

2004 ENGINES**3.2L V6****ENGINE - SERVICE INFORMATION****DESCRIPTION**

The engine is a modular design. The engine uses a 90-degree V-angle rotating assembly which provides space for long intake manifold runners which provide high torque across a broad range of engine speeds for driving ease. The engine uses a split-pin crankshaft to provide even firing, and a balance shaft to compensate for the rocking motion which occurs with a 90-degree V-6.

OPERATION

The engine produces 215 bhp @ 5700 RPM and 230 lb. ft. of torque @ 3000 RPM. Its 6000 RPM maximum operating speed is electronically limited by interrupting the fuel supply. The engine is tuned to provide high torque over a broad range of engine speed for optimum driveability. 90% of maximum torque is available from about 2300-5300 RPM, 98% of maximum torque is available from 3000-4500 RPM.

DIAGNOSIS AND TESTING**ENGINE DIAGNOSIS - INTRODUCTION**

Engine diagnosis is helpful in determining the causes of malfunctions not detected and remedied by routine maintenance.

These malfunctions may be classified as either mechanical (e.g., a strange noise), or performance (e.g., engine idles rough and stalls).

Additional tests and diagnostic procedures may be necessary for specific engine malfunctions that cannot be isolated with the Service Diagnosis charts. Information concerning additional tests and diagnosis is provided within the following:

- Cylinder Combustion Pressure Leakage Test
- Cylinder Compression Pressure Test
- Engine Cylinder Head Gasket Failure Diagnosis
- Engine Oil Leak Inspection
- Intake Manifold Leakage Diagnosis

ENGINE DIAGNOSIS - MECHANICAL

2004 Chrysler Crossfire

2004 ENGINES 3.2L V6

CONDITION	POSSIBLE CAUSES	CORRECTION
NOISY VALVES	<ol style="list-style-type: none">1. High or low oil level in crankcase.2. Thin or diluted oil.3. Thick oil4. Low oil pressure.5. Dirt in tappets/lash adjusters.6. Worn rocker arms.7. Worn tappets/lash adjusters.8. Worn valve guides.9. Excessive runout of valve seats on valve faces.10. Missing adjuster pivot.	<ol style="list-style-type: none">1. Check and correct engine oil level.2. Change oil to correct viscosity.3. (a.) Change oil and filter. (b.) Run engine to operating temperature. (c.) Change oil and filter again.4. Check and correct engine oil level.5. Replace rocker arm/adjuster assembly.6. Inspect oil supply to rocker arms.7. Install new rocker arm/adjuster assembly.8. Ream guides and install new valves with oversize stems.9. Grind valve seats and valves.10. Replace rocker arm/adjuster assembly.
CONNECTING ROD NOISE	<ol style="list-style-type: none">1. Insufficient oil supply.2. Low oil pressure.3. Thin or diluted oil.4. Thick oil5. Excessive bearing clearance.6. Connecting rod journal out-of-round.7. Misaligned connecting rods.	<ol style="list-style-type: none">1. Check engine oil level.2. Check engine oil level. Inspect oil pump.3. Change oil to correct viscosity.3. (a.) Change oil and filter. (b.) Run engine to operating temperature. (c.) Change oil and filter again.5. Measure bearings for correct clearance. Repair as necessary.6. Replace crankshaft or grind surface.7. Replace bent connecting rods.

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Fig. 1: Diagnosing Engine (Mechanical) Chart (1 Of 3)
Courtesy of DAIMLERCHRYSLER CORP.

2004 Chrysler Crossfire

2004 ENGINES 3.2L V6

CONDITION	POSSIBLE CAUSES	CORRECTION
MAIN BEARING NOISE	<ol style="list-style-type: none">1. Insufficient oil supply.2. Low oil pressure.3. Thin or diluted oil.4. Thick oil4. Excessive bearing clearance.5. Excessive end play.6. Crankshaft journal out-of-round or worn.7. Loose flywheel or torque converter.	<ol style="list-style-type: none">1. Check engine oil level.2. Check engine oil level. Inspect oil pump relief valve and spring.3. Change oil to correct viscosity.3. (a.) Change oil and filter. (b.) Run engine to operating temperature. (c.) Change oil and filter again.4. Measure bearings for correct clearance. Repair as necessary.5. Check thrust bearing for wear on flanges.6. Replace crankshaft or grind journals.7. Tighten to correct torque.
OIL PRESSURE DROP	<ol style="list-style-type: none">1. Low oil level.2. Faulty oil pressure sending unit.3. Low oil pressure.4. Clogged oil filter.5. Worn parts in oil pump.6. Thin or diluted oil.7. Oil pump relief valve stuck.8. Oil pump suction tube loose.9. Oil pump warped or cracked.10. Excessive bearing clearance.	<ol style="list-style-type: none">1. Check engine oil level.2. Install new sending unit.3. Check sending unit and main bearing oil clearance.4. Install new oil filter.5. Replace oil pump.6. Change oil to correct viscosity.7. Replace the oil pump.8. Remove oil pan and install new tube or clean, if necessary.9. Install new oil pump.10. Measure bearings for correct clearance.
OIL LEAKS	<ol style="list-style-type: none">1. Misaligned or deteriorated gaskets.2. Loose fastener, broken or porous metal part.3. Misaligned or deteriorated cup or threaded plug.	<ol style="list-style-type: none">1. Replace gasket(s).2. Tighten, repair or replace the part.3. Replace as necessary.

