

15 If the normally closed air bypass valve doesn't successfully pass the above tests, check the air pump (refer to Steps 4 through 6).

16 If the air pump is operating satisfactorily, replace the air bypass valve with a new one.

Check valve

17 Disconnect the hoses from both ends of the check valve, carefully noting the installed position of the valve and the hoses.

18 Blow through both ends of the check valve, verifying that air flows in one direction only.

19 If air flows in both directions or not at all, replace the check valve with a new one.

20 When reconnecting the valve, make sure it is installed in the proper direction.

Air injection system noise test

21 The air injection system is not completely noiseless. Under normal conditions, noise rises in pitch as the engine speed increases. To determine if noise is the fault of the air injection system, detach the drivebelt (after verifying that the belt tension is correct) and operate the engine. If the noise disappears, proceed with the following diagnosis. **Caution:** *The pump must accumulate 500 miles (vehicle miles) before the following check is valid.*

22 If the belt noise is excessive:

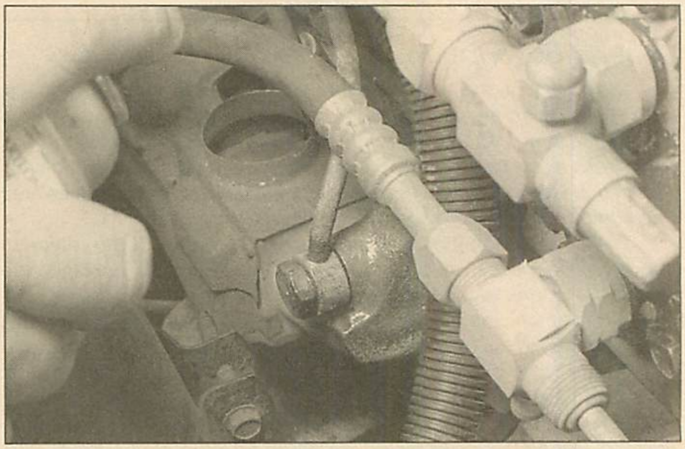
- a) *Check for a loose belt and tighten as necessary* (refer to Chapter 1).
- b) *Check for a seized pump and replace it if necessary.*
- c) *Check for a loose pulley. Tighten the mounting bolts as required.*
- d) *Check for loose, broken or missing mounting brackets or bolts. Tighten or replace as necessary.*

23 If there is excessive mechanical noise:

- a) *Check for an overtightened mounting bolt.*
- b) *Check for an overtightened drivebelt (see Chapter 1).*
- c) *Check for excessive casting flash (excess material) on the air pump adjusting arm boss and remove as necessary.*
- d) *Check for a distorted adjusting arm and, if necessary, replace the arm.*

24 If there is excessive thermactor system noise (whirring or hissing sounds):

- a) *Check for a leak in the hoses (use a soap and water solution to find the leaks) and replace the hose(s) as necessary.*
- b) *Check for a loose, pinched or kinked hose and reassemble, straighten or replace the hose and/or clamps as required.*
- c) *Check for a hose touching other engine parts and adjust or reroute the hose to prevent further contact.*
- d) *Check for an inoperative diverter (bypass) valve* (refer to Step 8) *and replace if necessary.*



2.27 Spray penetrating oil onto the threads of the air injection manifold bolts before removing them from the exhaust manifold

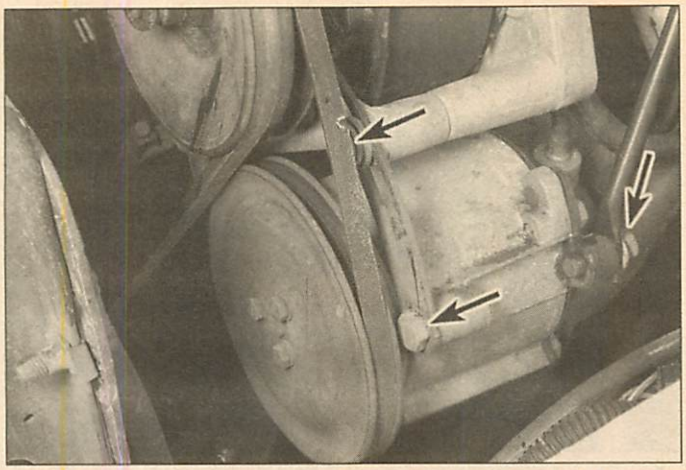
- e) *Check for an inoperative check valve* (refer to Step 17) *and replace if necessary.*
- f) *Check for loose pump or pulley mounting fasteners and tighten as necessary.*
- g) *Check for a restricted or bent pump outlet fitting. Inspect the fitting and remove any casting flash blocking the air passageway. Replace bent fittings.*
- h) *Check for air dumping through the bypass valve (only at idle). On many vehicles, the thermactor system has been designed to dump air at idle to prevent overheating the catalytic converter. This condition is normal. Determine that the noise persists at higher speeds before proceeding.*
- i) *Check for air dumping through the bypass valve (the decel and idle dump). On many vehicles, the thermactor air is dumped into the air cleaner or the remote silencer. Make sure that the hoses are connected properly and not cracked.*

25 If there is excessive pump noise, make sure the pump has had sufficient break-in time (at least 500 miles). Check for a worn or damaged pump and replace as necessary.

Component replacement

Refer to illustrations 2.26a, 2.26b, 2.27 and 2.28

26 To replace the air bypass valve, air supply control valve, check valve **(see illustration)**, combination air bypass/air control valve **(see illustration)** or the silencer, clearly label, then disconnect, the hoses leading to them, replace the faulty component and reattach the hoses to the proper ports. Make sure the hoses are in good condition. If not, replace them with new ones. **Note:** *Spray penetrating oil where the*



2.28 To remove the air pump, loosen the adjusting bolt (upper arrow) and remove the drivebelt, then unscrew the mounting bolts (lower arrows) and pivot bolt (not visible in this photo)

check valve meets the air injection manifold before attempting to loosen the valve.

27 To replace the air injection manifold **(see illustration)**, be sure to spray the bolt threads with penetrating oil before attempting to unscrew them from the exhaust manifold.

28 To replace the air supply pump, first loosen the drivebelt (see Chapter 1), then remove the pump mounting bolts **(see illustration)** from the mounting bracket.

29 If you're replacing either of the check valves on a Pulse Air System (Thermactor II), be sure to use a back-up wrench.

30 After the new pump is installed, adjust the drivebelts (see Chapter 1).

3 Thermostatically Controlled Air Cleaner (THERMAC) system

General description

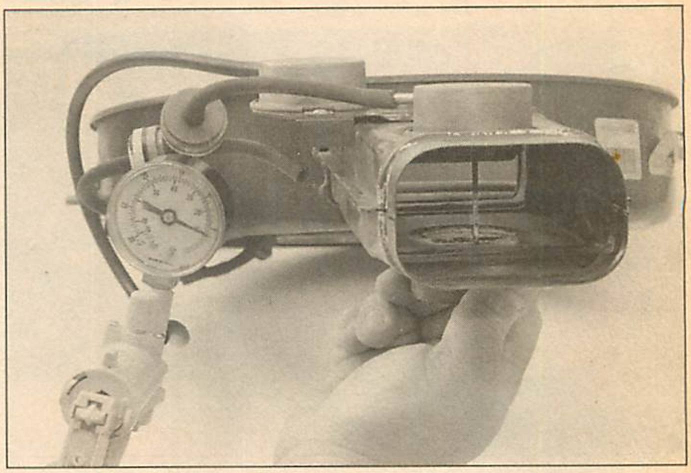
1 The inlet air temperature control system provides heated intake air during warm-up, then maintains the inlet air temperature within a 70-degrees F to 105-degrees F operating range by mixing warm and cool air. This allows leaner fuel/air mixture settings for the carburetor, which reduces emissions and improves driveability.

2 Two fresh air inlets - one warm and one cold - are used. The balance between the two is controlled by intake manifold vacuum, a temperature vacuum switch and a time delay valve. A vacuum motor, which operates a heat duct valve in the air cleaner, is controlled by the vacuum switch. **Note:** *Early six-cylinder engines are equipped with a thermostat unit that is mounted inside the air cleaner snorkel. The thermostat is connected to the air valve by linkage. This linkage retracts or extends the air valve when temperature changes occur.*

3 When the underhood temperature is cold, warm air radiating off the exhaust manifold is routed by a shroud which fits over the manifold up through a hot air inlet tube and into the air cleaner. This provides warm air for the carburetor, resulting in better driveability and faster warm-up. As the underhood temperature rises, a heat duct valve is gradually closed by a vacuum motor and the air cleaner draws air through a cold air duct instead. The result is a consistent intake air temperature.

4 On thermostat-equipped systems, the air valve is held closed by spring pressure when the engine is cold and air is drawn from the shroud mounted on the exhaust manifold. As the engine warms up to operating temperature, the thermostat starts to open and air enters the air cleaner snorkel. When the thermostat is fully open, the air valve closes off the heated air from the manifold and allows air to enter only through the snorkel.

5 On vacuum motor-type systems, the manifold vacuum acting on the vacuum motor diaphragm holds the air valve closed when the engine is cold. With the valve closed, heated air from the exhaust manifold is directed into the engine. As the engine warms up, the thermal sensor in the air cleaner housing bleeds off manifold vacuum and spring pressure in the vacuum motor opens the air valve, allowing air to be drawn through the air cleaner snorkel. If the engine is accelerated hard, the manifold vacuum drops, causing the air valve to open and allows maximum air flow. Some later models use an air cleaner with a spring loaded trap door which is closed when the engine is off. When the engine is started, the resulting manifold vacuum operates the door, opening it. A vacuum delay valve keeps the door from closing abruptly when the vacuum drops or the engine is shut off.



3.8 Apply vacuum to the motor and see if the door retracts

Checking

Refer to illustration 3.8

6 Refer to Chapter 1 for the general checking procedure. If the system is not operating properly, check the individual components as follows.

7 Check all vacuum hoses for cracks, kinks, proper routing and broken sections. Make sure the shroud and duct are in good condition as well.

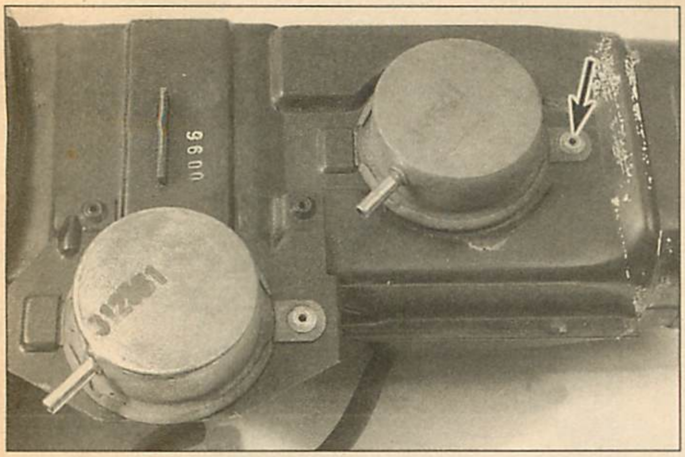
8 Remove the flexible duct and manually operate the air control valve and (if equipped) the trap door **(see illustration)**. If the valve or trap door sticks or hangs up, replace it with a new unit.

9 On thermostat-equipped systems, if the air valve does not open when the engine warms up to operating temperature, check the valve for binding and the spring for proper connection. If the valve is in good condition mechanically, the thermostat is defective and the air cleaner housing must be replaced with a new one.

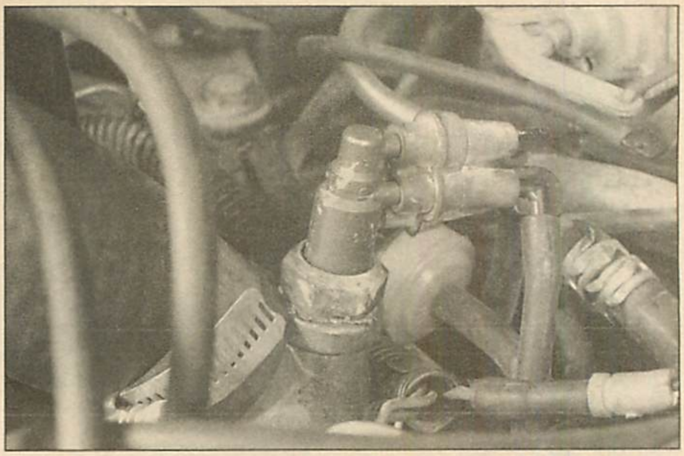
10 On vacuum motor-equipped systems, if the air valve does not open when the engine warms up, check for binding and vacuum leaks. If the mechanism is operating freely and there is no binding or vacuum leaks, remove the hose from the vacuum motor and connect a separate section of hose. Apply a vacuum with your mouth, a vacuum pump or manifold vacuum and see if the valve moves freely to the closed position, indicating it is working properly. If the valve moves to the open position, the thermal sensor is faulty and must be replaced with a new one. If the valve remains in the heat off position, replace the vacuum motor assembly. On some models this will require replacing the air cleaner housing.

11 On trap door-equipped models, remove the hose from the manifold and connect a vacuum pump. The trap door should open when vacuum is applied. If it does not, remove the hose from the motor and apply vacuum directly to it. If the door does not open, check for binding. If it does open, check the vacuum hose between the motor and the manifold for obstructions and leaks. If the hose appears to be in good condition, remove the delay valve, join the hoses and repeat the test. Replace the delay valve with a new one if the valve now opens. Replace the vacuum motor with a new one if the door swings freely, unaffected by vacuum.

6



3.14 To remove the vacuum motor, drill the rivet from the air snorkel



5.4 The vacuum advance Coolant Temperature Override (CTO) switch is located on the thermostat housing

Component replacement

Vacuum motor

Refer to illustration 3.14

12 Remove the air cleaner housing (see Chapter 4) and place it on a workbench.
13 Detach the vacuum hose from the motor.
14 Drill out the vacuum motor retaining strap rivet **(see illustration)**.
15 Remove the motor.
16 Installation is the reverse of removal. Use a sheet metal screw of the appropriate size to replace the rivet.

4 Vacuum throttle modulating system

1 This system reduces the amount of HC during rapid deceleration. This system consists of the deceleration valve, throttle modulating diaphragm and linkage. During high-speed deceleration, manifold vacuum reaches 21 to 22 in-Hg. which in turn signals a deceleration valve that signals vacuum to the throttle modulating diaphragm moving a plunger out to increase throttle momentarily. This action prevents the throttle lever from snapping shut rapidly.

Check

2 Check the adjustment of the deceleration valve. With the engine OFF and the curb idle speed already set (see Chapter 4), position the throttle lever against the curb idle adjusting screw.
3 Measure the clearance between the throttle modulating diaphragm plunger and the throttle lever. It should be 1/16-inch.
4 Adjust the clearance by loosening the jam nut and turning the diaphragm assembly.

5 Spark control system

General description

Refer to illustrations 5.4 and 5.6

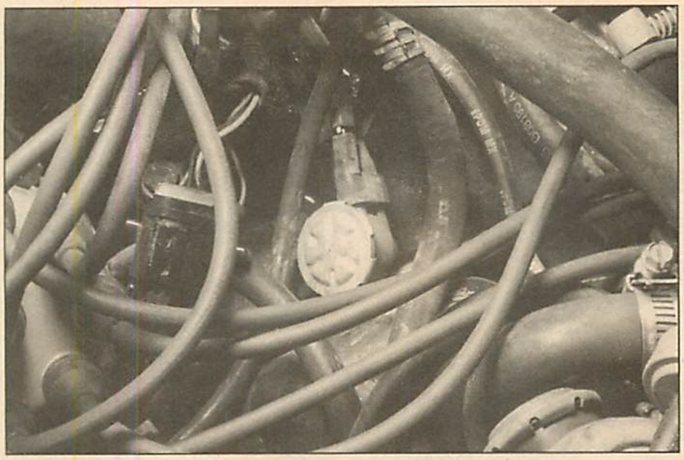
1 The spark control system is designed to reduce hydrocarbon (HC) and oxides of nitrogen (NOx) emissions by controlling ignition timing advance when the engine is cold or during certain driving conditions.
2 The spark control systems and devices used on these models may include:

Transmission controlled spark (TCS) system
Coolant temperature override (CTO) switch
Vacuum advance control delay valve
Delay valve
Non-linear vacuum regulator (NLVR) system

3 The TCS system is used on 1972 through 1978 models and controls NOx emissions by lowering the peak combustion temperature during the power stroke. This is accomplished by restricting the vacuum advance under certain conditions. System components include a solenoid vacuum valve located in or near the intake manifold, a solenoid control switch located in the transmission case (manual) or speedometer cable (automatic) and a coolant temperature override switch (CTO). The 1973 models are equipped with an ambient temperature switch instead of a CTO switch. It is located behind the left side of the radiator grille. This switch allows the system to operate at temperatures above 63-degrees F. At low speeds on 1974 through 1978 models, with the engine temperature below normal operating temperature, full engine vacuum is supplied to the distributor advance mechanism. With the engine temperature above 160-degrees F, the CTO blocks off the vacuum and the solenoid valve controls the ignition advance by releasing some or all of the vacuum to the atmosphere. At speeds over 38 mph (automatic) or in high gear (manual), the solenoid is de-energized by the control switch and normal vacuum advance is used.
4 The CTO is used on most models in conjunction with a variety of emissions control devices **(see illustration)**. The CTO is threaded into a coolant passage and incorporates a thermal unit which reacts to coolant temperature by moving a check ball up or down, which opens or closes the switch ports. The opening or closing of these ports routes vacuum through the switch in accordance with the operation of the emissions system involved.
5 A delay valve is used in conjunction with the CTO to help control diverter vacuum on later V8 engines with AIR. The valve reduces NOx emissions while improving driveability. When the coolant temperature is below 115-degrees F and the vacuum increases because of sudden deceleration, the delay valve routes the air through a check valve to equalize the pressure. The CTO bypasses the delay valve when the temperature is above 115-degrees F. Some models are equipped with a one-way reverse delay valve, which prevents sudden retarding of the ignition timing when the manifold vacuum drops due to sudden acceleration right after the engine is started.
6 The Non-Linear Vacuum Regulator (NLVR) valve system is used on later models **(see illustration)**. The vacuum regulator is calibrated to provide a constant vacuum and maintain the ignition advance within limits under all driving conditions to reduce hydrocarbon emissions. The regulator has inlet ports for manifold and carburetor ported vacuum and an outlet port for the CTO valve switch. At low engine torque, the NLVR valve meters the proper amount of the high manifold vacuum present under these conditions. As the engine torque increases, the valve then uses the higher ported vacuum from the carburetor.

Check

7 The first check of the spark control system should always be a careful inspection of all the rubber hoses for cracks, kinks and proper installation.



5.6 The Non Linear Vacuum Regulator (arrow) is located near the thermostat housing, behind the distributor

Transmission Controlled Spark (TCS) system

8 To test the TCS system, a vacuum gauge, test lamp and jumper wire are needed.

9 The TCS current supply is the first test of this system. With the ignition switch on, disconnect the wires from the solenoid vacuum valve and connect one lead of the test lamp to a good ground. Touch the other lead of the lamp to each connector terminal. The lamp should light at one of these terminals. If the lamp does not light, there is a fault in the ignition feed between the switch and the valve connector.

10 To check the ground circuit, shift the manual transmission into Neutral. On automatic transmission-equipped vehicles, raise the rear of the vehicle and support it securely on jackstands so the rear wheels are free to turn. Connect one lead of the test lamp to the battery positive terminal and touch the other lead to the solenoid vacuum valve ground wire terminal. This will be the terminal opposite the one which caused the test lamp to light in the previous test. On manual transmission models, shift into every gear but high and verify that the lamp remains lit. Shifting into high should cause the lamp to go out. On automatic transmission models, start the engine and shift into Drive. Watch the test lamp and accelerate the engine, noting the speed at which the lamp goes out, which indicates when the solenoid switch is opening. Decelerate the engine and note the speed at which the lamp lights, indicating the switch is closing. It should be between 28 and 38 mph. If the switch operates outside of this indicated range, replace it with a new one. If the lamp did not light at all during either of the tests, check the solenoid switch. **Warning:** *Don't allow the rear wheels to exceed 40 mph when supported on jackstands.*

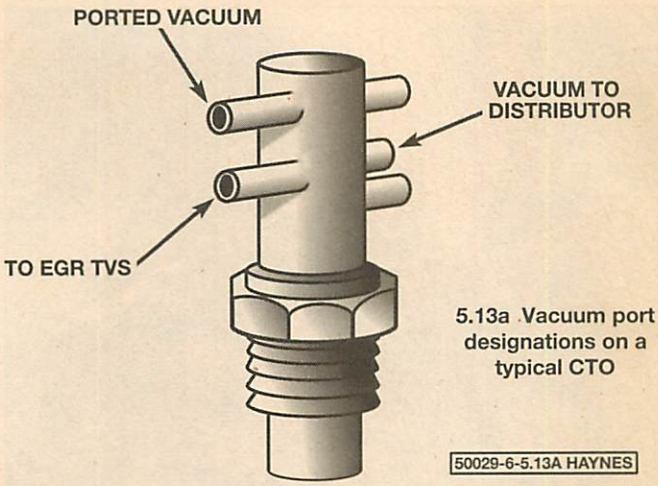
11 To check the solenoid switch, disconnect the wire from the switch at the transmission (manual) or speedometer cable (automatic). On later models the wire will be tan. Connect a jumper wire between the disconnected wire and a good ground. The test lamp should light when connected between the solenoid switch (tan) wire terminal and the battery positive terminal. If it does not, the switch is faulty and should be replaced with a new one. If the lamp does not light, the wire itself is faulty.

12 To test the solenoid vacuum valve, place the transmission in Neutral (manual) or Park (automatic), disconnect the vacuum advance line from the valve and connect a vacuum gauge. Start the engine, run it at between 1000 and 1500 rpm and verify that the gauge indicates no vacuum. With the engine still running, disconnect the wires from the valve. The gauge should now indicate vacuum. If it does not, the valve is faulty and should be replaced with a new one.

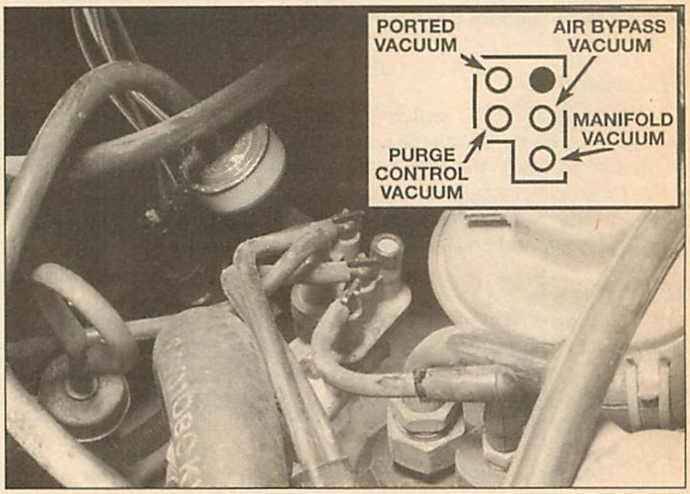
Coolant Temperature Override (CTO) switch

Refer to illustrations 5.13a and 5.13b

13 The primary symptom of a faulty CTO switch is sluggish operation when the engine is cold (because vacuum is not reaching the distributor to actuate the advance mechanism). With the engine cold, tag and remove the vacuum hoses from the CTO switch. Connect a hose to port 1 **(see illustration)** and either use a vacuum pump or suck on the hose to create a vacuum while holding your finger over the top and bottom ports. Vacuum should not be felt. Reconnect the hoses, start the engine and run it until normal operating temperature is reached (above 115-degrees F). Repeat the test and verify that the vacuum is felt at port 2 and port 3. If the CTO switch fails either of these tests, replace it with a new one. **Note:** *Be sure to verify that the vacuum source is providing the proper vacuum signal to the CTO* **(see illustration).**



5.13a Vacuum port designations on a typical CTO



5.13b Location of the vacuum distributor - 1986 V8 engine

6

Delay valves

14 A failed delay valve can cause poor throttle response. Since special equipment is needed to test a delay valve, the home mechanic should leave the checks to a dealer or properly equipped shop.

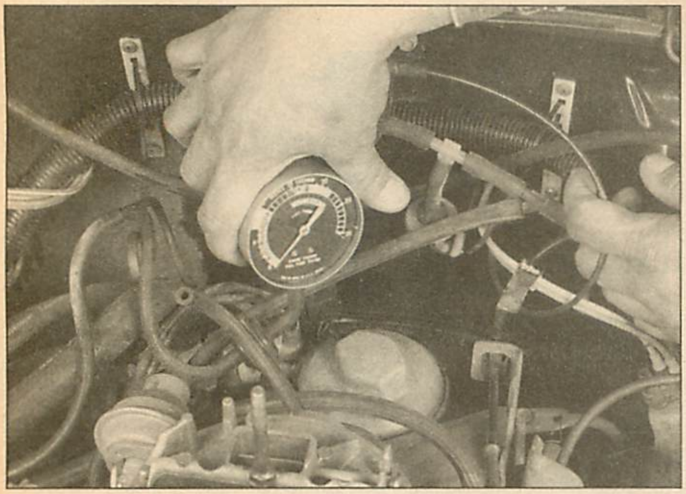
Non-linear vacuum regulator (NLVR) valve

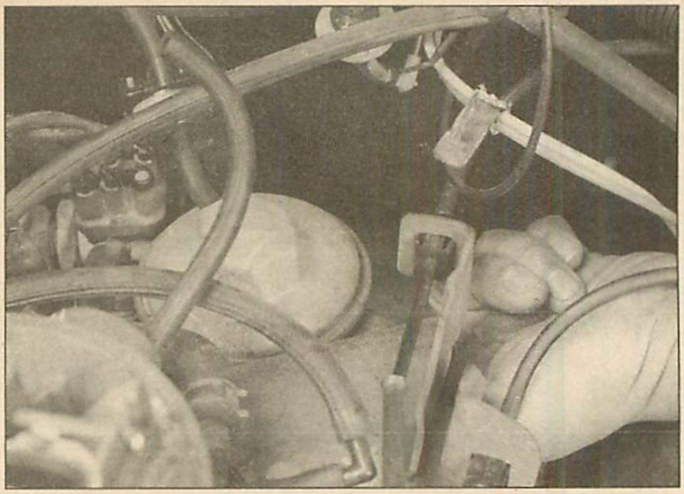
15 Remove the vacuum hose from the distributor port of the valve and connect a vacuum gauge. Start the engine and verify that the gauge reads approximately 7 in-Hg at idle. Further testing requires special equipment, so the home mechanic can either take the vehicle to a dealer or properly equipped shop or replace the valve with one that is known to be good.

Component replacement

TCS system

16 For all components, note the location of all wires or vacuum hoses before removal. Replacement of the components is a simple matter of removing the faulty one and replacing it with a new one. Make sure the hoses are correctly installed and tighten all mounting bolts and clamps securely.


6.5 Using a vacuum gauge, check for vacuum to the EGR valve


6.6 Check the movement of the EGR pintle with your finger

CTO switch

17 **Warning:** *The CTO switch is threaded into a coolant passage, so removal must be done with the engine cold.* The cooling system should be drained to below the level of the switch (see Chapter 1). Mark the hoses to simplify installation before disconnecting them. Apply thread sealant to the new switch before installing it and check for leaks when the job is done. Add coolant if necessary (see Chapter 1).

Delay valves

18 Replacement of a delay valve is a simple matter of removing the vacuum hoses and installing a new valve. Be sure to note the direction the valve is facing before removing it. The valves are color coded and the darker side has a crosshatch pattern which faces toward the component being controlled (photo).

NLVR valve

19 Tag the vacuum hoses before disconnecting them and replacing the valve. It is crucial that the hoses be connected to the correct ports.

6 Exhaust Gas Recirculation (EGR) system

General description

1 The EGR system is used to lower NOx (oxides of nitrogen) emission levels caused by high combustion temperatures. The EGR recirculates a small amount of exhaust gas into the intake manifold. The additional mixture lowers the temperature of combustion thereby reducing the formation of NOx compounds.

2 The main component in the system is the EGR valve. It operates in conjunction with a vacuum amplifier (early models), a coolant temperature override (CTO) switch, delay valve (later models), thermal vacuum switch (TVS) (later models), vacuum dump valve (later models) and a back pressure sensor (later models).

3 At low engine temperatures, the CTO, TVS (if so equipped) and EGR are closed and the exhaust gas is not being recirculated. At high temperatures, the CTO opens and allows ported vacuum from the carburetor to actuate the EGR valve. The TVS is located in the air cleaner and, on models so equipped, it controls the vacuum to the EGR valve, opening at higher ambient temperatures to improve cold engine driveability. At low intake manifold vacuum levels, a vacuum dump valve is used to interrupt vacuum to the EGR valve on some models. Also, some later models have a delay valve in the vacuum line to apply the vacuum more gradually and avoid sudden activation of the EGR valve.

4 The EGR valve is located at the rear of the intake manifold on V8 engines and on six-cylinder engines, on the side of the intake manifold. Two types of EGR valves are used on these models: back pressure sensor-equipped (later six-cylinder engines) and non-back pressure type (V8 engines and early six-cylinder engines). On non back-pressure type valves, the flow of exhaust gas is controlled by the vacuum signal overcoming the spring inside the EGR diaphragm, which opens it and allows exhaust gas recirculation. Back pressure sensor-equipped EGR valves use a combination of ported carburetor vacuum and back pressure from the exhaust manifold to control exhaust gas recirculation. The exhaust gas enters the sensor and controls the EGR valve opening if the back pressure is great enough.

Check

Refer to illustration 6.5

5 Check all vacuum lines and connections for damage and leaks **(see illustration).**

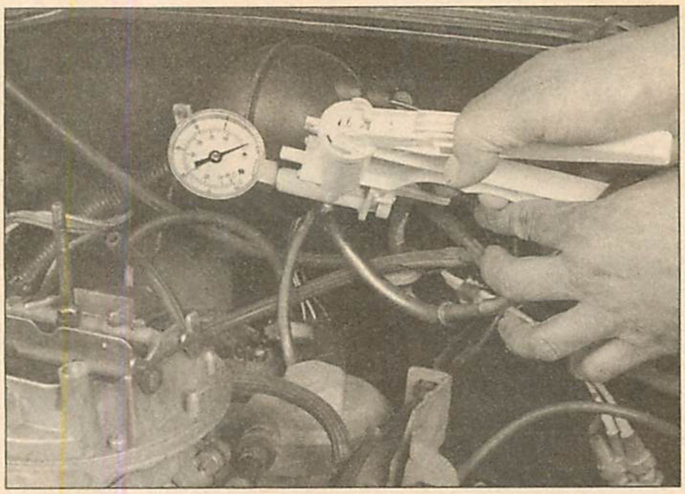
EGR valve

Refer to illustrations 6.6 and 6.7

6 The most noticeable symptom when the EGR valve is stuck in the open position is poor cold engine driveability and rough running or stalling regardless of temperature. With the engine idling and at normal operating temperature, check for proper opening of the valve by increasing engine speed to about 1,500 rpm and then allowing the throttle to snap shut. Verify that there is definite movement of the valve diaphragm **(see illustration). Warning:** *Be careful not to burn your fingers; wear a glove if the valve is hot.* If there is no diaphragm movement, there may be a leak or break in a vacuum line. If the vacuum hoses and connections are in good condition, the EGR valve and/or back pressure sensor may be defective.

7 To check the EGR valve for proper operation, depress the valve diaphragm **(see illustration 6.6)** with the engine at an idle (normal operating temperature). There should be an immediate drop in engine speed, which indicates that the valve is allowing the flow of exhaust gas. If the idle is not changed by depressing the diaphragm, the gases are not reaching the combustion chamber (probably due to a plugged EGR passage in the intake manifold). If the engine idle is rough and does not change greatly when the diaphragm is depressed, the EGR valve is not closing due to a fault in the hoses or the valve itself. Connect a hand-held vacuum pump to the valve and apply vacuum **(see illustration).** If the engine begins to run rough, the valve is working properly. If it doesn't, and the hose routing and connections are OK, replace the valve with a new one.

8 At the specified intervals, the EGR valve should be removed, cleaned and inspected. Use a wire brush to clean the deposits of carbon from the metering pintle. Check and clean the exhaust gas passages in the valve using a small wire brush or drill bit. Coat the end of the drill with heavy grease and use pliers to rotate the bit in the passage. On non back-pressure-type valves, depress the diaphragm and place your finger securely over the vacuum inlet. Press on the



6.7 Use a hand-held vacuum pump to apply vacuum to the EGR valve and confirm that the diaphragm moves smoothly without any binding

diaphragm several times and verify that the pintle remains retracted. If it does not, the diaphragm is leaking and the valve should be replaced with a new one. On back pressure sensor-type EGR valves, apply vacuum to the inlet port with a hand pump to make sure it retracts the pintle and replace the valve if it does not.

CTO

9 With the engine cold, disconnect the vacuum hose leading from the CTO at the EGR valve. Connect a vacuum gauge to the hose or place your finger over the end and start the engine. Accelerate the engine to approximately 1500 rpm and verify that no vacuum is indicated. If there is vacuum, the CTO is faulty and should be replaced with a new one. Warm the engine up to normal operating temperature and repeat the test to make sure vacuum is now present. If it is not, replace the CTO with a new one. Refer to the CTO testing procedure in Section 5.

Delay valve

10 The delay valve is located in the vacuum hose between the CTO and EGR valve. The only test for a suspected faulty valve is replacement with a unit known to be good. When inspecting it for faults, check for cracks and make sure the valve is installed facing in the proper direction. The black or red side always faces the vacuum source.

TVS

11 With the air cleaner temperature below the TVS operating temperature (40-degrees to 50-degrees F; 4.4-degrees to 10-degrees C), connect a vacuum pump to one fitting and a vacuum gauge to the other. Apply vacuum to the TVS and verify that no vacuum passes through it. Warm up the engine to normal operating temperature and repeat the vacuum check to make sure the TVS will now allow vacuum to pass through. If the TVS fails either test, replace it with a new one.

Vacuum dump valve

12 With the engine at normal operating temperature, disconnect the vacuum dump valve hose from the intake manifold (plug the manifold connection). Start the engine, accelerate it to about 2,000 rpm and verify that vacuum exits from the exhaust ports at the bottom of the valve. Reconnect the hose to the intake manifold and repeat the test to make sure no vacuum is coming from the valve exhaust ports. If the valve fails either test, replace it with a new one.

Component replacement

EGR valve

13 The EGR valve is easily removed after detaching the vacuum hose. Be sure to use a new gasket when installing the valve and check for leaks when the job is done.

Non-integral back pressure valve

14 The non-integral back pressure valve can be removed after marking and disconnecting the vacuum hoses. The EGR valve and back pressure valve are removed as an assembly. Clean the mating surfaces of the intake manifold before installation of the EGR and back pressure valve assembly. The CTO vacuum hose must be connected to the EGR valve fitting with the restriction.

CTO

Warning: *Wait until the engine is completely cool before beginning this procedure.*

15 Because the CTO is threaded into a cooling system passage, the coolant must be drained to below the level of the valve before removal. Mark the hoses to simplify installation before removing them. Apply thread sealant to the new valve before installing it and make certain the hoses are hooked up properly. Add coolant if necessary.

TVS

16 The TVS can be replaced after removing the air cleaner and element. Mark and disconnect the vacuum hoses. Remove the retaining clip and lift the TVS from the air cleaner housing. Installation is the reverse of removal. Be sure to install the vacuum hoses securely and correctly.

Delay valve

17 The delay valve is replaced by disengaging it from the vacuum hose and installing a new one, making sure the hoses are secure. The valves are color coded and the black or red side must be facing toward the vacuum source.

Vacuum dump valve

18 Replacement is a simple matter of disconnecting the vacuum hoses, removing the valve and installing a new one. Connect the vacuum hose leading from the EGR valve to port B, which is horizontal to the body valve, and the manifold vacuum hose to the vertical port A.

7 Evaporative Emissions Control (EVAP) system

6

General description

1 This system is designed to trap and store fuel vapors that evaporate from the fuel tank, throttle body and intake manifold.
2 The Evaporative Emission Control System (EVAP) consists of a charcoal-filled canister and the lines connecting the canister to the fuel tank, ported vacuum and intake manifold vacuum.
3 Fuel vapors are transferred from the fuel tank, carburetor and intake manifold to a canister where they are stored when the engine is not operating. When the engine is running, the fuel vapors are purged from the canister by a purge control valve and consumed in the normal combustion process.

Check

Refer to illustration 7.10

4 Poor idle, stalling and poor driveability can be caused by an inoperative purge control valve, a damaged canister, split or cracked hoses or hoses connected to the wrong tubes.
5 Evidence of fuel loss or fuel odor can be caused by fuel leaking from fuel lines, a cracked or damaged canister, an inoperative bowl vent valve, an inoperative purge valve, disconnected, misrouted, kinked, deteriorated or damaged vapor or control hoses or an improperly seated air cleaner or air cleaner gasket.
6 Inspect each hose attached to the canister for kinks, leaks and breaks along its entire length. Repair or replace as necessary.
7 Inspect the canister. If it is cracked or damaged, replace it.
8 Look for fuel leaking from the bottom of the canister. If fuel is leaking, replace the canister and check the hoses and hose routing.
9 Apply a short length of hose to the lower tube of the purge valve assembly and attempt to blow through it. Little or no air should pass into the canister (a small amount of air will pass because the canister has a constant purge hole).

10 With a hand-held vacuum pump, apply vacuum through the control vacuum signal tube to the purge control diaphragm **(see illustration)**
11 If the purge control valve does not hold vacuum for at least 20 seconds, the purge control valve is leaking and must be replaced.
12 If the diaphragm holds vacuum, apply battery voltage to the purge control valve and observe that vacuum (vapors) are allowed to pass through to the intake system.

Component replacement

13 If the canister is mounted under the vehicle, raise the vehicle and support it securely on jackstands.
14 Clearly label, then detach, all vacuum lines from the canister. Loosen the canister mounting clamp bolt(s) and pull the canister out.
15 Installation is the reverse of removal.

8 Positive Crankcase Ventilation (PCV) system

1 The Positive Crankcase Ventilation (PCV) system reduces hydrocarbon emissions by scavenging crankcase vapors. It does this by circulating fresh air from the air cleaner through the crankcase, where it mixes with blow-by gases and is then rerouted through a PCV valve to the intake manifold.
2 The main components of the PCV system are the PCV valve, a fresh air filtered inlet and the vacuum hoses connecting these two components with the engine and the EECS system.
3 To maintain idle quality, the PCV valve restricts the flow when the intake manifold vacuum is high. If abnormal operating conditions arise, the system is designed to allow excessive amounts of blow-by gases to flow back through the crankcase vent tube into the air cleaner to be consumed by normal combustion.
4 Checking and replacement of the PCV valve and filter is covered in Chapter 1.

9 Catalytic converter

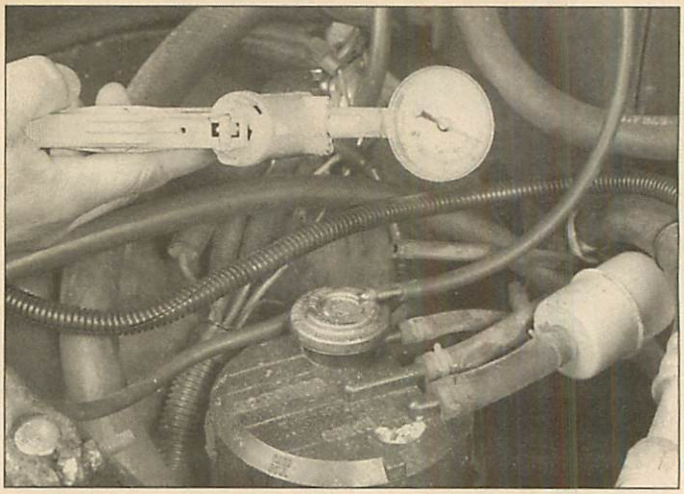
General description

Refer to illustration 9.1

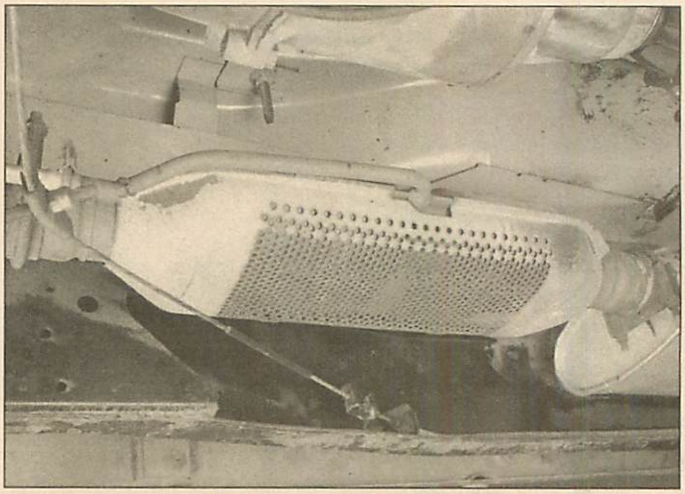
1 The catalytic converter is an emission control device added to the exhaust system to reduce pollutants from the exhaust gas stream **(see illustration)**. A single-bed converter design is used in combination with a three-way (reduction) catalyst. The catalytic coating on the three-way catalyst contains platinum and rhodium, which lowers the levels of oxides of nitrogen (NOx) as well as hydrocarbons (HC) and carbon monoxide (CO).

Check

2 The test equipment for a catalytic converter is expensive and highly sophisticated. If you suspect that the converter on your vehicle is malfunctioning, take it to a dealer or authorized emissions inspection facility for diagnosis and repair.



7.10 Apply vacuum to the purge control valve and confirm that the valve holds vacuum and does not leak

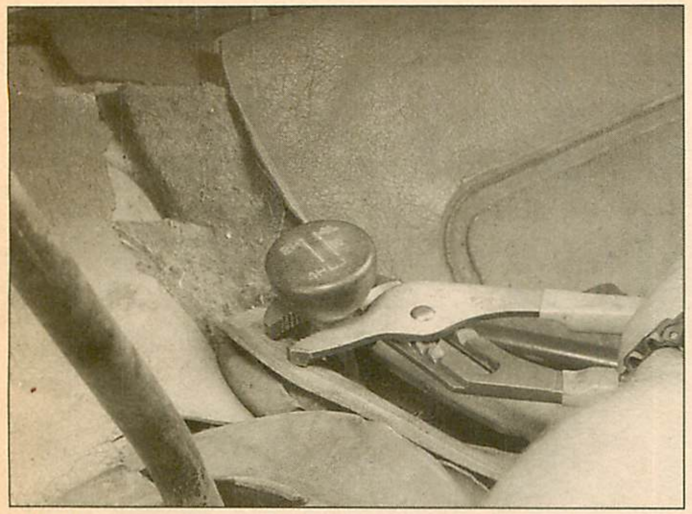


9.1 Typical catalytic converter

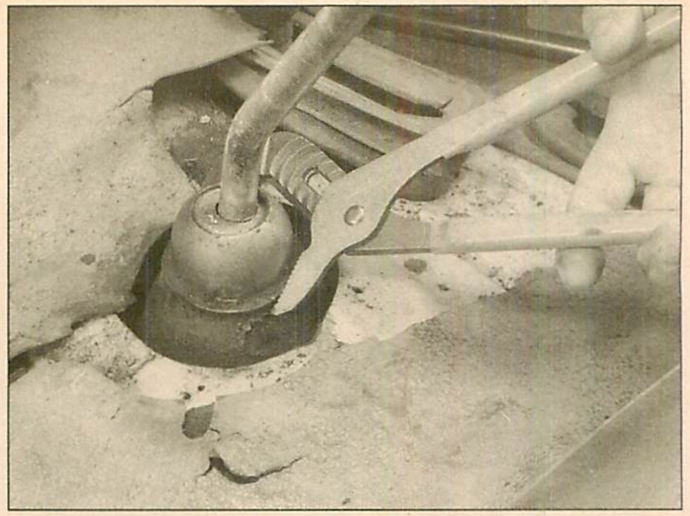
3 Whenever the vehicle is raised for servicing of underbody components, check the converter for leaks, corrosion and other damage. If damage is discovered, the converter should be replaced.

Replacement

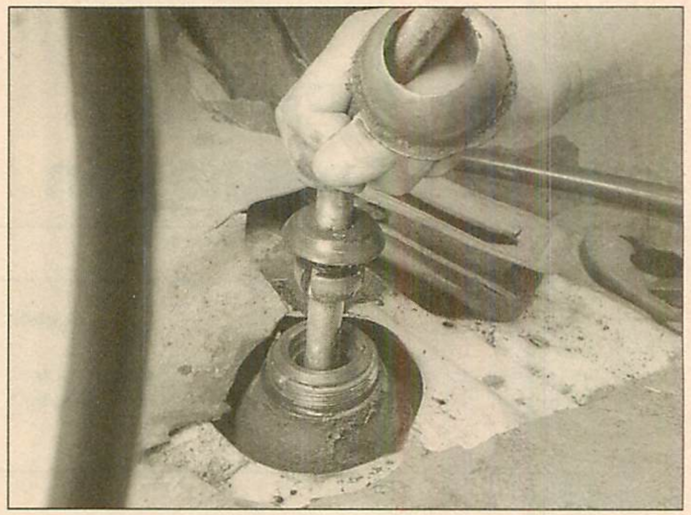
4 Because the converter is part of the exhaust system, converter replacement requires removal of the exhaust pipe assembly (see Chapter 4). Take the vehicle, or the exhaust system, to a dealer or a muffler shop.



2.2 Unscrew the knob for the transfer case shift lever (it's not necessary to remove the transmission shift lever knob since you're going to remove the shift lever assembly)



2.5 On models with a T-18 or T-18A transmission, unscrew the shift lever cap . . .



2.5b . . . then remove the shift lever assembly

2 Manual transmission - removal and installation

Refer to illustrations 2.2, 2.5a, 2.5b, 2.15a and 2.15b

1 Disconnect the negative cable from the battery.
2 Remove the transfer case shift lever knob **(see illustration)**.
3 Remove the carpeting and remove the dust boot trim rings, the dust boots and the trim ring gaskets for the transmission and transfer case shift levers.
4 On models with a T-14A, T-15A, SR-4, T-4 or T-5 transmission, simply remove the bolts which secure the shift lever housing to the top of the transmission and lift the shift lever and shift lever housing assembly off the transmission.
5 On models with a T-18 or T-18A unit, unscrew the shift lever cap, then remove the spring retainer, spring, shift lever and locating pin **(see illustrations)**.
6 On models with a T-176 unit, press down the shift lever retainer, turn it counterclockwise and remove the shift lever, boot, spring and seat as an assembly.
7 Raise the vehicle and support it securely on jackstands.
8 Remove the skid plate, if equipped.
9 Remove the front driveshaft and disconnect the rear driveshaft from the transfer case (see Chapter 8).
10 Disconnect the transfer case shift linkage (see Chapter 7C).
11 Detach any electrical wiring harnesses from their clips on the transmission or transfer case. Detach the transmission and transfer case vent hoses.
12 Support the engine. This can be done from above with an engine hoist, or by placing a jack (with a block of wood as an insulator) under the engine oil pan. The engine should remain supported at all times while the transmission is out of the vehicle.
13 Support the transmission with a jack - preferably a special jack made for this purpose. Safety chains will help steady the transmission on the jack.
14 Remove the rear crossmember nuts and bolts.
15 Raise the transmission slightly and remove the crossmember.
16 Remove the transfer case from the transmission (see Chapter 7C).
17 Remove the transmission-to-clutch housing bolts **(see illustrations)**.
18 Make a final check that all electrical connectors are unplugged and all hoses and lines are disconnected, then move the transmission and jack toward the rear of the vehicle until the transmission input shaft is clear of the clutch housing.
19 Once the input shaft is clear, lower the transmission and remove it from under the vehicle.
20 The clutch components can be inspected by removing the clutch housing from the engine (see Chapter 8). In most cases, new clutch components should be routinely installed if the transmission is removed.

Installation

21 If removed, install the clutch components (see Chapter 8).
22 Wheel the transmission into position on a jack, raise it up and, with the aid of a helper, carefully slide it forward and guide the input shaft through the hole in the clutch housing, through the release bearing, through the clutch disc hub assembly and into the pilot bushing. Make sure the input shaft is fully seated into the pilot bushing. You'll know if it isn't, because the transmission case won't seat flat against the clutch housing. If you have trouble inserting the input shaft through the release bearing or clutch hub, or seating it into the pilot bearing, carefully wiggle the transmission or readjust the angle of the transmission so it is level. You may even have to rotate the engine or input shaft slightly to align the splines on the input shaft with the splines on the inside of the clutch hub. But DO NOT try to force the input shaft through the release bearing or clutch hub, or into the pilot bearing, or you will will damage something.
23 Install the transmission-to-clutch housing bolts. Tighten the bolts to the torque listed in this Chapter's Specifications.

Chapter 7 Part A Manual transmission

Contents

7A

Specifications

Torque specifications

Shift lever cover/housing bolts	132 to 180 in-lbs
Transmission-to-clutch housing bolts	55 ft-lbs

1 General information

All vehicles covered in this manual come equipped with either a three-, four- or five-speed manual transmission or an automatic transmission. All information on the manual transmission is included in this part of Chapter 7. Information on the automatic transmission can be found in Part B of this Chapter. Information on the transfer case is in Part C of this Chapter.

1972 through 1975 models are equipped with either a T-14A or T-15A or T-18. The T-14A and T-15A are fully synchronized three-speeds; the T-18 is a four-speed with synchromesh shifting in second, third and fourth. An identification tag, attached to the upper left side of the transmission at the case cover or shift control housing, displays the vendor part number and Jeep part number. The information on this tag is vital when ordering a new or rebuilt transmission.

1976 through 1979 models are equipped with either a T-15A (see above) or T-18A. The T-18A is a fully-synchronized four-speed.

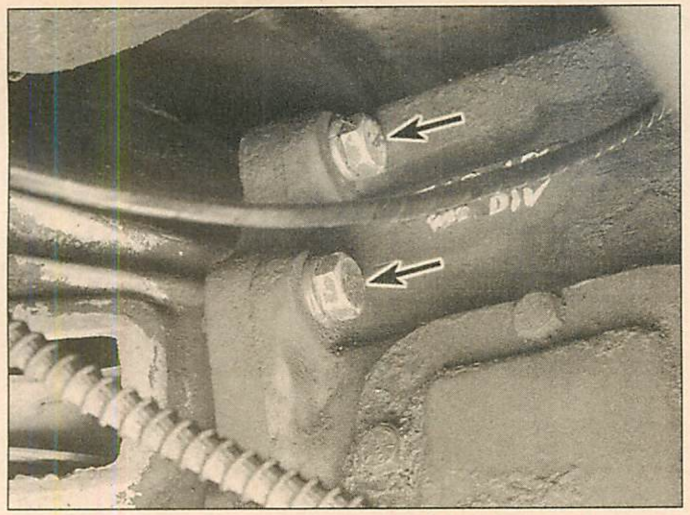
1980 and 1981 models are equipped with either a T-176 or T-18A. The T-176 is a fully-synchronized four-speed; the T-18A (unlike the earlier T-18A) is a four-speed with synchromesh shifting in second, third and fourth, but not in first; it's only available in the J-20 Truck.

1982 and 1983 models are equipped with either a T-5, T-176 or T-18A. The T-176 is a full-synchro four-speed; the T-5 is a full-synchro five-speed. The T-18A remains unchanged from the 1980-1981 unit with no synchro in first.

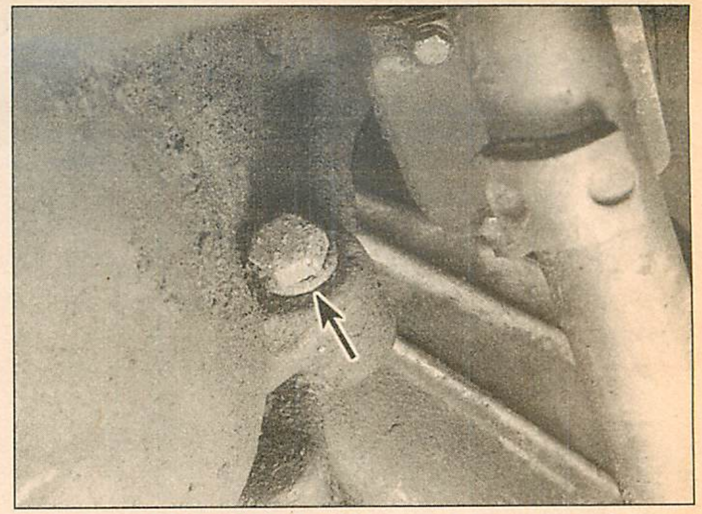
1984 through 1988 models are equipped with the T-176 unit.

Because of the complexity, unavailability of replacement parts and special tools needed, internal repair is not recommended. The information in this Chapter is limited to general information and removal and installation of the transmission.

Depending on the expense involved in having a faulty transmission overhauled, it may be a good idea to replace the unit with either a new or rebuilt unit. Your local dealer or transmission shop should be able to supply you with information concerning cost, availability and exchange policy. Regardless of how you decide to remedy a transmission problem, you can still save a lot of money by removing and installing it yourself.



2.17a Remove the transmission-to-clutch housing bolts (arrows) from the left . . .



2.17b . . . and right sides of the transmission (upper bolts not visible in these photos)

24 Install the crossmember and transmission support. Tighten all nuts and bolts securely.
25 Remove the jacks supporting the transmission and the engine.
26 Install the various items removed previously in the reverse order of removal. Refer to Chapter 7C for installation of the transfer case, and to Chapter 8 for the installation of the driveshaft.
27 Make a final check that all electrical connectors are plugged in.
28 Make sure that the transmission lubricant is filled to the proper level (see Chapter 1).
29 Remove the jackstands and lower the vehicle.
30 Connect the transfer case shift linkage (see Chapter 7C).
31 Connect the negative battery cable.
32 Road test the vehicle for proper operation and check for leakage.

3 Manual transmission overhaul - general information

Overhauling a manual transmission is a difficult job for the do-it-yourselfer. It involves the disassembly and reassembly of many small parts. Numerous clearances must be precisely measured and, if necessary, changed with select fit spacers and snap-rings. Therefore, if transmission problems arise, overhaul should be left to a transmission repair shop. However, you can remove and install the transmission yourself. Rebuilt transmissions may be available; check with your dealer parts department and auto parts stores. A rebuilt unit is usually considerably less expensive than having your old transmission overhauled.

Notes

Chapter 7 Part B
Automatic transmission

Contents

Specifications

Torque specifications	Ft-lbs (unless otherwise indicated)
Shift rod trunnion locknut (Turbo 400)	98 in-lbs
Transmission-to-engine bolts	
1972 through 1979	35
1980 on	28
Driveplate-to-torque converter bolts	
1972 through 1979	30
1980 on	22

1 General information and identification

General information

All vehicles covered in this manual come equipped with a three- or four-speed manual transmission or a three-speed automatic transmission. All information on the automatic transmission is included in this Part of Chapter 7. Information on the manual transmission can be found in Part A of this Chapter. Information on the transfer case is in Part C of this Chapter.

A General Motors Turbo Hydra-Matic 400 three-speed transmission is used on 1972 through 1979 models. A Chrysler Torqueflite 999 or 727 three-speed transmission is used on 1980 and later models. The 999 is used in Grand Wagoneers and J-10 trucks with a six-cylinder engine and a 2.73 axle ratio; the 727 is used in Grand Wagoneer and J-10 trucks with a V-8 engine or with a six-cylinder engine and a 3.31 axle ratio.

Transmission identification numbers are important when replacing the transmission. The Turbo 400 has a metal plate attached to the right side of the transmission case with the transmission serial number stamped on it. The 999 and 727 have three series of numbers stamped on the left side of the case just above the oil pan mating surface. The first, a seven-digit number, is the transmission part number; the second, a four-digit number, indicates the date of manufacture; the third, a four-digit number, represents the transmission serial number.

Due to the complexity of the automatic transmissions covered in this manual and the need for specialized equipment to perform most service operations, this Chapter contains only general diagnosis, routine maintenance, adjustment and removal and installation procedures.

If the transmission requires major repair work, it should be left to a dealer service department or an automotive or transmission repair shop. You can, however, remove and install the transmission yourself and save the expense, even if the repair work is done by a transmission shop.

2 Diagnosis - general

Note: *Automatic transmission malfunctions may be caused by five general conditions: poor engine performance, improper adjustments, hydraulic malfunctions, mechanical malfunctions or malfunctions in the computer or its signal network. Diagnosis of these problems should always begin with a check of the easily repaired items: fluid level and condition (Chapter 1), shift linkage adjustment and throttle linkage adjustment. Next, perform a road test to determine if the problem has been corrected or if more diagnosis is necessary. If the problem persists after the preliminary tests and corrections are completed, additional diagnosis should be done by a dealer service department or transmission repair shop. Refer to the* Troubleshooting *section at the front of this manual for information on symptoms of transmission problems.*

Preliminary checks

1 Drive the vehicle to warm the transmission to normal operating temperature.

2 Check the fluid level as described in Chapter 1:

a) *If the fluid level is unusually low, add enough fluid to bring the level within the designated area of the dipstick, then check for external leaks* (see below).

b) *If the fluid level is abnormally high, drain off the excess, then check the drained fluid for contamination by coolant. The presence of engine coolant in the automatic transmission fluid indicates that a failure has occurred in the internal radiator walls that separate the coolant from the transmission fluid* (see Chapter 3).

c) *If the fluid is foaming, drain it and refill the transmission, then check for coolant in the fluid or a high fluid level.*

3 Check the engine idle speed. **Note:** *If the engine is malfunctioning, do not proceed with the preliminary checks until it has been repaired and runs normally.*

4 On 1972 through 1979 models, inspect the vacuum modulator and vacuum line (see Section 4) and the kickdown system (see Section 5).

5 On 1980 and later models, check the throttle valve linkage for freedom of movement. Adjust it if necessary (see Section 6). **Note:** *The throttle valve linkage may function properly when the engine is shut off and cold, but it may malfunction once the engine is hot. Check it cold and at normal engine operating temperature.*

6 Inspect the shift control linkage (see Section 3). Make sure it's properly adjusted and the linkage operates smoothly.

Fluid leak diagnosis

7 Most fluid leaks are easy to locate visually. Repair usually consists of replacing a seal or gasket. If a leak is difficult to find, the following procedure may help.

8 Identify the fluid. Make sure it's transmission fluid and not engine oil or brake fluid (automatic transmission fluid is a deep red color).

9 Try to pinpoint the source of the leak. Drive the vehicle several miles, then park it over a large sheet of cardboard. After a minute or two, you should be able to locate the leak by determining the source of the fluid dripping onto the cardboard.

10 Make a careful visual inspection of the suspected component and the area immediately around it. Pay particular attention to gasket mating surfaces. A mirror is often helpful for finding leaks in areas that are hard to see.

11 If the leak still cannot be found, clean the suspected area thoroughly with a degreaser or solvent, then dry it.

12 Drive the vehicle several miles at normal operating temperature and varying speeds. After driving the vehicle, visually inspect the suspected component again.

13 Once the leak has been located, the cause must be determined before it can be properly repaired. If a gasket is replaced but the sealing flange is bent, the new gasket will not stop the leak. The bent flange must be straightened.

14 Before attempting to repair a leak, check to make sure the following conditions are corrected or they may cause another leak. **Note:** *Some of the following conditions cannot be fixed without highly specialized tools and expertise. Such problems must be referred to a transmission repair shop or a dealer service department.*

Gasket leaks

15 Check the pan periodically. Make sure the bolts are tight, no bolts are missing, the gasket is in good condition and the pan is flat (dents in the pan may indicate damage to the valve body inside).

16 If the pan gasket is leaking, the fluid level or the fluid pressure may be too high, the vent may be plugged, the pan bolts may be too tight, the pan sealing flange may be warped, the sealing surface of the transmission housing may be damaged, the gasket may be damaged or the transmission casting may be cracked or porous. If sealant instead of gasket material has been used to form a seal between the pan and the transmission housing, it may be the wrong sealant.

Seal leaks

17 If a transmission seal is leaking, the fluid level or pressure may be too high, the vent may be plugged, the seal bore may be damaged, the seal itself may be damaged or improperly installed, the surface of the shaft protruding through the seal may be damaged or a loose bearing may be causing excessive shaft movement.

18 Make sure the dipstick tube seal is in good condition and the tube is properly seated. Periodically check the area around the speedometer gear or sensor for leakage. If transmission fluid is evident, check the O-ring for damage.

Case leaks

19 If the case itself appears to be leaking, the casting is porous and will have to be repaired or replaced.

20 Make sure the oil cooler hose fittings are tight and in good condition.

Fluid comes out the vent pipe or fill tube

21 If this condition occurs, the transmission is overfilled, there is coolant in the fluid, the case is porous, the dipstick is incorrect, the vent is plugged or the drain back holes are plugged.

3 Shift linkage - adjustment

1972 through 1979 models

1 Put the steering column shift lever in Neutral.

2 Raise the vehicle and place it securely on jackstands.

3 Locate the shift rod that connects the lever on the steering column to the shift linkage on the transmission. At the transmission end, you will see a trunnion block that attaches the shift rod to the linkage. Loosen the lock nut on this trunnion just enough to allow the shift rod to slide freely.

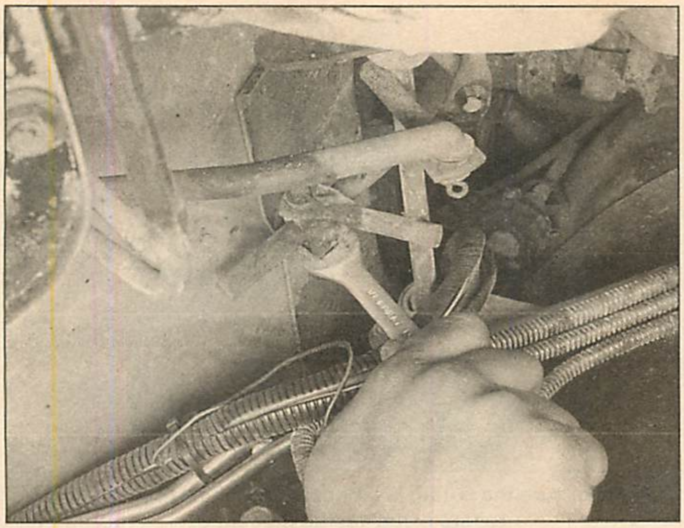
4 Put the outer range selector lever at the transmission in the Neutral detent position and tighten the trunnion lock nut to the torque listed in this Chapter's Specifications.

5 Lower the vehicle and operate the shift lever in all ranges. Verify that the engine starts only in Park and Neutral and make sure that the shift lever engages properly in all detent positions. Readjust the linkage again if necessary.

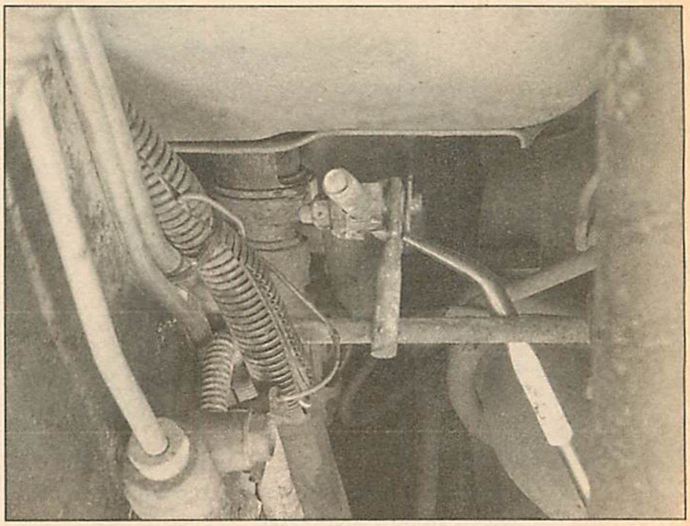
1980 and later models

Refer to illustrations 3.7, 3.8 and 3.12

6 Raise the vehicle and place it securely on jackstands.



3.7 Loosen the shift rod trunnion lock nuts



3.8 Remove the lock pin that secures the shift rod trunnion to the bellcrank

7 Loosen the shift rod trunnion lock nuts **(see illustration)**.

8 Remove the lock pin which secures the shift rod trunnion to the bellcrank **(see illustration)** and disengage the trunnion and shift rod at the bellcrank.

9 Put the shift lever in the Park position and lock the steering column.

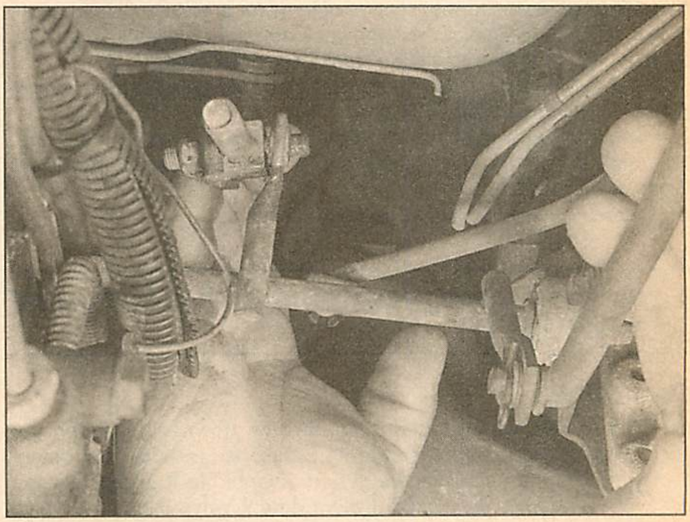
10 Move the valve body manual lever to the rear, into the Park detent (the last detent position, all the way back).

11 Verify that the Park lock is positively engaged by trying to rotate the driveshaft; if the Park lock pawl is fully engaged in the Park gear, the driveshaft won't turn.

12 Adjust the shift rod trunnion so that the pin fits freely in the bellcrank arm, then tighten the trunnion jam nuts. Do not allow the shift rod to turn while tightening the jam nuts, and make sure all freeplay is removed from the shift linkage by pulling down on the shift rod and pressing up on the outer bellcrank **(see illustration)**.

13 Verify that the engine starts only in Park and Neutral. If the engine doesn't start in either or both of these gears, or starts in any gear other than Park or Neutral, readjust the shift linkage.

14 Remove the jackstands and lower the vehicle.



3.12 Remove freeplay from the shift linkage by pulling down on the shift rod and pressing up on the bellcrank

4 Modulator valve - check and replacement

Check

Refer to illustration 4.2

1 Raise the vehicle and place it securely on jackstands.

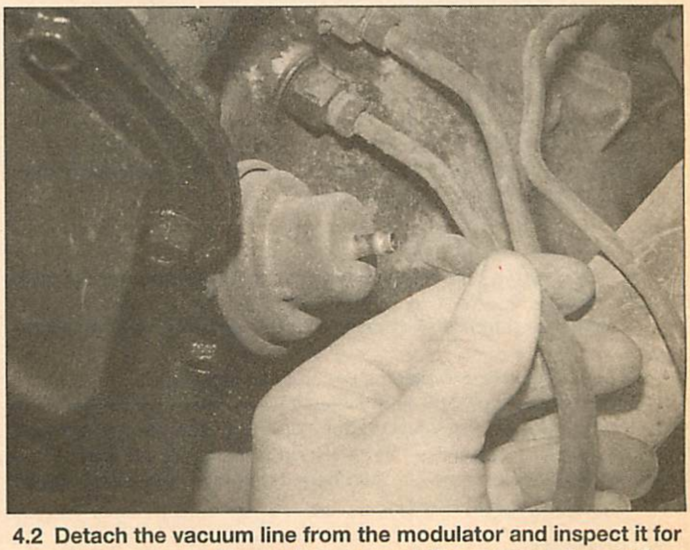
2 Detach the vacuum line from the modulator **(see illustration)** and check to see if there's transmission fluid either on the pipe or inside the line. If there is, replace the modulator assembly. (If there's a small amount of gasoline or water condensation present, that's normal.) Even if there's no fluid evident on the pipe or in the vacuum line, it's a good idea to insert a pipe cleaner or Q-tip into the vacuum pipe to check for the presence of transmission fluid inside. If the pipe cleaner or Q-tip has transmission fluid on it when you extract it from the vacuum pipe, replace the modulator.

3 Attach a hand-operated vacuum pump to the modulator valve vacuum pipe, apply 20 in-Hg of vacuum to the modulator and see if it holds vacuum for at least 30 seconds. If it doesn't, replace the modulator.

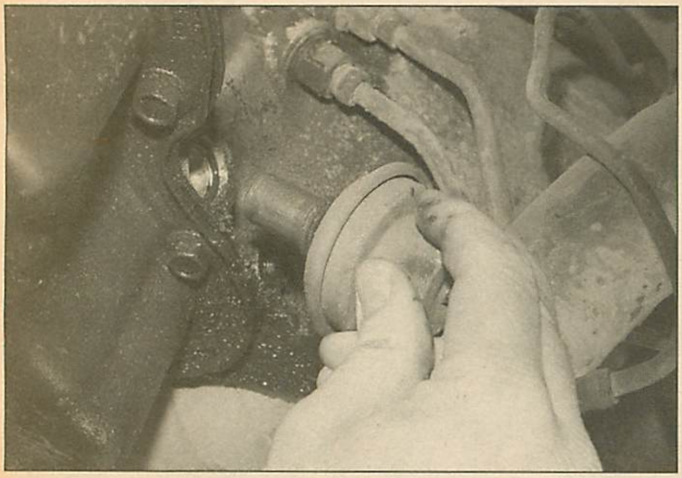
Replacement

Refer to illustrations 4.6 and 4.7

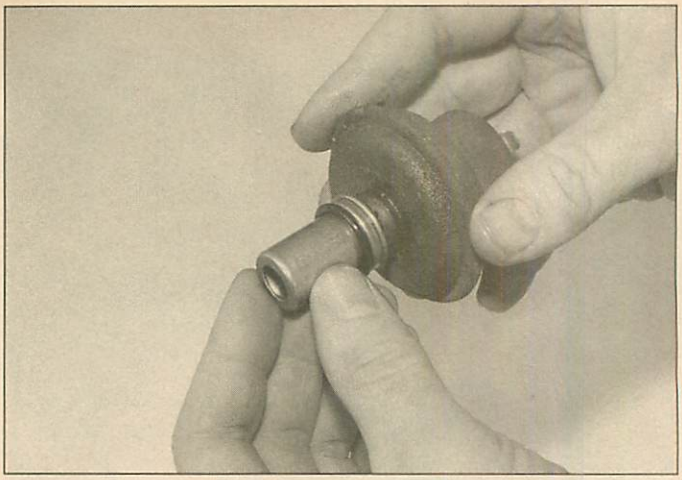
4 Raise the vehicle and support it securely on jackstands.



4.2 Detach the vacuum line from the modulator and inspect it for cracks, breaks and tears; then inspect the vacuum pipe on the modulator and the line for the presence of transmission fluid



4.6 Remove the modulator hold-down bolt and clamp, then pull out the modulator



4.7 Make sure the O-ring is lubricated and the surface is clean before installing the modulator

5 Disconnect the vacuum line at the modulator **(see illustration 4.2)**. Inspect the rubber section of hose for cracks or deterioration, replacing it if necessary. Check the vacuum line at the intake manifold. Replace the rubber section if it's cracked or deteriorated.
6 Remove the modulator hold-down bolt and clamp and remove the modulator **(see illustration)**.
7 Remove the modulator O-ring and replace it with a new one. Lubricate the O-ring with transmission fluid **(see illustration)** and install the modulator.
8 Attach the vacuum line and lower the vehicle.

5 Kickdown system - description, check and component replacement

Description

1 The detent switch initiates full-throttle downshifts. When the accelerator pedal is depressed to its wide-open position, the detent switch closes the circuit to the detent solenoid in the transmission case. This detent solenoid controls a detent valve inside the valve body. The detent valve is controlled by the opposing forces of line pressure on one end and spring pressure on the other. When the detent solenoid is energized by the detent switch, it opens a small needle valve inside an exhaust passage, allowing line pressure to the detent valve to bleed off. Spring force moves the detent valve to its open position, causing a 3-2 or 2-1 downshift. At any accelerator pedal position other than wide-open throttle, the detent switch opens the circuit to the detent solenoid, the solenoid is de-energized, the exhaust passage is closed and line pressure overcomes spring pressure, moving the detent valve to its closed position. The detent switch is located at the upper end of the accelerator pedal.

Check

Note: *Make sure the carburetor is properly adjusted before beginning this procedure.*

2 Locate the detent switch at the upper end of the accelerator pedal.
3 Raise the vehicle and place it securely on jackstands.
4 Hook up a 12-volt test light between the detent switch terminal and ground. Turn on the ignition, but don't start the engine; the test light should be off. Depress the accelerator pedal all the way to the floor; the light should come on. If it doesn't come on, the switch needs to be either adjusted or replaced.

Adjustment

5 The switch is self-adjusting. To set it, push in the switch plunger (toward the firewall) as far as it will go. Then depress the accelerator pedal all the way to the floor. The switch should adjust itself automatically. If it doesn't, replace it.

Replacement

6 Disconnect the electrical leads from the switch, remove the bolt attaching the switch to its bracket and remove the switch.
7 Installation is the reverse of removal. Be sure to adjust the switch as described above.

6 Throttle Valve (TV) linkage - description and adjustment

Description

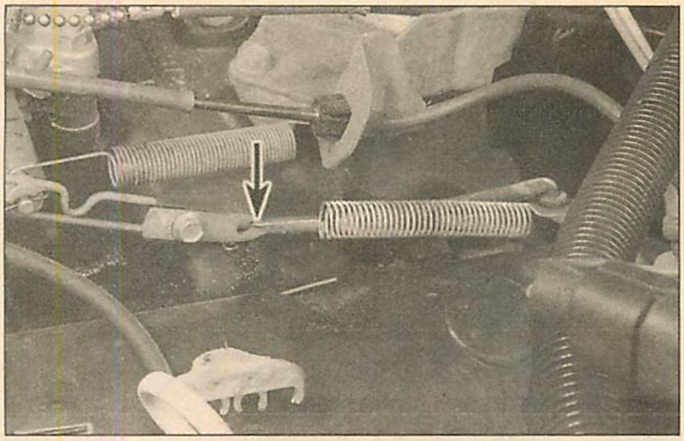
1 The transmission Throttle Valve (TV) is operated by a cam on the throttle lever, which in turn is operated by an adjustable cable. The cable is attached to an arm mounted on the throttle lever shaft. A lock button at the engine end of the cable is provided for cable adjustment. A correctly adjusted throttle valve cable will synchronize the throttle lever on the transmission with the throttle shaft lever on the throttle body so that the throttle lever on the transmission neither moves ahead of nor lags behind the lever on the throttle body.

Adjustment

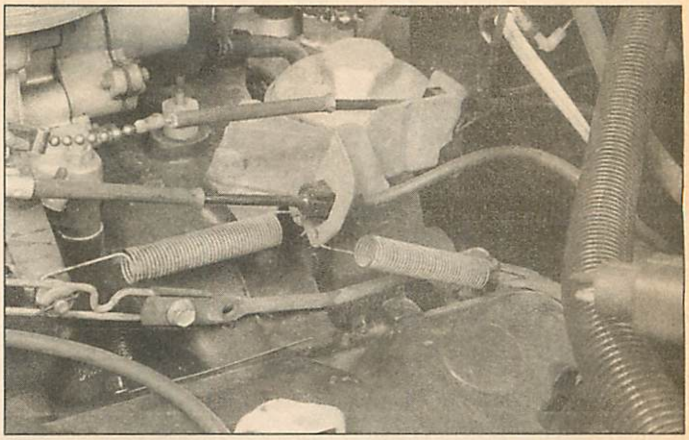
1980 and 1981 models

Six-cylinder models

2 Disconnect the throttle control rod spring from the control rod at the carburetor.
3 Raise the vehicle and place it securely on jackstands.
4 Push the transmission throttle control lever forward, against its stop, and use the throttle control rod spring to hold it there. Hook one end of the spring to the throttle control lever and the other end to the throttle linkage bellcrank bracket attached to the converter housing.
5 Block the choke open and set the carburetor throttle off the fast idle cam (see Chapter 4). If the carburetor is equipped with a throttle-operated solenoid valve, turn the ignition lock to the On position to energize the solenoid, open the throttle halfway to allow the solenoid to lock and return the carburetor to the idle position.
6 Loosen the retaining bolt on the throttle control adjusting link. Do NOT remove the spring clip and nylon washer.
7 Pull on the end of the link to eliminate lash and tighten the link retaining bolt.
8 Disconnect the throttle control rod spring from the linkage and reattach it to the control rod.
9 Remove the jackstands and lower the vehicle.



6.37 Disconnect the throttle control rod spring (arrow)



6.39 Use the throttle control rod spring to hold the throttle valve control rod forward

V8 models

10 Disconnect the throttle control rod spring from the control rod at the carburetor.

11 Raise the vehicle and place it securely on jackstands.

12 Push the transmission throttle valve control lever forward against its stop and use the throttle control rod spring to hold it there.

13 Block the choke open and set the carburetor throttle off the fast idle cam (see Chapter 4). If the carburetor is equipped with a throttle-operated solenoid valve, turn the ignition lock to the On position to energize the solenoid, open the throttle halfway to allow the solenoid to lock and return the carburetor to the idle position.

14 Loosen the retaining bolt on the throttle control rod adjusting link, remove the spring clip and move the nylon washer to the rear of the link.

15 Push on the end of the link to eliminate lash and tighten the link retaining bolt. Install the nylon washer and spring clip.

16 Disconnect the throttle control rod spring from the linkage and hook it up to the control rod.

17 Remove the jackstands and lower the vehicle.

1982 through 1988 models

Six-cylinder models with a Torqueflite 999 transmission

18 Disconnect the throttle control rod spring.

19 Use the throttle control rod spring to hold the adjusting link forward, against the nylon washer.

20 Block the choke open and set the carburetor throttle off the fast idle cam.

21 Raise the vehicle and place it securely on jackstands.

22 Loosen both retaining bolts on the throttle control adjusting link (but don't remove the spring clip and nylon washer.

23 Using a spare throttle return spring to hold the transmission throttle lever forward against its stop, hook one end of the spring to the throttle lever and the other end to the cast boss on the side of the torque converter housing.

24 Push on the end of the link to eliminate lash and pull the clamp to the rear so that the bolt in the rod bottoms in the rear of the slot in the rod. Tighten the clamp to the link using the forward bolt.

25 Pull the throttle control rod to the rear so that the bolt in the rod bottoms in front of the slot in the rod. Tighten the rear retaining bolt.

26 Remove the spare throttle return spring from the throttle lever.

27 Remove the jackstands and lower the vehicle.

28 Disconnect the throttle control rod spring from the adjusting link and hook it up to the control rod.

Six-cylinder models with a Torqueflite 727 transmission

29 Disconnect the throttle control rod spring at the carburetor.

30 Raise the vehicle and place it securely on jackstands.

31 Using the throttle control rod spring to hold the transmission throttle control lever forward against its stop, hook one end of the spring to the throttle control lever and the other end to the throttle linkage bellcrank bracket attached to the converter housing.

32 Block the choke open and set the carburetor throttle off the fast idle cam. If the carburetor is equipped with a throttle-operated solenoid valve, turn the ignition lock to the On position to energize the solenoid, open the throttle halfway to allow the solenoid to lock and return the carburetor to the idle position.

33 Loosen the retaining bolt on the throttle control adjusting link. Do NOT remove the spring clip and nylon washer.

34 Pull on the end of the link to eliminate lash and tighten the link retaining bolt.

35 Remove the throttle control rod spring from the linkage and install it on the control rod.

36 Remove the jackstands and lower the vehicle.

V8 models

Refer to illustrations 6.37, 6.39, 6.41 and 6.42

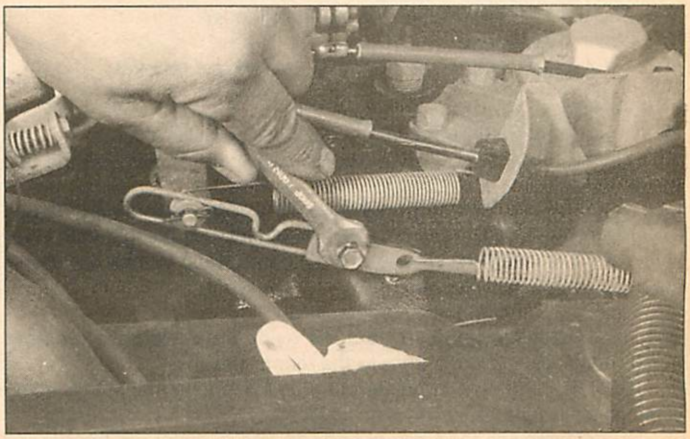
37 Disconnect the throttle control rod spring at the carburetor **(see illustration)**.

38 Raise the vehicle and place it securely on jackstands.

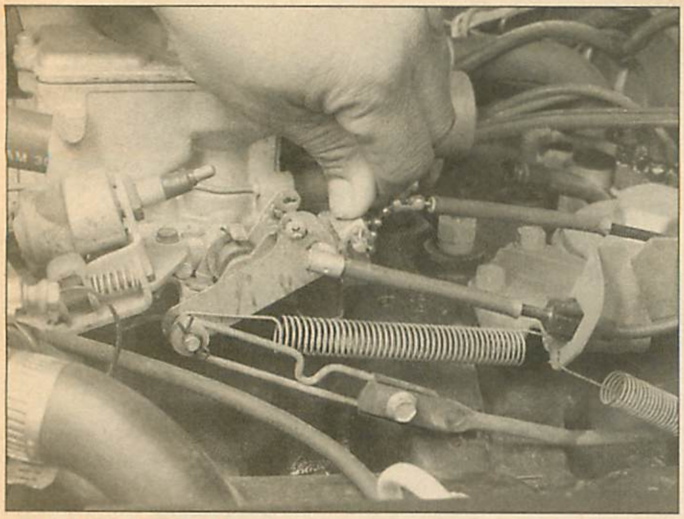
39 Move the transmission throttle valve control lever all the way forward until it's against its stop. In the engine compartment, use the throttle control rod spring to hold the throttle control rod forward **(see illustration)**.

40 Block the choke open and set the carburetor throttle off the fast idle cam. If the carburetor is equipped with a throttle-operated solenoid valve, turn the ignition lock to the On position to energize the solenoid, open the throttle halfway to allow the solenoid to lock, and return the carburetor to the idle position.

41 Loosen the retaining bolt on the throttle control rod adjusting link **(see illustration)**.



6.41 Loosen the retaining bolt on the throttle control rod adjusting link



6.42 Push the throttle lever all the way to the rear to eliminate lash, then tighten the link retaining bolt

42 Push the throttle lever all the way to the rear **(see illustration)** to eliminate lash, then tighten the link retaining bolt.
43 Detach the throttle control rod spring from the linkage and reattach it to the rod.
44 Remove the jackstands and lower the vehicle.

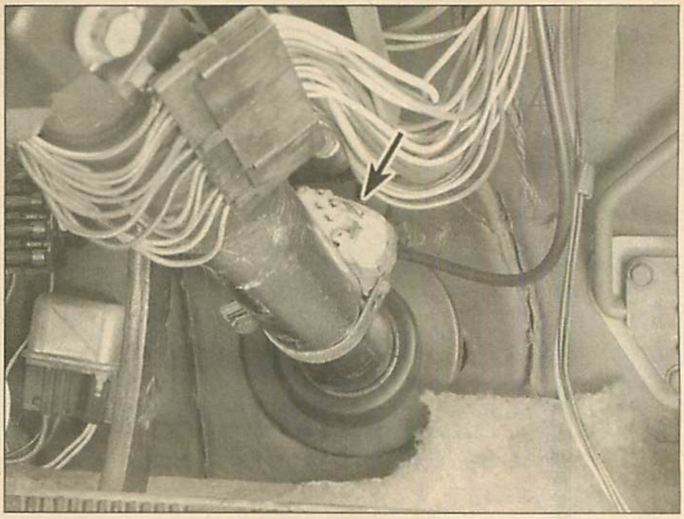
1989 and later vehicles

Six-cylinder models

45 Disconnect the throttle rod spring.
46 Use the throttle rod spring to hold the link forward against the nylon stop.
47 If the carburetor is equipped with a throttle-operated solenoid valve, turn the ignition switch to the On position to energize the solenoid, open the throttle halfway to allow the solenoid to lock and return the carburetor to the idle position.
48 If the carburetor is not equipped with a solenoid valve, block the choke open and set the carburetor throttle off the fast idle cam.
49 Raise the vehicle and place it securely on jackstands.
50 Loosen the two throttle rod retainer bolts.
51 Hold the throttle lever forward with a spare spring.
52 Pull on the end of the link to eliminate all lash.
53 Slide the clamp to the rear until the bolt which attaches the throttle rod to the clamp bottoms against the rear of the slot in the throttle rod.
54 Tighten the throttle rod retainer bolts securely.
55 Remove the holding spring from the throttle valve lever.
56 Remove the throttle valve spring from the link.
57 Lower the vehicle.
58 Connect the throttle rod spring to the rod and bracket.

V8 models

59 Disconnect the throttle rod spring from the bellcrank.
60 Block the choke open and set the carburetor throttle off the fast idle cam.
61 If the carburetor is equipped with a throttle-operated solenoid valve, turn the ignition switch to the On position to energize the solenoid, open the throttle halfway to allow the solenoid to lock and return the carburetor to the idle position.
62 Loosen the throttle rod retainer bolt.
63 Remove the spring clip from the nylon stop. Remove the stop from the lug and move the step to the rear of the link.
64 Hold the bellcrank in place, push on the end of the link to eliminate lash and tighten the link retaining bolt.
65 Install the nylon stop and spring clip and connect the throttle rod spring.



7.1 A typical neutral start/back-up light switch (arrow) used on 1972 through 1979 models (electrical connector unplugged for clarity)

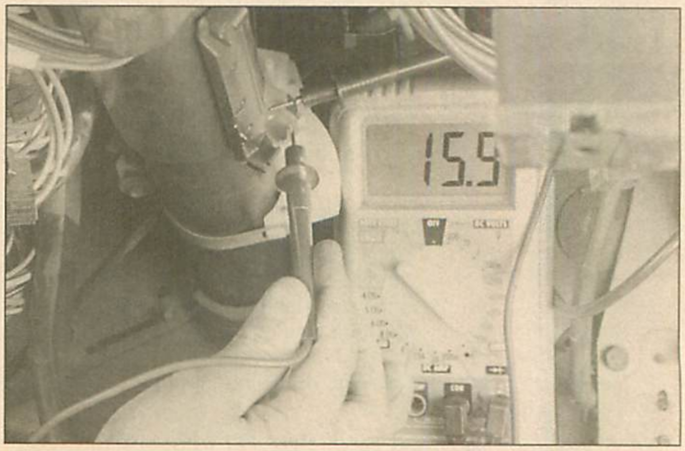
7 Neutral start/back-up light switch - check, adjustment and replacement

Check

1972 through 1979 models

Refer to illustrations 7.1 and 7.5

1 The Neutral start and back-up light switch **(see illustration)** is located on top of the steering column, near the firewall. When the switch is operating properly, the engine should start only when the shift lever is in Park or Neutral, and the back-up lights should come on when the shift lever is in Reverse. If the engine starts in any other gear, or the back-up lights don't come on, either the shift linkage is out of adjustment or the switch needs to be adjusted or replaced.
2 Make sure the shift linkage is properly adjusted (see Section 3).
3 Verify that there's voltage available at the switch with the ignition key turned to On.
4 Verify that the switch has continuity when it's in Park, Neutral or Reverse as follows.
5 Unplug the electrical connector and, using an ohmmeter **(see illustration)**, verify that there's continuity when the switch is in Park or



7.5 To check a neutral start/back-up light switch, unplug the electrical connector and check continuity of the appropriate terminals with the shift lever in Park and Neutral, then check continuity of the appropriate terminals with the shift lever in Reverse

7.9 A typical neutral start/back-up light switch (arrow) used on 1980 and later models

Neutral (neutral start terminals) and Reverse (back-up light terminals). There are many terminal arrangements on various switches, so how do you know which terminals to check? You don't! But it's easy to figure out. There are no more than six terminals: two are for the neutral start switch, two are for the back-up lights and two are for the seat belt warning buzzer, if equipped; early switches may have only four terminals (neutral start and back-up lights). So try each pair of terminals in Neutral, Park and Reverse, and you'll figure it out. The neutral start switch should have continuity only when the switch carrier tang (the sliding contact that moves as the shift lever is rotated) is in the Neutral or Park position. The back-up light switch should have continuity only when the switch carrier tang is in the Reverse position. **Note:** *If testing the switch on the steering column proves difficult or inconclusive, remove it and check it on the bench instead.*

6 If the switch doesn't operate as described, try adjusting it (see below) and retest.

7 If the switch doesn't operate as described after adjustment, replace it (see below)

1980 and later models

Refer to illustrations 7.9 and 7.11

8 Raise the front of the vehicle and place it securely on jackstands.

9 The Neutral start/back-up switch is threaded into the lower left front edge of the transmission case. The Neutral start and back-up light switch functions are combined into one unit, with the center terminal of the switch grounding the starter solenoid circuit when the transmission is in Park or Neutral, allowing the engine to start. The outer terminals make up the back-up light switch circuit **(see illustration)**.

10 Prior to checking the switch, make sure the shift linkage is properly adjusted (see Section 3). Raise the vehicle and support it securely on jackstands.

11 Unplug the connector and use an ohmmeter or self-powered test light to check for continuity between the two outer terminals **(see illustration)**. There should be continuity only when the transmission is in Reverse. There should be no continuity between either of the outer terminals and the transmission case.

12 Check for continuity between the center terminal and the transmission case. Continuity should exist only when the transmission is in Park or Neutral.

Replacement and adjustment

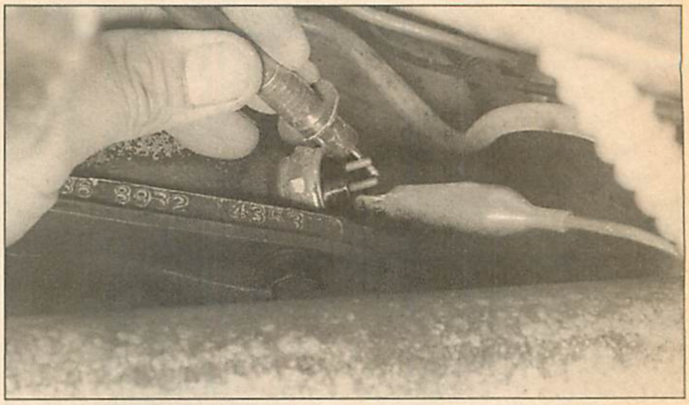
1972 through 1979 models

Refer to illustrations 7.14, 7.15 and 7.16

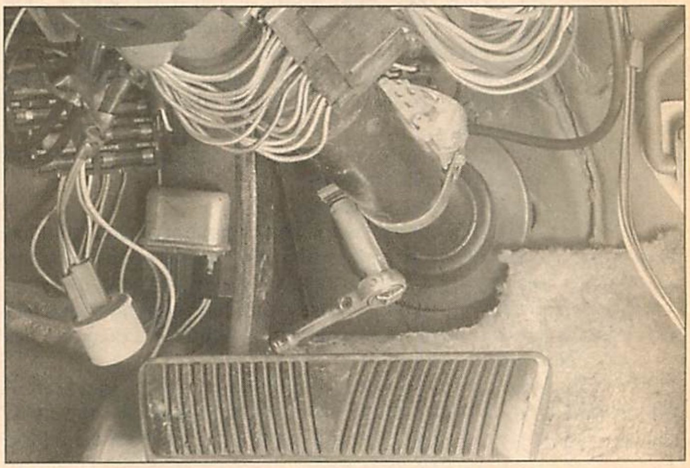
13 Unplug the electrical connector(s). If there is more than one connector, make sure you label or mark the connectors and terminals.