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Fig. 2: Diagnosing Engine (Mechanical) Chart (2 Of 3)
Courtesy of DAIMLERCHRYSLER CORP.

2004 Chrysler Crossfire

2004 ENGINES 3.2L V6

CONDITION	POSSIBLE CAUSES	CORRECTION
OIL CONSUMPTION OR SPARK PLUGS FOULED	<ol style="list-style-type: none">1. PCV system malfunction.2. Worn, scuffed or broken rings.3. Carbon in oil ring slots.4. Rings fitted too tightly in grooves.5. Worn valve guide(s).6. Valve stem seal(s) worn or damaged.	<ol style="list-style-type: none">1. Check system and repair as necessary. (Refer to Appropriate Diagnostic Manual.)2. Hone cylinder bores. Install new rings.3. Clean pistons and install new rings.4. Remove rings and check grooves. If groove is not proper width, replace piston.5. Replace cylinder head(s).6. Replace seal(s).

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Fig. 3: Diagnosing Engine (Mechanical) Chart (3 Of 3)
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ENGINE DIAGNOSIS - PERFORMANCE

CONDITION	POSSIBLE CAUSES	CORRECTION
ENGINE WILL NOT CRANK	<ol style="list-style-type: none">1. Weak or discharged battery.2. Corroded or loose battery connections.3. Faulty starter or related circuits.4. Seized accessory drive component.5. Engine internal mechanical failure or hydrostatic lock.	<ol style="list-style-type: none">1. Charge or replace battery as necessary. Check charging system.2. Clean/tighten battery/starter connections.3. Check starting system.4. Remove accessory drive belt and attempt to start engine. If engine cranks, repair/replace seized component.5. Refer to standard procedure - hydrostatic locked engine.
ENGINE CRANKS BUT WILL NOT START	<ol style="list-style-type: none">1. No spark.2. No fuel.3. Low or no engine compression.	<ol style="list-style-type: none">1. Check for spark.2. Perform fuel pressure test.3. Perform cylinder compression test.
ENGINE LOSS OF POWER	<ol style="list-style-type: none">1. Worn or incorrect gapped spark plugs.2. Dirt or water in fuel system.3. Faulty fuel pump.4. Incorrect valve timing.5. Blown cylinder head gasket(s).6. Low compression.7. Burned, warped, or pitted valves.8. Plugged or restricted exhaust.9. Faulty ignition cables.10. Faulty coil(s).	<ol style="list-style-type: none">1. Replace spark plugs or set gap.2. Clean system and replace fuel filter.3. Replace fuel pump.4. Correct valve timing.5. Replace cylinder head gasket(s).6. Test cylinder compression.7. Install new or reface valves as necessary.8. Replace parts as necessary.9. Replace ignition cables as necessary.10. Test and replace as necessary.

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Fig. 4: Diagnosing Engine (Performance) Chart (1 Of 2)

Courtesy of DAIMLERCHRYSLER CORP.

CONDITION	POSSIBLE CAUSES	CORRECTION
ENGINE STALLS OR ROUGH IDLE	<ol style="list-style-type: none"> 1. Carbon build-up on throttle plate(s). 2. Engine idle speed too low. 3. Worn or incorrectly gapped spark plugs. 4. Faulty or crossed ignition cables. 5. Faulty coil(s). 6. Intake manifold vacuum leak. 	<ol style="list-style-type: none"> 1. Remove throttle body(s) and de-carbon. 2. Check Idle Air Control circuit. 3. Replace spark plugs or set gap. 4. Check for correct firing order or replace ignition cables as necessary. 5. Test and replace as necessary. 6. Inspect intake manifold gasket and vacuum hoses. Replace as necessary.
ENGINE MISSES ON ACCELERATION	<ol style="list-style-type: none"> 1. Worn or incorrectly gapped spark plugs. 2. Faulty ignition cables. 3. Dirt or water in fuel system. 4. Burned, warped, or pitted valves. 5. Faulty coil(s). 	<ol style="list-style-type: none"> 1. Replace spark plugs or set gap. 2. Replace ignition cables as necessary. 3. Clean system and replace fuel filter. 4. Install new or reface valves as necessary. 5. Test and replace as necessary.

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Fig. 5: Diagnosing Engine (Performance) Chart (2 Of 2)
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CYLINDER COMPRESSION PRESSURE TEST

The results of a cylinder compression pressure test can be utilized to diagnose several engine malfunctions.

Ensure the battery is completely charged and the engine starter motor is in good operating condition. Otherwise the indicated compression pressures may not be valid for diagnosis purposes.

1. Check the engine oil level and add oil if necessary.
2. Drive the vehicle until engine reaches normal operating temperature. Select a route free from traffic and other forms of congestion, observe all traffic laws, and accelerate through the gears several times briskly.
3. Disconnect all of the ignition coils from the spark plugs.
4. Remove one spark plug from each cylinder of the engine. As the spark plugs are being removed, check electrodes for abnormal firing indicators; fouled, hot, oily, etc. Record cylinder number of spark plug for future reference.
5. Make sure the throttle blade is fully open during the compression check.
6. Insert compression gauge into the #1 spark plug hole in the cylinder head.
7. Crank the engine until maximum pressure is reached on the gauge. Record this pressure as #1 cylinder pressure.
8. Repeat the previous step for all of the remaining cylinders.
9. Compression should not be less than 689 kPa (100 psi) and not vary more than 25 percent from cylinder to cylinder.