14 Remove the switch retaining screw **(see illustration)** and clamp.

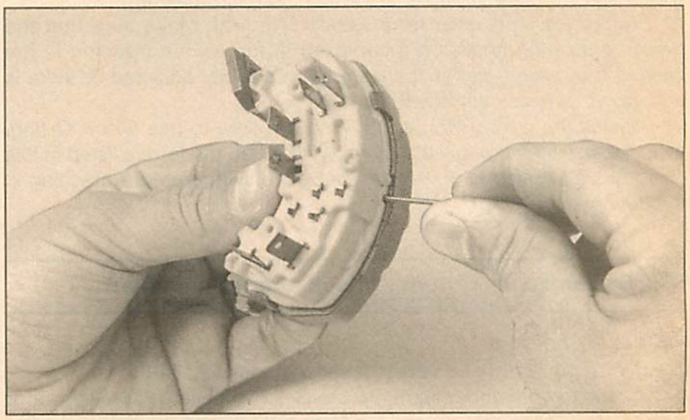
15 If you're installing the old switch, adjust it by sliding the carrier tang to the Neutral position and inserting an 0.080-inch diameter gage



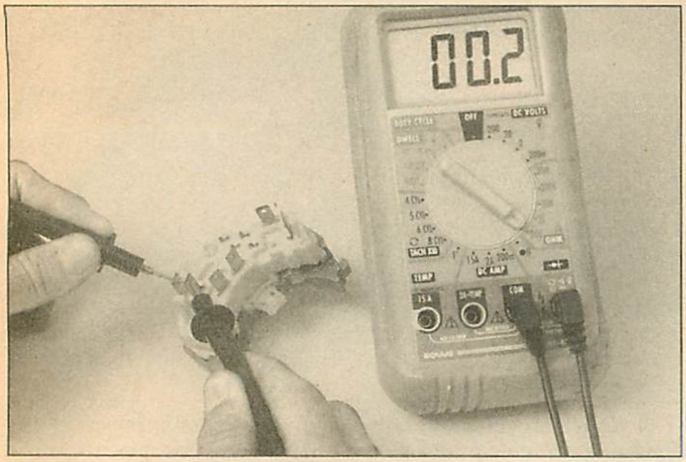
7.11 Check for continuity between the two outer terminals of the Neutral start/backup light switch - there should be continuity only when the transmission is in Reverse and no continuity between either of the outer terminals and the transmission case; check for continuity between the center terminal and the transmission case - continuity should exist only when the transmission is in Park or Neutral



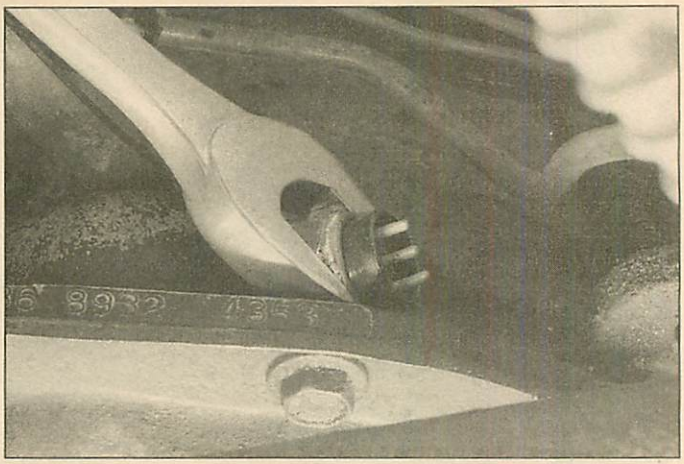
7.14 To remove a neutral start/back-up light switch on a 1972 through 1979 model, remove the small retaining screw on the left side of the column, remove the band that clamps the switch to the column, then lift the switch straight up



7.15 On 1972 through 1979 models, slide the carrier tang to the Neutral position, insert an 0.080-inch diameter gage pin through the hole in the switch cover, then slide the carrier tang back-and-forth a tiny bit until the pin drops through the alignment hole in the inner plastic slide; leave this pin in place until the switch has been installed, but be sure to remove it before shifting out of Neutral



7.16 Using an ohmmeter, verify that the switch has continuity with the carrier tang in the Neutral position (1972 through 1979 models)



7.20 Remove the neutral start/back-up light switch with a wrench or socket (1980 and later models)

pin through the hole in the switch housing and the alignment hole in the sliding plastic carrier **(see illustration)**. If you don't have a gage pin, use a drill bit or a needle. Jiggle the tang back and forth a little to verify that the gage pin has gone all the way through the housing and the tang. Do not remove the pin until the switch is installed. (A new switch will have a shear pin already installed; when you shift out of Neutral, it will shear off.)

16 Use an ohmmeter to verify that the switch has continuity with the carrier tang in Neutral **(see illustration)**.

17 Installation is the reverse of removal.

18 Make sure the column shift lever is in the Neutral position and the carrier tang on the switch is locked into the neutral position by the gage pin (or shear pin on a new switch). Do not pull out the gage pin until the switch retaining clamp is in place and the retaining screw has been tightened. Make sure the electrical connectors are plugged into the correct terminals.

19 Verify that the car starts in Neutral, then remove the gage pin. If you installed a new switch, simply move the shift lever all the way to the right (Low), then move it all the way to the left (Park) to shear off the pin.

1980 and later models

Refer to illustration 7.20

20 Place a container under the transmission to catch the fluid which will be released, then remove the switch **(see illustration)**.

21 Move the shift lever from Park to Neutral. Make sure that the switch operating fingers are centered in the switch opening in the case. If they aren't, the shift linkage is incorrectly adjusted or there is an internal problem with the transmission.

22 Install the new switch and O-ring (be sure to use a new O-ring, even if installing the original switch), tighten it to the torque listed in this Chapter's Specifications, then recheck the switch before plugging in the connector.

8 Transmission mount - check and replacement

Refer to illustration 8.2

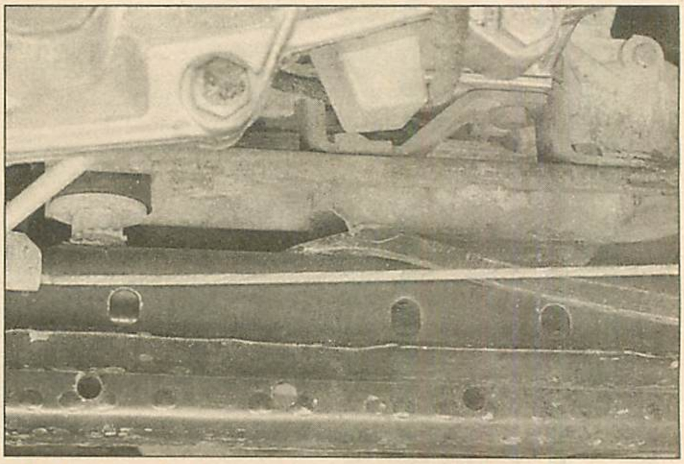
1 Raise the vehicle and place it securely on jackstands.

2 Working from underneath the vehicle, insert a large screwdriver or prybar into the space between the transmission and the crossmember **(see illustration)**. Try to pry the transmission up slightly. The transmission should not move away from the insulator much at all. If the mount insulator is cracked, torn or worn out, replace the mount.

3 To replace the mount, remove the bolts which attach the mount to the crossmember and to the transmission.

4 Raise the transmission or transfer case slightly with a jack and remove the insulator, noting which holes are used in the crossmember for proper alignment during installation.

5 Installation is the reverse of the removal procedure. Be sure to tighten the nuts/bolts securely.



8.2 To check the transmission mount, insert a large screwdriver or prybar between the extension housing and crossmember (2WD models) or between the transfer case and crossmember (4WD models) and try to lever the transmission up off the mount

9 Automatic transmission - removal and installation

Removal

Refer to illustrations 9.15, 9.20, 9.21, 9.23a, 9.23b, 9.23c and 9.25

1 Disconnect the negative cable from the battery.

2 Remove the fan shroud, if equipped (see Chapter 3).

3 Remove the transmission dipstick and unbolt the upper bracket for the transmission fill tube (it's easier to unbolt the lower end of the tube after raising the vehicle).

4 Raise the vehicle and support it securely on jackstands.

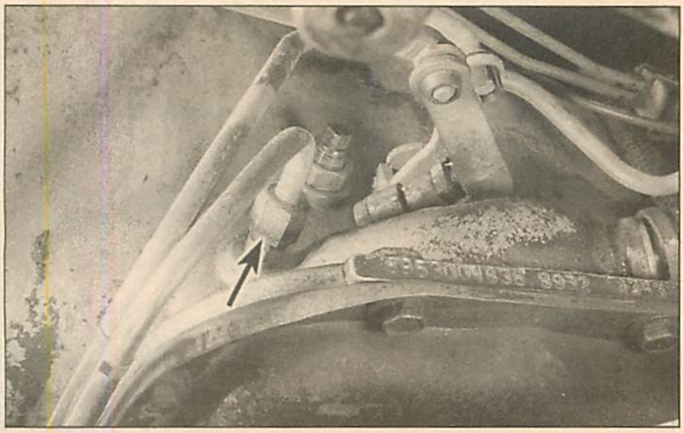
5 Remove those parts of the exhaust system that interfere with transmission/transfer case removal (see Chapter 4).

6 Remove the skid plate, if equipped.

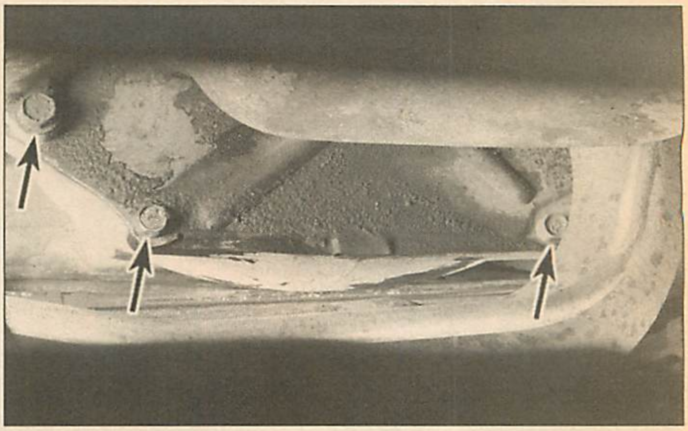
7 Unbolt the lower end of the transmission fill tube and remove the tube.

8 Mark the U-joints and remove the front and rear driveshafts (see Chapter 8).

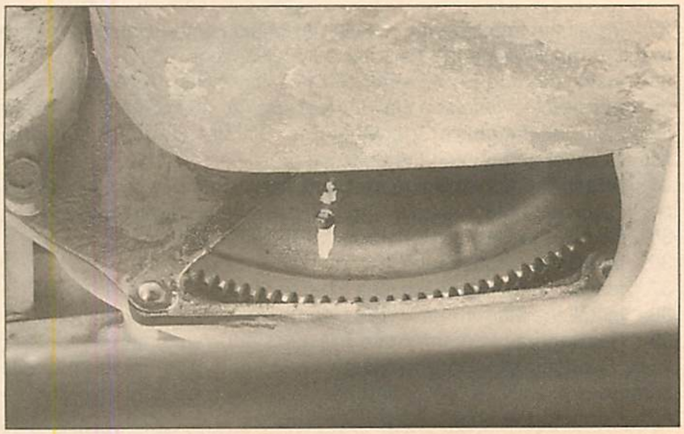
9 Disconnect the parking brake cable at the adjuster and disengage



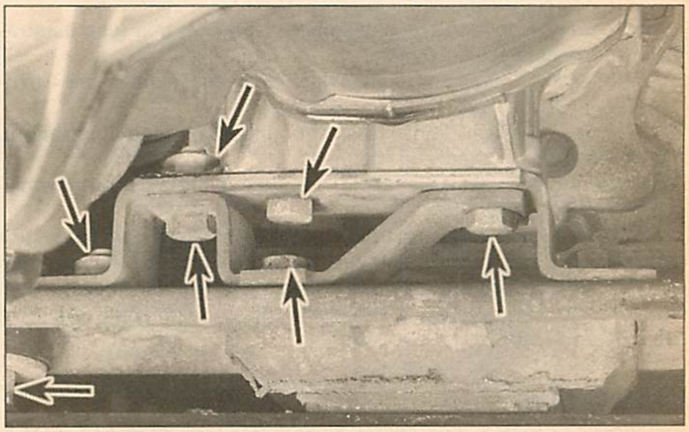
9.15 Disconnect the oil cooler lines at the fittings (arrow) on the transmission (forward fitting shown, rear fitting not visible in this photo)



9.20 To remove the torque converter access cover, remove these bolts (arrows) (some covers may have more bolts)



9.21 Mark the relationship of the torque converter to the driveplate, then remove the torque converter bolts one at a time by rotating the crankshaft at the pulley/damper end with a wrench



9.23a To disconnect the transmission mount from the transmission and the crossmember, remove these nuts and bolts (arrows), . . .

the front cable from the crossmember (see Chapter 9).

10 On models with a low-range reduction unit, remove the reduction unit shift lever (Wagoneer) or disconnect the shift rod at the reduction unit shift lever (truck).

11 Disconnect the speedometer cable (see Chapter 7, Part C).

12 Unplug all electrical connectors, unclip the wire harnesses from their retaining clips on the transmission and transfer case, and set the harnesses aside. It's a good idea to label all connectors with colored electrical tape to simplify reassembly. Remove any electrical harness brackets that may interfere with removal.

13 Clearly label, then disconnect, all vacuum lines from the transmission and transfer case. Remove any vacuum line brackets that may interfere with removal.

14 Drain the transmission fluid (see Chapter 1).

15 Disconnect the transmission cooler hoses and lines **(see illustration)**. Plug the cooler hoses/lines to prevent leakage and to protect the transmission from contamination.

16 Disconnect the throttle valve (TV) linkage from the transmission (see Section 3).

17 Disconnect the transfer case shift linkage at the transfer case range lever (see Chapter 7 Part C). Move the linkage aside for clearance. Remove any linkage brackets that may interfere with removal.

18 Remove the transfer case (see Chapter 7 Part C).

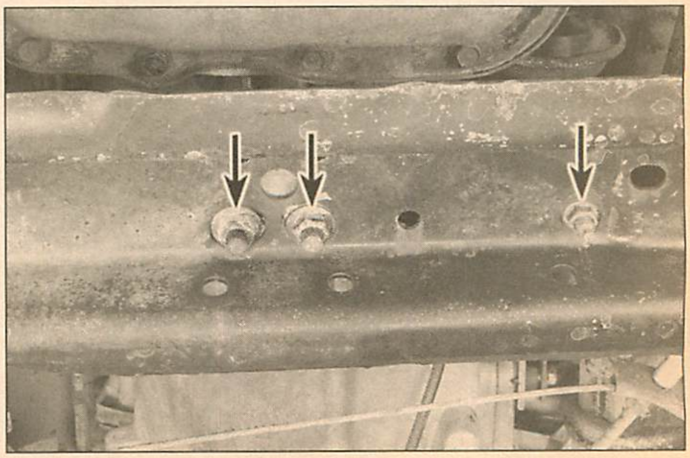
19 Remove the starter (see Chapter 5).

20 Remove the torque converter access cover from the transmission **(see illustration)**.

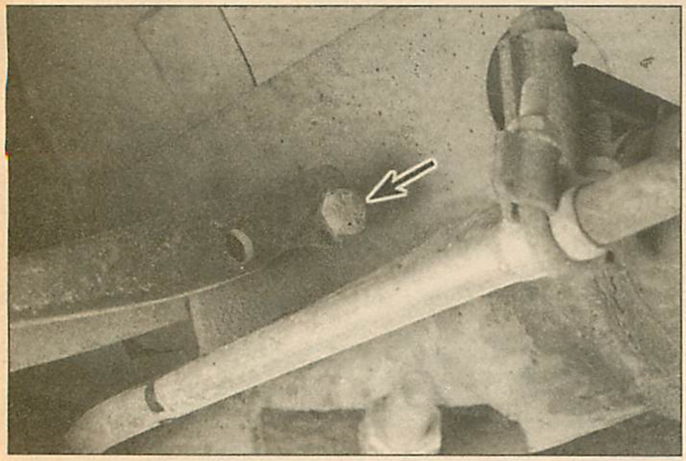
21 Mark the relationship of the torque converter to the driveplate so they can be installed in the same position **(see illustration)**. Remove the torque converter-to-driveplate bolts. Turn the crankshaft for access to each bolt. Turn the crankshaft in a clockwise direction only (as viewed from the front).

22 Support the transmission with a floor jack and, if available, a transmission jack adapter. Safety chains will help steady the transmission on the jack.

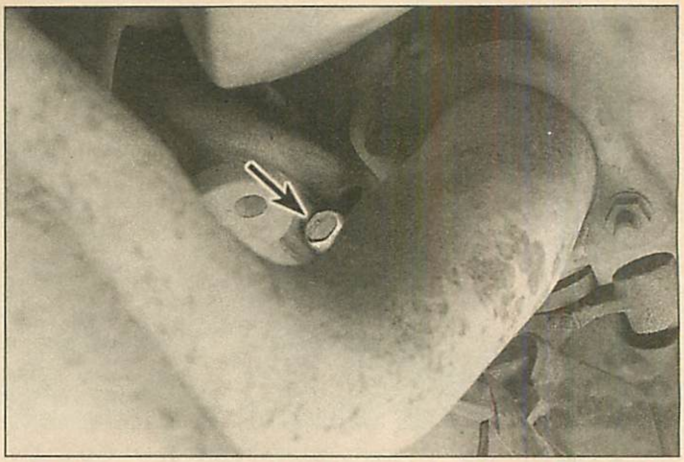
23 Remove the nuts and bolts which attach the transmission mount to the crossmember **(see illustrations)**. Raise the transmission



9.23b . . . and these nuts (arrows) from underneath the crossmember



9.23c Raise the transmission with a jack, remove this nut and bolt (arrow) and remove the crossmember



9.25 The right transmission-to-engine bolt (arrow) is located above the starter

slightly, then remove the crossmember-to-bracket bolt **(see illustration)** and remove the crossmember.

24 Support the engine with a floor jack or an engine hoist (see Chapter 2).

25 Remove the right transmission-to-engine bolt **(see illustration)**, which is located above the starter hole.

26 Lower the transmission slightly and remove the upper transmission-to-engine bolts.

27 Move the transmission to the rear to disengage it from the engine block dowel pins and make sure the torque converter is detached from the driveplate. Secure the torque converter to the transmission so it won't fall out during removal. Lower the transmission and move it out from under the vehicle.

Installation

28 Prior to installation, make sure the torque converter hub is securely engaged in the front pump. This can be done by turning the converter in a clockwise direction while pushing in on it. The converter will "clunk" into place if it isn't already seated. Keep turning the converter until it is completely seated (you may feel two or three clunks).

29 With the transmission secured to the jack, raise it into position. Be sure to keep it level so the torque converter does not slide forward. Connect the transmission fluid cooler lines.

30 Turn the torque converter to line up its bolt holes with the holes in the driveplate. The mark on the torque converter and the driveplate made in Step 21 must line up.

31 Carefully move the transmission forward until the dowel pins and the torque converter are engaged.

32 Install the transmission housing-to-engine bolts. Tighten the bolts to the torque listed in this Chapter's *Specifications*.

33 Install the torque converter-to-driveplate bolts. **Note:** *Install all of the bolts before tightening any of them.* Tighten the bolts to the torque listed in this Chapter's Specifications. Install the torque converter access cover and tighten the bolts securely.

34 Attach the transmission mount-to-crossmember and crossmember-to-bracket nuts and bolts. Tighten the nuts/bolts securely.

35 Remove the jacks supporting the transmission.

36 Install the dipstick tube.

37 Install the transfer case (see Chapter 7 Part C).

38 Install the starter motor (see Chapter 5).

39 Reattach all vacuum hose brackets and reconnect all vacuum lines. Reattach all wiring harness brackets and clips, route the wiring harnesses exactly as before and plug in all electrical connectors.

40 Connect the shift linkage (see Section 3) and the throttle valve linkage (see Section 6). Connect the transfer case shift linkage (see Chapter 7 Part C).

41 Install the driveshaft(s) (see Chapter 8).

42 Install any exhaust system components that were removed or disconnected.

43 Remove the jackstands and lower the vehicle.

44 Fill the transmission with the specified fluid (see Chapter 1), run the engine and check for fluid leaks.

45 Adjust the transmission shift linkage (see Section 3) and the TV linkage (see Section 6). Adjust the transfer case shift linkage (see Chapter 7 Part C).

46 Test drive the vehicle and make sure everything is working properly.

Chapter 7 Part C
Transfer case

Contents

Specifications

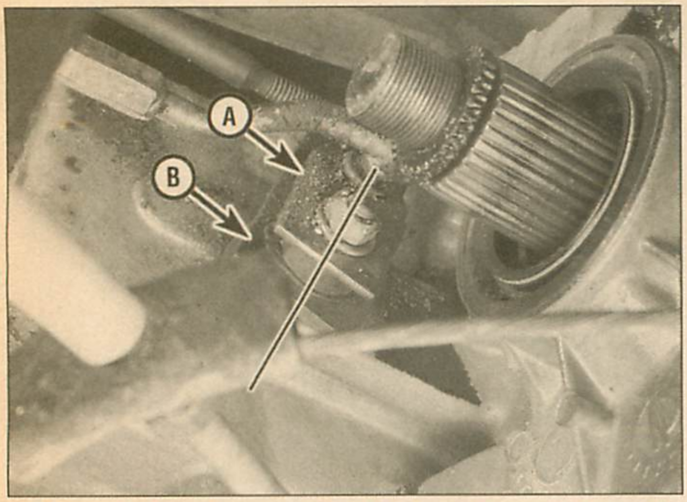
Torque specifications

	Ft-lbs
Front and rear output shaft yoke nuts	
1972 through 1978 Model 20	240
All others	120
Transfer case-to-transmission bolts	
Model 20	30
All others	40

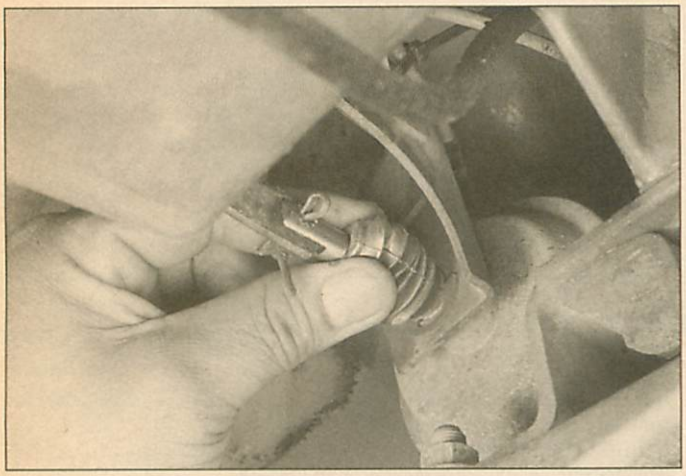
1 General information

The transfer case is basically a transmission which passes the power from the engine and transmission to the front and rear driveshafts and axles. Over the long production life of these vehicles, five transfer cases were used: Dana/Spicer Model 20, Borg-Warner Quadra-Trac, New Process Model 208, New Process Model 219 Quadra-Trac and New Process Model 229 Selec-Trac. The Dana/Spicer Model 20, used in part time 4WD models through 1979 and can be identified by its cast iron case. On all other models, the model number can be determined by looking the identification tag, the model number will be stamped into the tag.

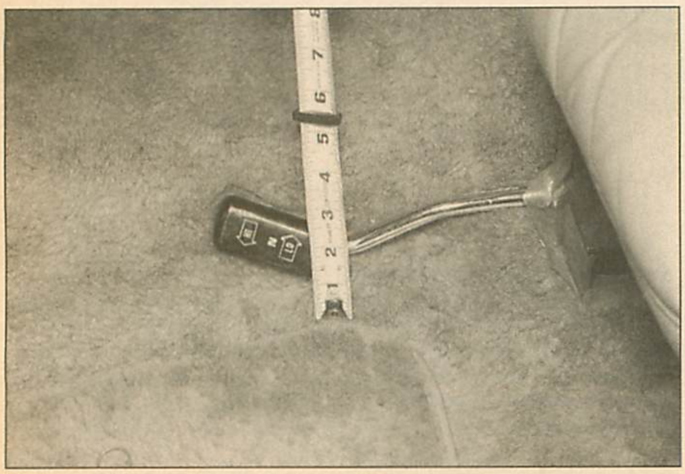
The Dana/Spicer Model 20 provides two gear ratios (high and low) in 4WD; 2WD; and neutral. The Borg-Warner Quadra-Trac provides full-time 4WD; a lockout device locks the front and rear drives together; and a low-gear reduction unit is bolted to the back of the transfer case. The New Process 208 provides 2HI, 4HI and 4LOW; there is no center differential, so 4HI and 4LOW are available for off-road use only. The New Process Model 219 Quadra-Trac is similar to the Model 208, except that it has a center differential, so 4HI can also be used on pavement. The New Process Model 229 Selec-Trac is similar in operation to the Model 219.



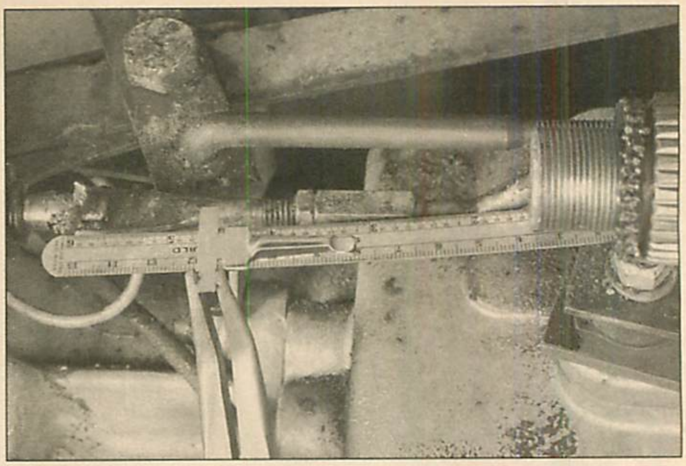
2.4 With the transfer case in 2WD/HI, locate the mode lever (A) and the range lever (B) - verify that they're aligned on the same centerline



2.8 Once you have verified that the transfer case is in 2WD/HI, the mode lever and range lever are properly aligned, and the mode rod is the correct length, pull the vacuum motor shaft rearward as far as it will go and verify that the pin moves freely in the holes through the vacuum motor shaft and the mode rod. If it doesn't, readjust the mode rod



2.9 Inside the vehicle, measure the height of the range lever above the floor



2.5 Measure the length of the mode rod from the center of the hole in the mode lever to the hole for the pin that attaches the mode rod to the vacuum motor shaft and repeat the procedure.

2 Shift linkage (Model 229) - adjustment

Mode rod

Refer to illustrations 2.4, 2.5 and 2.8

1 The mode rod must be adjusted correctly for proper operation of the transfer case and the Selec-Trac system.

2 Shift the transfer case into 2WD/HI. The transfer case must be in 2WD/HI before the mode rod can be measured and adjusted.

3 Raise the vehicle and place it securely on jackstands.

4 Look at the mode lever and the range lever **(see illustration)**. They should be aligned on the same centerline.

5 Measure the length of the mode rod **(see illustration)**. It should be approximately 5.9 inches long. If it's not, first make sure that the mode lever is actually in the 2WD/HI position. If you had difficulty putting the transfer case into 2WD/HI, it may not be fully engaged, or the linkage may be so far out of adjustment that the transfer case simply won't go into 2WD/HI. There are two ways to ensure that the transfer case is fully engaged in 2WD/HI:

6 First, try rotating the transfer case output shaft by having an assistant rotate the rear axle or driveshaft while you apply a load on the mode lever to fully engage 2WD/HI. This method usually aligns the splines, which allows complete engagement. Now measure the length of the mode rod again and if it's still too long or too short, loosen the jam nut and turn the adjuster to achieve the correct length, then repeat the procedure and measure the rod again. Do this several times until the transfer case is fully engaged in 2WD/HI, the mode lever and range lever are aligned as described in Step 4, and the mode rod is the correct length.

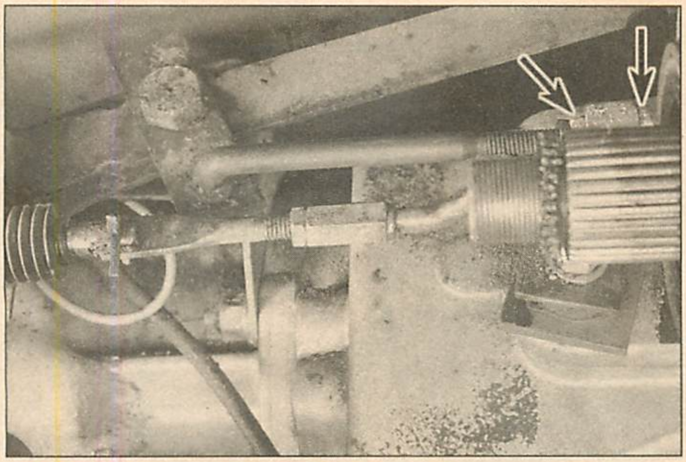
7 If the first method fails, drive the vehicle. First, make sure that all vacuum lines are properly attached and are a tight fit. Then measure and adjust the rod as described in Step 6. Drive the vehicle a short distance, shifting back and forth between 4WD and 2WD/HI. Put the vehicle back up on jackstands and check the mode lever position. The lever should be aligned with the range lever as described in Step 4. If it isn't, increase the mode rod length one turn and repeat the procedure.

8 Once you have verified that the transfer case is in 2WD/HI, the mode lever and range lever are properly aligned, and the mode rod is the correct length, pull the vacuum motor shaft rearward as far as it will go **(see illustration)** and verify that the pin moves freely in the holes through the vacuum motor shaft and the mode rod. If it doesn't, adjust the mode rod length as described in Step 5.

Range rod

Refer to illustrations 2.9 and 2.10

9 After the mode rod has been adjusted, check the position of the range lever inside the vehicle **(see illustration)**. The range lever should



2.10 To shorten or lengthen the length of the range rod, loosen these two locknuts (arrows) on either side of the trunnion at the upper end of the range lever

4.4a To remove the output shaft yoke retaining nut from the yoke, . . .

be about 1/2-inch to 1-inch above the floor when it's in the 2WD/HI mode. This allows enough travel for full engagement.

10 If the range lever inside the vehicle is too high or too low, go back underneath the vehicle and loosen the locknuts **(see illustration)** at the upper end of the range lever on the transfer case and shorten or loosen the range rod until the range lever inside the vehicle is the correct height above the floor. Tighten the locknuts securely.

3 Shift cable (Quadra-Trac reduction unit) - adjustment

1 Raise the vehicle and place it securely on jackstands.

2 Disconnect the swivel block from the control lever on the reduction unit.

3 Move the control lever as far forward as it will go.

4 Screw the swivel block in or out on the threaded end of the cable to produce a free fit in the reduction unit control lever.

5 Reconnect the swivel block to the control lever.

6 Lower the vehicle, take it for a test drive and check the operation of the reduction unit.

4 Oil seal replacement

1 Oil leaks frequently occur due to wear of the front or rear output shaft seals and/or the speedometer driven gear assembly O-ring and seal. Replacement of these seals and O-rings is relatively easy, since they can be replaced without removing the transfer case from the vehicle.

Output shaft seals

Refer to illustrations 4.4a, 4.4b, 4.5, 4.6 and 4.7

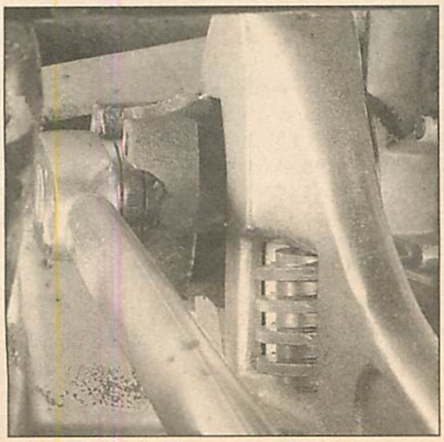
2 There are oil seals for the front and rear output shafts of the transfer case. If you suspect leakage at the seal, raise the vehicle and support it securely on jackstands. If the front seal is leaking, transmission lubricant will be dripping from behind the dust cover for the front output shaft yoke, down the front and underside of the transfer case; if the rear seal is leaking, transmission fluid will be dripping onto the U-joint at the forward end of the driveshaft.

3 Remove the front or rear driveshaft (see Chapter 8).

4 Remove the yoke retaining nut and remove the yoke **(see illustrations)**. If the yoke is stuck on the splines of the output shaft, use a soft-faced hammer to carefully tap it loose.

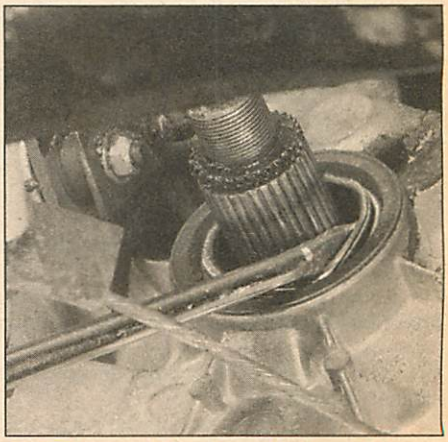
5 Remove the felt seal from the output shaft **(see illustration)**. Inspect this seal and discard it if it's damaged. use a new one when you install the yoke.

6 Using a prybar or a screwdriver, carefully pry the oil seal out of the transfer case **(see illustration)**. Do not damage the splines on the output shaft. If the oil seal cannot be removed with a screwdriver or pry bar, a special oil seal puller tool (available at auto parts stores) will be required.

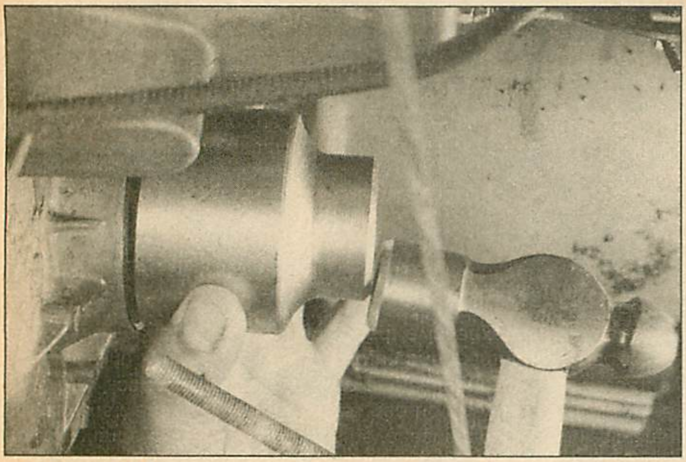


4.4b . . . hold the yoke with a large wrench and break the nut loose with a breaker bar

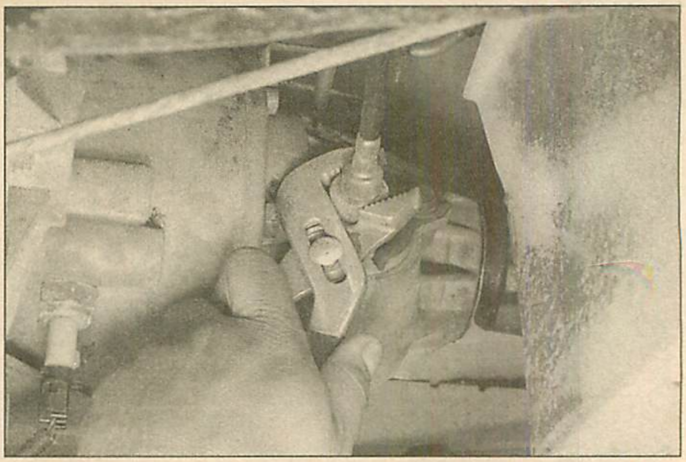
4.5 Remove the felt seal (if equipped) from the output shaft and inspect it for wear; if it's worn, replace it



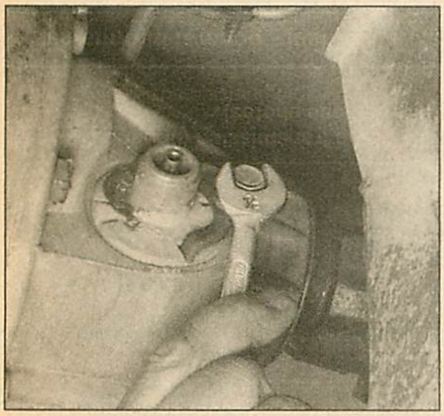
4.6 Remove the output shaft seal with a prybar or screwdriver; make sure you don't damage the splines or the seal bore



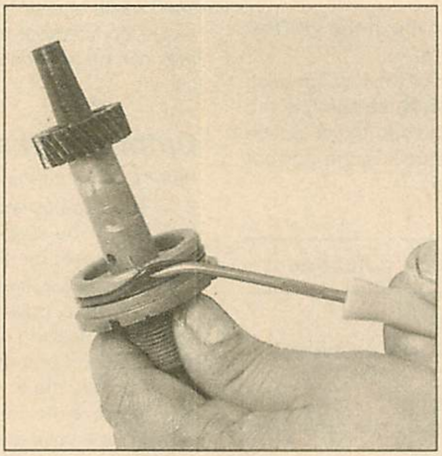
4.7 Install the new seal with a large deep socket or section of pipe with an outside diameter slightly smaller than the outside diameter of the new seal



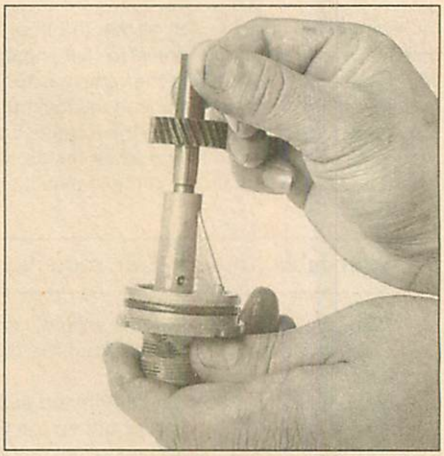
4.10 Unscrew the knurled speedometer cable fitting and disconnect the cable from the speedometer driven gear assembly



4.11 Remove the speedometer driven gear retaining bolt and hold-down clamp, then pull the driven gear assembly straight out of the case



4.12a Replace the large O-ring on the housing, . . .



4.12b . . . remove the speedometer driven gear, . . .

7 Using a large section of pipe or a very large deep socket as a drift, install the new oil seal **(see illustration)**. Drive it into the bore squarely and make sure it's completely seated.

8 Lubricate the splines of the output shaft and the inside of the yoke with anti-seize compound or grease, then install the yoke and tighten the yoke retaining nut to the torque listed in this Chapter's Specifications. Be careful not to damage the lip of the new seal.

Speedometer driven gear assembly O-ring and seal

Refer to illustrations 4.10, 4.11, 4.12a, 4.12b and 4.12c

9 The speedometer driven gear assembly is located on the rear part of the transfer case. Look for transmission fluid around the cable housing to determine if the seals are leaking.

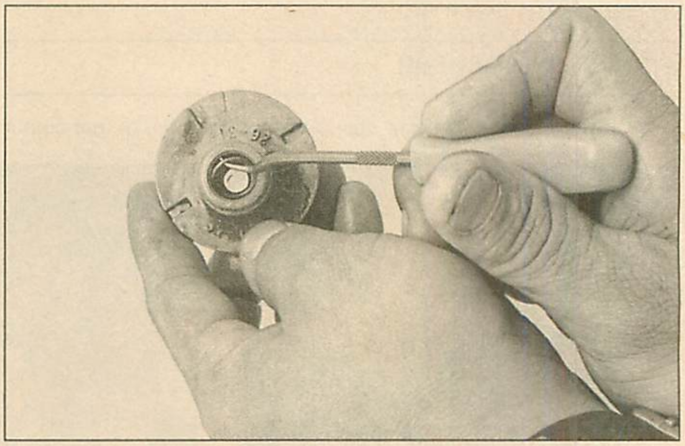
10 Disconnect the speedometer cable from the driven gear **(see illustration)**.

11 Remove the driven gear assembly retaining bolt and adapter clamp **(see illustration)**. Remove the speedometer driven gear assembly.

12 Remove the O-ring and the driven gear shaft seal from the housing **(see illustrations)**.

13 Thoroughly clean the housing flange and mounting surface in the transfer case. These surfaces must be clean for the seals to seal properly.

14 Install a new O-ring and seal on the housing . Lubricate the O-ring and seal with transmission fluid.

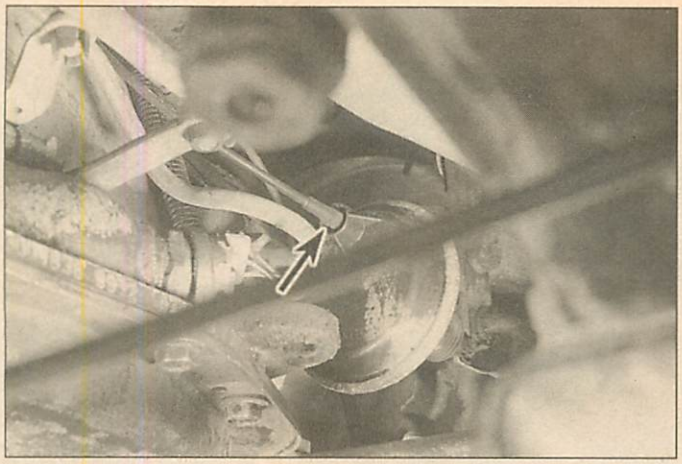


4.12c . . . and replace the small seal inside the bore for the driven gear shaft; be sure to lubricate the new O-ring and seal with transmission fluid

15 Installation is the reverse of removal. Be sure to tighten the retaining bolt securely.

16 Remove the jackstands and lower the vehicle.

17 Test drive the vehicle, make sure the speedometer works, then check for leaks.



5.2 Detach the front vacuum hose from the front port (arrow) of the shift motor

5 Transfer case shift motor (Model 229) - check and replacement

Check

Refer to illustrations 5.2, 5.3, 5.6, 5.8a, 5.8b and 5.8c

1 Raise the vehicle and place it securely on jackstands.

2 Detach the front vacuum hose from the shift motor **(see illustration)**.

3 Connect a hand-operated vacuum pump to the shift motor front port **(see illustration)**.

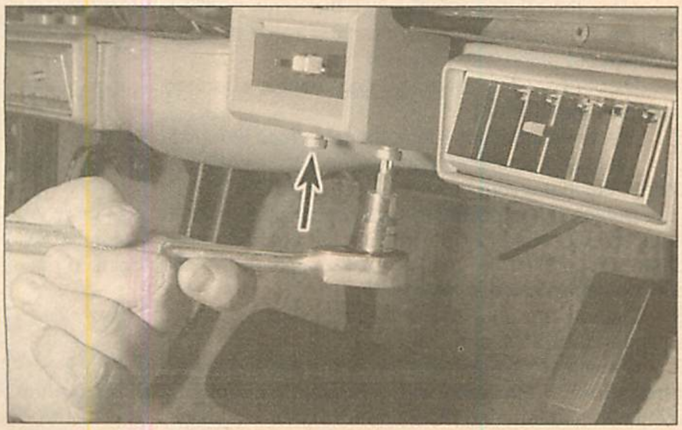
4 Apply 15 inches of vacuum to the shift motor. Make sure the transfer case fully engages into 4WD by rotating the rear driveshaft.

5 The shift motor should maintain the vacuum applied to the front port for at least 30 seconds. If it doesn't, replace the motor. If it does, proceed to the next step.

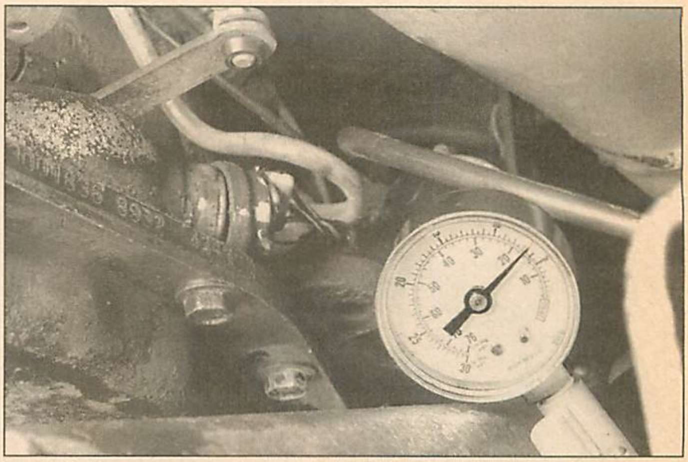
6 Disconnect the vacuum pump from the front port, reattach the front vacuum hose to the front port, detach the rear vacuum hose from the rear shift motor port **(see illustration)**, connect the vacuum pump to the rear port and apply 15 inches of vacuum to the motor.

7 The shift motor should maintain the vacuum applied to the rear port for at least 30 seconds. If it doesn't, replace the motor. If it does, proceed to the next Step.

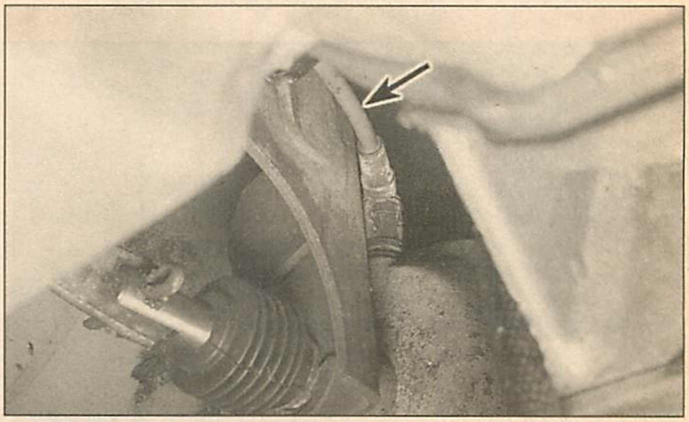
8 If vacuum holds in both of these tests, the shift motor is okay, but there's a problem else where in the system. Inspect the vacuum lines



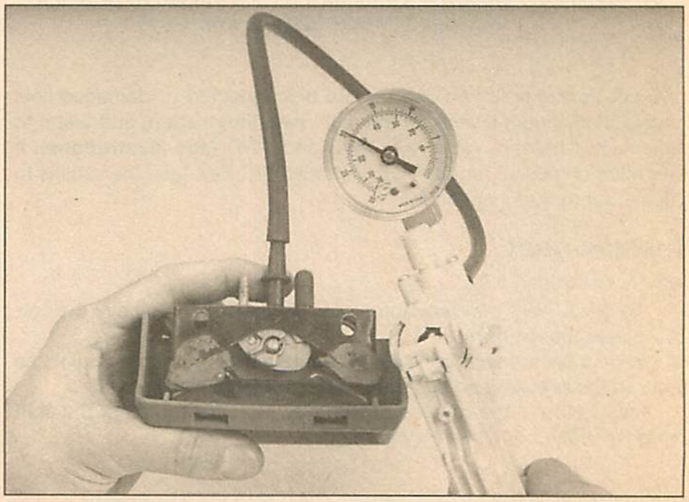
5.8a To detach the vacuum switch from the dash, remove these two screws, pull the switch down, unplug the electrical leads for the illumination lights and detach the three vacuum hoses (label the vacuum hoses to make sure you reattach them to the correct ports)



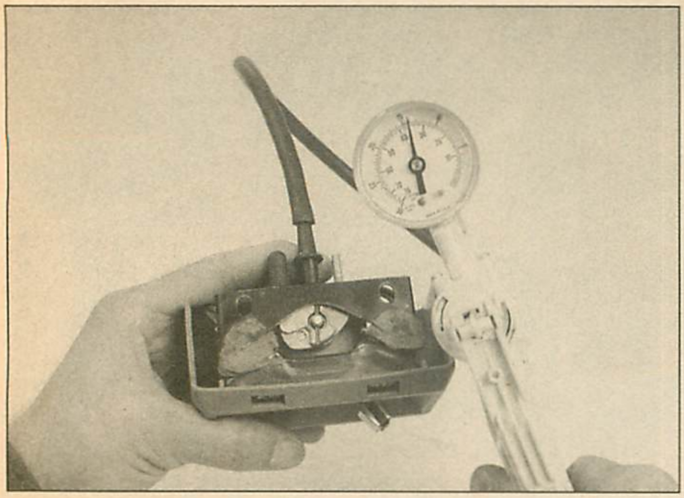
5.3 Connect a hand-operated vacuum pump to the shift motor front port and apply 15 in-Hg of vacuum; the shift motor should hold this vacuum for at least 30 seconds



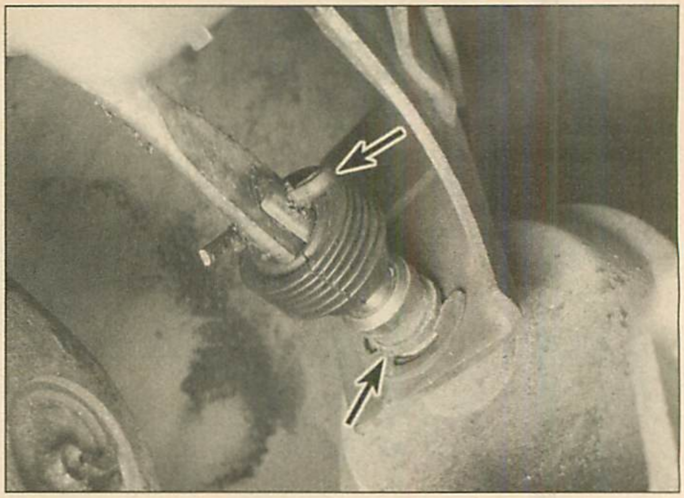
5.6 Detach the rear vacuum hose (arrow) from the rear port, connect the vacuum pump to this port and apply 15 in-Hg of vacuum to the motor; again, it should be able to hold this vacuum for at least 30 seconds



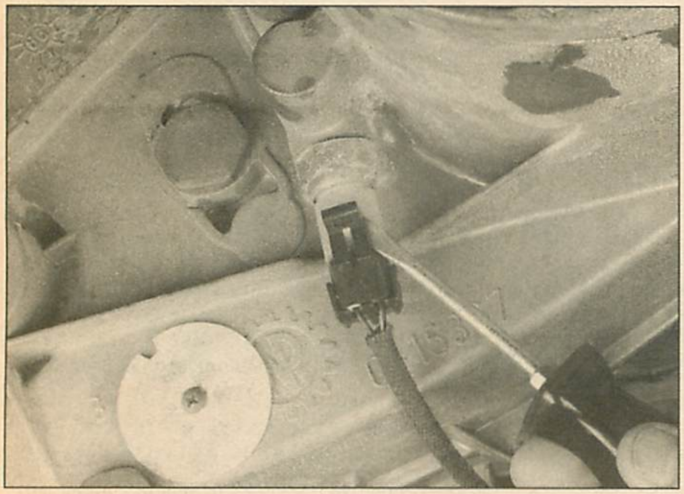
5.8b There are three ports on the vacuum switch: the left port is for 2WD, the right port is for 4WD and the center port is for intake manifold vacuum; to test the switch, hook up a hand-operated vacuum pump to the center port, flip the mode switch to 2WD, plug the 2WD (right) port with a rubber plug as shown and apply 15 or more in-Hg of vacuum and note whether the switch holds vacuum



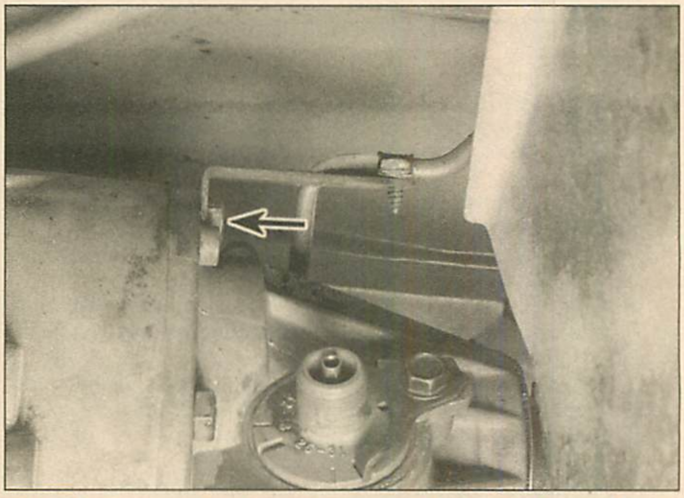
5.8c Flip the switch to the 4WD mode, plug the 4WD (left) port, apply at least 15 in-Hg of vacuum and note whether the switch holds it; if the switch fails either test, replace it



5.9 To detach the shift motor from the mode rod, remove the cotter pin (arrow); to detach the motor from its mounting bracket, remove the E-clip (arrow)



6.4 Unplug the electrical connector for the indicator switch, if equipped (Model 229 shown)



6.7a Remove the bolt (arrow) from the left fuel line bracket, . . .

for a possible leak. If you can't find a disconnected or damaged line, remove the vacuum switch on the dash **(see illustration)** and test it to make sure it holds a vacuum in 2WD and 4WD **(see illustrations)**. If the switch is leaking, replace it. If the switch is okay, take the vehicle to a dealer for further inspection.

Replacement

Refer to illustration 5.9

9 To disconnect the shift motor from the mode rod, remove the cotter pin **(see illustration)**.

10 Slide back the shift motor boot, remove the E-ring that retains the motor to the bracket and separate the motor from the bracket.

11 Installation is the reverse of removal. Be sure to adjust the shift linkage (see Section 2) when you're done.

6 Transfer case - removal and installation

Refer to illustrations 6.4, 6.7a, 6.7b, 6.9, 6.11a and 6.11b

Removal

1 Raise the vehicle and support it on jackstands.

2 Drain the transfer case lubricant (see Chapter 1).

3 Mark the relative positions of the universal joints to the transfer case yokes, disconnect the driveshafts from the transfer case and fasten them out of the way with wire.

4 Disconnect any electrical connectors attached to the transfer case **(see illustration)**.

5 Disconnect the speedometer cable **(see illustration 4.10)**.

6 Label and disconnect any vacuum hoses attached to the transfer case. Detach the vent hose.

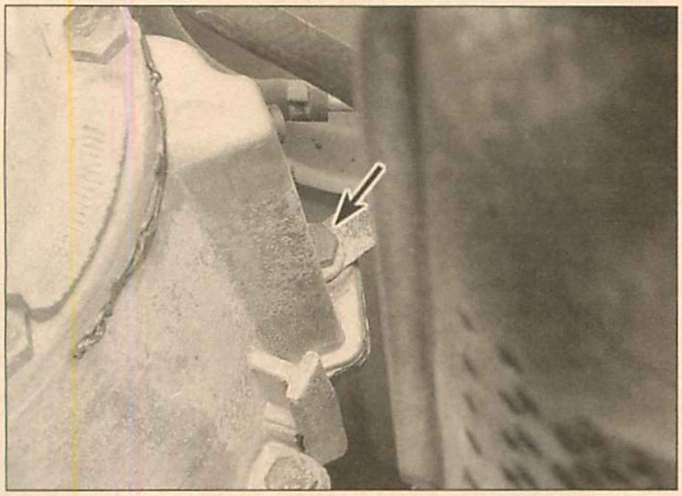
7 Detach the exhaust pipe support bracket from the transfer case. Remove any other brackets attached to the transfer case **(see illustrations)**. Disconnect the parking brake cable at the equalizer and position the cables aside, if necessary.

8 Detach the shift motor bracket and shift motor assembly, if equipped (see Section 5).

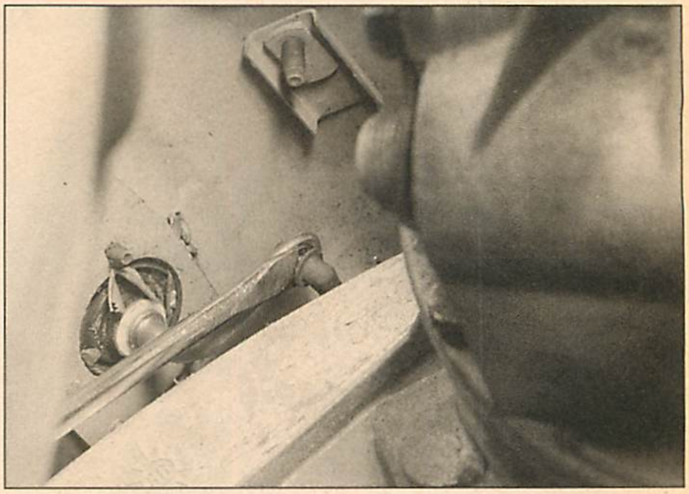
9 Disconnect the shift lever from the transfer case shift linkage **(see illustration)**. If equipped with a Model 20 transfer case, remove the shift knob and trim ring before removing the shift lever.

10 Place a transmission jack under the transmission and remove the crossmember.

11 Support the transfer case with a jack and remove the transfer case-to-transmission retaining bolts/nuts **(see illustrations)**. On some models, one or more of the bolts may attach from the front.



6.7b . . . and remove the bolt (arrow) from the right fuel line bracket (Model 229 shown)



6.9 Locate the shift lever/shift linkage connection above the transfer case and pry the lever from the linkage with a screwdriver (Model 229 shown)

12 Separate the transfer case from the transmission. Pull the transfer case straight back to disengage the splined hub of the transfer case input shaft from the splined output shaft of the transmission.

Installation

13 To install the transfer case, raise it into position and align the input shaft splines with the transmission output shaft. If necessary, rotate the transfer case output shaft yoke slightly to line up the splines.
14 Make sure the holes are aligned, install the transfer case-to-transmission attaching bolts/nuts and tighten them to the torque listed in this Chapter's Specifications.
15 The remainder of installation is the reverse of removal.
16 Fill the transfer case with the specified lubricant (see Chapter 1).
17 Lower the vehicle.

7 Transfer case overhaul - general information

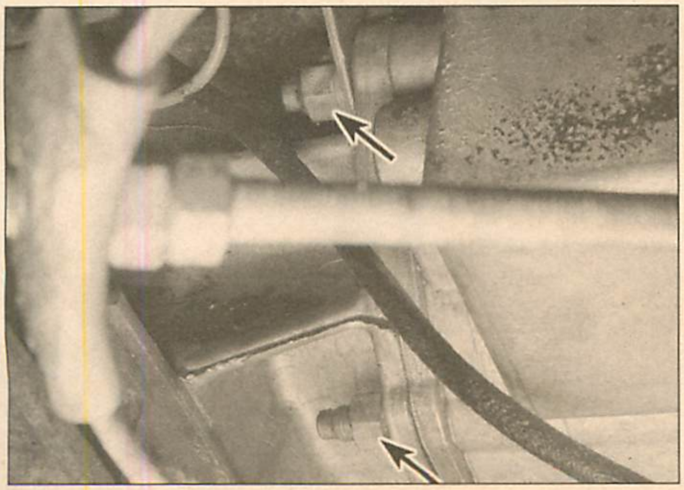
Overhauling a transfer case is a difficult job for the do-it-yourselfer. It involves the disassembly and reassembly of many small parts. Numerous clearances must be precisely measured and, if necessary, changed with select fit spacers and snap-rings. As a result, if transfer case problems arise, it can be removed and installed by a competent do-it-yourselfer, but overhaul should be left to a transmission repair shop. Rebuilt transfer cases may be available - check with your dealer parts department and auto parts stores. At any rate, the time and money involved in an overhaul is almost sure to exceed the cost of a rebuilt unit.

Nevertheless, it's not impossible for an inexperienced mechanic to rebuild a transfer case if the special tools are available and the job is done in a deliberate step-by-step manner so nothing is overlooked.

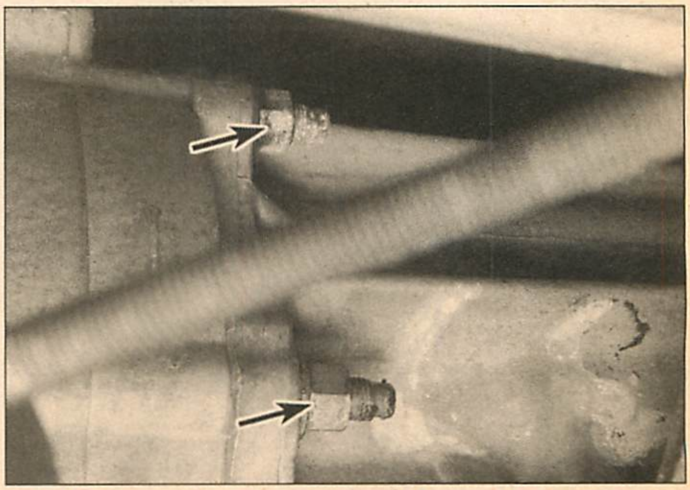
The tools necessary for an overhaul include internal and external snap-ring pliers, a bearing puller, a slide hammer, a set of pin punches, a dial indicator and possibly a hydraulic press. In addition, a large, sturdy workbench and a vise or transmission stand will be required.

During disassembly of the transfer case, make careful notes of how each piece comes off, where it fits in relation to other pieces and what holds it in place. Note how parts are installed when you remove them; this will make it much easier to get the transfer case back together.

Before taking the transfer case apart for repair, it will help if you have some idea what area of the transfer case is malfunctioning. Certain problems can be closely tied to specific areas in the transfer case, which can make component examination and replacement easier. Refer to the *Troubleshooting* section at the front of this manual for information regarding possible sources of trouble.



6.11a Remove the left transfer case retaining nuts (arrows) (upper nut not visible) (Model 229 shown)



6.11b Remove the right transfer case retaining nuts (arrows) (upper nut not visible) (Model 229 shown)

Notes

Chapter 8
Clutch and drivetrain

Contents

Specifications

Clutch pedal freeplay	3/8 to 5/8-inch
Torque specifications	**Ft-lbs**
Clutch	
Clutch pressure plate-to-flywheel bolts	35 to 45
Drivetrain	
Driveshaft U-joint clamp strap bolt	15
Differential pinion shaft nut	
Model 30 and 44 axles	210
Model 60 axle	260

1 General information

The information in this Chapter deals with the components from the rear of the engine to the drive wheels, except for the transmission and transfer case, which are dealt with in the previous Chapter. For the purposes of this Chapter, these components are grouped into three categories; clutch, driveshaft and axles. Separate Sections within this Chapter offer general descriptions and checking procedures for components in each of the three groups.

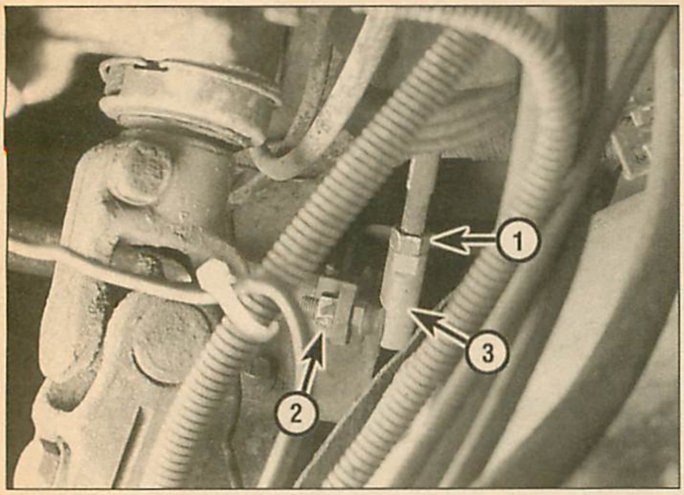
Since nearly all the procedures covered in this Chapter involve working under the vehicle, make sure it's securely supported on sturdy jackstands or on a hoist where the vehicle can be easily raised and lowered.

2 Clutch - description and check

1 Vehicles with a manual transmission use a single dry-plate, lever-and-spring (1972 through 1981 models) or diaphragm spring (1982 and later models) type clutch. The clutch disc has a splined hub which allows it to slide along the splines of the transmission input shaft. The clutch and pressure plate are held in contact by spring pressure exerted by the coil springs or diaphragm in the pressure plate.

2 The clutch release system is cable-operated on 1972 models; all other models use a bellcrank and linkage to connect the clutch pedal to the release lever. The release system consists of the clutch pedal, a clutch cable or linkage, a release lever and a release bearing which rides on the transmission input shaft.

8



5.3a To adjust the clutch linkage, back off the locknut (1) on the lower end of the clutch pushrod, remove the nut (2) that secures the lower ball pivot assembly (3) to the bellcrank outer lever, disconnect the lower ball pivot from the bellcrank lever, and turn the lower ball pivot up or down until . . .

3 When pressure is applied to the clutch pedal, the clutch cable pulls the outer end of the release lever (1972 models) or a release rod pushes against it (all other models). When the lever pivots at its fulcrum point on a ball stud, the inner end of the lever pushes against the release bearing, which slides forward on the transmission input shaft against the three pressure plate release levers (1972 through 1981 models) or the diaphragm fingers (1982 and later models), releasing the pressure plate from the clutch disc.

4 Terminology can be a problem when discussing the clutch components because common names are in some cases different from those used by the manufacturer. For example, the driven plate is also called the clutch plate or disc, the clutch release bearing is sometimes called a throwout bearing.

5 Other than replacement of components with obvious damage, some preliminary checks should be performed to diagnose clutch problems.

a) *The first check should be the clutch cable (1972 models) or the clutch linkage (all other models).*
b) *To check "clutch spin down time," run the engine at normal idle speed with the transmission in Neutral (clutch pedal up - engaged). Disengage the clutch (pedal down), wait several seconds and shift the transmission into Reverse. No grinding noise should be heard. A grinding noise would most likely indicate a problem in the pressure plate or the clutch disc (assuming the transmission is in good condition).*
c) *To check for complete clutch release, run the engine (with the parking brake applied to prevent movement) and hold the clutch pedal approximately 1/2-inch from the floor. Shift the transmission between 1st gear and Reverse several times. If the shift is rough, component failure is indicated.*
d) *Visually inspect the pivot bushing at the top of the clutch pedal to make sure there is no binding or excessive play.*

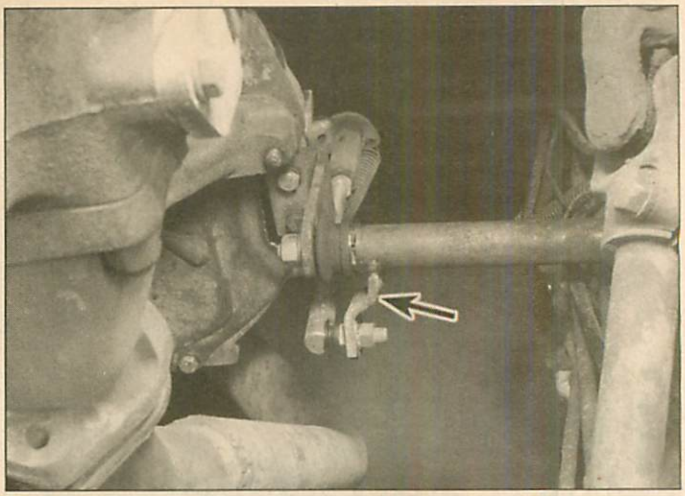
3 Clutch pedal (1972 models) - check and adjustment

1 The clutch pedal has an adjustable pedal stop, a bolt threaded into the top of the pedal support bracket directly in front of the instrument cluster.

2 Using a flashlight or drop light, and a small mechanic's mirror, locate the adjustable pedal stop bolt on top of the pedal support bracket.

3 Turn the adjustable pedal stop bolt to provide a pedal height of about 8-3/8 inches, measured from the lower firewall to the top of the pedal pad (the lower firewall is the steeply-angled part of the firewall below and ahead of the pedal, between the vertical part of the firewall and the floorpan). Make sure your measurement is taken at an angle of 90 degrees (perpendicular) to the lower firewall. And remove any floor mats or carpeting. The measurement must be made from the top of the pedal to bare metal **(see illustration 5.4b)**.

4 After the pedal height is adjusted correctly, adjust the clutch cable (see Section 4).



5.3b . . . the inner lever (arrow) is parallel to the clutch housing cover when it's reconnected to the outer bellcrank lever (facing down and slightly forward)

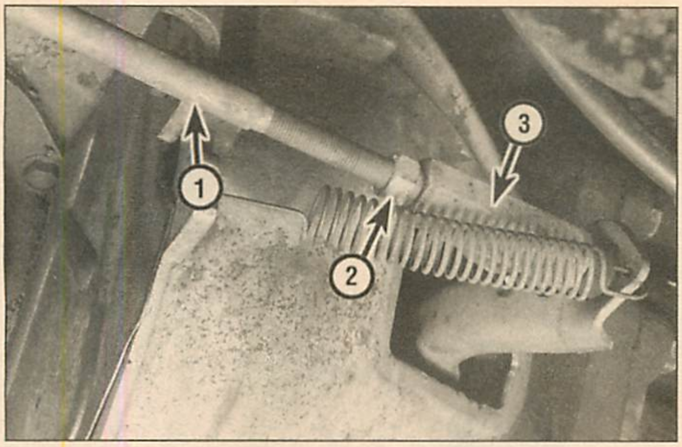
4 Clutch cable (1972 models) - adjustment

1 Raise the vehicle and place it securely on jackstands.
2 Have an assistant lift up the clutch pedal until it's up against the pedal stop.
3 Unhook the clutch release lever return spring.
4 Loosen the adjuster jam nut at the lower end of the cable.
5 Loosen the adjuster until there's some slack in the cable.
6 Tighten the adjuster until the slack is removed from the cable and the release bearing is just contacting the pressure plate release fingers.
7 Back off the adjuster 3/4-turn to provide a little freeplay.
8 Tighten the jam nut.
9 Hook up the release lever return spring.
10 Lower the vehicle.

5 Clutch linkage (1973 and later models) - adjustment

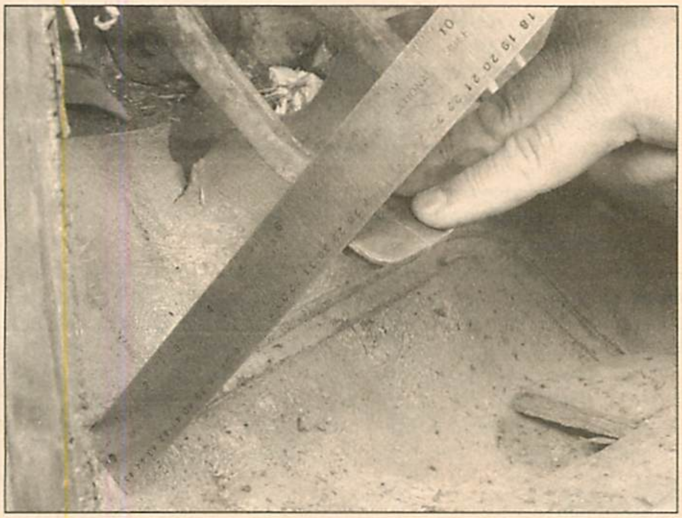
Refer to illustration 5.3a, 5.3b 5.4a, 5.4b and 5.4c

1 Raise the vehicle and place it securely on jackstands.
2 Have an assistant lift the clutch pedal up against its pedal stop and hold it there.
3 There are two levers - an inner one facing down and slightly forward and an outer one facing forward and up - on the clutch linkage bellcrank. Verify that the inner lever is parallel to the front face of the clutch housing (slightly forward from the vertical). If it's not, adjust the linkage by disconnecting the lower ball pivot assembly **(see illustrations)** - at the lower end of the clutch pushrod (the rod between the clutch pedal and the bellcrank) - from the bellcrank lever and turning the ball pivot to achieve the correct lever angle.
4 Once the bellcrank lever angle is correctly set, adjust the clutch release lever rod **(see illustration)** - the rod connecting the inner bellcrank lever to the clutch release lever - to provide clutch pedal freeplay within the range listed in this Chapter's Specifications **(see illustrations)**.
5 Lower the vehicle.



5.4a Once the bellcrank lever angle is correctly set, adjust the clutch release lever rod (1) to provide the correct clutch pedal freeplay by loosening the locknut (2) and turning the adjuster (3); tighten the locknut when you're through

5.4b To determine the clutch pedal freeplay, first measure the height of the clutch pedal above the lower firewall (the inclined portion of the firewall between the vertical part of the firewall and the floorpan); make your measurement at a 90-degree angle to the lower firewall and measure to the top of the pedal



5.4c Once you know the clutch pedal height, push down on the pedal and measure the distance it travels before you feel resistance (this is the point at which the clutch linkage actually begins to move the clutch release lever); this distance is the pedal freeplay - compare your measurement to the range of freeplay listed in this Chapter's Specifications

6 Clutch release bearing - removal, inspection and installation

Warning: *Dust produced by clutch wear and deposited on clutch components may contain asbestos, which is hazardous to your health. DO NOT blow it out with compressed air and DO NOT inhale it. DO NOT use gasoline or petroleum-based solvents to remove the dust. Brake system cleaner should be used to flush the dust into a drain pan. After the clutch components are wiped clean with a rag, dispose of the contaminated rags and cleaner in a covered, marked container.*

Removal

Refer to illustrations 6.4a, 6.4b and 6.6

1 Remove the driveshafts (see Section 11), the transfer case (see Chapter 7C) and transmission (see Chapter 7A).

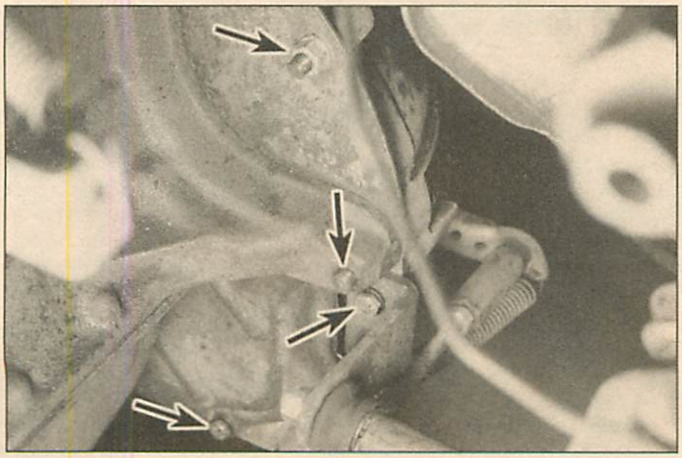
2 Remove the starter (see Chapter 5).

3 Disengage the return spring from the release lever **(see illustration 5.4a)** and disconnect the clutch cable (see Section 4) or linkage (see Section 5).

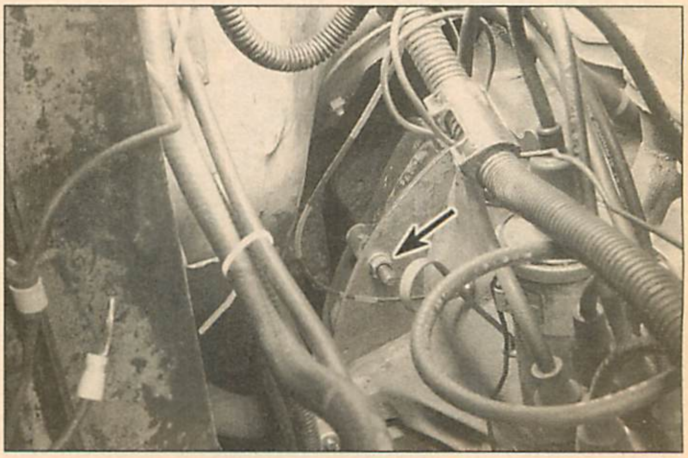
4 Remove the inspection cover. Remove the clutch housing nuts and bolts **(see illustrations)**. Note the location of the different length bolts and spacers.

5 Remove the clutch housing.

6 Remove the release bearing from the release lever **(see illustration)**. Pull out the release lever.



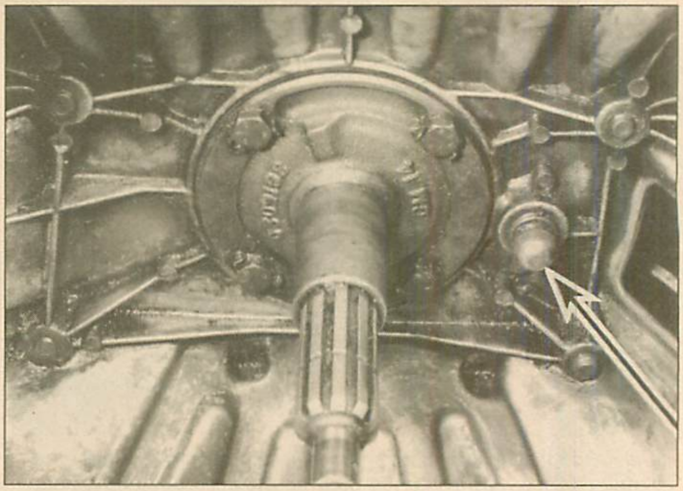
6.4a Typical left-side clutch housing-to-engine/clutch housing-to-spacer bolts/nuts (arrows) - not all fasteners visible in this photo (six-cylinder engine shown)



6.4b Typical right-side clutch housing-to-engine/clutch housing-to-spacer bolt/nut (arrow) - not all fasteners visible in this photo (six-cylinder engine shown)

8

6.6 The release bearing is secured to the release lever by a retaining spring located on the back side of the lever; pay close attention to how this spring is installed before disengaging the release lever and bearing: the lever, bearing and spring must be reassembled exactly the same way



6.9a Make sure the pivot ball (arrow) for the release lever is clean and well lubricated with high-temperature grease

Inspection

7 Hold the center portion of the bearing stationary and rotate the outer portion while applying pressure. If the bearing doesn't turn smoothly or if it's noisy, replace it with a new one. Wipe the bearing with a clean rag and inspect it for damage and wear. Don't immerse the bearing in solvent - it is sealed for life and immersion would ruin it. Inspect the bearing for fluid leakage. If any leakage is evident, replace the entire assembly.

8 Inspect the release lever and the pivot stud. Make sure the pivot stud is tight and in good condition. Make sure the lever isn't distorted or worn. Inspect the release lever return spring. If it's bent or damaged, replace it.

Installation

Refer to illustrations 6.9a, 6.9b and 6.9c

9 Installation is basically the reverse of removal. Be sure to lightly lubricate the pilot bushing, the transmission input shaft splines, the release lever, the release lever pivot ball, the fingers of the release lever and the release bearing groove engaged by the release lever fingers and the inner hub of the release bearing **(see illustrations)**. Make sure the release lever and release bearing are properly engaged **(see illustration)** before sliding the input shaft through the release bearing when the transmission is installed.

10 Install the transmission (see Chapter 7A), the transfer case (see Chapter 7C) and the driveshafts (see Section 11).

11 Reattach the clutch cable (see Section 4) or the clutch linkage (see Section 5). Reattach the clutch release lever return spring.

12 Remove the jackstands and lower the vehicle.

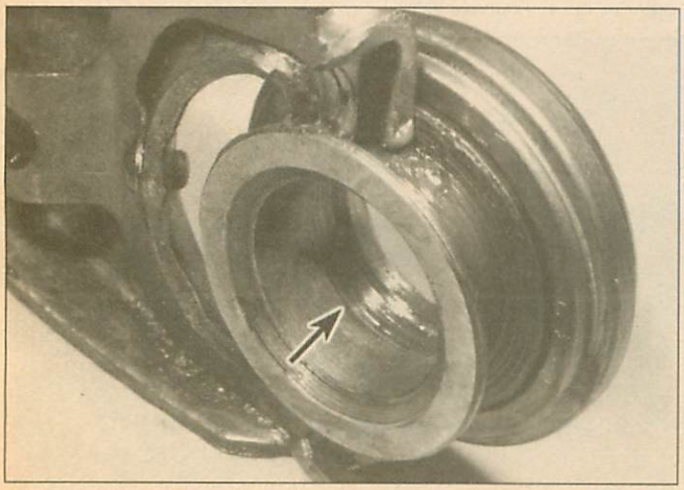
7 Clutch components - removal, inspection and installation

Warning: *Dust produced by clutch wear and deposited on clutch components may contain asbestos, which is hazardous to your health. DO NOT blow it out with compressed air and DO NOT inhale it. DO NOT use gasoline or petroleum-based solvents to remove the dust. Brake system cleaner should be used to flush the dust into a drain pan. After the clutch components are wiped clean with a rag, dispose of the contaminated rags and cleaner in a covered, marked container.*

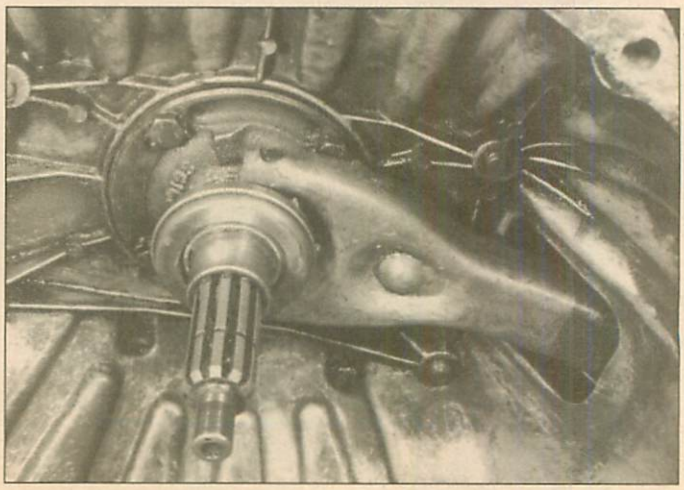
Removal

Refer to illustration 7.4

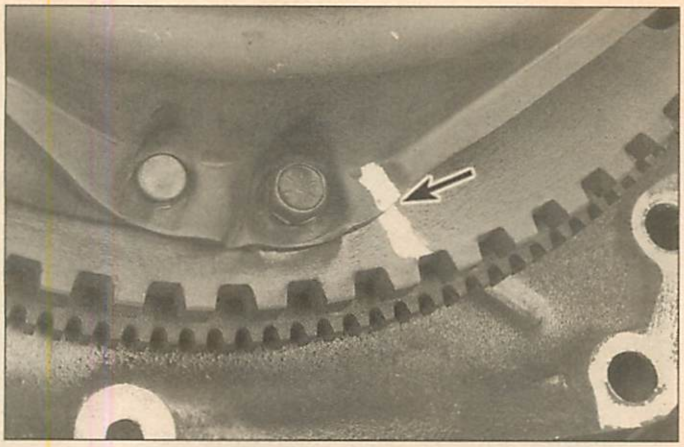
1 Access to the clutch components is normally accomplished by removing the transmission, leaving the engine in the vehicle. If the engine is being removed for major overhaul, then check the clutch for wear and replace worn components as necessary. However, the



6.9b Pack the groove in the inner hub of the release bearing with high-temperature grease (arrow); also lightly lubricate the clutch fork fingers and the sleeve in which they ride as well



6.9c This is how the release lever and release bearing should look when they're properly installed



7.4 If you are going to re-use the original pressure plate, mark the relationship of the pressure plate to the flywheel (arrow)

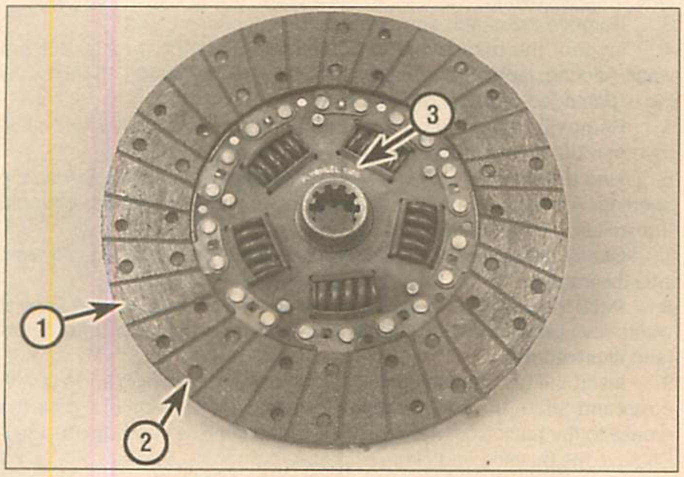
relatively low cost of the clutch components compared to the time and trouble spent gaining access to them warrants their replacement anytime the engine or transmission is removed, unless they are new or in near perfect condition. The following procedures are based on the assumption the engine will stay in place.

2 Remove the transmission from the vehicle (see Chapter 7A). Support the engine while the transmission is out. Preferably, an engine hoist should be used to support it from above. However, if a jack is used underneath the engine, make sure a piece of wood is positioned between the jack and oil pan to spread the load. **Caution:** *The pickup for the oil pump is very close to the bottom of the oil pan. If the pan is bent or distorted in any way, engine oil starvation could occur.*

3 Remove the inspection cover, clutch housing, release lever and release bearing (see Section 6).

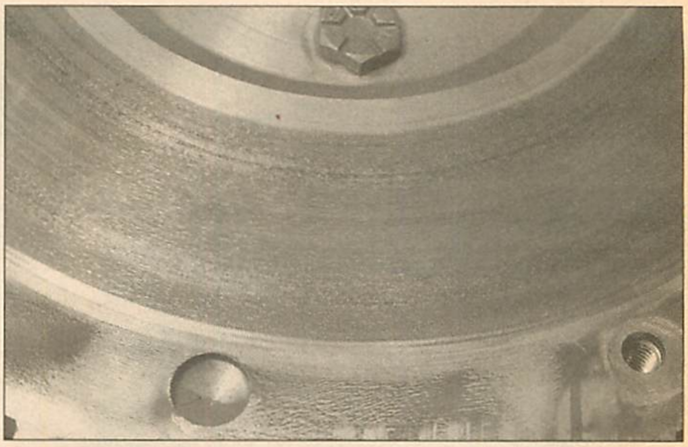
4 Carefully inspect the flywheel and pressure plate for indexing marks. The marks are usually an X, an O or a white letter. If they cannot be found, scribe marks yourself so the pressure plate and the flywheel will be in the same alignment during installation (assuming your using the original clutch) **(see illustration).**

5 Turning each bolt a little at a time, loosen the pressure plate-to-flywheel bolts. Work in a criss-cross pattern until all spring pressure is relieved. Then hold the pressure plate securely and completely remove the bolts, followed by the pressure plate and clutch disc. Install a clutch alignment tool through the clutch disc hub to support the clutch disc during removal.



7.8 Typical clutch disc components

1) **Lining** - *will wear down in use*
2) **Rivets** - *secure the lining and will damage the pressure plate or flywheel surface if allowed to contact it*
3) **Marks** - *"Flywheel side" or something similar*



7.7 Check the surface of the flywheel for cracks, hot spots (dark colored areas) and other obvious defects; resurfacing by a machine shop will correct minor defects

Inspection

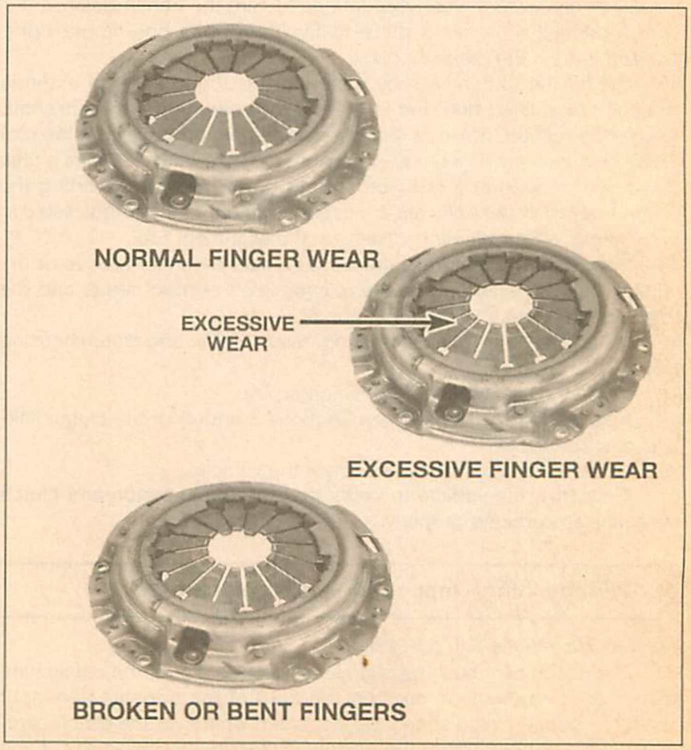
Refer to illustrations 7.7, 7.8 and 7.9

6 Ordinarily, when a problem occurs in the clutch, it can be attributed to wear of the clutch driven plate assembly (clutch disc). However, all components should be inspected at this time.

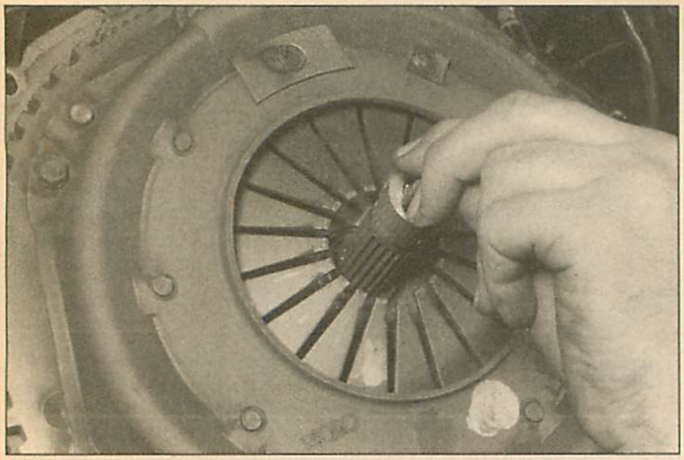
7 Inspect the flywheel for cracks, heat checking, grooves and other obvious defects **(see illustration).** If the imperfections are slight, a machine shop can machine the surface flat and smooth, which is highly recommended regardless of the surface appearance. Refer to Chapter 2 for the flywheel removal and installation procedure.

8 Inspect the lining on the clutch disc. There should be at least 1/16-inch of lining above the rivet heads. Check for loose rivets, distortion, cracks, broken springs and other obvious damage **(see illustration).** As mentioned above, ordinarily the clutch disc is routinely replaced, so if in doubt about the condition, replace it with a new one.

9 Check the machined surfaces and the diaphragm spring fingers of the pressure plate **(see illustration).** If the surface is grooved or oth-



7.9 Replace the pressure plate if excessive wear is noted



7.13 Center the clutch disc in the pressure plate with an alignment tool (available at auto parts stores) before the bolts are tightened

erwise damaged, replace the pressure plate. Also check for obvious damage, distortion, cracking, etc. Light glazing can be removed with medium-grit emery cloth. If a new pressure plate is required, new and factory-rebuilt units are available.

10 Check the condition of the release bearing (see Section 6).

11 Inspect the pilot bushing (see Section 8).

Installation

Refer to illustration 7.13

12 Before installation, clean the flywheel and pressure plate machined surfaces with lacquer thinner or acetone. It's important that no oil or grease is on these surfaces or the lining of the clutch disc. Handle the parts only with clean hands.

13 Position the clutch disc and pressure plate against the flywheel with the clutch held in place with an alignment tool **(see illustration)**. Make sure it's installed properly (most replacement clutch plates will be marked "flywheel side" or something similar - if not marked, install the clutch disc with the damper springs toward the transmission.

14 Tighten the pressure plate-to-flywheel bolts only finger tight, working around the pressure plate.

15 Center the clutch disc by ensuring the alignment tool extends through the splined hub and into the pilot bearing in the crankshaft. Wiggle the tool up, down or side-to-side as needed to bottom the tool in the pilot bearing. Tighten the pressure plate-to-flywheel bolts a little at a time, working in a criss-cross pattern to prevent distorting the cover. After all of the bolts are snug, tighten them to the torque listed in this Chapter's Specifications. Remove the alignment tool.

16 Using high-temperature grease, lubricate the inner groove of the release bearing; also grease the release lever contact areas and the transmission input shaft (see Section 6).

17 Install the clutch release bearing, release lever and clutch housing (see Section 6).

18 Install the transmission (see Chapter 7A).

19 Adjust the clutch cable (see Sections 3 and 4) or the clutch linkage (see Section 5).

20 Remove the jackstands and lower the vehicle.

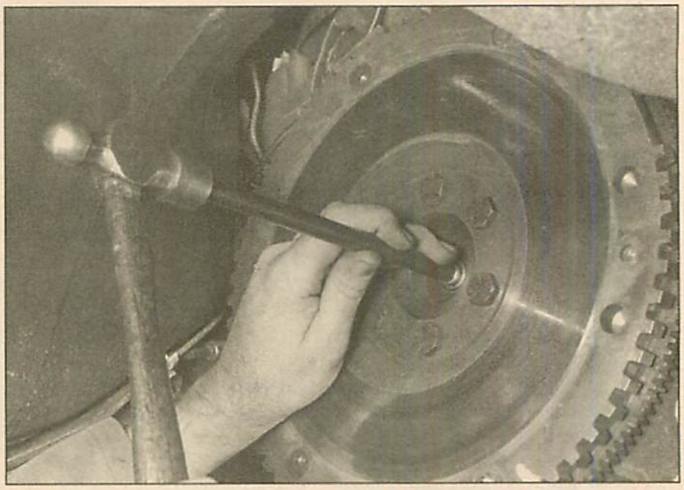
21 Test drive the vehicle to verify that the transmission and clutch assembly are working properly.

8 Pilot bushing - inspection and replacement

Refer to illustrations 8.8, 8.9 and 8.10

1 The clutch pilot bushing is pressed into the rear of the crankshaft. Its primary purpose is to support the front of the transmission input shaft. The pilot bushing should be inspected whenever the clutch components are removed from the engine. Due to its inaccessibility, if you are in doubt as to its condition, replace it with a new one.

8.8 Fill the cavity behind the pilot bushing with grease



8.9 Pack the recess behind the pilot bushing with heavy grease and force it out hydraulically with a steel rod slightly smaller than the bore in the bushing - when the hammer strikes the rod, the bushing will pop out of the crankshaft

2 Remove the transfer case (see Chapter 7C) and the transmission (see Chapter 7A).

3 Remove the clutch components (see Sections 6 and 7).

4 Inspect the pilot bushing (a flashlight is helpful) for excessive wear, scoring, lack of grease, dryness or obvious damage. If the bushing is damaged or worn, replace it.

5 Removal can be accomplished with a special puller and slide hammer, but an alternative method also works very well.

6 Find a solid steel bar which is slightly smaller in diameter than the bushing. Alternatives to a solid bar would be a wood dowel or an old transmission input shaft.

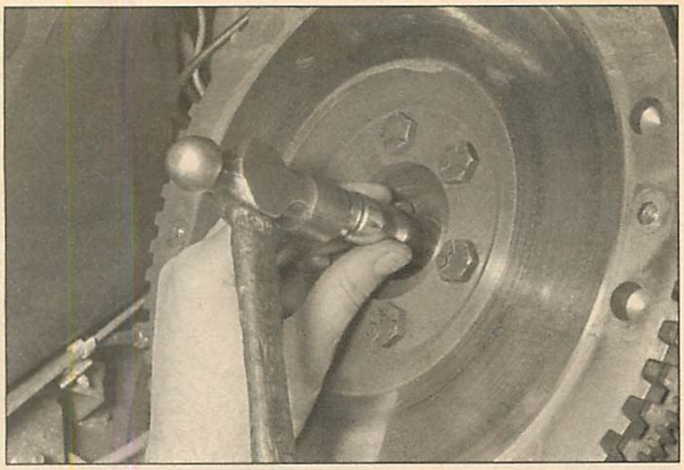
7 Check the bar for fit - it should just slip into the bushing with very little clearance.

8 Pack the bushing and the area behind it (in the crankshaft recess) with heavy grease. Pack it tightly to eliminate as much air as possible **(see illustration)**.