NOTE: The recommended compression pressures are to be used only as a guide to diagnosing engine problems. An engine should not be disassembled to determine the cause of low compression unless some form of malfunction is present.

10. If one or more cylinders have an abnormally low compression pressure, repeat the compression test.
11. If the same cylinder or cylinders repeat an abnormally low reading on the second compression test, it could indicate the existence of a problem in the cylinder in question.

CYLINDER COMBUSTION PRESSURE LEAKAGE TEST

The combustion pressure leakage test provides an accurate means for determining engine condition.

Combustion pressure leakage testing will detect:

- Exhaust and intake valve leaks (improper seating).
- Leaks between adjacent cylinders or into water jacket.
- Any causes for combustion/compression pressure loss.

WARNING: DO NOT REMOVE THE PRESSURE CAP WITH THE SYSTEM HOT AND UNDER PRESSURE BECAUSE SERIOUS BURNS FROM COOLANT CAN OCCUR.

1. Check the coolant level and fill as required. **DO NOT** install the pressure cap.
2. Start and operate the engine until it attains normal operating temperature, then turn the engine **OFF**.
3. Clean spark plug recesses with compressed air.
4. Remove one spark plug from each cylinder.
5. Remove the oil filler cap.
6. Remove the air cleaner.
7. Calibrate the tester according to the manufacturer's instructions. The shop air source for testing should maintain 483 kPa (70 psi) minimum, 1,379 kPa (200 psi) maximum, with 552 kPa (80 psi) recommended.

Perform the test procedures on each cylinder according to the tester manufacturer's instructions. While testing, listen for pressurized air escaping through the throttle body, tailpipe and oil filler cap opening. Check for bubbles in the coolant.

All gauge pressure indications should be equal, with no more than 25% leakage per cylinder.

FOR EXAMPLE: At 552 kPa (80 psi) input pressure, a minimum of 414 kPa (60 psi) should be maintained in the cylinder.

STANDARD PROCEDURE

HYDROSTATIC LOCKED ENGINE

When an engine is suspected to be hydrostatically locked, regardless of what caused the problem, the following steps should be used.

CAUTION: DO NOT use starter motor to rotate the engine, severe damage may occur.

1. Inspect the air cleaner, induction system and intake manifold to insure system is dry and clear of foreign material.
2. Disconnect the negative battery cable.
3. Place a shop towel around the spark plugs when removing them from the engine. This will catch any fluid that may possibly be in the cylinder under pressure.
4. With all the spark plugs removed, rotate the engine crankshaft using a breaker bar and socket.
5. Identify the fluid in the cylinder(s) (i.e., coolant, fuel, oil or other).
6. Make sure all fluid has been removed from the cylinders. Inspect engine for damage (i.e., connecting rods, pistons, valves, etc.)
7. Repair engine or components as necessary to prevent this problem from reoccurring.

CAUTION: Squirt approximately one teaspoon of oil into the cylinders, rotate engine to lubricate the cylinder walls to prevent damage on restart.

8. Install new spark plugs.
9. Drain the engine oil and remove the oil filter.
10. Install a new oil filter.
11. Fill the engine with the specified amount of approved oil.
12. Connect the negative battery cable.
13. Start the engine and check for any leaks.

REPAIR OF DAMAGED OR WORN THREADS

CAUTION: Be sure that the tapped holes maintain the original center line.

Damaged or worn threads (excluding spark plug and camshaft bearing cap attaching threads) can be repaired. Essentially, this repair consists of drilling out worn or damaged threads, tapping the hole with a special Heli-Coil® Tap, (or equivalent) and installing an insert into the tapped hole. This brings the hole back to its original thread size. Heli-Coil® tools and inserts are readily available from automotive parts jobbers.

FORM-IN-PLACE GASKETS AND SEALERS

There are numerous places where form-in-place gaskets are used on the engine. Care must be taken when applying form-in-place gaskets to assure obtaining the desired results. **Do not use form-in-place gasket material unless specified.** Bead size, continuity, and location are of great importance. Too thin a bead can result in leakage while too much can result in spill-over which can break off and obstruct fluid feed lines. A

continuous bead of the proper width is essential to obtain a leak-free gasket.

There are numerous types of form-in-place gasket materials that are used in the engine area. Mopar® Engine RTV GEN II, Mopar® ATF-RTV, Mopar® Gasket Maker gasket materials, and Mopar® Gasket Sealant each have different properties and can not be used in place of the other.

MOPAR® ENGINE RTV GEN II is used to seal components exposed to engine oil. This material is a specially designed black silicone rubber RTV that retains adhesion and sealing properties when exposed to engine oil. Moisture in the air causes the material to cure. This material is available in three ounce tubes and has a shelf life of one year. After one year this material will not properly cure. Always inspect the package for the expiration date before use.

MOPAR® ATF RTV is a specifically designed black silicone rubber RTV that retains adhesion and sealing properties to seal components exposed to automatic transmission fluid, engine coolants, and moisture. This material is available in three ounce tubes and has a shelf life of one year. After one year this material will not properly cure. Always inspect the package for the expiration date before use.

MOPAR® GASKET MAKER is an anaerobic type gasket material. The material cures in the absence of air when squeezed between two metallic surfaces. It will not cure if left in the uncovered tube. The anaerobic material is for use between two machined surfaces. Do not use on flexible metal flanges.

MOPAR® GASKET SEALANT is a slow drying, permanently soft sealer. This material is recommended for sealing threaded fittings and gaskets against leakage of oil and coolant. Can be used on threaded and machined parts under all temperatures. This material is used on engines with multi-layer steel (MLS) cylinder head gaskets. This material also will prevent corrosion. Mopar® Gasket Sealant is available in a 13 oz. aerosol can or 4oz./16 oz. can w/applicator.

SEALER APPLICATION

Mopar® Gasket Maker material should be applied sparingly, 0.040 in. (1 mm) diameter or less of sealant to one gasket surface. Be certain the material surrounds each mounting hole. Excess material can easily be wiped off. Components should be torqued in place within 15 minutes. The use of locating dowel is recommended during assembly to prevent smearing material off the location.

Mopar® Engine RTV GEN II or ATF RTV gasket material should be applied in a continuous bead approximately 0.120 in. (3 mm) in diameter. All mounting holes must be circled. For corner sealing, a 1/8 or 1/4 in. (3.17 or 6.35 mm) drop is placed in the center of the gasket contact area. Uncured sealant may be removed with a shop towel. Components should be torqued in place while the sealant is still wet to the touch (within 10 minutes). The usage of a locating dowel is recommended during assembly to prevent smearing material off the location.

Mopar® Gasket Sealant in an aerosol can should be applied using a thin, even coat sprayed completely over both surfaces to be joined, and both sides of a gasket. Then proceed with assembly. Material in a can w/applicator can be brushed on evenly over the sealing surfaces. Material in an aerosol can should be used on engines with multi-layer steel gaskets.

ENGINE GASKET SURFACE PREPARATION

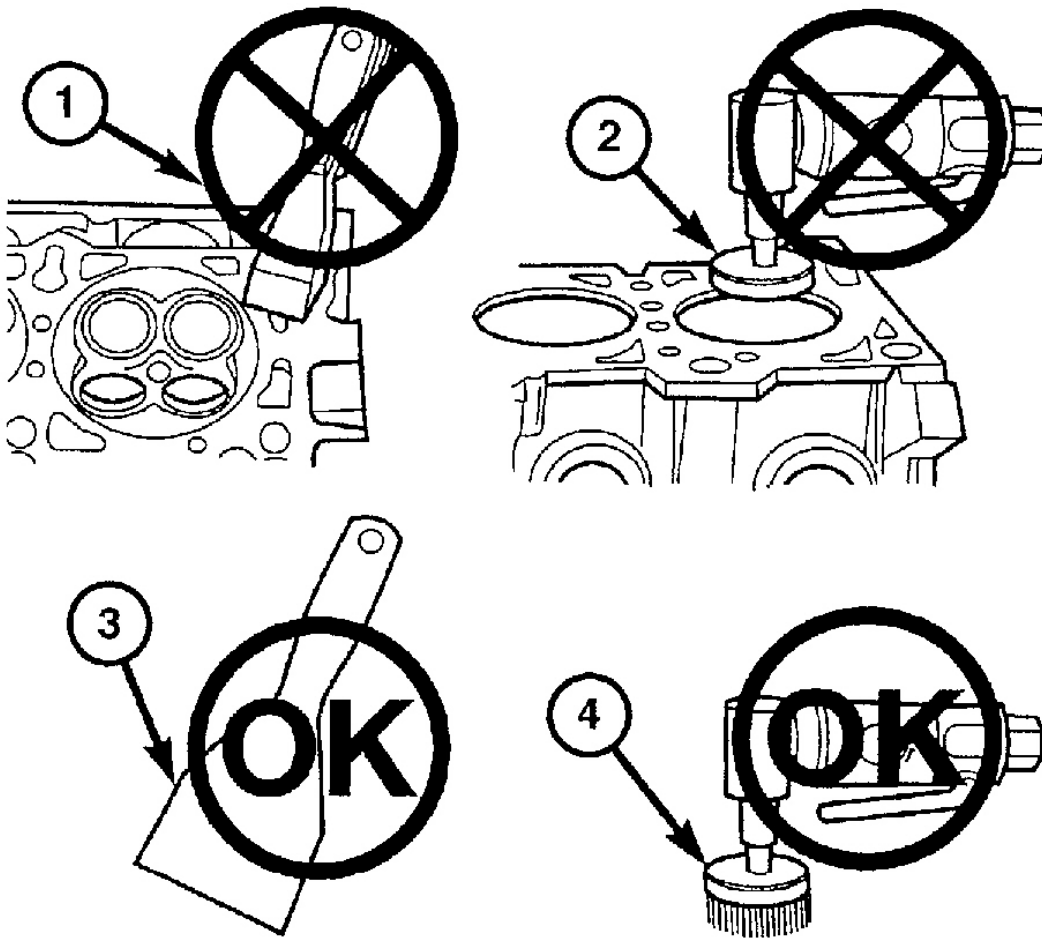
To ensure a good gasket seal, proper surface preparation must be performed, especially with the use of aluminum engine components and multi-layer steel cylinder head gaskets.

Never use the following to clean gasket surfaces:

- Metal scraper (1)
- Abrasive pad or paper to clean cylinder block and head (2).
- High speed power tool with an abrasive pad or a wire brush.