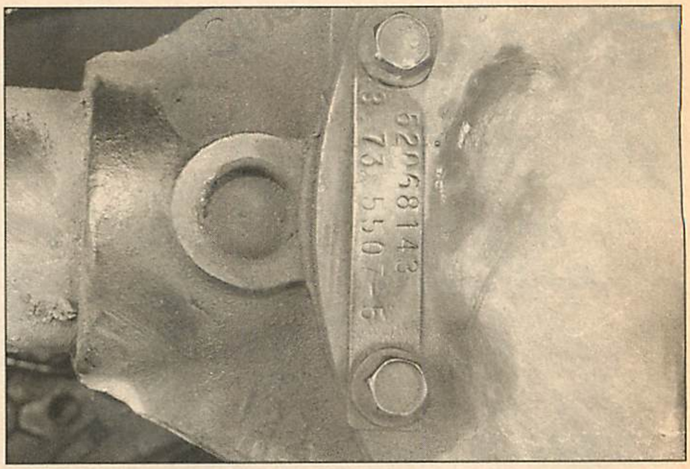
9 Insert the bar into the bushing bore, cover the bushing and bar with a rag and strike the bar sharply with a hammer which will force the grease to the back side of the bushing and push it out **(see illustration)**. Remove the bushing and clean all grease from the crankshaft recess.

10 To install the new bushing, pack the inside of the bushing and lightly lubricate the outside surface with wheel bearing grease. Drive the bushing into the recess with an alignment tool or bushing driver **(see illustration)**. The bushing must go in perfectly straight.

11 Install the clutch components, transmission and all other components removed previously, tightening all fasteners properly.



8.10 Tap the bushing into place with a bushing driver or a socket



9.11 A tag on the differential housing cover contains information such as identification number and gear ratio

9 Driveshafts, differentials and axles - general information

Driveshafts

1 The driveshafts transmit power from the transfer case to the front and rear axles.

2 As the vehicle travels over irregular surfaces, the axles "float" up and down, so the driveshaft must be able to operate while constantly changing its angle relative to the transmission/transfer case and the axle. This is made possible by universal joints (U-joints) at each end of the driveshaft. As the angle between the transfer case and the axles changes, so does the *length* between them, so the driveshafts must also be able to change their lengths. The necessary change in length is made possible by a sliding yoke, also referred to as a sleeve yoke or slip joint, in the middle of each driveshaft.

3 Both single- and double-cardan U-joints are used: single-cardan U-joints are used at both ends of the rear driveshaft and at the front end of the front driveshaft; a double-cardan U-joint is employed at the rear end of the front driveshaft.

4 The U-joints and slip yokes require occasional lubrication; it's a good idea to lubricate them every time the vehicle is raised to lubricate the steering, suspension and chassis (see Chapter 1). The U-joints and slip yokes are equipped with zerk-type fittings for this purpose.

5 The front and rear driveshafts are finely balanced during production. Whenever they are removed or disassembled, they must be reassembled and installed in the exact manner and positions they were originally installed, to avoid excessive vibration.

Differentials

6 The differentials are located inside cast-iron housings which are integral part of the axle assemblies. A stamped steel cover bolted to the side of the housing opposite the pinion flange allows inspection and servicing of the differential. The differential itself is a hypoid-gear design with the centerline of the pinion below the centerline of the ring gear. Besides the standard differential, a limited-slip unit, known as "Trac-Lok," is available as an option. If one wheel spins and loses traction, the limited-slip unit transfers torque from that wheel to the other wheel. Because of the special tools and skills needed to adjust and/or overhaul differentials, this work should be left to a dealer service department or a qualified repair shop.

Axles

Refer to illustration 9.11

7 Several axles have been used on the vehicles covered by this manual: Most models use a Model 44 front axle and either an AMC/Jeep or a Model 44 rear axle, but some very early Wagoneers used a Model 30 front axle and some truck models use a Model 60 rear axle.

8 All front axles are similar in design: a pair of axleshafts are housed inside the axle, which consists of two steel tubes welded to either side of the iron center casting that houses the differential assembly. A vent relieves internal pressure caused by lubricant vaporization and internal expansion.

9 The AMC/Jeep and Model 44 rear axles are equipped with "semi-floating" axleshafts, i.e. the vehicle weight is supported by the axle bearings, which are attached directly to the axle (they're pressed on). The axleshafts are retained by a retaining plate bolted to the brake backing plate. Axle bearings are serviced as an assembly, i.e. they cannot be rebuilt. On front axles, the outer ends of the axleshafts are equipped with a U-joint to allow the front wheels to turn.

10 The Model 60 rear axle is equipped with "full-floating" axleshafts, i.e. the axleshafts are splined to the differential side gears and the outer ends are bolted to the hub/bearing assembly. The full-floating axle transmit only torque, vehicle weight is supported by the hub/bearing assembly. You can easily identify a rear full-floating axle from a rear semi-floating axle by the ring of bolts in the center of the hub. All front axles are of the full-floating design.

11 You'll find the assembly part number and gear ratio listed on a tag, or tags, attached to the housing cover **(see illustration)**. Build-date identification codes are stamped on the backside of the axleshaft tube. Always refer to these numbers when replacing the axle.

10 Driveline inspection

1 Raise the rear of the vehicle and support it securely on jackstands.

2 From underneath the vehicle, visually inspect the driveshaft. Look for any dents or cracks in the tubing. If any are found, the driveshaft must be replaced.

3 Check for any oil leakage at the front and rear of the driveshaft. Leakage at the transfer case indicates a defective output shaft seal (see Chapter 7C). Leakage from the differential indicates a defective pinion seal (see Section 13).

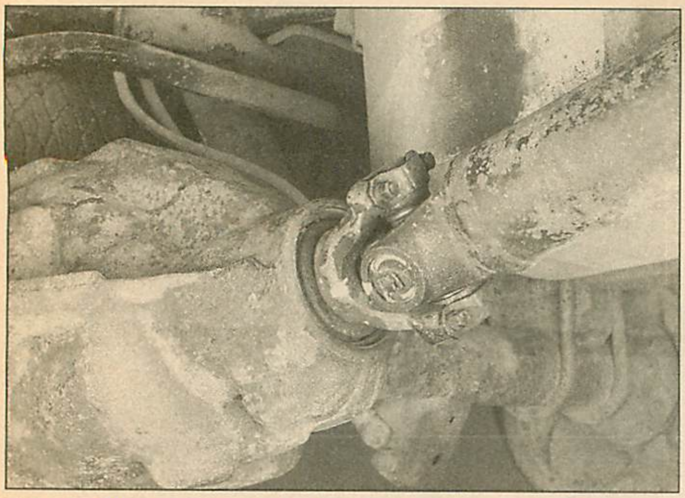
4 While you're under the vehicle, have an assistant turn a rear wheel so the driveshaft will rotate. As it rotates, make sure the U-joints are functioning properly; they should not be binding, noisy or loose.

5 The U-joints can also be checked with the driveshaft motionless. First, make sure the U-joint bolts at both ends are tight, then grip either side of each joint and try to twist it. Any movement in the U-joint is evidence of considerable wear. Lifting up on the shaft will also indicate movement in the universal joints.

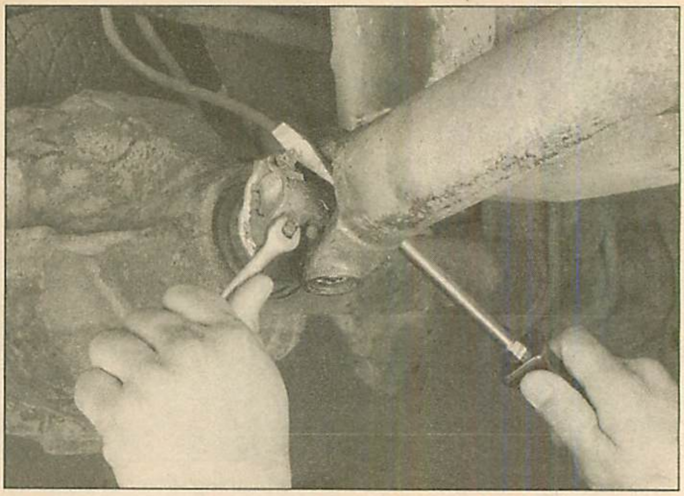
6 Inspect for leakage around both sliding yokes. Grease in this area indicates failure of the yoke seal.

7 While you're under the vehicle, inspect both ends of both axle tubes for leaks. Gear oil leakage onto the brake backing plate or drum indicates a leaking axleshaft seal.

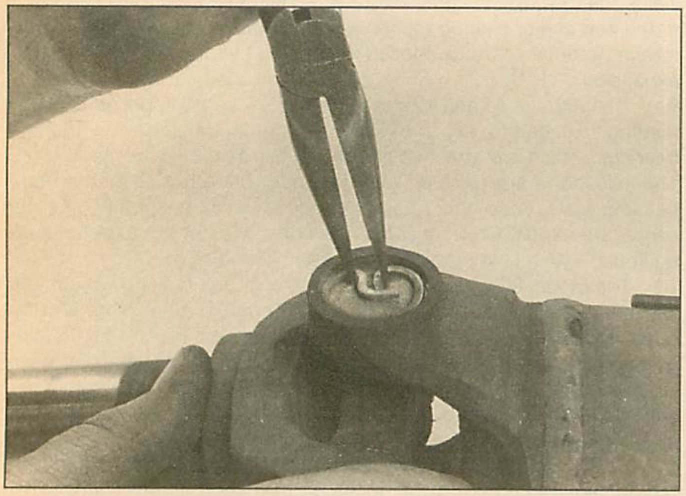
8 Remove the jackstands and lower the vehicle.



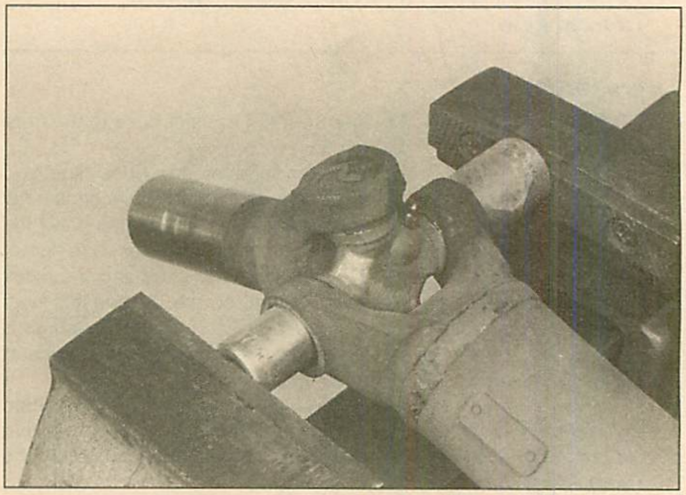
11.3 Be sure to mark both ends of the driveshaft and the flanges to ensure that the driveshaft retains its dynamic balance



11.4 Use a screwdriver, as shown, to keep the driveshaft from turning while you loosen the strap bolts



12.2 A pair of needle-nose pliers can be used to remove the universal joint snap-rings



12.4 To press the universal joint out of the driveshaft yoke, set it up in a vise with the small socket pushing the joint and bearing cap into the large socket

11 Driveshafts - removal and installation

Removal

Refer to illustrations 11.3 and 11.4

1 Disconnect the negative cable from the battery.

2 Raise the vehicle and support it securely on jackstands. Place the transmission in Neutral with the parking brake off.

3 Using a scribe, white paint or a hammer and punch, place marks on the driveshaft and flanges **(see illustration)** at both ends to ensure that the driveshaft is reinstalled in the same position to preserve the balance.

4 Remove the U-joint bolts and straps **(see illustration)**. Turn the driveshaft (or tires) as necessary to bring the bolts into the most accessible position. **Note:** *You may want an assistant to hold one end of the driveshaft while you're disconnecting the other end. If no one is available, support one end with mechanics wire while you disconnect the other.*

5 Tape the bearing caps to the spiders to prevent the caps from coming off during removal.

Installation

6 Raise the driveshaft into position, checking to be sure the marks are in alignment. If not, turn the flange to match the marks on the driveshaft.

7 Remove the tape securing the bearing caps and install new straps and bolts. Tighten the bolts to the torque listed in this Chapter's Specifications.

12 Universal joints - replacement

Refer to illustrations 12.2 and 12.4

Note: *A press or large vise will be required for this procedure. If the tools are not available, take the driveshaft to a repair or machine shop where the universal joints can be replaced for you, normally at a reasonable charge.*

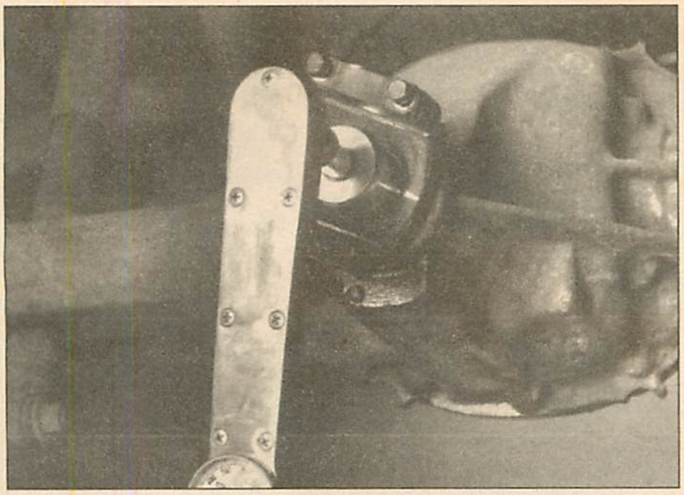
1 Remove the driveshaft as outlined in the previous Section.

Single cardan U-joint

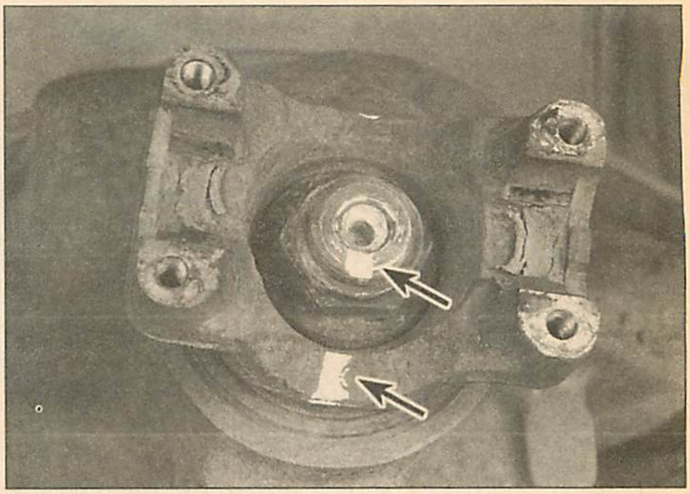
2 Using a small pair of pliers, remove the snap-rings from the spider **(see illustration)**.

3 Supporting the driveshaft, place it in position on either an arbor press or on a workbench equipped with a vise.

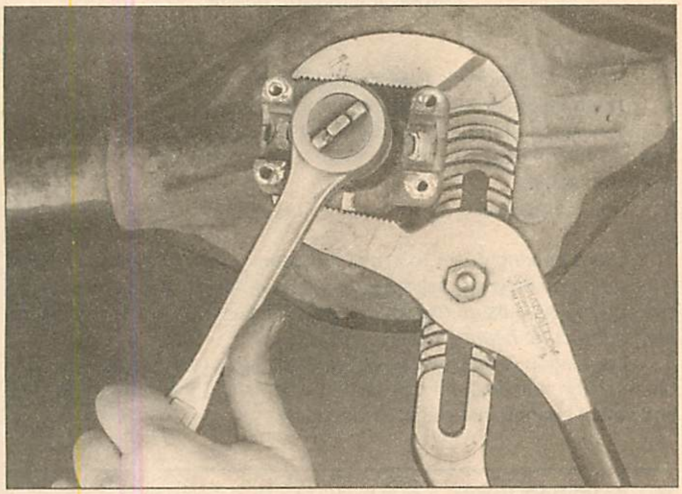
4 Place a piece of pipe or a large socket with the same inside diameter over one of the bearing caps. Position a socket which is of slightly smaller diameter than the cap on the opposite bearing cap **(see illustration)** and use the vise or press to force the cap out (inside the pipe or large socket), stopping just before it comes completely out of the yoke.



13.5 Use an inch-pound torque wrench to determine the torque necessary to rotate the pinion shaft



13.6a Mark the relationship of the pinion shaft to the pinion shaft yoke



13.6b Hold the pinion shaft yoke in place with a suitable tool and loosen the nut

Use the vise or large pliers to work the cap the rest of the way out.

5 Transfer the sockets to the other side and press the opposite bearing cap out in the same manner.

6 Pack the new universal joint bearings with grease. Ordinarily, specific instructions for lubrication will be included with the universal joint servicing kit and should be followed carefully.

7 Position the spider in the yoke and partially install one bearing cap in the yoke. If the replacement spider is equipped with a grease fitting, be sure it's offset in the proper direction (toward the driveshaft).

8 Start the spider into the bearing cap and then partially install the other cap. Align the spider and press the bearing caps into position, being careful not to damage the dust seals.

9 Install the snap-rings. If difficulty is encountered in seating the snap-rings, strike the driveshaft yoke sharply with a hammer. This will spring the yoke ears slightly and allow the snap-rings to seat in the groove.

10 Install the grease fitting and fill the joint with grease. Be careful not to overfill the joint, as this could blow out the grease seals.

11 Install the driveshaft. Tighten the flange bolts to the specified torque.

Double cardan U-joint

12 **Note:** *Replacing the double cardan U-joint requires special expertise and equipment, we recommend taking the driveshaft to a driveline repair facility for repair. If any component of the double cardan U-joint is defective, the entire assembly must be replaced.*

13 Pinion oil seal - replacement

Refer to illustrations 13.5, 13.6a and 13.6b

1 A pinion shaft oil seal failure results in the leakage of differential gear lubricant past the seal and onto the driveshaft yoke or flange. The seal is replaceable without removing or disassembling the differential.

2 Loosen the rear wheel lug nuts, raise the vehicle and place it on jackstands.

3 Remove the rear wheels and brake drums.

4 Disconnect the driveshaft from the pinion shaft yoke (see Section 11).

1980 to 1988 rear differential (except Model 60)

5 Using a torque wrench cable of reading inch-pounds positioned on the pinion shaft nut, rotate the pinion several revolutions. Measure and record the torque required to turn the pinion **(see illustration)**.

6 Mark the relationship of the pinion shaft to the pinion shaft yoke **(see illustration)**. Hold the pinion shaft yoke with a large adjustable wrench, pair of adjustable pliers or other suitable tool, then remove the nut **(see illustration)**.

7 Remove the pinion shaft yoke from the shaft, using a puller if necessary.

8 Using a large screwdriver or seal removal tool, carefully pry the pinion seal out of the differential. Be careful not to damage the splines on the pinion shaft.

9 Lubricate the new seal lip with multi-purpose grease or differential lubricant and carefully install it in position in the differential. Using a seal driver or a short section of pipe of the proper diameter and a hammer, carefully drive the seal into place.

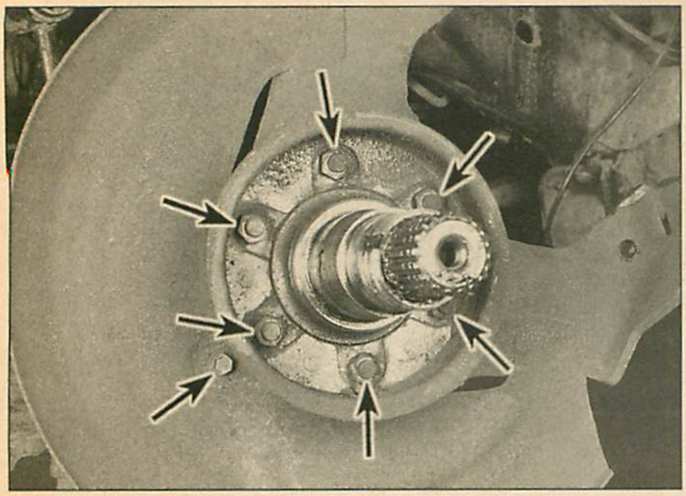
10 Clean the sealing lip contact surface of the pinion shaft yoke. Apply a thin coat of multi-purpose grease to the seal contact surface and the shaft spines and, using a soft-faced hammer, tap the pinion shaft yoke onto the shaft, making sure the match-marks align.

11 Coat the threads of a new pinion shaft nut with multi-purpose grease and, using a suitable tool to hold the flange, tighten the nut just enough to eliminate all endplay in the pinion shaft.

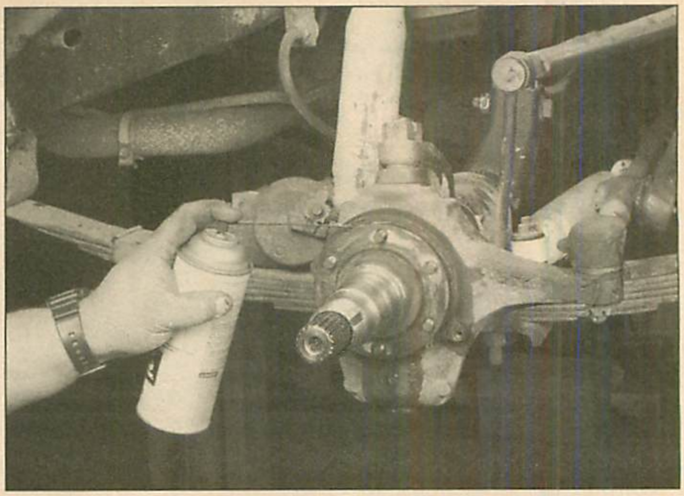
12 Turn the pinion shaft yoke several times to seat the bearing.

13 Using a torque wrench, measure the torque required to turn the pinion shaft. Tighten the nut in small increments until the torque recorded in Step 5, plus an additional five inch pounds, is reached. **Caution:** *Be very careful not to exceed the torque readings described in this Step, which applies the proper preload to the pinion bearings. If the preload is exceeded, the differential will have to be disassembled and a new collapsible spacer installed. DO NOT loosen the pinion nut once the tightening process has begun.* After the preload is properly adjusted, proceed to Step 17.

8



14.2 Remove the nuts (arrows) and bolt retaining the brake baking plate and spindle to the knuckle



14.3a If the spindle is difficult to remove from the steering knuckle, spray penetrant on the bolt threads and around the mating flange

All others

14 Using the techniques described in Steps 6, 7 and 8, remove the pinion shaft nut and washer, pull the yoke from the shaft and remove the seal.

15 Following Steps 9 and 10, install the seal and pinion shaft yoke.

16 Lubricate the pinion shaft nut with multi-purpose grease. Install the washer and a new nut, then tighten the nut to the torque listed in this Chapter's Specifications.

17 Connect the driveshaft to the pinion shaft yoke (see Section 11).

18 Install the brake drums or discs and wheels, lower the vehicle to the ground and tighten the lug nuts to the torque listed in the Chapter 1 Specifications.

19 Test drive the vehicle and check around the differential pinion shaft yoke for evidence of leakage.

14 Front spindle - removal, bearing replacement and installation

Refer to illustrations 14.2, 14.3a, 14.3b, 14.6 and 14.7

1 Following the procedure described in Chapter 1, Section 39, remove the front axle hub and wheel bearing assembly.

2 Remove bolts attaching the brake backing plate and spindle to the knuckle and remove the backing plate **(see illustration)**. If equipped with front drum brakes, remove the complete brake assembly and tie it aside without disconnecting the hydraulic line (don't let it hang by the line).

3 Remove the spindle **(see illustrations)**.

4 Wash the spindle thoroughly in clean solvent.

5 Inside the spindle is a caged needle roller bearing. Inspect the bearing for galling, scoring and excessive wear. If it's damaged or worn, replace it.

6 Use a small puller to remove the bearing assembly **(see illustration)**.

7 Use a bearing driver to install the bearing **(see illustration)**. **Note:** *If a bearing driver is not available, use a suitable size socket. The socket should have an outside diameter slightly smaller than the outside diameter of the outer bearing race.*

8 Installation is the reverse of removal. Be sure to tighten the spindle retaining nuts securely. Refer to Chapter 1, Section 39 for the hub and wheel bearing installation procedure.

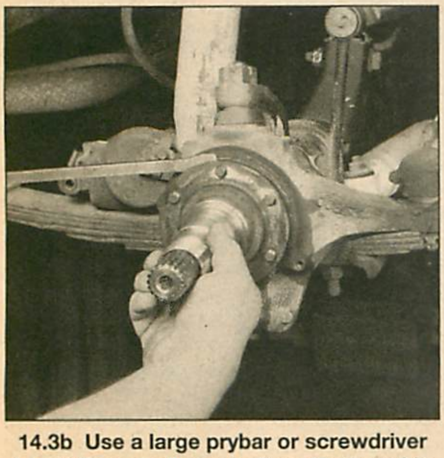
15 Axleshaft (front) - removal, overhaul and installation

Removal

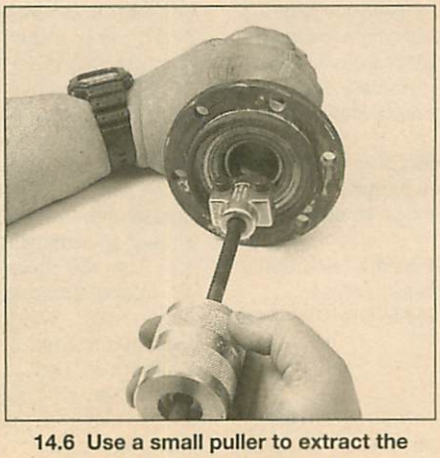
Refer to illustration 15.4

1 Raise the vehicle and place it securely on jackstands. Remove the front wheel.

2 Following the procedure described in Section 39, Chapter 1, remove the front axle hub and bearing assembly.



14.3b Use a large prybar or screwdriver to pry the spindle loose from the knuckle



14.6 Use a small puller to extract the needle roller bearing assembly from the spindle

14.7 Use a bearing driver to drive the new needle roller bearing into the spindle

15.4 When you remove an axleshaft, make sure you keep it level and pull straight out so that the splines on the inner end of the axleshaft don't damage the seal at the inner end of the axle tube

3 Remove the front spindle (see Section 14).
4 Slide the axle *straight out* of the axle housing **(see illustration)**. Be extremely careful not to damage the axleshaft seal, which is located at the inner end of the tube, where the axleshaft is splined into the differential.

Overhaul

5 Follow the U-joint replacement procedure in Section 10, but note that the snap-rings are inboard of the yoke ears and fit into grooves in the bearing caps. They are removed by driving them out with a screwdriver.

Installation

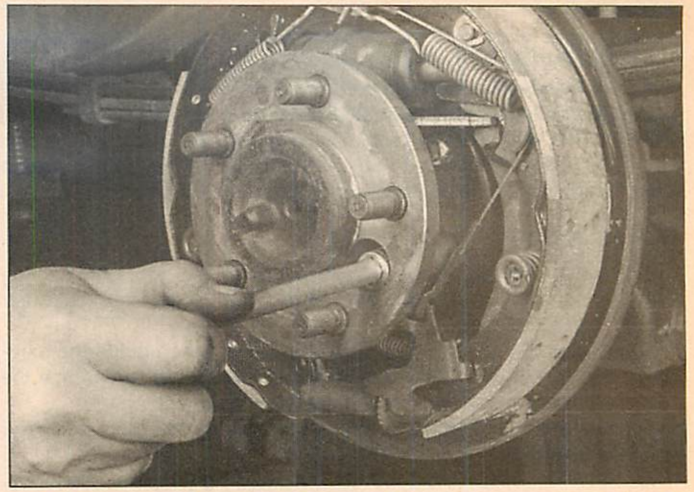
6 Lubricate the splines on the inner end of the axleshaft with grease and - keeping the axleshaft straight - insert it through the steering knuckle and into the axle tube. Make sure you don't damage the seal at the inner end of the axle tube. And make sure the splined inner end of the axleshaft is properly engaged with the differential.
7 Install the front spindle and brake backing plate (see Section 14).
8 Refer to Section 39, Chapter 1 for the front axle hub and bearing assembly installation procedure.
9 Installation is otherwise the reverse of removal.

16 Axle assembly - removal and installation

Note: *This procedure applies to both front and rear axles.*

Removal

1 Loosen the front wheel lug nuts, raise the vehicle and support it securely on jackstands positioned under the frame rails. Remove the wheels.
2 Remove the brake components (see Chapter 9).
3 On front axles, disconnect the tie-rod end and center link from the steering knuckles (see Chapter 10).
4 Disconnect the driveshaft from the pinion flange (see Section 11).
5 If the axle is equipped with a stabilizer bar, disconnect the stabilizer links from the spring tie plates (see Chapter 10).
6 If the axle is equipped with a track bar, disconnect it from the axle (see Chapter 10).
7 Unbolt the lower ends of the shock absorbers from the axle (see Chapter 10).
8 Disconnect the breather tube from the axle housing.
9 Position a hydraulic jack under the differential. If two jacks are available, place them under the axle tubes to balance the assembly. Raise the jack slightly to relieve spring tension.



17.2 Remove the four brake backing plate nuts using a socket on an extension passing through the hole in the axle flange

10 Unbolt the leaf spring U-bolts and tie plates from the axle (see Chapter 10).
11 Remove the bolts attaching the front spring shackles to the springs and lower the springs to the ground.
12 Slowly lower the axle assembly and wheel it out from under the vehicle.

Installation

13 Installation is the reverse of the removal procedure. When installing the axle, make sure it's positioned properly. For fasteners with specified torque values, be sure they are tightened to the torque listed in the Chapter 8, 9 and 10 Specifications.

17 Axleshaft, bearing and seal (rear) (semi-floating axle) - removal and installation

Removal

Refer to illustrations 17.2, 17.3 and 17.5

1 Loosen the wheel lug nuts, raise the rear of the vehicle and support it securely on jackstands. Remove the wheel.
2 Remove the brake drum and the brake backing plate retaining nuts **(see illustration)**.
3 Connect a slide hammer and adapter to the axle flange and pull the axle from the housing **(see illustration)**.

17.3 Pull the axle from the housing using a slide hammer and axle flange adapter

4 If the bearing must be replaced, take the assembly to a dealer service department or an automotive repair facility to have the old bearing removed and a new one pressed on. If a new bearing is installed, be sure to also replace the outer axle seal (see next Step).
5 If the brake backing plate shows evidence of leaking differential lubricant, the inner axleshaft seal should be replaced. Remove the seal using the slide hammer with an internal puller jaw attachment **(see illustration)**. Install the new seal using a seal driver or section of pipe.

Installation

6 Wipe the bearing bore in the axle housing clean. Pack the bearing with wheel bearing grease and apply a thin coat of grease to the outer surface of the bearing.
7 Coat the lips of the inner seal with grease, then guide the axleshaft straight into the axle housing, being careful not to damage the seal. Rotate the axle slightly to engage the differential.
8 Install the brake backing plate nuts and tighten them securely. Slide the brake drum over the axle flange.
9 Install the wheels and the lug nuts and tighten them securely. Lower the vehicle and tighten the lug nuts to the torque listed in the Chapter 1 Specifications.

18 Axleshaft (rear) (full-floating axle) - removal and installation

Refer to illustrations 18.3 and 18.6

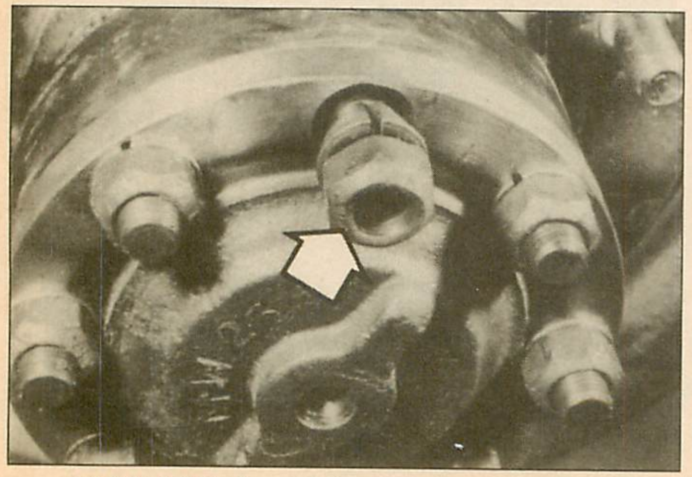
1 Remove the axleshaft flange bolts or nuts and lock washers.
2 Rap the axleshaft sharply in the center of the flange with a hammer to loosen the tapered dowels, if equipped.
3 Remove the dowels and pull out the axleshaft **(see illustration)**.
4 When installing the axleshaft, clean the gasket sealing area and place a new gasket on the flange.
5 Slide the axleshaft into the housing, engaging the axleshaft splines into the differential.
6 Install the bolts or tapered dowels, lock washers and nuts (if equipped) **(see illustration)**. Tighten the bolts/nuts securely.

19 Hub/drum assembly and wheel bearing (rear) (full-floating axle) - removal, installation and adjustment

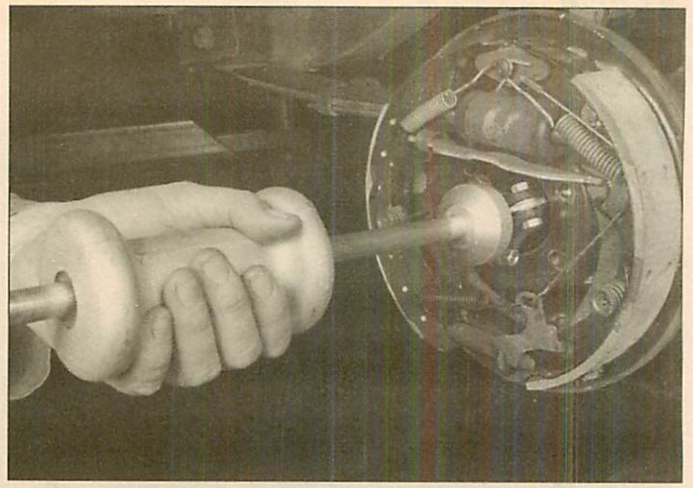
Removal

Refer to illustrations 19.3, 19.4 and 19.6

1 Raise the vehicle, support it securely on jackstands and remove the rear wheel.
2 Remove the axleshaft (see Section 18).

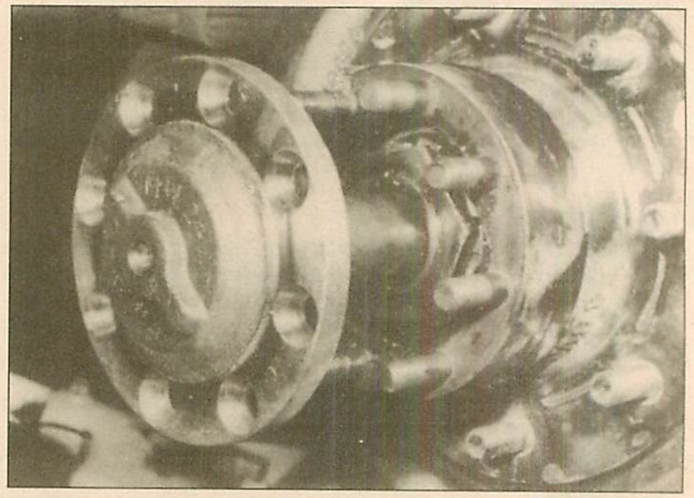


18.6 Install the tapered dowels and seat them in the flange nuts (arrow)

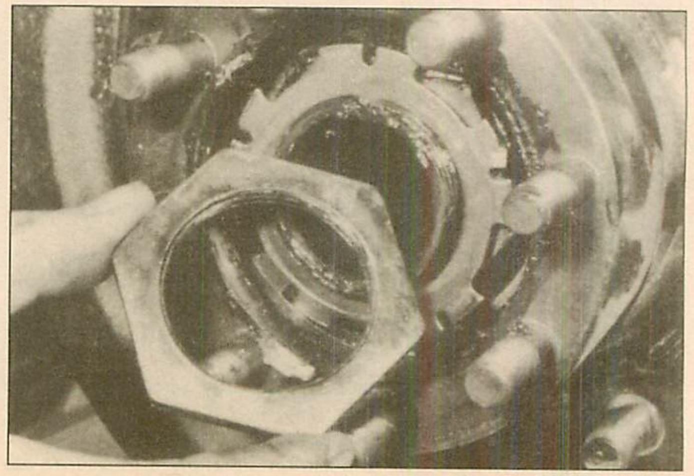


17.5 Remove the inner axle seal from the housing using a slide hammer and internal puller jaw attachment

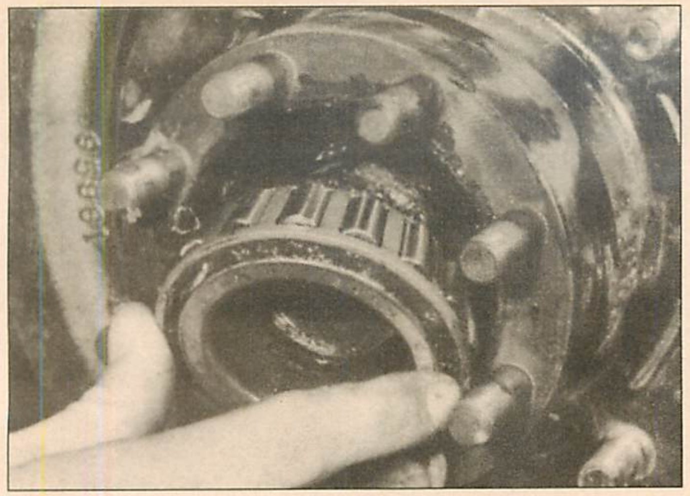
3 Straighten the locking tabs on the lockring and remove the locknut, lockring and adjusting nut **(see illustration)**.
4 Slide the hub off the axle slightly and remove the outer wheel bearing **(see illustration)**.
5 Pull the hub/drum assembly straight off the axle tube and place it



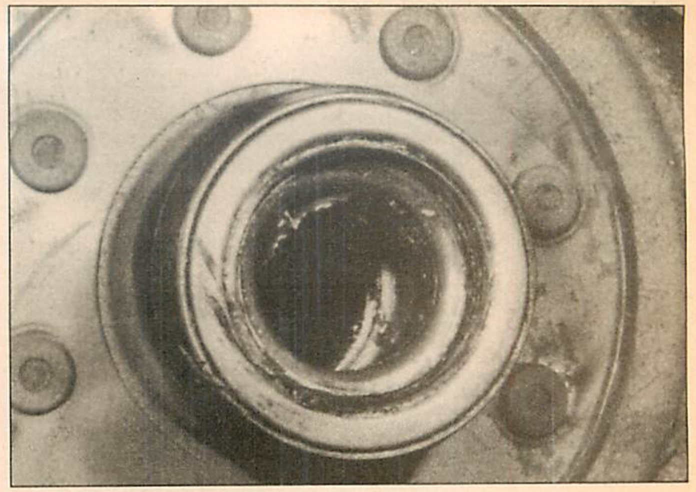
18.3 Remove the bolts or flange nuts and tapered dowels, then slide the axleshaft out of the housing



19.3 Straighten the lockring tabs and, using a large socket and breaker bar, remove the locknut, lockring and adjusting nut



19.4 Remove the outer wheel bearing from the hub



19.6 Pry the oil seal from the hub and remove the inner wheel bearing

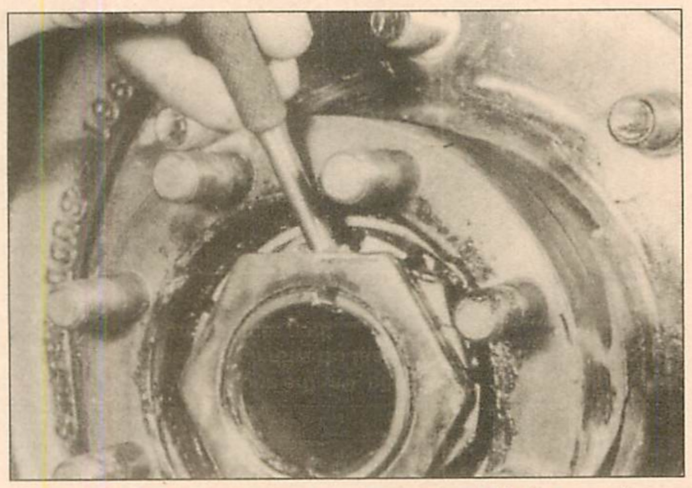
on a clean flat surface with the inside of the drum facing up.

6 Use a large screwdriver, pry bar or seal removal tool to pry out the oil seal **(see illustration)**.

7 Remove the inner wheel bearing from the hub.

8 Use solvent to wash the bearings, hub and axle tube. A small brush may prove useful; make sure no bristles from the brush embed themselves in the bearing rollers. Allow the parts to air dry.

9 Carefully inspect the bearings for cracks, wear and damage.



19.16 Bend the locking tabs over to keep the inner and outer nuts from turning

Check the axle tube flange, studs, and hub splines for damage and corrosion. Check the bearing cups (races) for pitting or scoring. Worn or damaged components must be replaced with new ones. If necessary, tap the bearing cups from the hub with a hammer and brass drift and install new ones with the appropriate size bearing driver.

10 Inspect the brake drum for scoring or damage (see Chapter 9).

Installation

11 Lubricate the bearings and the axle tube contact areas with wheel bearing grease. Work the grease completely into the bearings, forcing it between the rollers, cone and cage. Place the inner bearing into the hub and install the seal (with the seal lip facing into the hub). Using a seal driver or block of wood, drive the seal in until it's flush with the hub. Lubricate the seal with gear oil or grease.

12 Place the hub assembly on the axle tube, taking care not to damage the oil seal. Place the outer bearing into the hub.

13 Install the adjusting nut and adjust the bearings as described below.

Adjustment

Refer to illustration 19.16

14 Spin the wheel, and while it is spinning, tighten the inner nut until there is a slight drag, then back off the nut one flat.

15 Install the lockring and outer nut. make sure the inner nut doesn't turn while tightening the outer nut.

16 Bend over two tabs of the lockring to make sure that neither the inner or outer nuts can turn **(see illustration)**.

17 Install the axleshaft (see Section 18). Install the rear wheel and lower the vehicle.

8

Notes

Chapter 9 Brakes

Contents

Specifications

General

Brake fluid type	See Chapter 1

Disc brakes

Brake pad minimum thickness	See Chapter 1
Disc minimum thickness	Stamped or cast into disc
Maximum allowable disc thickness variation	No more than 0.0005 inch
Disc runout (maximum)	0.005 inch

Drum brakes

Minimum brake lining thickness	See Chapter 1
Drum maximum diameter	Stamped or cast into drum
Drum maximum out-of-round	0.005

Torque specifications

	Ft-lbs (unless otherwise indicated)
Power brake booster mounting nuts	22
Master cylinder mounting nuts	25
Caliper mounting bolts	
8000 GVW truck	45
All others	35
Caliper bracket-to-steering knuckle bolts	77
Brake hose-to-caliper banjo bolt	160 in-lbs
Wheel cylinder mounting bolts	18

1 General information

The vehicles covered by this manual are equipped with hydraulically operated front and rear brake systems. 1972 and 1973 models are equipped with front and rear drum brakes. In 1974, Wagoneer models were equipped with front disc brakes, and discs were an option on Truck models. All 1975 and later models use disc brakes up front and drum brakes at the rear. Both the front and rear brakes are self-adjusting: Disc brake calipers automatically compensate for pad wear by pushing the piston out farther as the pads wear down; drum brakes have an adjustment mechanism which is activated when the brakes are applied with the vehicle in reverse.

Hydraulic circuits

The hydraulic system consists of two separate circuits; if a leak or failure occurs in one hydraulic circuit, the other circuit will remain operative. The master cylinder has separate reservoirs for each circuit. A visual warning of circuit failure or air in the system is given by a warning light activated by displacement of the piston in the pressure differential switch portion of the combination valve from its normal "in balance" position.

Master cylinder/reservoir assembly

The master cylinder has separate primary and secondary piston assemblies for the front and rear circuits.

Two basic types of master cylinders are used on the vehicles covered by this book: A one-piece cast-iron unit with an integral reservoir is used on 1972 through 1980 models; a two-piece unit with an aluminum body and a separate plastic reservoir is used on 1981 and later models. Both cast iron and aluminum units are rebuildable.

When you go to a dealer parts department or an auto parts store to purchase a new or rebuilt master cylinder unit, or a rebuild kit, be sure to specify the make, model, type of master cylinder (cast-iron or aluminum) in your vehicle. Be as specific as you can. It's a good idea to take the unit you're rebuilding or replacing with you so you can compare parts. If that's not possible, be sure to take the serial numbers off the casting to assist the parts people in providing you with the correct unit.

Combination valve

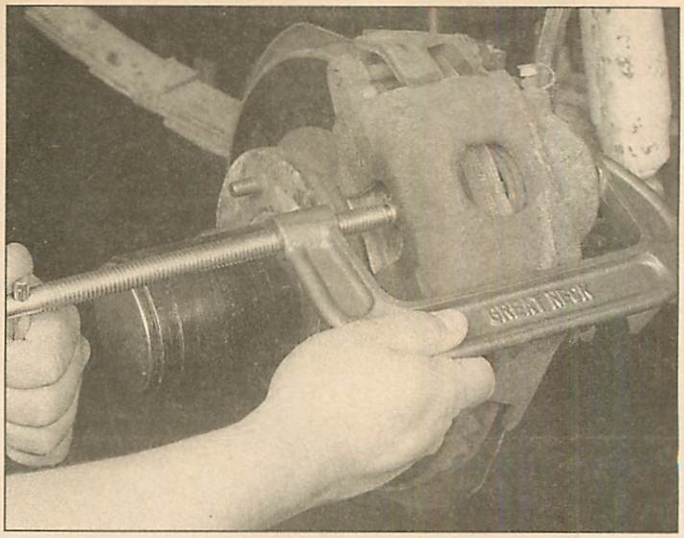
The combination valve, located on the left frame rail, performs several functions. A metering valve limits pressure to the front brakes until a predetermined front-brake pressure is reached and the rear brakes have been activated. A fixed-rate proportioning valve meters outlet pressure to the rear brakes once a predetermined rear input pressure has been reached, preventing premature rear-wheel lock-up during heavy braking. The combination valve is also designed to ensure full pressure to one circuit should the other circuit fail. A brake pressure differential switch continuously compares the front and rear brake pressures. If a failure occurs somewhere in the system, a red warning light on the instrument cluster comes on. Once a failure has occurred, the warning light remains on until the system has been repaired.

Power brake booster

A dual-diaphragm, vacuum-operated power brake booster, mounted between the firewall and the master cylinder, utilizes engine manifold vacuum and atmospheric pressure to provide assistance to the hydraulic brake system.

Parking brake system

The parking brake system consists of a pedal assembly under the left end of the dash, the cable connecting this pedal to an equalizer which adjusts the tension of the rear cable, and the parking brake levers in the rear drum brake assemblies. When the parking brake pedal is depressed, it pulls on the front cable, which pulls on the equalizer, which pulls on the rear cable, which pulls the parking brake levers in the drums and expands the brake shoes against the drums.



2.5 Using a large C-clamp, push the piston back into the caliper bore - note that one end of the clamp is on the flat area on the backside of the caliper and the other end (screw end) is pressing against the outer brake pad

Service

After completing any operation involving disassembly of any part of the brake system, always test drive the vehicle to check for proper braking performance before resuming normal driving. When testing the brakes, perform the tests on a clean, dry, flat surface. Conditions other than these can lead to inaccurate test results.

Test the brakes at various speeds with both light and heavy pedal pressure. The vehicle should stop evenly without pulling to one side or the other. Avoid locking the brakes because this slides the tires and diminishes braking efficiency and control of the vehicle.

Tires, vehicle load and front-end alignment are factors which also affect braking performance.

2 Disc brake pads - replacement

Refer to illustrations 2.5 and 2.6a through 2.6q

Warning: *Disc brake pads must be replaced on both front wheels or rear wheels at the same time - never replace the pads on only one wheel. Also, the dust created by the brake system may contain asbestos, which is harmful to your health. Never blow it out with compressed air and don't inhale any of it. An approved filtering mask should be worn when working on the brakes. Do not, under any circumstances, use petroleum-based solvents to clean brake parts. Use brake system cleaner or clean brake fluid only!*

1 Remove the cover from the brake fluid reservoir, siphon off two-thirds of the fluid into a container and discard it.

2 Loosen the wheel lug nuts, raise the front of the vehicle and support it securely on jackstands.

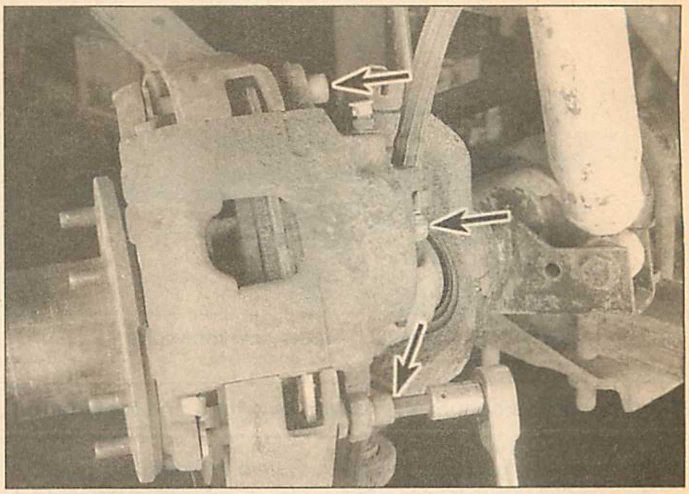
3 Remove the front wheels. Work on one brake assembly at a time, using the assembled brake for reference if necessary.

4 Inspect the brake disc carefully (see Section 4). If machining is necessary, follow the information in that Section to remove the disc, at which time the pads can be removed from the calipers as well.

5 Push the piston back into the bore to provide room for the new brake pads. A C-clamp can be used to accomplish this **(see illustration)**. As the piston is depressed to the bottom of the caliper bore, the fluid in the master cylinder will rise. Make sure it doesn't overflow. If necessary, siphon off some more of the fluid.

6 Follow the **accompanying illustrations, beginning with 2.6a**, for the actual pad replacement procedure. Be sure to stay in order and read the caption under each illustration.

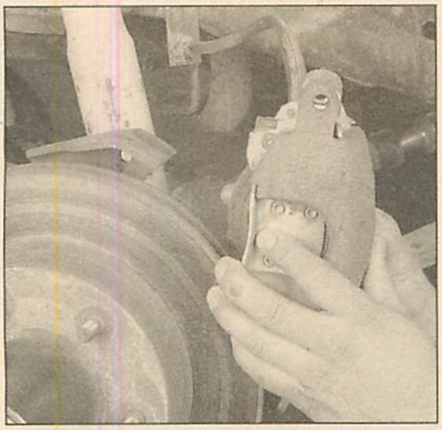

2.6a Before removing the caliper, wash off all traces of brake dust with brake system cleaner

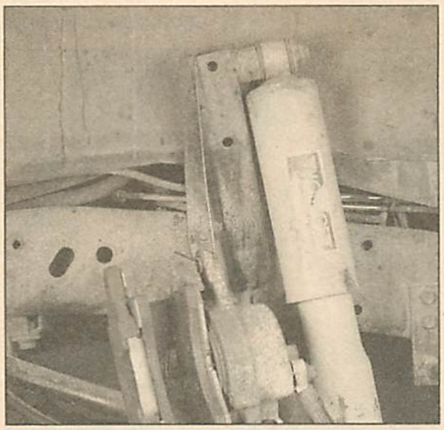

2.6b To remove the caliper, remove these two mounting bolts (upper and lower arrows); don't remove the brake hose-to-caliper banjo bolt (center arrow) unless you intend to overhaul or replace the caliper

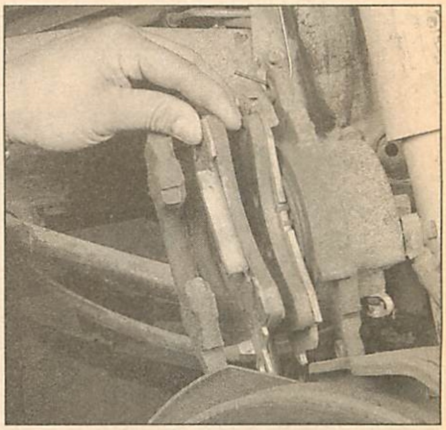
7 When reinstalling the caliper, be sure to tighten the mounting bolts to the torque listed in this Chapter's Specifications. After the job has been completed, firmly depress the brake pedal a few times to bring the pads into contact with the disc.

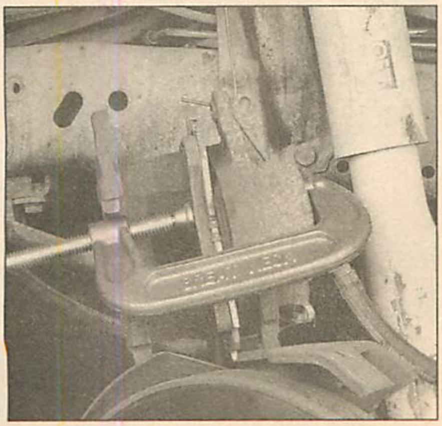
8 Check the brake fluid level in the master cylinder reservoir and add some, if necessary (see Chapter 1).

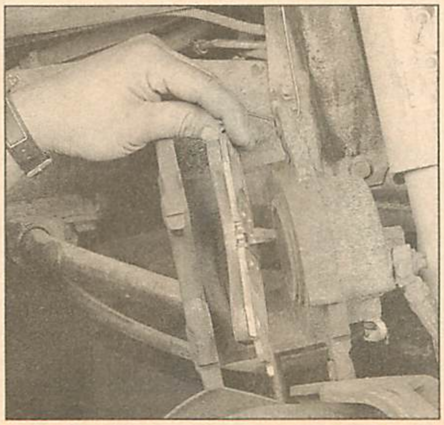
9 Check for fluid leakage and make sure the brakes operate normally before driving in traffic.

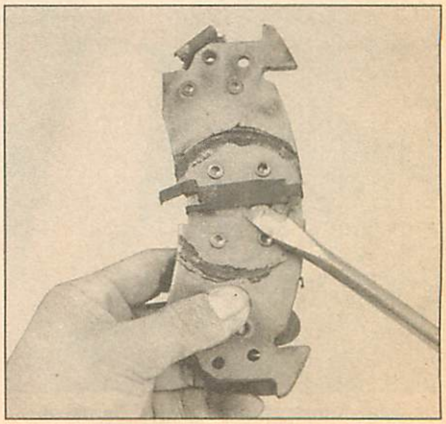

2.6c Remove the caliper; this is a good time to check for fluid leakage around the caliper piston boot, which would indicate the need for an overhaul (see Section 3)

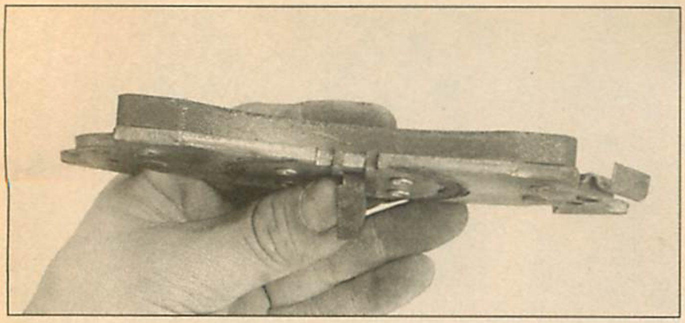

2.6d Whenever you have to let go of the caliper, hang it from the shock absorber bracket with a piece of wire - DON'T let it hang by the brake hose!


2.6e Remove the outer brake pad from the caliper

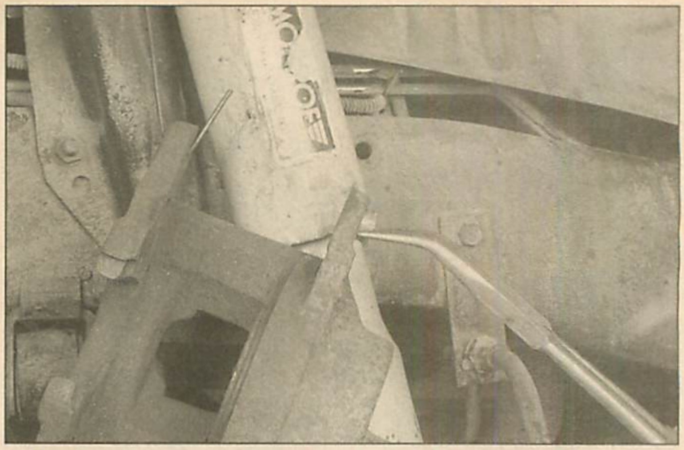

2.6f Install the C-clamp again and depress the piston the rest of the way into the caliper


2.6g To remove the inner brake pad from the caliper, pop the inner pad retaining clip out of the piston


2.6h Pry the retaining clip off the inner pad . . .



2.6i . . . and install it on the new inner pad



2.6j Remove the bushings from both caliper ears, clean them thoroughly, and inspect them for corrosion and excessive wear - if either bushing is damaged, replace it; also inspect the small O-ring inside each caliper ear - if it's damaged, replace it too

3 Disc brake caliper - removal, overhaul and installation

Warning: *Dust created by the brake system may contain asbestos, which is harmful to your health. Never blow it out with compressed air and don't inhale any of it. An approved filtering mask should be worn when working on the brakes. Do not, under any circumstances, use petroleum-based solvents to clean brake parts. Use brake system cleaner or clean brake fluid only!*

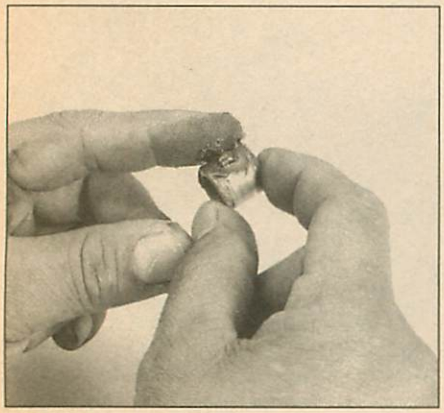
Note: *If an overhaul is indicated (usually because of fluid leakage) explore all options before beginning the job. New and factory rebuilt calipers are available on an exchange basis, which makes this job quite easy. If it's decided to rebuild the calipers, make sure a rebuild kit is available before proceeding. Always rebuild the calipers in pairs - never rebuild just one of them.*

Removal

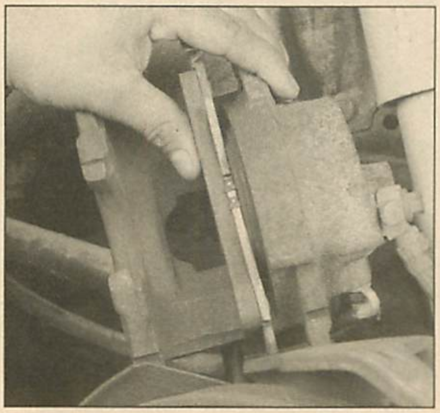
Refer to illustration 3.4

1 Remove the cover from the brake fluid reservoir, siphon off two-thirds of the fluid into a container and discard it.

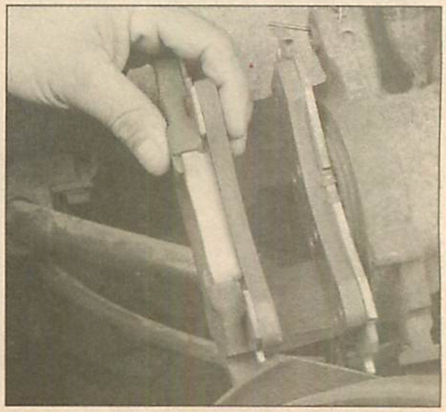
2 Loosen the wheel lug nuts, raise the front of the vehicle and support it securely on jackstands. Remove the front wheels.



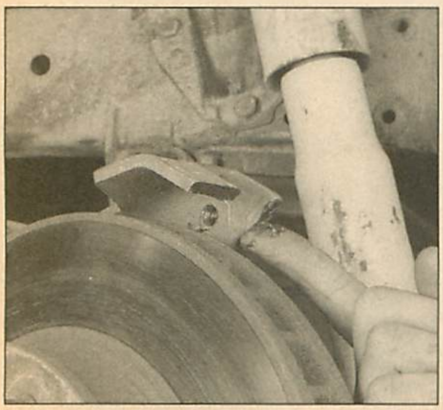
2.6k Lubricate the bushings with high-temperature grease, then install them in the caliper ears



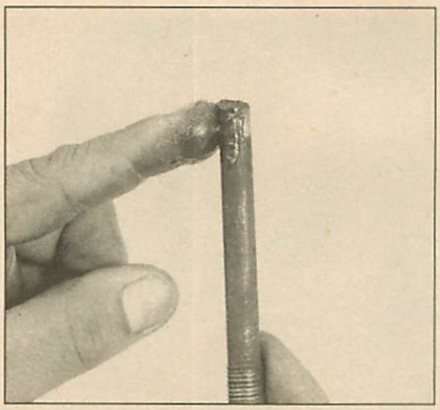
2.6l Install the inner brake pad - make sure the retaining clip is fully seated in the piston



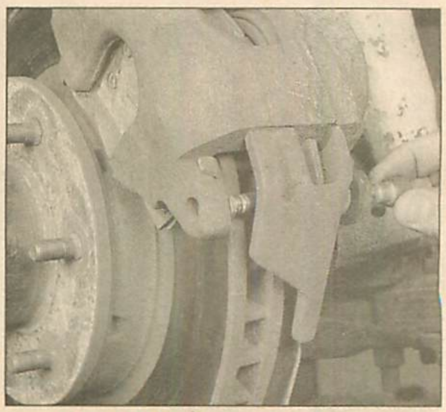
2.6m Install the outer brake pad



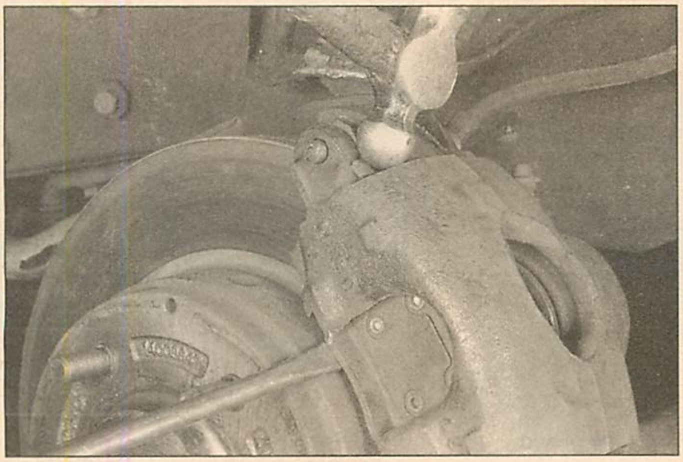
2.6n Lubricate the "ways" (contact surfaces) of the steering knuckle with high-temperature grease



2.6o Lubricate the ends of the caliper mounting bolts with a little high-temperature grease



2.6p Install the caliper assembly, install the mounting bolts and tighten them to the torque listed in this Chapter's Specifications



2.6q Insert a screwdriver between the disc and the outer brake pad, then pry up and strike the pad ears with a hammer to eliminate all play between the pad and caliper

3 Using a C-clamp, push the piston back into the caliper bore **(see illustration 2.5)**.

4 To disconnect the brake hose from the caliper, remove the brake hose-to-caliper banjo bolt **(see illustration)**. **Note:** *Do not disconnect the brake hose from the caliper if you are only removing the caliper for access to other components.* Have a rag handy to catch spilled fluid and immediately wrap a plastic bag tightly around the end of the hose to prevent fluid loss and contamination.

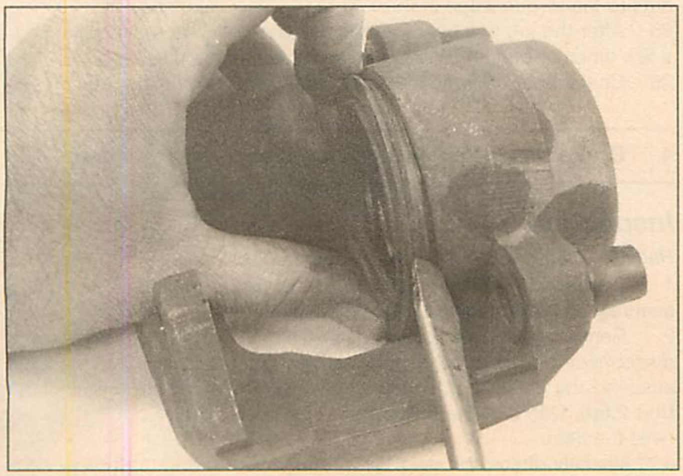
5 Unscrew the two caliper mounting bolts and detach the caliper (see Section 2). If you're removing the caliper for access to other components, hang it with a piece of wire from the shock absorber bracket **(see illustration 2.6d)** - DON'T let it hang by the brake hose.

Overhaul

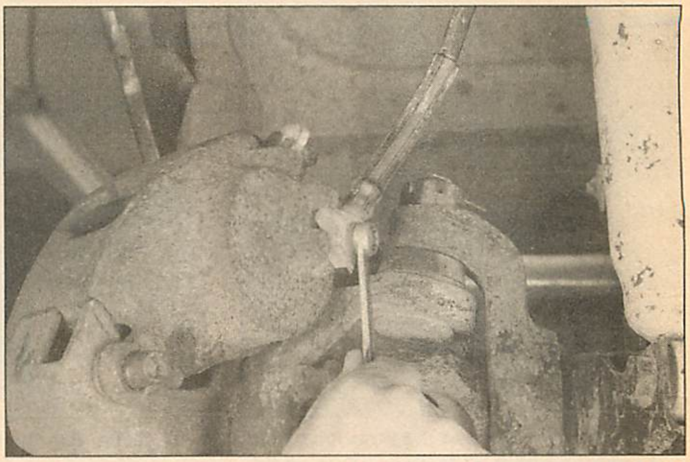
Refer to illustrations 3.7, 3.8, 3.9, 3.10, 3.15a, 3.15b and 3.16

6 Clean the exterior of the caliper with brake system cleaner. Never use gasoline, kerosene or petroleum-based cleaning solvents. Place the caliper on a clean workbench.

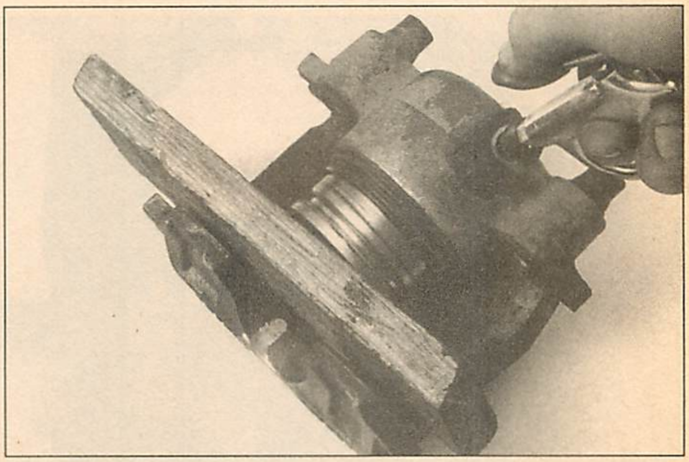
7 Position a wooden block or several shop rags in the caliper as a pad, then use compressed air to remove the piston from the caliper **(see illustration)**. Use only enough air pressure to ease the piston out of the bore. If the piston is blown out, even with the cushion in place, it may be damaged. **Warning:** *Never place your fingers in front of the piston in an attempt to catch or protect it when applying compressed air, as serious injury could occur.*



3.8 Carefully pry the dust boot out of the caliper



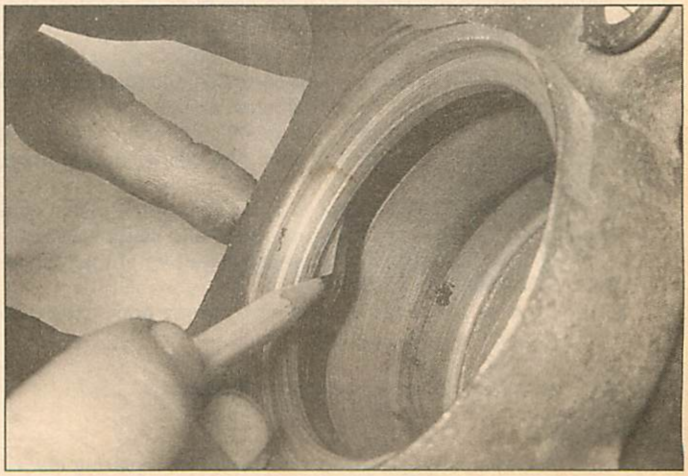
3.4 If you're removing the caliper to overhaul it, remove the banjo bolt which connects the brake hose to the caliper



3.7 With the caliper padded to catch the piston, use compressed air to force the piston out of its bore - make sure your hands or fingers are not between the piston and caliper frame!

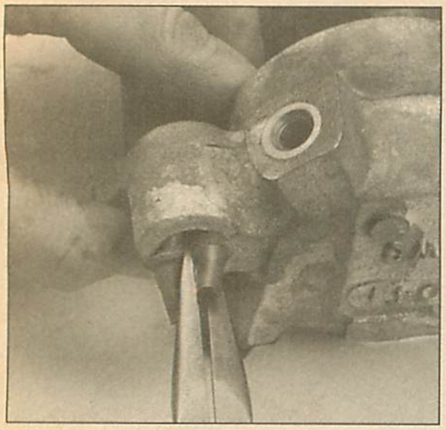
8 Carefully pry the dust boot out of the caliper bore **(see illustration)**.

9 Using a wood or plastic tool, remove the piston seal from the groove in the caliper bore **(see illustration)**. Metal tools may cause bore damage.

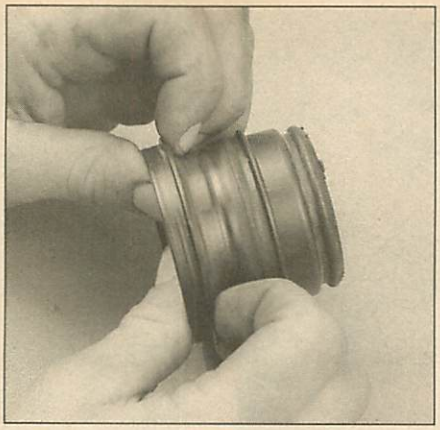


3.9 The piston seal should be removed with a plastic or wooden tool to avoid damage to the bore and seal groove. A pencil will do the job

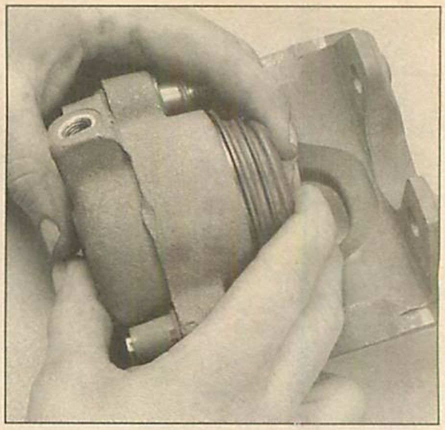
9



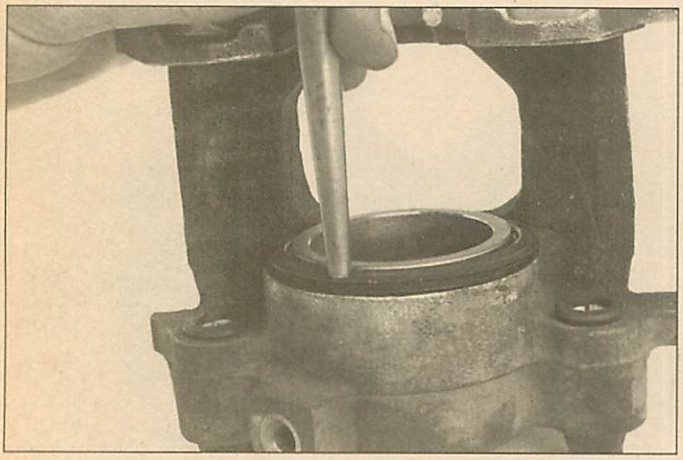
3.10 Grab the ends of the mounting bolt bushings with needle-nose pliers and, using a twisting motion, push them through the caliper ears



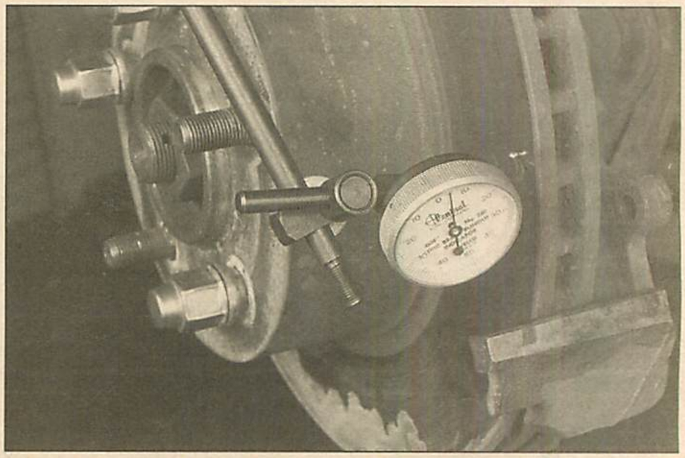
3.15a Slip the boot over the piston



3.15b Push the piston straight into the caliper - make sure it doesn't become cocked in the bore



3.16 If the correct seal driver tool isn't available, a drift punch can be used to tap around the circumference until the dust boot is seated



4.4a Use a dial indicator to check disc runout - if the reading exceeds the specified allowable runout limit, the disc will have to be machined or replaced

10 Remove the caliper bleeder screw, then remove and discard the mounting bolt rubber bushings, if equipped **(see illustration)**. Discard all rubber parts.

11 Clean the remaining parts with brake system cleaner or clean brake fluid, then blow them dry with compressed air.

12 Carefully examine the piston for nicks and burrs and loss of plating. If surface defects are present, the parts must be replaced.

13 Check the caliper bore in a similar way. Light polishing with crocus cloth is permissible to remove light corrosion and stains. Discard the caliper pins if they're corroded or damaged.

14 When assembling the caliper, lubricate the piston bore and seal with clean brake fluid. Position the seal in the caliper bore groove, making sure it isn't twisted.

15 Install the dust boot in the groove in the end of the piston **(see illustration)**. Dip the piston in clean brake fluid and insert it squarely into the the cylinder. Depress the piston to the bottom of the cylinder bore **(see illustration)**.

16 Seat the boot in the caliper counterbore using a boot installation tool to a blunt punch **(see illustration)**.

17 Install the bleeder screw.

18 Install new inner and outer mounting bolt bushings.

Installation

19 Inspect the caliper pins for excessive corrosion, replacing them if necessary.

20 Clean and lubricate the caliper mounting bolts, bushings and steering knuckle ways (see Section 2).

21 Install the caliper (see Section 2).

22 Install the brake hose and banjo bolt. Use new copper washers, then tighten the bolt to the torque listed in this Chapter's Specifications.

23 Bleed the brakes (see Section 10).

24 Install the wheels and lower the vehicle. Tighten the wheel lug nuts to the torque listed in this Chapter's Specifications.

25 After the job has been completed, firmly depress the brake pedal a few times to bring the pads into contact with the disc.

26 Check brake operation before driving the vehicle in traffic.

4 Brake disc - inspection, removal and installation

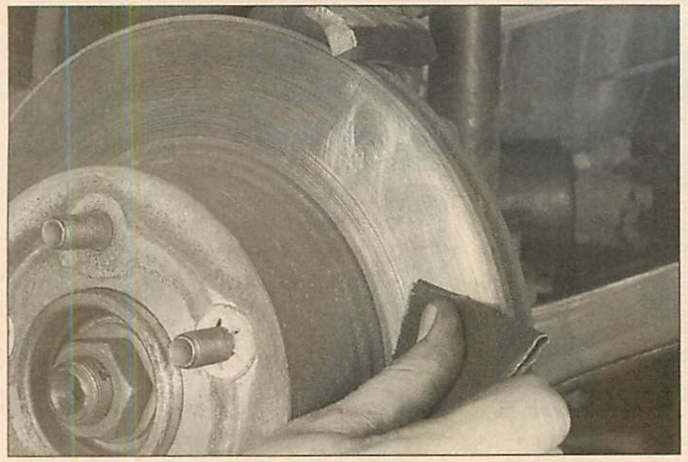
Inspection

Refer to illustrations 4.4a, 4.4b, 4.5a and 4.5b

1 Loosen the wheel lug nuts, raise the vehicle and support it securely on jackstands. Remove the wheel.

2 Remove the brake caliper (see Section 3). It's not necessary to disconnect the brake hose. After removing the caliper mounting bolts, suspend the caliper out of the way with a piece of wire **(see illustration 2.6d)**. Don't let the caliper hang by the hose and don't stretch or twist the hose.

3 Visually check the disc surface for score marks and other damage. Light scratches and shallow grooves are normal after use and may not always be detrimental to brake operation, but deep score marks - over 0.015-inch (0.38 mm) - require disc removal and refinish-

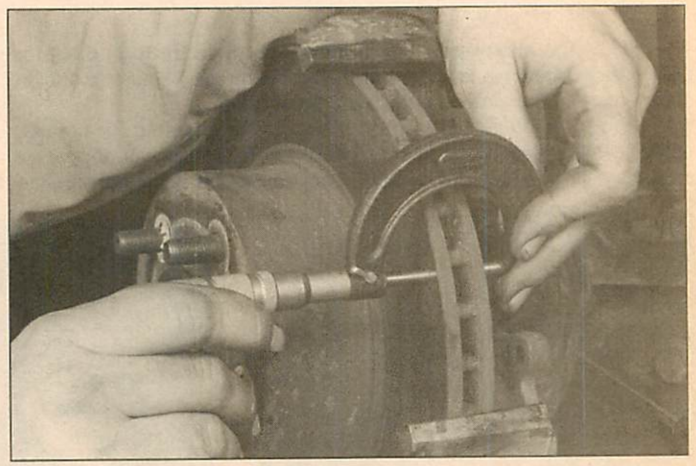

4.4b Using a swirling motion, remove the glaze from the disc surface with sandpaper or emery cloth

ing by an automotive machine shop. Be sure to check both sides of the disc. If pulsating has been noticed during application of the brakes, suspect disc runout. Be sure to check the wheel bearings to make sure they're properly adjusted.

4 To check disc runout, place a dial indicator at a point about 1/2-inch from the outer edge of the disc **(see illustration)**. Set the indicator to zero and turn the disc. The indicator reading should not exceed the specified allowable runout limit. If it does, the disc should be refinished by an automotive machine shop. **Note:** *Professionals recommend resurfacing of brake discs regardless of the dial indicator reading (to produce a smooth, flat surface that will eliminate brake pedal pulsations and other undesirable symptoms related to questionable discs). At the very least, if you elect not to have the discs resurfaced, deglaze them with sandpaper or emery cloth (use a swirling motion to ensure a non-directional finish)* **(see illustration)**.

5 The disc must not be machined to a thickness less than the specified minimum refinish thickness. The minimum (or discard) thickness is cast into the inside of the disc **(see illustration)**. The disc thickness can be checked with a micrometer **(see illustration)**.

4.5a The minimum thickness is either cast into the inside of the disc or on the outer edge of the disc (typical)


4.5b Use a micrometer to measure disc thickness at several points

Removal and installation

6 Refer to Chapter 1, Section 39, to remove the front axle hub and wheel bearing assembly (the brake disc is an integral part of the hub).

7 Install the caliper and brake pad assembly (see Section 2). Tighten the caliper mounting bolts to the torque listed in this Chapter's Specifications.

8 Install the wheel and lug nuts, then lower the vehicle to the ground. Tighten the wheel lug nuts to the torque listed in the Chapter 1 Specifications.

9 Depress the brake pedal a few times to bring the brake pads into contact with the disc. Bleeding of the system will not be necessary unless the brake hose was disconnected from the caliper. Check the operation of the brakes carefully before placing the vehicle into normal service.

5 Drum brake shoes - replacement

Refer to illustrations 5.4a through 5.4v, and 5.5

Warning: *Drum brake shoes must be replaced on both wheels at the same time - never replace the shoes on only one wheel. Also, the dust created by the brake system may contain asbestos, which is harmful to your health. Never blow it out with compressed air and don't inhale any of it. An approved filtering mask should be worn when working on the brakes. Do not, under any circumstances, use petroleum-based solvents to clean brake parts. Use brake system cleaner or clean brake fluid only!*

Caution: *Whenever the brake shoes are replaced, the retracting and hold-down springs should also be replaced. Due to the continuous heating/cooling cycle that the springs are subjected to, they lose their tension over a period of time and may allow the shoes to drag on the drum and wear at a much faster rate than normal.*

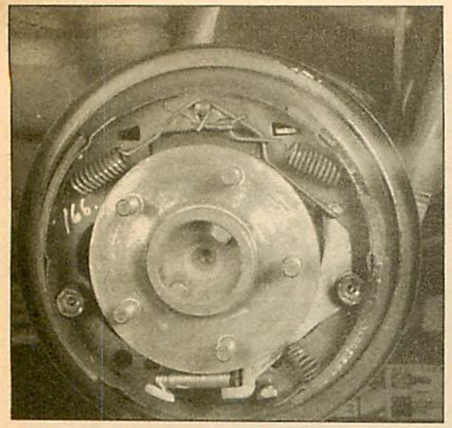
Note 1: *The following procedure was performed on a rear drum brake. If you are working on a front drum brake, ignore the steps which do not apply.*

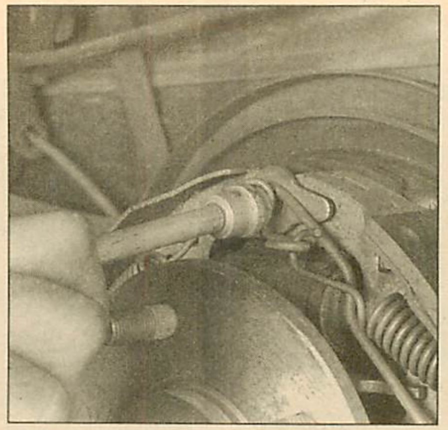
Note 2: *All four rear brake shoes must be replaced at the same time, but to avoid mixing up parts, work on only one brake assembly at a time.*

1 Loosen the wheel lug nuts, raise the rear of the vehicle and support it securely on jackstands. Block the front wheels to keep the vehicle from rolling.

2 Release the parking brake.

3 Remove the wheel and brake drum. If you're working on the rear drum brake of a semi-floating axle, simply pull the drum off the axle flange. If you're working on a front drum brake, see Chapter 1, Section 39. If you're working on the rear drum brake of a full-floating axle, see Chapter 8, Section 19. **Note 1:** *Some full-floating rear axles have drums that can be removed without removing the axleshaft and hub/bearing/drum assembly; instead, they have two screws securing the drum to the hub.* **Note 2:** *If the brake drum cannot be easily pulled off the axle and shoe assembly, make sure that the parking brake is completely released, then apply some penetrating oil at the hub-to-drum joint. Allow the oil to soak in and try to pull the drum off. If the drum still cannot be pulled off, the brake shoes will have to be retracted. This is accomplished by first removing the plug from the backing plate. With the plug removed, pull the lever off the adjusting star wheel with one narrow screwdriver while turning the adjusting wheel with another narrow screwdriver, moving the shoes away from the drum. The drum should now come off.*

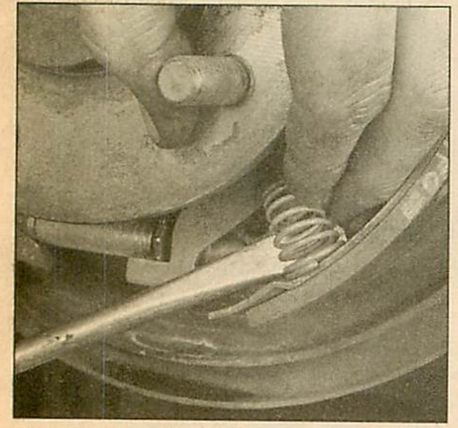

5.4a Wash down the brake assembly with brake cleaner; do NOT blow it off with compressed air!

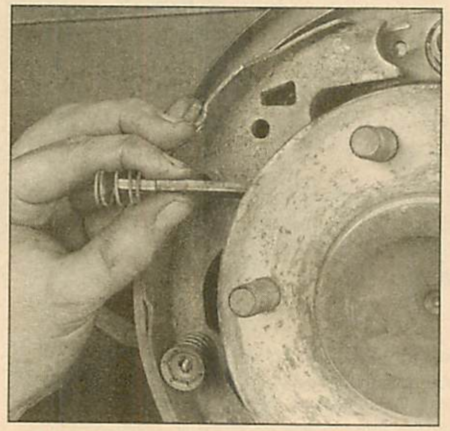

5.4b Remove the shoe return springs - the spring tool shown here is available at most auto parts stores and makes this job much easier and safer

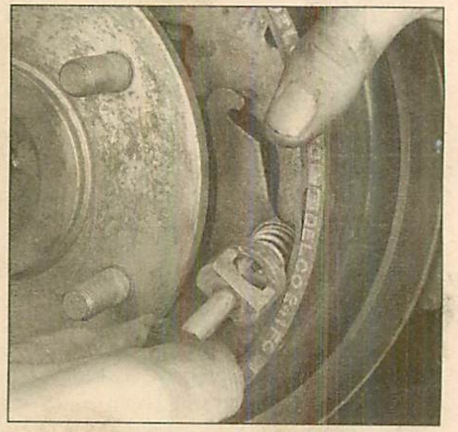

5.4c Pull the bottom of the actuator lever toward the secondary brake shoe, compressing the lever return spring - the actuator link can now be removed from the top of the lever

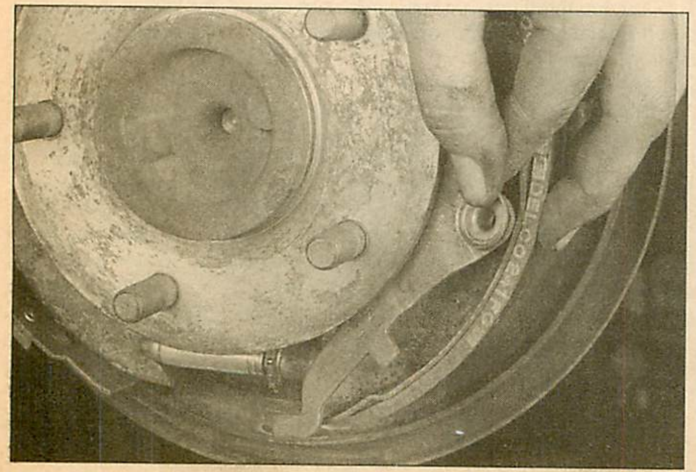
4 Follow the **accompanying illustrations (5.4a through 5.4v)** for the inspection and replacement of the brake shoes. Be sure to stay in order and read the caption under each illustration.

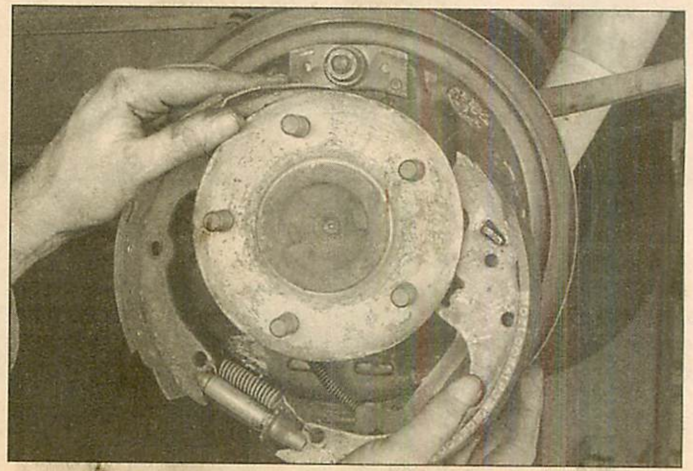
5 Before reinstalling the drum it should be checked for cracks, score marks, deep scratches and hard spots, which will appear as small discolored areas. If the hard spots cannot be removed with fine emery cloth or if any of the other conditions listed above exist, the drum must be taken to an automotive machine shop to have it machined. **Note:** *Professionals recommend resurfacing the drums whenever a brake job is done. Resurfacing will eliminate the possibility of out-of-round drums. If the drums are worn so much that they can't be resurfaced without exceeding the maximum allowable diameter*


5.4d Pry the actuator lever spring out with a large screwdriver

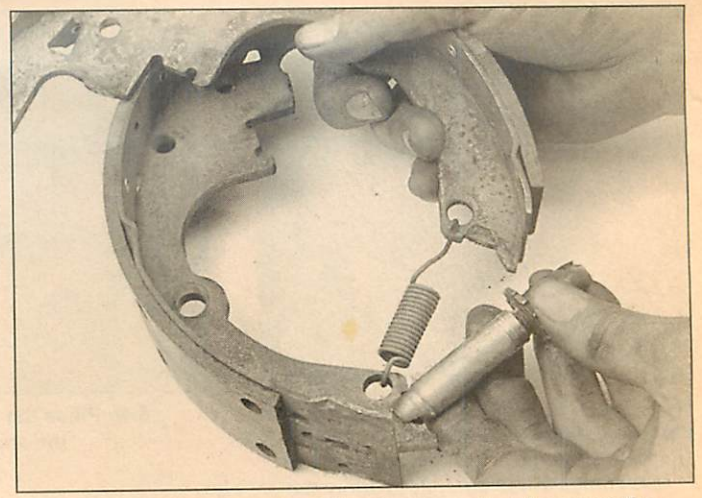

5.4e Slide the parking brake strut out from between the axle flange and primary shoe


5.4f Remove the hold-down springs and pins - the hold-down spring tool shown here is available at most auto parts stores


5.4g Remove the actuator lever and pivot - be careful not to let the pivot fall out of the lever

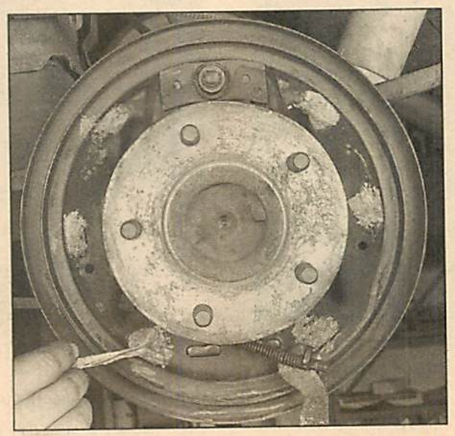

5.4h Spread the top of the shoes apart and slide the assembly around the axle

5.4i Unhook the parking brake lever from the secondary shoe - on some models, you'll have to pry off an E-clip with a small screwdriver before the shoe pin will slide out of the lever - you may have to drive the pin out of the old shoe with a hammer and punch and transfer it to the new shoe

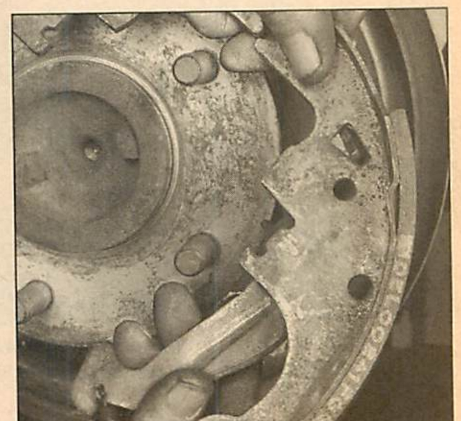


5.4j Spread the bottom of the shoes apart and remove the adjusting screw assembly, followed by the spring

5.4k Clean and lubricate the adjusting screw threads and end with multi-purpose grease, then reinstall the spring and adjusting screw between the new brake shoes (the long end must point forward)



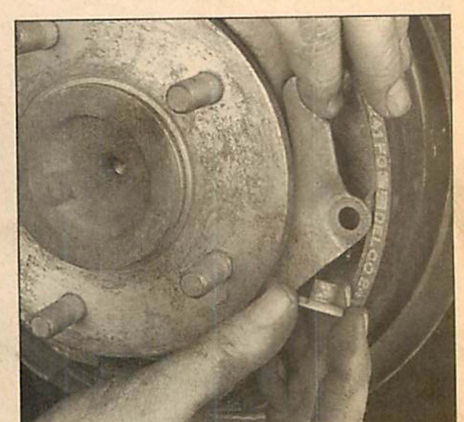
5.4l Lubricate the shoe contact points on the backing plate with high-temperature brake grease



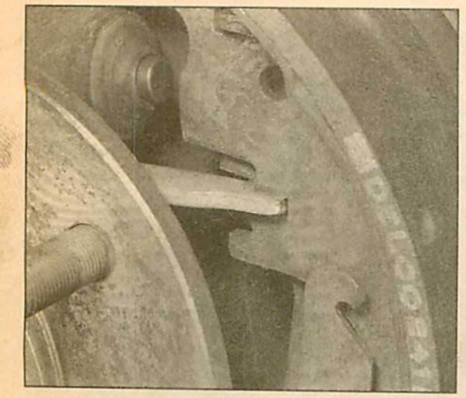
5.4m Insert the parking brake lever into the opening in the secondary brake shoe or insert the pin in the shoe through the lever and install a new E-clip, depending on design

5.4n Spread the shoes apart and slide them into position on the backing plate

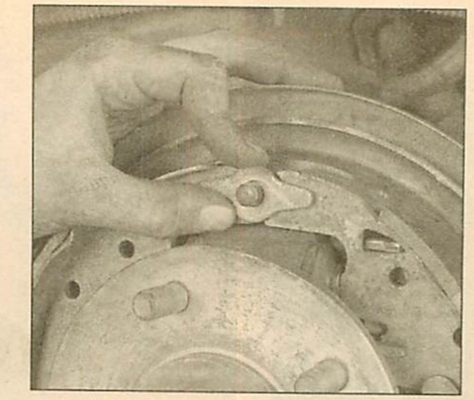
5.4o Install the hold-down pin through the backing plate and primary shoe, then secure it with the spring and retainer



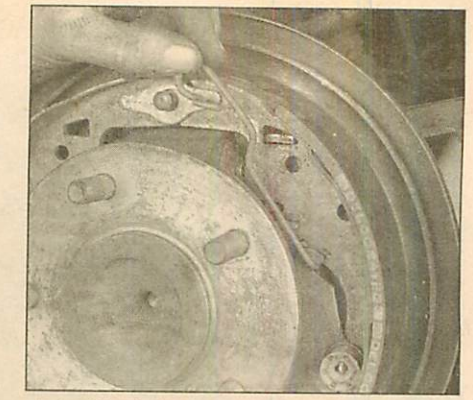
5.4p Insert the lever pin into the actuator lever, place the lever over the secondary shoe hold-down pin and install the hold-down spring



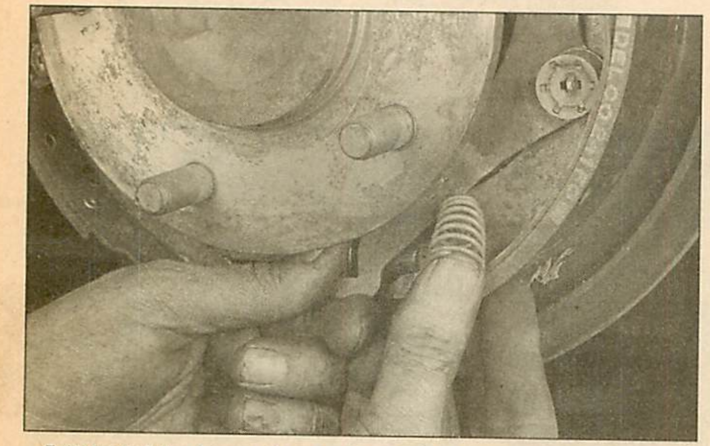
5.4q Guide the parking brake strut behind the axle flange and engage the rear end of it in the slot on the parking brake lever - spread the shoes enough to allow the other end to seat against the primary shoe



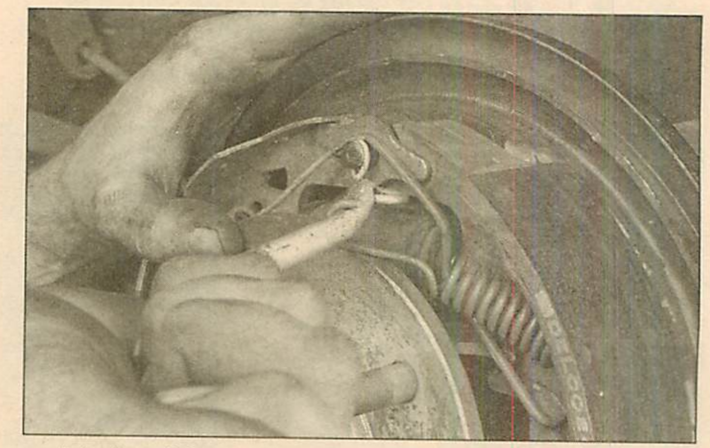
5.4r Place the shoe guide over the anchor pin



5.4s Hook the lower end of the actuator link to the actuator lever, then loop the top end over the anchor pin



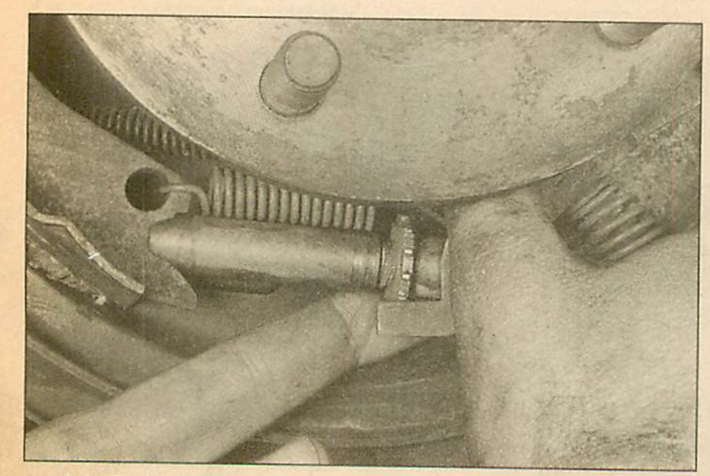
5.4t Install the lever return spring over the tab on the actuator lever, then push the spring up onto the brake shoe



5.4u Install the primary and secondary shoe return springs

(stamped into the drum) **(see illustration)**, *then new ones will be required. At the very least, if you elect not to have the drums resurfaced, remove the glazing from the surface with medium-grit emery cloth using a swirling motion.*

6 Once the new shoes are in place, install the drums on the axle



5.4v Pull out on the actuator lever to disengage it from the adjusting screw wheel, turn the wheel to adjust the shoes in or out as necessary - the brake drum should slide over the shoes and turn with a very slight amount of drag (complete the adjustment by following Steps 7 and 8)

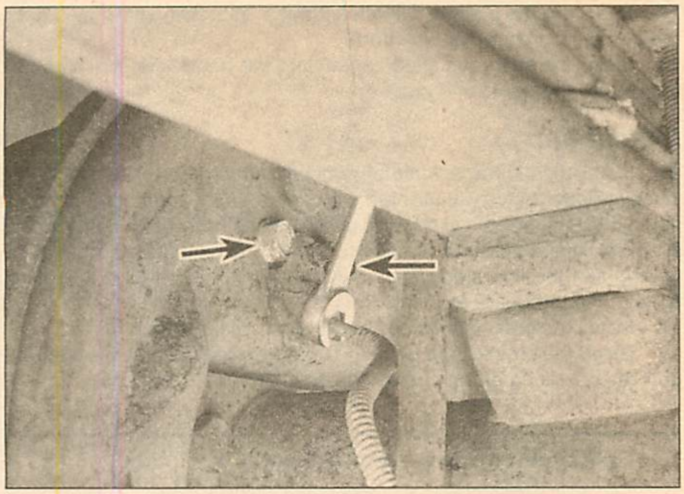
flanges. Remove the rubber plugs from the brake backing plates.