NOTE: **Multi-Layer Steel (MLS) head gaskets require a scratch free sealing surface.**

CAUTION: Excessive pressure or high RPM (beyond the recommended speed), can damage the sealing surfaces. The mild (white, 120 grit) bristle disc is recommended. If necessary, the medium (yellow, 80 grit) bristle disc may be used on cast iron surfaces with care.



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Fig. 6: Preparing Engine Gasket Surface
Courtesy of DAIMLERCHRYSLER CORP.

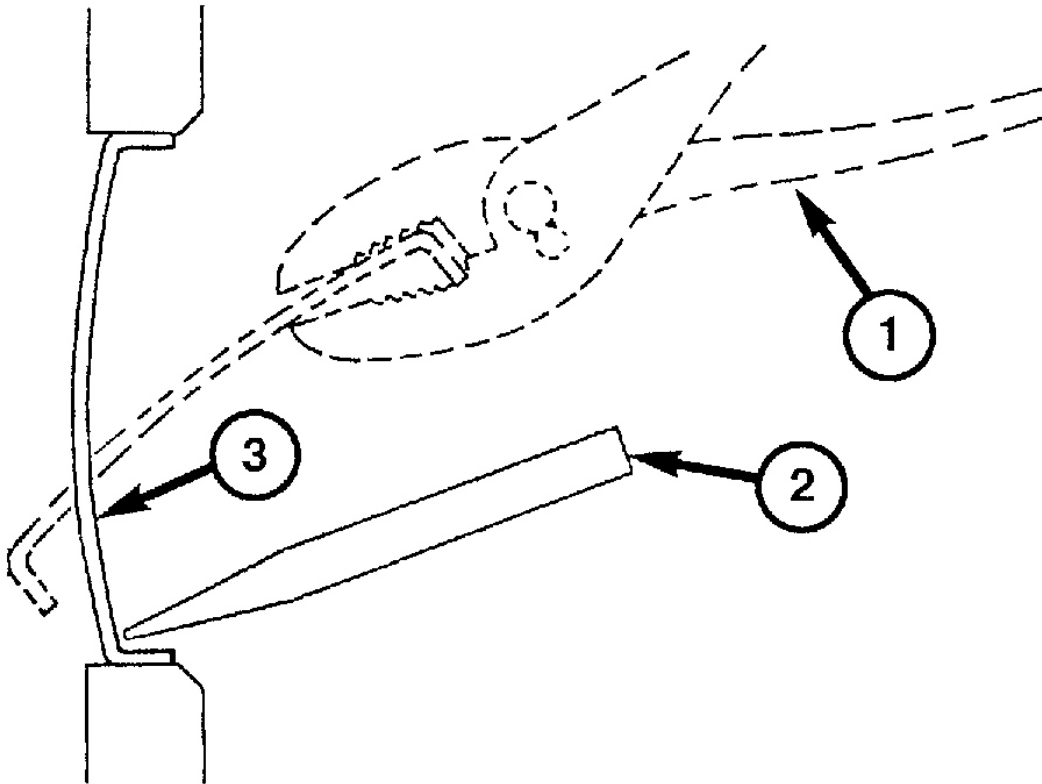
Only use the following for cleaning gasket surfaces:

- Solvent or a commercially available gasket remover.
- Plastic or wood scraper (3).
- Drill motor with 3M Roloc™ Bristle Disc (4) (white or yellow).

ENGINE CORE AND OIL GALLERY PLUGS

CAUTION: Do not drive cup plug into the casting as restricted cooling can result and cause serious engine problems.

Using a blunt tool such as a drift (2) and a hammer, strike the bottom edge of the cup plug (3). With the cup plug rotated, grasp firmly with pliers (1) or other suitable tool and remove plug.



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Fig. 7: Preparing Engine Core & Oil Gallery Plugs
Courtesy of DAIMLERCHRYSLER CORP.

Thoroughly clean the inside of the cup plug hole in the cylinder block or head. Be sure to remove any old sealer. Lightly coat the inside of the cup plug hole with Mopar® Stud and Bearing Mount. Make certain the new plug is cleaned of all oil or grease. Using the proper drive plug, drive the plug into the hole so that the sharp edge of the plug is at least 0.020 in. (0.5 mm) inside the lead-in chamfer.