7 Insert a narrow screwdriver or brake adjusting tool through the adjustment hole and turn the star wheel until the brakes drag slightly as the drum is turned.

8 Turn the star wheel in the opposite direction until the drum turns freely. Keep the adjuster lever from contacting the star wheel or it won't turn. This can be done by pushing on it with another narrow screwdriver.

9 Repeat the adjustment on the opposite wheel and install the backing plate plugs.

5.5 The maximum allowable drum diameter is cast into the drum (typical)



6.4 Completely loosen the brake line fitting, then remove the two wheel cylinder mounting bolts (arrows)

10 Mount the wheel, install the lug nuts, then lower the vehicle. Tighten the lug nuts to the torque listed in the Chapter 1 Specifications.

11 Make a number of forward and reverse stops to allow the brakes to further adjust themselves.

12 Check brake operation before driving the vehicle in traffic.

6 Wheel cylinder - removal, overhaul and installation

Note: *If an overhaul is indicated (usually because of fluid leakage or sticky operation) explore all options before beginning the job. New wheel cylinders are available, which makes this job quite easy. If it's decided to rebuild the wheel cylinder, make sure that a rebuild kit is available before proceeding. Never overhaul only one wheel cylinder - always rebuild both of them at the same time.*

Removal

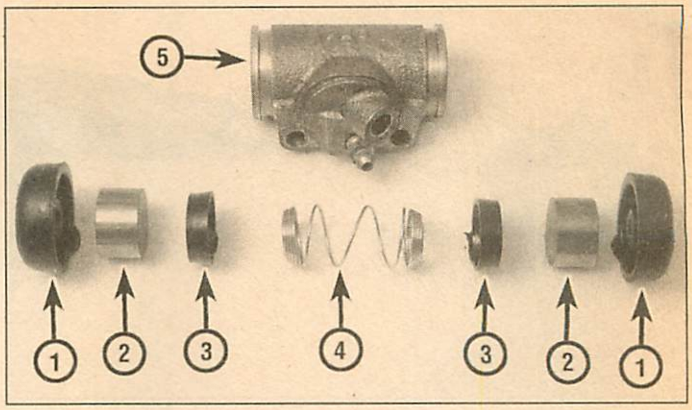
Refer to illustration 6.4

1 Raise the rear of the vehicle and support it securely on jackstands. Block the front wheels to keep the vehicle from rolling.

2 Remove the brake shoe assembly (see Section 5).

3 Remove all dirt and foreign material from around the wheel cylinder.

4 Completely loosen the brake line fitting **(see illustration)**. Don't pull the brake line away from the wheel cylinder, as it could get bent. Remove the wheel cylinder mounting bolts.



6.6a An exploded view of a typical wheel cylinder assembly

1 *Dust boot*
2 *Piston*
3 *Cup*
4 *Spring*
5 *Wheel cylinder housing*

5 Detach the wheel cylinder from the brake backing plate and place it on a clean workbench. Immediately plug the brake line to prevent fluid loss and contamination. **Note:** *If the brake shoe linings are contaminated with brake fluid, install new brake shoes.*

Overhaul

Refer to illustrations 6.6a, 6.6b, 6.10a, 6.10b, 6.11, 6.12a, 6.12b, 6.14 and 6.15

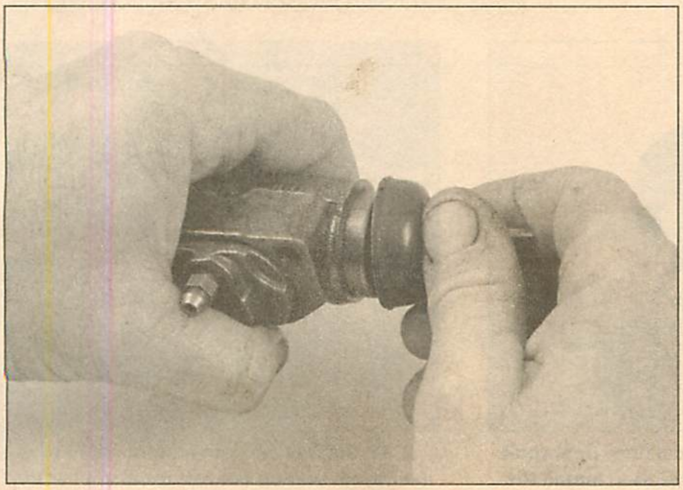
6 To disassemble the wheel cylinder, remove the rubber dust boot from each end of the cylinder, then push out the two pistons, the cups (seals) and the expander/spring assembly **(see illustrations)**. Discard the rubber parts and use new ones from the rebuild kit when reassembling the wheel cylinder. Remove the bleeder screw.

7 Inspect the pistons for scoring and scuff marks. If present, the pistons should be replaced with new ones.

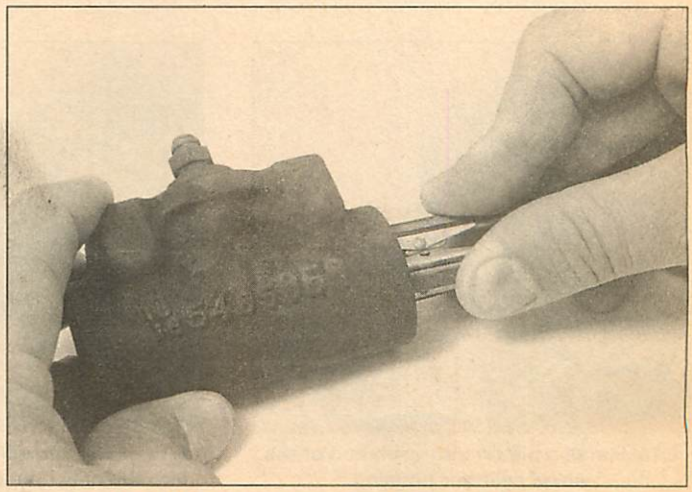
8 Examine the inside of the cylinder bore for score marks and corrosion.

9 If the cylinder is in good condition, clean it with brake system cleaner or denatured alcohol. **Warning:** *DO NOT, under any circumstances, use gasoline or petroleum-based solvents to clean brake parts!* Use compressed air to remove excess fluid from the wheel cylinder and to blow out the passages.

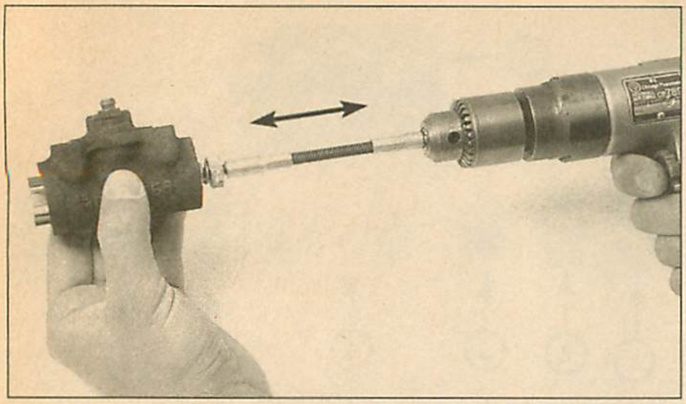
10 If the cylinder is not in good condition, crocus cloth can be used to remove light corrosion and stains. The cylinder can also be lightly honed **(see illustrations)**, but the cylinder must be replaced with a new one if the defects cannot be removed easily, or if the bore is scored.



6.6b Remove the wheel cylinder dust seals



6.10a Insert the hone into the wheel cylinder bore as shown . . .



6.10b . . . and, using plenty of honing oil, make several light passes up and down the bore; don't overdo it; stop and inspect your work. You're only trying to remove any glaze or small imperfections so the piston cups seal properly. Be sure to clean the cylinder with brake system cleaner after honing it

11 Lubricate the cylinder bore with clean brake fluid, then insert one of the new rubber cups into the bore **(see illustration)**. Make sure the lip on the rubber cup faces in.

12 Install the cup expanders, if equipped, onto the ends of the spring, insert the expander/spring assembly into the opposite end of the bore and push it in until it contacts the rear of the rubber cup **(see illustrations)**.

13 Install the remaining cup in the cylinder bore.

14 Lubricate the pistons with clean brake fluid, then install them into the cylinder bore **(see illustration)**.

15 Insert the pushrods (if equipped) into the boots **(see illustration)**, then install the boots and pushrods.

Installation

16 Installation is the reverse of removal. Attach the brake line to the wheel cylinder before installing the mounting bolts and tighten the line fitting after the wheel cylinder mountings bolts have been tightened. If available, use a flare-nut wrench to tighten the line fitting. Make sure you tighten the line fitting securely and the wheel cylinder mounting bolts to the torque listed in this Chapter's Specifications.

17 Install the brake shoes and brake drum, (see Section 5).

18 Bleed the brakes (see Section 10). Don't drive the vehicle in traffic until the operation of the brakes has been thoroughly tested.

7 Combination valve - removal and installation

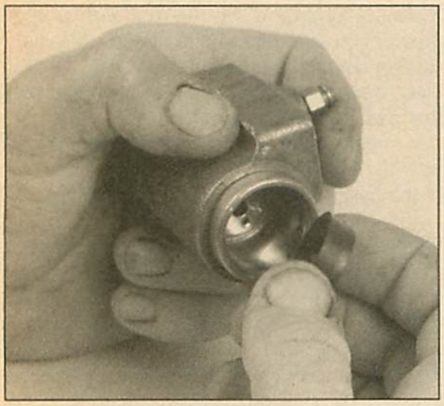
Refer to illustration 7.2

1 Raise the front of the vehicle and place it securely on jackstands.

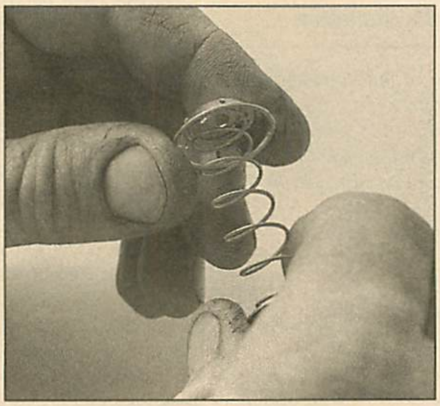
2 Locate the combination valve **(see illustration)** on the left frame rail.

3 Unplug the electrical connector for the brake fluid warning switch, unscrew the brake line tube nuts, disconnect all of the lines and unbolt the valve. **Note:** *Use a flare-nut wrench, if available, to prevent rounding off the corners of the fittings.*

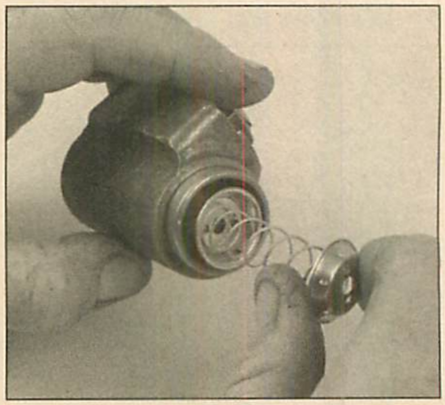
4 Installation is the reverse of removal. Be sure to bleed the entire brake system (see Section 10).



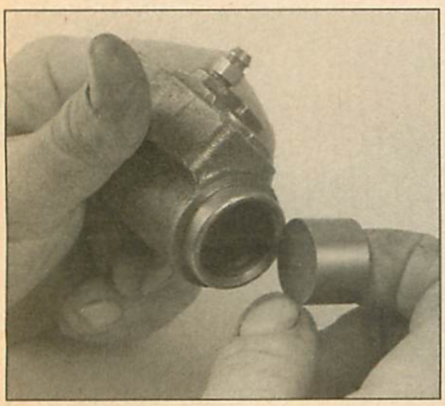
6.11 Install one of the piston cups with its open end facing in



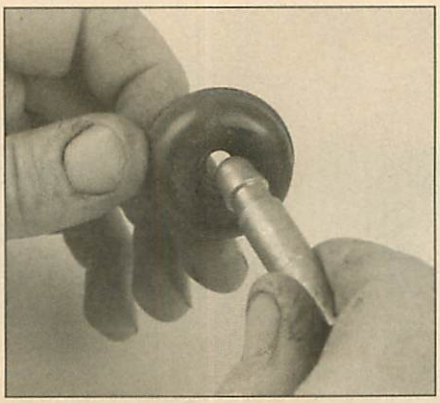
6.12a Attach the cup expanders to the spring . . .



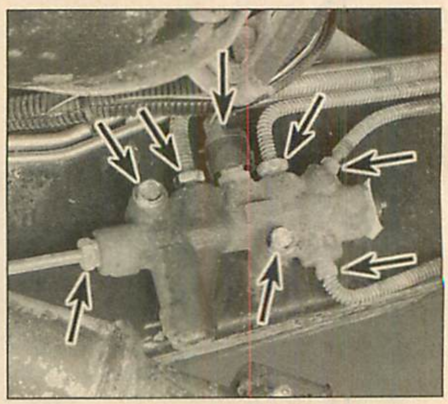
6.12b . . . then insert the spring assembly into the opposite end of the wheel cylinder, followed by the other piston cup



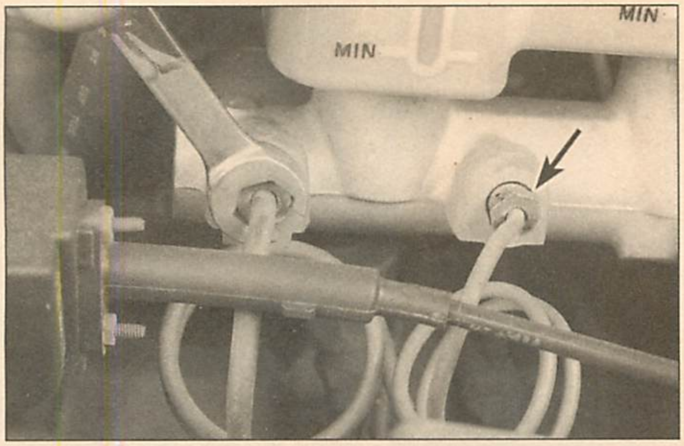
6.14 Install a piston into each end of the wheel cylinder housing



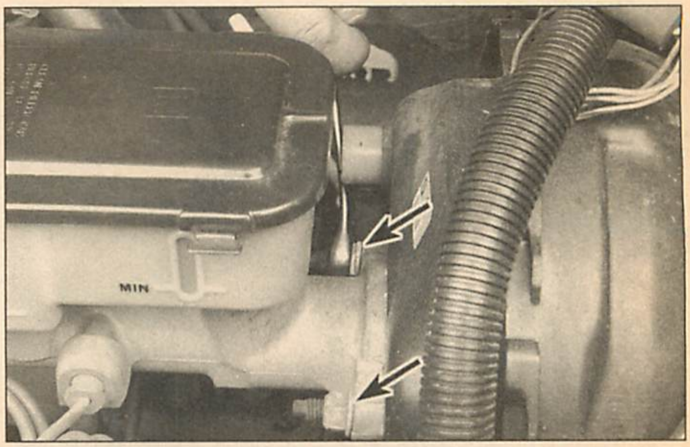
6.15 Insert the wheel cylinder pushrods into the new dust boots, then install the dust boots and pushrods onto both ends of the wheel cylinder



7.2 To detach the combination valve from the frame, unplug the electrical connector, unscrew the brake line tube nuts and remove the two mountings bolts (arrows)



8.2 Unscrew the brake line tube nuts with a flare-nut wrench to protect the corners of the nuts



8.4 To detach the master cylinder from the power brake booster, remove these nuts (arrows)

8 Master cylinder - removal and installation

Removal

Refer to illustrations 8.2 and 8.4

1 Place rags under the brake line fittings and prepare caps or plastic bags to cover the ends of the lines once they're disconnected. **Caution:** *Brake fluid will damage paint. Cover all painted surfaces and avoid spilling fluid during this procedure.*

2 Loosen the tube nuts at the ends of the brake lines where they enter the master cylinder. To prevent rounding off the flats on these nuts, a flare-nut wrench, which wraps around the nut, should be used **(see illustration)**.

3 Pull the brake lines away from the master cylinder slightly and plug the ends to prevent contamination. Also plug the openings in the master cylinder to prevent fluid spillage.

4 Remove the two master cylinder mounting nuts **(see illustration)** and unbolt the bracket. Move the bracket aside slightly, taking care not to kink the hydraulic lines. Remove the master cylinder from the vehicle.

5 Remove the reservoir caps, or cover and gasket, then discard any fluid remaining in the reservoir.

Overhaul

Refer to illustrations 8.8, 8.9, 8.10, 8.11, 8.13, 8.14a, 8.14b, 8.15a, 8.15b, 8.15c, 8.15d, 8.19 and 8.25

Warning: *A number of different master cylinders have been used on the vehicles covered by this manual. There are some minor differences between various master cylinders but, basically, there are two types: cast iron and aluminum. The master cylinders used on 1972 through 1980 models are cast iron; the master cylinders used on 1981 and later vehicles are aluminum. It's essential that you obtain the correct rebuild kit for the master cylinder you're servicing. Be sure to state the year, make and model of the vehicle when buying a kit. If you're still unsure, take the master cylinder with you when buying parts. DO NOT try to use the rebuild kit for a cast iron master cylinder in an aluminum unit, or vice versa. And don't open a new parts kit until you've compared the contents to the old parts you're removing from the master cylinder you intend to rebuild. Regarding the availability of parts for various master cylinders: At dealerships, there may be no parts available for certain master cylinders, particularly older cast-iron units from the early Seventies. If the unit you wish to rebuild is leaking or malfunctioning, you might have to replace it with a new or rebuilt unit unless, of course, you can obtain the correct kit from an aftermarket source. Always verify parts availability before beginning a master cylinder rebuild.*

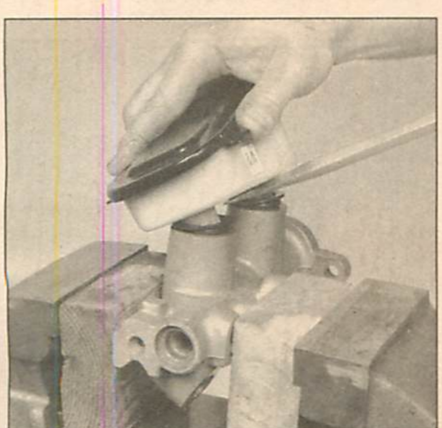
6 Remove the caps or the cover and gasket and drain the brake fluid into a container, if you haven't already done so.

7 Remove the plugs from the master cylinder outlets and drain the remaining brake fluid.

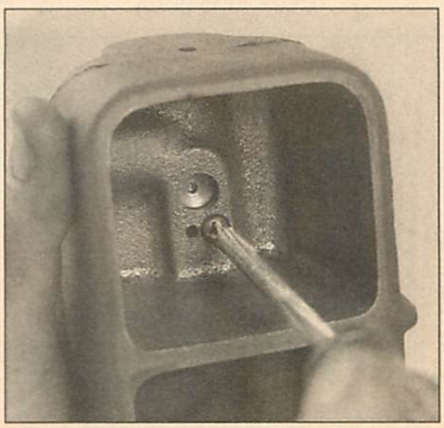
8 On aluminum-body master cylinders, remove the plastic reservoir **(see illustration)** by rocking it back-and-forth and pulling up on it. Remove the reservoir-to-housing grommets.

9 Remove the piston retainer screw (cast iron models) **(see illustration)** or piston retainer pin/piston stop pin (aluminum models).

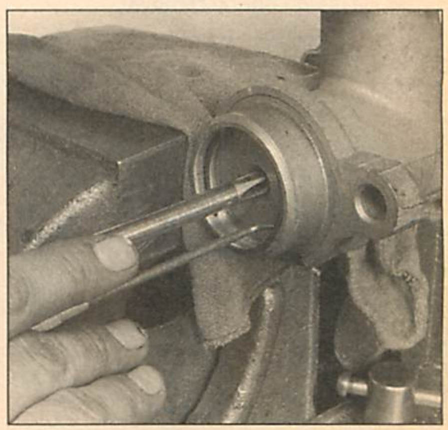
10 Push in on the primary piston and remove the piston snap-ring **(see illustration)**.



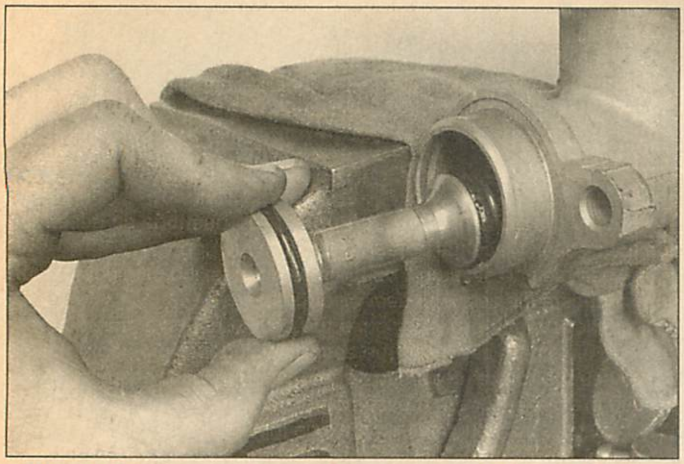
8.8 The reservoir is removable on aluminum master cylinders; put the master cylinder in a bench vise and pry the reservoir off with a screwdriver



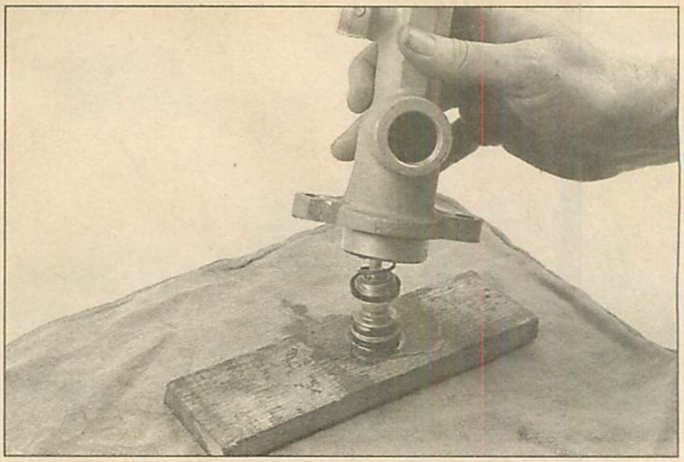
8.9 Remove the piston retainer screw, if equipped



8.10 Push the primary piston in with a Phillips screwdriver and remove the lock ring



8.11 Pull the primary piston and spring assembly out of the bore



8.13 To remove the secondary piston, tap the cylinder against a block of wood

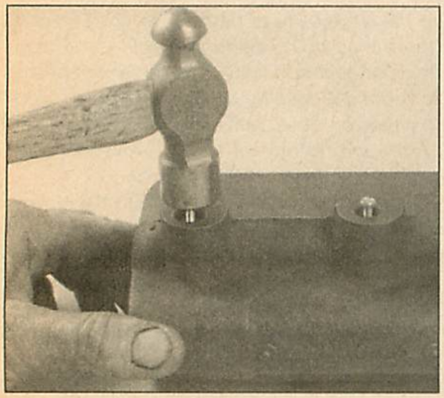
11 Remove the primary piston assembly from the master cylinder bore **(see illustration)**.

12 Tap the open end of the master cylinder on the workbench to dislodge the secondary piston assembly.

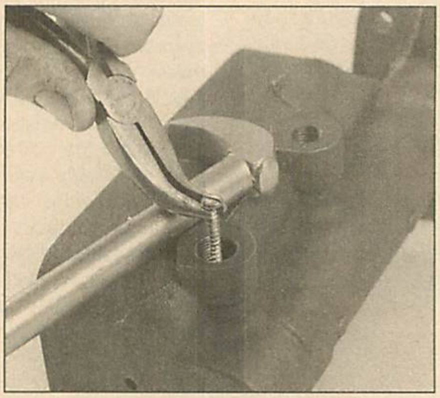
13 Remove the secondary piston and spring from the master cylinder bore **(see illustration)**.

14 On cast iron units, install an EZ out or a sheet metal screw in the tube seats as shown **(see illustration)**. Remove and discard the tube seats **(see illustration)**. Remove the residual pressure valves and springs, if equipped.

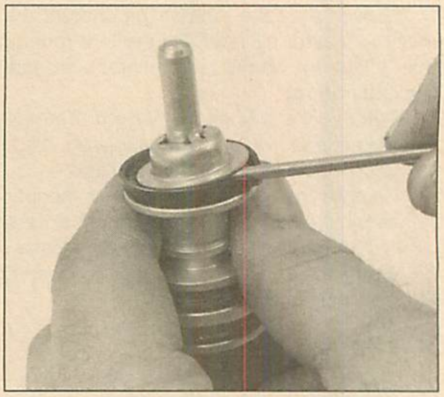
15 Replace the rubber cups from the ends of the pistons **(see illustrations)**. However, don't remove the primary cup of the primary piston; the primary piston must be replaced as an assembly. On cast iron master cylinders, remove the O-ring or seal cup from the second land of the secondary piston. *Always use new piston cups and seals - or piston assemblies - when overhauling a master cylinder.*



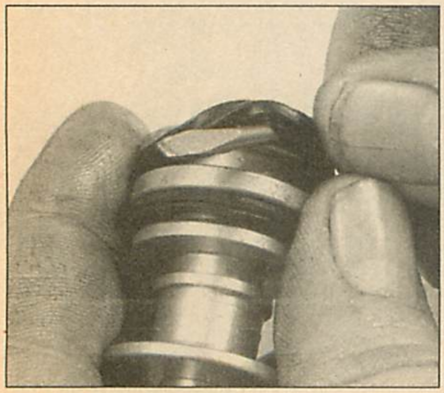
8.14a To remove the master cylinder tube seats, tap a sheet metal screw into them; this will give you something to pry on during removal



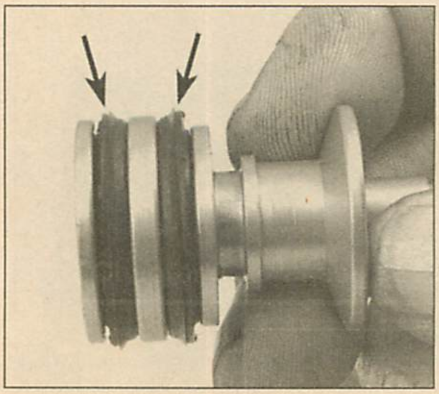
8.14b Using a prybar as a fulcrum, remove the tube seats by prying them out with a pair of long or curved needle-nose pliers



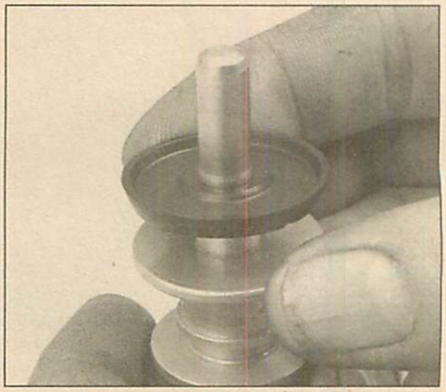
8.15a Pry the secondary piston spring seat off with a small screwdriver, then remove the seal



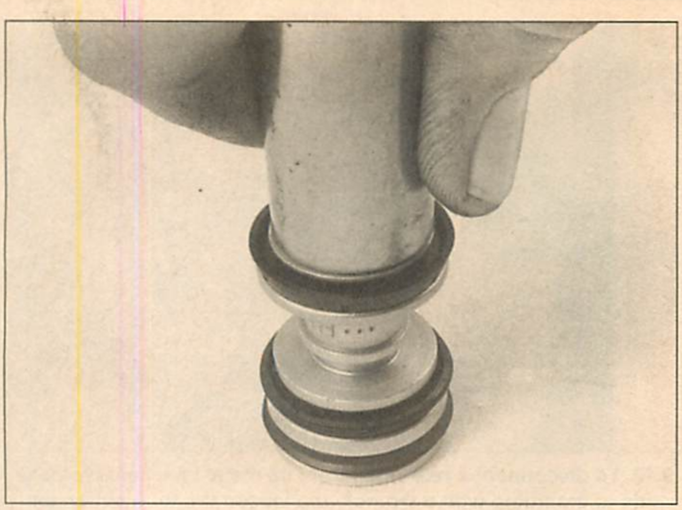
8.15b Remove the secondary seals from the piston (some pistons have only one seal)



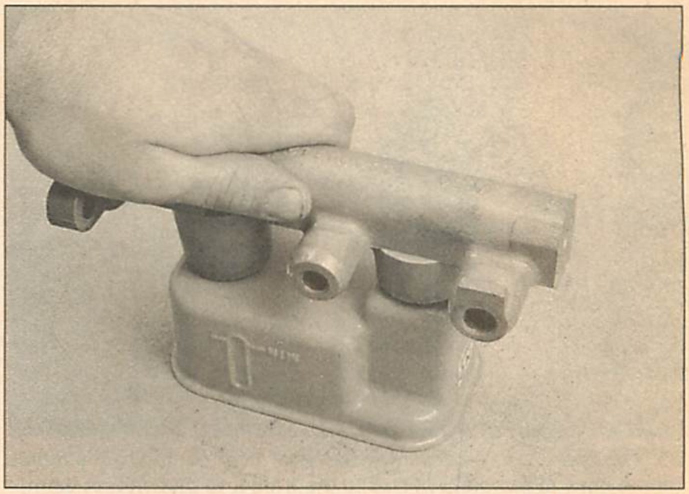
8.15c Install the secondary seals with the lips facing away from each other (on the single-seal design, the seal lips should face away from the center of the piston)



8.15d Install a new primary seal on the secondary piston with the seal lip facing in the direction shown



8.19 Install a new spring seat over the end of the secondary piston and push it into place with a socket



8.25 Lay the reservoir upside down on a work bench and push the master cylinder straight down over the reservoir fittings with a rocking motion

16 Clean the master cylinder with fresh brake fluid or brake system cleaner. **Warning:** *DO NOT, under any circumstances, use petroleum-based solvents to clean brake parts.*

17 Clean the cylinder bore with fresh brake fluid and inspect the bore for scoring and pitting. Light scratches and corrosion on the cylinder bore walls can be usually be removed with crocus cloth or with a hone. **Warning:** *Never attempt to hone an aluminum master cylinder.* Deep scratches or score marks mean the cylinder must be replaced with a new unit. If the pistons or bore are severely corroded, replace them.

18 All components must be assembled wet after dipping them in clean brake fluid.

19 Attach the spring seat to the secondary piston assembly **(see illustration)**. Carefully insert the complete secondary piston and return spring assembly into the master cylinder bore, easing the seals into the bore. Push the assembly all the way in.

20 Insert the primary piston assembly into the master cylinder bore.

21 Depress the primary piston assembly and install and tighten the secondary piston retainer screw.

22 Push in on the piston again and install the snap-ring.

23 Install the residual pressure valves and springs, if equipped, in the outlet ports.

24 On cast iron models, the best way to drive the seats into place is with a spare section of brake line (a flared end) with a tube fitting. Place the flared portion of the line over the seat, slide the tube nut into place and thread it into the outlet. Tighten the fitting to push the seat into place.

25 On aluminum master cylinders, lubricate a pair of new grommets with clean brake fluid and install them into their bores in the master cylinder. Install the reservoir into the grommets **(see illustration)**.

Installation

26 Whenever the master cylinder is removed, the entire hydraulic system must be bled. The time required to bleed the system can be reduced is the master cylinder is filled with fluid and bench bled before it's installed on the vehicle. Since you'll have to apply pressure to the master cylinder piston and, at the same time, control flow from the brake line outlets, the master cylinder should be mounted in a vise, with the jaws of the vise clamping on the mounting flange.

27 Insert threaded plugs into the brake line outlet holes and snug them down so that air won't leak past them - but not so tight that they can't be easily loosened.

28 Fill the reservoir with brake fluid of the recommended type (see Chapter 1).

29 Remove one plug and push the piston assembly into the bore to expel the air from the master cylinder. A large Phillips screwdriver can be used to push on the piston assembly.

30 To prevent air from being drawn back into the master cylinder, the plug must be replaced and snugged down before releasing the pressure on the piston.

31 Repeat the procedure until only brake fluid is expelled from the brake line outlet hole. When only brake fluid is expelled, repeat the procedure at the other outlet hole and plug. Be sure to keep the master cylinder reservoir filled with brake fluid to prevent the introduction of air into the system.

32 Since high pressure isn't involved in the bench bleeding procedure, an alternative to the removal and replacement of the plugs with each stroke of the piston assembly is available. Before pushing in on the piston assembly, remove the plug as described in Step 29. Before releasing the piston, however, instead of replacing the plug, simply put your finger tightly over the hole to keep air from being drawn back into the master cylinder. Wait several seconds for brake fluid to be drawn from the reservoir into the bore, then depress the piston again, removing your finger as brake fluid is expelled. Be sure to put your finger back over the hole each time before releasing the piston, and when the bleeding procedure is complete for that outlet, replace the plug and tighten it before going on to the other port.

33 Carefully install the master cylinder by reversing the removal steps. Make sure you tighten the master cylinder mounting nuts to the torque listed in this Chapter's Specifications.

34 Bleed the brake system as described in Section 10.

9 Brake hoses and lines - inspection and replacement

Inspection

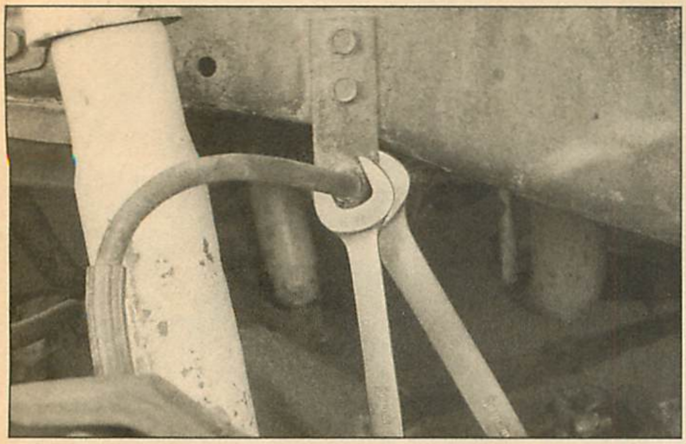
1 About every six months, with the vehicle raised and supported securely on jackstands, the rubber hoses which connect the steel brake lines with the front and rear brake assemblies should be inspected for cracks, chafing of the outer cover, leaks, blisters and other damage. These are important and vulnerable parts of the brake system and inspection should be complete. A light and mirror will be helpful for a thorough check. If a hose exhibits any of the above conditions, replace it with a new one.

Replacement

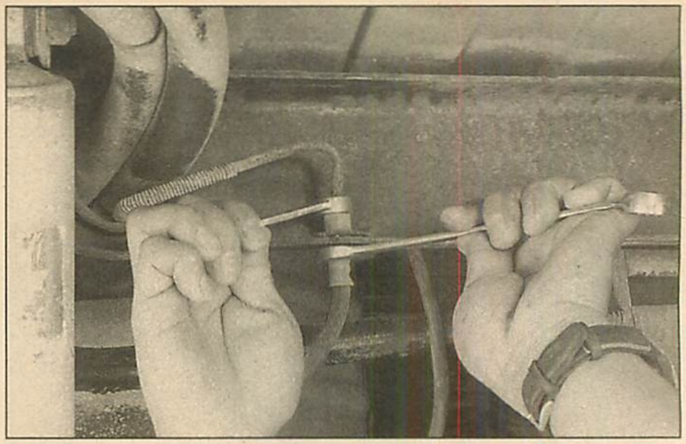
Front brake hose

Refer to illustration 9.2

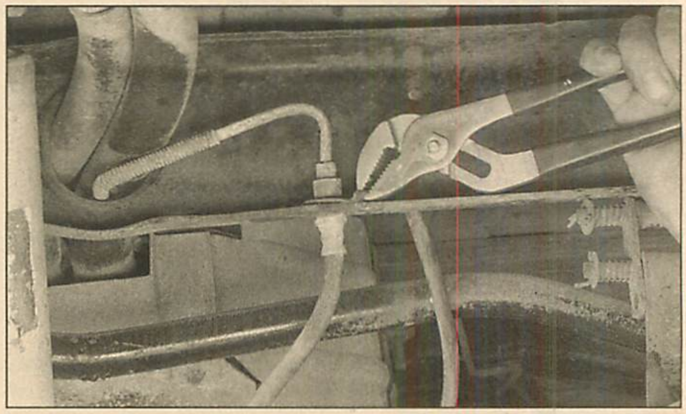
2 Disconnect the brake line from the hose fitting, being careful not to bend the frame bracket or brake line **(see illustration)**. Use a flare nut wrench, if available.



9.2 The brake hoses on some models are connected to the metal brake lines at brackets bolted to the frame; to disconnect them, put a back-up wrench on the hose side of the connection and loosen the nut with another wrench (on other models, brake hoses and lines are connected in the conventional manner, with a U-clip, as shown in the next two photos)



9.10 To disconnect a rear hose from its metal line, hold the hose side of the fitting with a wrench and loosen the tube nut on the metal line side of the bracket with a flare-nut wrench . . .



9.11 . . . then remove this U-clip to disengage the hose from the bracket

3 Remove the U-clip from the bracket **(see illustration 9.11)**, if equipped, and disengage the hose from the bracket. **Note:** *Not all front brake hose/brake line connections use a C-clip; some are secured to the frame-mounted bracket by a large nut on the metal line side of the bracket.*

4 Remove the banjo bolt from the brake caliper **(see illustration 3.4)** and separate the hose from the caliper. Discard the sealing washers.

5 To install the hose, first attach it to the caliper, using new sealing washers on both sides of the fitting. Tighten the banjo bolt to the torque listed in this Chapter's Specifications.

6 Without twisting the hose, insert the brake hose through the bracket and reconnect it to the metal line.

7 Install the U-clip, if equipped, to hold it in place.

8 Tighten the brake line fitting securely.

9 When the brake hose installation is complete, there should be no kinks in the hose. Make sure the hose doesn't contact any part of the suspension. Check this by turning the wheels to the extreme left and right positions. If the hose makes contact, remove it and correct the installation as necessary. Bleed the system (see Section 10).

Rear brake hose

Refer to illustrations 9.10, 9.11, 9.12a and 9.12b

10 Using an open-end wrench on the hose and a flare-nut wrench on the fitting, disconnect the hose at the frame bracket **(see illustration)**, being careful not to bend the bracket or steel lines.

11 Remove the U-clip with a pair of pliers **(see illustration)** and separate the female fitting from the bracket.

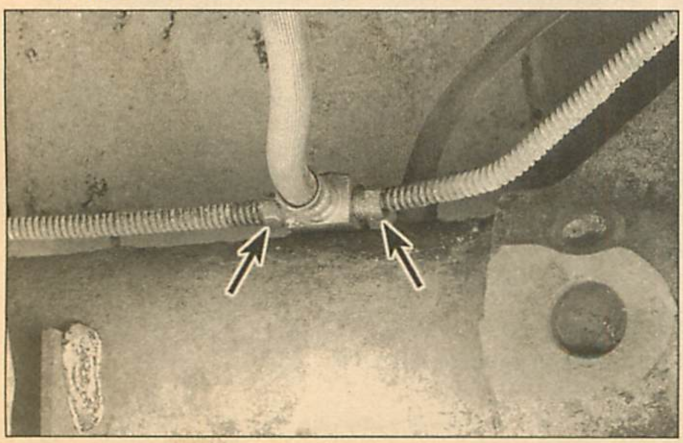
12 Disconnect the two hydraulic lines at the junction block, then unbolt and remove the junction block **(see illustrations)**.

13 Bolt the junction block to the axle housing and connect the metal lines, tightening them securely. Without twisting the hose, install the female end of the hose in the frame bracket.

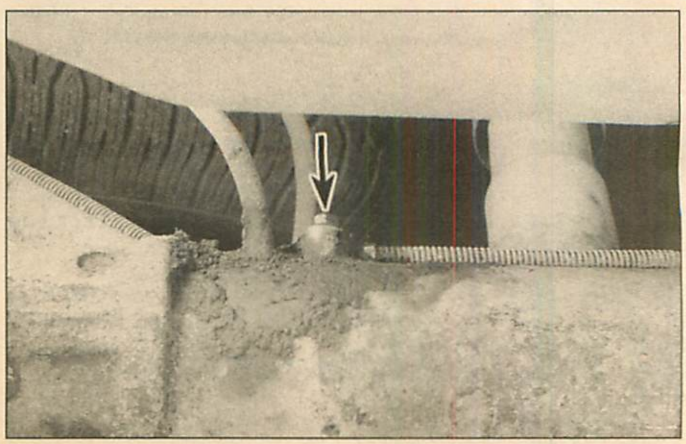
14 Install the U-clip retaining the female end to the bracket.

15 Attach the steel line fitting to the female fitting. Again, be careful not to bend the bracket or steel line.

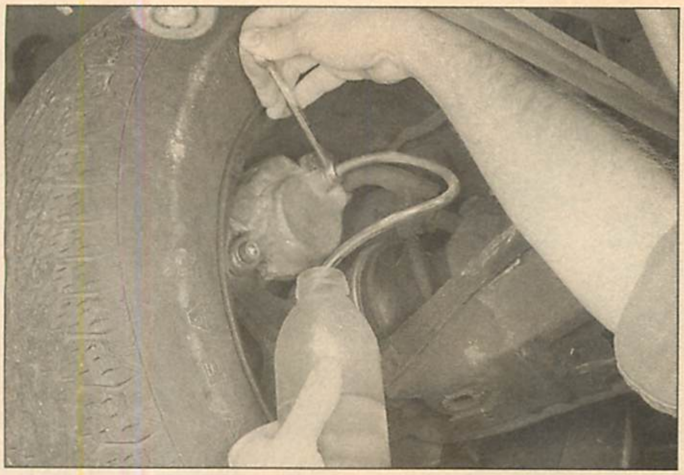
16 Make sure the hose installation did not loosen the frame bracket.



9.12a To disconnect the rear end of the rear hose, unscrew the tube nuts (arrows) for the metal brake lines . . .



9.12b . . . then remove this retaining bolt (arrow) to detach the junction block from the axle tube



10.8 When bleeding the brakes, a hose is connected to the bleed screw at the caliper or wheel cylinder and then submerged in brake fluid - air will be seen as bubbles in the tube and container (all air must be expelled before moving to the next wheel)

Tighten the bracket if necessary.

17 Fill the master cylinder reservoir and bleed the system (see Section 10).

Metal brake lines

18 When replacing brake lines be sure to use the correct parts. Don't use copper tubing for any brake system components. Purchase steel brake lines from a dealer or auto parts store.

19 Prefabricated brake line, with the tube ends already flared and fittings installed, is available at auto parts stores and dealers.

20 When installing the new line, make sure it's securely supported in the brackets and has plenty of clearance between moving or hot components.

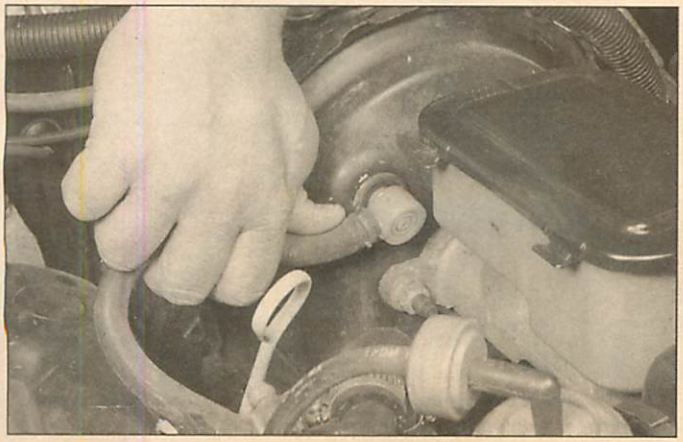
21 After installation, check the master cylinder fluid level and add fluid as necessary. Bleed the brake system as outlined in Section 10 and test the brakes carefully before driving the vehicle in traffic.

10 Brake system bleeding

Refer to illustration 10.8

Warning: *Wear eye protection when bleeding the brake system. If the fluid comes in contact with your eyes, immediately rinse them with water and seek medical attention.*

Note: *Bleeding the hydraulic system is necessary to remove any air that manages to find its way into the system when it's been opened during removal and installation of a hose, line, caliper or master cylinder.*



11.5 Detach the intake manifold vacuum hose from the power brake booster

1 It will probably be necessary to bleed the system at all four brakes if air has entered the system due to low fluid level, or if the brake lines have been disconnected at the master cylinder.

2 If a brake line was disconnected only at a wheel, then only that caliper or wheel cylinder must be bled.

3 If a brake line is disconnected at a fitting located between the master cylinder and any of the brakes, that part of the system served by the disconnected line must be bled.

4 Remove any residual vacuum from the brake power booster by applying the brake several times with the engine off.

5 Remove the master cylinder reservoir cover and fill the reservoir with brake fluid. Reinstall the cover. **Note:** *Check the fluid level often during the bleeding operation and add fluid as necessary to prevent the fluid level from falling low enough to allow air bubbles into the master cylinder.*

6 Have an assistant on hand, as well as a supply of new brake fluid, a clear container partially filled with clean brake fluid, a length of 3/16-inch plastic, rubber or vinyl hose to fit over the bleeder valve and a wrench to open and close the bleeder valve.

7 Beginning at the right rear wheel, loosen the bleeder valve slightly, then tighten it to a point where it is snug but can still be loosened quickly and easily.

8 Place one end of the hose over the bleeder valve and submerge the other end in brake fluid in the container **(see illustration)**.

9 Have the assistant push the brake pedal slowly to the floor, then hold the pedal firmly depressed.

10 While the pedal is held depressed, open the bleeder valve just enough to allow a flow of fluid to leave the valve. Watch for air bubbles to exit the submerged end of the tube. When the fluid flow slows after a couple of seconds, close the valve and have your assistant release the pedal.

11 Repeat Steps 9 and 10 until no more air is seen leaving the tube, then tighten the bleeder valve and proceed to the left rear wheel, the right front wheel and the left front wheel, in that order, and perform the same procedure. Be sure to check the fluid in the master cylinder reservoir frequently.

12 Never use old brake fluid. It contains moisture which will deteriorate the brake system components and can boil under heavy braking, which will render the brakes useless.

13 Refill the master cylinder with fluid at the end of the operation.

14 Check the operation of the brakes. The pedal should feel solid when depressed, with no sponginess. If necessary, repeat the entire process. **Warning:** *Do not operate the vehicle if you are in doubt about the effectiveness of the brake system.*

15 As soon as you have completed this procedure, test drive the vehicle and verify that the brake system is in good working order.

11 Power brake booster - check, removal and installation

Operating check

1 Depress the brake pedal several times with the engine off and make sure that there is no change in the pedal reserve distance.

2 Depress the pedal and start the engine. If the pedal goes down slightly, operation is normal.

Airtightness check

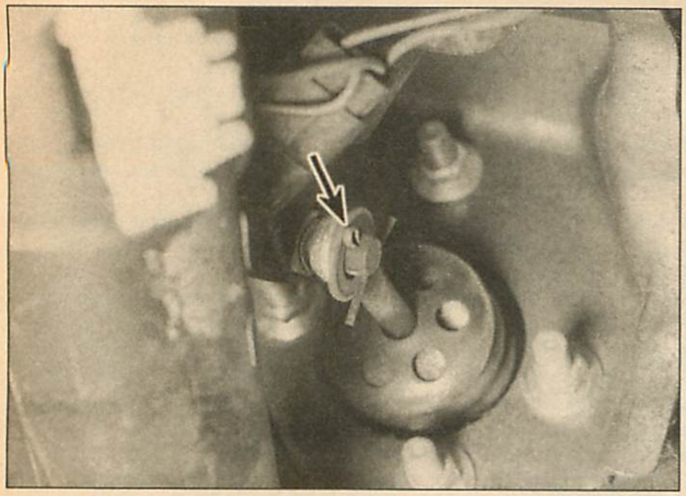
3 Start the engine and turn it off after one or two minutes. Depress the brake pedal several times slowly. If the pedal goes down farther the first time but gradually rises after the second or third depression, the booster is airtight.

4 Depress the brake pedal while the engine is running, then stop the engine with the pedal depressed. If there is no change in the pedal reserve travel after holding the pedal for 30 seconds, the booster is airtight.

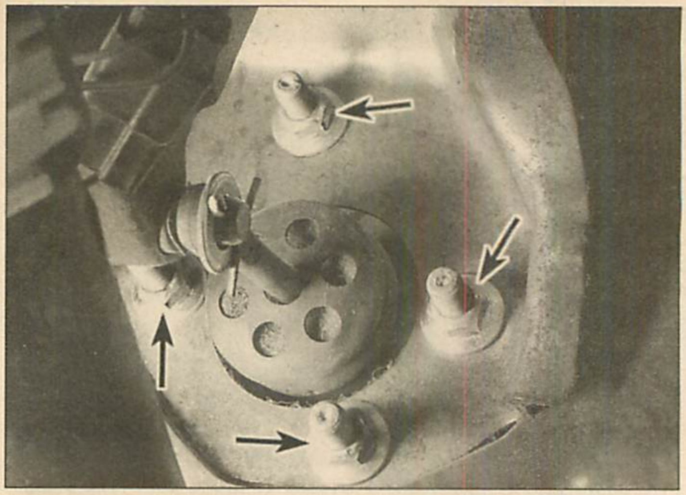
Removal

Refer to illustrations 11.5, 11.7 and 11.8

5 Detach the intake manifold vacuum hose from the booster **(see illustration)**.



11.7 To disconnect the rear end of the power brake booster pushrod from the upper end of the brake pedal, remove this cotter pin (arrow) and slide the end of the pushrod off the pedal pin



11.8 To detach the power brake booster from the firewall, remove these four nuts (arrows)

6 Detach the brake master cylinder from the booster (see Section 8) and carefully pull it forward. It isn't necessary to disconnect the brake lines from the master cylinder.

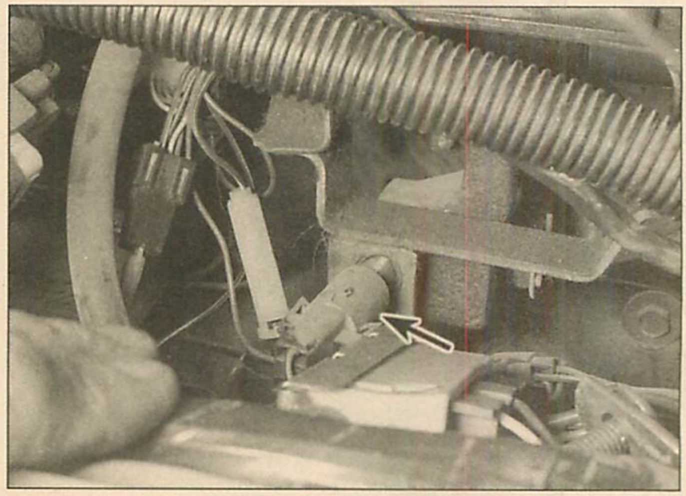
7 Using a flashlight, locate the rear (brake pedal) end of the booster pushrod. This end of the pushrod is connected to a pin at the top of the brake pedal, and retained by a small cotter pin **(see illustration)**. Remove the cotter and slide the pushrod off the pin.

8 Remove the four nuts **(see illustration)** holding the brake booster to the firewall. You may need a light to see these, as they are up under the dash area.

9 Slide the booster straight out from the firewall until the studs clear the holes and pull the booster, brackets and gaskets from the engine compartment area.

Installation

10 Installation is the reverse of removal. Be sure to tighten the booster mounting nuts to the torque listed in this Chapter's Specifications.



12.1 The brake light switch (arrow) is mounted on a flange attached to the brake pedal support bracket (instrument cluster removed for clarity)

12 Brake light switch - check, replacement and adjustment

Refer to illustration 12.1

1 The brake light switch **(see illustration)** is mounted on a flange attached to the brake pedal support bracket. A spring-loaded plunger in the switch opens and closes the brake light circuit. When the brake pedal is in the released position, the pedal arm contacts the switch plunger, opening the brake light circuit. When the brake pedal is depressed, the spring-loaded plunger extends and closes the brake light circuit.

Check

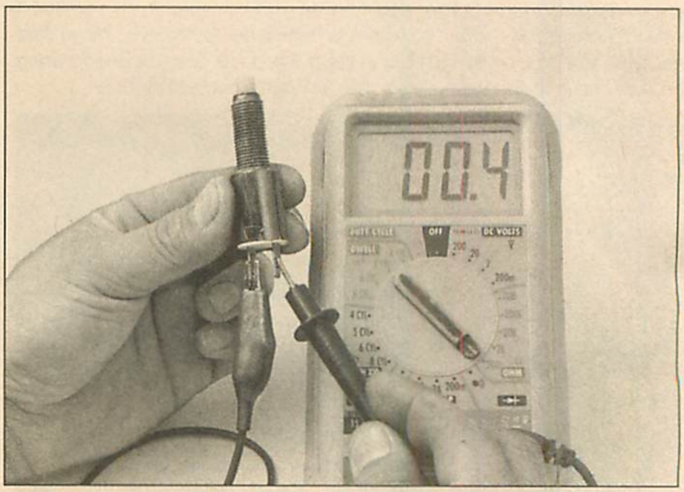
Refer to illustration 12.7

2 Verify that the brake lights come on when the brake pedal is depressed.

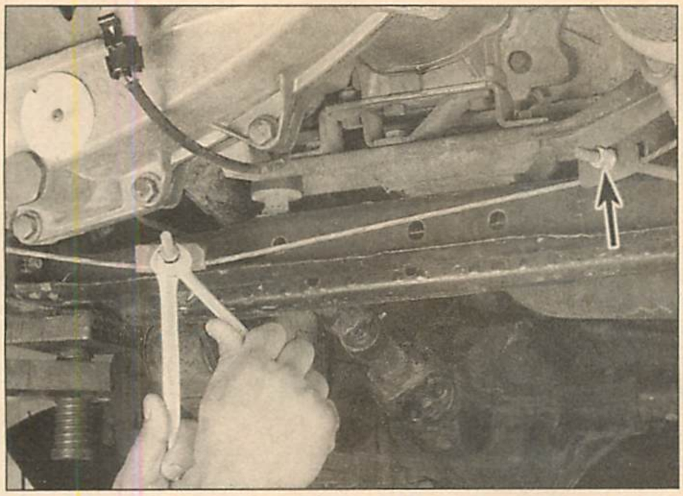
3 If the brake lights do not come on when the pedal is depressed, check the fuse and the brake light bulbs (see Chapter 12), then check the switch again.

4 If the brake lights still don't come on when the brake pedal is depressed, try adjusting the switch (see Steps 18 through 23), then check it again.

5 If the brake lights still fail to come on even after the switch has been adjusted, verify that the switch is getting voltage (see the *Wiring diagrams* at the end of Chapter 12).



12.7 To check the brake light switch on the bench, hook up an ohmmeter and verify that there is continuity (shown) with the plunger extended, and no continuity (infinite resistance) with the plunger depressed



13.3 There are two parking brake cable equalizers located right behind the transmission crossmember; each equalizer has a locknut (outer nut) and an adjuster nut (inner nut)

6 If the switch is getting voltage, verify that there is voltage at the terminal that feeds the wire to the brake lights when the pedal is depressed.

7 If the switch doesn't work as described, remove it (see below) and check it with an ohmmeter **(see illustration)**. With the plunger extended, there should be continuity; with the plunger depressed, there should be no continuity. If the switch doesn't operate as described, replace it. If the switch is operating properly, but the brake lights are still inoperative, there's a short or open between the switch and the brake lights.

Replacement

8 Disconnect the cable from the negative terminal of the battery.
9 Remove the lower trim panel from the dash (see Chapter 11).
10 Unplug the switch electrical connector.
11 Pull the switch to the rear and remove it from its mounting flange.
12 Install the new switch; make sure it's fully seated in the retainer and the plunger is touching the brake pedal.
13 Adjust the switch (see below).
14 Plug in the electrical connector.
15 Install the trim panel (see Chapter 11).
16 Reconnect the cable to the negative battery terminal.
17 Depress the brake pedal and verify that the brake lights come on.

14.4 Pull off the U-clip retainer and disengage the end of the cable from the parking brake pedal assembly

Adjustment

18 Depress, then release, the brake pedal.
19 Unplug the electrical connector.
20 Move the brake pedal forward by hand and note the operation of the switch plunger (you'll need a flashlight and a small mechanic's mirror for this operation). The plunger should be fully extended at the point at which all pedal freeplay is taken up and brake application begins. The clearance between the plunger and the pedal at this point should be about 3/8 to 5/8-inch.
21 If the switch plunger-to-pedal clearance is okay, and the brake lights are operating properly, no adjustment is required.
22 If the switch plunger is not fully extended, i.e. clearance between the plunger and the brake pedal is insufficient, adjust the switch position by moving it in or out in its mounting flange until the clearance is correct.
23 Try the brakes and verify that the switch is operating properly.

13 Parking brake - adjustment

Refer to illustration 13.3

1 Verify that the drums or discs rotate freely without drag when the parking brake lever is released, then depress the parking brake pedal and verify that the parking brake system holds the vehicle in place. If it doesn't, adjust the parking brake cable.
2 Apply and release the parking brakes two or three times, then raise the rear of the vehicle and support it securely on jackstands. Block the front wheels to prevent the vehicle from rolling.
3 Loosen both equalizer locknuts, then tighten the two adjuster nuts **(see illustration)** evenly until you feel a slight drag on both rear wheels.
4 Loosen the adjuster nuts just enough to allow both rear wheels to rotate freely.
5 Tighten the locknuts securely.
6 Remove the jackstands and lower the vehicle.
7 Test the operation of the parking brake on an incline.

14 Parking brake cables - replacement

Front cable

Refer to illustration 14.4

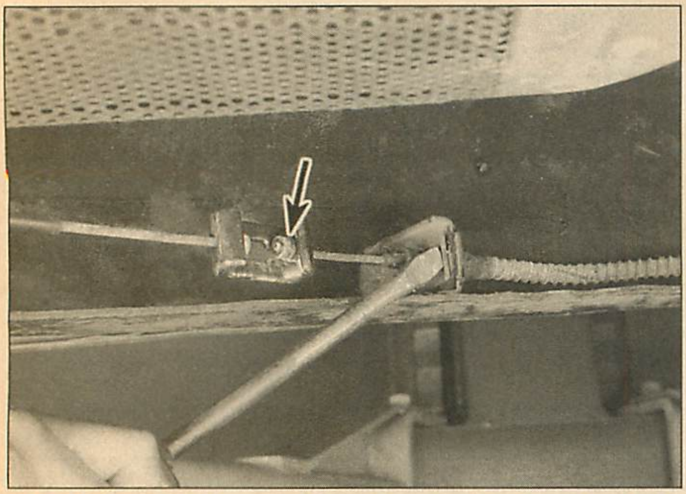
1 Release the parking brake.
2 Raise the rear of the vehicle and support it securely on jackstands.
3 Back off both equalizer locknuts and adjuster nuts **(see illustration 13.3)** and disengage the front cable from the left equalizer. Remove the U-clip that secures the cable to the crossmember.
4 Inside the vehicle, remove the U-clip from the parking brake pedal bracket **(see illustration)**, then disconnect the cable from the pedal clevis.
5 Pull the cable through the hole in the firewall.
6 Installation is the reverse of removal.
7 Be sure to adjust the parking brake cable (see Section 13) when you're done.

Rear cables

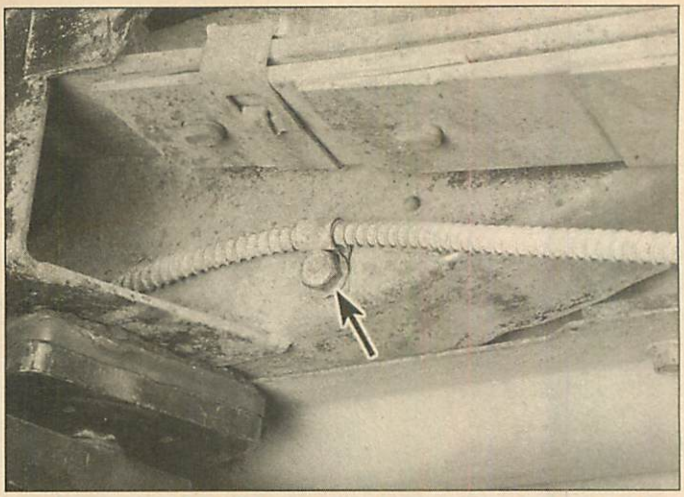
Refer to illustrations 14.10, 14.11 and 14.13

Note: *There are actually three rear cables: the equalizer cable, which extends across the vehicle between both equalizers, and a pair of rear cables, each of which is attached to one end of the equalizer cable. You can replace either rear cable separately. The procedure is the same for either side, although the left side is slightly more difficult because of the fuel tank.*

8 Loosen the rear wheel lug nuts, raise the vehicle, place it securely on jackstands and remove the rear wheels.
9 Back off both equalizer locknuts and adjuster nuts **(see illustration 13.3)** until all tension is removed from the equalizer cable.

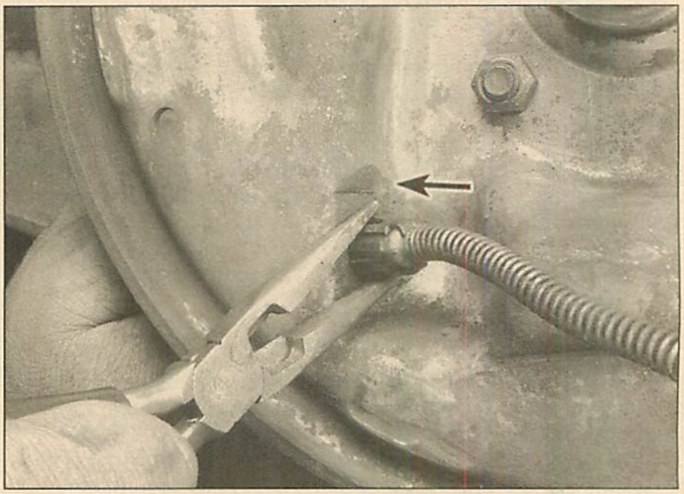


14.10 Pry off the U-clip cable retainer from the frame bracket with a screwdriver, then disengage the forward end of the rear cable (arrow) from the cable connector (right side rear cable, bracket and connector shown, left side assembly identical)



14.11 Remove this bolt (arrow) to detach a rear parking bracket cable from the frame

10 Remove the U-clip that secures the rear cable to the equalizer cable **(see illustration)**.
11 Unbolt the cable clip from the frame **(see illustration)**.
12 Remove the brake drum, remove the brake shoes (see Section 5) and disconnect the cable from the secondary shoe.
13 Compress the cable retainer and pull the cable through the brake backing plate **(see illustration)**.
14 Installation is the reverse of removal.
15 Adjust the parking brake cable assembly when you're done (see Section 13).



14.13 To release the parking brake cable from the brake backing plate, squeeze the cable housing retainer tangs together and pull the cable through the backing plate

Chapter 10
Suspension and steering systems

Contents

Specifications

Torque specifications	Ft-lbs
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5/8-inch bolt	55 to 75
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7/16-inch bolt	25 to 40
9/16-inch bolt	50 to 70
1974	
9/16-inch bolt	50 to 70
5/8-inch bolt	45 to 65
1975, 1976	
9/16-inch bolt	50 to 100
5/8-inch bolt	45 to 65
1977 on	100
U-bolt-to-tie plate nuts	
7/16-inch bolt	36 to 42
1/2-inch bolt	45 to 65
9/16-inch bolt	85 to 105
Shock absorber	
Upper nut	35
Lower nut	45
Stabilizer bar	
Stabilizer-to-link nut	45
Stabilizer link-to-tie plate bracket	45
Stabilizer bushing bracket bolts	30 to 40
Steering knuckle-to-axle yoke ballstud nuts	
1988 and earlier	
Upper	100
Lower	75
1989 on	
Upper	100
Lower	80
Upper ballstud split-ring seat	50
Track bar	
Track bar-to-frame bracket nut/bolt	125
Track bar-to-axle bracket nut/bolt	74

Steering

Drag link adjustment sleeve clamp bolt	30
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1972	30 to 40
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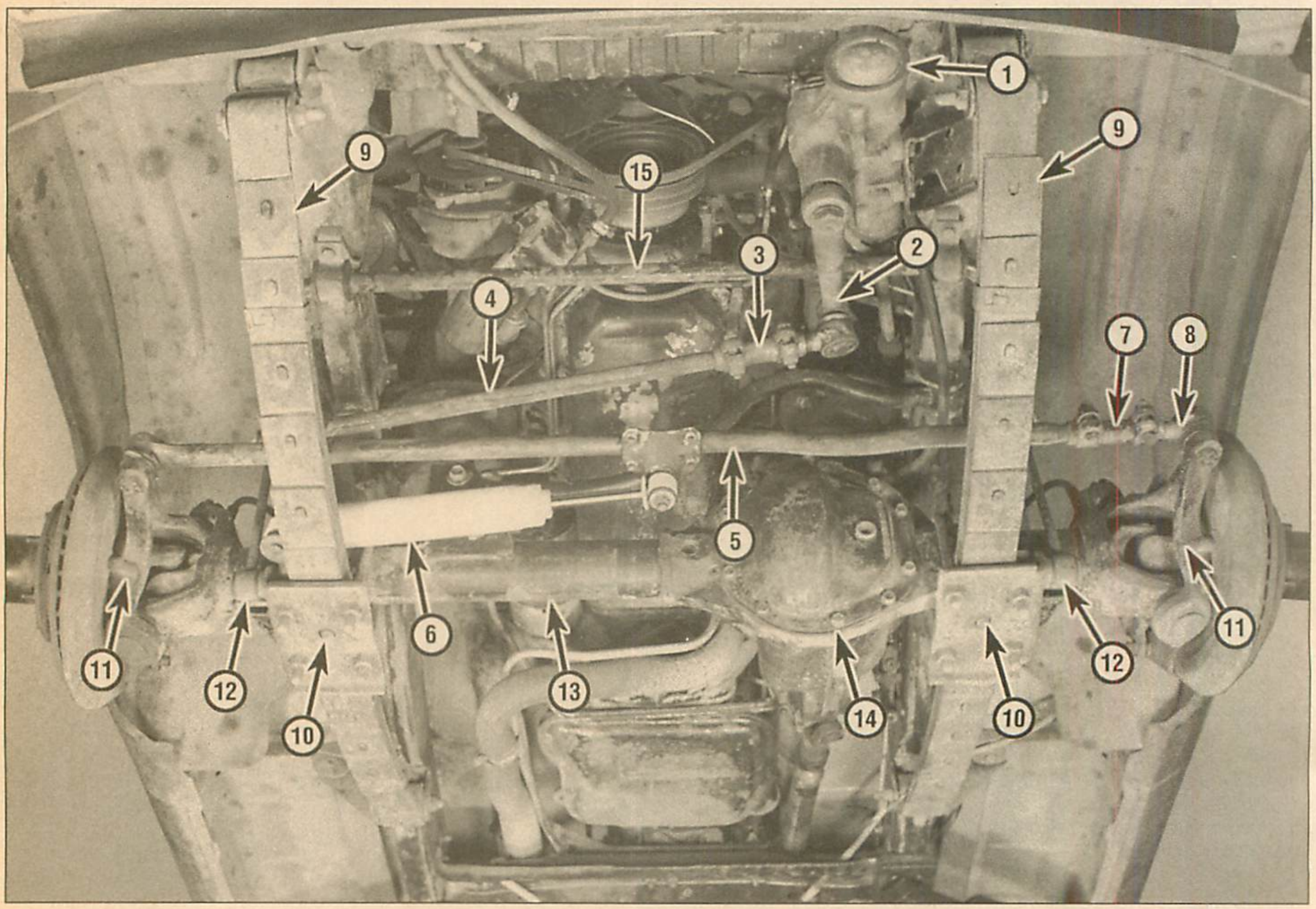
Tie-rod adjustment sleeve clamp bolt	30
Tie-rod end stud nut	
1972	30 to 40
1973	40 to 50
1974 on	60
Wheel lug nuts	80 to 110



1.1a Front suspension and steering components

1 *Steering gear*
2 *Pitman arm*
3 *Drag link adjustment sleeve*
4 *Drag link*
5 *Tie-rod*
6 *Steering damper*
7 *Tie-rod adjustment sleeve*
8 *Tie-rod end*
9 *Leaf spring*
10 *U-bolt tie plate*
11 *Steering knuckle*
12 *Stabilizer bar connecting link*
13 *Axle tube*
14 *Differential*
15 *Stabilizer bar*

1 General information

Front suspension

Refer to illustrations 1.1a and 1.1b

All of the vehicles covered by this manual utilize a solid front axle, which consists of a cast-iron housing for the differential with a pair of steel tubes for the axleshafts welded to either side (for information on the axleshafts, see Chapter 8). The front axle is suspended by a pair of shock absorbers and two leaf springs. Lateral movement is prevented by a track bar. A stabilizer bar controls body roll. Each steering knuckle is positioned by a pair of balljoints pressed into the upper and lower ends of a yoke welded to the end of the axle **(see illustrations)**.

Rear suspension

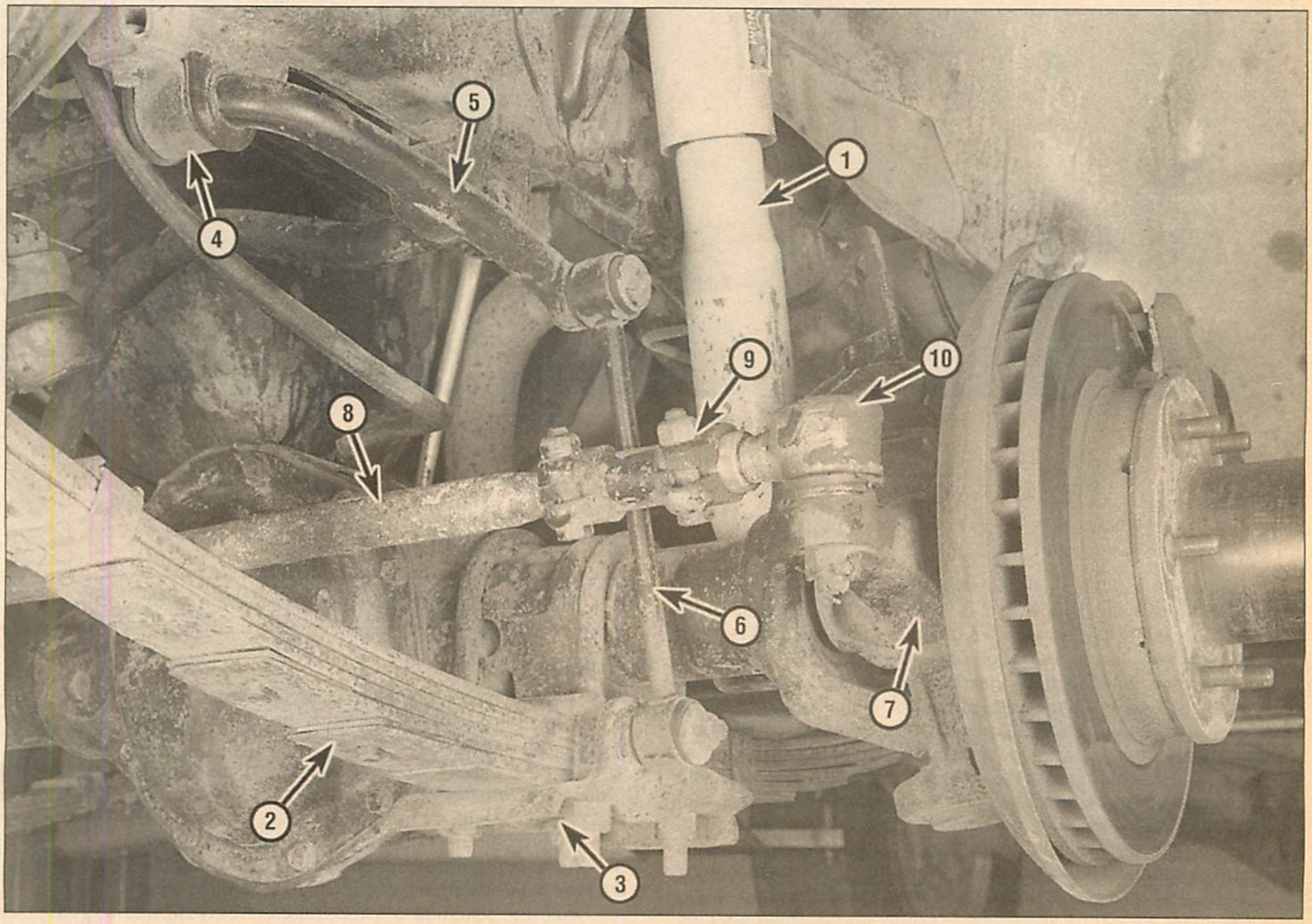
Refer to illustration 1.2

The rear axle consists of a cast-iron center housing for the differential with a pair of steel tubes for the axleshafts welded to either side (for information on the axleshafts, see Chapter 8). The rear axle is suspended by two shock absorbers and two leaf springs. Lateral movement is prevented by a track bar **(see illustration)**.

Steering

The power steering system uses a recirculating-ball type steering gearbox which transmits turning force through the steering linkage (Pitman arm, drag link and tie-rod) to the steering knuckle arms. A steering damper mounted between the right spring plate and the tie-rod assembly reduces unwanted "bump steer" (the slight turning or steering of a wheel away from its normal direction of travel as it moves through its suspension travel). A small U-joint connects the steering column to the steering gearbox. The steering column is designed to collapse in the event of an accident.

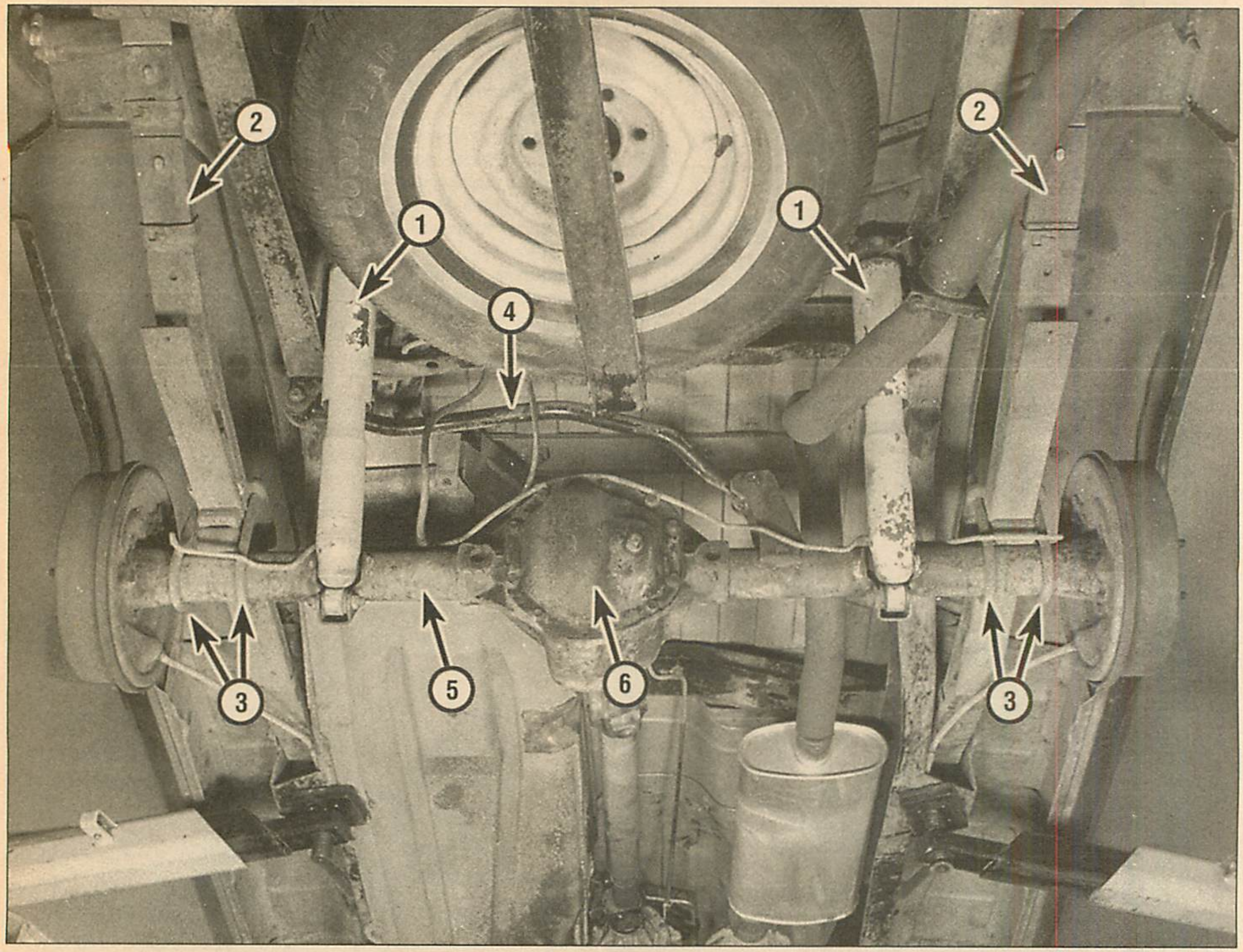
Frequently, when working on the suspension or steering system components, you may come across fasteners which seem impossible to loosen. These fasteners on the underside of the vehicle are continually subjected to water, road grime, mud, etc., and can become rusted or "frozen," making them extremely difficult to remove. In order to unscrew these stubborn fasteners without damaging them (or other components), be sure to use lots of penetrating oil and allow it to soak in for a while. Using a wire brush to clean exposed threads will also ease removal of the nut or bolt and prevent damage to the threads. Sometimes a sharp blow with a hammer and punch is effective in breaking the bond between a nut and bolt threads, but care must be taken to prevent the punch from slipping off the fastener and ruining



1.1b Front suspension and steering components

1 *Shock absorber*
2 *Leaf springs*
3 *U-bolt tie plate*
4 *Stabilizer bar/bushing bracket*
5 *Stabilizer bar*
6 *Stabilizer bar link*
7 *Steering knuckle*
8 *Tie-rod*
9 *Adjustment sleeve for tie-rod*
10 *Tie-rod end*

10



1.2 Rear suspension components

1. *Shock absorber*
2. *Leaf spring*
3. *Axle U-bolts*
4. *Track bar*
5. *Axle tube*
6. *Differential*

the threads. Heating the stuck fastener and surrounding area with a torch sometimes helps too, but isn't recommended because of the obvious dangers associated with fire. Long breaker bars will increase leverage, but never use an extension pipe on a breaker bar or ratchet - the breaker bar or ratcheting mechanism could break, resulting in personal injury. Sometimes, turning the nut or bolt in the tightening (clockwise) direction first will help to break it loose. Fasteners that require drastic measures to unscrew should always be replaced with new ones.

Since most of the procedures that are dealt with in this chapter involve jacking up the vehicle and working underneath it, a good pair of jackstands will be needed. A hydraulic floor jack is the preferred type of jack to lift the vehicle, and it can also be used to support certain components during various operations. **Warning:** *Never, under any circumstances, rely on a jack to support the vehicle while working on it.*

Whenever any of the suspension or steering fasteners are loosened or removed they must be inspected and, if necessary, be replaced with new ones of the same part number or of original equipment quality and design. Torque specifications must be followed for proper reassembly and component retention. Never attempt to heat or straighten any suspension or steering components. Instead, replace any bent or damaged part with a new one.

2 Stabilizer bar (front) - removal and installation

Removal

Refer to illustrations 2.2a, 2.2b and 2.3

1 Apply the parking brake. Raise the front of the vehicle and support it securely on jackstands.

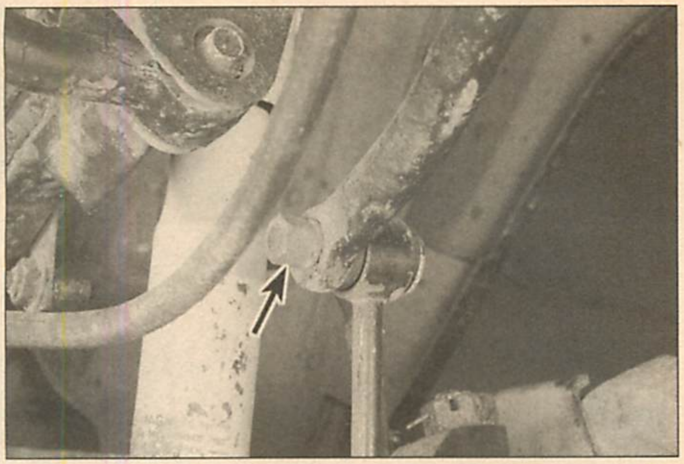
2 Remove the stabilizer bar-to-link nuts **(see illustration)**. Note the order in which the upper and lower retainers and grommets are installed on the links. If it is necessary to remove the links, simply unbolt them from the U-bolt tie plates **(see illustration)**.

3 Remove the retaining bolts from the stabilizer bar bushing brackets **(see illustration)** and detach the bar from the vehicle.

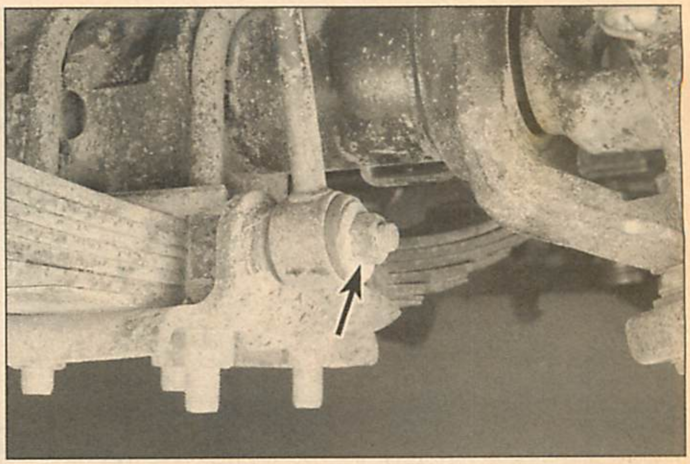
4 Pull the bushings off the stabilizer bar and inspect them for cracks, hardness and other signs of deterioration. If the bushings are damaged, replace them. Inspect the bushings in the lower ends of the links, replacing them if necessary.

Installation

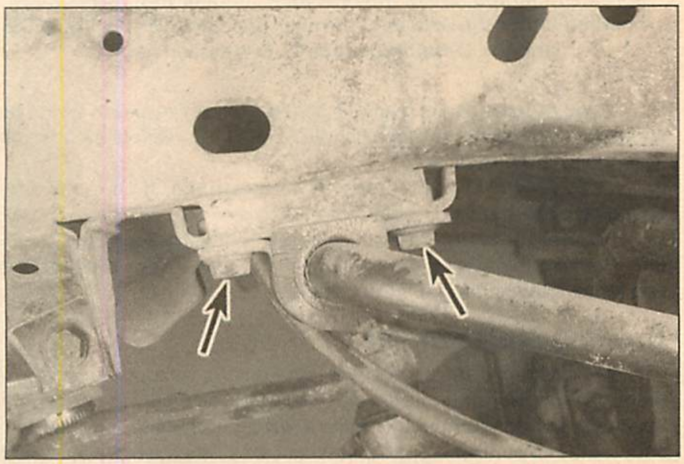
5 Position the stabilizer bar bushings on the bar.



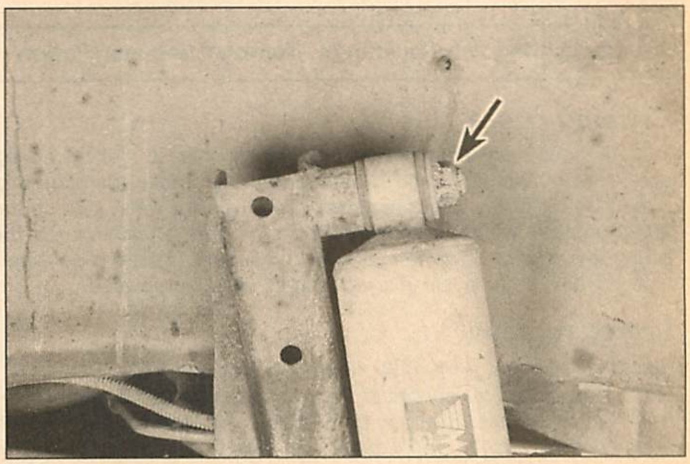
2.2a To disconnect the stabilizer bar from the axle, remove the upper link nut (arrow)



2.2b It isn't necessary to remove the lower link nut and bolt (arrows) unless you're planning to replace the link itself



2.3 To disconnect the stabilizer bar from the frame, remove the bushing bracket bolts (arrows); inspect the rubber bushings and replace them if they're hard, cracked or otherwise deformed



3.2 Upper shock absorber nut (arrow) (front shown, rear similar)

6 Push the brackets over the bushings and raise the bar up to the frame. Install the bracket bolts but don't tighten them completely at this time.

7 Install the stabilizer bar-to-link nuts, washers, spacers and rubber bushings and tighten the nuts to the torque listed in this Chapter's Specifications.

8 Tighten the bracket bolts to the torque listed in this Chapter's Specifications.

3 Shock absorber - removal and installation

Removal

Refer to illustrations 3.2 and 3.3

Note: *This procedure applies to front and rear shock absorbers.*

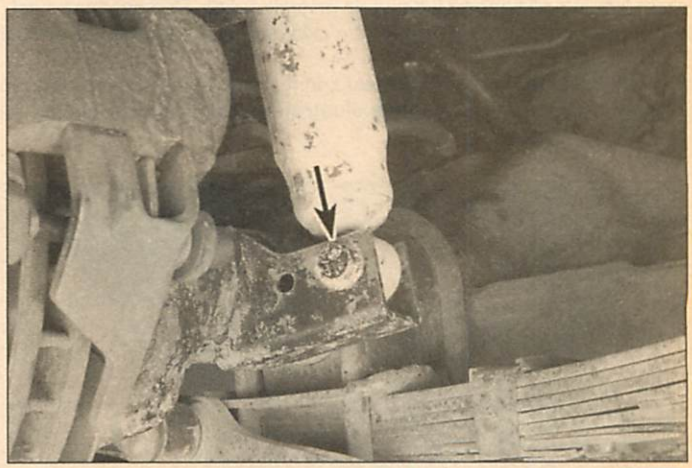
1 Loosen the wheel lug nuts, raise the vehicle and support it securely on jackstands. Remove the wheel.

2 Remove the upper shock absorber nut **(see illustration)**. If the nut won't loosen because of rust, squirt some penetrating oil on the threads and allow it to soak in for awhile. Note that washers are used on both sides of the bushing.

3 Remove the lower shock nut and bolt **(see illustration)** and pull the shock absorber out from the wheel well.

Installation

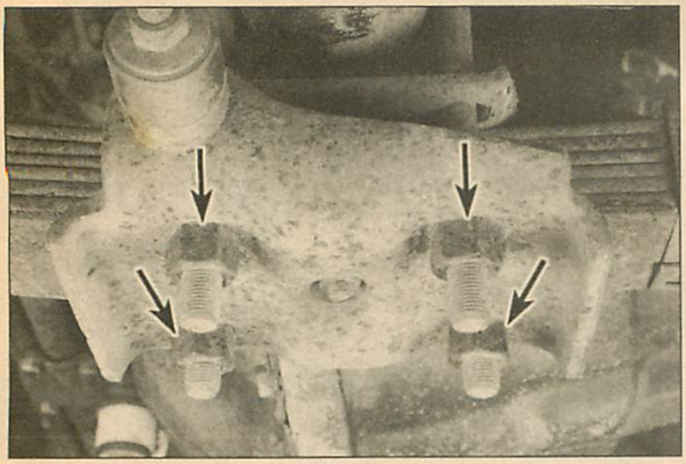
4 Installation is basically the reverse of removal. Be sure to extend the new shock absorber as far as possible before installing it.



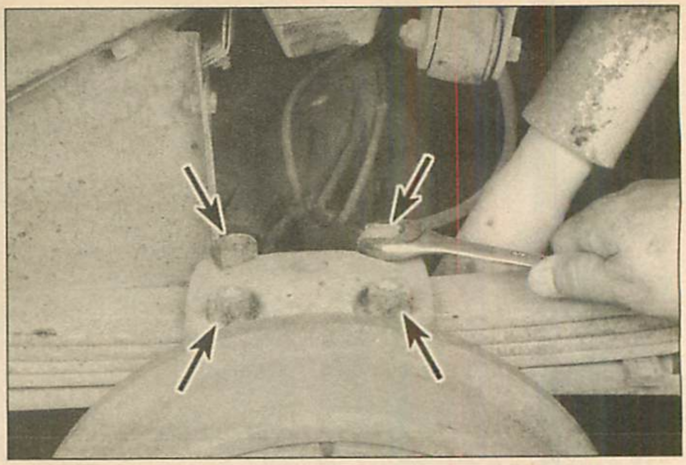
3.3 Lower shock absorber mounting bolt (arrow) (front shown, rear similar)

5 Make sure washers are installed on both sides of the upper and lower bushings. Install the mounting nuts (and bolts, if you're replacing the rear shocks) and tighten them to the torque listed in this Chapter's Specifications.

6 Install the wheels, remove the jackstands and lower the vehicle. Tighten the wheel lug nuts to the torque listed in this Chapter's Specifications.



4.6a If you're removing a front leaf spring, remove the stabilizer bar link nut, then remove these four nuts and the tie plate



4.6b If you're removing a rear leaf spring, remove these four nuts (arrows) and the tie plate (this vehicle is equipped with leaf springs mounted above the rear axle; models with leaf springs mounted under the axle use a similar design, however, the plate and the U-bolt nuts face down instead of up)

4 Leaf springs and bushings - removal and installation

Bushing check

1 All models are equipped with bushings pressed into the spring eyes. The bushings should be inspected for cracks, damage and looseness indicating excessive wear. To check for wear, jack up the frame until the weight is removed from the spring bushing. Pry the spring eye up-and-down to check for movement. If there is considerable movement, the bushing is worn and should be replaced.

Spring removal

Refer to illustrations 4.6a, 4.6b, 4.7a, 4.7b, 4.8a and 4.8b

Note: *This procedure applies to the front and rear leaf spring assemblies. We recommend that you do one side at a time, to keep the axle under control and so you'll have one side to use as a "guide" to reassembly.*

2 Loosen the front or rear wheel lug nuts, raise the front or rear of the vehicle and support it securely on jackstands. Remove the wheel.

3 Position a floor jack under the axle and raise the jack just enough to support the axle.

4 If you're removing a front leaf spring, remove the stabilizer bar link nut at the spring tie plate **(see illustration 2.2b)** and disconnect the link from the plate.

5 If you're removing a rear leaf spring from a vehicle on which the spring is mounted *above* the axle, disconnect the rear shock absorber from the axle tube bracket.

6 Unscrew the U-bolt nuts **(see illustrations)**, then remove the spring tie plate and the U-bolts from the axle.

7 Remove the spring-to-shackle bolt **(see illustrations)**.

8 Remove the spring eye-to-frame bracket bolt **(see illustrations)** and remove the spring from the vehicle.

Bushing replacement

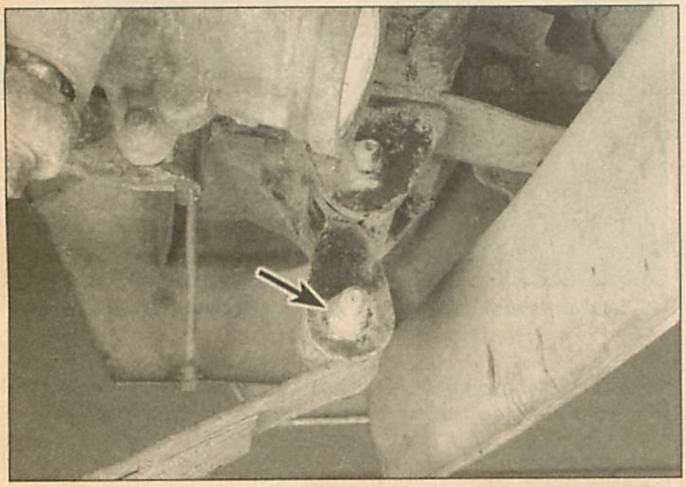
9 The bushings are one of two different sizes; tools for pressing them out can be fabricated from threaded rod. For small diameter bushings, cut an eight-inch length of 3/8-inch diameter threaded rod and, for the large diameter bushings, cut an 11-inch length of 1/2-inch diameter threaded rod.

10 Insert the threaded rod through the bushing.

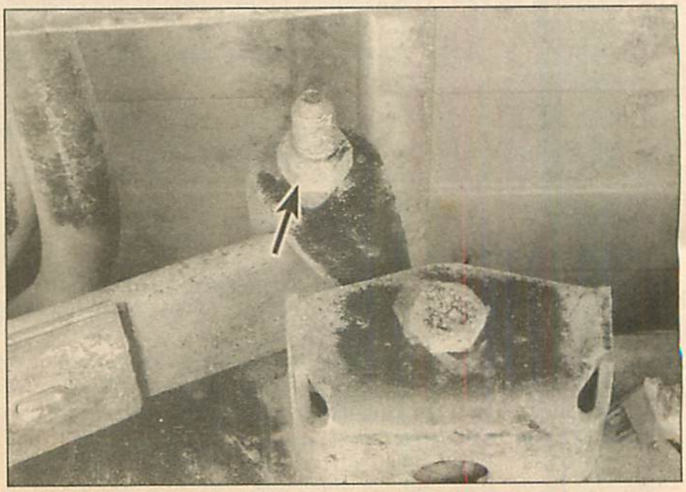
11 Place a socket over one end of the rod with the open end toward the bushing to serve as a driver. The socket must be large enough to bear against the bushing outer sleeve and small enough to pass through the spring eye.

12 Install a flat washer and hex nut on the rod behind the socket.

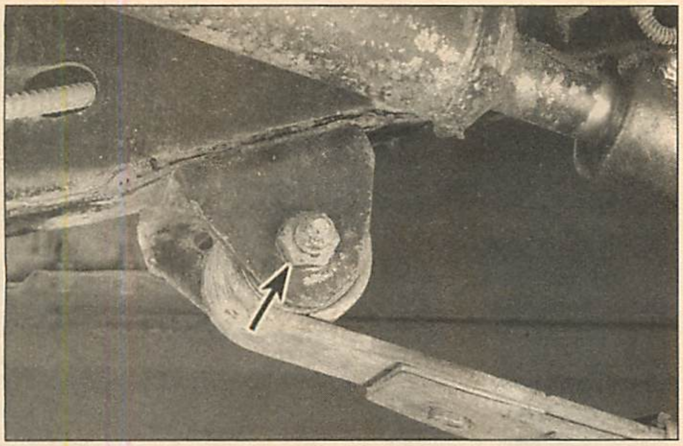
13 On the opposite end of the threaded rod, install a piece of pipe to



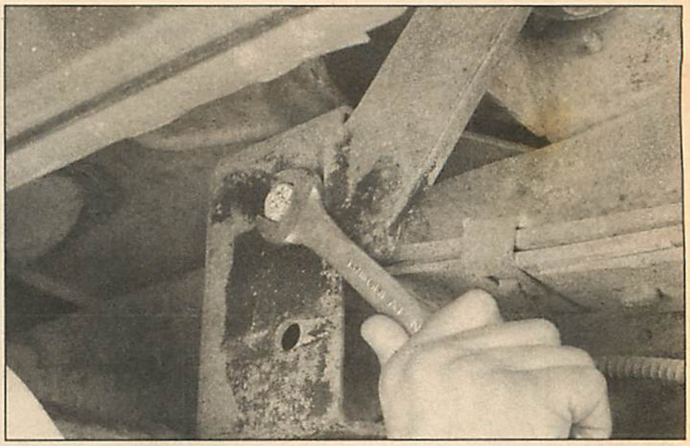
4.7a If you're removing a front leaf spring, remove this nut (arrow) and bolt from the shackle (the shackle is located at the forward end of the front leaf spring)



4.7b If you're removing a rear leaf spring, remove this nut (arrow) and bolt from the shackle (the shackle is located at the rear end of the leaf spring)



4.8a If you're removing a front leaf spring, remove this nut (arrow) and bolt from the frame bracket



4.8b If you're removing a rear leaf spring, remove this bolt from the frame bracket

serve as a receiver. The inside diameter of the pipe must be large enough to accommodate the bushing while still seating against the spring eye surface. It must also be long enough to accept the entire bushing.

14 Secure the pipe section on the rod with a flat washer and nut. The washer must be large enough to properly support the pipe.

15 Tighten the nuts finger tight to align the components. The socket must be positioned in the spring eye and aligned with the bushing and the pipe must butt against the eye surface so the bushing can pass through it.

16 Press the bushing out of the spring eye by tightening the nut at the socket end of the rod.

17 Remove the bushing and tool from the spring eye.

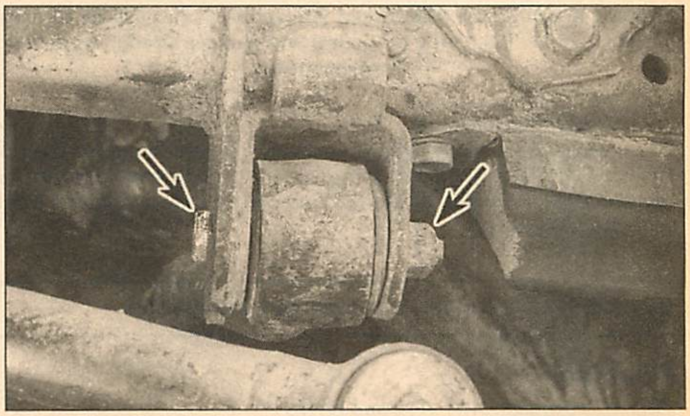
18 Install the new bushing on the threaded rod and assemble and align the tools as previously described.

19 Line up the bushing with the spring eye and press the new bushing into position.

20 Loosen the nuts and check to make sure the bushing is centered in the spring eye with the ends of the bushing flush with or slightly below the sides of the eye. If necessary, reinstall the tools and adjust the bushing position.

Spring installation

21 Installation is the reverse of the removal procedure. Be sure to tighten the spring mounting bolts and the spring tie plate U-bolt nuts to the torque listed in this Chapter's Specifications. **Note:** *The vehicle must be sitting at normal ride height before tightening the front and rear mounting bolts.*



5.2a Front track bar-to-frame bracket nut and bolt (arrows)

5 Track bar - removal and installation

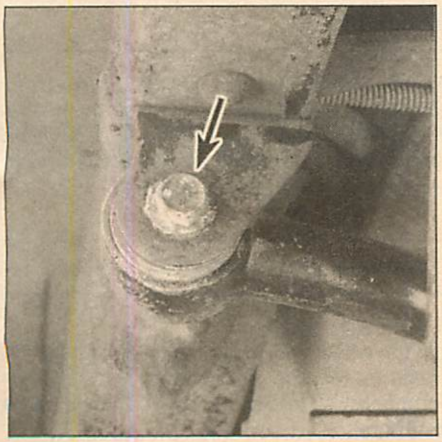
Refer to illustrations 5.2a, 5.2b, 5.3a and 5.3b

Note: *This procedure applies to front and rear track bars.*

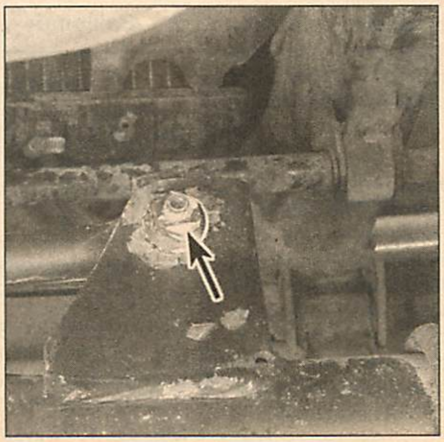
1 Raise the front or rear of the vehicle and support it securely on jackstands.

2 Remove the retaining nut and bolt from the frame rail bracket **(see illustrations).**

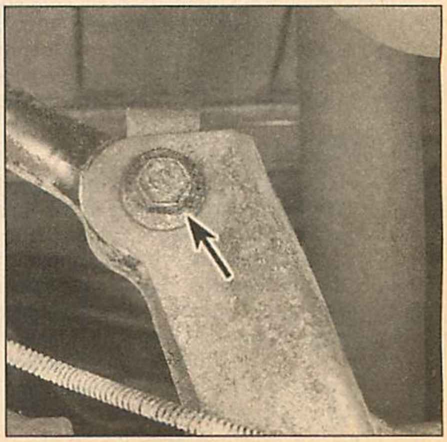
3 Remove the retaining nut and bolt from the axle tube bracket **(see illustrations).**



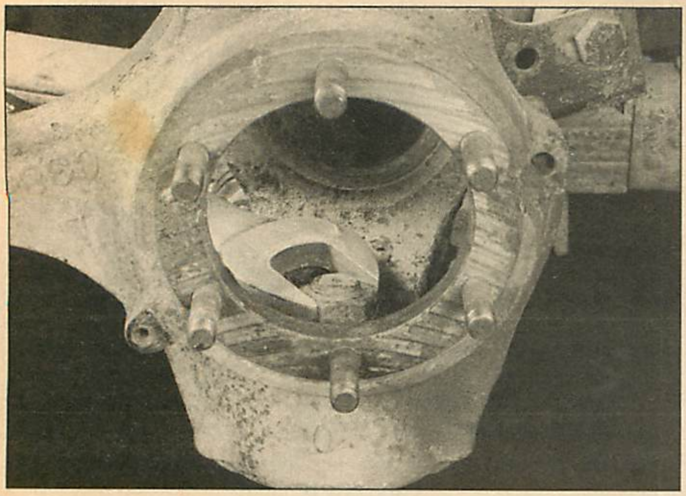
5.2b Rear track bar-to-frame bracket bolt (arrow)



5.3a Front track bar-to-axle bracket nut (arrow)



5.3b Rear track bar-to-axle bracket bolt (arrow)



6.6 Loosen, but don't remove, the nuts on the balljoint studs; getting a tool on the bottom nut (shown) is a tight fit - try turning the knuckle all the way to the left and using a wrench from the front as shown

4 Remove the track bar.
5 Installation is the reverse of removal. Be sure to tighten the fasteners to the torque listed in this Chapter's Specifications. **Note:** *The vehicle must be sitting at normal ride height before tightening the mounting fasteners.*

6 Steering knuckle - removal and installation

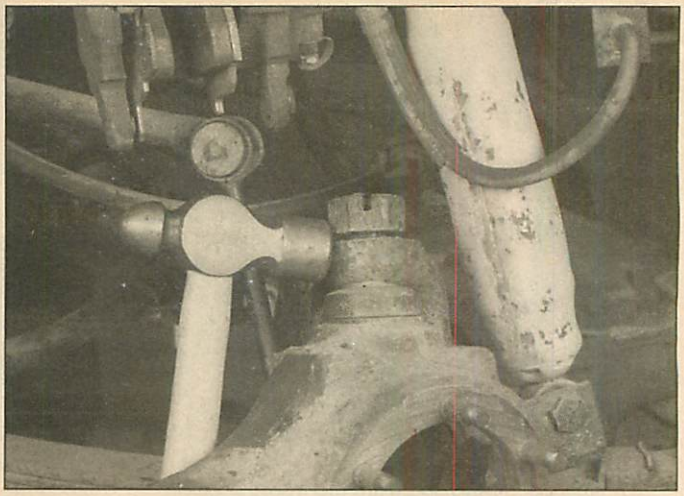
Removal

Refer to illustrations 6.6, 6.7a and 6.7b

1 Loosen the wheel lug nuts, raise the vehicle and support it securely on jackstands. Remove the wheel.
2 Disconnect the tie-rod from the steering knuckle (see Section 9).
3 Remove the disc brake caliper and disc, or, on models with front drum brakes, remove the brake drum, shoes and backing plate (see Chapter 9).
4 Remove the front axle hub and bearing assembly (see Chapter 1, Section 39).
5 Remove the axleshaft (see Chapter 8).
6 Remove the cotter pin from the upper ballstud nut and loosen - but don't remove - the nuts on the balljoint studs **(see illustration)**.
7 Using a large hammer, tap the steering knuckle at the top and bottom to separate it from the balljoint studs **(see illustrations)**. Remove the nuts and detach the steering knuckle.
8 Carefully inspect the steering knuckle for cracks, especially around the steering arm and spindle mounting area. Check the yoke ears on the axle housing for elongated balljoint stud holes. Replace the steering knuckle or axle housing if any of these conditions are found.

Installation

9 Position the steering knuckle on the axle housing yoke and insert the balljoint studs into the holes in the knuckle. **Note:** *The split-ring seat should be flush with the top of the upper yoke ear on the axle housing.* Install the lower nut and tighten it to the torque listed in this Chapter's Specifications. Tighten the upper ballstud split ring to the torque listed in this Chapters specifications (a special tool, available at most auto parts stores, is required). Install the upper nut and tighten it to the torque listed in this Chapter's Specifications. Use a new cotter pin to secure the upper nut, tightening the nut an additional amount, if necessary, to align the hole in the ballstud with the slots in the nut.
10 Install the axleshaft (see Chapter 8).
11 Install the front axle hub and bearing assembly (see Chapter 1, Section 39).



6.7a Using a large hammer, tap the steering knuckle here . . .

6.7b . . . and here to separate it from the balljoint studs

12 Install the brake disc and caliper or backing plate, brake shoe assembly and drum (see Chapter 9).
13 Connect the tie-rod to the steering knuckle (see Section 9).
14 Install the wheel and lug nuts. Lower the vehicle and tighten the lug nuts to the torque listed in this Chapter's Specifications.

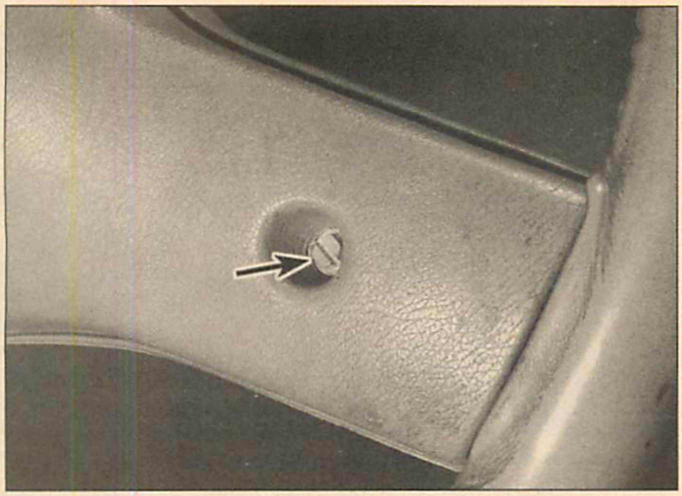
7 Balljoints - replacement

The balljoints are a press fit in the front axle housing yokes, which necessitates the use of a special tool to remove and install them. Since the tool is not normally available to the home mechanic, it is recommended that the vehicle be taken to a dealer service department or other qualified repair shop to have the balljoints replaced.

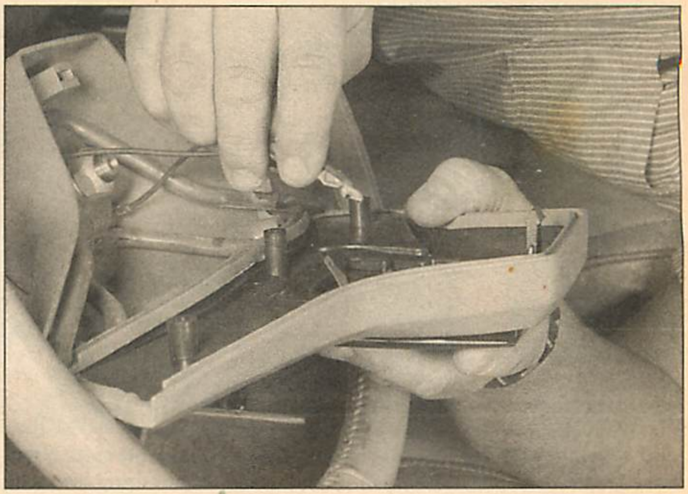
8 Steering wheel - removal and installation

Refer to illustrations 8.2, 8.3, 8.4 and 8.5

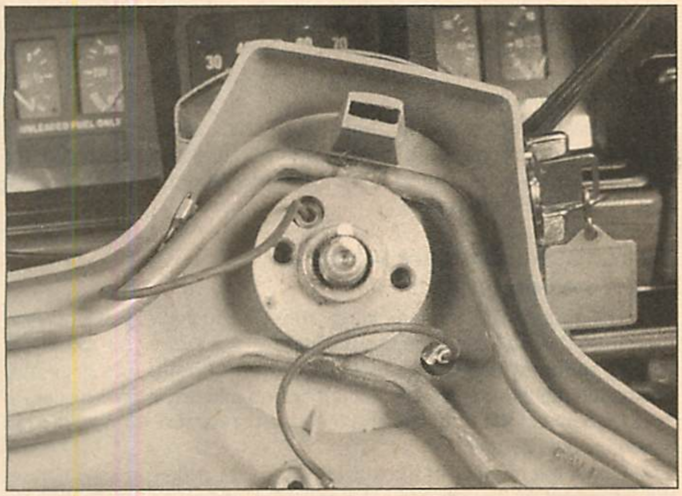
1 Park the vehicle with the wheels pointing straight ahead. Disconnect the cable from the negative terminal of the battery.
2 Remove the retaining screws from the front (dash side) of the steering wheel **(see illustration)**.
3 Remove the steering wheel cover and disconnect the horn leads **(see illustration)**.



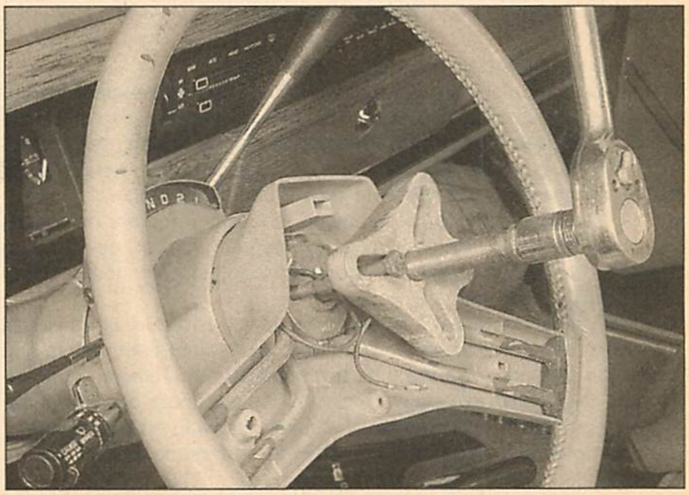
8.2 Remove the two horn pad retaining screws



8.3 Remove the horn pad and disconnect the horn leads



8.4 Before removing the steering wheel, look for alignment marks between the steering wheel and the steering shaft; if there are none, use a sharp scribe or white paint to make your own marks



8.5 Remove the steering wheel from the shaft with a puller - DO NOT HAMMER ON THE SHAFT!

4 Remove the steering wheel retaining nut, then mark the relationship of the steering shaft to the hub **(see illustration)**.

5 Use a puller to detach the steering wheel from the shaft **(see illustration)**. Don't hammer on the shaft to dislodge the steering wheel.

6 To install the wheel, align the mark on the steering wheel hub with the mark on the shaft and slip the wheel onto the shaft. Install the nut and tighten it to the torque listed in this Chapter's Specifications.

7 Connect the negative battery cable.

9 Steering linkage - inspection, removal and installation

Inspection

1 The steering linkage connects the steering gear to the front wheels and keeps the wheels in proper relation to each other. The linkage consists of the Pitman arm, fastened to the steering gear shaft, which moves the drag link back and forth. The back-and-forth motion of the drag link is transmitted to the tie-rod assembly. The tie-rod consists of a rod with balljoints on both ends. The left balljoint is part of a separate, adjustable tie-rod end; the right balljoint is part of the tie-rod itself. There are two adjustment sleeves - the one on the left end of the tie-rod is for adjusting toe-in; the one on the drag link is for centering the steering wheel after the toe adjustment has been performed. Each tube is secured by two pinch bolts and clamps. A steering damper, connected between the right spring plate and the tie-rod assembly reduces shimmy and unwanted forces to the steering gear.

2 Set the wheels in the straight ahead position and lock the steering wheel.

3 Raise one side of the vehicle until the tire is approximately 1-inch off the ground.

4 Mount a dial indicator with the needle resting on the outside edge of the wheel. Grasp the front and rear of the tire and using light pressure, wiggle the wheel back-and-forth and note the dial indicator reading. The gauge reading should be less than 0.108-inch. If the play in the steering system is more than specified, inspect each steering linkage pivot point and balljoint for looseness and replace parts if necessary.

5 Raise the vehicle and support it on jackstands. Check for torn ballstud boots, frozen balljoints and bent or damaged linkage components.

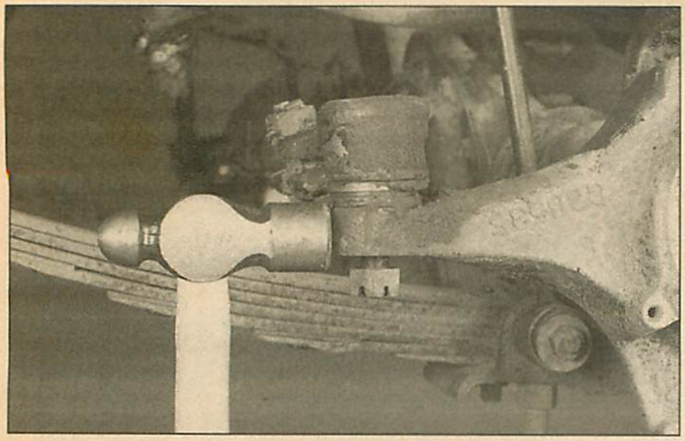
Removal and installation

Left tie-rod end

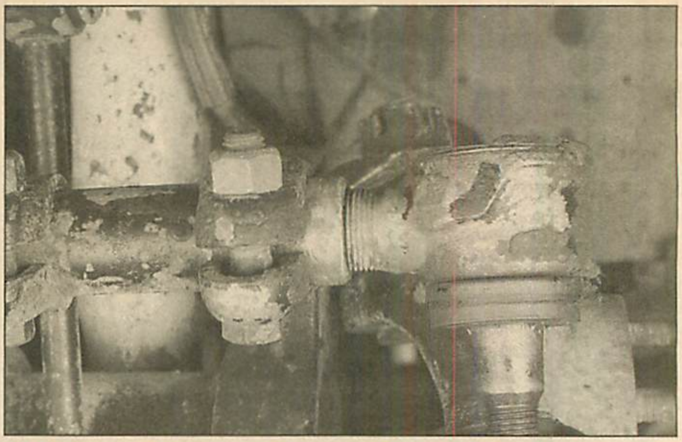
Refer to illustrations 9.8 and 9.9

6 Loosen the wheel lug nuts, raise the vehicle and support it securely on jackstands. Apply the parking brake. Remove the wheel.

7 Remove the cotter pin and loosen, but do not remove, the castle



9.8 If you don't have the appropriate puller for disconnecting the tie-rod end from the steering knuckle, strike the steering arm with a hammer (note that the nut is loose but still installed, to prevent the ballstud from suddenly jumping out of the steering arm when it comes loose)



9.9 Counter the number of threads showing before removing the tie-rod end, jot down this number and install the new tie-rod end with the same number of threads showing

nut from the ballstud on the end of the tie-rod.

8 If you have a small puller that will work, use it to separate the tie-rod end from the steering knuckle; if not, use a hammer to strike the steering arm **(see illustration)**. Remove the castle nut and pull the tie-rod from the knuckle. **Caution:** *The use of a picklefork-type balljoint separator most likely will cause damage to the balljoint boot.*

9 If a tie-rod end must be replaced, count the number of threads showing and jot down this number to maintain correct toe-in during reassembly **(see illustration)**. Loosen the adjustment sleeve clamp and unscrew the tie-rod end.

10 Lubricate the threaded portion of the tie-rod end with chassis grease. Screw the new tie-rod end into the adjustment sleeve and adjust the distance from the tube to the ballstud by threading the tie-rod into the adjustment sleeve until the same number of threads are showing as before (the number of threads showing on both sides of the adjustment sleeve should be within three threads of each other). Don't tighten the adjustment sleeve clamps yet.

11 To install the tie-rod assembly, insert the left tie-rod end ballstud into the steering knuckle. Make sure the ballstud is fully seated. Install the nut and tighten it to the torque listed in this Chapter's Specifications. If the ballstud spins when attempting to tighten the nut, force it into the tapered hole with a large pair of pliers.

12 Install a new cotter pin. If necessary, tighten the nut slightly to align a slot in the nut with the hole in the ballstud.

13 Tighten the adjustment sleeve clamp nuts to the torque listed in this Chapter's Specifications. The adjustment sleeve clamp bolts should be nearly horizontal.

14 Install the wheel and lug nuts, lower the vehicle and tighten the lug nuts to the torque listed in this Chapter's Specifications. Drive the vehicle to an alignment shop to have the front end alignment checked and, if necessary, adjusted.

Tie-rod assembly/right tie-rod end

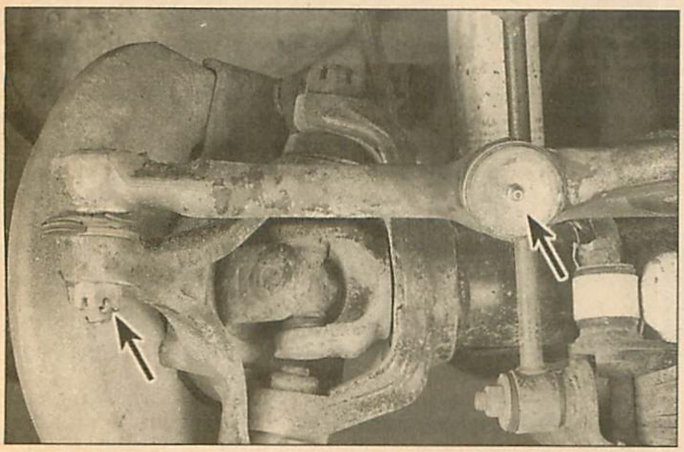
Refer to illustration 9.15

15 The right tie-rod end **(see illustration)** is an integral part of the tie-rod assembly. The replacement procedure for the right tie-rod end is slightly different than for the left tie-rod end: the tie-rod assembly (minus the adjustment sleeve and left tie-rod end) must be replaced.

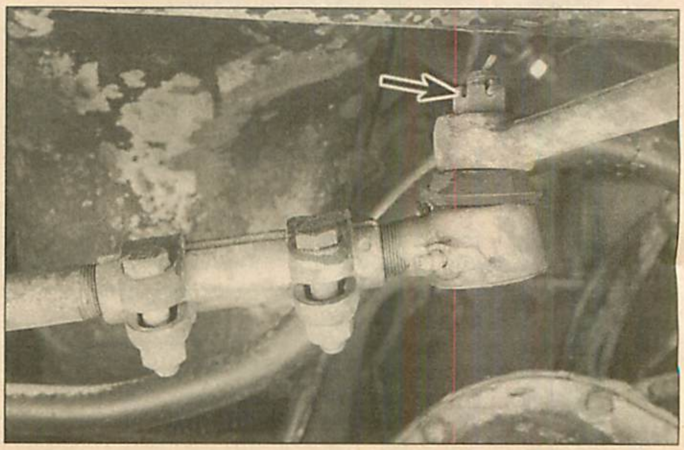
16 Disconnect the drag link and the steering damper from the tie-rod assembly (see below).

17 Count the number of threads showing on the tie-rod assembly, at the *inner* end of the adjustment sleeve, jot down this information for reassembly, then loosen the adjustment sleeve inner clamp bolt and unscrew the left adjustment sleeve and tie-rod end from the tie-rod assembly.

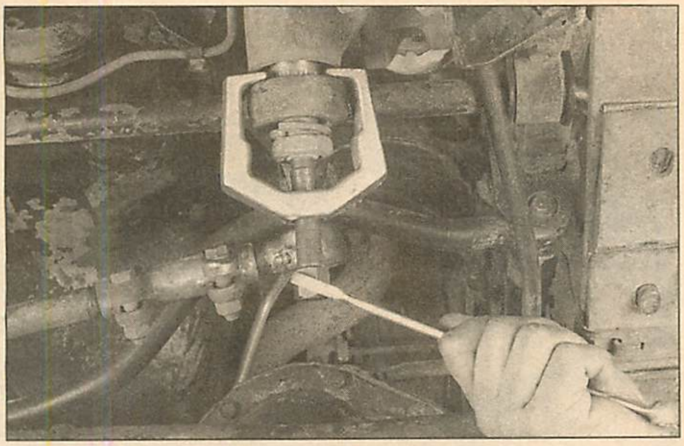
18 Disconnect the tie-rod assembly from the right steering knuckle (see Step 8). Remove the tie-rod assembly.



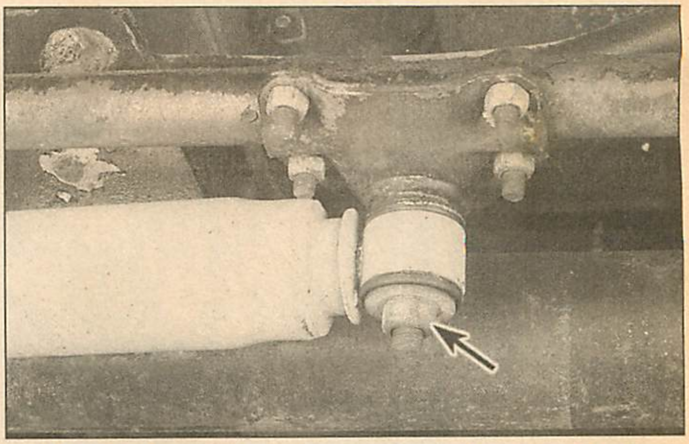
9.15 The right tie-rod end is part of the tie-rod assembly: if it must be replaced, the tie-rod must be replaced, too; the arrow on the right points to the ballstud connecting the drag link to the tie-rod assembly (ballstud nut is facing to the rear)



9.20 To disconnect the drag link from the Pitman arm, loosen this nut and separate the ballstud with a small puller; if you're going to replace the balljoint, be sure to count the number of threads showing before loosening the adjustment sleeve clamp and unscrewing the balljoint



9.25 To remove the Pitman arm from the steering gear, loosen the retaining nut and install a Pitman arm puller; be sure to mark the relationship of the Pitman arm to the shaft before removing it



9.28 To disconnect the steering damper from the tie-rod assembly, remove this nut (arrow)

19 Be sure to screw the left tie-rod end and adjustment sleeve assembly onto the tie-rod so the same number of threads are showing again, then tighten the adjustment sleeve clamp bolt to the torque listed in this Chapter's Specifications. Installation is otherwise the reverse of removal.

Drag link

Refer to illustration 9.20

20 Loosen, but do not remove, the nuts securing the drag link ballstuds to the Pitman arm **(see illustration)** and to the tie-rod assembly **(see illustration 9.15)**. Separate the drag link from the Pitman arm and from the tie-rod assembly with a two-jaw puller, then remove the nuts and remove the drag link.

21 If you're going to disassemble the drag link from the adjustment sleeve in order to replace the balljoint at the Pitman arm end, be sure to count the number of threads showing before separating the two parts.

22 Installation is the reverse of the removal procedure. If you disassembled the drag link and adjustment sleeve, make sure the same number of threads are showing when you install the new balljoint. If the ballstuds spin at either end of the drag link when you tighten the nuts, force them into the tapered holes with a large pair of pliers. Be sure to tighten all fasteners to the torque listed in this Chapter's Specifications.

Pitman arm

Refer to illustration 9.25

23 Disconnect the drag link from the Pitman arm (see above).

24 Loosen - but don't remove - the Pitman arm retaining nut. Mark the relationship of the Pitman arm to the steering shaft.

25 Install a Pitman arm removal tool and pull off the Pitman arm **(see illustration)**.

26 Remove the Pitman arm retaining nut and remove the Pitman arm.

27 Installation is the reverse of removal. Make sure the marks you made before removal are aligned when installing the Pitman arm.

Steering damper

Refer to illustrations 9.28 and 9.29

28 Separate the steering damper from the tie-rod assembly **(see illustration)**.

29 Unbolt the damper from the spring bracket **(see illustration)** and remove it from the vehicle.

30 Installation is the reverse of removal. Be sure to tighten the steering damper fasteners to the torque listed in this Chapter's Specifications.

10 Steering gear - removal and installation

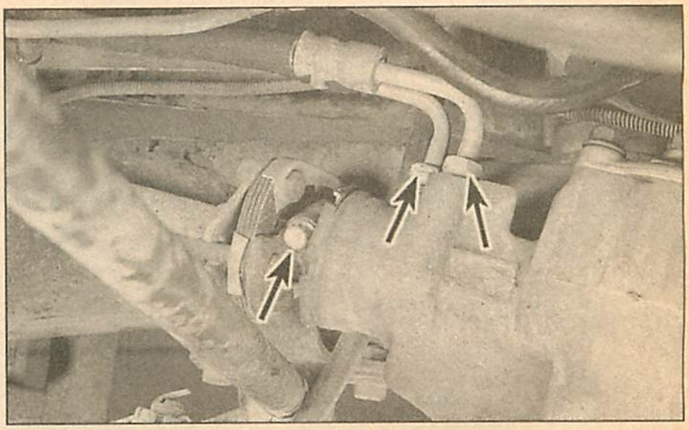
Removal

Refer to illustrations 10.2 and 10.5

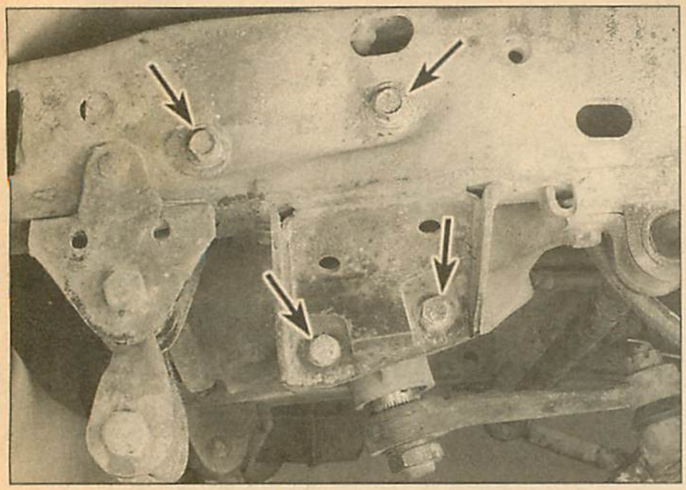
1 Raise the front of the vehicle and support it securely on jackstands. Apply the parking brake.

2 Place a drain pan under the steering gear (power steering only). Disconnect the line fittings **(see illustration)** and cap the ends to pre-

9.29 To disconnect the steering damper from the spring plate, remove this nut (arrow)



10.2 Unscrew the power steering line tube fittings (right arrows), disconnect the lines and plug them to prevent fluid from leaking out; mark the relationship of the steering shaft U-joint to the steering gear input shaft, then loosen the pinch bolt (left arrow)



10.5 To detach the steering gear from the frame, remove these four bolts (arrows)

vent excessive fluid loss and contamination. If available, use a flare-nut wrench to remove the hoses/lines.

3 Mark the relationship of the intermediate shaft lower universal joint to the steering gear input shaft. Remove the intermediate shaft lower pinch bolt **(see illustration 10.2)**.

4 Remove the Pitman arm nut and washer (see Section 9).

5 Support the steering gear and remove the mounting bolts **(see illustration)**. Lower the unit, separate the intermediate shaft from the steering gear input shaft and remove the steering gear from the vehicle.

Installation

6 Raise the steering gear into position and connect the intermediate shaft, aligning the marks.

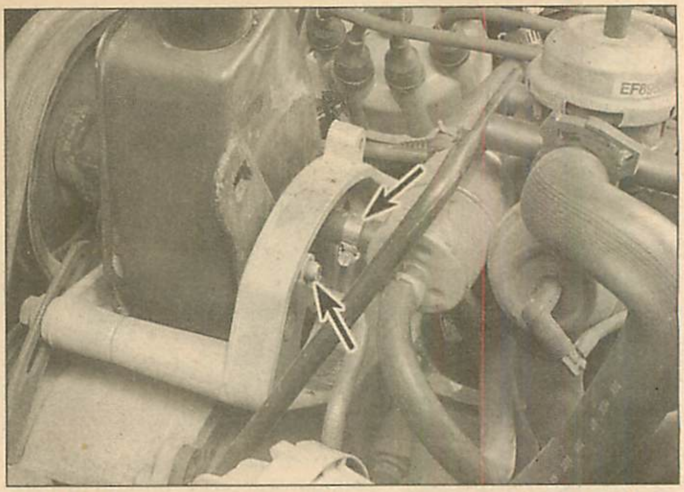
7 Install the mounting bolts and washers and tighten them to the torque listed in this Chapter's Specifications.

8 Slide the Pitman arm onto the shaft. Make sure the marks are aligned. Install the washer and nut and tighten the nut to the torque listed in this Chapter's Specifications.

9 Install the intermediate shaft lower pinch bolt and tighten it to the torque listed in this Chapter's Specifications.

10 Connect the power steering hoses/lines to the steering gear and fill the power steering pump reservoir with the recommended fluid (see Chapter 1).

11 Lower the vehicle and bleed the steering system (see Section 12).



11.2 After extracting as much power steering fluid as possible from the reservoir, disconnect the power steering pressure and return lines (arrows) and plug them to prevent fluid from dripping

11 Power steering pump - removal and installation

Refer to illustrations 11.2, 11.3a, 11.3b, 11.3c and 11.5

Note: *The illustrations accompanying this section depict a typical pump installation on a V8 engine; the mounting bracket and mounting bolt configuration on six-cylinder engines is slightly different, but the procedure for removing and installing the pump is basically the same.*

1 Loosen the pump drivebelt and slip the belt over the pulley (see Chapter 1).

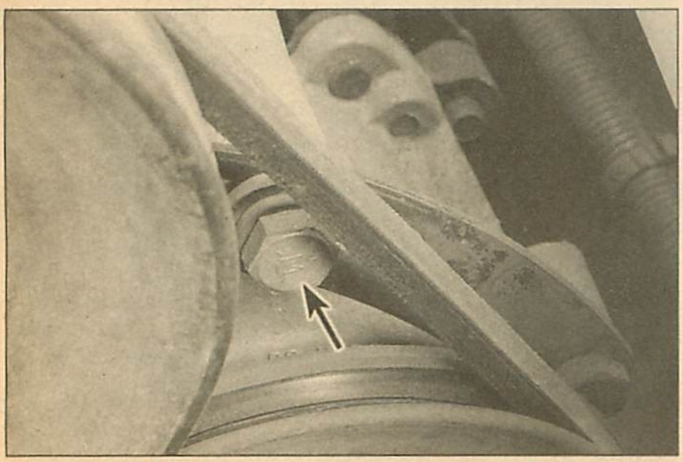
2 Using a suction gun, suck out as much power steering fluid from the reservoir as possible. Position a drain pan under the pump and disconnect the high pressure line and the fluid return hose **(see illustration)**. It may be necessary to remove the air cleaner housing for access to the return hose (if so, see Chapter 4). Cap the ends of the lines to prevent excessive fluid leakage and the entry of contaminants.

3 Remove the upper attaching bolts **(see illustrations)** and the rear attaching bolts and nuts, then lift the pump from the engine.

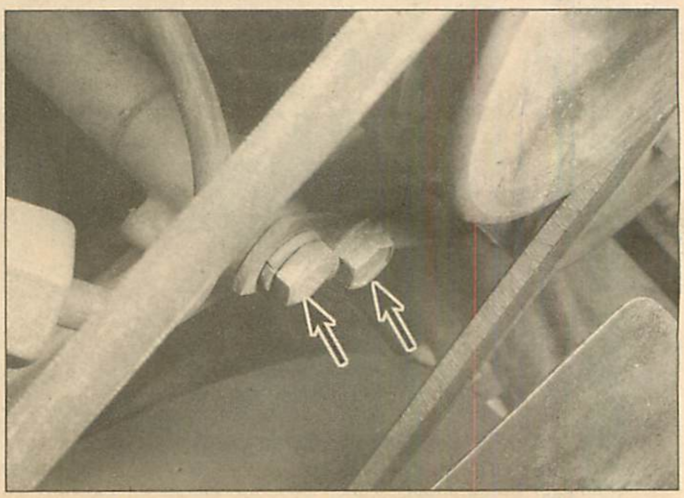
4 Raise the front of the vehicle and place it securely on jackstands.

5 Unscrew the lower mounting nut **(see illustration)** and remove the pump.

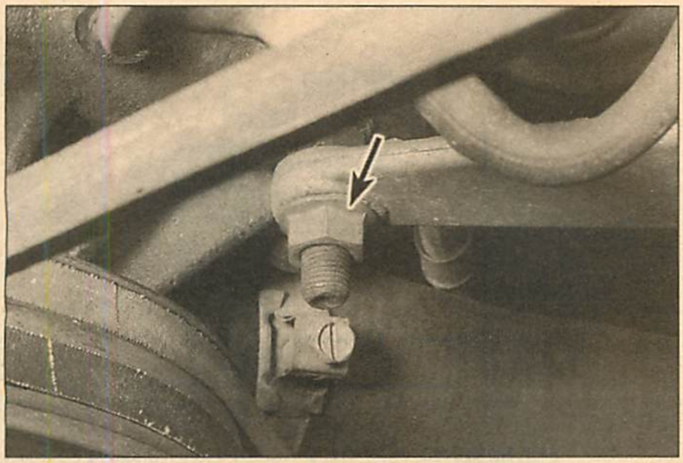
6 Installation is the reverse of removal. Be sure to fill the pump reservoir with the recommended fluid (see Chapter 1) and bleed the power steering system (see Section 12).



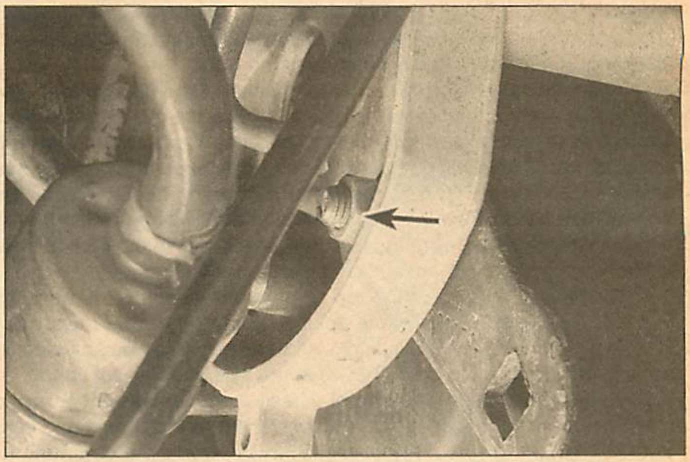
11.3a To detach the power steering pump from the bracket, remove this bolt (arrow) on the left side . . .



11.3b . . . these two bolts (arrows) on the right . . .



11.3c . . . and this nut (arrow) to the right of the previous two



11.5 After raising the vehicle, remove this mounting nut (arrow) from below

12 Power steering system - bleeding

1 Following any operation in which the power steering fluid lines have been disconnected, the power steering system must be bled to remove all air and obtain proper steering performance.
2 With the front wheels in the straight ahead position, check the power steering fluid level and, if low, add fluid until it reaches the Cold (C) mark on the dipstick.
3 Start the engine and allow it to run at fast idle. Recheck the fluid level and add more if necessary to reach the Cold (C) mark on the dipstick.
4 Bleed the system by turning the wheels from side-to-side, without hitting the stops. This will work the air out of the system. Keep the reservoir full of fluid as this is done.
5 When the air is worked out of the system, return the wheels to the straight ahead position and leave the vehicle running for several more minutes before shutting it off.
6 Road test the vehicle to be sure the steering system is functioning normally and noise-free.
7 Recheck the fluid level to be sure it is up to the Hot (H) mark on the dipstick while the engine is at normal operating temperature. Add fluid if necessary (see Chapter 1).

13 Wheels and tires - general information

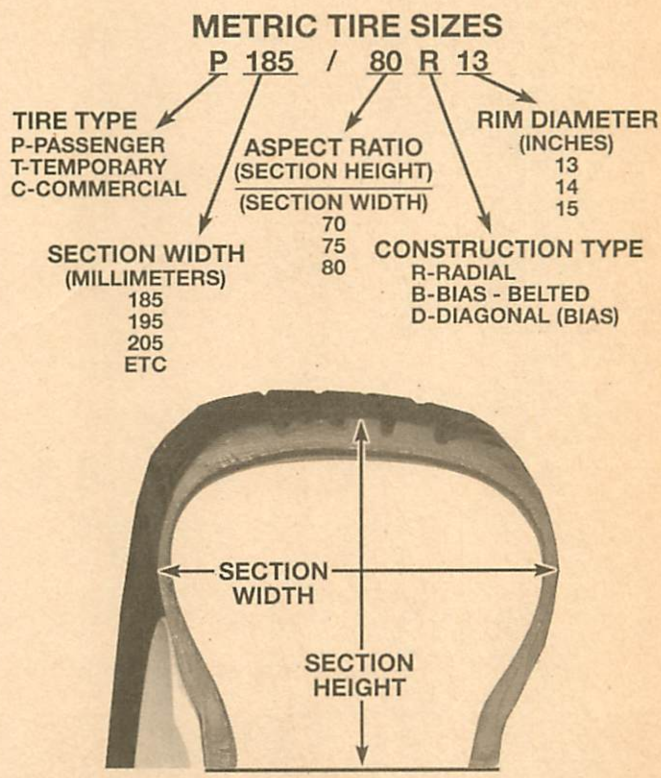
Refer to illustration 13.1

Most vehicles covered by this manual are equipped with metric-sized fiberglass or steel-belted radial tires **(see illustration)**. Use of other size or type of tires may affect the ride and handling of the vehicle. Don't mix different types of tires, such as radials and bias belted, on the same vehicle as handling may be seriously affected. It's recommended that tires be replaced in pairs on the same axle, but if only one tire is being replaced, be sure it's the same size, structure and tread design as the other.

Because tire pressure has a substantial effect on handling and wear, the pressure on all tires should be checked at least once a month or before any extended trips (see Chapter 1).

Wheels must be replaced if they are bent, dented, leak air, have elongated bolt holes, are heavily rusted, out of vertical symmetry or if the lug nuts won't stay tight. Wheel repairs that use welding or peening are not recommended.

Tire and wheel balance is important to the overall handling, braking and performance of the vehicle. Unbalanced wheels can adversely affect handling and ride characteristics as well as tire life. Whenever a tire is installed on a wheel, the tire and wheel should be balanced by a shop with the proper equipment.



13.1 Metric tire size code

A = Section width *B = Section height*

14 Front end alignment - general information

Refer to illustration 14.3

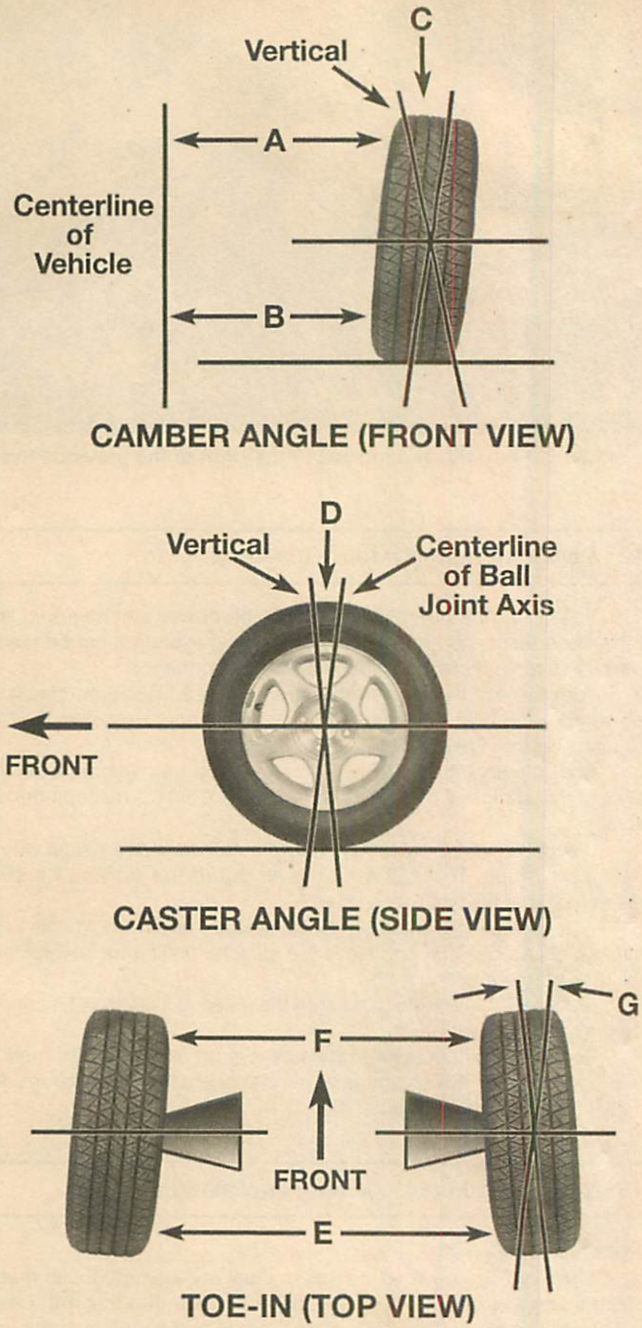
A front end alignment refers to the adjustments made to the front wheels so they are in proper angular relationship to the suspension and the ground. Front wheels that are out of proper alignment not only affect steering control, but also increase tire wear. The only front end adjustments possible on these vehicles are caster and toe-in.

Getting the proper front wheel alignment is a very exacting process, one in which complicated and expensive machines are necessary to perform the job properly. Because of this, you should have a technician with the proper equipment perform these tasks. We will, however, use this space to give you a basic idea of what is involved with front end alignment so you can better understand the process and deal intelligently with the shop that does the work.

Toe-in is the turning in of the front wheels **(see illustration)**. The purpose of a toe specification is to ensure parallel rolling of the front wheels. In a vehicle with zero toe-in, the distance between the front edges of the wheels will be the same as the distance between the rear edges of the wheels. The actual amount of toe-in is normally only a fraction of an inch. Toe-in adjustment is controlled by the left tie-rod end position on the tie-rod. Incorrect toe-in will cause the tires to wear improperly by making them scrub against the road surface.

Caster is the tilting of the top of the front steering axis from the vertical. A tilt toward the rear is positive caster and a tilt toward the front is negative caster. If this angle isn't correct, it can be adjusted by adding caster adjusting shims between the axle and the leaf spring.

Camber (the tilting of the front wheels from vertical when viewed from the front of the vehicle) is factory present at 0-degrees and cannot be adjusted. If the camber angle isn't correct, the components causing the problem must be replaced. **Caution:** *Never attempt to adjust the camber angle by heating or bending the axle or any other suspension component!*



14.3 Front end alignment details

1 *A minus B = C (degrees camber)*
2 *E minus F = toe-in (measured in inches)*
3 *G - toe-in (expressed in degrees)*

Chapter 11 Body

Contents

1 General information

The vehicles covered by this manual are built with a body-on-frame construction. The frame is a ladder-type, consisting of two C-sectioned steel side rails joined by crossmembers. These crossmembers are secured to the side rails by a combination of welds and rivets, with the exception of the transmission crossmember which is bolted into place for easy removal. The vehicle bodies are secured to the chassis by rubber insulated mounts and can be completely removed from the chassis.

Certain components are particularly vulnerable to accident damage and can be unbolted and repaired or replaced. Among these parts are the body moldings, front fenders, doors, bumpers, the hood and tailgate and all glass. Only general body maintenance practices and body panel repair procedures within the scope of the do-it-yourselfer are included in this Chapter.

2 Body - maintenance

1 The condition of your vehicle's body is very important, because the resale value depends a great deal on it. It's much more difficult to repair a neglected or damaged body than it is to repair mechanical components. The hidden areas of the body, such as the wheel wells, the frame and the engine compartment, are equally important, although they don't require as frequent attention as the rest of the body.

2 Once a year, or every 12,000 miles, it's a good idea to have the underside of the body steam cleaned. All traces of dirt and oil will be removed and the area can then be inspected carefully for rust, damaged brake lines, frayed electrical wires, damaged cables and other problems. The front suspension components should be greased after completion of this job.

3 At the same time, clean the engine and the engine compartment with a steam cleaner or water-soluble degreaser.

4 The wheel wells should be given close attention, since undercoating can peel away and stones and dirt thrown up by the tires can cause the paint to chip and flake, allowing rust to set in. If rust is found, clean down to the bare metal and apply an anti-rust paint.

5 The body should be washed about once a week. Wet the vehicle thoroughly to soften the dirt, then wash it down with a soft sponge and plenty of clean soapy water. If the surplus dirt is not washed off very carefully, it can wear down the paint.

6 Spots of tar or asphalt thrown up from the road should be removed with a cloth soaked in solvent.

7 Once every six months, wax the body and chrome trim. If a chrome cleaner is used to remove rust from any of the vehicle's plated parts, remember that the cleaner also removes part of the chrome, so use it sparingly.

3 Vinyl trim - maintenance

Don't clean vinyl trim with detergents, caustic soap or petroleum-based cleaners. Plain soap and water works just fine, with a soft brush to clean dirt that may be ingrained. Wash the vinyl as frequently as the rest of the vehicle. After cleaning, application of a high-quality rubber and vinyl protectant will help prevent oxidation and cracks. The protectant can also be applied to weatherstripping, vacuum lines and rubber hoses, which often fail as a result of chemical degradation, and to the tires.

4 Upholstery and carpets - maintenance

1 Every three months remove the floormats and clean the interior of the vehicle (more frequently if necessary). Use a stiff whisk broom to brush the carpeting and loosen dirt and dust, then vacuum the upholstery and carpets thoroughly, especially along seams and crevices.
2 Dirt and stains can be removed from carpeting with basic household or automotive carpet shampoos available in spray cans. Follow the directions and vacuum again, then use a stiff brush to bring back the "nap" of the carpet.
3 Most interiors have cloth or vinyl upholstery, either of which can be cleaned and maintained with a number of material-specific cleaners or shampoos available in auto supply stores. Follow the directions on the product for usage, and always spot-test any upholstery cleaner on an inconspicuous area (bottom edge of a back seat cushion) to ensure that it doesn't cause a color shift in the material.
4 After cleaning, vinyl upholstery should be treated with a protectant. **Note:** *Make sure the protectant container indicates the product can be used on seats - some products may make a seat too slippery.* **Caution:** *Do not use protectant on vinyl-covered steering wheels.*
5 Leather upholstery requires special care. It should be cleaned regularly with saddlesoap or leather cleaner. Never use alcohol, gasoline, nail polish remover or thinner to clean leather upholstery.
6 After cleaning, regularly treat leather upholstery with a leather conditioner, rubbed in with a soft cotton cloth. Never use car wax on leather upholstery.
7 In areas where the interior of the vehicle is subject to bright sunlight, cover leather seating areas of the seats with a sheet if the vehicle is to be left out for any length of time.

5 Body repair - minor damage

Repair of scratches

1 If the scratch is superficial and does not penetrate to the metal of the body, repair is very simple. Lightly rub the scratched area with a fine rubbing compound to remove loose paint and built-up wax. Rinse the area with clean water.
2 Apply touch-up paint to the scratch, using a small brush. Continue to apply thin layers of paint until the surface of the paint in the scratch is level with the surrounding paint. Allow the new paint at least two weeks to harden, then blend it into the surrounding paint by rubbing with a very fine rubbing compound. Finally, apply a coat of wax to the scratch area.
3 If the scratch has penetrated the paint and exposed the metal of the body, causing the metal to rust, a different repair technique is required. Remove all loose rust from the bottom of the scratch with a pocket knife, then apply rust inhibiting paint to prevent the formation of rust in the future. Using a rubber or nylon applicator, coat the scratched area with glaze-type filler. If required, the filler can be mixed with thinner to provide a very thin paste, which is ideal for filling narrow scratches. Before the glaze filler in the scratch hardens, wrap a piece of smooth cotton cloth around the tip of a finger. Dip the cloth in thinner and then quickly wipe it along the surface of the scratch. This will ensure that the surface of the filler is slightly hollow. The scratch can now be painted over as described earlier in this Section.

Repair of dents

See photo sequence

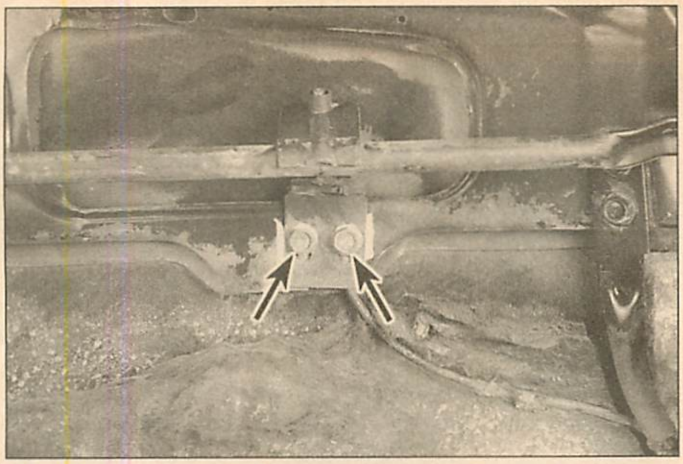
4 When repairing dents, the first job is to pull the dent out until the affected area is as close as possible to its original shape. There is no point in trying to restore the original shape completely as the metal in the damaged area will have stretched on impact and cannot be restored to its original contours. It is better to bring the level of the dent up to a point which is about 1/8-inch below the level of the surrounding metal. In cases where the dent is very shallow, it is not worth trying to pull it out at all.
5 If the back side of the dent is accessible, it can be hammered out gently from behind using a soft-face hammer. While doing this, hold a block of wood firmly against the opposite side of the metal to absorb the hammer blows and prevent the metal from being stretched.
6 If the dent is in a section of the body which has double layers, or some other factor makes it inaccessible from behind, a different technique is required. Drill several small holes through the metal inside the damaged area, particularly in the deeper sections. Screw long, self tapping screws into the holes just enough for them to get a good grip in the metal. Now the dent can be pulled out by pulling on the protruding heads of the screws with locking pliers.
7 The next stage of repair is the removal of paint from the damaged area and from an inch or so of the surrounding metal. This is easily done with a wire brush or sanding disk in a drill motor, although it can be done just as effectively by hand with sandpaper. To complete the preparation for filling, score the surface of the bare metal with a screwdriver or the tang of a file or drill small holes in the affected area. This will provide a good grip for the filler material. To complete the repair, see the Section on *filling and painting*.

Repair of rust holes or gashes

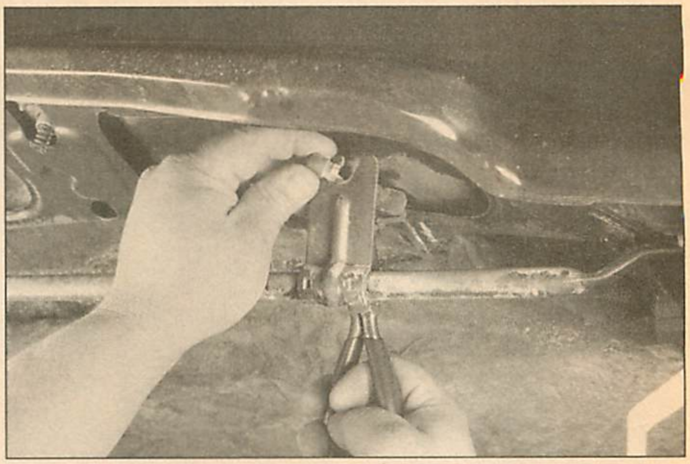
8 Remove all paint from the affected area and from an inch or so of the surrounding metal using a sanding disk or wire brush mounted in a drill motor. If these are not available, a few sheets of sandpaper will do the job just as effectively.
9 With the paint removed, you will be able to determine the severity of the corrosion and decide whether to replace the whole panel, if possible, or repair the affected area. New body panels are not as expensive as most people think and it is often quicker to install a new panel than to repair large areas of rust.
10 Remove all trim pieces from the affected area except those which will act as a guide to the original shape of the damaged body, such as headlight shells, etc. Using metal snips or a hacksaw blade, remove all loose metal and any other metal that is badly affected by rust. Hammer the edges of the hole on the inside to create a slight depression for the filler material.
11 Wire brush the affected area to remove the powdery rust from the surface of the metal. If the back of the rusted area is accessible, treat it with rust inhibiting paint.
12 Before filling is done, block the hole in some way. This can be done with sheet metal riveted or screwed into place, or by stuffing the hole with wire mesh.
13 Once the hole is blocked off, the affected area can be filled and painted. See the following subsection on *filling and painting*.

Filling and painting

14 Many types of body fillers are available, but generally speaking, body repair kits which contain filler paste and a tube of resin hardener are best for this type of repair work. A wide, flexible plastic or nylon applicator will be necessary for imparting a smooth and contoured finish to the surface of the filler material. Mix up a small amount of filler on a clean piece of wood or cardboard (use the hardener sparingly). Follow the manufacturer's instructions on the package, otherwise the filler will set incorrectly.
15 Using the applicator, apply the filler paste to the prepared area. Draw the applicator across the surface of the filler to achieve the desired contour and to level the filler surface. As soon as a contour that approximates the original one is achieved, stop working the paste. If you continue, the paste will begin to stick to the applicator. Continue



9.3a Remove the bolts (arrows) securing the hood release cable (if equipped) . . .



9.3b . . . then remove the cable end from the latch

to add thin layers of paste at 20-minute intervals until the level of the filler is just above the surrounding metal.

16 Once the filler has hardened, the excess can be removed with a body file. From then on, progressively finer grades of sandpaper should be used, starting with a 180-grit paper and finishing with 600-grit wet-or-dry paper. Always wrap the sandpaper around a flat rubber or wooden block, otherwise the surface of the filler will not be completely flat. During the sanding of the filler surface, the wet-or-dry paper should be periodically rinsed in water. This will ensure that a very smooth finish is produced in the final stage.

17 At this point, the repair area should be surrounded by a ring of bare metal, which in turn should be encircled by the finely feathered edge of good paint. Rinse the repair area with clean water until all of the dust produced by the sanding operation is gone.

18 Spray the entire area with a light coat of primer. This will reveal any imperfections in the surface of the filler. Repair the imperfections with fresh filler paste or glaze filler and once more smooth the surface with sandpaper. Repeat this spray-and-repair procedure until you are satisfied that the surface of the filler and the feathered edge of the paint are perfect. Rinse the area with clean water and allow it to dry completely.

19 The repair area is now ready for painting. Spray painting must be carried out in a warm, dry, windless and dust free atmosphere. These conditions can be created if you have access to a large indoor work area, but if you are forced to work in the open, you will have to pick the day very carefully. If you are working indoors, dousing the floor in the work area with water will help settle the dust which would otherwise be in the air. If the repair area is confined to one body panel, mask off the surrounding panels. This will help minimize the effects of a slight mismatch in paint color. Trim pieces such as chrome strips, door handles, etc., will also need to be masked off or removed. Use masking tape and several thickness of newspaper for the masking operations.

20 Before spraying, shake the paint can thoroughly, then spray a test area until the spray painting technique is mastered. Cover the repair area with a thick coat of primer. The thickness should be built up using several thin layers of primer rather than one thick one. Using 600-grit wet-or-dry sandpaper, rub down the surface of the primer until it is very smooth. While doing this, the work area should be thoroughly rinsed with water and the wet-or-dry sandpaper periodically rinsed as well. Allow the primer to dry before spraying additional coats.

21 Spray on the top coat, again building up the thickness by using several thin layers of paint. Begin spraying in the center of the repair area and then, using a circular motion, work out until the whole repair area and about two inches of the surrounding original paint is covered. Remove all masking material 10 to 15 minutes after spraying on the final coat of paint. Allow the new paint at least two weeks to harden, then use a very fine rubbing compound to blend the edges of the new paint into the existing paint. Finally, apply a coat of wax.

6 Body repair - major damage

1 Major damage must be repaired by an auto body shop specifically equipped to perform body and frame repairs. These shops have the specialized equipment required to do the job properly.

2 If the damage is extensive, the body must be checked for proper alignment or the vehicle's handling characteristics may be adversely affected and other components may wear at an accelerated rate.

3 Due to the fact that all of the major body components (hood, fenders, etc.) are separate and replaceable units, any seriously damaged components should be replaced rather than repaired. Sometimes the components can be found in a wrecking yard that specializes in used vehicle components, often at considerable savings over the cost of new parts.

7 Hinges and locks - maintenance

Once every 3000 miles, or every three months, the hinges and latch assemblies on the doors, hood and trunk should be given a few drops of light oil or lock lubricant. The door latch strikers should also be lubricated with a thin coat of grease to reduce wear and ensure free movement. Lubricate the door and trunk locks with spray-on graphite lubricant.

8 Windshield and fixed glass - replacement

Replacement of the windshield and fixed glass requires the use of special fast-setting adhesive/caulk materials and some specialized tools and techniques. These operations should be left to a dealer service department or a shop specializing in glass work.

9 Hood - removal, installation and adjustment

Refer to illustrations 9.3a, 9.3b, 9.4, 9.11 and 9.12

Note: *The hood is heavy and somewhat awkward to remove and install - at least two people should perform this procedure.*

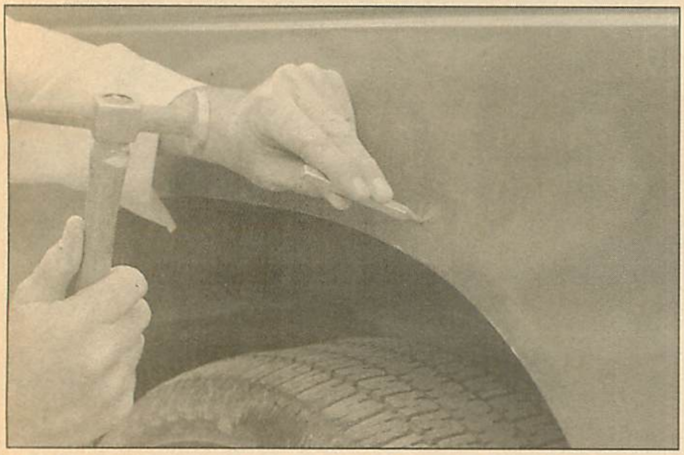
Removal and installation

1 Use blankets or pads to cover the cowl area of the body and the fenders. This will protect the body and paint as the hood is lifted off.

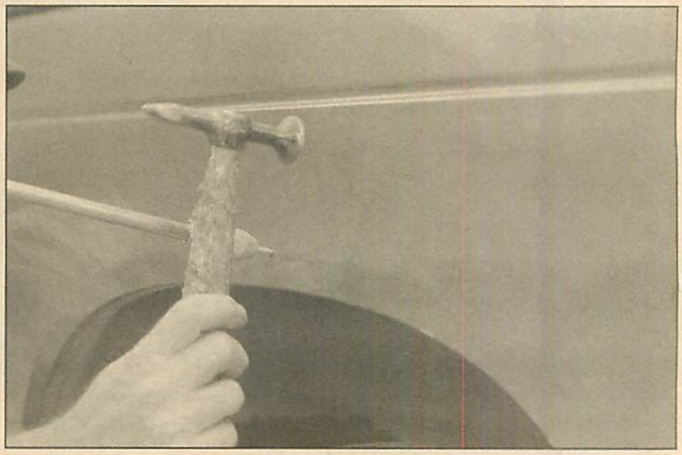
2 Scribe alignment marks around the hinge plates to insure proper alignment during installation (paint or a permanent-type felt-tip marker also will work for this).

3 Disconnect the hood release cable and wire harnesses which will interfere with removal **(see illustrations)**.

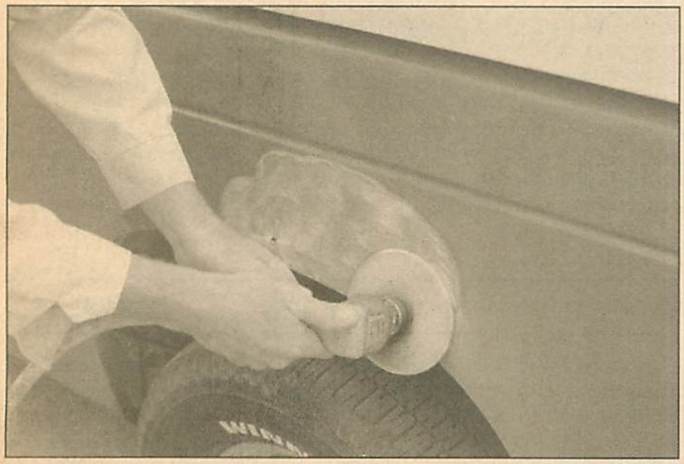
These photos illustrate a method of repairing simple dents. They are intended to supplement *Body repair - minor damage* in this Chapter and should not be used as the sole instructions for body repair on these vehicles.



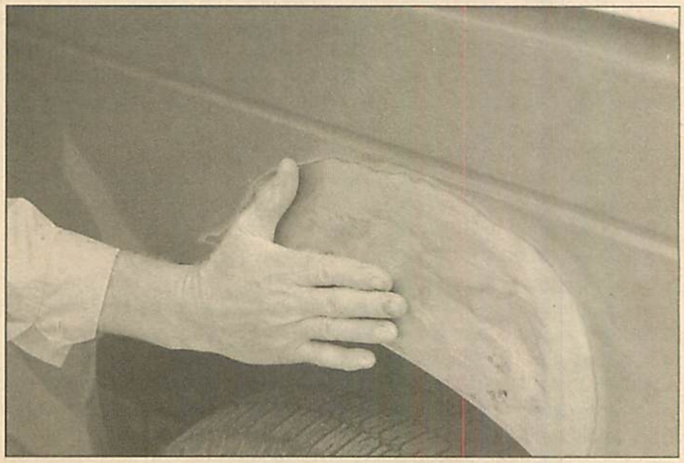
1 If you can't access the backside of the body panel to hammer out the dent, pull it out with a slide-hammer-type dent puller. In the deepest portion of the dent or along the crease line, drill or punch hole(s) at least one inch apart . . .



2 . . . then screw the slide-hammer into the hole and operate it. Tap with a hammer near the edge of the dent to help 'pop' the metal back to its original shape. When you're finished, the dent area should be close to its original contour and about 1/8-inch below the surface of the surrounding metal

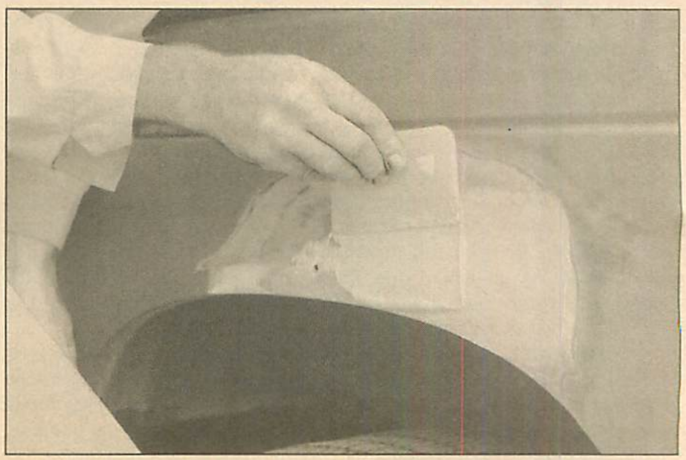


3 Using coarse-grit sandpaper, remove the paint down to the bare metal. Hand sanding works fine, but the disc sander shown here makes the job faster. Use finer (about 320-grit) sandpaper to feather-edge the paint at least one inch around the dent area



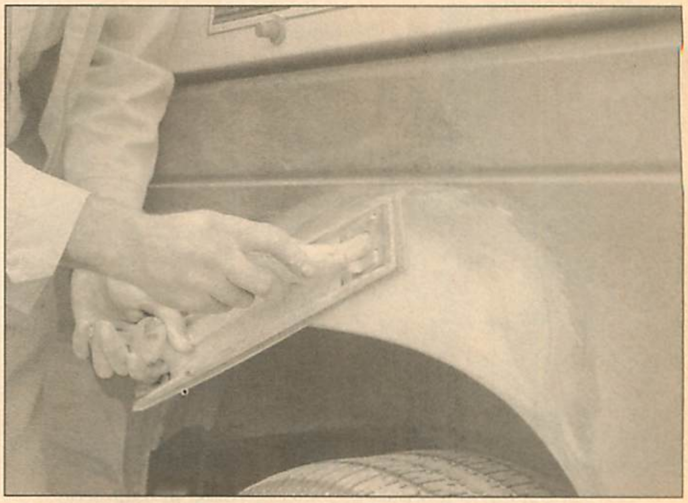
4 When the paint is removed, touch will probably be more helpful than sight for telling if the metal is straight. Hammer down the high spots or raise the low spots as necessary. Clean the repair area with wax/silicone remover

5 Following label instructions, mix up a batch of plastic filler and hardener. The ratio of filler to hardener is critical, and, if you mix it incorrectly, it will either not cure properly or cure too quickly (you won't have time to file and sand it into shape)

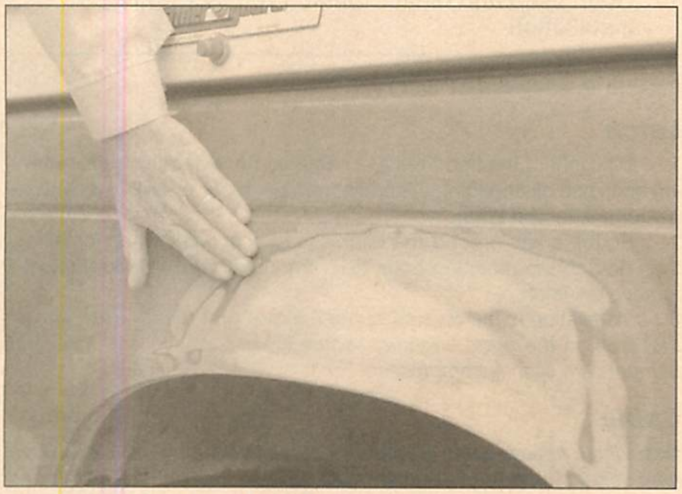


6 Working quickly so the filler doesn't harden, use a plastic applicator to press the body filler firmly into the metal, assuring it bonds completely. Work the filler until it matches the original contour and is slightly above the surrounding metal

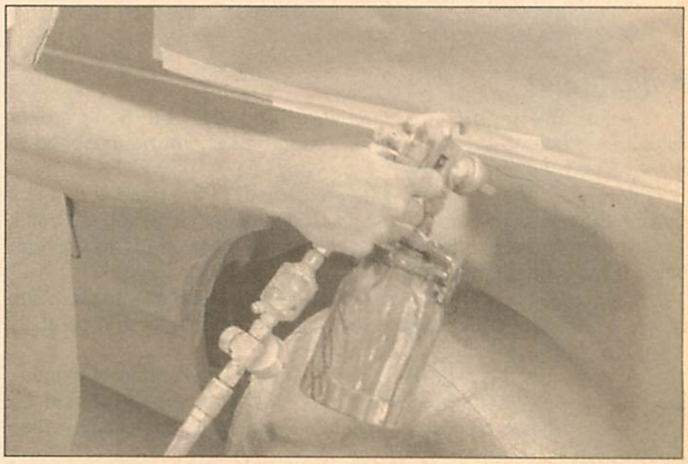
7 Let the filler harden until you can just dent it with your fingernail. Use a body file or Surform tool (shown here) to rough-shape the filler



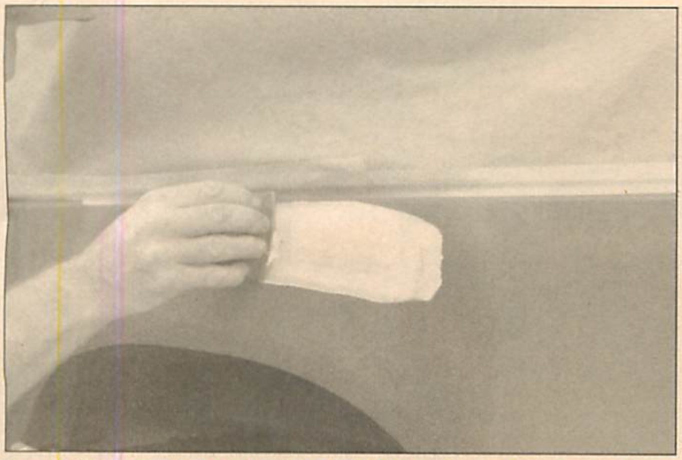
8 Use coarse-grit sandpaper and a sanding board or block to work the filler down until it's smooth and even. Work down to finer grits of sandpaper - always using a board or block - ending up with 360 or 400 grit



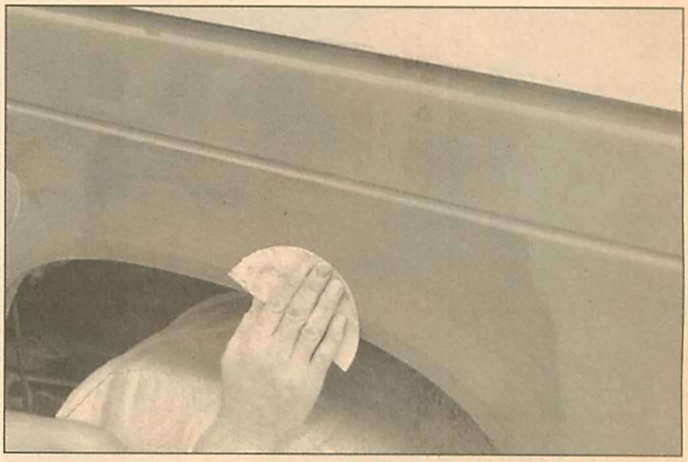
9 You shouldn't be able to feel any ridge at the transition from the filler to the bare metal or from the bare metal to the old paint. As soon as the repair is flat and uniform, remove the dust and mask off the adjacent panels or trim pieces



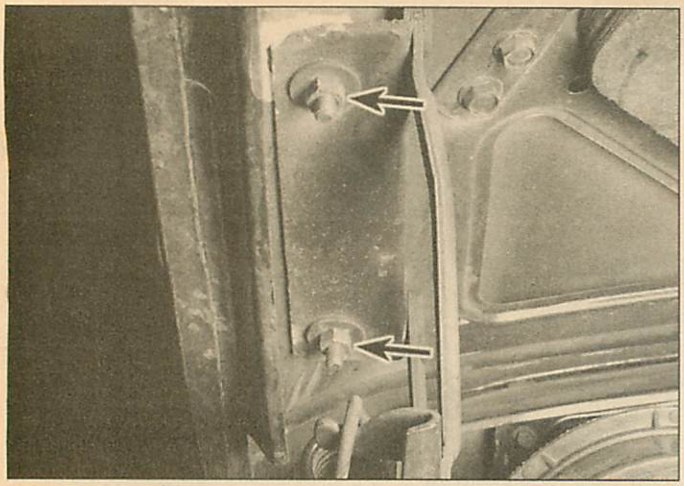
10 Apply several layers of primer to the area. Don't spray the primer on too heavy, so it sags or runs, and make sure each coat is dry before you spray on the next one. A professional-type spray gun is being used here, but aerosol spray primer is available inexpensively from auto parts stores



11 The primer will help reveal imperfections or scratches. Fill these with glazing compound. Follow the label instructions and sand it with 360 or 400-grit sandpaper until it's smooth. Repeat the glazing, sanding and respraying until the primer reveals a perfectly smooth surface



12 Finish sand the primer with very fine sandpaper (400 or 600-grit) to remove the primer overspray. Clean the area with water and allow it to dry. Use a tack rag to remove any dust, then apply the finish coat. Don't attempt to rub out or wax the repair area until the paint has dried completely (at least two weeks)

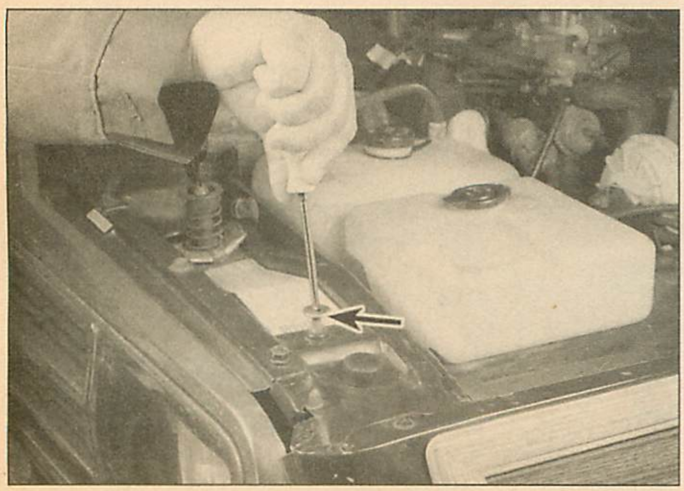


9.4 Detach the hinge-to-hood nuts (arrows) at each side of the hood

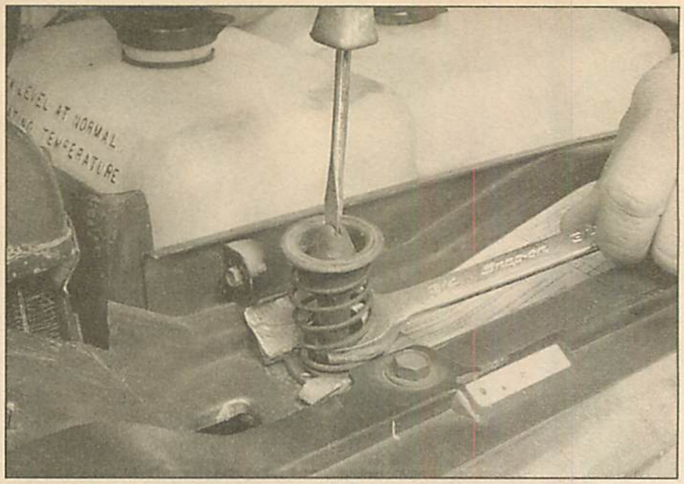
4 Have an assistant support the weight of the hood. Remove the hinge-to-hood nuts **(see illustration)**.
5 Lift off the hood.
6 Installation is the reverse of removal.

Adjustment

7 Before the hood can be adjusted properly, both hood striker assemblies located on the radiator support must first be loosened to allow correct alignment of the hood.
8 Fore-and-aft and side-to-side adjustment of the hood is done by moving the hood in relation to the hinge plate after loosening the bolts.
9 Scribe or trace a line around the entire hinge plate so you can judge the amount of movement.
10 Loosen the nuts and move the hood into correct alignment. Move it only a little at a time. Tighten the hinge bolts or nuts and carefully lower the hood to check the alignment.
11 After the hood is aligned properly with the cowl and front fenders, the height and position of the hood striker assembly should be adjusted to provide positive engagement with the latch assembly **(see illustration)**.
12 Adjust the hood bumpers on the radiator support so the hood is flush with the fenders when closed **(see illustration)**.
13 The hood latch assembly, as well as the hinges, should be periodically lubricated with white lithium-base grease to prevent sticking and wear.



9.12 Adjust the hood bumpers in-or-out to make the hood flush with the fenders



9.11 Adjust the position of the hood striker by loosening the lock nut at the bottom, then adjust the height of the hood striker by turning it in or out with a screwdriver

10 Hood latch and release cable - removal and installation

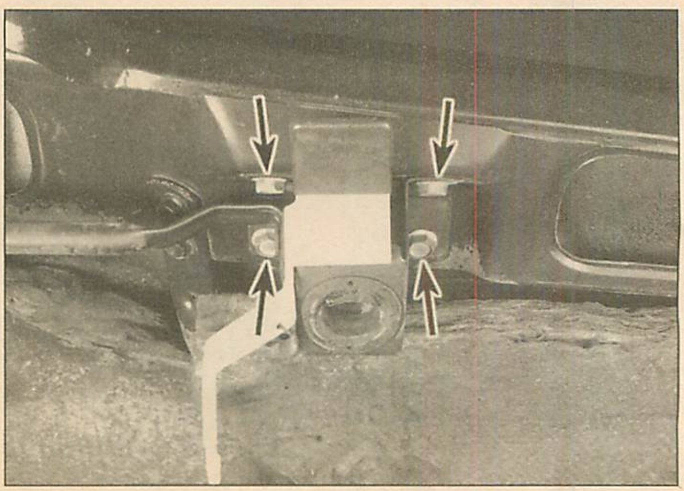
Refer to illustrations 10.2 and 10.6

Latch

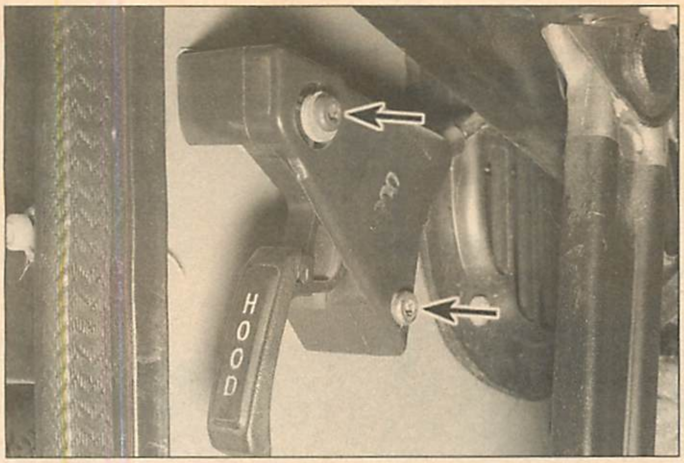
1 Disconnect the hood release cable by removing the cable retaining bolts and disengaging the cable from the latch assembly **(see illustrations 9.3a and 9.3b)**.
2 Scribe a line around the latch to aid alignment when installing, then detach the retaining bolts from the hood **(see illustration)** and remove the latch.
3 Installation is the reverse of the removal procedure. **Note:** *Adjust the latch so the hood engages securely when closed and the hood bumpers are slightly compressed.*

Cable

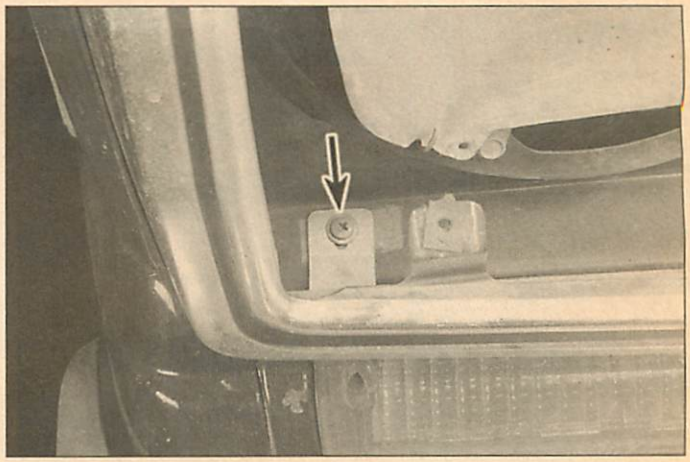
Note: *If the release cable is inoperative, the hood latch can be released manually by inserting a screwdriver through the grille opening and pushing the latch lever towards the rear of the vehicle.*
4 Disconnect the hood release cable as described in Step 1.
5 Attach a piece of thin wire or string to the end of the cable and unclip all remaining cable retaining clips.



10.2 Remove the hood latch bolts (arrows) on each side of the hood



10.6 Detach the hood release lever mounting screws (arrows), then pull the cable into the passenger compartment



11.5a Remove the grille retaining screws (arrow) located behind the headlight bezels

6 Working in the passenger compartment, remove two release lever mounting screws and detach hood release lever **(see illustration)**.

7 Pull the cable and grommet rearward into the passenger compartment until you can see the wire or string. Ensure that the new cable has a grommet attached then remove the old cable from the wire or string and replace it with the new cable.

8 Working from engine compartment, pull the wire or string back through the firewall.

9 Installation is the reverse of the removal procedure. **Note:** *Push on the grommet with your fingers from the passenger compartment side to seat the grommet in the firewall.*

11 Radiator grille - removal and installation

Refer to illustrations 11.5a, 11.5b, 11.5c, 11.6 and 11.9

1 Detach the screws securing the headlight bezels (see Chapter 12).

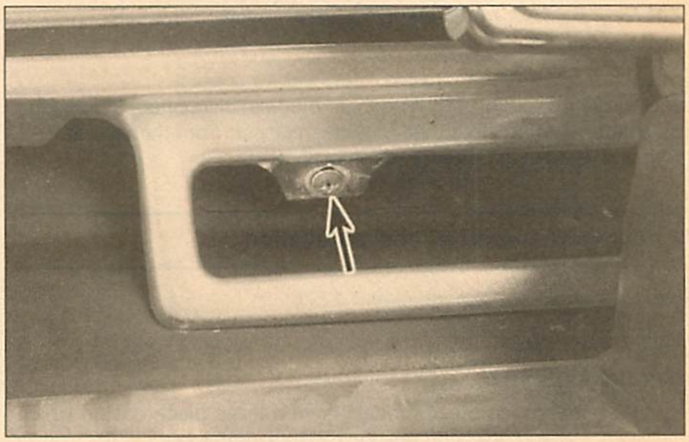
2 On 1972 through 1978 models detach the headlight retaining ring, then disconnect the electrical connectors from the backside of the headlamp and remove headlights from the vehicle.