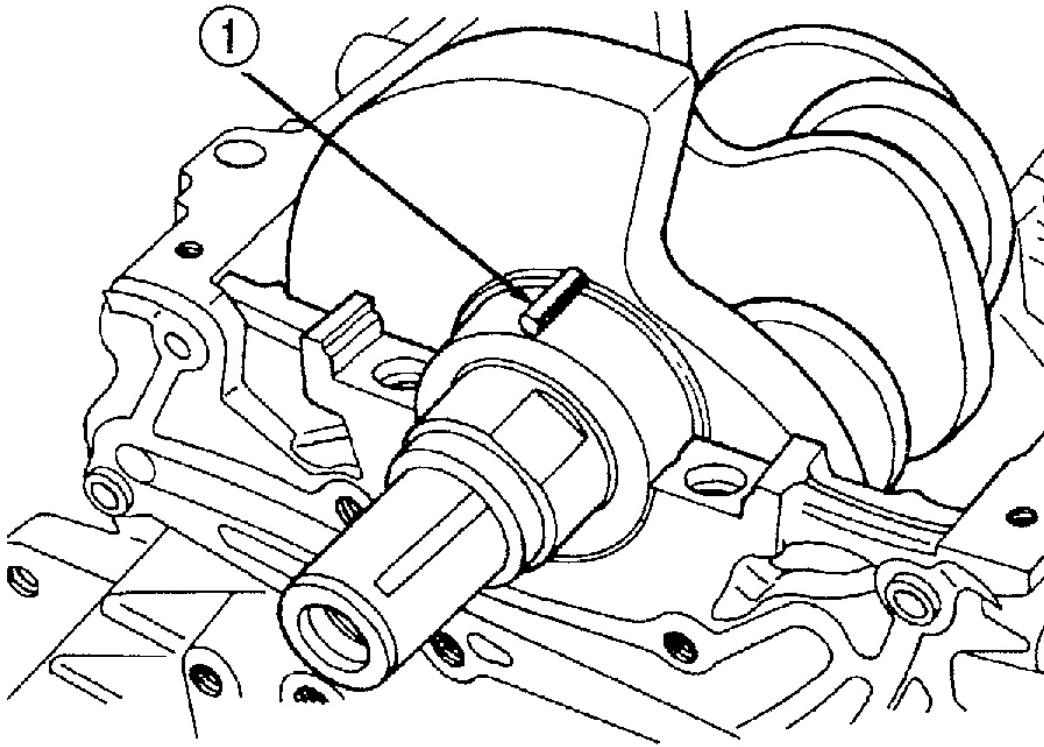
It is not necessary to wait for the curing of the sealant. The cooling system can be refilled and the vehicle placed in service immediately.

MEASURING BEARING CLEARANCE USING PLASTIGAGE®

The engine crankshaft bearing clearances can be determined by the use of a Plastigage® or equivalent. The following is the recommended procedure for the use of the Plastigage®:

1. Remove any oil film from the surface to be checked. The plastigage will dissolve in oil.

2. Place a piece of the Plastigage® (1) across the entire width of the bearing shell in the cap approximately 1/4 in. (6.35 mm) off center, and away from the oil holes (In addition, suspected areas can be checked by placing the Plastigage in the suspected area). Torque the bearing cap bolts of the bearing being checked to the proper torque specifications.



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Fig. 8: Placing Plastigage® Across Bearing Shell
Courtesy of DAIMLERCHRYSLER CORP.

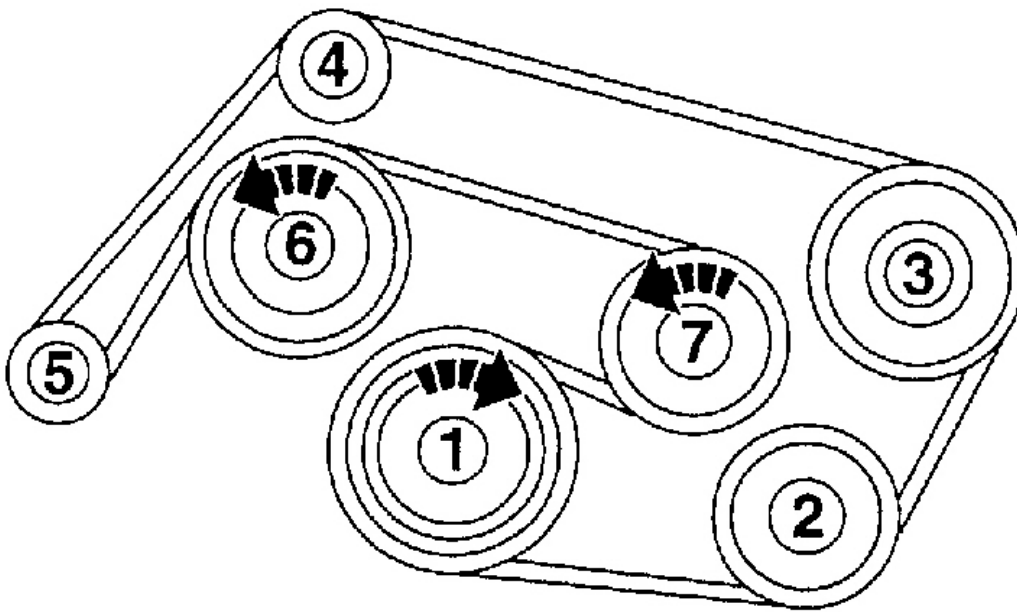
3. Remove the bearing cap and compare the width of the flattened Plastigage® with the metric scale provided on the package of the Plastigage®. Locate the band closest to the same width. This band shows the amount of clearance in thousandths of a millimeter. Differences in readings between the ends indicate the amount of taper present. Record all the readings taken. Compare the clearance measurements to the specifications found in the engine specifications. See **SPECIFICATIONS**. Plastigage® generally is accompanied by two scales. One scale is in inches, the other is a metric scale.

NOTE: Plastigage is available in a variety of clearance ranges. Use the most appropriate range for the specifications you are checking.