3 On 1972 and 1973 Wagoneer models, remove the side marker lights.

4 On 1974 through 1978 Wagoneer models remove the front parking light assemblies.

5 Remove the screws securing the lower half of the radiator grille **(see illustrations)**.

6 Unscrew the bolts securing the upper half of the radiator grille



11.5b Remove the retaining screws (arrow) located in the lower grille opening

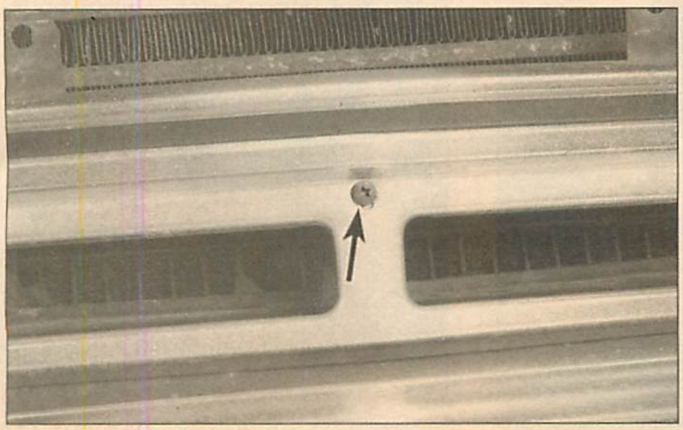
and remove the grille from the vehicle **(see illustration)**.

7 Installation is the reverse of removal.

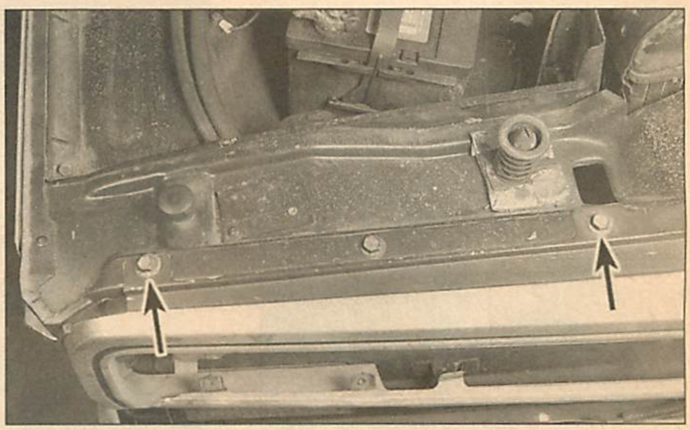
Grille insert

8 Some models have an insert in the center of the grille which can be removed without detaching the entire grille assembly.

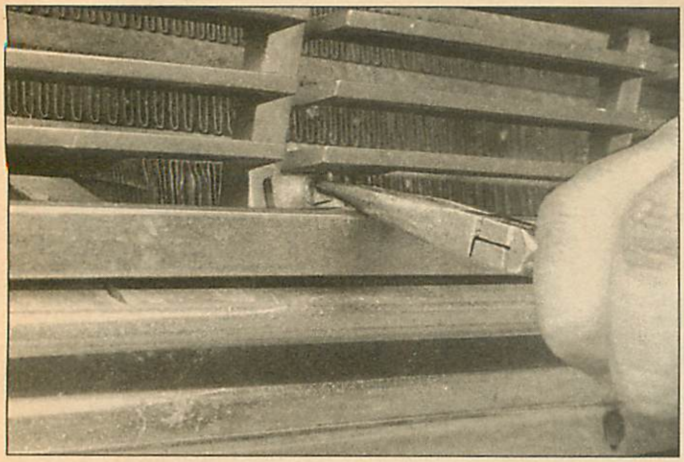
9 To detach the grille insert remove the plastic fasteners from the upper and lower edges and detach the insert from the grille **(see illus-**



11.5c Remove the retaining screw (arrow) located in the center of the grille



11.6 Detach the remaining bolts securing the upper edge of the grille to the radiator support



11.9 On later models the grille insert can be removed by pulling out the center pin from the plastic fastener - on early models the center pin must be driven out with an small punch to allow the grille insert to be removed

tration).
10 On 1974 through 1978 Wagoneer models, disconnect the parking light electrical connectors then remove the insert from the vehicle.
11 Installation is the reverse of removal.

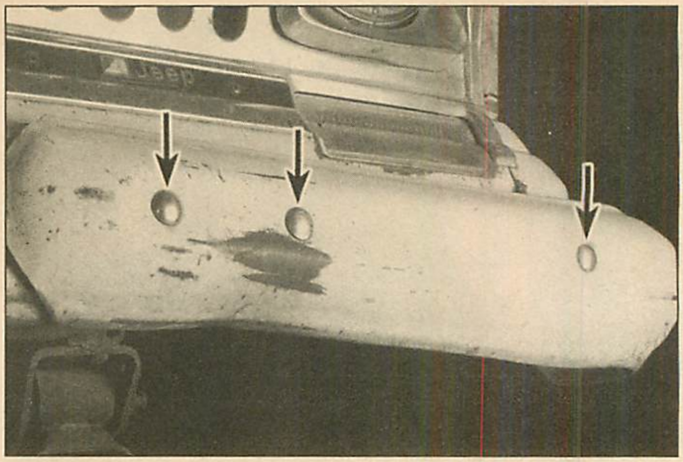
12 Bumpers - removal and installation

Refer to illustrations 12.2, 12.7a and 12.7b

Front and rear

1972 through 1978

1 The bumpers on these models have a three piece design which consists of left and right end rails bolted to a center rail.
2 Working from the backside of the bumper, remove the nuts and washers securing the left and right end rails to the center rail **(see illustration)**. Then remove the end rails from the vehicle.
3 Detach the nuts and bolts securing the center rail to the bumper frame brackets, then remove the center rail from the vehicle.
4 On J-series pick-ups with one-piece rear bumpers, remove the retaining bolts securing the bumper bracket to the outside of each frame rail. Then disconnect any electrical connections and remove bumper from the vehicle.
5 Installation is the reverse of removal.



12.2 Detach the bolts securing the left and right end rails to the center rail

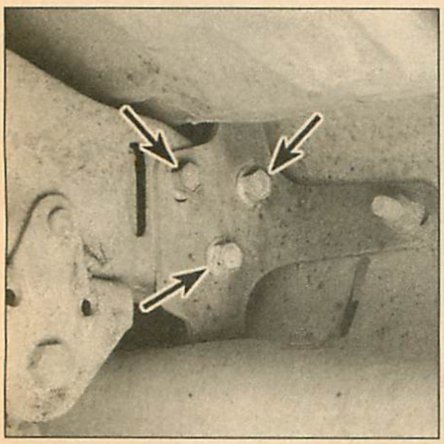
1979 on

6 The bumpers on these models are a one-piece design with horizontal and vertical bumper guards attached to the outside.
7 Working from the backside of the bumper, remove the retaining bolts securing the bumper bracket to the outside of each frame rail **(see illustrations)**. Then disconnect any electrical connections and remove the bumper from the vehicle.
8 Remove the nuts or bolts securing the bumper brackets and bumper guards to the bumper.
9 Installation is the reverse of removal.

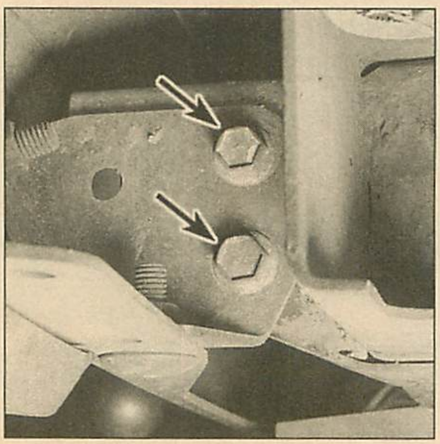
13 Front fender - removal and installation

Refer to illustrations 13.5a, 13.5b, 13.5c, 13.5d and 13.5e

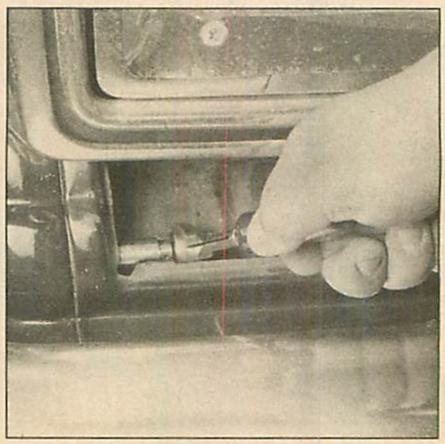
1 Loosen the front wheel lug nuts, raise the vehicle and support it securely on jackstands. Remove the wheel.
2 Remove the front bumper (see Section 12).
3 Remove the side marker and turn signal lights (see Chapter 12).
4 Disconnect the antenna and all light bulb electrical connectors and other components that would interfere with fender removal.
5 Remove the fender mounting bolts and nuts **(see illustrations)**.
6 Detach the fender. It's a good idea to have an assistant support the fender while it's being moved away from the vehicle to prevent damage to the surrounding body panels.
7 Installation is the reverse of removal.



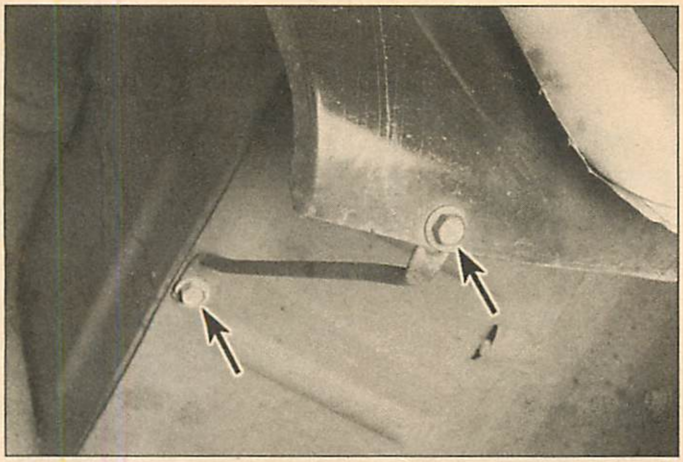
12.7a Remove the front bumper bracket-to-frame rail bolts (arrows)



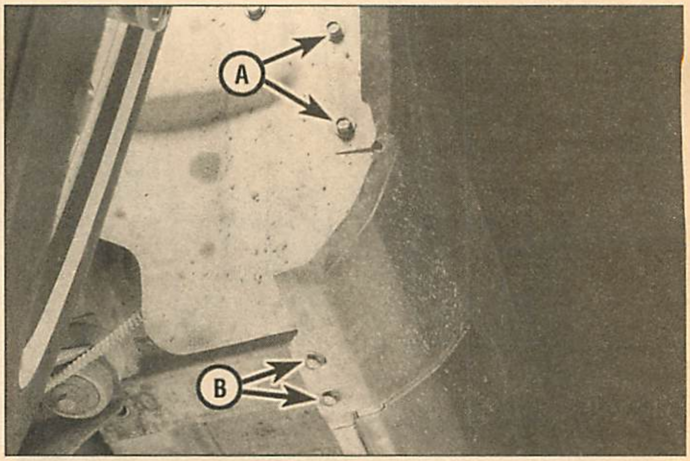
12.7b Remove the rear bumper bracket-to-frame rail bolts (arrows)



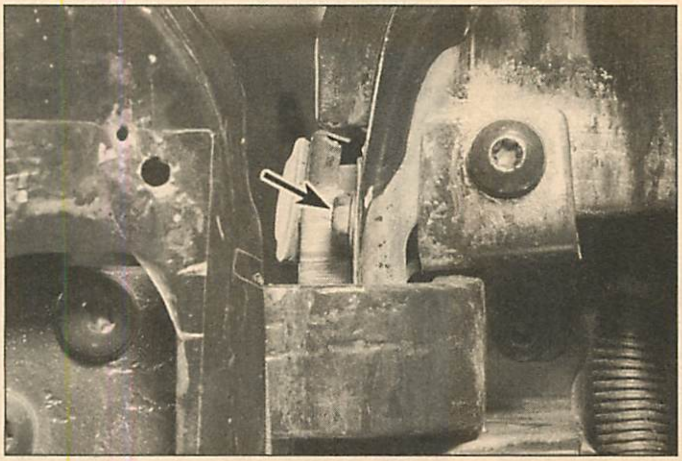
13.5a Remove the fender retaining bolt located behind the front turn signal light



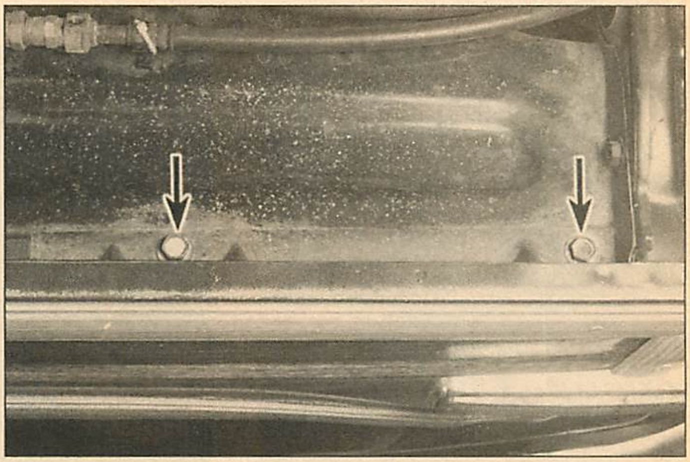
13.5b Remove the lower fender brace retaining bolts (arrows)



13.5c Remove the fender-to-inner fenderwell bolts (A), then detach the fender-to-rocker panel bolts (B)



13.5d Open the door and remove the fender to door pillar bolts (arrows)



13.5e Remove the remaining bolts along the top of the fender (arrows)

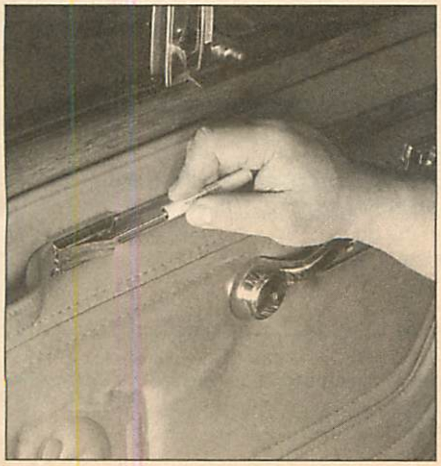
14 Door trim panel - removal and installation

Refer to illustrations 14.2a, 14.2b, 14.2c, 14.2d, 14.3, 14.4 and 14.5

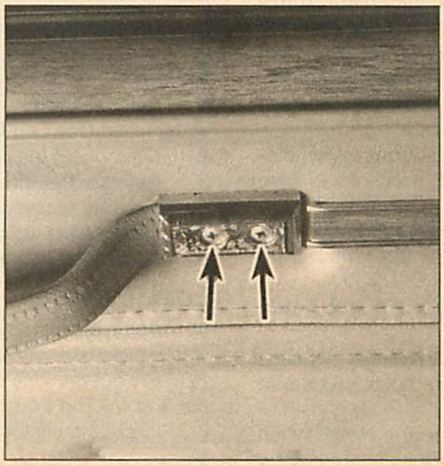
1 Disconnect the negative cable from the battery.

2 Remove the door pull/armrest assemblies **(see illustrations)**.

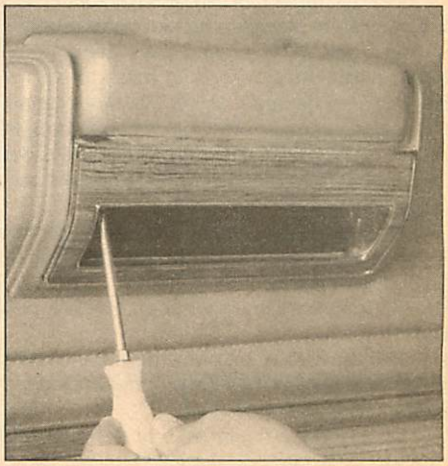
3 Remove the screws securing the inside door handle and the window crank on vehicles equipped with manually operated windows. On vehicles equipped with electrically operated windows, remove the



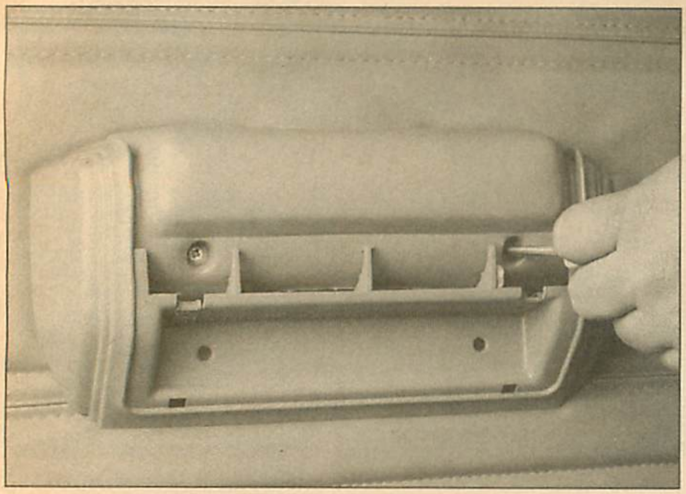
14.2a Carefully peel back the wood trim covering the door pull handle retaining screws



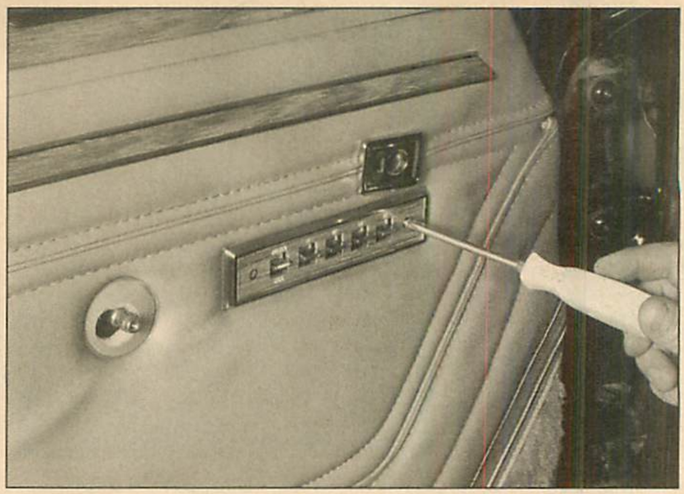
14.2b Remove the screws securing the door pull assembly



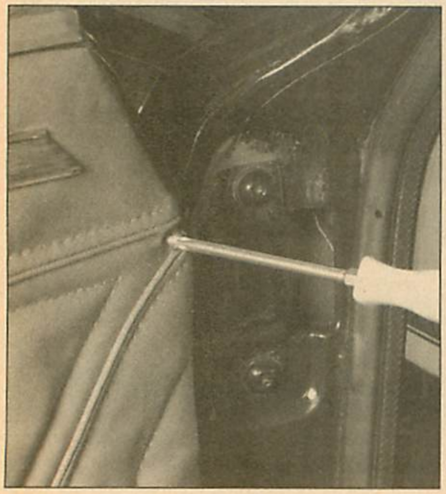
14.2c Remove the trim cover from the door armrest assembly



14.2d Remove the screws securing the armrest assembly

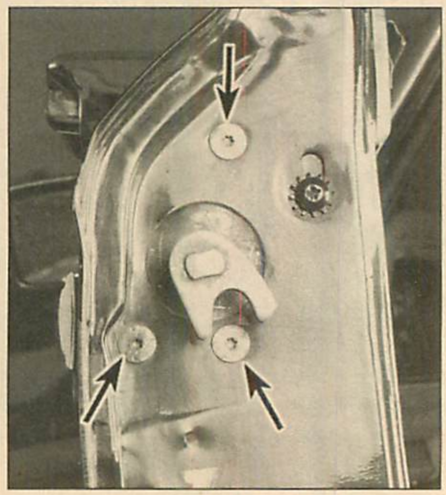


14.3 Remove the switch plate on vehicles with electrically operated windows



14.4 Remove the retaining screws along the outer edge of the door trim panel

14.5 Pry out the remaining door panel retaining clips



15.3 Remove the three door latch retaining bolts

screws securing the switch plate to the door **(see illustration)**.

4 Remove the retaining screws along the outside edge of the door trim panel **(see illustration)**.

5 Insert a trim panel clip removal tool (available at auto parts stores) or a putty knife between the trim panel and the door and disengage the retaining clips. Work around the outer edge until the panel is free **(see illustration)**. **Note:** *Door trim panel retaining clips are approximately five to six inches apart. Pry at the clip location only. Prying in between clips will result in distorted or damaged door trim panels.*

6 Once all of the clips are disengaged, detach the trim panel, disconnect any wire harness connectors and remove the trim panel from the vehicle.

7 On vehicles equipped with electric remote control mirrors, loosen the set screw securing the mirror switch and detach the switch from the door trim panel.

8 For access to the inner door, carefully peel back the plastic watershield.

9 Prior to installation of the door panel, be sure to reinstall any clips in the panel which may have come out during the removal procedure and remain in the door itself.

10 Installation is the reverse of the removal procedure. **Note:** *When installing door trim panel retaining clips, make sure the clips are lined up with their mating holes first, then gently tap the clips in with the palm of your hand.*

15 Door latch, lock cylinder and handles - removal and installation

Refer to illustrations 15.3, 15.7a, 15.7b, 15.10 and 15.13

Latch

1 Raise the window completely and remove the door trim panel and watershield (see Section 14).

2 Disconnect the link rods from the latch.

3 Remove the three latch mounting bolts **(see illustration)**. It may be necessary to use an impact-driver to loosen them.

4 Remove the latch from the door.

5 Installation is the reverse of removal.

Lock cylinder

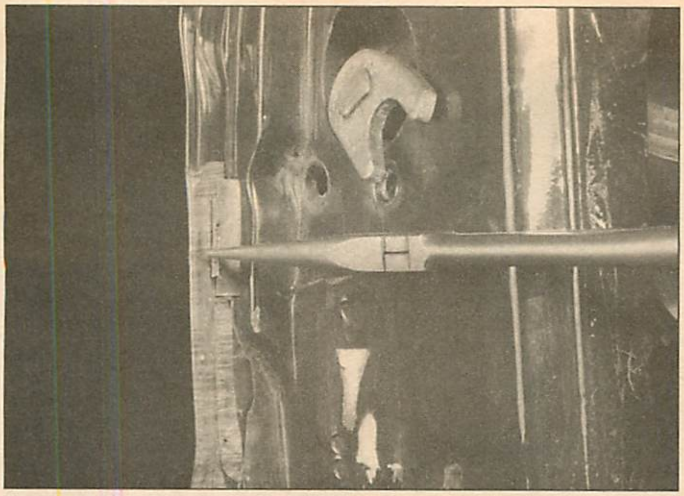
6 Raise the window completely and remove the door trim panel and watershield (see Section 14).

7 Pry out the lock cylinder retaining clip, then remove the lock cylinder and link rod from the outside of the door **(see illustrations)**.

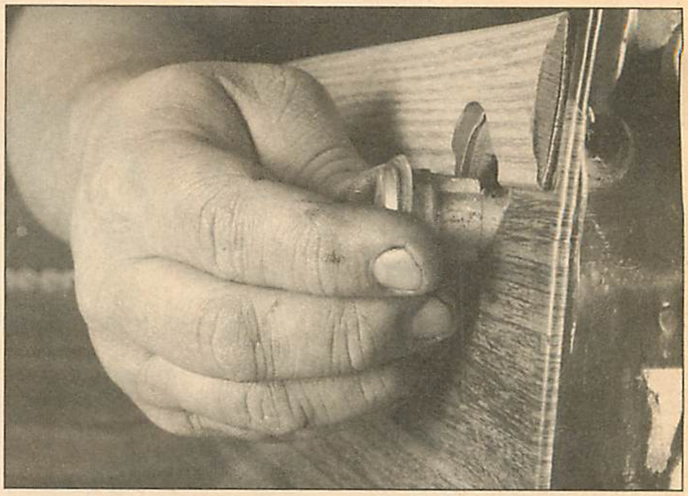
8 Installation is the reverse of removal.

Outside handle

9 Raise the window completely and remove the door trim panel and watershield (see Section 14).



15.7a Pry out the door lock cylinder retaining clip

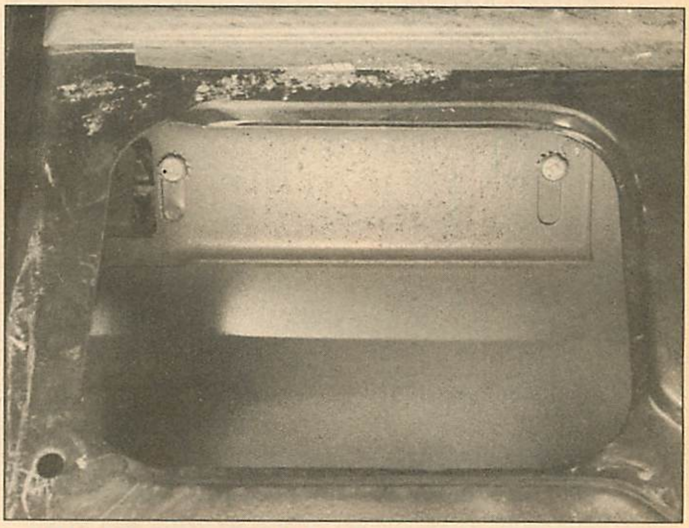


15.7b Remove the door lock cylinder and link rod from the outside of the door

10 Working through the access hole, remove the door handle retaining bolts **(see illustration)**. Detach the handle and gaskets from the outside of the door.
11 Installation is the reverse of removal.

Inside handle

12 Raise the window completely and remove the door trim panel and watershield (see Section 14).
13 Remove the bolts securing the inside handle assembly to the door **(see illustration)**. Lower the handle assembly in the door and remove the link rod from the backside.
14 Installation is the reverse of removal.

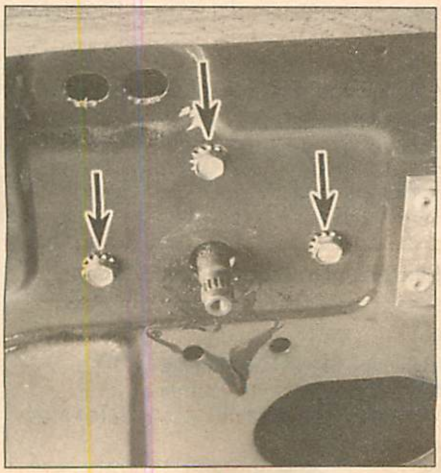


15.10 Remove the outside handle retaining bolts through the access hole in the door

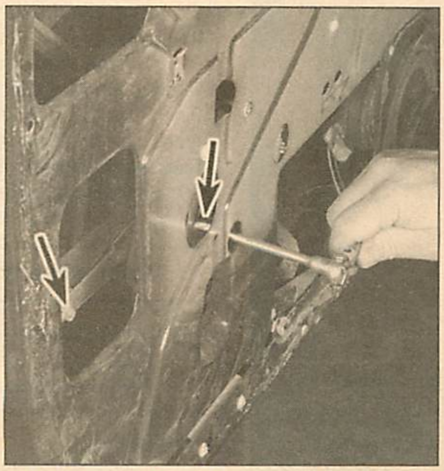
16 Door window glass - removal and installation

Refer to illustrations 16.2, 16.5a, 16.5b, 16.6, 16.7, 16.8 and 16.9

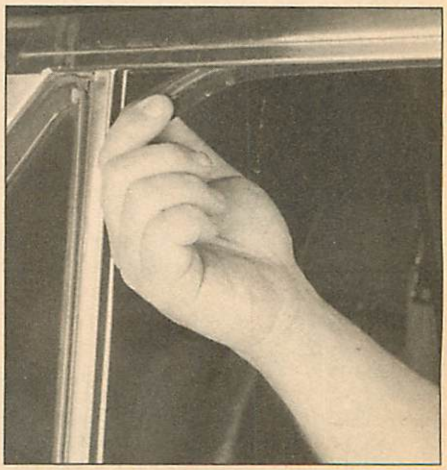
1 Remove the door trim panel and watershield (see Section 14).
2 Lower the glass until the lower glass channel retaining bolts are visible **(see illustration)**. Working through the access holes, remove the retaining bolts.
3 Remove the glass stop bracket and door lock rod assembly.
4 Lower the window glass to the bottom of the door.
5 Remove the door weatherstripping **(see illustrations)**.



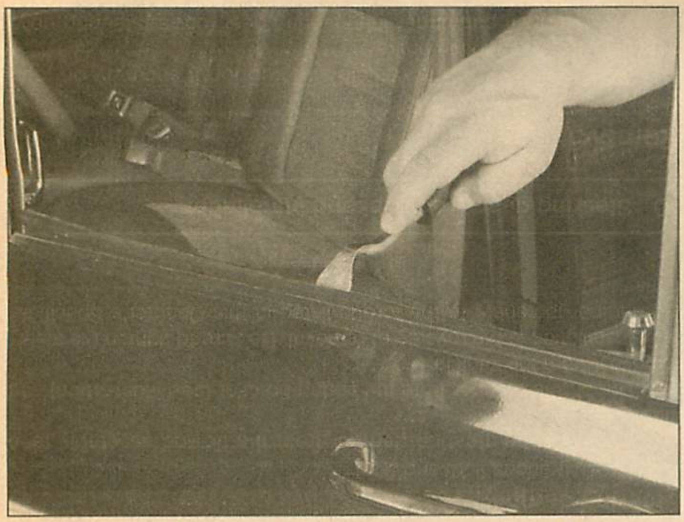
15.13 Remove the bolts securing the inside handle assembly



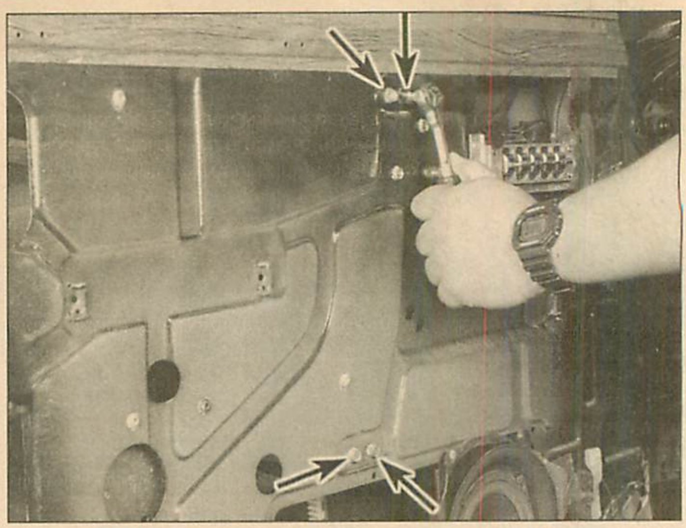
16.2 Lower the glass enough to access the lower channel-to-glass retaining bolts (arrows)



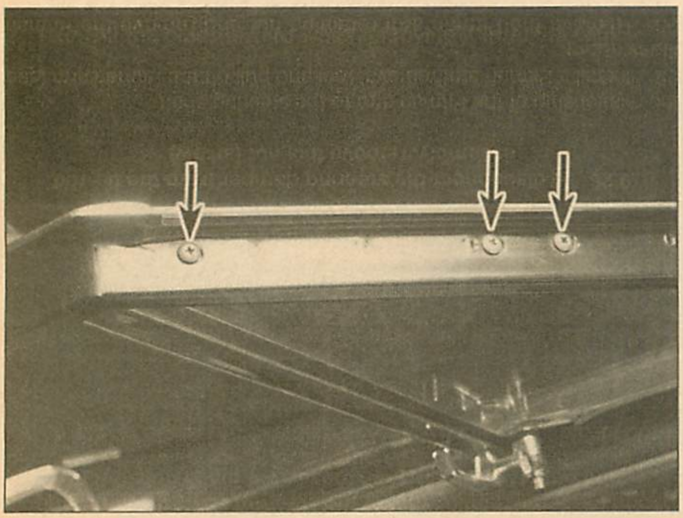
16.5a Peel back the weatherstripping along the upper edge of the window channel



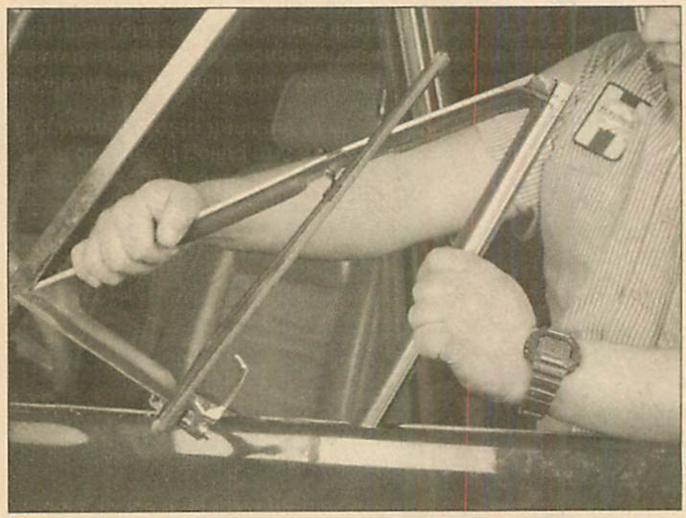
16.5b Using a trim removal tool or a putty knife, carefully pry out the door weatherstripping



16.6 Remove the retaining bolts securing the vent window channel



16.7 Remove the screws on the outer edge of the door which secure the vent window



16.8 Tilt the vent window towards the center of the door, then pull up and out to remove it from the vehicle

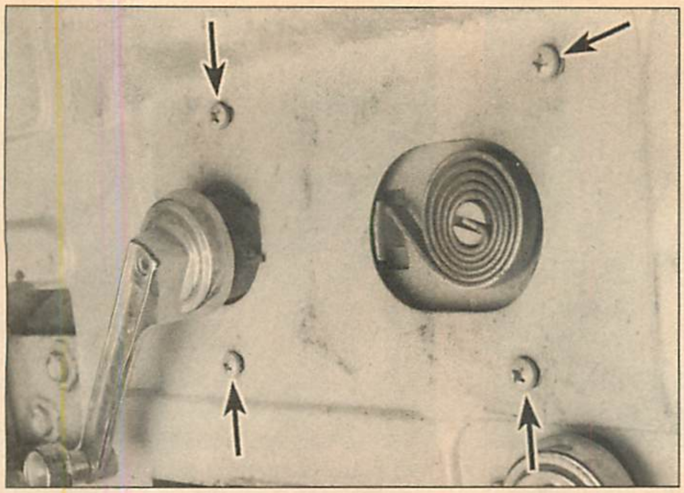
16.9 Tilt the glass inward while removing it from the vehicle

6 Detach the retaining bolts from the window channel located between the vent glass and the window glass **(see illustration)**.
7 Remove the remaining screws securing the vent window **(see illustration)**.
8 Tilt the vent window back towards the center of the door and remove the vent window from the door assembly **(see illustration)**.
9 After the vent window has been removed from the door, the door glass can be lifted up and out of the door through the glass opening **(see illustration)**.
10 Installation is the reverse of removal.

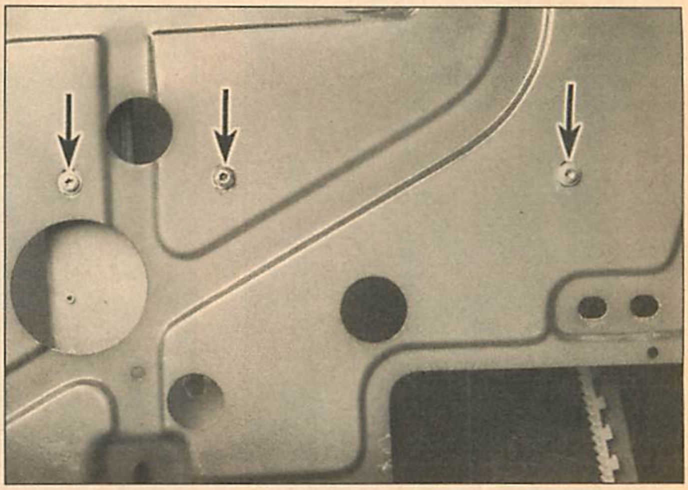
17 Door window regulator - removal and installation

Refer to illustrations 17.3a, 17.3b and 17.3c

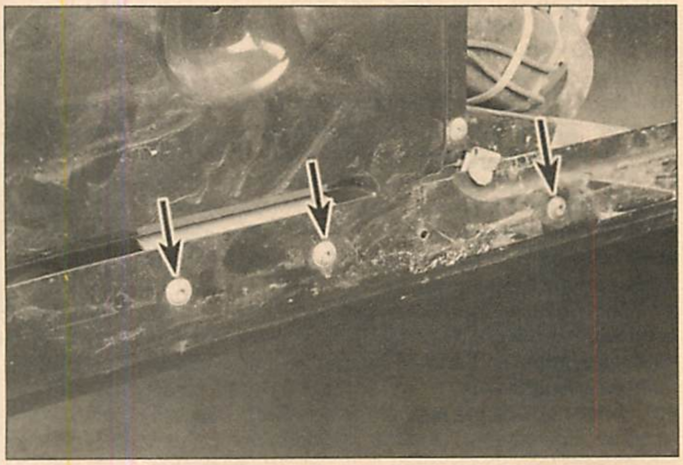
1 Remove the door trim panel and watershield (see Section 14).
2 Remove the door window glass (see Section 16).
3 Remove the window regulator-to-door attaching screws **(see illustrations)**.
4 Remove the regulator from the door through the lower access hole.
5 On models with sector-gear type regulators, if the motor or regulator requires replacement, it is necessary to lock the sector gear to the



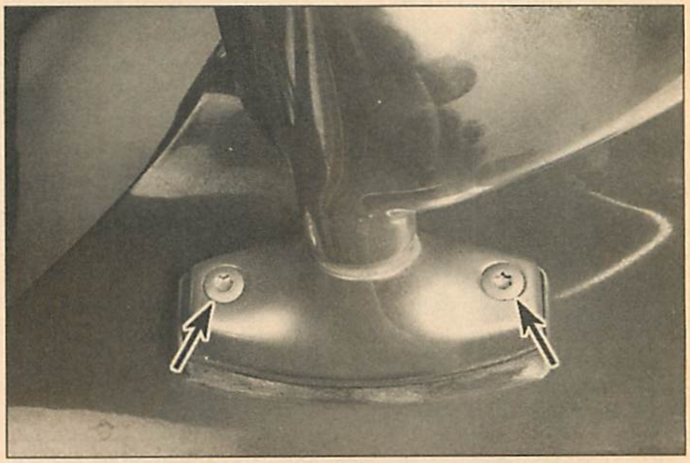
17.3a On manually operated windows, use a Phillips screwdriver to remove these retaining screws (arrows)



17.3b On electrically operated windows, remove the upper retaining screws (arrows) . . .



17.3c . . . then remove the window regulator lower retaining screws (arrows)



18.5 The door mirror is retained with two screws

regulator backplate. This can be done by fastening the sector gear to the backplate with a bolt and nut inserted through one of the holes in the backplate and sector gear. If none of the holes line up, drill a hole through the backplate and sector gear. **Warning:** *The regulator arms are under pressure and can cause serious injury if the motor is removed without locking the sector gear.* The motor and regulator can now safely be separated.

6 Installation is the reverse of removal.

18 Rear view mirrors - removal and installation

Refer to illustration 18.5

Interior mirror

1 Remove the set screw, then slide the mirror up and off the button on the windshield.

2 Installation is the reverse of removal.

Exterior mirror

3 On vehicles with manually operated mirrors, the mirrors can be detached by removing the screws from the outside of the vehicle.

4 On vehicles with electrically operated mirrors remove the door trim panel and watershield (see Section 14). Disconnect the electrical connector.

5 Remove the mirror retaining screws and detach the mirror from the door **(see illustration)**.

6 Installation is the reverse of removal.

19 Door - removal, installation and adjustment

Note: *The door is heavy and somewhat awkward to remove and install - at least two people should perform this procedure.*

Removal and installation

Refer to illustrations 19.7a and 19.7b

1 Lower the window completely in the door and then disconnect the negative cable from the battery.

2 Open the door all the way and support it on jacks or blocks covered with rags to prevent damaging the paint.

3 Remove the door trim panel and water deflector as described in Section 14.

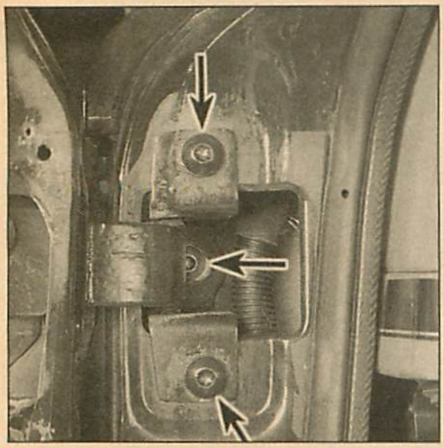
4 Unplug all electrical connections, ground wires and harness retaining clips from the door. **Note:** *It is a good idea to label all connections to aid the reassembly process.*

5 From the door side, detach the plastic conduit (if equipped) between the body and the door. Then pull the wiring harness through the conduit hole and remove it from the door.

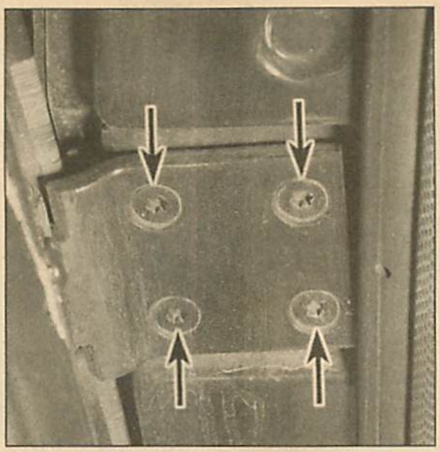
6 Mark around the door hinges with a pen or a scribe to facilitate realignment during reassembly.

7 Have an assistant hold the door, remove the hinge bolts **(see**

11

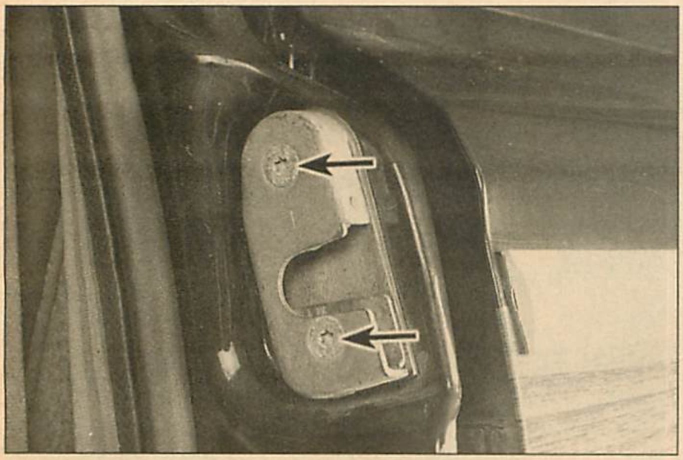


19.7a To detach the front door, remove the hinge bolts (arrow) then lift the door off



19.7b On vehicles with rear doors, detach the hinge bolts from the center pillar

19.11 Add or subtract shim plates (arrow) so the striker has the proper depth to engage the latch correctly



19.12 Loosen the striker retaining bolts and adjust as necessary to provide positive latch engagement

illustrations) and lift the door off.

8 Installation is the reverse of removal.

Adjustment

Refer to illustrations 19.11 and 19.12

9 Having proper door-to-body alignment is a critical part of a well functioning door. First check the door hinge pins and bushings for excessive play. **Note:** *If the door can be lifted 1/16-inch or more without the car body lifting with it, the hinge pins and bushings should be replaced.*

10 Door to body alignment adjustments are made by loosening the hinge-to-body or hinge to door bolts and moving the door. Proper body alignment is achieved when the top of door is aligned with the top of front fender and rear quarter panel and the bottom of the door is aligned with the lower rocker panel. If these goals can't be reached by adjusting the hinge-to-body or hinge-to-door bolts, body alignment shims may have to be purchased and inserted behind the hinges to achieve correct alignment.

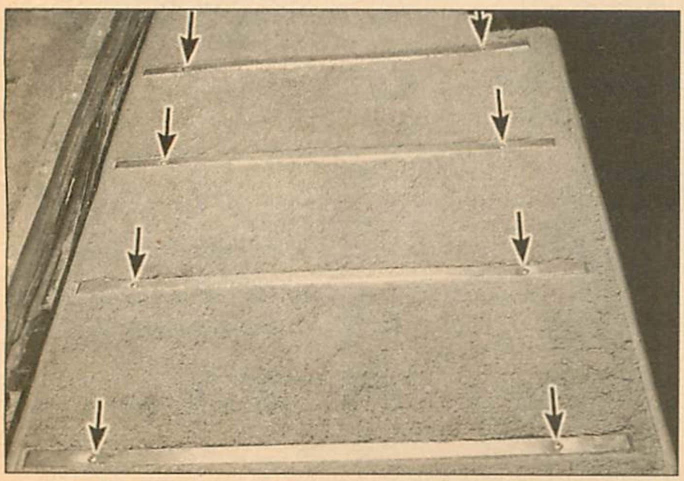
11 To adjust the door closed position, first check that the door latch is contacting the center of the latch striker assembly. If not, remove striker assembly and add or subtract shims to achieve correct alignment **(see illustration)**.

12 Finally adjust the latch striker assembly as necessary (up and down or sideways) to provide positive engagement with the latch mechanism **(see illustration)** and align the door panel flush with the rear door or quarter panel.

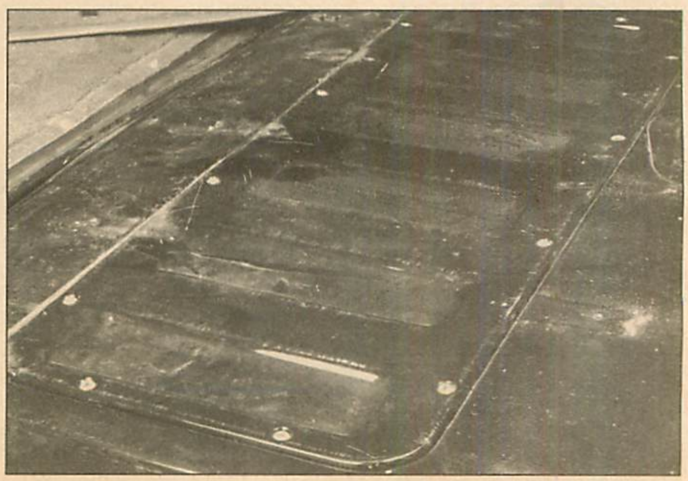
20 Tailgate latch, handle and lock cylinder - removal and installation

Refer to illustrations 20.1, 20.2, 20.4, 20.7, 20.10 and 20.11

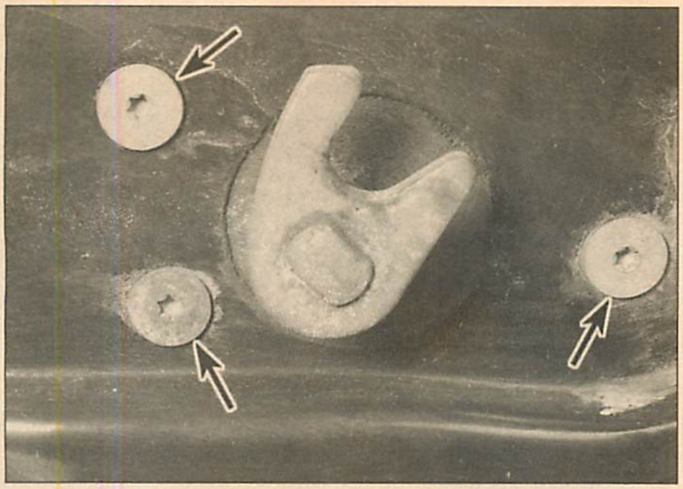
1 Lower the tailgate and remove the tailgate trim panel retaining



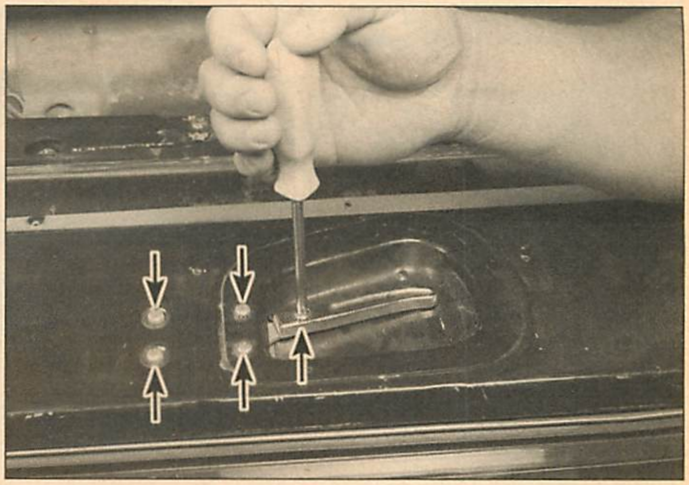
20.1 Remove the tailgate trim panel screws (arrows)



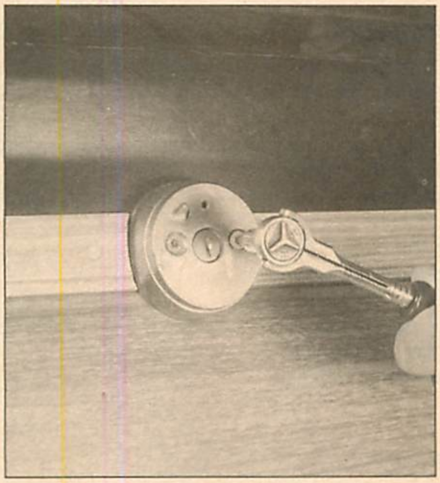
20.2 Remove the cover to access the inside of the tailgate



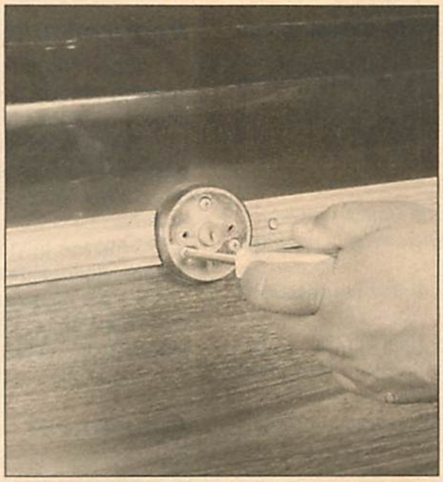
20.4 Remove the tailgate latch retaining screws



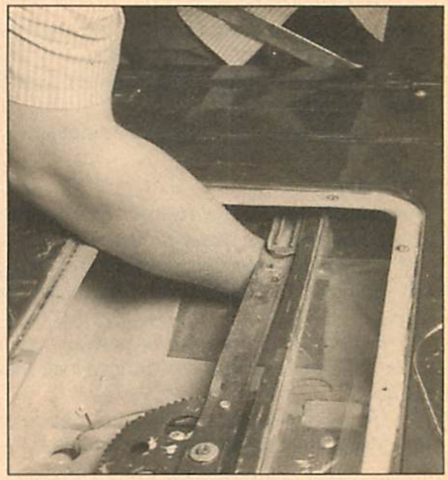
20.7 Remove the screws (arrows) securing the handle to the tailgate



20.10 Remove the lock cylinder retaining plate screws



20.11 Remove the screws, then pull outward to remove the lock assembly



21.4 Raise the window enough to access the window-to-regulator bolts

screws if equipped **(see illustration)**.
2 Remove the tailgate access cover **(see illustration)**.

Latch

3 Move the tailgate glass to the full-up position. **Note:** *The glass must be supported to relieve stress on the lower edge which is encountered when the window is in this position.* Vehicles with power windows must first activate the safety switch located on the left side of the tailgate to achieve this window position.
4 Remove the three latch mounting bolts **(see illustration)**. It may be necessary to use an impact-driver to loosen them.
5 Disconnect the control rods from the latch and remove the latch from the door.
6 Installation is the reverse of removal.

Handle

7 Remove the retaining screws **(see illustration)**.
8 Disconnect the control rod and remove the handle from the door.
9 Installation is the reverse of removal.

Lock cylinder

10 Remove the screws from the lock plate **(see illustration)**.
11 Remove the screws securing the lock to the door **(see illustration)**.
12 Pull the lock cylinder out and remove from the door.
13 Installation is the reverse of removal.

21 Tailgate glass, window regulator and motor - removal and installation

Refer to illustrations 21.4, 21.8 and 21.13

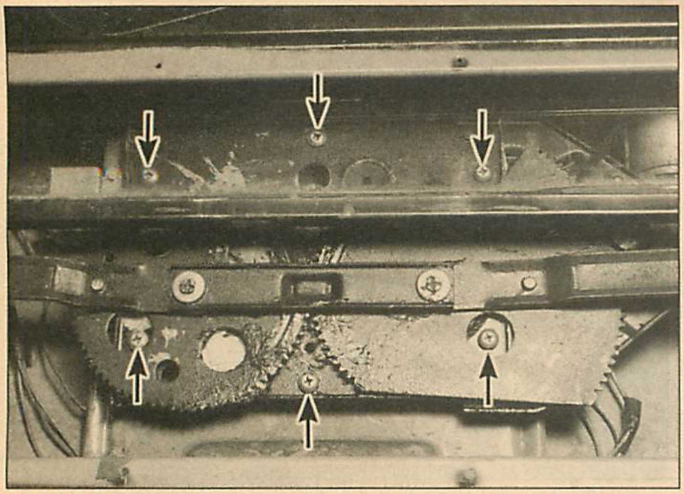
1 Lower the tailgate and remove the tailgate trim panel retaining screws if equipped (see Section 20).
2 Remove the tailgate access cover (see Section 20).

Glass

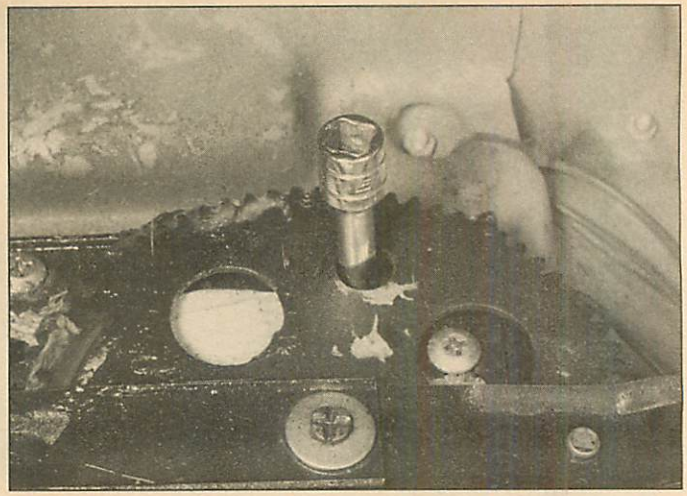
3 Raise the tailgate glass enough to access the regulator arms.
4 Remove the bolts securing the window glass to the regulator arms **(see illustration)**.
5 Disconnect rear defogger connector (if equipped) and pull the glass out of the tailgate.
6 Installation is the reverse of removal.

Regulator

7 Remove the tailgate glass as described above.
8 Move the regulator assembly up or down to access the retaining



21.8 To access the regulator mounting screws, the regulator must be placed in the half-way up position



21.13 To remove the regulator motor, the sector gears must be locked in place or serious injury could occur

screws through the large holes in the regulator gears **(see illustration)**.
9 Unplug all electrical connectors.
10 Remove the regulator and motor assembly (if equipped) through the access hole.
11 Installation is the reverse of removal.

Motor

Warning: *On gear-driven sector-type electrically operated regulators, the control arms are under pressure and can cause serious injury if the motor is removed without locking the sector gear.*
12 Remove the regulator and motor as one assembly as described above.
13 Insert a pin or screwdriver between the sector gears of the regulator and the frame of the regulator to lock the gears in place **(see illustration)**.
14 Detach the motor retaining bolts and remove the regulator motor.
15 Installation is the reverse of removal.

22 Tailgate - removal, installation and adjustment

Note: *The tailgate is heavy and somewhat awkward to remove and install - at least two people should perform this procedure.*

Removal and installation

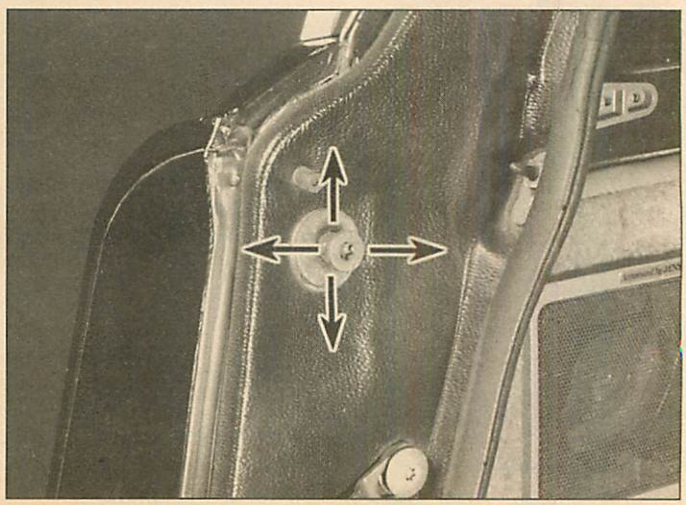
1 Open the tailgate and cover the upper body area around the opening with pads or cloths to protect the painted surfaces when the liftgate is removed.
2 Remove the trim panel, disconnect all electrical connectors and pull the wiring harness out of the tailgate.
3 Close the tailgate and drive out the hinge pins with a punch and a hammer.
4 With the tailgate in the closed position, remove the torque rods (tailgate springs) from underneath the vehicle.
5 Lower the tailgate.
6 While an assistant supports the tailgate, detach the support arms and remove the tailgate from the vehicle.
7 Installation is the reverse of removal.

Adjustment

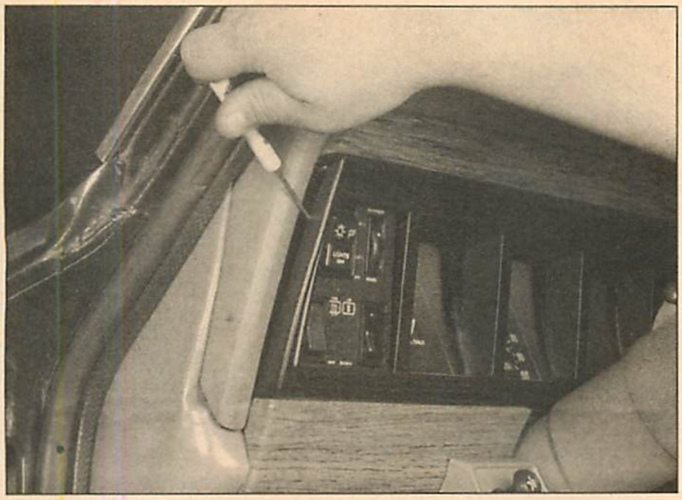
Refer to illustrations 22.8 and 22.10

8 Tailgate adjustments are made by loosening the hinge-to-body or hinge-to-tailgate bolts and moving the tailgate **(see illustration)**. Proper alignment is achieved when the top of the tailgate is aligned with the top of the rear quarter panel. If these goals can't be reached by adjusting the hinge to body or hinge to tailgate bolts, body alignment shims may have to be purchased and inserted behind the hinges

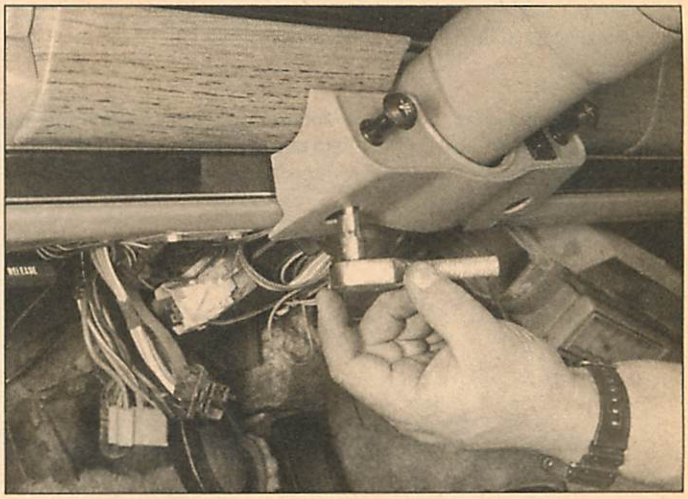
22.8 Remove the hinge cover plates to access the hinge bolts



22.10 Loosen the striker and adjust as necessary to provide positive latch engagement



23.1 Use a small screwdriver to help unsnap the cluster bezel from the instrument panel



24.1 Remove the screws from the steering column lower trim panel, then disconnect the fresh air door control cables

to achieve correct alignment.

9 To adjust the tailgate closed position, first check that the latch is contacting the center of the latch striker assembly. If not, remove striker assembly and add or subtract shims to achieve correct alignment.

10 Finally, adjust the latch striker assembly as necessary (up and down or sideways) to provide positive engagement with the latch mechanism **(see illustration)** and the outside of the tailgate is flush with rear quarter panel.

23 Instrument cluster bezel - removal and installation

Refer to illustration 23.1

1 On 1984 through 1991 models, detach the retaining screws (if equipped) and unsnap the bezel from the instrument panel **(see illustration)**.

2 Remove the bezel.

3 Installation is the reverse of removal.

24 Dashboard trim panels - removal and installation

Refer to illustrations 24.1 and 24.4

Lower steering column trim panel

1 Remove the steering column lower trim panel **(see illustration)**.

2 Remove the air door control cables (if equipped).

3 Installation is the reverse of removal.

Glove box door

4 Detach the retaining screws securing the hinge **(see illustration)**.

5 Remove the door from the instrument panel.

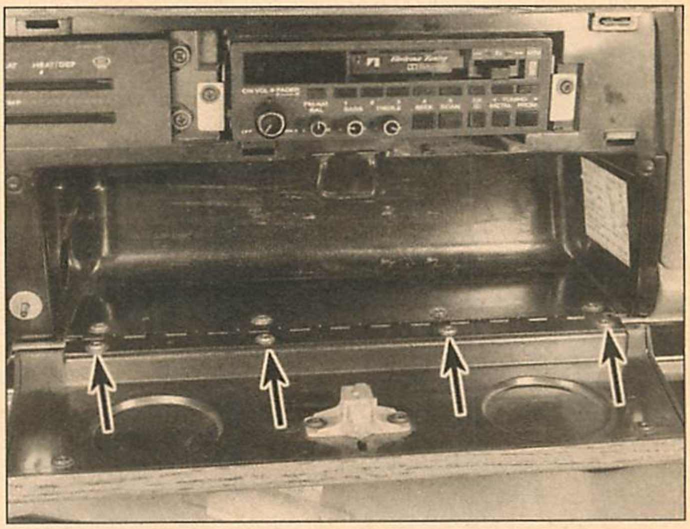
6 Installation is the reverse of removal.

25 Seats - removal and installation

Refer to illustrations 25.1 and 25.4

Front

1 Move the front seat to the forward position and remove the seat track-to-floorpan nuts located behind the front seat. Move the seat to the rear and remove the nuts at the front **(see illustration)**. Disconnect any electrical connectors attached to the seat.



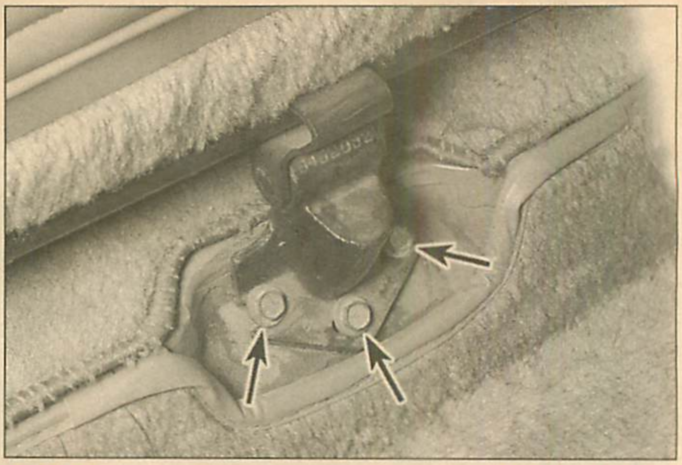
24.4 Detach the door-to-hinge screws (arrows)

25.1 The front seat retaining nuts can be accessed by moving the seat forward or backward

2 Lift the seat from the vehicle.
3 Installation is the reverse of removal.

Rear

4 Remove the seat-to-floor mounting bolts, then detach the seat and lift it out of the vehicle **(see illustration)**.
5 Installation is the reverse of removal.



25.4 The rear seat can be removed by unscrewing the retaining bolts (arrows)

Chapter 12
Chassis electrical system

Contents

1 General information

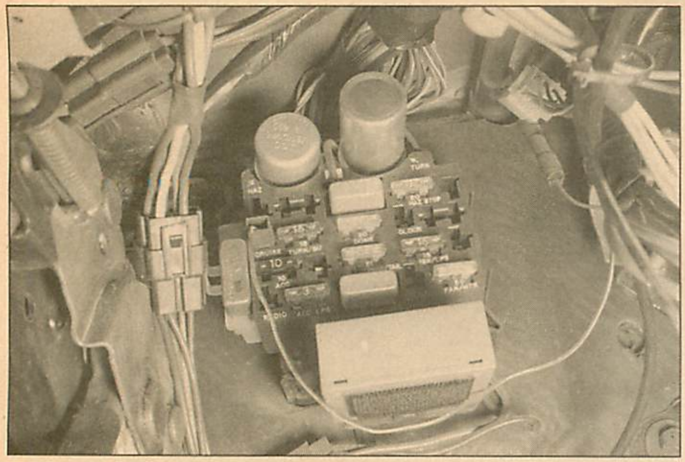
The electrical system is a 12-volt, negative ground type. Power for the lights and all electrical accessories is supplied by a lead/acid-type battery which is charged by the alternator.

This Chapter covers repair and service procedures for the various electrical components not associated with the engine. Information on the battery, alternator, distributor and starter motor can be found in Chapter 5. **Warning:** *When working on the electrical system, disconnect the negative battery cable from the battery to prevent electrical shorts and/or fires.*

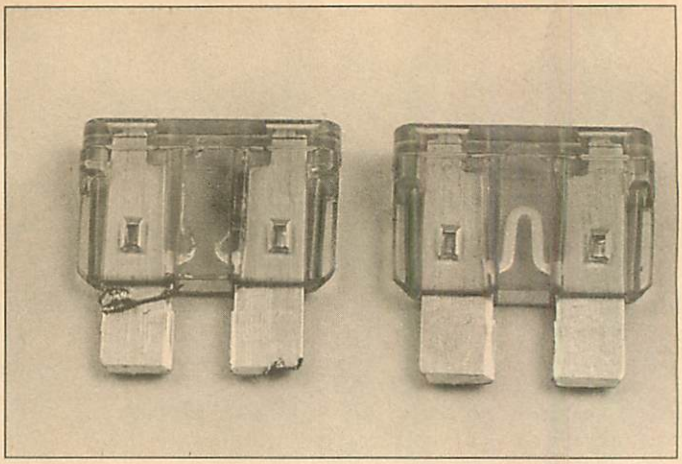
2 Electrical troubleshooting - general information

A typical electrical circuit consists of an electrical component, any switches, relays, motors, fuses, fusible links or circuit breakers related to the component and the wiring and connectors that link the component to both the battery and the chassis. To help pinpoint an electrical circuit problem, wiring diagrams are included at the end of this Chapter.

Before tackling any troublesome electrical circuit, first study the appropriate wiring diagrams to get a complete understanding of what makes up that individual circuit. Trouble spots, for instance, can often be narrowed down by noting if other components related to the circuit



3.1 The fuse block is located to the left of steering column below the instrument panel - later model with miniaturized fuses shown



3.3 When a fuse blows, the element between the terminals burns - the fuse on the left is blown; the fuse on the right is good

are operating properly. If several components or circuits fail at one time, chances are the problem is in a fuse or ground connection, because several circuits are often routed through the same fuse and ground connections.

Electrical problems usually stem from simple causes, such as loose or corroded connections, a blown fuse, a melted fusible link or a bad relay. Visually inspect the condition of all fuses, wires and connections in a problem circuit before troubleshooting it.

If testing instruments are going to be utilized, use the diagrams to plan ahead of time where to make the necessary connections to accurately pinpoint the trouble spot.

The basic tools needed for electrical troubleshooting include a circuit tester or voltmeter (a 12-volt bulb with a set of test leads can also be used), a continuity tester (which includes a bulb, battery and set of test leads) and a jumper wire, preferably with a circuit breaker incorporated, which can be used to bypass electrical components. Before attempting to locate a problem with test instruments, use the wiring diagram(s) to decide where to make the connections.

Voltage checks

Voltage checks should be performed if a circuit isn't functioning properly. Connect one lead of a circuit tester to either the negative battery terminal or a known good ground. Connect the other lead to a connector in the circuit being tested, preferably nearest to the battery or fuse. If the bulb of the tester lights, voltage is present, which means the part of the circuit between the connector and the battery is problem free. Continue checking the rest of the circuit in the same fashion. When you reach a point where no voltage is present, the problem lies between that point and the last test point with voltage. Most of the time the problem can be traced to a loose connection. **Note:** *Keep in mind that some circuits receive voltage only when the ignition key is in the Accessory or Run position.*

Finding a short

One method of finding a short in a circuit is to remove the fuse and connect a test light or voltmeter in its place to the fuse terminals. There should be no voltage present in the circuit. Move the wiring harness from side-to-side while watching the test light. If the bulb lights, there's a short to ground somewhere in that area, probably where the insulation has rubbed through. The same test can be performed on each component in the circuit, even a switch.

Ground check

Perform a ground test to check whether a component is properly grounded. Disconnect the battery and connect one lead of a self-powered test light, known as a continuity tester, to a known good ground. Connect the other lead to the wire or ground connection being tested. If the bulb lights, the ground is good. If the bulb doesn't light, the ground is no good.

Continuity check

A continuity check is done to determine if there are breaks in a circuit - if it's capable of passing electricity properly. With the circuit off (no power in the circuit), a self-powered continuity tester can be used to check it. Connect the test leads to both ends of the circuit (or to the "power" end and a good ground) - if the test light comes on the circuit is passing current properly. If the light doesn't come on, there's a break (open) somewhere in the circuit. The same procedure can be used to test a switch by connecting the continuity tester to the switch terminals. With the switch on, the test light should come on.

Finding an open circuit

When diagnosing for possible open circuits, it's often difficult to locate them by sight because oxidation or terminal misalignment are hidden by the connectors. Merely wiggling a connector on a sensor or in the wiring harness may correct the open circuit condition. Remember this when an open is indicated when troubleshooting a circuit. Intermittent problems may also be caused by oxidized or loose connections. Electrical troubleshooting is simple if you keep in mind that all electrical circuits are basically electricity running from the battery, through the wires, switches, relays, fuses and fusible links to each electrical component (light bulb, motor, etc.) and to ground, where it's passed back to the battery. Any electrical problem is an interruption in the flow of electricity to and from the battery.

3 Fuses - general information

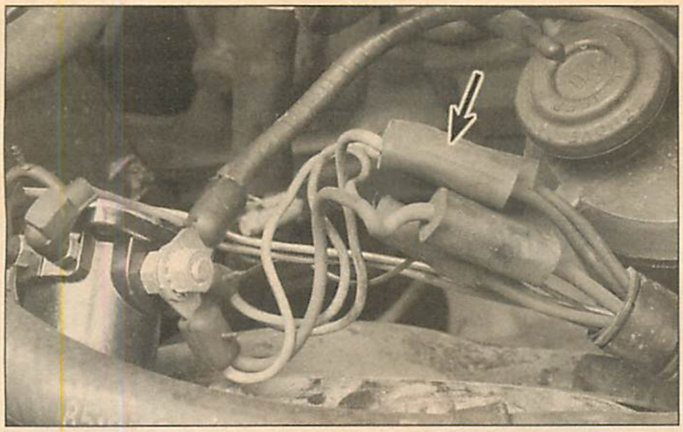
Refer to illustrations 3.1 and 3.3

1 The electrical circuits of the vehicle are protected by a combination of fuses, circuit breakers and fusible links. The fuse block is located in the end of the instrument panel on the right side of the dashboard under a cover **(see illustration)**. There is also a fuse and relay block, called the power distribution center, located on the right side of the engine compartment (see Section 6).

2 Each of the fuses is designed to protect a specific circuit, and the various circuits are identified on the fuse panel itself.

3 Miniaturized fuses are employed in the fuse block. These compact fuses, with blade terminal design, allow fingertip removal and replacement. If an electrical component fails, always check the fuse first. The best way to check the fuses is with a test light. Check for power at the exposed terminal tips of each fuse. If power is present on one side of the fuse but not the other, the fuse is blown. A blown fuse can also be confirmed by visually inspecting it **(see illustration)**.

4 Be sure to replace blown fuses with the correct type. Fuses of different ratings are physically interchangeable, but only fuses of the proper rating should be used. Replacing a fuse with one of a higher or lower value than specified is not recommended. Each electrical circuit



4.1 Fusible links are generally located at the starter solenoid positive battery lead

needs a specific amount of protection. The amperage value of each fuse is molded into the fuse body.

5 If the replacement fuse immediately fails, don't replace it again until the cause of the problem is isolated and corrected. In most cases, the cause will be a short circuit in the wiring caused by a broken or deteriorated wire.

4 Fusible links - general information

Refer to illustration 4.1

Some circuits are protected by fusible links **(see illustration)**. Fusible links are used in circuits which are not ordinarily fused, such as the ignition circuit.

Although the fusible links appear to be a heavier gauge than the wire they are protecting, the appearance is due to the thick insulation. All fusible links are several wire gauges smaller than the wire they are designed to protect.

Fusible links cannot be repaired, but a new link of the same size wire can be put in its place. The procedure is as follows:

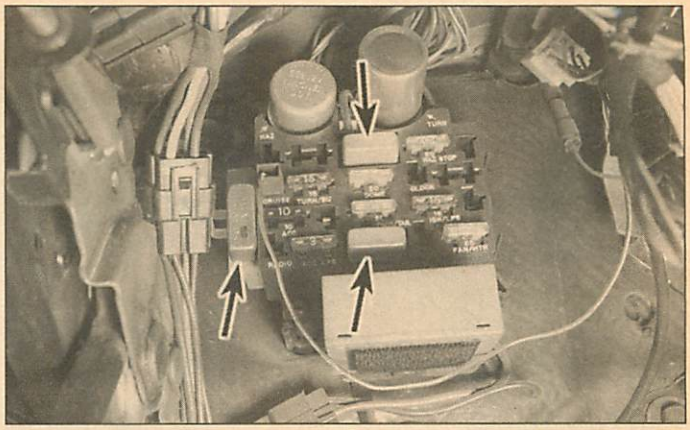
- *a) Disconnect the negative cable from the battery.*
- *b) Disconnect the fusible link from the wiring harness.*
- *c) Cut the damaged fusible link out of the wiring just behind the electrical connector.*
- *d) Strip the insulation back approximately 1/2-inch.*
- *e) Position the electrical connector on the new fusible link and crimp it into place.*
- *f) Use rosin core solder at each end of the new link to obtain a good solder joint.*
- *g) Use plenty of electrical tape around the soldered joint. No wires should be exposed.*
- *h) Connect the battery ground cable. Test the circuit for proper operation.*

5 Circuit breakers - general information

Refer to illustrations 5.1 and 5.2

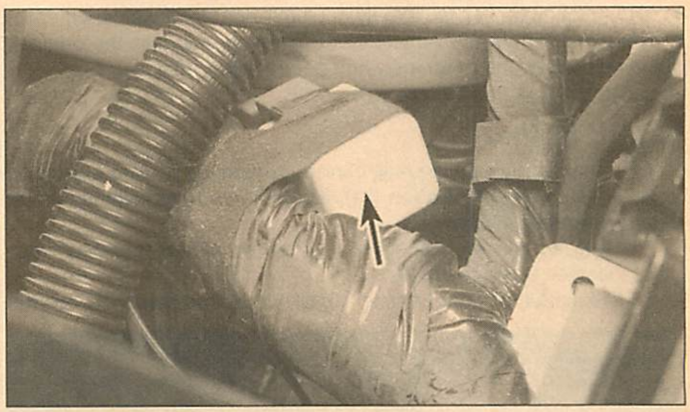
Circuit breakers protect components such as power windows, power door locks and headlights. Some circuit breakers are located in the fuse box **(see illustration)**. On some models the circuit breaker resets itself automatically, so an electrical overload in the circuit will cause it to fail momentarily, then come back on. If the circuit doesn't come back on, check it immediately. Once the condition is corrected, the circuit breaker will resume its normal function. Some circuit breakers have a button on top and must be reset manually.

To test a circuit breaker , simply use an ohmmeter to check continuity between the terminals. A reading of zero to 1.0 ohms indicates a good circuit breaker . No reading on the meter indicates a bad circuit breaker **(see illustration)**.



5.1 Circuit breakers are located in the passenger compartment fuse box

5.2 Perform a continuity test with an ohmmeter to check a circuit breaker - no reading (infinite resistance) indicates a bad circuit breaker



6.2 The relays are usually taped to the wiring harnesses

6 Relays - general information

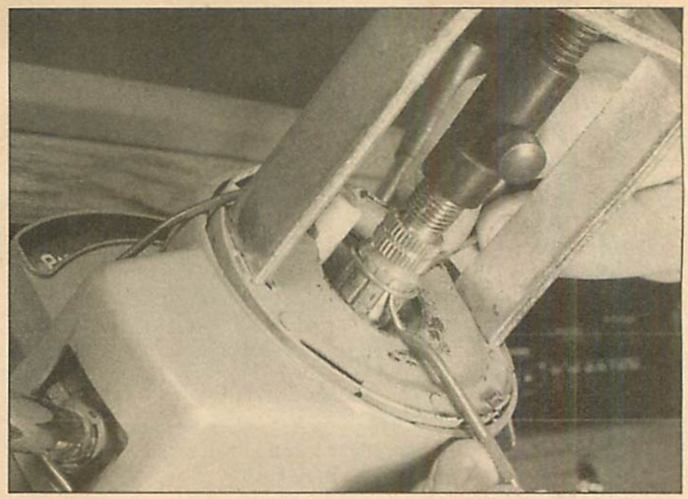
Refer to illustration 6.2

Several electrical accessories in the vehicle utilize relays to transmit current to the component. If the relay is defective, the component won't operate properly.

The relays are generally taped to the wiring harness on which circuit they are being used **(see illustration)**. Consult the wiring diagrams at the end of this Chapter to determine if your particular circuit utilizes a relay if any.

If a faulty relay is suspected, it can be removed and tested by a dealer service department or a repair shop. Defective relays must be replaced as a unit.

7.1 The hazard (A) and turn signal flashers (B) are mounted in the passenger compartment fuse panel



8.3 Use a special tool (available at auto parts stores) to compress the lockplate. With the lockplate compressed, remove the retaining clip

7 Turn signal/hazard flasher - check and replacement

Refer to illustration 7.1

Turn signal flasher

1 The turn signal flasher is a small canister-shaped unit located under the dash in the fuse panel **(see illustration)**.

2 When the flasher unit is functioning properly, an audible click can be heard during its operation. If the turn signals fail on one side or the other and the flasher unit does not make its characteristic clicking sound, a faulty turn signal bulb is indicated.

3 If both turn signals fail to blink, the problem may be due to a blown fuse, a faulty flasher unit, a broken switch or a loose or open connection. If a quick check of the fuse box indicates that the turn signal fuse has blown, check the wiring for a short before installing a new fuse.

4 To replace the flasher, simply unplug it from the fuse panel.

5 Make sure that the replacement unit is identical to the original. Compare the old one to the new one before installing it.

6 Installation is the reverse of removal.

Hazard flasher

7 The hazard flasher, a small canister-shaped unit, also located in the fuse panel **(see illustration 7.1)**, flashes all four turn signals simultaneously when activated.

8 The hazard flasher is checked in a fashion similar to the turn signal flasher (see Steps 2 and 3).

9 To replace the hazard flasher, reach under the dash and pull the flasher from the fuse panel.

10 Make sure the replacement unit is identical to the one it replaces. Compare the old one to the new one before installing it.

11 Installation is the reverse of removal.

8 Multi-function and dimmer switches - removal and installation

Multi function switch

Refer to illustrations 8.3, 8.4, 8.5, 8.6a, 8.6b, 8.7a, and 8.7b

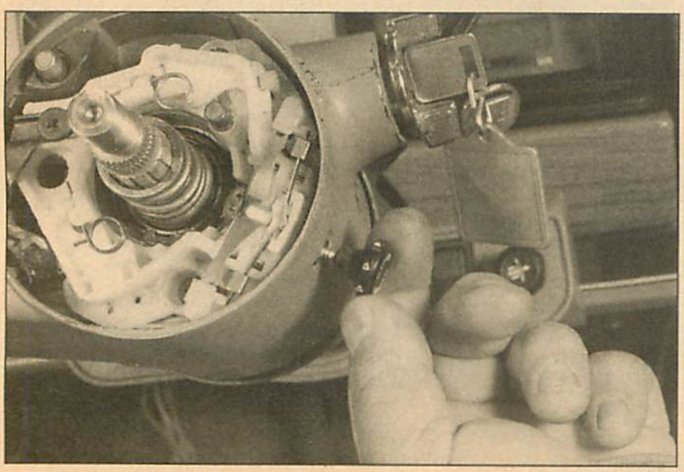
1 The multi-function switch is located in the steering column. It incorporates the turn signal, headlight dimmer and windshield wiper/washer functions into one switch. Disconnect the negative battery cable and remove the steering wheel (see Chapter 10).

2 Remove the steering column trim cover located below the dashboard.

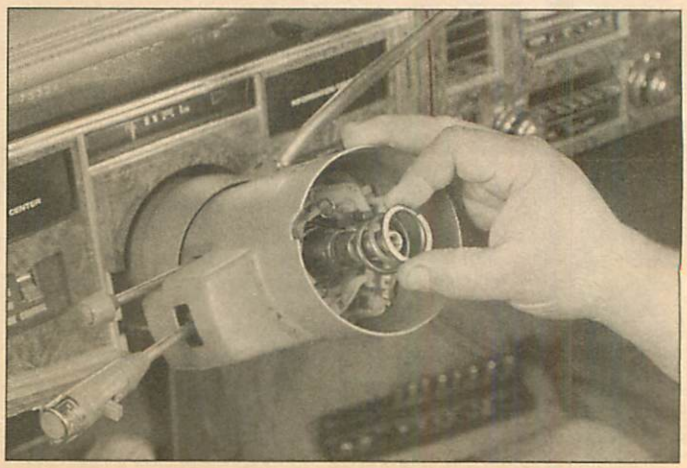
3 The lockplate will now have to be removed from the steering column. This is held in place with a snap-ring or clip which fits into a groove in the steering shaft. The lockplate must be depressed to relieve pressure on the snap-ring clip. A special U-shaped tool (available at automotive parts stores) which fits on the shaft should be used to depress the lockplate as the snap-ring is removed from its groove **(see illustration)**.

4 Unscrew the hazard warning knob **(see illustration)**.

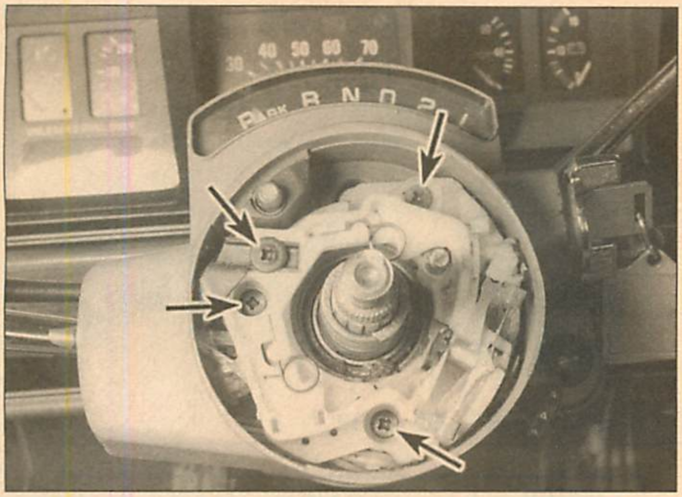
5 Remove the upper bearing preload spring and thrust washer off



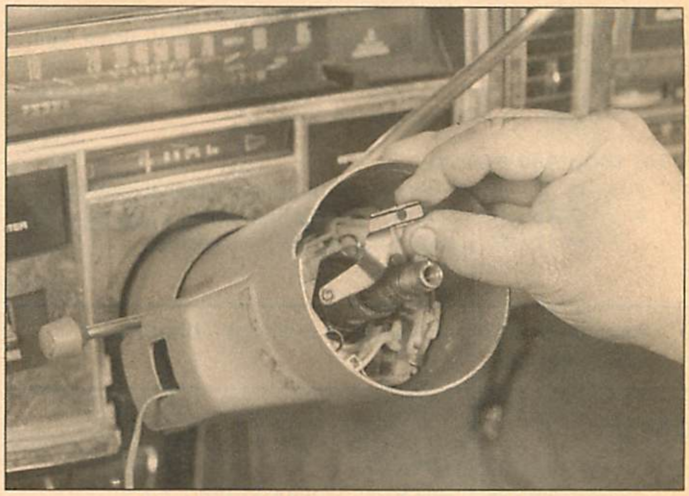
8.4 Remove the hazard warning knob



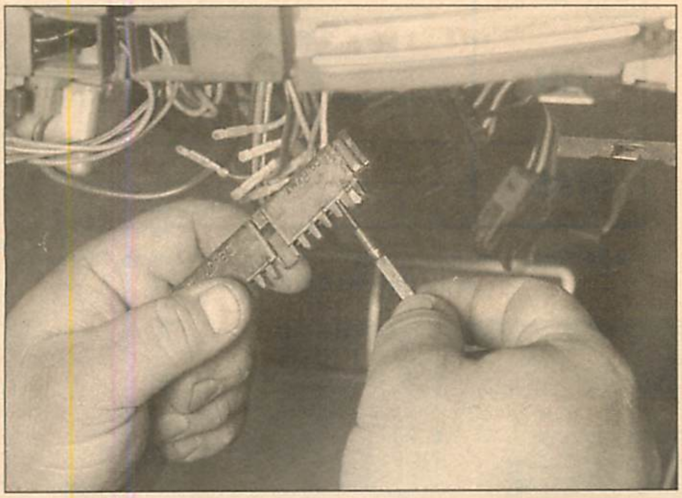
8.5 Remove the spring



8.6a Remove the turn signal lever screw; the locations of the switch mounting screws are shown by arrows - to get at the upper screw in this photo, the top of the switch must be rotated



8.6b Lift out the turn signal internal lever



8.7a The turn signal switch electrical connector is located under the dash near the steering column - unplug it as shown and detach the turn signal switch wires (if necessary, mark them so they can be returned to the same locations on the connector)

the end of the shaft **(see illustration)**.

6 Remove the screw that secures the turn-signal switch actuating lever and remove the lever **(see illustrations)**. Remove the three screws that secure the plastic turn signal switch assembly to the steering column bowl. It may be necessary to rotate the top portion of the switch to gain access to all the screws.

7 Pull the switch connector out of the bracket on the steering column jacket. Mark the locations of the wires at the switch connector, then use a small screwdriver to detach the connector terminals **(see illustration)**. Feed the wiring connector up through the column support bracket and pull the switch, wiring harness and connectors out the top of the steering column **(see illustration)**.

8 Installation is the reverse of removal. If using a new switch, try to feed the wiring harness through the steering column with the connector still attached.

Dimmer switch

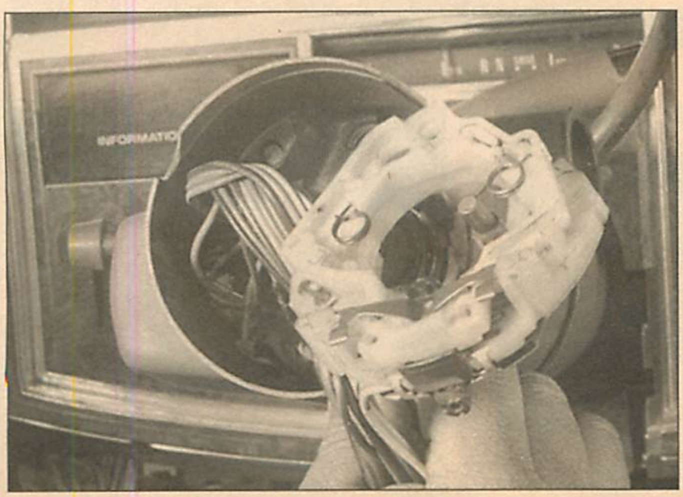
9 Disconnect the negative battery cable.

Steering column mounted switch

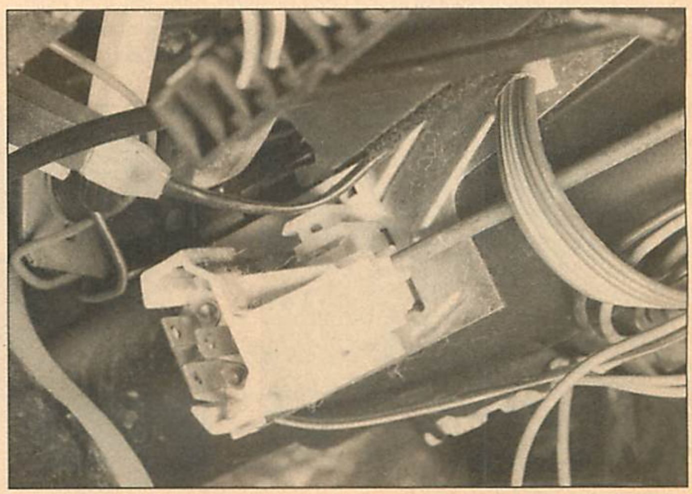
Refer to illustration 8.10

10 The dimmer switch is located on the lower steering column and connected to the turn signal switch by an actuating rod **(see illustration)**. Remove the bolts that secure the steering column to the dash frame, then lower the steering column for access.

11 Unplug the electrical connector from the switch.



8.7b Pull the turn signal switch out, carefully drawing the wiring harness through the steering column



8.10 On later models the dimmer switch is located on the left side of the steering column

12 Remove the bolts, detach the switch from the steering column.
13 Place the new switch in position and install the bolts finger tight.
14 Move the switch as necessary to take up any slack in the actuator control rod, then tighten the bolts securely. Plug in the electrical connector and install the steering column bolts.

Floor mounted switch

15 Pull back the carpet, remove the bolts and detach the switch.
16 Plug the electrical connector into the new switch, place the switch in position and install the bolts. Tighten the bolts securely.

9 Ignition switch and key lock cylinder - check and replacement

Check

Refer to illustrations 9.2a and 9.2b

1 Remove the switch (see Steps 12 through 16).
2 Use an ohmmeter or self-powered test light and check for continuity between the indicated switch terminals **(see illustrations)**.
3 If the switch does not have correct continuity, replace it.

Replacement

Lock cylinder

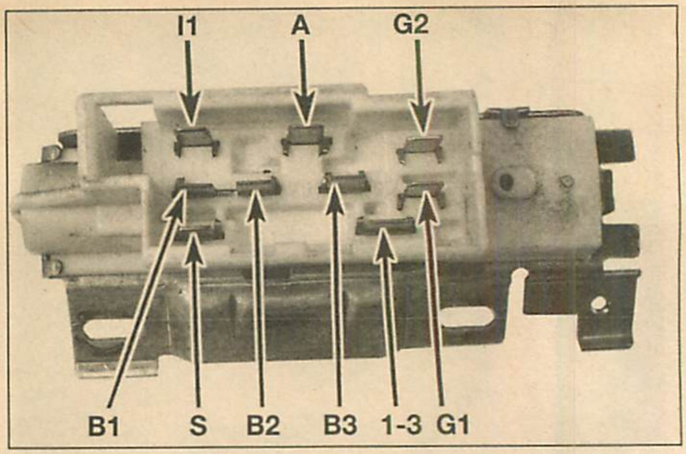
Refer to illustrations 9.6, 9.7 and 9.8

4 The lock cylinder should be removed only in the On position, otherwise damage to the warning buzzer switch may occur.
5 Remove the steering wheel (Chapter 10) and turn signal switch (see Section 8). **Note:** *The turn signal switch need not be fully removed provided that it is pulled out far enough for it to be slipped over the end of the shaft. Do not pull the harness out of the column.*
6 Insert the key and place the lock cylinder in the On position, then use needle-nose pliers to remove the buzzer switch **(see illustration)**.
7 Remove the lock cylinder retaining screw **(see illustration)**.
8 Remove the lock cylinder by turning the key to the Start position, then pulling the assembly straight out **(see illustration)**.
9 To install, insert the key into the lock cylinder, rotate the lock cylinder and align the cylinder key with the keyway in the steering column housing.
10 Push the lock all the way in and install the retaining screw.
11 Install the remaining components, referring to the appropriate Sections.

Ignition switch

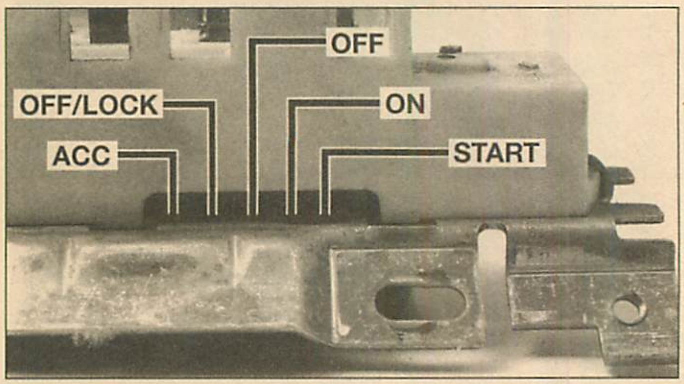
Refer to illustrations 9.16 and 9.17

12 Disconnect the negative cable at the battery.
13 Place the ignition switch in the Lock position. If the key lock cylinder has been removed, pull the actuating rod up until a definite stop can be felt, then move it down one detent to the On position.

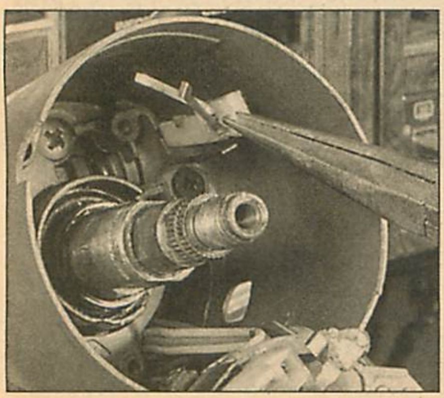


SWITCH POSITION	CONTINUITY BETWEEN TERMINALS
ACC	A AND B2
OFF/LOCK	
ON	1-3 AND B3
	I1 AND B1
	A AND B2
START	I1, B1 AND S
	G1 AND G2 TO GROUND

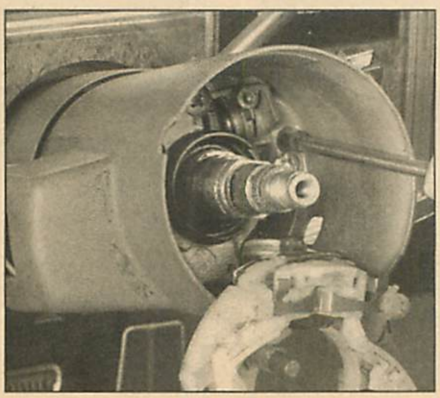
9.2a Check the ignition switch terminals for continuity in the indicated positions



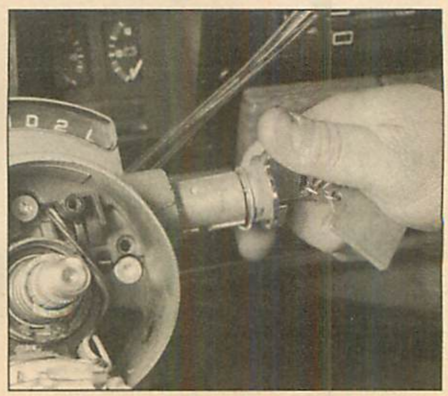
9.2b Ignition switch position details



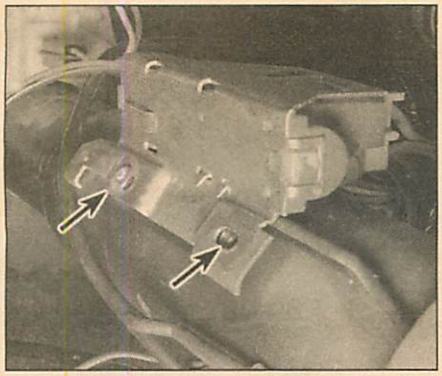
9.6 Pull out the buzzer switch and clip with needle-nose pliers



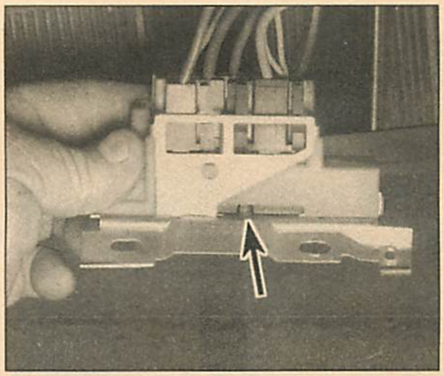
9.7 The lock cylinder is held in place by a screw



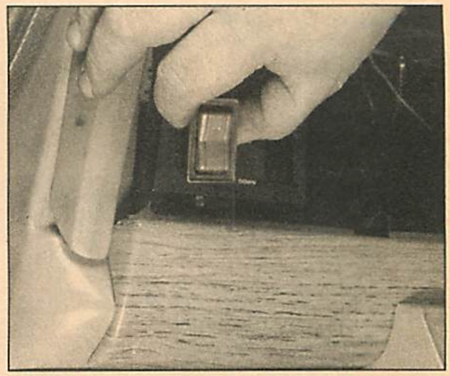
9.8 Pull the lock cylinder straight out



9.16 The ignition switch is located on top of the lower end of the steering column - disconnect the electrical connector, remove these two screws (arrows) and lift it off



9.17 The slot in the ignition switch slider (arrow) must be all the way forward when installing the switch so the actuating rod will engage it



10.4 After disengaging the clips from the backside, pull the switch(s) out from the front

14 Remove the lower finish panel from beneath the steering column.
15 Remove the two nuts that secure the steering column to the lower edge of the dash assembly, then carefully lower the steering column down and rest the steering wheel on the seat.
16 Disconnect the electrical connector at the switch, then remove the ignition switch retaining screws **(see illustration)** and lift the switch out of the steering column jacket.
17 Prior to installation, make sure the ignition switch is in the Lock position **(see illustration)**.
18 Connect the actuating rod to the switch.
19 Press the switch into position and install the screws.
20 Raise the steering column into position and install and tighten the nuts.

10 Instrument panel switches (1984 through 1991) - removal and installation

Refer to illustration 10.4

1 Remove the instrument cluster trim bezel (see Chapter 11).
2 Remove the instrument cluster (see Section 12).
3 Working through the instrument cluster opening disconnect the electrical connector(s) from the backside of the switch.
4 Using a small screwdriver depress the retaining clips from the backside of the switch, then pull the switch out to remove it **(see illustration)**.
5 Installation is the reverse of removal.

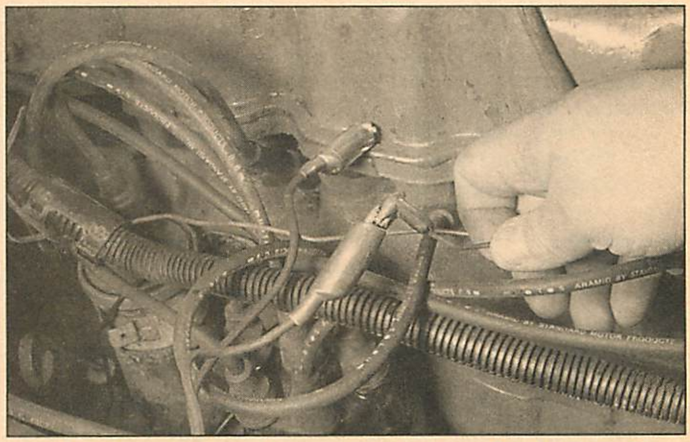
11 Instrument panel gauges - check

Refer to illustration 11.2

1 All tests below require the ignition switch to be turned to ON position when testing.

Fuel, oil and temperature gauges

2 If the gauge pointer does not move from the empty, low or cold positions, check the fuse. If the fuse is OK, locate the particular sending unit for the circuit you're working on (see Chapter 4 for fuel sending unit location, Chapter 2C for the oil sending unit location or Chapter 3 for the temperature sending unit location). Connect the sending unit connector to ground **(see illustration)**. If the pointer goes to the full, high or hot position replace the sending unit. If the pointer stays in same position, use a jumper wire to ground the terminal on the back of the gauge. If the pointer moves, the problem lies in the wire between the gauge and the sending unit. If the pointer does not move with the back of the gauge grounded, check for voltage at the other terminal of the gauge. If voltage is present, replace the gauge.

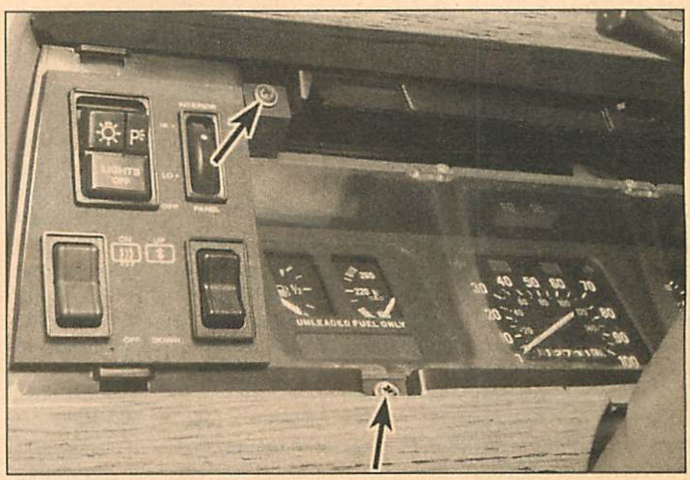


11.2 Connect the sending unit wire to ground - if the gauge moves replace the sending unit

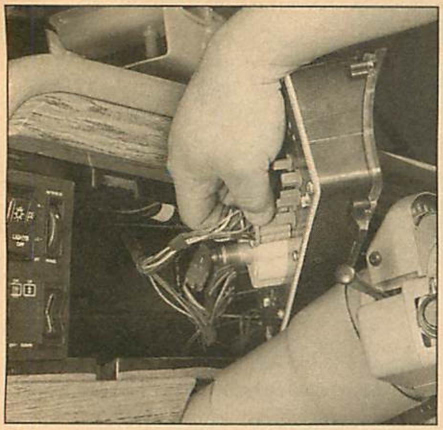
12 Instrument cluster - removal and installation

Refer to illustrations 12.3 and 12.4

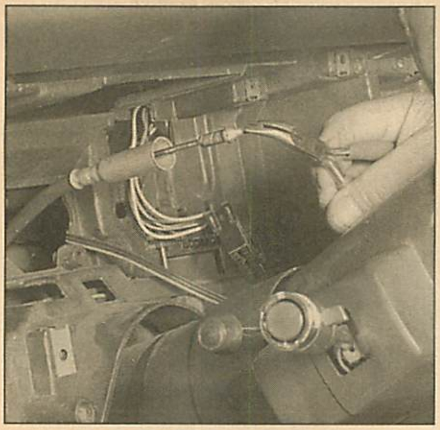
1 Disconnect the negative battery cable.
2 On later models remove the instrument cluster bezel (see Chapter 11).
3 Remove the cluster mounting screws **(see illustration)** and pull the instrument cluster towards the steering wheel.



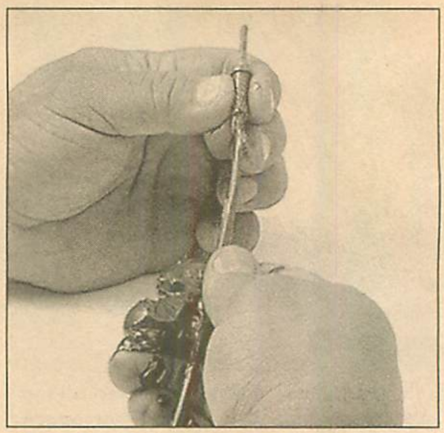
12.3 Remove the retaining screws from the outside edges of the instrument cluster



12.4 Detach the electrical connectors from the back of the cluster



13.2 Use pliers to pull the speedometer cable out



13.3 Coat the entire length of the cable with a lubricant designed for use on speedometer cables (available at auto parts stores)

4 Unscrew the speedometer cable from the backside of the cluster, then disconnect any electrical connectors that would interfere with removal **(see illustration)**.
5 Cover the steering column with a cloth to protect the paint, then remove the instrument cluster from the vehicle.
6 Installation is the reverse of removal.

13 Speedometer cable - replacement

Refer to illustrations 13.2 and 13.3
1 The instrument cluster must first be removed as described in Section 12.
2 Once the end of the speedometer drive cable is exposed, grip the inner cable with pliers and draw it out of the housing **(see illustration)**.
3 Lubricate the entire cable. Use special speedometer cable lubricant, not oil or ordinary grease, for this purpose **(see illustration)**.
4 Insert the cable into the housing using a twisting movement until the lower end is felt to engage with the pinion gear at the transmission. The remainder of installation is the reverse of removal.

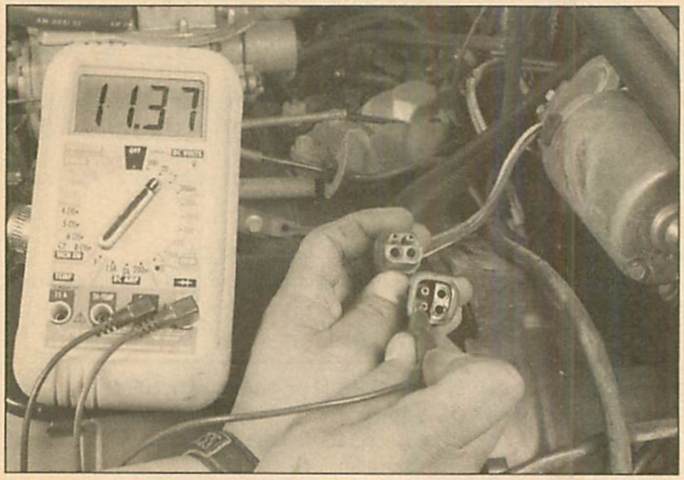
14 Windshield wiper motor - check and replacement

Wiper motor circuit check

Refer to illustration 14.2

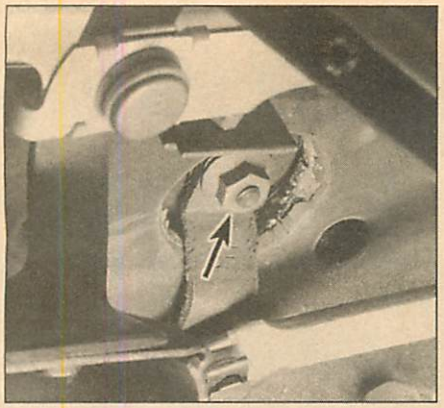
Note: *Refer to the wiring diagrams at the end of this Chapter when performing the following checks. Keep in mind that power wires are generally larger in diameter and brighter colors, where ground wires are usually smaller in diameter and darker colors. When checking for voltage, the probe of a grounded 12-volt test light may be touched to each terminal at a connector until it lights; this verifies voltage (power) at the terminal.*

1 **If the wipers work slowly,** make sure the battery is in good condition and has a strong charge (see Chapter 1). If the battery is in good condition, remove the wiper motor (see below) and operate the wiper arms by hand. Check for binding linkage and pivots. Lubricate or repair the linkage or pivots as necessary. Reinstall the wiper motor. If the wipers still operate slowly, check for loose or corroded connections, especially the ground connection. If all connections look OK, replace the motor.
2 **If the wipers don't work at all,** check the fuse or circuit breaker. If the fuse or circuit breaker are OK, connect a jumper wire between the wiper motor and ground, then retest. If the motor works now, repair the ground connection. If the wipers still don't work, turn on the wipers and check for voltage at the motor **(see illustration)**. If there's no voltage at the motor, remove the motor and check it off the vehicle with

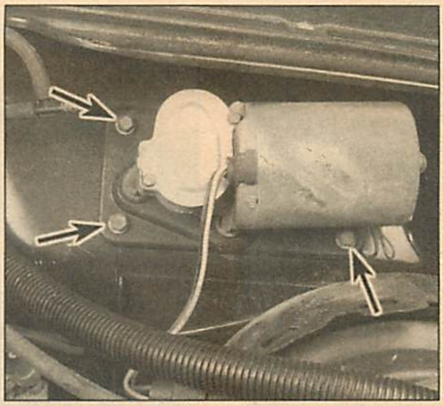


14.2 Use a voltmeter or test light to check for power to the wiper motor

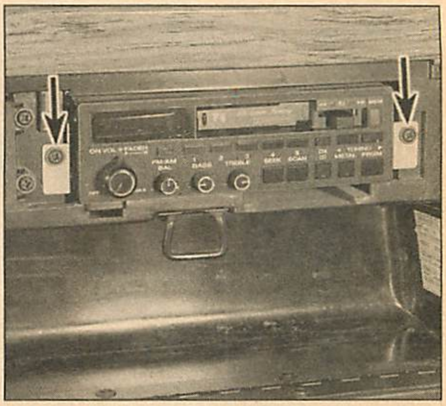
fused jumper wires from the battery. If the motor now works, check for a binding linkage (see Step 1 above). If the motor still doesn't work, replace it. If there's no voltage at the motor, check for voltage at the switch. If there's no voltage at the switch, check the wiring between the switch and fuse panel for continuity. If the wiring is OK, the switch is probably bad.
3 **If the wipers only work on one speed**, check the continuity of the wires between the switch and motor. If the wires are OK, replace the switch.
4 **If the interval (delay) function is inoperative**, check the continuity of all the wiring between the switch and motor. If the wiring is OK, replace the interval module.
5 **If the wipers stop wherever they are when the switch is turned off (fail to park)**, check for voltage at the wiper motor when the wiper switch is OFF but the ignition is ON. If voltage is present, the limit switch in the motor is malfunctioning. Replace the wiper motor. If no voltage is present, trace and repair the limit switch wiring between the fuse panel and wiper motor.
6 **If the wipers won't shut off unless the ignition is OFF**, disconnect the wiring from the wiper control switch. If the wipers stop, replace the switch. If the wipers keep running, there's a defective limit switch in the motor; replace the motor.
7 **If the wipers won't retract below the hoodline**, check for mechanical obstructions in the wiper linkage or on the vehicle's body which would prevent the wipers from retracting. If there are no obstructions, check the wiring between the switch and motor for continuity. If the wiring is OK, replace the wiper motor.



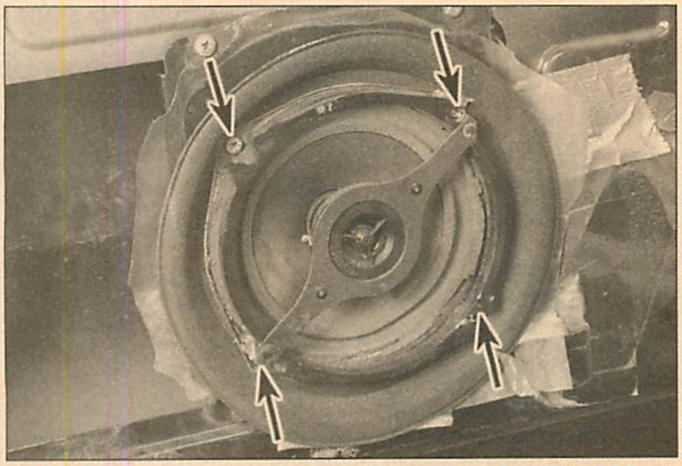
14.8 Remove the nut (arrow) and detach the wiper arm from the motor



14.9 Remove the bolts (there are usually three, as shown by the arrows) and lift the windshield wiper motor assembly out



15.7 Remove the screws securing the radio (later model shown)



15.10 Remove the screws, detach the speaker and unplug the electrical connector

Wiper motor replacement

Refer to illustrations 14.8 and 14.9

8 Working up under the instrument panel, remove the motor spindle nut **(see illustration)**.

9 Remove the wiper motor retaining bolts **(see illustration)**, detach the wiper arm then pull the motor out from the firewall.

10 Unplug the electrical connector and remove the motor from the vehicle.

11 Installation is the reverse of removal.

Rear wiper

Check

12 Check the wiper fuse and circuit breaker in the fuse block (see Section 3).

13 Remove the instrument panel switch pod bezel and remove the rear wiper switch (see Section 10). Connect the switch and backprobe the terminals with the ignition switch On. There should be battery voltage at one of the terminals. If no voltage is found, there is an open circuit between the switch and the fuse block.

14 If there is battery voltage at the corresponding terminal, and nothing is wrong with the wiring or connections and the motor still won't run, the switch is faulty.

15 Open the tailgate and remove the trim panel (see Chapter 11).

16 Disconnect the electrical connector from the wiper motor assembly.

17 With the ignition Off, check to make sure there is zero resistance between the wiper motor and ground. If there is resistance, repair the ground connection.

18 With the rear window in the up position, turn the ignition On and check for battery voltage at the motor connector with the wiper switch in each position. If battery voltage is present and nothing is wrong with the switch or wiring, replace the motor.

Replacement

19 Detach the wiper arm and remove the nut, bezel and gasket from the outside of the vehicle.

20 Open the tailgate and remove the tailgate trim panel (see Chapter 11). Raise the window to access the motor and disconnect the electrical connector from the motor. **Note:** *Support the glass to remove stress on the lower edge of the glass.*

21 Detach the screws securing the wiper motor, then remove the wiper motor from the vehicle.

22 Installation is the reverse of removal.

15 Radio and speakers - removal and installation

Refer to illustrations 15.7, 15.10 and 15.15

1 Disconnect the negative battery cable.

Radio

2 On early models remove the glove box liner.

3 Disconnect the electrical connectors, antenna connector and rear brace from the back of the radio

4 Detach the radio control knobs and retaining nuts from the frontside of the radio.

5 Push the radio back into the dash and remove it through the glove box opening.

6 On later models remove the instrument cluster bezel (see Chapter 11).

7 Remove the mounting screws **(see illustration)**, pull the radio out of the instrument panel far enough to disconnect the electrical connectors and antenna, then remove it from the vehicle.

8 Installation is the reverse of removal.

Speakers

Front door

9 Remove the door trim panel (see Chapter 11).

10 Remove the screws and detach the speaker **(see illustration)**. Pull the speaker out of the door, disconnect the electrical connector and remove the speaker from the vehicle.

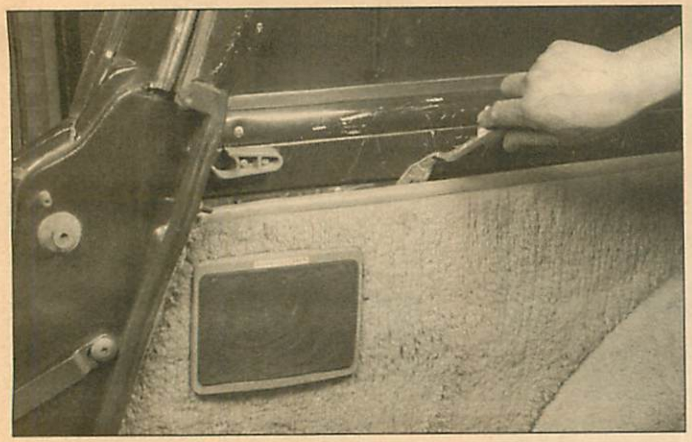
11 Installation is the reverse of removal.

Instrument panel

12 Remove the radio as described above.

13 Disconnect the connector, remove the screws and detach the speaker.

14 Installation is the reverse of removal.



15.15 Insert a trim tool or putty knife between the rear quarter panel and trim panel - carefully pry the clips out

Rear

15 On vehicles with rear speakers, insert a trim panel clip removal tool (available at auto parts stores) or a putty knife between the trim panel and the quarter panel and disengage the retaining clips **(see illustration)**. **Note:** *Trim panel retaining clips are approximately five to six inches apart. Pry at the clip location only. Prying in between clips will result in distorted or damaged trim panels.*

16 Remove the screws and detach the speaker. Pull the speaker outward, disconnect the electrical connector and remove the speaker from the vehicle.

17 Installation is the reverse of removal. When installing trim panel retaining clips, make sure the clips are lined up with their mating holes first, then gently tap the clips in with the palm of your hand

16 Antenna - removal and installation

Refer to illustration 16.3

1 On early models equipped with a standard antenna, disconnect the antenna lead from the backside of the radio. Working from the outside of the vehicle, remove the antenna retaining nut and pad, then pull the antenna up and out to remove it.

2 On later models equipped with a standard antenna, disconnect the antenna lead from the backside of the radio.

3 Working from the outside of the vehicle, use a small wrench and remove the mast **(see illustration)**.

4 Pry off the antenna trim cap.

5 Remove the screws securing the antenna to the body, then pull the antenna up and out to remove it.

6 Installation is the reverse of removal.

17 Rear window defogger - check and repair

1 The rear window defogger consists of a number of horizontal elements baked onto the glass surface.

2 Small breaks in the element can be repaired without removing the rear window.

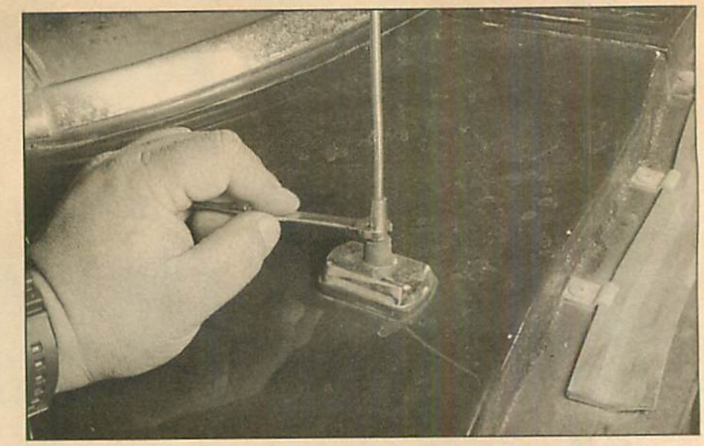
Check

Refer to illustrations 17.4, 17.5 and 17.7

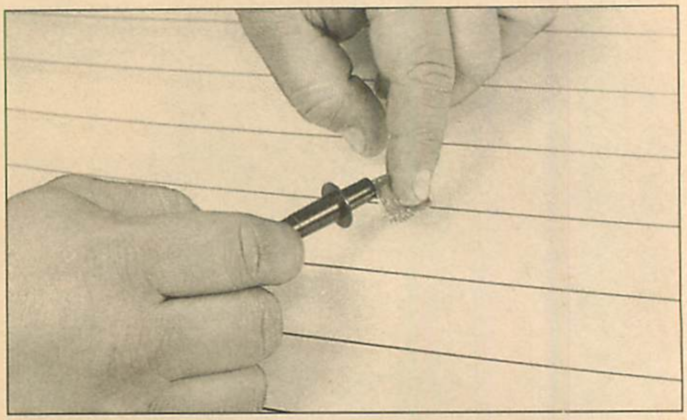
3 Turn the ignition switch and defogger system switches to the ON position.

4 When measuring voltage during the next two tests, wrap a piece of aluminum foil around the tip of the voltmeter negative probe and press the foil against the wire with your finger **(see illustration)**. Place the voltmeter positive lead against the defogger positive terminal.

5 Check the voltage at the center of each heat wire **(see illustration)**. If the voltage is 6-volts, the wire is okay (there is no break). If the voltage is 12-volts, the wire is broken between the center of the element and the positive end. If the voltage is 0-volts the wire is broken between the center of the element and ground.



16.3 On later models use a small wrench to remove the antenna mast



17.4 When measuring the voltage at the rear window defogger grid, wrap a piece of aluminum foil around the negative probe of the voltmeter and press the foil against the wire with your finger

6 Connect the negative lead to a good body ground. The reading should stay the same.

7 To find the break, place the voltmeter positive lead against the defogger positive terminal. Place the voltmeter negative lead with the foil strip against the heat wire at the positive terminal end and slide it toward the negative terminal end. The point at which the voltmeter deflects from zero to several volts is the point at which the heat element is broken **(see illustration)**. **Note:** *If the heat element is not broken, the voltmeter will indicate no voltage at the positive end of the heat element but gradually increase to about 12-volts.*

Repair

Refer to illustration 17.13

8 Repair the break in the element using a repair kit specifically recommended for this purpose, such as Dupont paste No. 4817 (or equivalent). Included in this kit is plastic conductive epoxy.

9 Prior to repairing a break, turn off the system and allow it to cool off for a few minutes.

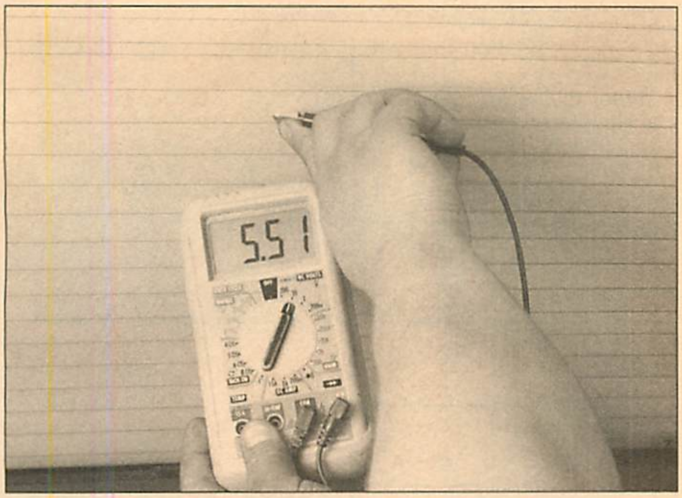
10 Lightly buff the element area with fine steel wool, then clean it thoroughly with rubbing alcohol.

11 Use masking tape to mask off the area being repaired.

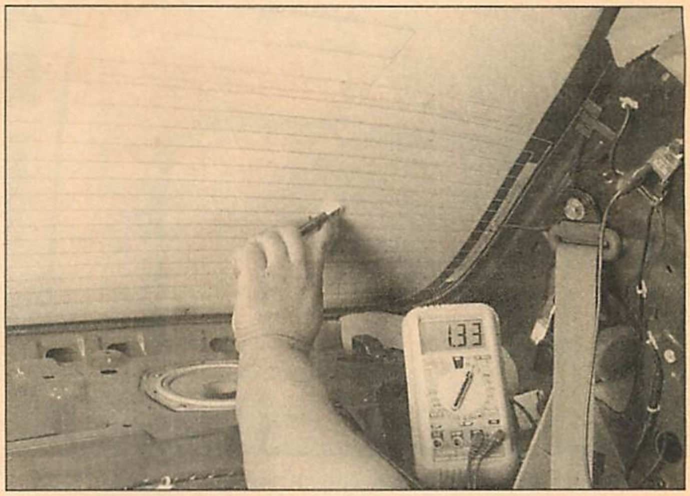
12 Thoroughly mix the epoxy, following the instructions provided with the repair kit.

13 Apply the epoxy material to the slit in the masking tape, overlapping the undamaged area about 3/4-inch on either end **(see illustration)**.

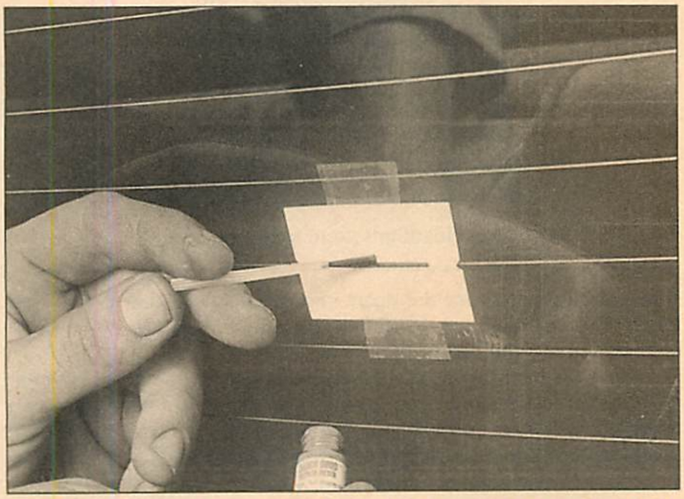
14 Allow the repair to cure for 24 hours before removing the tape and using the system.



17.5 To determine if a wire has broken, check the voltage at the center of each wire. If the voltage is 6-volts, the wire is unbroken; if the voltage is 12-volts, the wire is broken between the center of the wire and the positive end; if the voltage is 0-volts, the wire is broken between the center of the wire and ground



17.7 To find the break, place the voltmeter positive lead against the defogger positive terminal, place the voltmeter negative lead with the foil strip against the heat wire at the positive terminal end and slide it toward the negative terminal end - the point at which the voltmeter deflects from zero to several volts is the point at which the wire is broken



17.13 To use a defogger repair kit, apply masking to the inside of the window at the damaged area, then brush on the special conductive coating

18 Headlight - replacement

Refer to illustrations 18.2, 18.3 and 18.4

1 Whenever replacing a headlight, be careful not to turn the spring-loaded adjusting screws of the headlight, as this will alter the aim.

2 Remove the headlight bezel screws and remove the bezel **(see illustration)**.

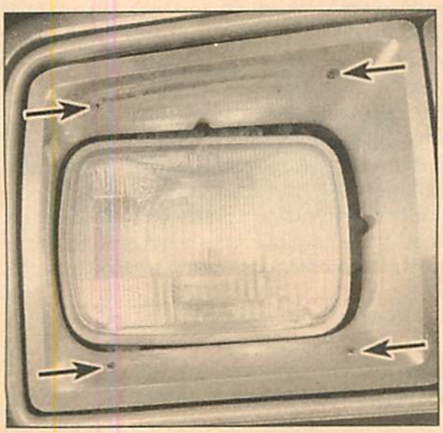
3 Remove the screws which secure the retaining ring and withdraw the ring. Support the light as this is done **(see illustration)**.

4 Pull the headlight out slightly and disconnect the electrical connector from the rear of the light **(see illustration)**. Remove the light from the vehicle.

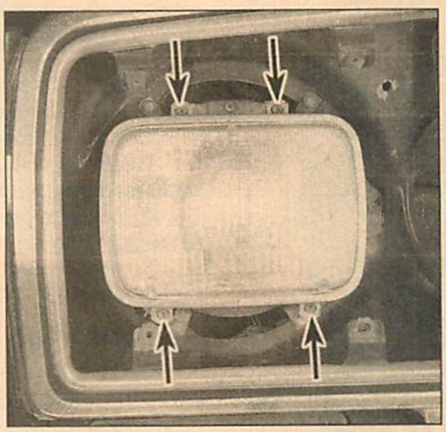
5 Position the new unit close enough to connect the electrical connector. Make sure that the numbers molded into the lens are at the top.

6 Install the retaining ring with its mounting screws and spring.

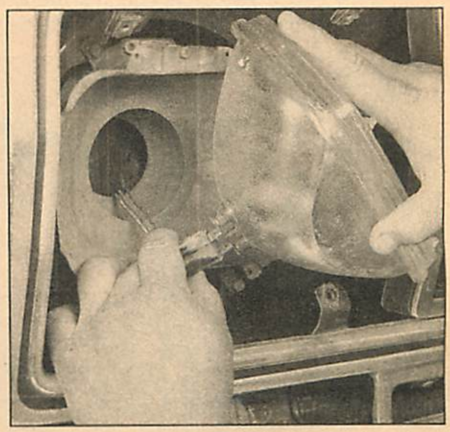
7 Install the bezel and check for proper operation. If the adjusting screws were not altered, the new headlight will not need to have its aim adjusted.



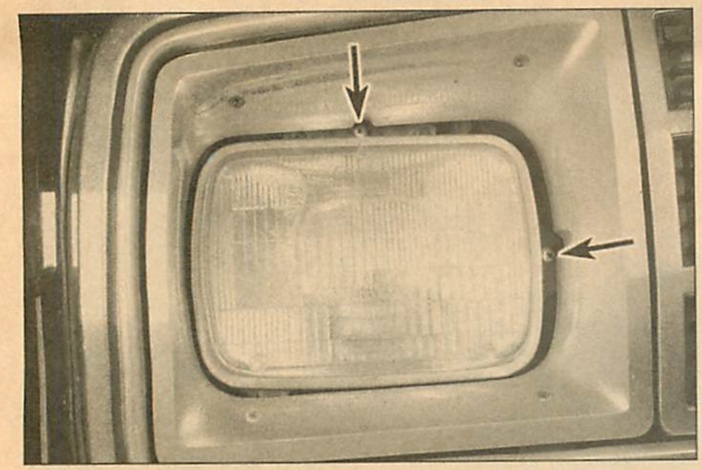
18.2 Use a Phillips screwdriver to remove each headlight bezel screw (arrows)



18.3 Remove the retaining screws (don't confuse them with the adjustment screws) and lift the headlight ring off (rectangular headlight shown, round headlight attaches the same way)



18.4 Pull the headlight forward and unplug the connector



19.1 The headlight vertical adjustment screw is located at the top of the headlight and the horizontal screw is on the side of the headlight (arrows) (rectangular headlight shown, round headlight similar)

19 Headlights - adjustment

Refer to illustrations 19.1 and 19.3

Warning: *The headlights must be aimed correctly. If adjusted incorrectly, they could temporarily blind the driver of an oncoming vehicle and cause an accident or seriously reduce your ability to see the road. The headlights should be checked for proper aim every 12 months and any time a new headlight is installed or front end body work is performed. The following procedure is only an interim step to provide temporary adjustment until the headlights can be adjusted by a properly equipped shop.*

1 Headlights have two spring loaded adjusting screws, located at the rear of the housing. The top adjuster controls up-and-down movement and the inner adjuster controls left and-right movement **(see illustration)**.

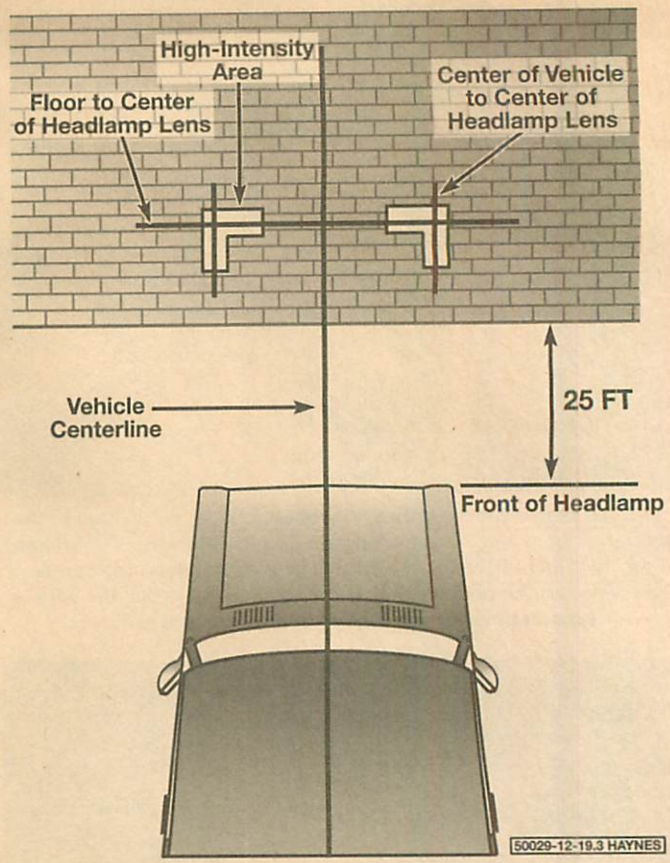
2 This adjustment procedure requires a blank wall and a level floor.

3 Position masking tape vertically on the wall in reference to the vehicle centerline and the centerlines of both headlights **(see illustration)**.

4 Position a horizontal tape line in reference to the centerline of all the headlights. **Note:** *It may be easier to position the tape on the wall with the vehicle parked only a few inches away.*

5 Adjustment should be made with the vehicle parked 25 feet from the wall, sitting level, the gas tank half-full and no unusually heavy load in the vehicle.

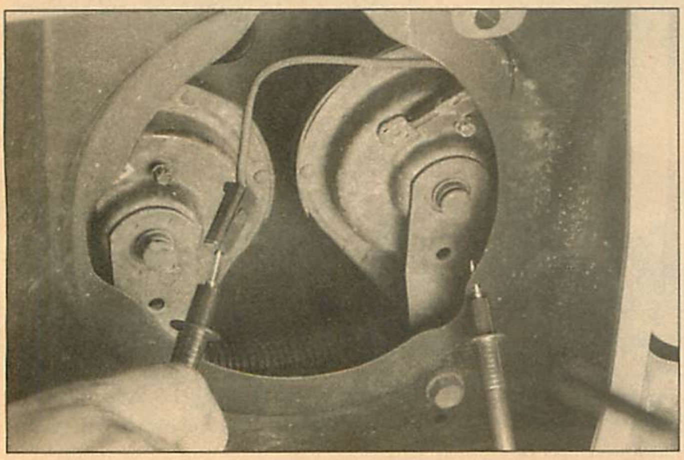
6 Starting with the low beam adjustment, position the high intensity zone so it's two inches above the horizontal line and centered on the headlight vertical line. Adjustment is made by turning the top adjusting screw clockwise to raise the beam and counterclockwise to lower the beam. The adjusting screw on the side should be used in the same manner to move the beam left or right.



19.3 Headlight adjustment details

7 With the high beams on, the high intensity zone should be vertically centered with the exact center just below the horizontal line. **Note:** *It may not be possible to properly aim the high beams. The high beam pattern should be correct if the low beams are adjusted properly.*

8 Have the headlights adjusted by a dealer service department or service station at the earliest opportunity.



20.2 Connect a voltmeter to the horn wire - test for voltage while the switch is depressed

20 Horn - check and replacement

Refer to illustrations 20.2 and 20.7

Check

Note: *Check the fuse before beginning electrical diagnosis.*

1 Disconnect the electrical connector from the horn.

2 Check for voltage at the electrical connector while the switch is depressed **(see illustration)**.

3 If voltage is present, test the horn by connecting battery voltage to the horn with jumper wires. If the horn doesn't sound, replace it.

4 If voltage is not present, the problem lies in the switch, or in the wiring between components.

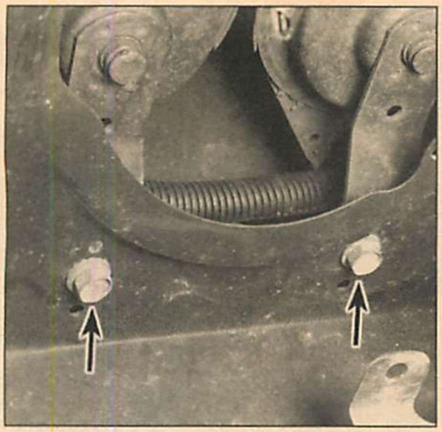
Replacement

5 On early model vehicles the horn is mounted in the engine compartment. Disconnect the electrical connector(s) and remove the mounting bolt.

6 On later model vehicles the horn is mounted behind the radiator grille. Remove the grille insert (see Chapter 11).

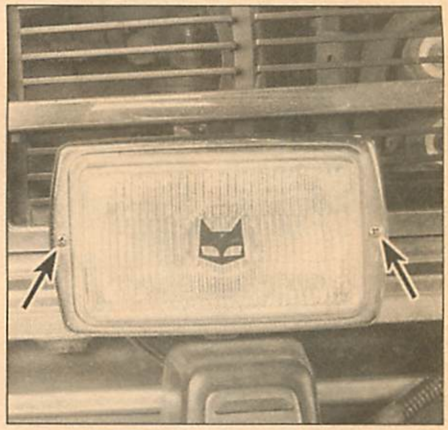
7 Disconnect the electrical connector(s) and remove the mounting bolt(s) **(see illustration)**.

8 Installation is the reverse of removal.



20.7 Remove the horn retaining bolts (later model shown)

21.1 Remove the turn signal lens retaining screws (arrows)



21.4 Detach the fog lamp retaining ring

21 Bulb replacement

Front turn signal/side marker lights

Refer to illustration 21.1

1 Remove the screws that secure the turn signal housing, lift the lens out and, rotate the bulb holder counterclockwise and pull the bulb out **(see illustration)**.

2 Remove the screws and detach the side marker housing for access to the bulb.

3 Installation is the reverse of removal.

Fog lamps

Refer to illustrations 21.4 and 21.5

4 Remove the screws securing the lamp retaining ring **(see illustration)**.

5 Lower the lamp assembly from the housing and detach the bulb from the backside **(see illustration)**..

6 Installation is the reverse of removal.

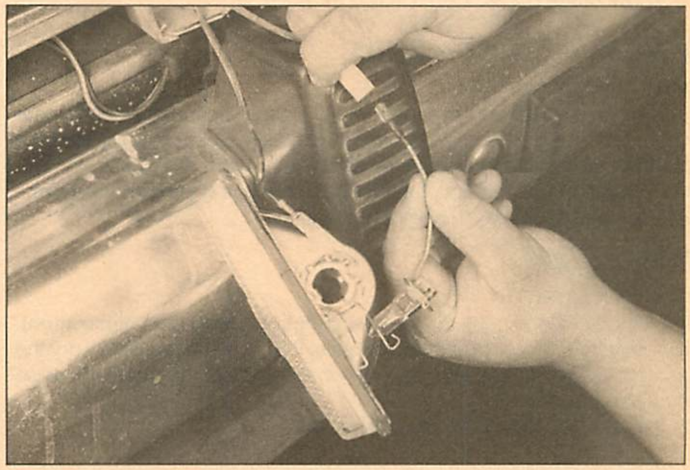
Rear tail light/brake light/turn signal

Refer to illustration 21.7

7 Remove screws and detach the tail light lens **(see illustration)**.

8 Push in and rotate the turn signal, brake light and tail light bulbs counterclockwise to remove them from the holder.

9 Installation is the reverse of removal.



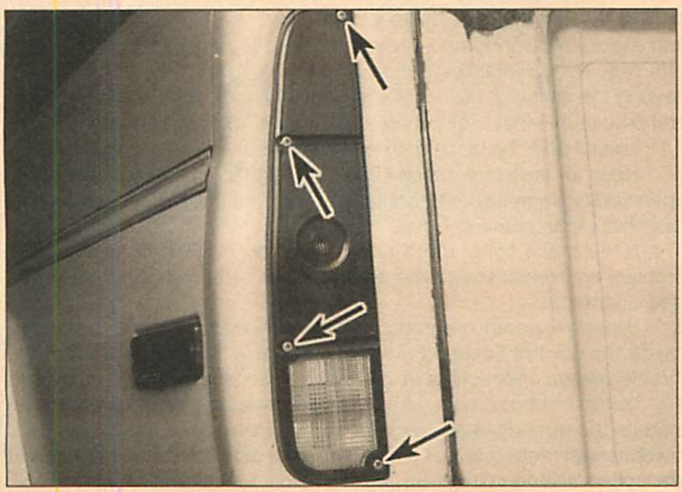
21.5 Detach the bulb from the backside as shown

License plate light

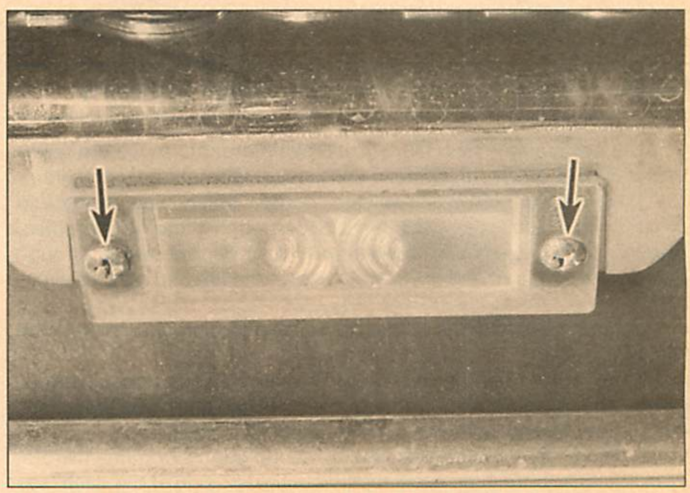
Refer to illustration 21.10

10 Remove the screws (if equipped) and detach the bulb and lens assembly **(see illustration)**, then disconnect the wires from the backside.

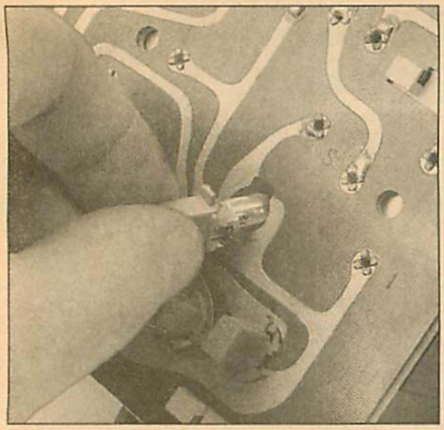
11 Installation is the reverse of removal.



21.7 Remove the tail light lens to access the bulb (early model shown)

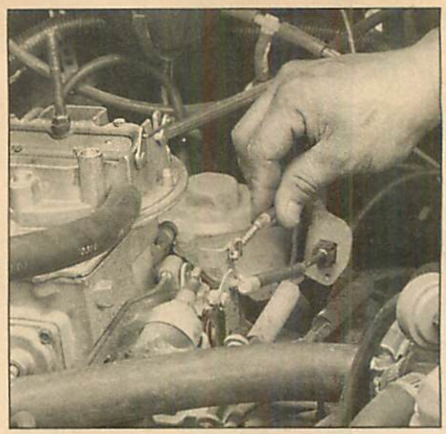


21.10 To remove the license plate light, detach the screws and electrical connector(s) then pull it down and out (later model shown)



21.13 Remove the instrument cluster bulbs by rotating them 1/4-turn counterclockwise and pulling straight out

21.15 Pop out the dome light lens to access the bulb



24.5 Check for free movement of the cruise control throttle linkage

Instrument cluster lights

Refer to illustration 21.13

12 To gain access to the instrument cluster illumination bulbs, the instrument cluster will have to be removed (see Section 12). The bulbs can then be removed and replaced from the rear of the cluster.
13 Rotate the bulb counterclockwise to remove it **(see illustration)**.
14 Installation is the reverse of removal.

Interior light

Refer to illustration 21.15

15 Pry the interior lens off the interior light housing **(see illustration)**.
16 Detach the bulb from the terminals. It may be necessary to pry the bulb out - if this is the case, pry only on the ends of the bulb (otherwise the glass may shatter).
17 Installation is the reverse of removal.

22 Daytime Running Lights (DRL) - general information

The Daytime Running Lights (DRL) system used on Canadian models applies power to the headlights whenever the engine is started. The only exception is when the engine is started with the parking brake engaged. Once the parking brake is released, the lights will remain on as long as the ignition switch is on, even if the parking brake is later applied.

The DRL system supplies reduced power to the headlights so they won't be too bright for daytime use while prolonging headlight life.

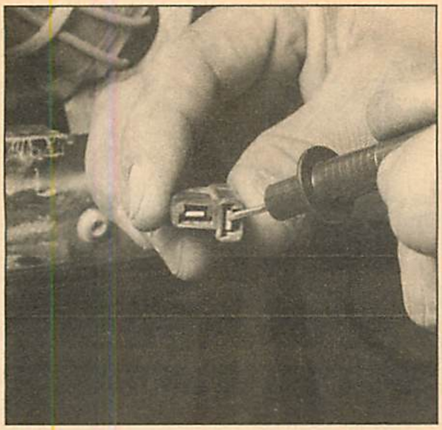
23 Electric rear view mirrors - description and check

1 The electric rear view mirrors use two motors to move the glass; one for up and down adjustments and one for left-right adjustments.
2 The control switch has a selector portion which sends voltage to the left or right side mirror. With the ignition switch in the ACC position, roll down the windows and operate the mirror control switch through all functions (left-right and up-down) for both the left and right side mirrors.
3 Listen carefully for the sound of the electric motors running in the mirrors.
4 If the motors can be heard but the mirror glass doesn't move, there's probably a problem with the drive mechanism inside the mirror. Remove and disassemble the mirror to locate the problem.
5 If the mirrors don't operate and no sound comes from the mirrors, check the fuse in the fuse block located in the left side of the dash (see Section 3).
6 If the fuse is OK, remove the switch bezel (see Chapter 11) for access to the back of the mirror control switch without disconnecting the wires attached to it. Turn the ignition ON and check for voltage at the switch. There should be voltage at one terminal. If there's no voltage at the switch, check for an open or short in the wiring between the fuse panel and the switch.
7 If there's voltage at the switch, disconnect it. Check the switch for continuity in all its operating positions. If the switch does not have continuity, replace it.
8 Re-connect the switch. Locate the wire going from the switch to ground. Leaving the switch connected, connect a jumper wire between this wire and ground. If the mirror works normally with this wire in place, repair the faulty ground connection.
9 If the mirror still doesn't work, remove the mirror and check the wires at the mirror for voltage. Check with the ignition ON and the mirror selector switch on the appropriate side. Operate the mirror switch in all its positions. There should be voltage at two of the switch-to-mirror wires in each switch position (except the neutral "off" position).
10 If there's not voltage in each switch position, check the wiring between the mirror and control switch for opens and shorts.
11 If there's voltage, remove the mirror and test it off the vehicle with jumper wires. Replace the mirror if it fails this test.

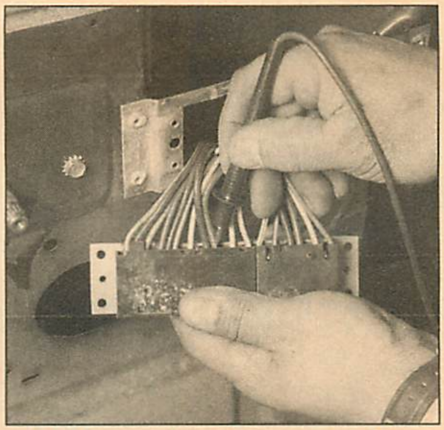
24 Cruise control system - description and check

Refer to illustrations 24.5

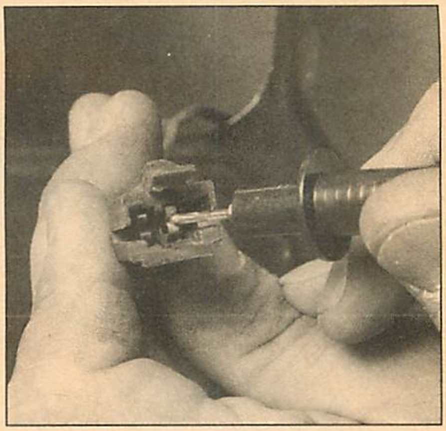
1 The cruise control system maintains vehicle speed with servo motor connected to the throttle linkage by a cable. The system consists of the servo motor, brake switch, clutch switch, control switches and associated wiring and vacuum hoses. Some features of the system requires special testers and diagnostic procedures which are beyond the scope of the home mechanic. Listed below are some general procedures that may be used to locate common problems.
2 Locate and check the fuse (see Section 3).
3 Have an assistant operate the brake lights while you check their operation (voltage from the brake light and, if equipped, clutch switch deactivates the cruise control).
4 If the brake lights don't come on or don't shut off, correct the problem and retest the cruise control. Check the clutch pedal switch (see Chapter 8).
5 Visually inspect the vacuum hose connected to the servo and check the control linkage between the cruise control servo and the throttle linkage and replace as necessary **(see illustration)**.
6 Cruise controls use a variety of speed sensing devices. On these models the speed sensor pickup is located between the upper and lower speedometer cables. It converts speedometer cable revolutions into speed analog voltage for the regulator. Detach the sensor, rotate the sensor and check it with a digital voltmeter while it's rotating (see Chapter 4). If the resistance doesn't vary as the cable rotates, the sensor is defective.



25.9 Check for voltage at each terminal with the switch depressed in either position



25.11 Check for voltage at the switch



26.10 Voltage should be present at one terminal with the switch depressed in one direction; voltage should be present at the other terminal with the switch depressed the other direction

7 Test drive the vehicle to determine if the cruise control is now working. If it isn't, take it to a dealer service department or an automotive electrical specialist for further diagnosis and repair.

25 Power window system - description and check

Refer to illustrations 25.9 and 25.11

1 The power window system consists of the control switches, the motors, glass mechanisms (regulators) and associated wiring.

2 Power windows are wired so they can be lowered and raised from the master control switch by the driver or by remote switches located at the individual windows. Each window has a separate motor which is reversible. The position of the control switch determines the polarity and therefore the direction of operation. Depending on the model year of the vehicle some power window circuits are equipped with a relay that controls current flow to the motors.

3 When the ignition switch is turned ON, power flows from the battery through the circuit breaker in the fuse block, then to the window control switches.

4 These procedures are general in nature, so if you can't find the problem using them, take the vehicle to a dealer service department or other qualified repair shop.

5 If the power windows don't work at all, check the fuse or circuit breaker.

6 If only one window is inoperative from the master control switch, try the other control switch at the window. **Note:** *This doesn't apply to the drivers door window.*

7 If the same window works from one switch but not the other, check the switch for continuity.

8 If the switch tests OK, check for a short or open in the wiring between the affected switch and the window motor.

9 If one window is inoperative from both switches, remove the trim panel from the affected door and check for voltage at the motor while the switch is operated **(see illustration)**.

10 If voltage is reaching the motor, disconnect the glass from the regulator (see Chapter 11). Move the window up and down by hand while checking for binding and damage. Also check for binding and damage to the regulator. If the regulator is not damaged and the window moves up and down smoothly, replace the motor (see Chapter 11). If there's binding or damage, lubricate, repair or replace parts, as necessary.

11 If voltage isn't reaching the motor, and the switch tests OK, check for voltage at the switch **(see illustration)**. If no voltage is present at the switch, check the wiring in the circuit for continuity between the switches and the fuse panel. On vehicles with electrically operated tailgate windows, check that the relay (if equipped) is grounded properly and receiving voltage from the switches. Also check that the relay sends voltage to the motor when the switch is turned on. If it doesn't, replace the relay. If the relay is OK, check tailgate safety switch for continuity.

26 Power door lock and keyless entry system - description and check

Refer to illustration 26.10

1 The power door lock system operates the door lock actuators mounted in each door. The system consists of the switches, actuators, relays and associated wiring. Diagnosis can usually be limited to simple checks of the wiring connections and actuators for minor faults which can be easily repaired.

2 Power door lock systems are operated by bi-directional solenoids located in the doors. The lock switches have two operating positions: lock and unlock. On later models with keyless entry the switches activate a relay which in turn connects voltage to the door lock solenoids. Depending on which way the relay is activated, it reverses polarity, allowing the two sides of the circuit to be used alternately as the feed (positive) and ground side. On earlier models with out keyless entry the switches directly activate the door lock motors.

3 If you are unable to locate the trouble using the following general steps, consult your a dealer service department.

4 Always check the circuit protection first. On these models the battery voltage passes through the 30 amp circuit breaker located in the passenger compartment fuse block.

5 Operate the door lock switches in both directions (Lock and Unlock) with the engine off. Listen for the faint click of the door lock solenoid (motor) or relay operating.

6 If there's no click, check for voltage at the switches. If no voltage is present, check the wiring between the fuse block and the switches for shorts and opens.

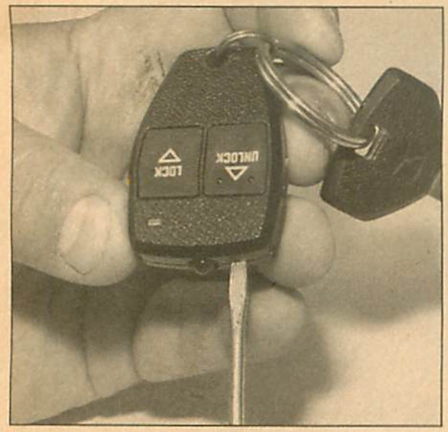
7 If voltage is present but no click is heard, test the switch for continuity. Replace it if there's no continuity in both switch positions.

8 If the switch has continuity but the solenoid or relay don't click, check the wiring between the switch and solenoid or relay for continuity. Repair the wiring if there's not continuity.

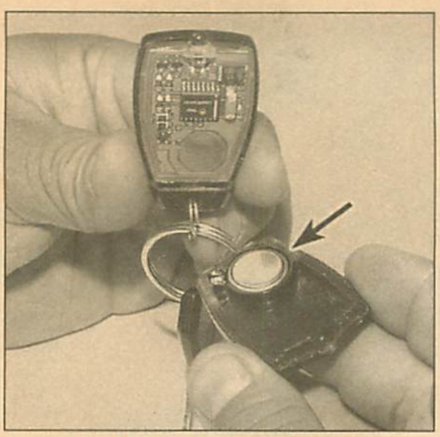
9 On later models if the relay is receiving voltage from the switch but is not sending voltage to the solenoids, check for a bad ground at the relay case. If the relay case is grounding properly, replace the relay.

10 If all but one lock solenoids operate, remove the trim panel from the affected door (see Chapter 11) and check for voltage at the solenoid while the lock switch is operated **(see illustration)**. One of the wires should have voltage in the Lock position; the other should have voltage in the unlock position.

12



26.15 Use a small screwdriver to separate the transmitter halves



26.16 Replace the lithium batteries (arrow)

27.6 Check for voltage at the power seat motor connector

11 If the inoperative solenoid is receiving voltage, replace the solenoid.

12 If the inoperative solenoid isn't receiving voltage, check for an open or short in the wire between the lock solenoid and the relay.

Note: *It's common for wires to break in the portion of the harness between the body and door (opening and closing the door fatigues and eventually breaks the wires).*

Keyless entry system

Refer to illustrations 26.15 and 26.16

13 The keyless entry system consists of a remote control transmitter that sends a coded infrared signal to a receiver located in the overhead console or dome lamp housing that operates the door lock system.

14 Replace the transmitter batteries when the red LED light on the side of the case doesn't light when the button is pushed.

15 Use a small screwdriver to carefully separate the case halves **(see illustration)**.

16 Replace the two lithium batteries **(see illustration)**.

17 Snap the case halves together.

27 Power seats - description and check

Refer to illustration 27.6

1 Power seats allow you to adjust the position of the seat with little effort. These models feature a six-way seat that goes forward and backward, up and down and tilts forward and backward. The seats are powered by a three armature permanent magnet reversible motor that is mounted under the seat and is controlled by switches on the side of the seat. Each switch changes the direction of seat travel by reversing polarity to the drive motor.

2 Diagnosis is a simple matter, using the following procedures.

3 Look under the seat for any object which may be preventing the seat from moving.

4 If the seat won't work at all, check the 30 amp circuit breaker in the fuse block.

5 With the engine off to reduce the noise level, operate the seat controls in all directions and listen for sound coming from the seat motors.

6 If the motor doesn't work, check for voltage at the motor while an assistant operates the switch **(see illustration)**.

7 If the motor is getting voltage but doesn't run, test it off the vehicle with jumper wires. If it still doesn't work, replace it.

8 If the motor isn't getting voltage, check for voltage at the switch. If there's no voltage at the switch, check the circuit breaker. If the circuit breaker is OK, check the wiring between the fuse panel and the switch. If there's voltage at the switch, check the switch for continuity in all its operating positions. Replace the switch if there's no continuity.

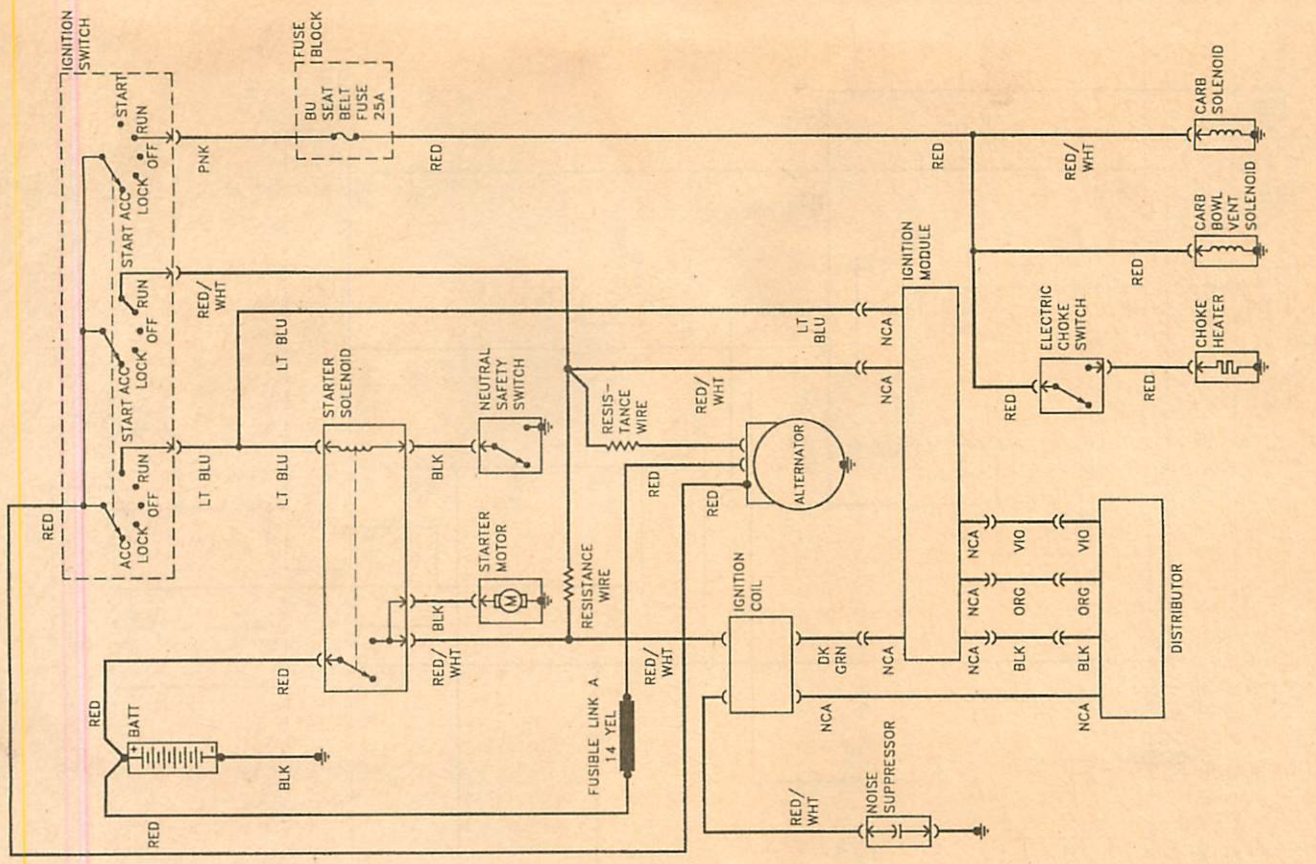
9 If the switch is OK, check for a short or open in the wiring between the switch and motor.

28 Wiring diagrams - general information

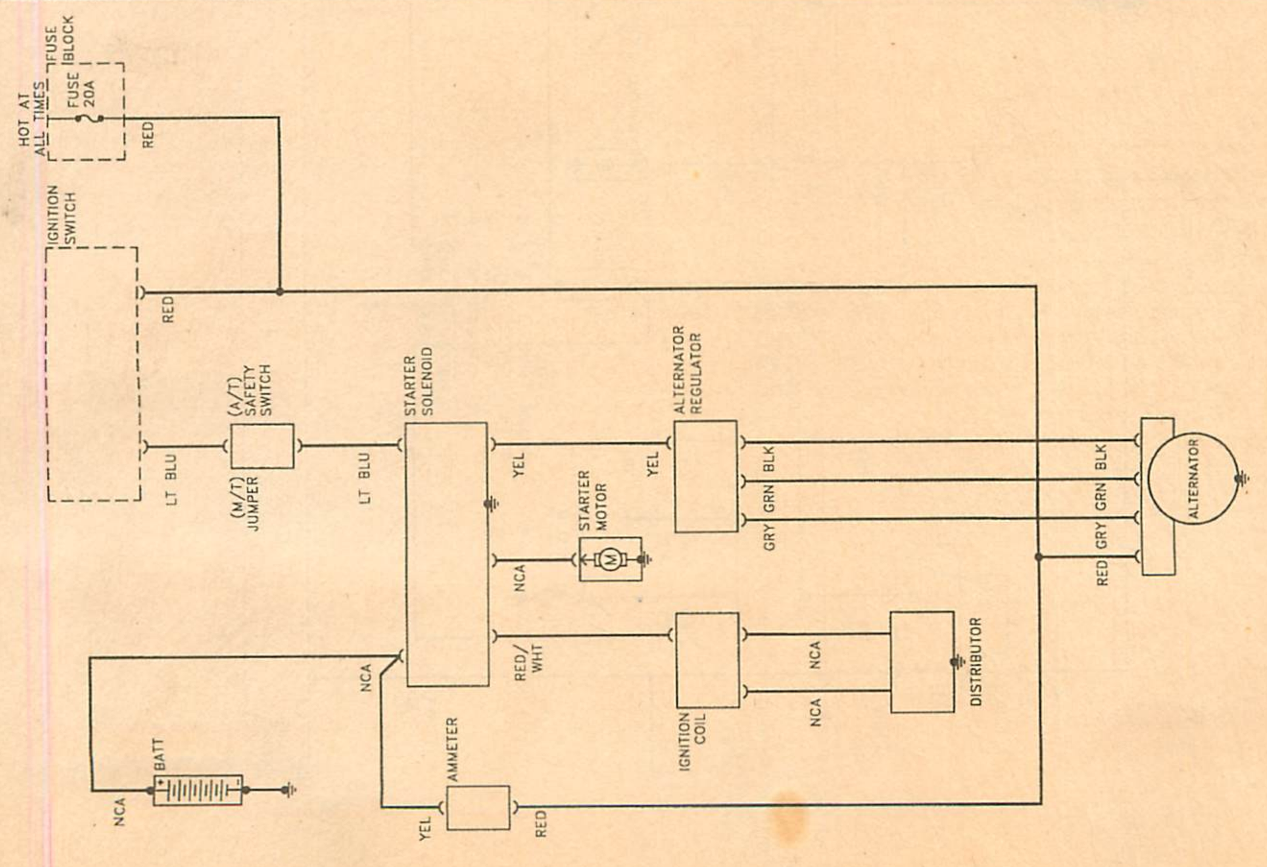
Since it isn't possible to include all wiring diagrams for every year covered by this manual, the following diagrams are those that are typical and most commonly needed.

Prior to troubleshooting any circuits, check the fuse and circuit breakers (if equipped) to make sure they are in good condition. Make sure the battery is properly charged and has clean, tight cable connections (see Chapter 1).

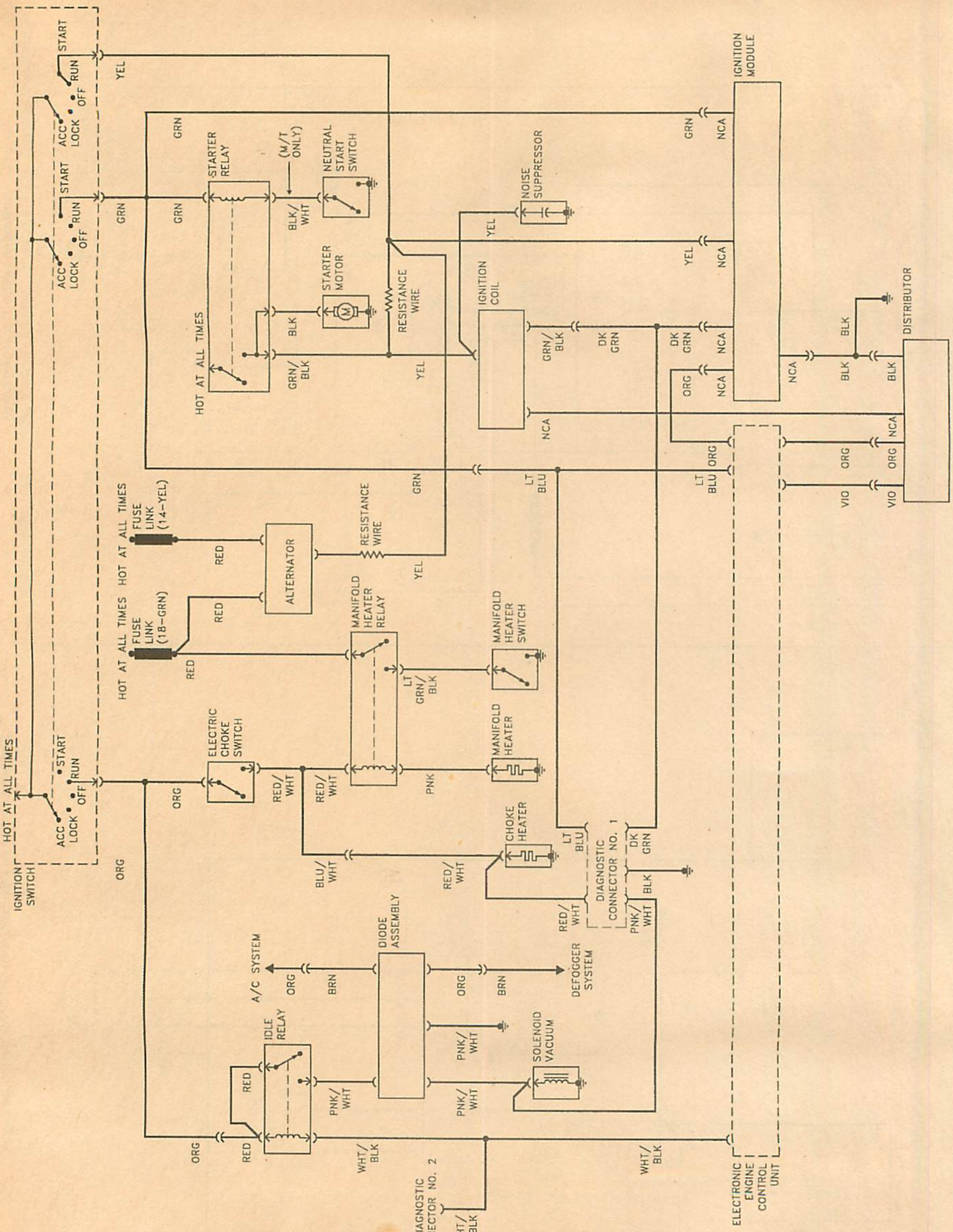
When checking the wiring system, make sure that all electrical connectors are clean, with no broken or loose pins. When disconnecting an electrical connector, do not pull on the wires, only on the connector housings themselves.



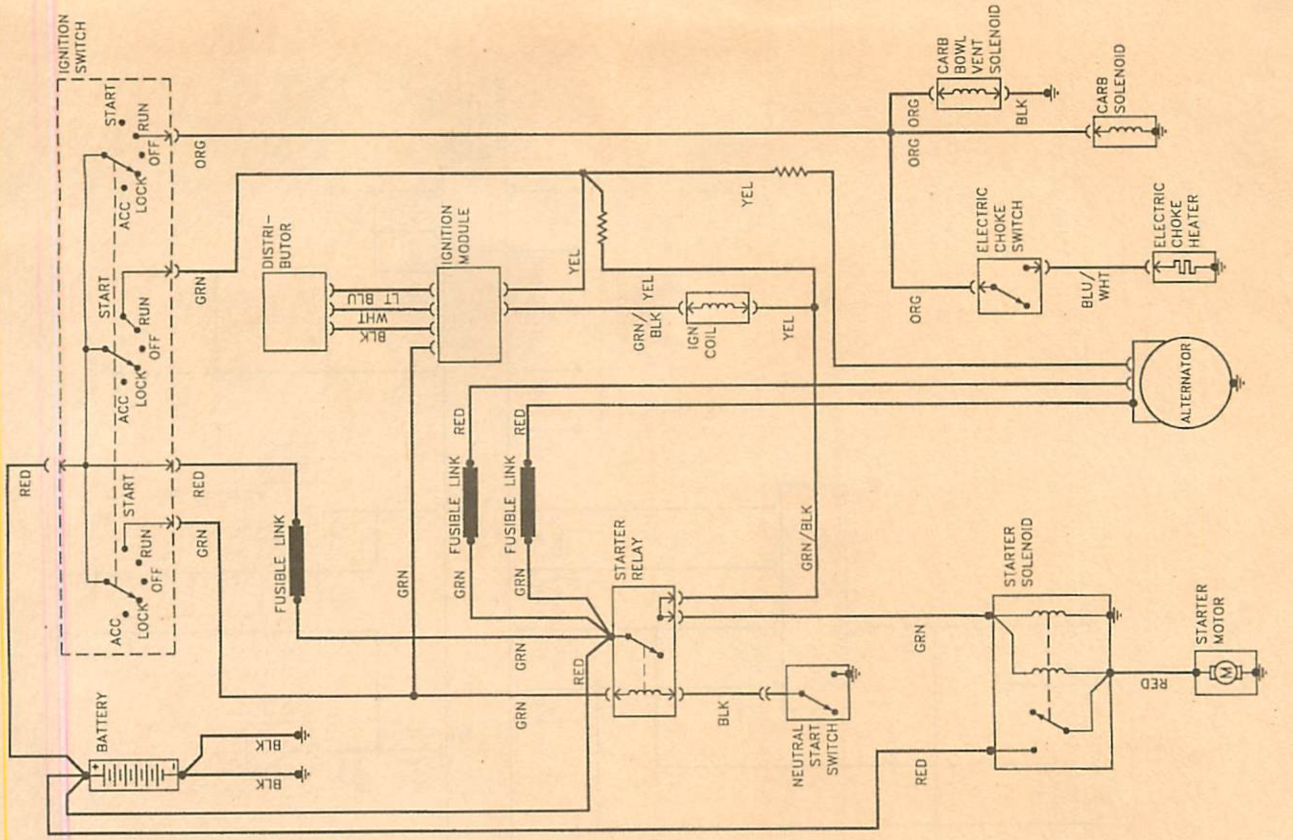
1975 through 1986 V8 engine and 1975 through 1980 six-cylinder engine starting, charging and ignition systems



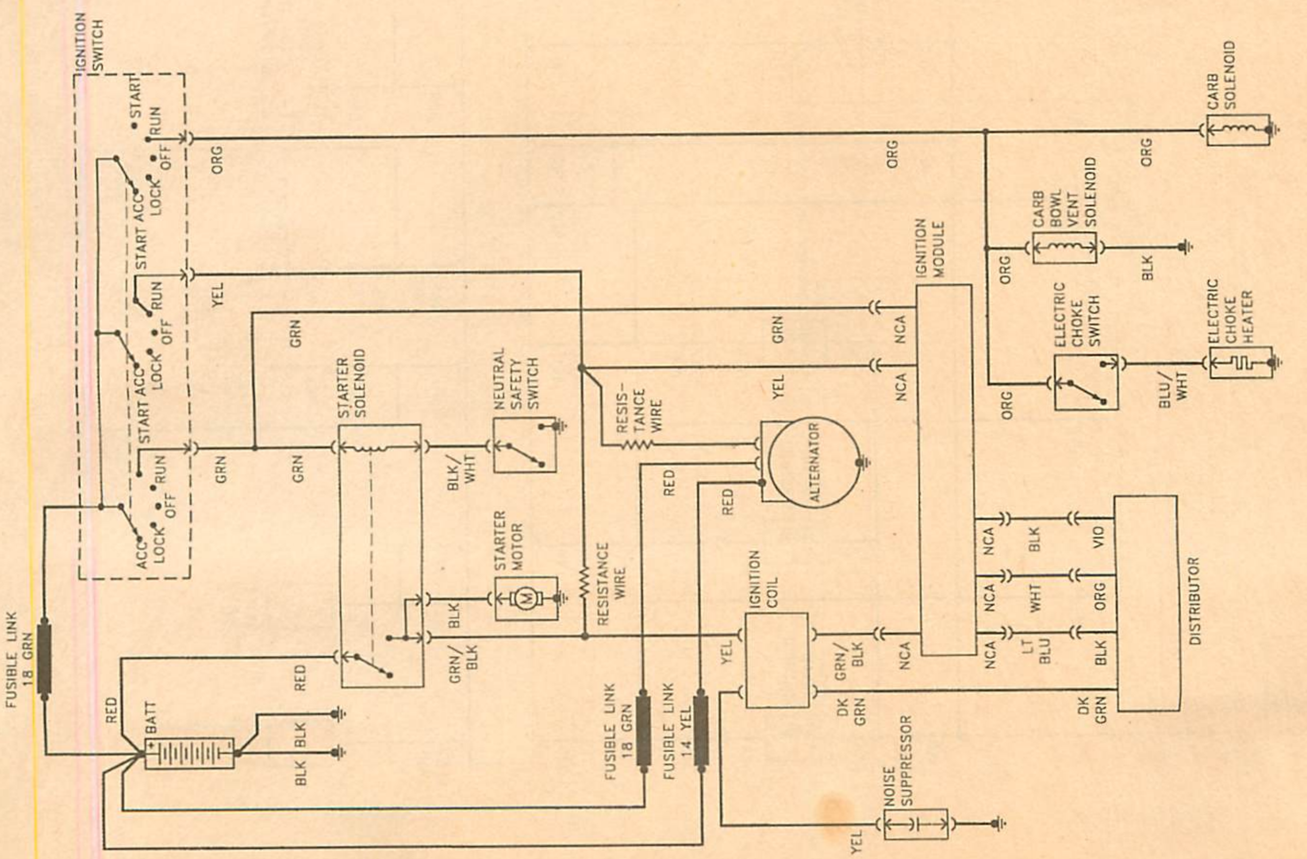
1974 and earlier starting, charging and ignition systems



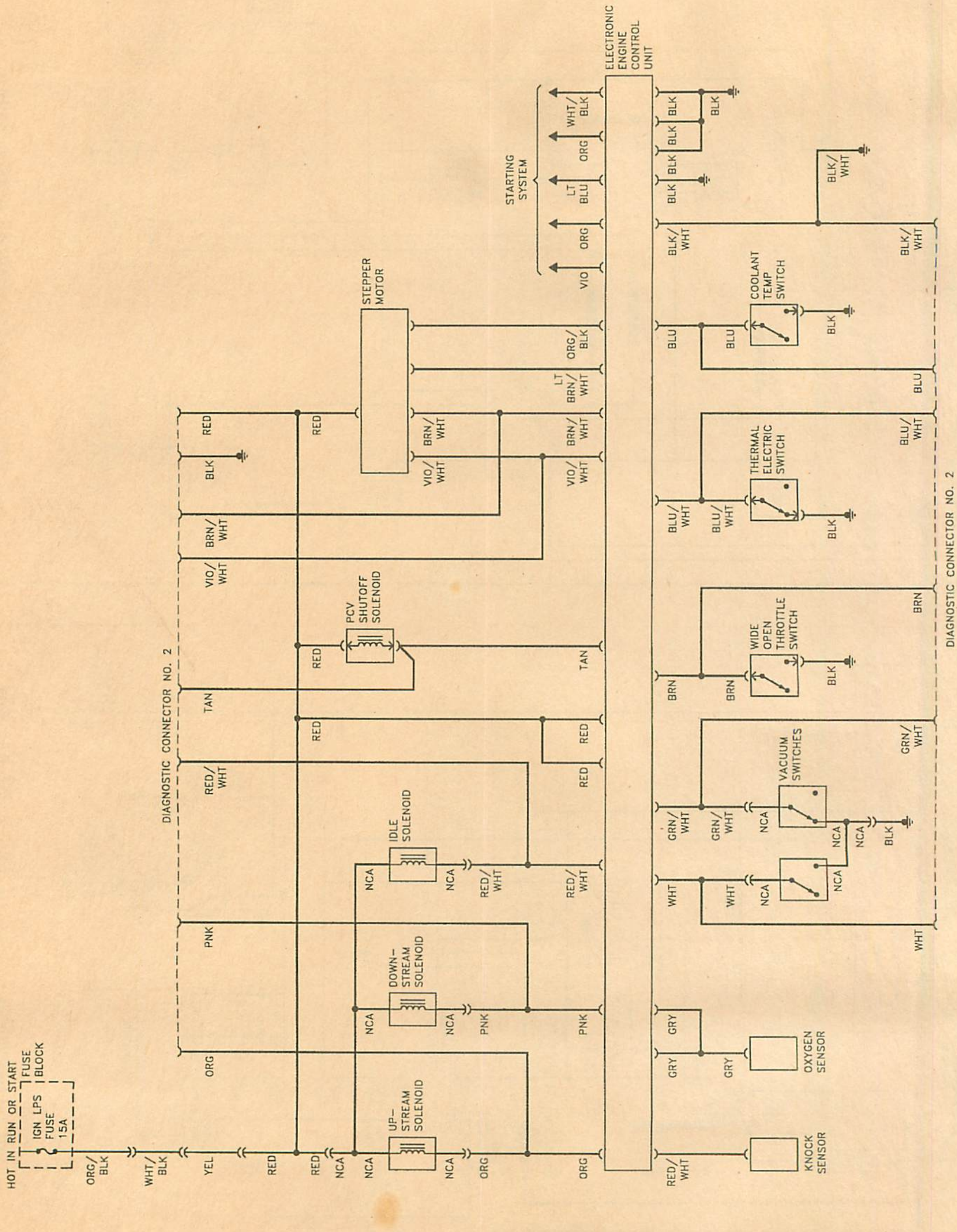
1981 through 1988 six-cylinder engine starting, charging and ignition systems



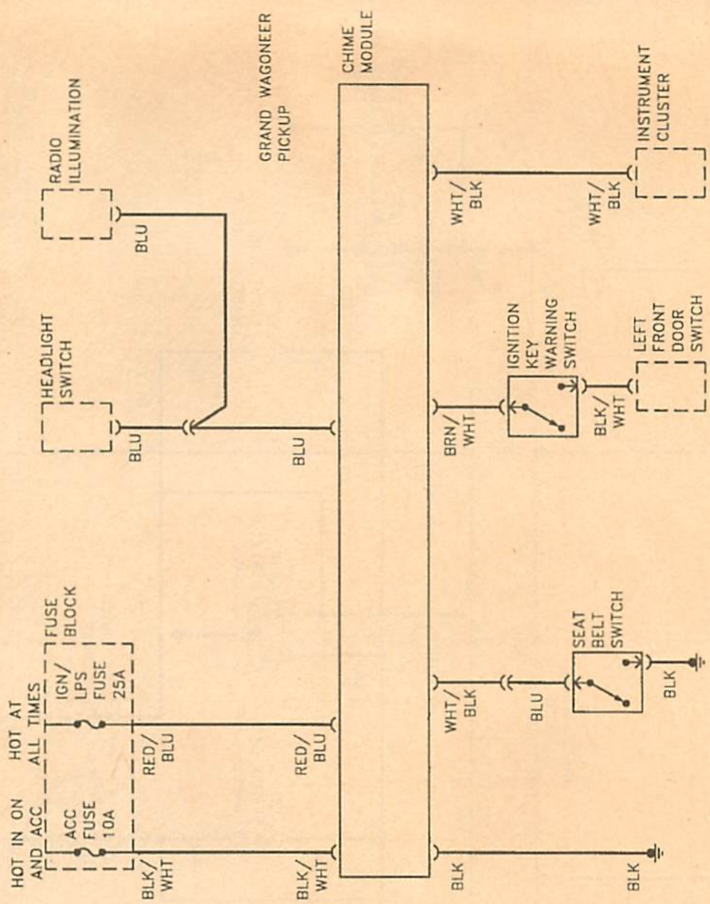
1989 and later starting, charging and ignition systems



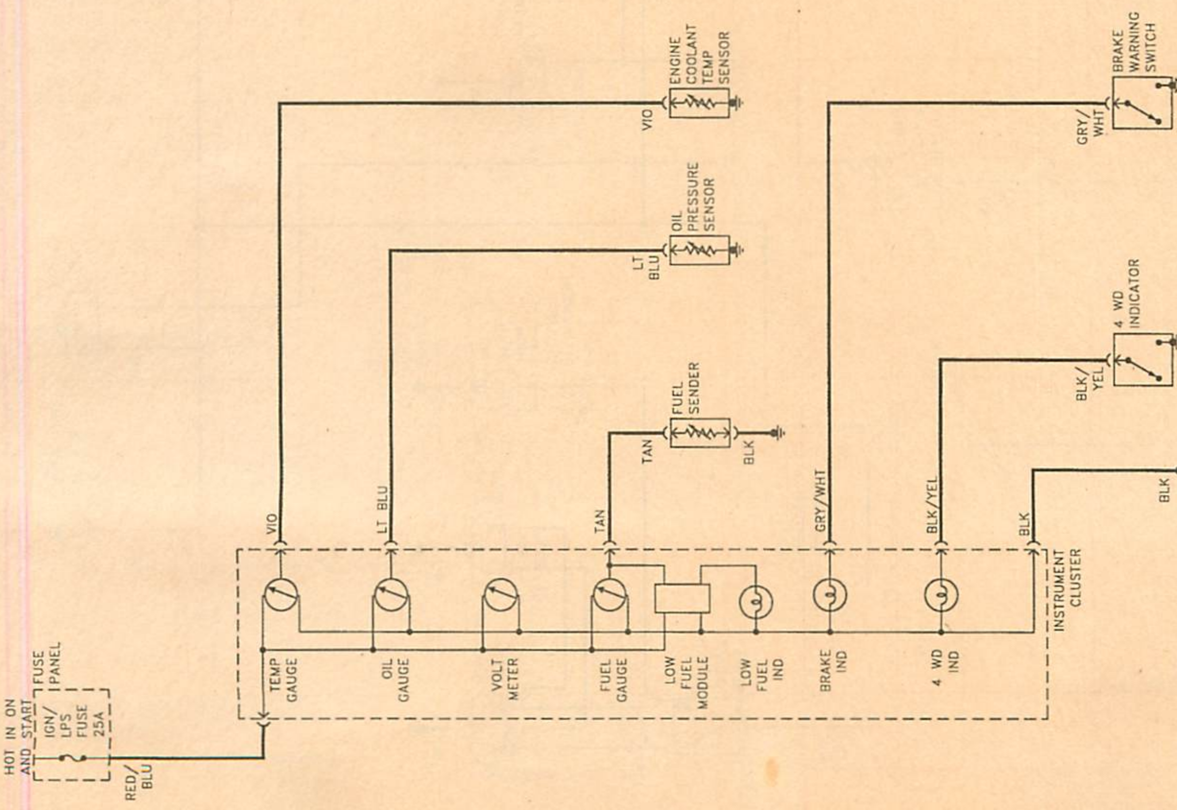
1987 and 1988 V8 engine starting, charging and ignition systems



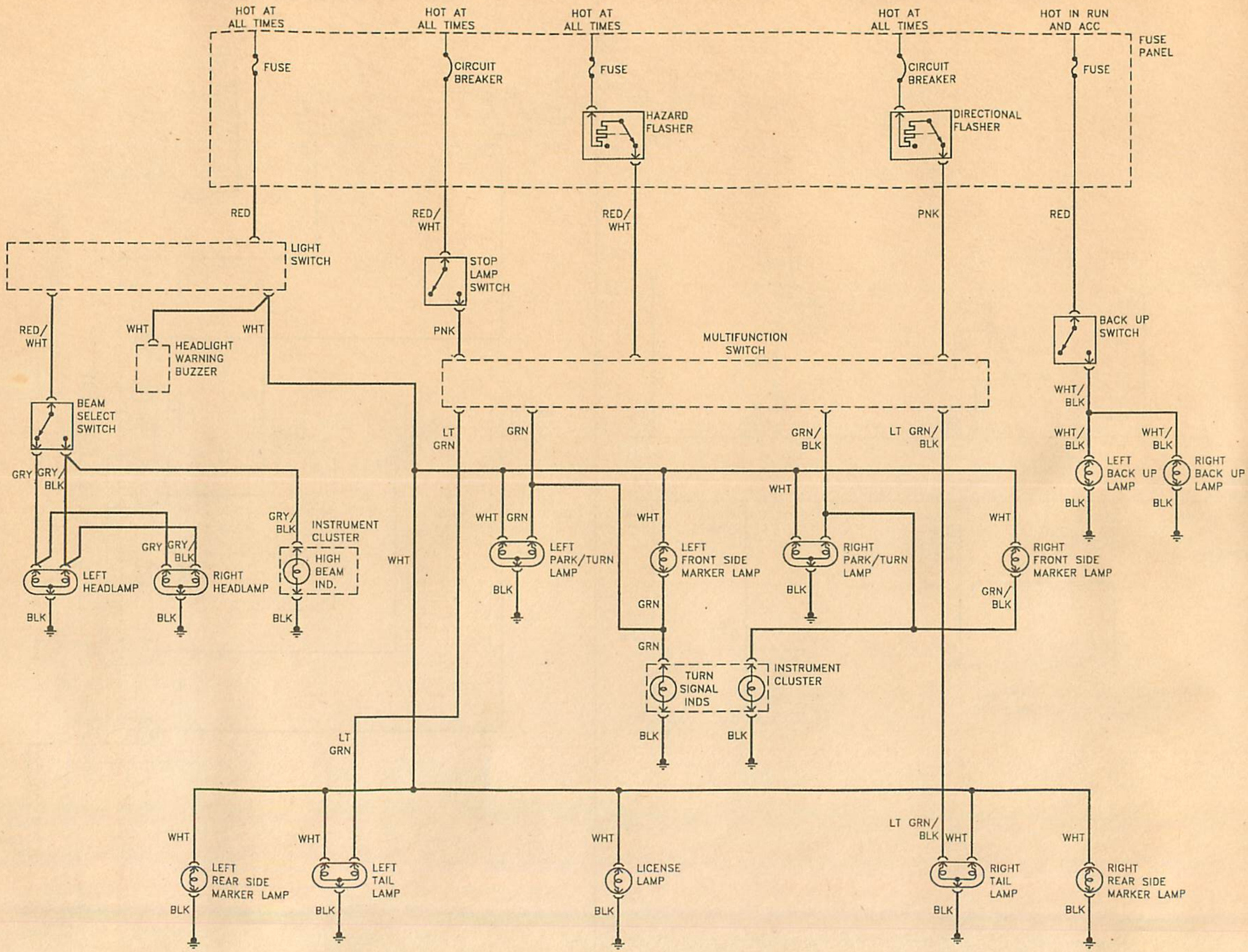
Six-cylinder engine feedback carburetor control system