4. Install the proper crankshaft bearings to achieve the specified bearing clearances.

REMOVAL

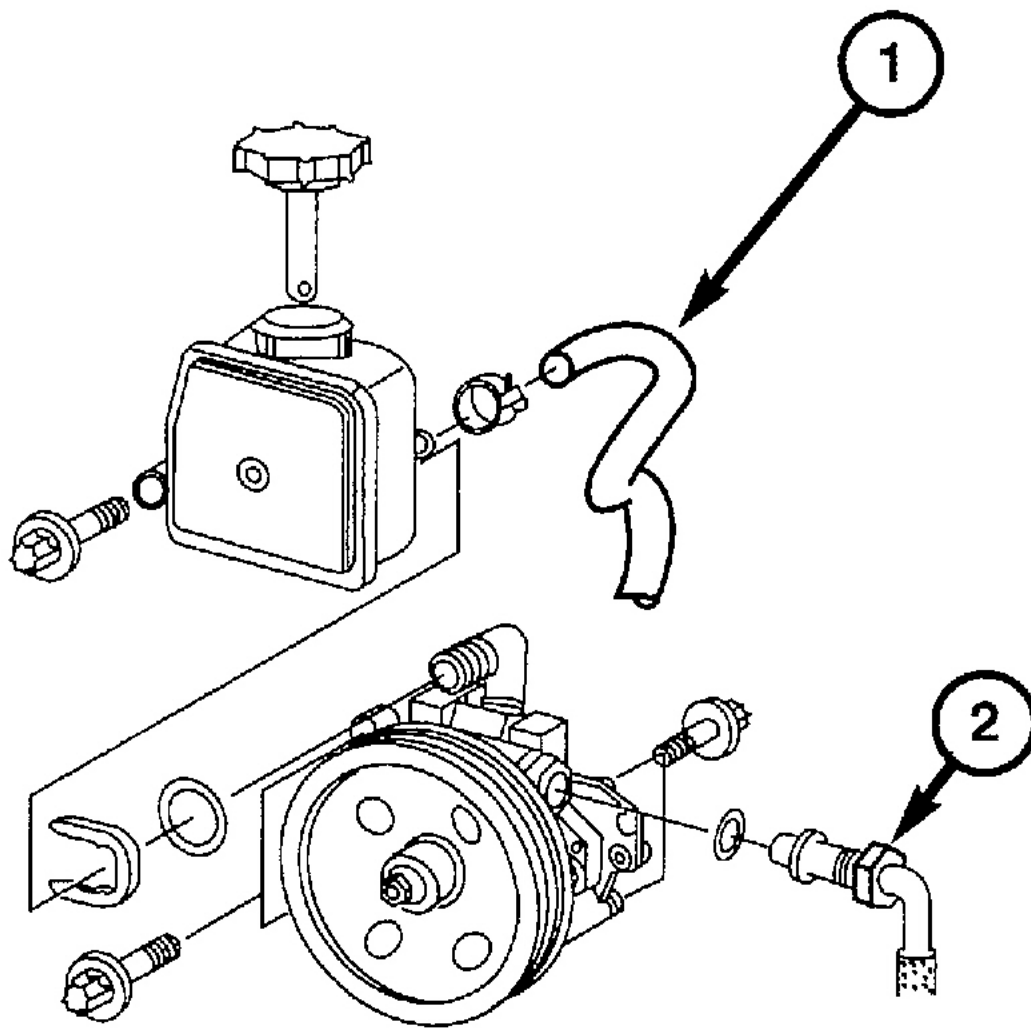
1. Disconnect the negative battery cable.
2. Remove the air cleaner housing assembly. See **AIR CLEANER HOUSING**.
3. Drain the cooling system. See **COOLING SYSTEM (MECHANICAL)** article.
4. Remove the radiator with the radiator fan. See **COOLING SYSTEM (MECHANICAL)** article.
5. Remove the accessory drive belt.



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Fig. 9: Identifying Drive Belt Routing
Courtesy of DAIMLERCHRYSLER CORP.

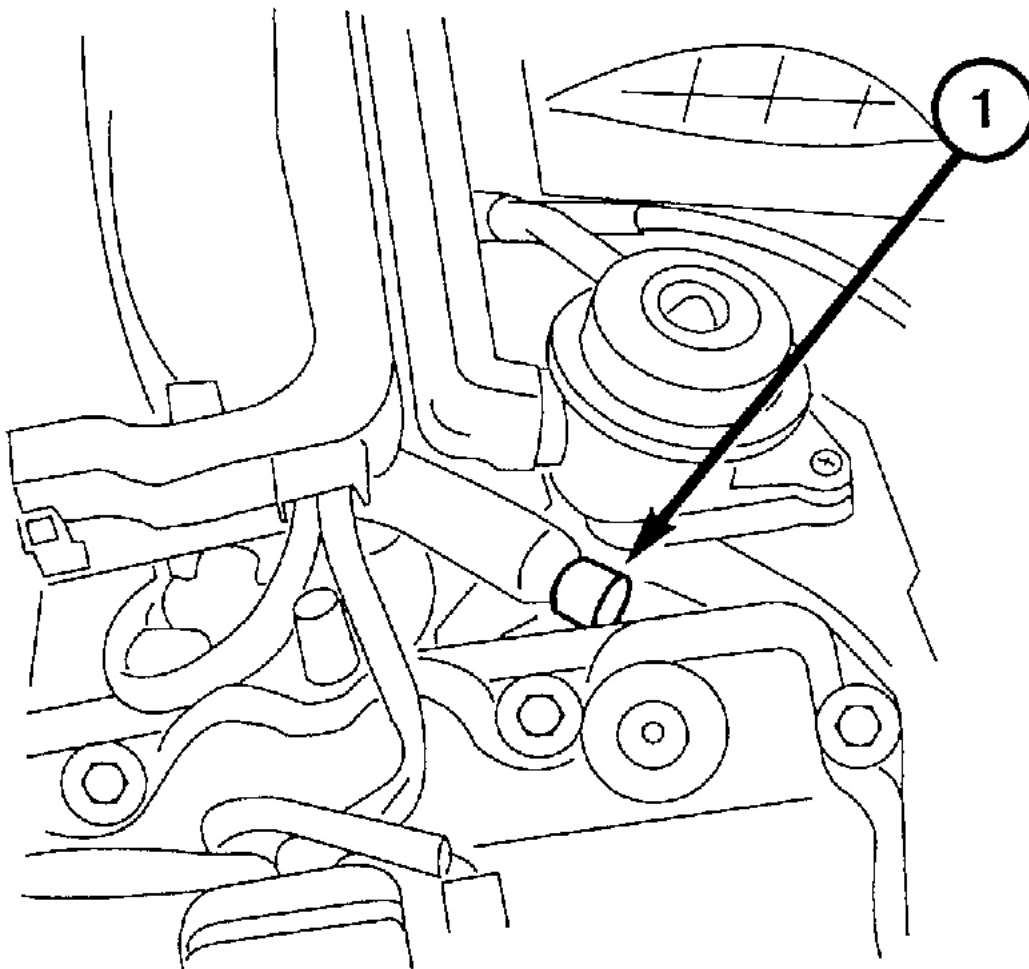
6. Remove the mass air flow sensor.
7. Disconnect the vacuum hoses at the vacuum booster, the intake manifold, and the purge valve.
8. Remove the oil from the power steering pump reservoir.
9. Disconnect the ground lead at the power steering pump.
10. Disconnect the pressure (2) and return (1) lines from the power steering pump.