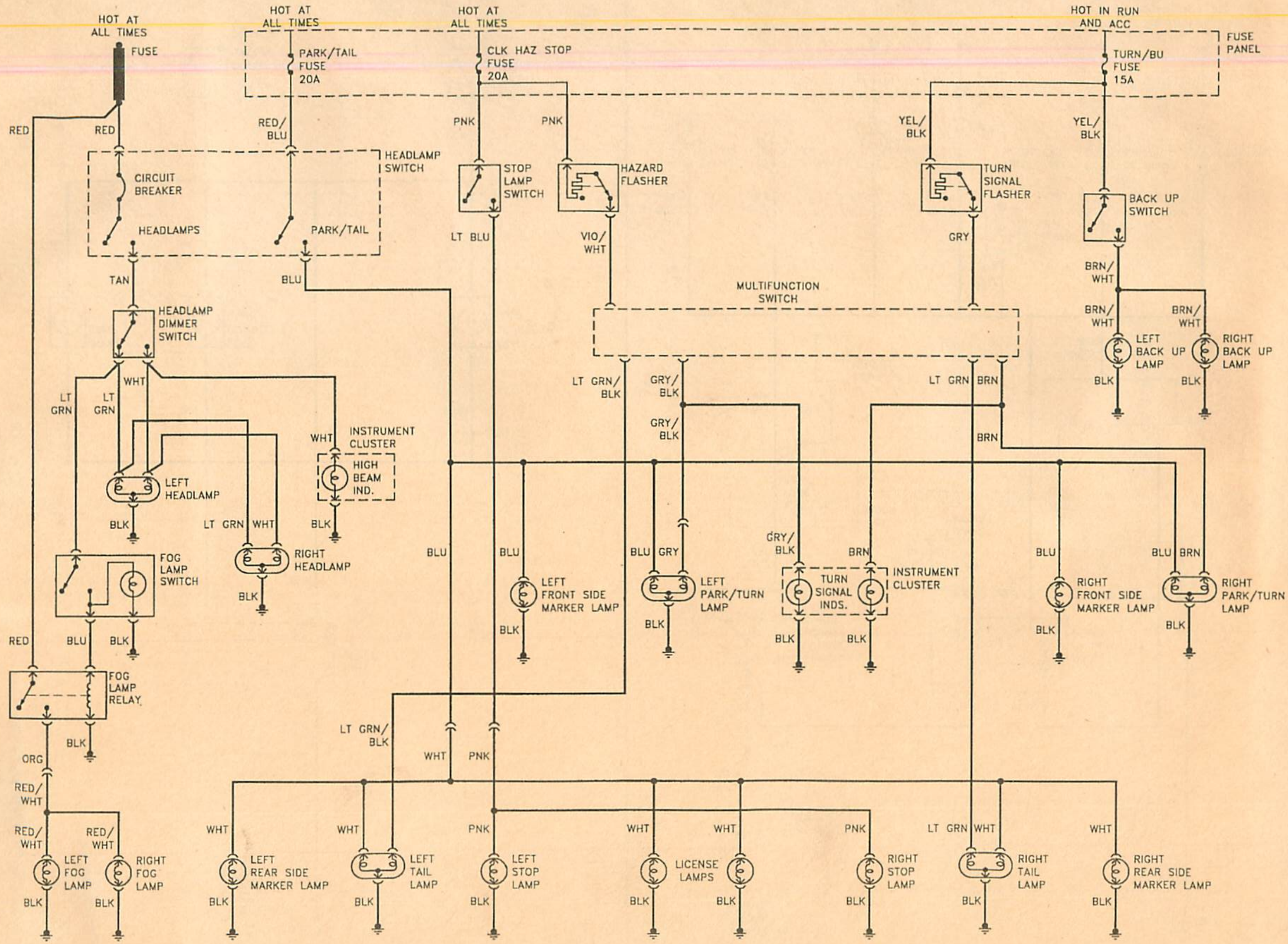
Typical warning chime system



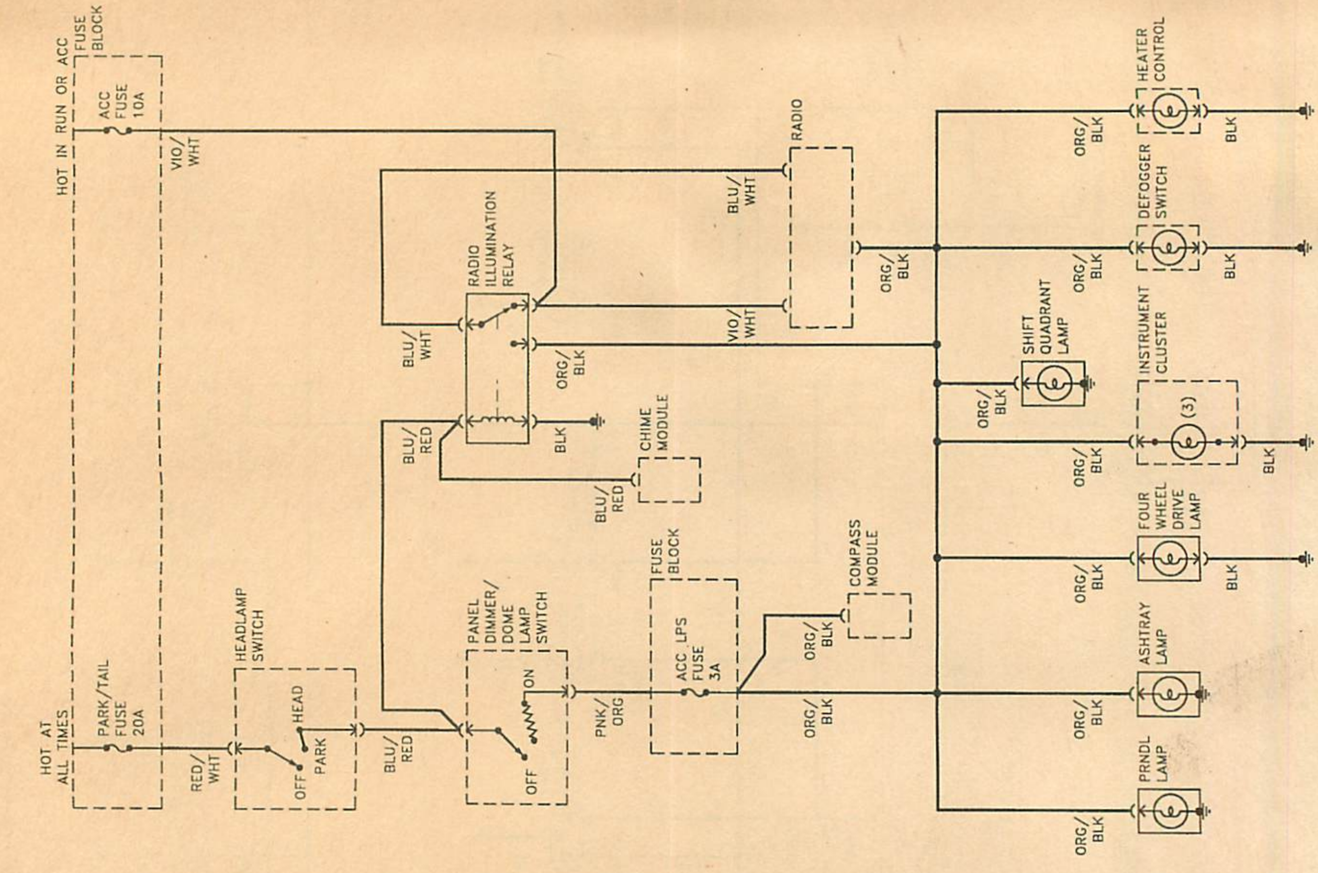
Typical engine indicators and warning systems



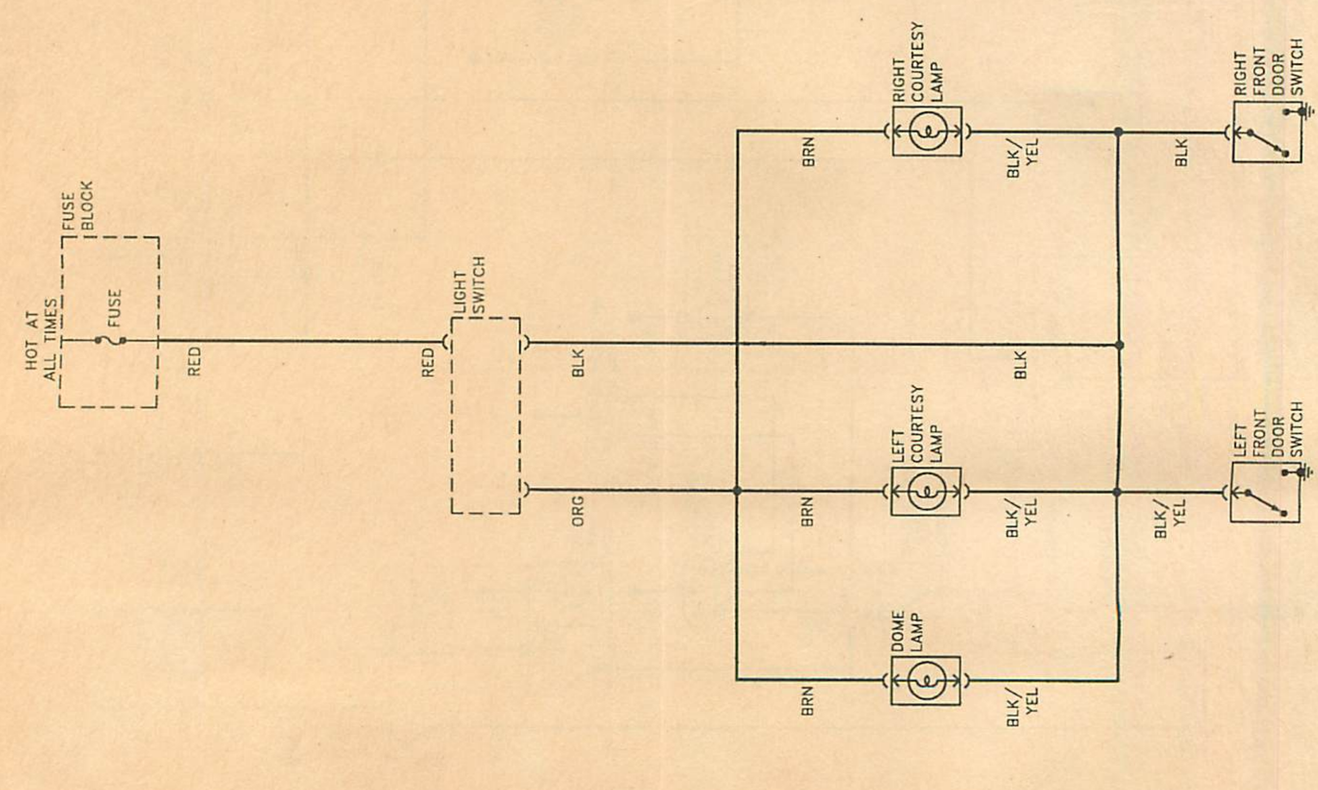
1981 and earlier exterior lighting system



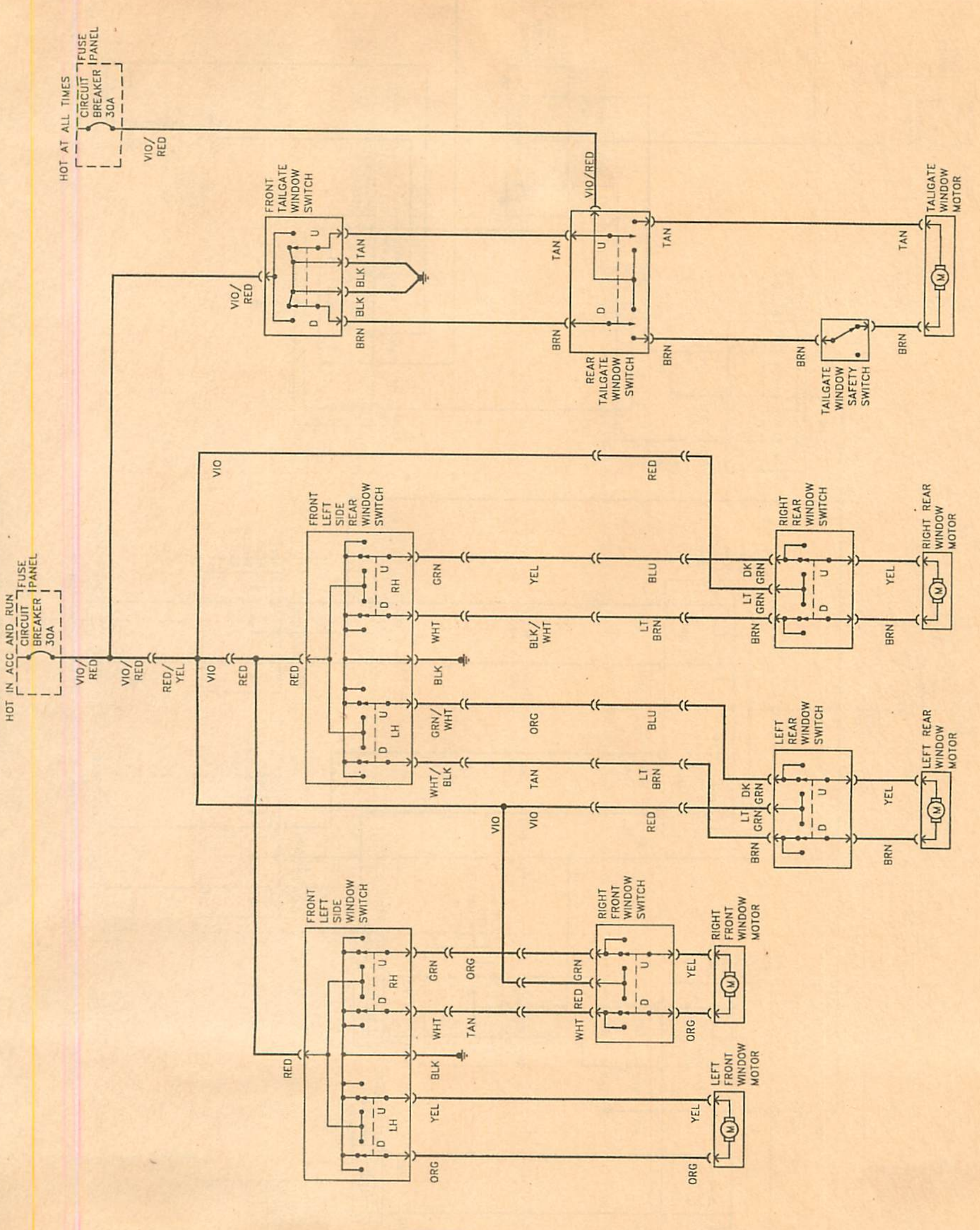
1982 and later exterior lighting system



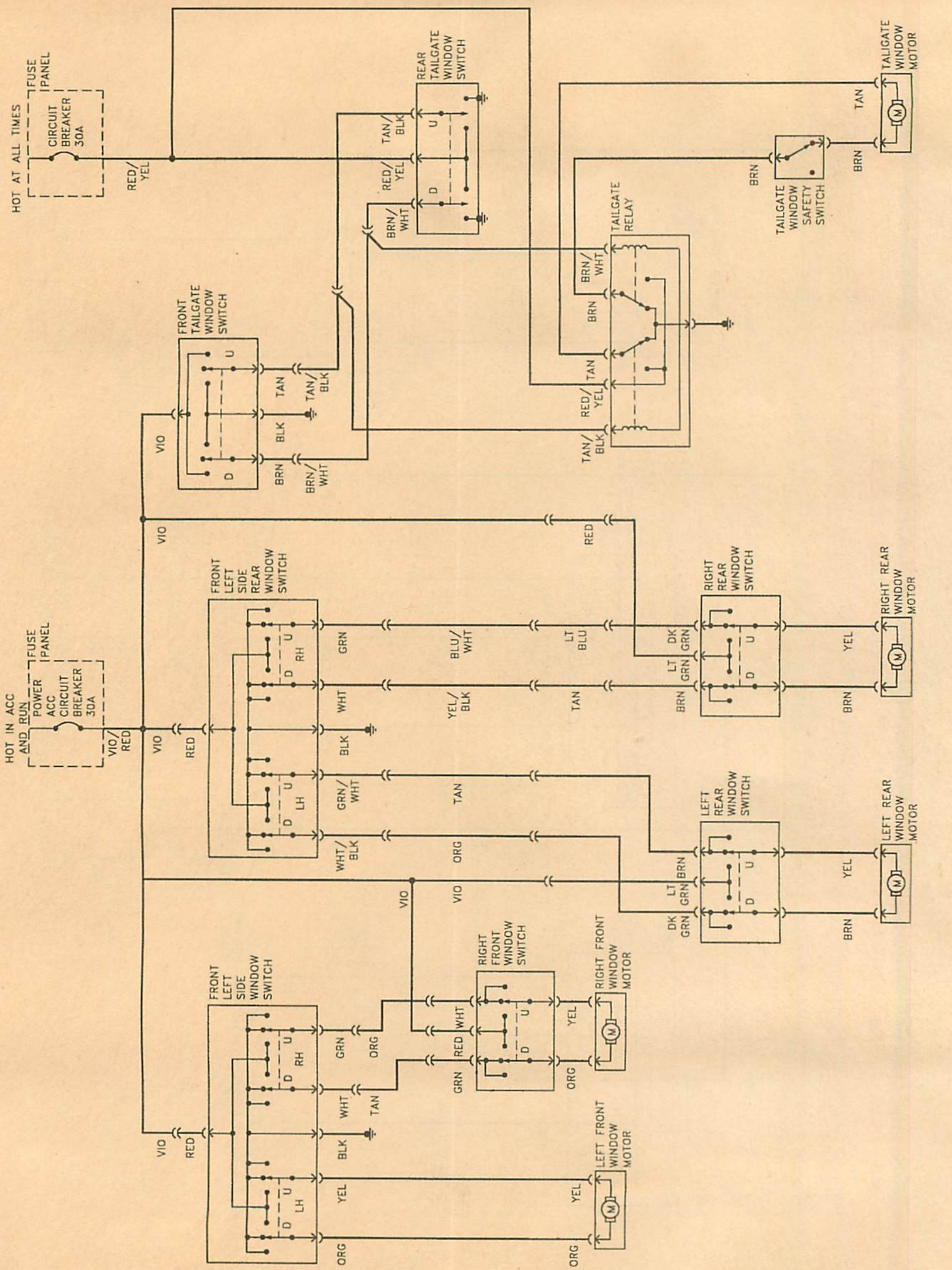
Typical instrument panel illumination



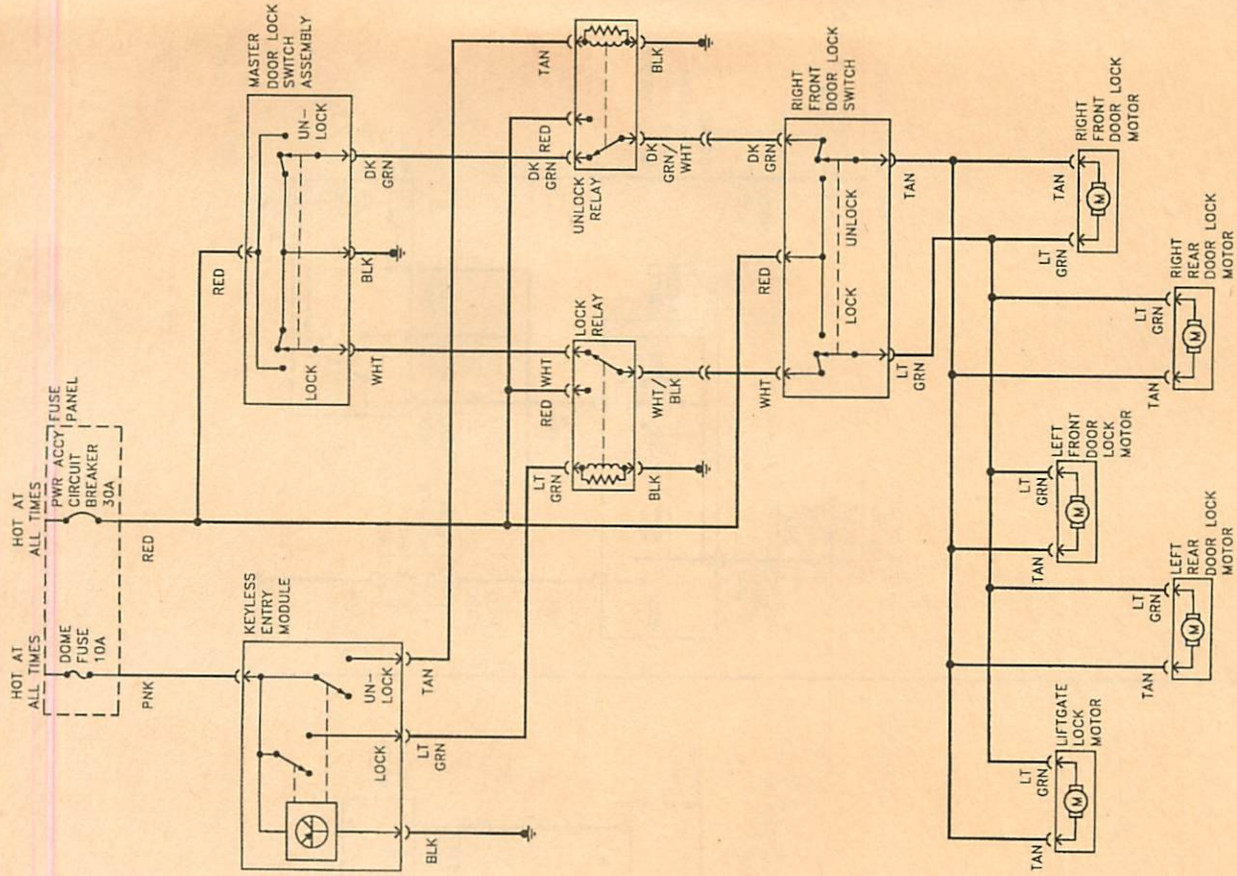
Typical dome light illumination



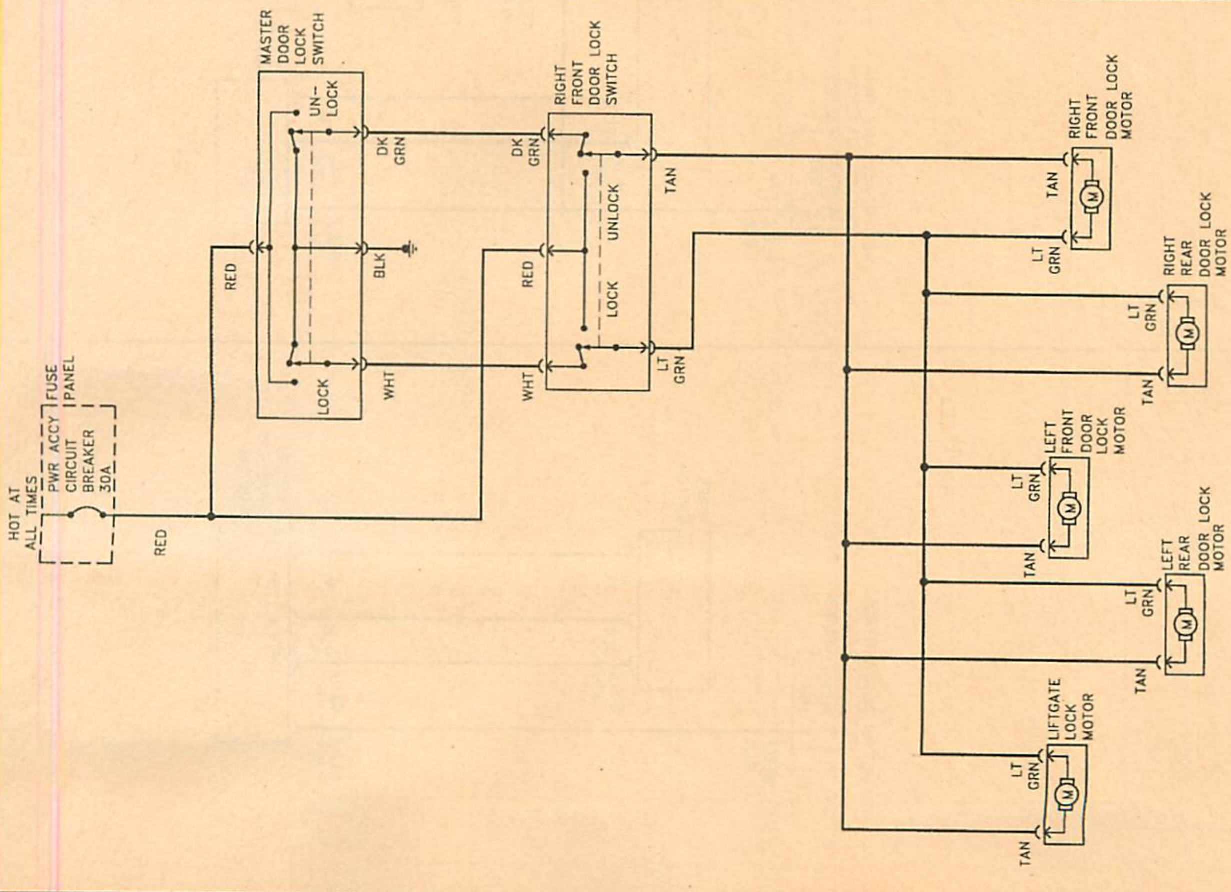
1988 and earlier power window system



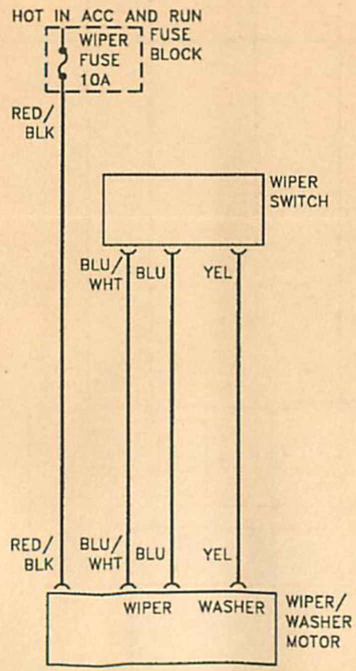
1989 and later power window system



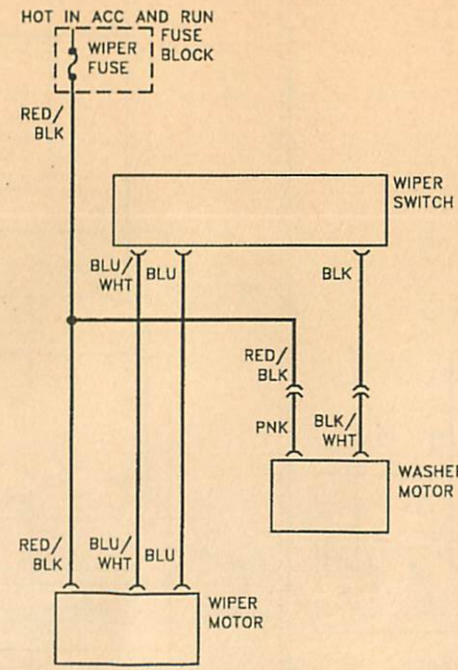
Power door lock system - with keyless entry



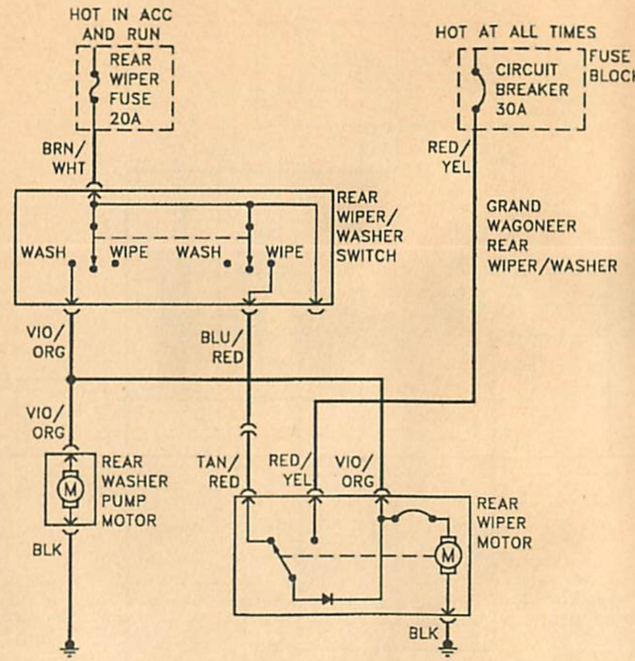
Power door lock system - without keyless entry



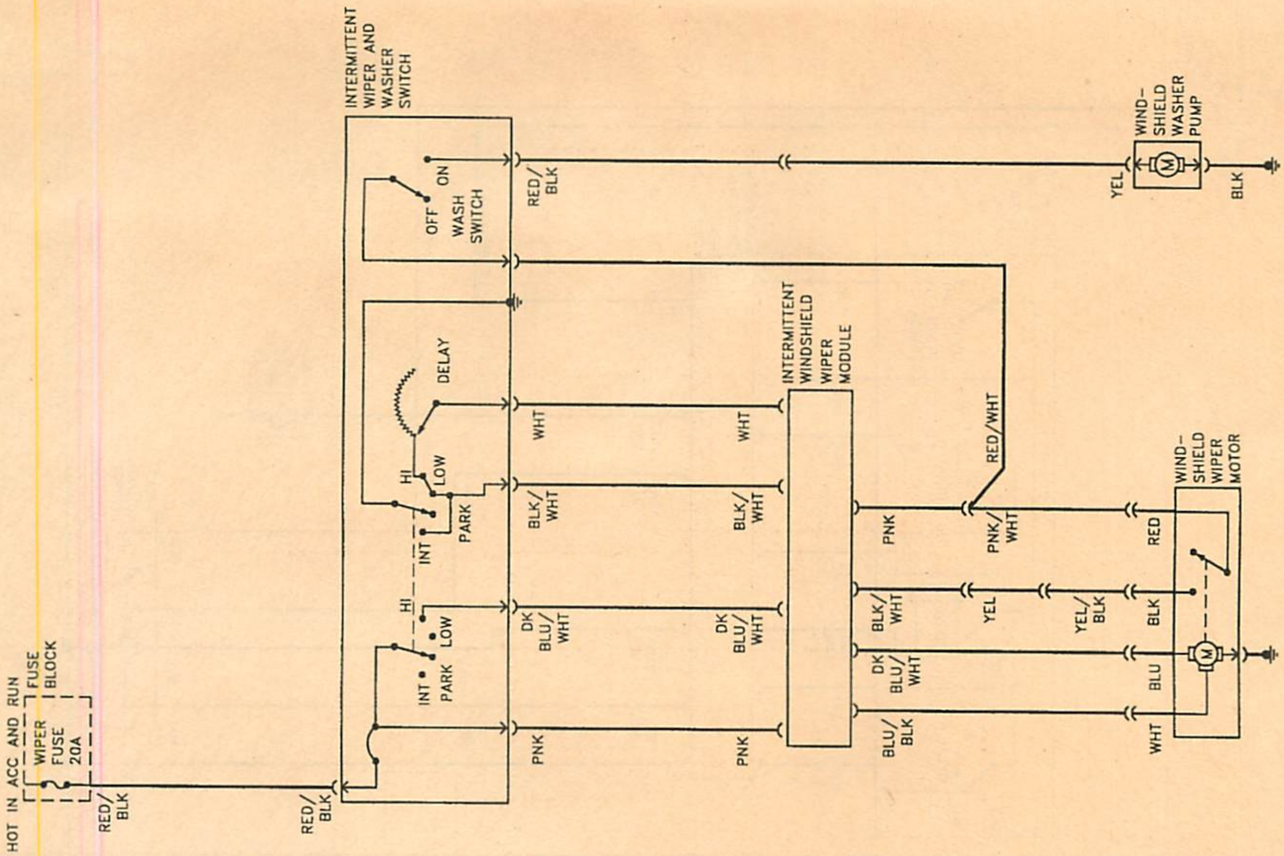
1974 and earlier windshield wiper/washer system



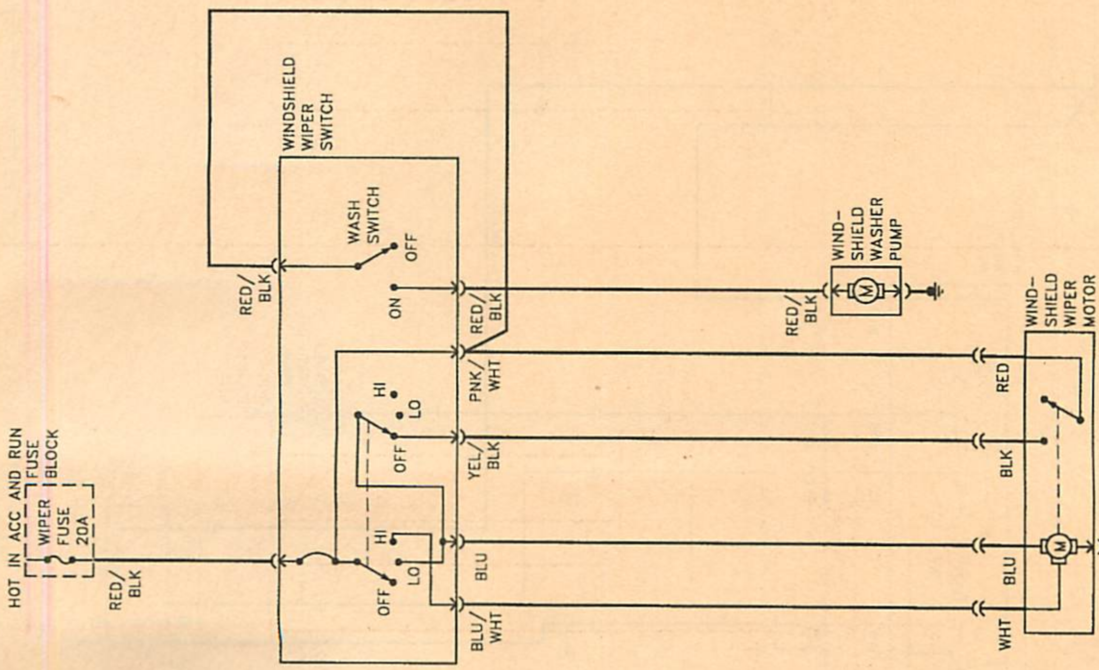
1975 through 1979 windshield wiper/washer system



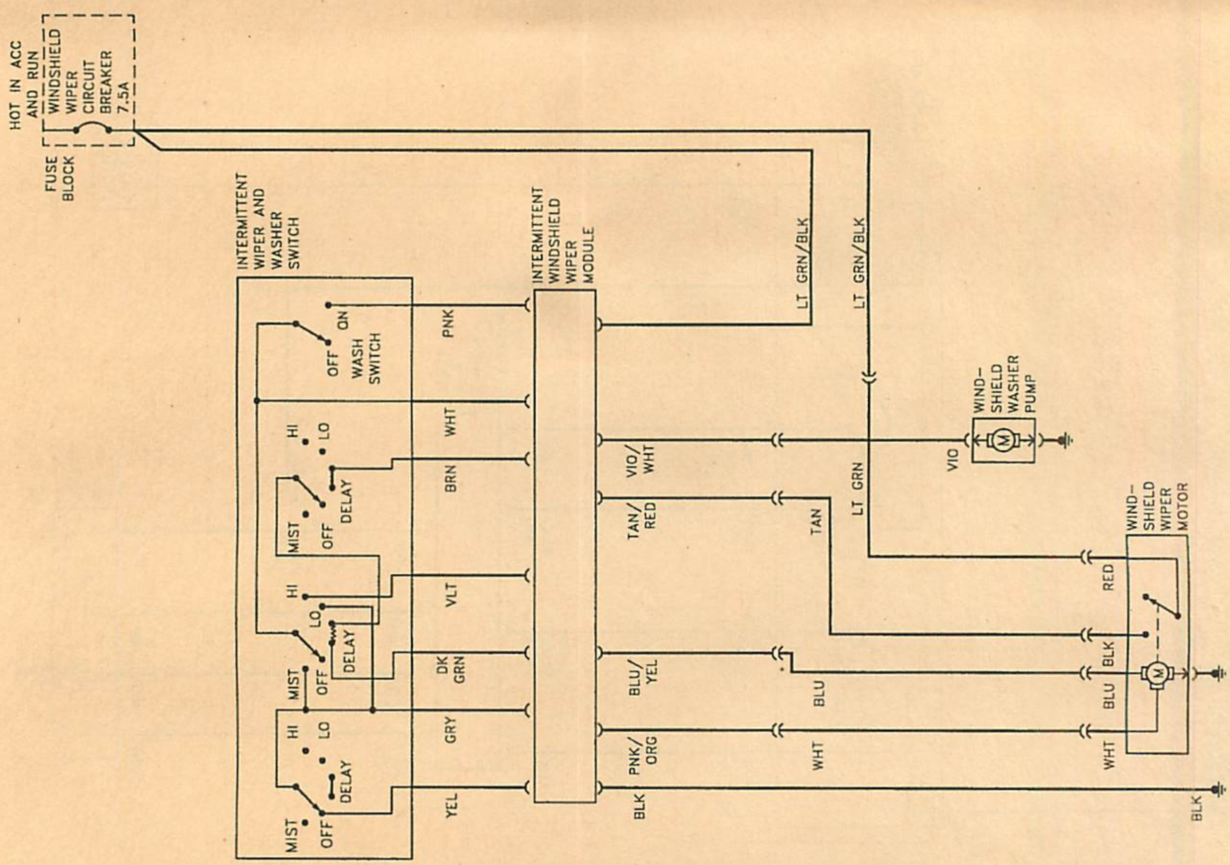
Typical rear window wiper/washer system



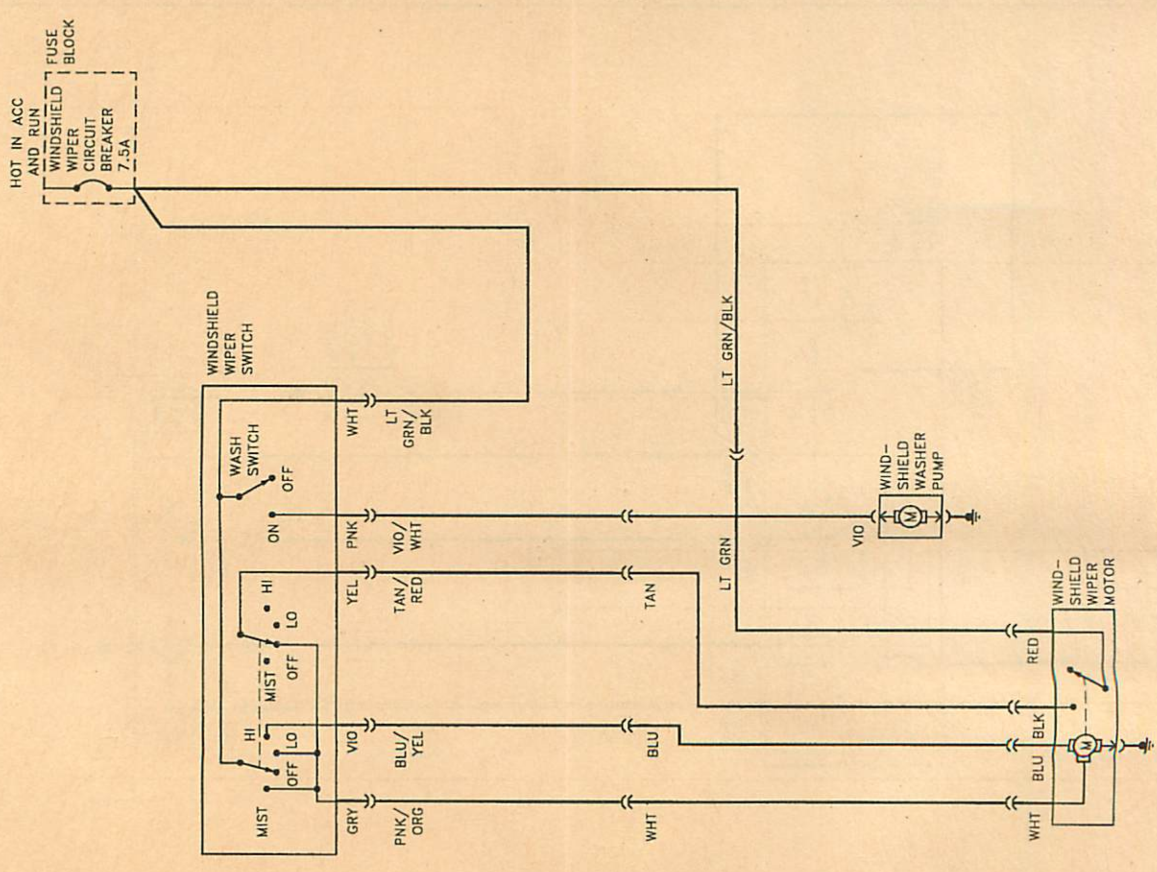
1980 through 1985 windshield wiper/washer system - with intermittent wipers



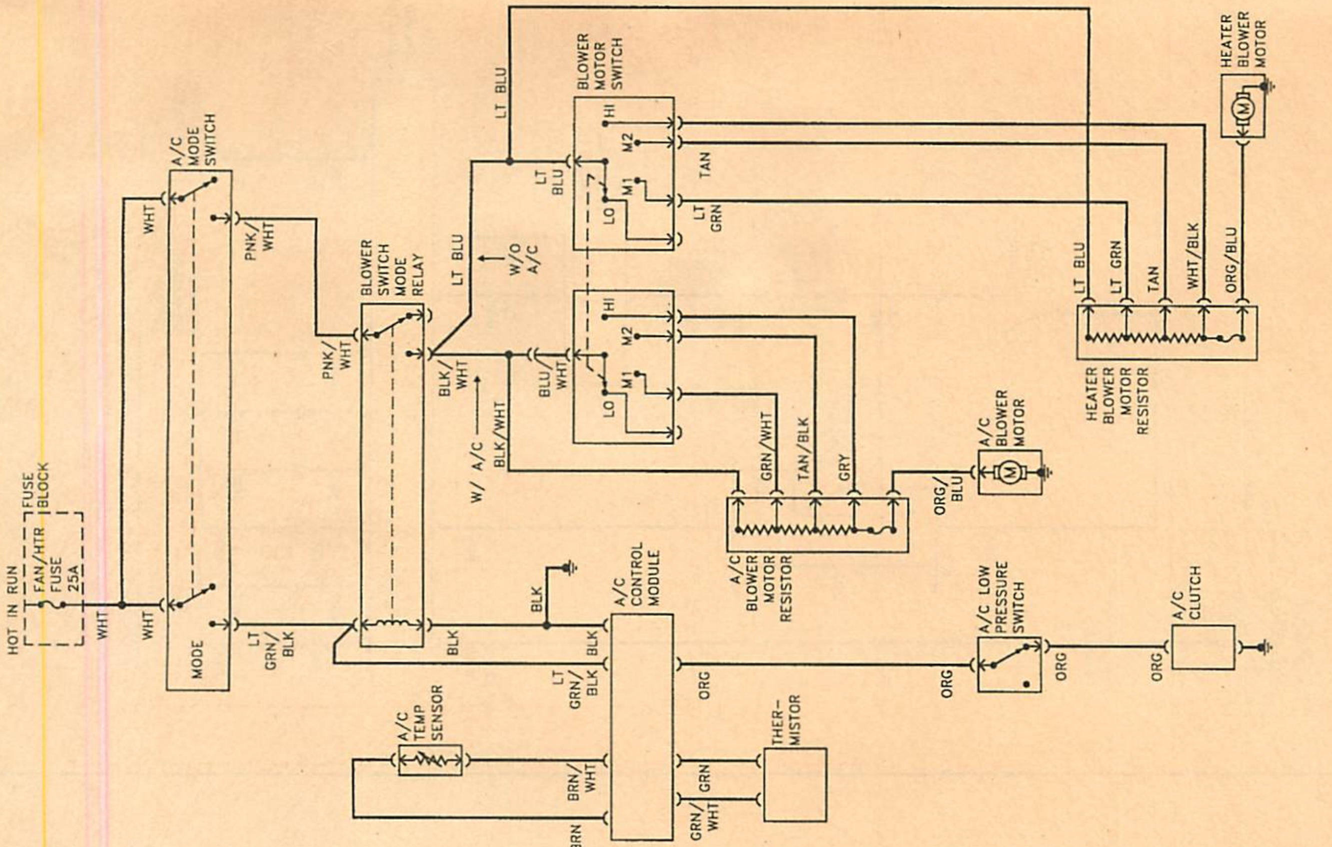
1980 through 1985 windshield wiper/washer system - without intermittent wipers



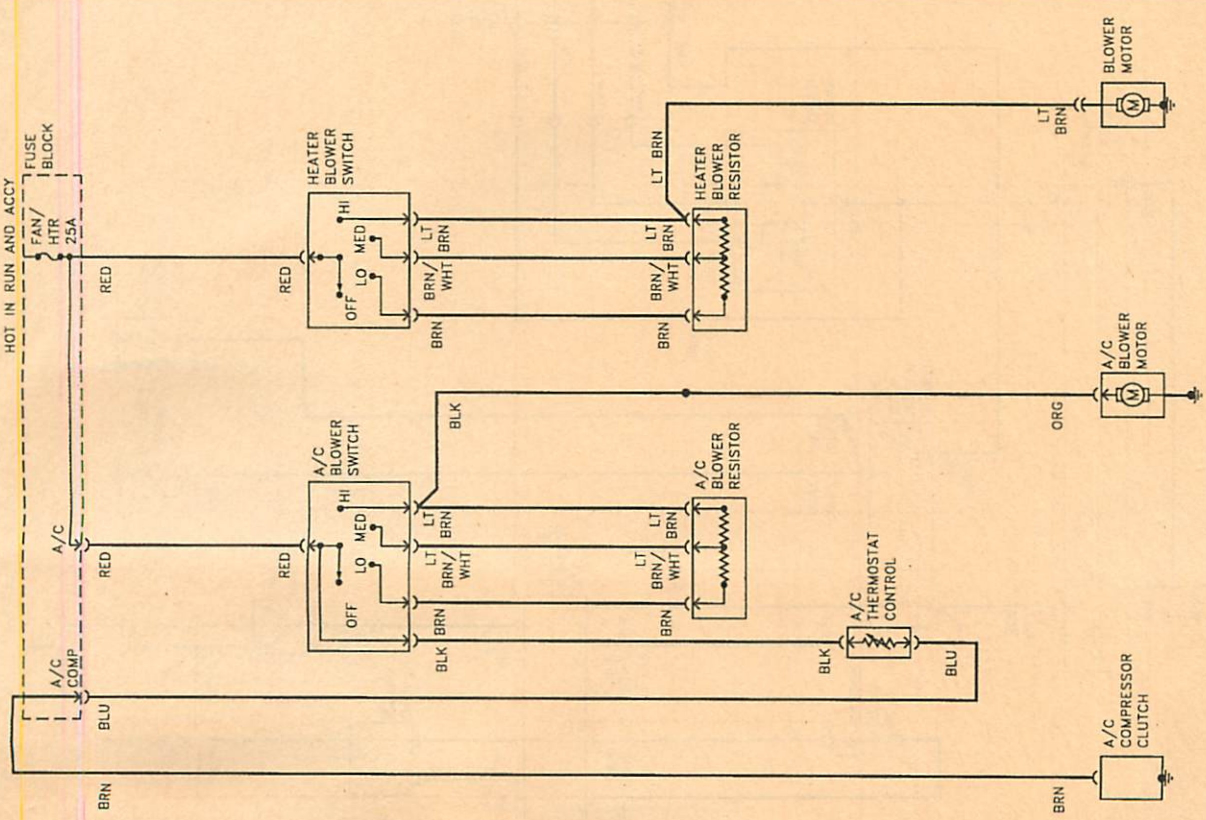
1986 and later windshield wiper/washer system - with intermittent wipers



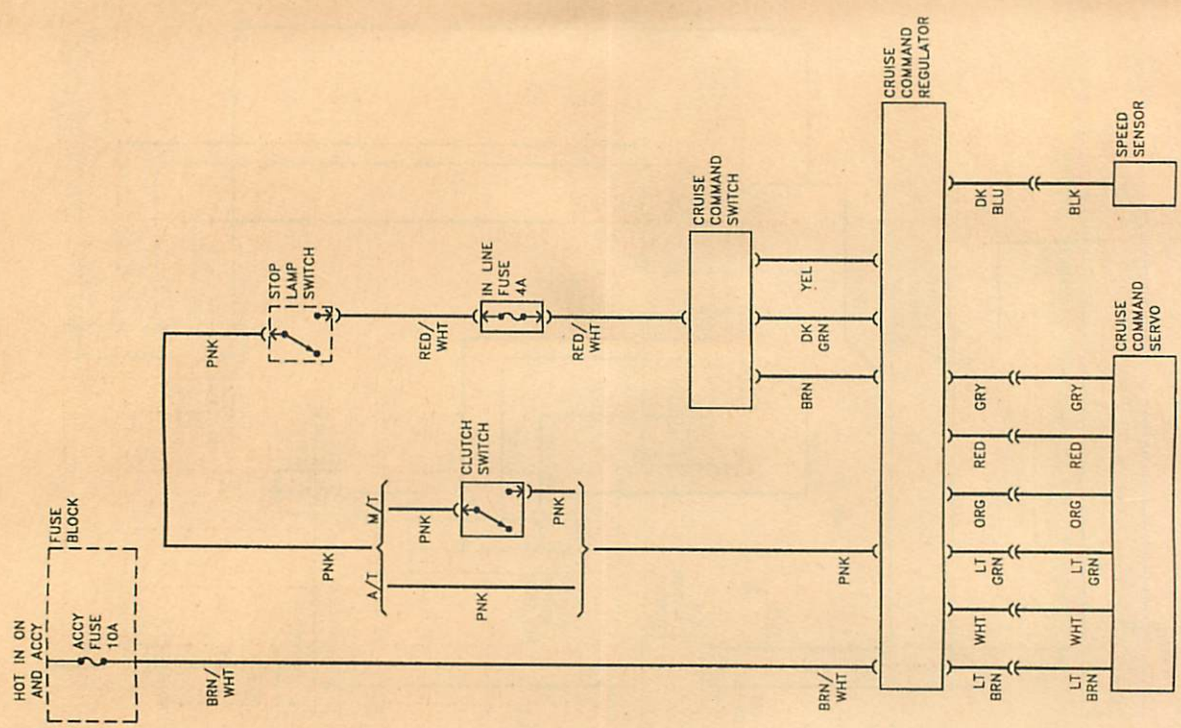
1986 and later windshield wiper/washer system - without intermittent wipers



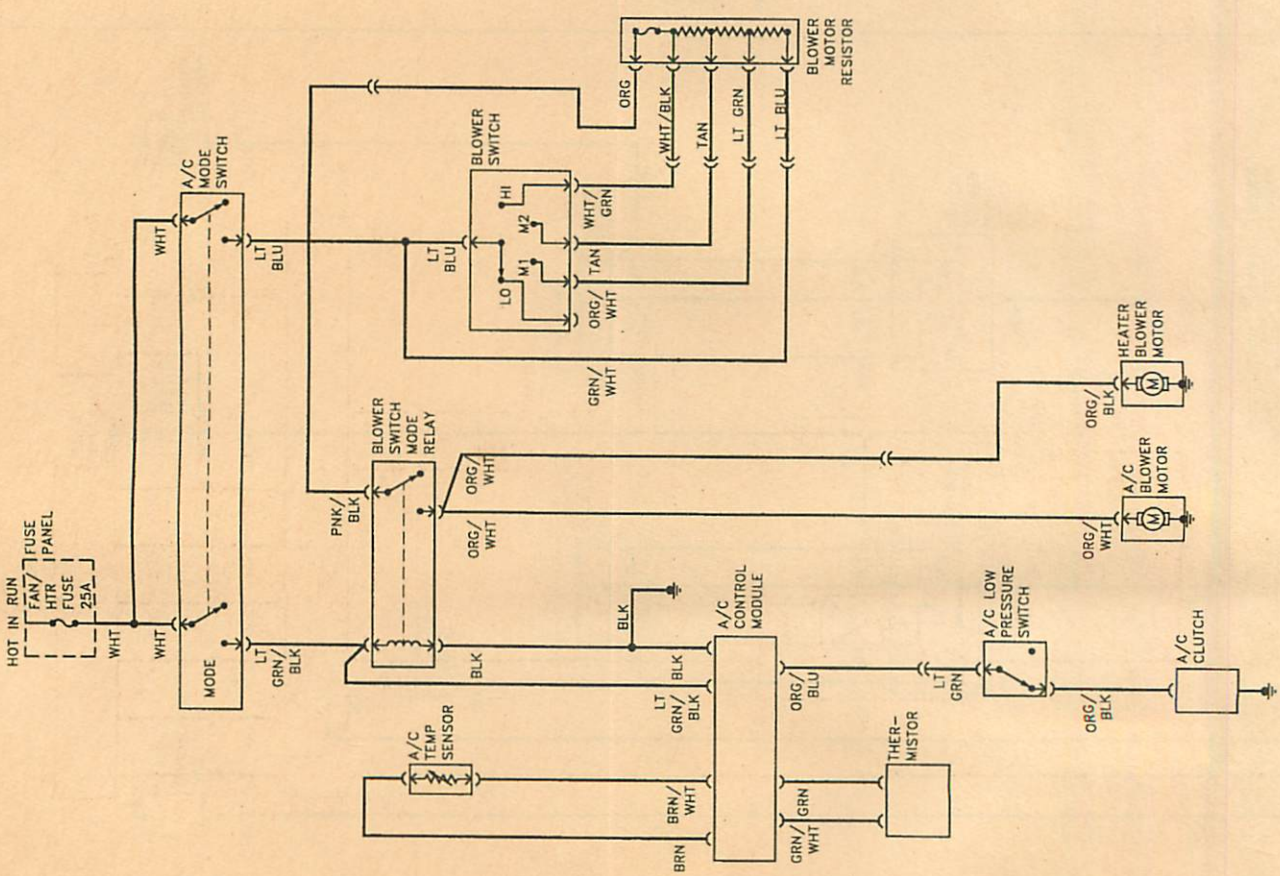
1986 through 1988 heating and air conditioning system



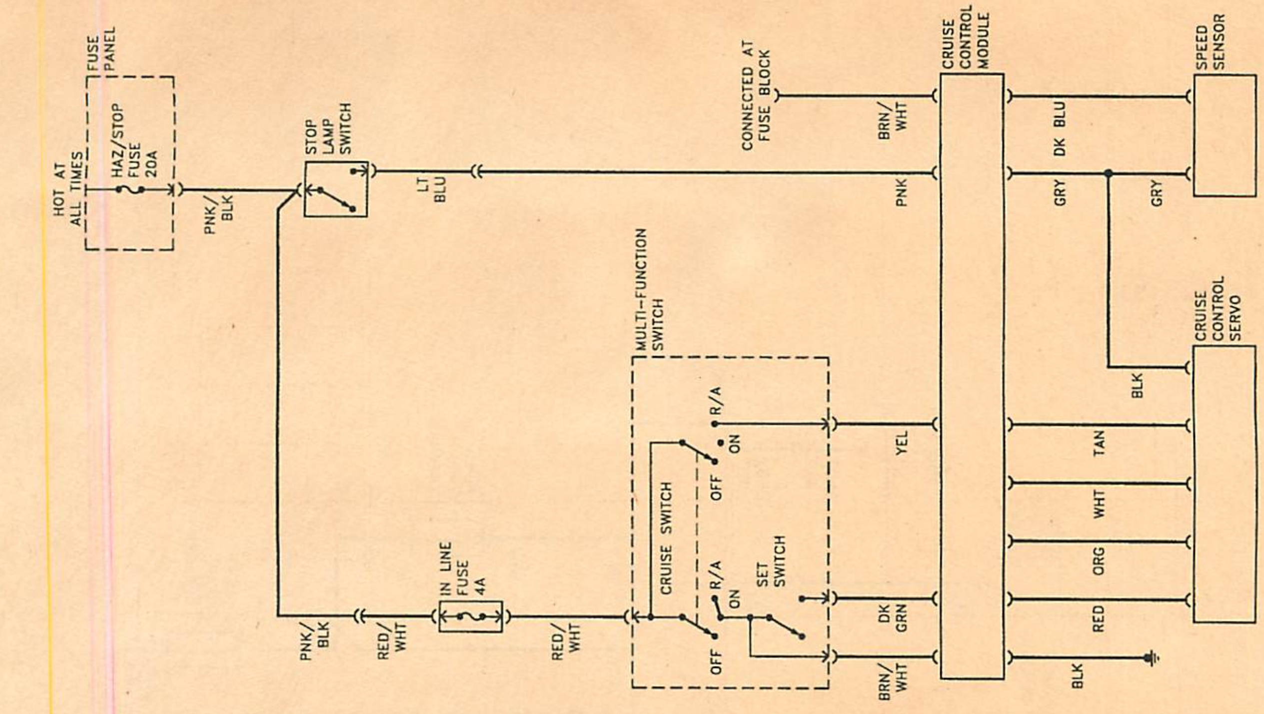
1985 and earlier heating and air conditioning system



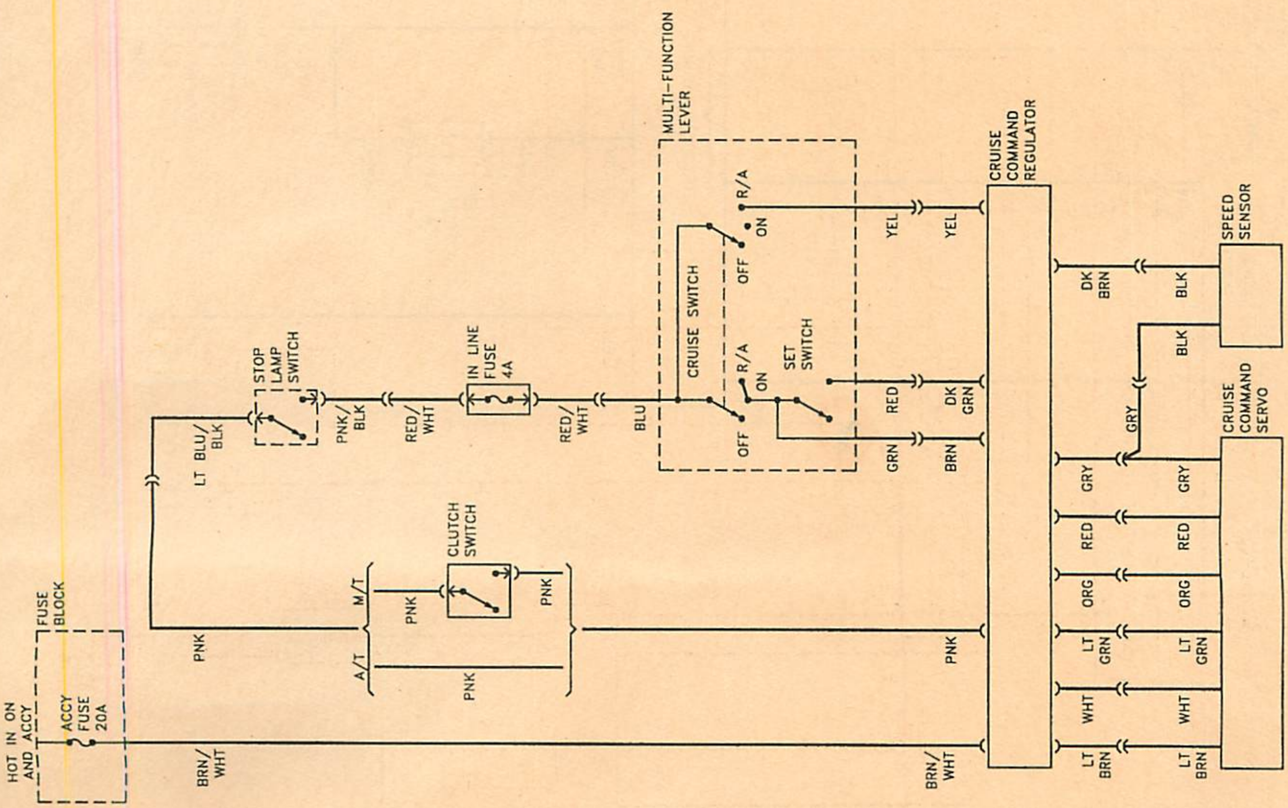
1985 and earlier cruise control system



1989 and later heating and air conditioning system



1989 and later cruise control system



1986 through 1988 cruise control system

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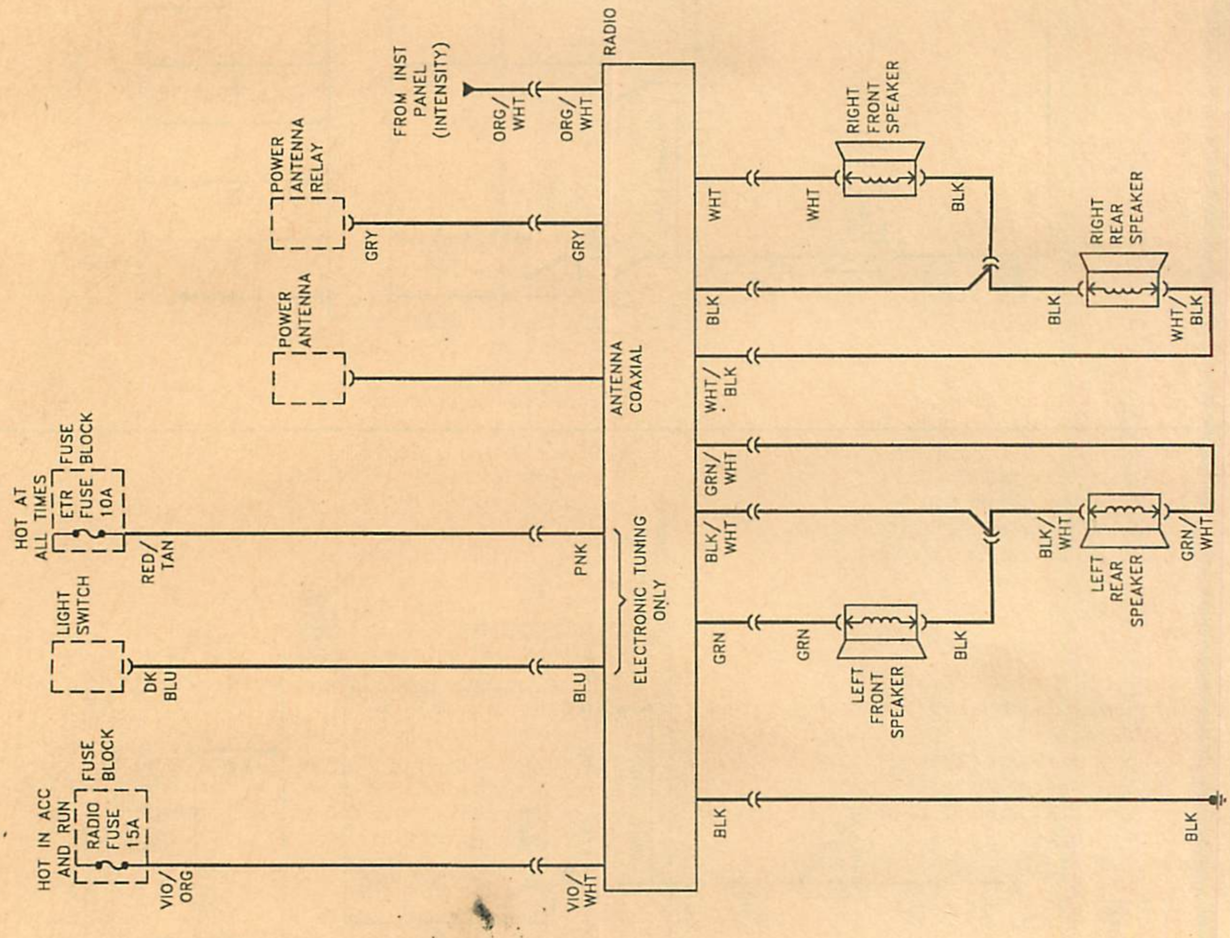

Typical audio system

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Haynes Automotive Manuals (continued)

NOTE: New manuals are added to this list on a periodic basis. If you do not see a listing for your vehicle, consult your local Haynes dealer for the latest product information.

GEO
- Metro - *see CHEVROLET Sprint (24075)*
- Prizm - *'85 thru '92 see CHEVY (24060), '93 thru '96 see TOYOTA Corolla (92036)*
- *40030 Storm all models '90 thru '93
- Tracker - *see SUZUKI Samurai (90010)*

GMC
- Safari - *see CHEVROLET ASTRO (24010)*
- Vans & Pick-ups - *see CHEVROLET*

HONDA
- 42010 Accord CVCC all models '76 thru '83
- 42011 Accord all models '84 thru '89
- 42012 Accord all models '90 thru '93
- 42013 Accord all models '94 thru '95
- 42020 Civic 1200 all models '73 thru '79
- 42021 Civic 1300 & 1500 CVCC '80 thru '83
- 42022 Civic 1500 CVCC all models '75 thru '79
- 42023 Civic all models '84 thru '91
- *42024 Civic & del Sol '92 thru '95
- *42040 Prelude CVCC all models '79 thru '89

HYUNDAI
- *43015 Excel all models '86 thru '94

ISUZU
- Hombre - *see CHEVROLET S-10 (24071)*
- *47017 Rodeo '91 thru '97; Amigo '89 thru '94; Honda Passport '95 thru '97
- *47020 Trooper & Pick-up, all gasoline models Pick-up, '81 thru '93; Trooper, '84 thru '91

JAGUAR
- *49010 XJ6 all 6 cyl models '68 thru '86
- *49011 XJ6 all models '88 thru '94
- *49015 XJ12 & XJS all 12 cyl models '72 thru '85

JEEP
- *50010 Cherokee, Comanche & Wagoneer Limited all models '84 thru '96
- 50020 CJ all models '49 thru '86
- *50025 Grand Cherokee all models '93 thru '98
- 50029 Grand Wagoneer & Pick-up '72 thru '91 Grand Wagoneer '84 thru '91, Cherokee & Wagoneer '72 thru '83, Pick-up '72 thru '88
- *50030 Wrangler all models '87 thru '95

LINCOLN
- Navigator - *see FORD Pick-up (36059)*
- 59010 Rear Wheel Drive all models '70 thru '96

MAZDA
- 61010 GLC Hatchback (rear wheel drive) '77 thru '83
- 61011 GLC (front wheel drive) '81 thru '85
- *61015 323 & Protegé '90 thru '97
- *61016 MX-5 Miata '90 thru '97
- *61020 MPV all models '89 thru '94
- Navajo - *see Ford Explorer (36024)*
- 61030 Pick-ups '72 thru '93
- Pick-ups '94 thru '96 - *see Ford Ranger (36071)*
- 61035 RX-7 all models '79 thru '85
- *61036 RX-7 all models '86 thru '91
- 61040 626 (rear wheel drive) all models '79 thru '82
- *61041 626/MX-6 (front wheel drive) '83 thru '91

MERCEDES-BENZ
- 63012 123 Series Diesel '76 thru '85
- *63015 190 Series four-cyl gas models, '84 thru '88
- 63020 230/250/280 6 cyl sohc models '68 thru '72
- 63025 280 123 Series gasoline models '77 thru '81
- 63030 350 & 450 all models '71 thru '80

MERCURY
See FORD Listing.

MG
- 66010 MGB Roadster & GT Coupe '62 thru '80
- 66015 MG Midget, Austin Healey Sprite '58 thru '80

MITSUBISHI
- *68020 Cordia, Tredia, Galant, Precis & Mirage '83 thru '93
- *68030 Eclipse, Eagle Talon & Ply. Laser '90 thru '94
- *68040 Pick-up '83 thru '96 & Montero '83 thru '93

NISSAN
- 72010 300ZX all models including Turbo '84 thru '89
- *72015 Altima all models '93 thru '97
- *72020 Maxima all models '85 thru '91
- *72030 Pick-ups '80 thru '96 Pathfinder '87 thru '95
- 72040 Pulsar all models '83 thru '86
- *72050 Sentra all models '82 thru '94
- *72051 Sentra & 200SX all models '95 thru '98
- *72060 Stanza all models '82 thru '90

OLDSMOBILE
- *73015 Cutlass V6 & V8 gas models '74 thru '88

For other OLDSMOBILE titles, see BUICK, CHEVROLET or GENERAL MOTORS listing.

PLYMOUTH
For PLYMOUTH titles, see DODGE listing.

PONTIAC
- 79008 Fiero all models '84 thru '88
- 79018 Firebird V8 models except Turbo '70 thru '81
- 79019 Firebird all models '82 thru '92

For other PONTIAC titles, see BUICK, CHEVROLET or GENERAL MOTORS listing.

PORSCHE
- *80020 911 except Turbo & Carrera 4 '65 thru '89
- 80025 914 all 4 cyl models '69 thru '76
- 80030 924 all models including Turbo '76 thru '82
- *80035 944 all models including Turbo '83 thru '89

RENAULT
- Alliance & Encore - *see AMC (14020)*

SAAB
- *84010 900 all models including Turbo '79 thru '88

SATURN
- 87010 Saturn all models '91 thru '96

SUBARU
- 89002 1100, 1300, 1400 & 1600 '71 thru '79
- *89003 1600 & 1800 2WD & 4WD '80 thru '94

SUZUKI
- *90010 Samurai/Sidekick & Geo Tracker '86 thru '96

TOYOTA
- 92005 Camry all models '83 thru '91
- 92006 Camry all models '92 thru '96
- 92015 Celica Rear Wheel Drive '71 thru '85
- *92020 Celica Front Wheel Drive '86 thru '93
- 92025 Celica Supra all models '79 thru '92
- 92030 Corolla all models '75 thru '79
- 92032 Corolla all rear wheel drive models '80 thru '87
- 92035 Corolla all front wheel drive models '84 thru '92
- *92036 Corolla & Geo Prizm '93 thru '97
- 92040 Corolla Tercel all models '80 thru '82
- 92045 Corona all models '74 thru '82
- 92050 Cressida all models '78 thru '82
- 92055 Land Cruiser FJ40, 43, 45, 55 '68 thru '82
- 92056 Land Cruiser FJ60, 62, 80, FZJ80 '80 thru '96
- *92065 MR2 all models '85 thru '87
- 92070 Pick-up all models '69 thru '78
- *92075 Pick-up all models '79 thru '95
- *92076 Tacoma '95 thru '98, 4Runner '96 thru '98, & T100 '93 thru '98
- *92080 Previa all models '91 thru '95
- 92085 Tercel all models '87 thru '94

TRIUMPH
- 94007 Spitfire all models '62 thru '81
- 94010 TR7 all models '75 thru '81

VW
- 96008 Beetle & Karmann Ghia '54 thru '79
- 96012 Dasher all gasoline models '74 thru '81
- *96016 Rabbit, Jetta, Scirocco, & Pick-up gas models '74 thru '91 & Convertible '80 thru '92
- 96017 Golf & Jetta all models '93 thru '97
- 96020 Rabbit, Jetta & Pick-up diesel '77 thru '84
- 96030 Transporter 1600 all models '68 thru '79
- 96035 Transporter 1700, 1800 & 2000 '72 thru '79
- 96040 Type 3 1500 & 1600 all models '63 thru '73
- 96045 Vanagon all air-cooled models '80 thru '83

VOLVO
- 97010 120, 130 Series & 1800 Sports '61 thru '73
- 97015 140 Series all models '66 thru '74
- *97020 240 Series all models '76 thru '93
- 97025 260 Series all models '75 thru '82
- *97040 740 & 760 Series all models '82 thru '88

TECHBOOK MANUALS
- 10205 Automotive Computer Codes
- 10210 Automotive Emissions Control Manual
- 10215 Fuel Injection Manual, 1978 thru 1985
- 10220 Fuel Injection Manual, 1986 thru 1996
- 10225 Holley Carburetor Manual
- 10230 Rochester Carburetor Manual
- 10240 Weber/Zenith/Stromberg/SU Carburetors
- 10305 Chevrolet Engine Overhaul Manual
- 10310 Chrysler Engine Overhaul Manual
- 10320 Ford Engine Overhaul Manual
- 10330 GM and Ford Diesel Engine Repair Manual
- 10340 Small Engine Repair Manual
- 10345 Suspension, Steering & Driveline Manual
- 10355 Ford Automatic Transmission Overhaul
- 10360 GM Automatic Transmission Overhaul
- 10405 Automotive Body Repair & Painting
- 10410 Automotive Brake Manual
- 10415 Automotive Detaiing Manual
- 10420 Automotive Eelectrical Manual
- 10425 Automotive Heating & Air Conditioning
- 10430 Automotive Reference Manual & Dictionary
- 10435 Automotive Tools Manual
- 10440 Used Car Buying Guide
- 10445 Welding Manual
- 10450 ATV Basics

SPANISH MANUALS
- 98903 Reparación de Carrocería & Pintura
- 98905 Códigos Automotrices de la Computadora
- 98910 Frenos Automotriz
- 98915 Inyección de Combustible 1986 al 1994
- 99040 Chevrolet & GMC Camionetas '67 al '87 Incluye Suburban, Blazer & Jimmy '67 al '91
- 99041 Chevrolet & GMC Camionetas '88 al '95 Incluye Suburban '92 al '95, Blazer & Jimmy '92 al '94, Tahoe y Yukon '95
- 99042 Chevrolet & GMC Camionetas Cerradas '68 al '95
- 99055 Dodge Caravan & Plymouth Voyager '84 al '95
- 99075 Ford Camionetas y Bronco '80 al '94
- 99077 Ford Camionetas Cerradas '69 al '91
- 99083 Ford Modelos de Tamaño Grande '75 al '87
- 99088 Ford Modelos de Tamaño Mediano '75 al '86
- 99091 Ford Taurus & Mercury Sable '86 al '95
- 99095 GM Modelos de Tamaño Grande '70 al '90
- 99100 GM Modelos de Tamaño Mediano '70 al '88
- 99110 Nissan Camionetas '80 al '96, Pathfinder '87 al '95
- 99118 Nissan Sentra '82 al '94
- 99125 Toyota Camionetas y 4Runner '79 al '95

** Listings shown with an asterisk (*) indicate model coverage as of this printing. These titles will be periodically updated to include later model years - consult your Haynes dealer for more information.*

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Haynes Automotive Manuals

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ACURA
- *12020 Integra '86 thru '89 & Legend '86 thru '90

AMC
- Jeep CJ - *see JEEP (50020)*
- 14020 Mid-size models, Concord, Hornet, Gremlin & Spirit '70 thru '83
- 14025 (Renault) Alliance & Encore '83 thru '87

AUDI
- 15020 4000 all models '80 thru '87
- 15025 5000 all models '77 thru '83
- 15026 5000 all models '84 thru '88

AUSTIN-HEALEY
- Sprite - *see MG Midget (66015)*

BMW
- *18020 3/5 Series not including diesel or all-wheel drive models '82 thru '92
- *18021 3 Series except 325iX models '92 thru '97
- 18025 320i all 4 cyl models '75 thru '83
- 18035 528i & 530i all models '75 thru '80
- 18050 1500 thru 2002 except Turbo '59 thru '77

BUICK
- Century (front wheel drive) - *see GM (829)*
- *19020 Buick, Oldsmobile & Pontiac Full-size (Front wheel drive) all models '85 thru '98 Buick Electra, LeSabre and Park Avenue; Oldsmobile Delta 88 Royale, Ninety Eight and Regency; Pontiac Bonneville
- 19025 Buick Oldsmobile & Pontiac Full-size (Rear wheel drive) Buick Estate '70 thru '90, Electra'70 thru '84, LeSabre '70 thru '85, Limited '74 thru '79 Oldsmobile Custom Cruiser '70 thru '90, Delta 88 '70 thru '85,Ninety-eight '70 thru '84 Pontiac Bonneville '70 thru '81, Catalina '70 thru '81, Grandville '70 thru '75, Parisienne '83 thru '86
- 19030 Mid-size Regal & Century all rear-drive models with V6, V8 and Turbo '74 thru '87
- Regal - *see GENERAL MOTORS (38010)*
- Riviera - *see GENERAL MOTORS (38030)*
- Roadmaster - *see CHEVROLET (24046)*
- Skyhawk - *see GENERAL MOTORS (38015)*
- Skylark '80 thru '85 - *see GM (38020)*
- Skylark '86 on - *see GM (38025)*
- Somerset - *see GENERAL MOTORS (38025)*

CADILLAC
- *21030 Cadillac Rear Wheel Drive all gasoline models '70 thru '93
- Cimarron - *see GENERAL MOTORS (38015)*
- Eldorado - *see GENERAL MOTORS (38030)*
- Seville '80 thru '85 - *see GM (38030)*

CHEVROLET
- *24010 Astro & GMC Safari Mini-vans '85 thru '93
- 24015 Camaro V8 all models '70 thru '81
- 24016 Camaro all models '82 thru '92
- Cavalier - *see GENERAL MOTORS (38015)*
- Celebrity - *see GENERAL MOTORS (38005)*
- 24017 Camaro & Firebird '93 thru '97
- 24020 Chevelle, Malibu & El Camino '69 thru '87
- 24024 Chevette & Pontiac T1000 '76 thru '87
- Citation - *see GENERAL MOTORS (38020)*
- *24032 Corsica/Beretta all models '87 thru '96
- 24040 Corvette all V8 models '68 thru '82
- *24041 Corvette all models '84 thru '96
- 10305 Chevrolet Engine Overhaul Manual
- 24045 Full-size Sedans Caprice, Impala, Biscayne, Bel Air & Wagons '69 thru '90
- 24046 Impala SS & Caprice and Buick Roadmaster '91 thru '96
- Lumina - *see GENERAL MOTORS (38010)*
- 24048 Lumina & Monte Carlo '95 thru '98
- Lumina APV - *see GM (38035)*
- 24050 Luv Pick-up all 2WD & 4WD '72 thru '82
- *24055 Monte Carlo all models '70 thru '88
- Monte Carlo '95 thru '98 - *see LUMINA (24048)*
- 24059 Nova all V8 models '69 thru '79
- *24060 Nova and Geo Prizm '85 thru '92
- 24064 Pick-ups '67 thru '87 - Chevrolet & GMC, all V8 & in-line 6 cyl, 2WD & 4WD '67 thru '87; Suburbans, Blazers & Jimmys '67 thru '91
- *24065 Pick-ups '88 thru '98 - Chevrolet & GMC, all full-size pick-ups, '88 thru '98; Blazer & Jimmy '92 thru '94; Suburban '92 thru '98; Tahoe & Yukon '98
- 24070 S-10 & S-15 Pick-ups '82 thru '93, Blazer & Jimmy '83 thru '94,
- *24071 S-10 & S-15 Pick-ups '94 thru '96 Blazer & Jimmy '95 thru '96
- *24075 Sprint & Geo Metro '85 thru '94
- *24080 Vans - Chevrolet & GMC, V8 & in-line 6 cylinder models '68 thru '96

CHRYSLER
- 25015 Chrysler Cirrus, Dodge Stratus, Plymouth Breeze '95 thru '98
- 25025 Chrysler Concorde, New Yorker & LHS, Dodge Intrepid, Eagle Vision, '93 thru '97
- 10310 Chrysler Engine Overhaul Manual
- *25020 Full-size Front-Wheel Drive '88 thru '93
- K-Cars - *see DODGE Aries (30008)*
- Laser - *see DODGE Daytona (30030)*
- *25030 Chrysler & Plymouth Mid-size front wheel drive '82 thru '95
- Rear-wheel Drive - *see Dodge (30050)*

DATSUN
- 28005 200SX all models '80 thru '83
- 28007 B-210 all models '73 thru '78
- 28009 210 all models '79 thru '82
- 28012 240Z, 260Z & 280Z Coupe '70 thru '78
- 28014 280ZX Coupe & 2+2 '79 thru '83
- 300ZX - *see NISSAN (72010)*
- 28016 310 all models '78 thru '82
- 28018 510 & PL521 Pick-up '68 thru '73
- 28020 510 all models '78 thru '81
- 28022 620 Series Pick-up all models '73 thru '79
- 720 Series Pick-up - *see NISSAN (72030)*
- 28025 810/Maxima all gasoline models, '77 thru '84

DODGE
- 400 & 600 - *see CHRYSLER (25030)*
- *30008 Aries & Plymouth Reliant '81 thru '89
- 30010 Caravan & Plymouth Voyager Mini-Vans all models '84 thru '95
- *30011 Caravan & Plymouth Voyager Mini-Vans all models '96 thru '98
- 30012 Challenger/Plymouth Saporro '78 thru '83
- 30016 Colt & Plymouth Champ (front wheel drive) all models '78 thru '87
- *30020 Dakota Pick-ups all models '87 thru '96
- 30025 Dart, Demon, Plymouth Barracuda, Duster & Valiant 6 cyl models '67 thru '76
- *30030 Daytona & Chrysler Laser '84 thru '89
- Intrepid - *see CHRYSLER (25025)*
- *30034 Neon all models '95 thru '97
- *30035 Omni & Plymouth Horizon '78 thru '90
- *30040 Pick-ups all full-size models '74 thru '93
- *30041 Pick-ups all full-size models '94 thru '96
- *30045 Ram 50/D50 Pick-ups & Raider and Plymouth Arrow Pick-ups '79 thru '93
- 30050 Dodge/Plymouth/Chrysler rear wheel drive '71 thru '89
- *30055 Shadow & Plymouth Sundance '87 thru '94
- *30060 Spirit & Plymouth Acclaim '89 thru '95
- *30065 Vans - Dodge & Plymouth '71 thru '96

EAGLE
- Talon - *see Mitsubishi Eclipse (68030)*
- Vision - *see CHRYSLER (25025)*

FIAT
- 34010 124 Sport Coupe & Spider '68 thru '78
- 34025 X1/9 all models '74 thru '80

FORD
- 10355 Ford Automatic Transmission Overhaul
- *36004 Aerostar Mini-vans all models '86 thru '96
- *36006 Contour & Mercury Mystique '95 thru '98
- 36008 Courier Pick-up all models '72 thru '82
- 36012 Crown Victoria & Mercury Grand Marquis '88 thru '96
- 10320 Ford Engine Overhaul Manual
- 36016 Escort/Mercury Lynx all models '81 thru '90
- *36020 Escort/Mercury Tracer '91 thru '96
- *36024 Explorer & Mazda Navajo '91 thru '95
- 36028 Fairmont & Mercury Zephyr '78 thru '83
- 36030 Festiva & Aspire '88 thru '97
- 36032 Fiesta all models '77 thru '80
- 36036 Ford & Mercury Full-size, Ford LTD & Mercury Marquis ('75 thru '82); Ford Custom 500,Country Squire, Crown Victoria & Mercury Colony Park ('75 thru '87); Ford LTD Crown Victoria & Mercury Gran Marquis ('83 thru '87)
- 36040 Granada & Mercury Monarch '75 thru '80
- 36044 Ford & Mercury Mid-size, Ford Thunderbird & Mercury Cougar ('75 thru '82); Ford LTD & Mercury Marquis ('83 thru '86); Ford Torino,Gran Torino, Elite, Ranchero pick-up, LTD II, Mercury Montego, Comet, XR-7 & Lincoln Versailles ('75 thru '86)
- 36048 Mustang V8 all models '64-1/2 thru '73
- 36049 Mustang II 4 cyl, V6 & V8 models '74 thru '78
- 36050 Mustang & Mercury Capri all models Mustang, '79 thru '93; Capri, '79 thru '86
- *36051 Mustang all models '94 thru '97
- 36054 Pick-ups & Bronco '73 thru '79
- 36058 Pick-ups & Bronco '80 thru '96
- 36059 Pick-ups, Expedition & Mercury Navigator '97 thru '98
- 36062 Pinto & Mercury Bobcat '75 thru '80
- 36066 Probe all models '89 thru '92
- 36070 Ranger/Bronco II gasoline models '83 thru '92
- *36071 Ranger '93 thru '97 & Mazda Pick-ups '94 thru '97
- 36074 Taurus & Mercury Sable '86 thru '95
- *36075 Taurus & Mercury Sable '96 thru '98
- *36078 Tempo & Mercury Topaz '84 thru '94
- 36082 Thunderbird/Mercury Cougar '83 thru '88
- *36086 Thunderbird/Mercury Cougar '89 and '97
- 36090 Vans all V8 Econoline models '69 thru '91
- *36094 Vans full size '92-'95
- *36097 Windstar Mini-van '95-'98

GENERAL MOTORS
- *10360 GM Automatic Transmission Overhaul
- *38005 Buick Century, Chevrolet Celebrity, Oldsmobile Cutlass Ciera & Pontiac 6000 all models '82 thru '96
- *38010 Buick Regal, Chevrolet Lumina, Oldsmobile Cutlass Supreme & Pontiac Grand Prix front-wheel drive models '88 thru '95
- *38015 Buick Skyhawk, Cadillac Cimarron, Chevrolet Cavalier, Oldsmobile Firenza & Pontiac J-2000 & Sunbird '82 thru '94
- *38016 Chevrolet Cavalier & Pontiac Sunfire '95 thru '98
- 38020 Buick Skylark, Chevrolet Citation, Olds Omega, Pontiac Phoenix '80 thru '85
- 38025 Buick Skylark & Somerset, Oldsmobile Achieva & Calais and Pontiac Grand Am all models '85 thru '95
- 38030 Cadillac Eldorado '71 thru '85, Seville '80 thru '85, Oldsmobile Toronado '71 thru '85 & Buick Riviera '79 thru '85
- *38035 Chevrolet Lumina APV, Olds Silhouette & Pontiac Trans Sport all models '90 thru '95
- General Motors Full-size Rear-wheel Drive - *see BUICK (19025)*

(Continued on other side)

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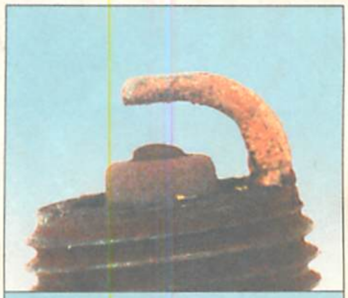
Common spark plug conditions

NORMAL

Symptoms: Brown to grayish-tan color and slight electrode wear. Correct heat range for engine and operating conditions.
Recommendation: When new spark plugs are installed, replace with plugs of the same heat range.



WORN

Symptoms: Rounded electrodes with a small amount of deposits on the firing end. Normal color. Causes hard starting in damp or cold weather and poor fuel economy.
Recommendation: Plugs have been left in the engine too long. Replace with new plugs of the same heat range. Follow the recommended maintenance schedule.

CARBON DEPOSITS

Symptoms: Dry sooty deposits indicate a rich mixture or weak ignition. Causes misfiring, hard starting and hesitation.
Recommendation: Make sure the plug has the correct heat range. Check for a clogged air filter or problem in the fuel system or engine management system. Also check for ignition system problems.

ASH DEPOSITS

Symptoms: Light brown deposits encrusted on the side or center electrodes or both. Derived from oil and/or fuel additives. Excessive amounts may mask the spark, causing misfiring and hesitation during acceleration.
Recommendation: If excessive deposits accumulate over a short time or low mileage, install new valve guide seals to prevent seepage of oil into the combustion chambers. Also try changing gasoline brands.

OIL DEPOSITS

Symptoms: Oily coating caused by poor oil control. Oil is leaking past worn valve guides or piston rings into the combustion chamber. Causes hard starting, misfiring and hesitation.
Recommendation: Correct the mechanical condition with necessary repairs and install new plugs.

GAP BRIDGING

Symptoms: Combustion deposits lodge between the electrodes. Heavy deposits accumulate and bridge the electrode gap. The plug ceases to fire, resulting in a dead cylinder.
Recommendation: Locate the faulty plug and remove the deposits from between the electrodes.

TOO HOT

Symptoms: Blistered, white insulator, eroded electrode and absence of deposits. Results in shortened plug life.
Recommendation: Check for the correct plug heat range, over-advanced ignition timing, lean fuel mixture, intake manifold vacuum leaks, sticking valves and insufficient engine cooling.

PREIGNITION

Symptoms: Melted electrodes. Insulators are white, but may be dirty due to misfiring or flying debris in the combustion chamber. Can lead to engine damage.
Recommendation: Check for the correct plug heat range, over-advanced ignition timing, lean fuel mixture, insufficient engine cooling and lack of lubrication.

HIGH SPEED GLAZING

Symptoms: Insulator has yellowish, glazed appearance. Indicates that combustion chamber temperatures have risen suddenly during hard acceleration. Normal deposits melt to form a conductive coating. Causes misfiring at high speeds.
Recommendation: Install new plugs. Consider using a colder plug if driving habits warrant.

DETONATION

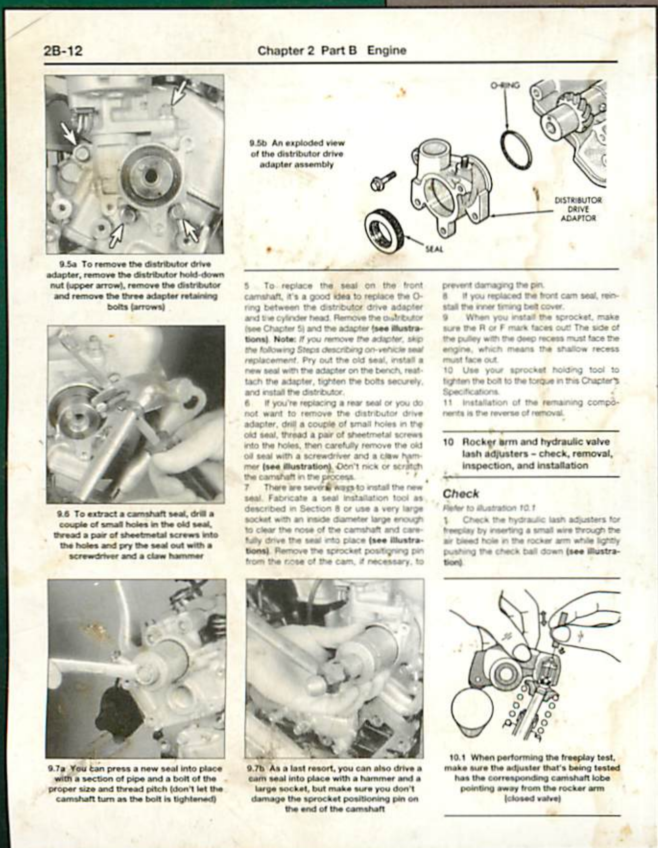
Symptoms: Insulators may be cracked or chipped. Improper gap setting techniques can also result in a fractured insulator tip. Can lead to piston damage.
Recommendation: Make sure the fuel anti-knock values meet engine requirements. Use care when setting the gaps on new plugs. Avoid lugging the engine.

MECHANICAL DAMAGE

Symptoms: May be caused by a foreign object in the combustion chamber or the piston striking an incorrect reach (too long) plug. Causes a dead cylinder and could result in piston damage.
Recommendation: Repair the mechanical damage. Remove the foreign object from the engine and/or install the correct reach plug.

Inside this manual:

- Routine maintenance
- Tune-up procedures
- Engine repair
- Cooling and heating
- Air conditioning
- Fuel and exhaust
- Emissions control
- Ignition
- Brakes
- Suspension and steering
- Electrical systems
- Wiring diagrams



9.5a To remove the distributor drive adapter, remove the distributor hold-down nut (upper arrow), remove the distributor and remove the three adapter retaining bolts (arrows)

9.5b An exploded view of the distributor drive adapter assembly

O-RING
DISTRIBUTOR DRIVE ADAPTOR
SEAL

5 To replace the seal on the front camshaft, it's a good idea to replace the O-ring between the distributor drive adapter and the cylinder head. Remove the distributor (see Chapter 5) and the adapter **(see illustrations)**. **Note:** *If you remove the adapter, skip the following Steps describing on-vehicle seal replacement.* Pry out the old seal, install a new seal with the adapter on the bench, reattach the adapter, tighten the bolts securely, and install the distributor.

6 If you're replacing a rear seal or you do not want to remove the distributor drive adapter, drill a couple of small holes in the old seal, thread a pair of sheetmetal screws into the holes, then carefully remove the old oil seal with a screwdriver and a claw hammer **(see illustration)**. Don't nick or scratch the camshaft in the process.

7 There are several ways to install the new seal. Fabricate a seal installation tool as described in Section 8 or use a very large socket with an inside diameter large enough to clear the nose of the camshaft and carefully drive the seal into place **(see illustrations)**. Remove the sprocket positioning pin from the nose of the cam, if necessary, to prevent damaging the pin.

8 If you replaced the front cam seal, reinstall the inner timing belt cover.

9 When you install the sprocket, make sure the R or F mark faces out! The side of the pulley with the deep recess must face the engine, which means the shallow recess must face out.

10 Use your sprocket holding tool to tighten the bolt to the torque in this Chapter's Specifications.

11 Installation of the remaining components is the reverse of removal.

10 Rocker arm and hydraulic valve lash adjusters – check, removal, inspection, and installation

Check

Refer to illustration 10.1

1 Check the hydraulic lash adjusters for freeplay by inserting a small wire through the air bleed hole in the rocker arm while lightly pushing the check ball down **(see illustration)**.

9.6 To extract a camshaft seal, drill a couple of small holes in the old seal, thread a pair of sheetmetal screws into the holes and pry the seal out with a screwdriver and a claw hammer

9.7a You can press a new seal into place with a section of pipe and a bolt of the proper size and thread pitch (don't let the camshaft turn as the bolt is tightened)

9.7b As a last resort, you can also drive a cam seal into place with a hammer and a large socket, but make sure you don't damage the sprocket positioning pin on the end of the camshaft

10.1 When performing the freeplay test, make sure the adjuster that's being tested has the corresponding camshaft lobe pointing away from the rocker arm (closed valve)

- **Step-by-step procedures** linked to hundreds of **easy-to-follow photos** and illustrations
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- Written from **hands-on experience** based on a vehicle teardown using **commonly available tools**
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- Easy to use **index**

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J-Series Pick-up - 1972 thru 1988
Does not include 1984 and later Comanche Pick-up models