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Fig. 10: Disconnecting Pressure & Return Lines From Power Steering Pump
Courtesy of DAIMLERCHRYSLER CORP.

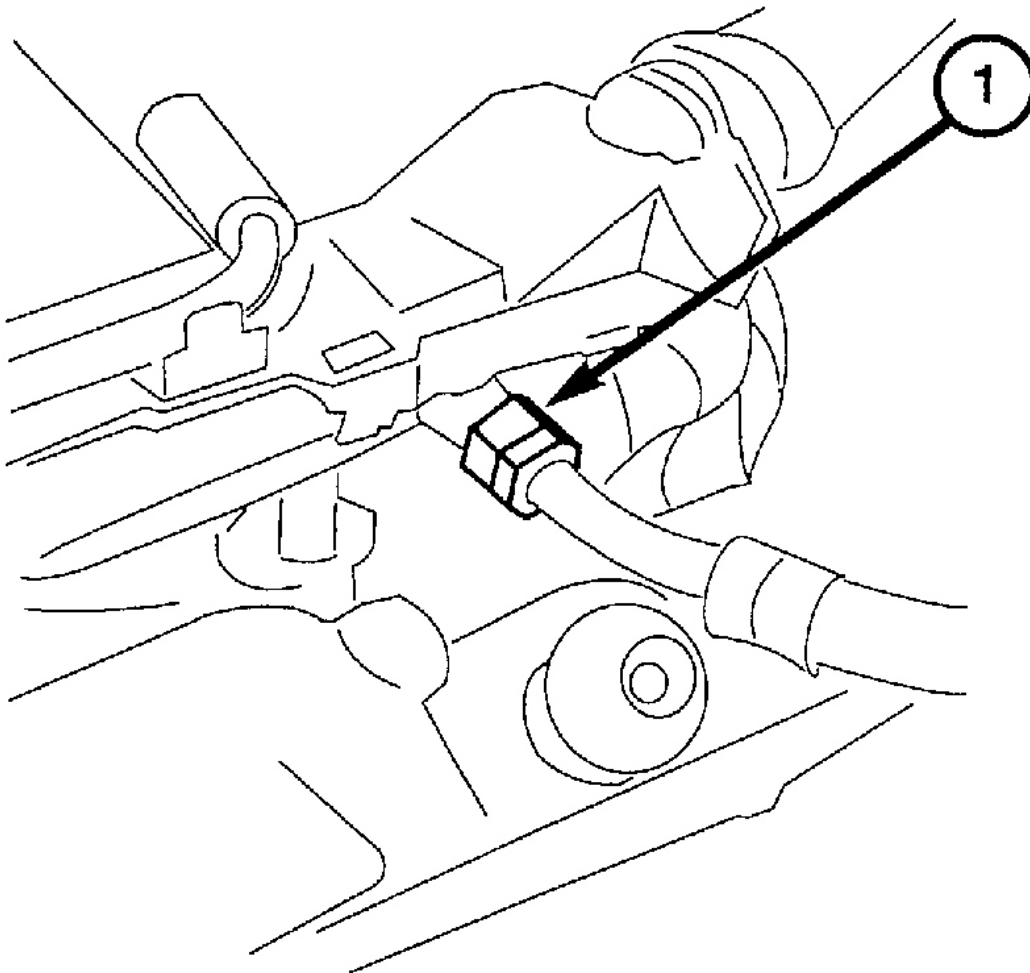
11. Relieve the fuel pressure at the service valve (1) on the fuel rail. See **FUEL SYSTEM** article.



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Fig. 11: Relieving Fuel Pressure At Service Valve On Fuel Rail
Courtesy of DAIMLERCHRYSLER CORP.

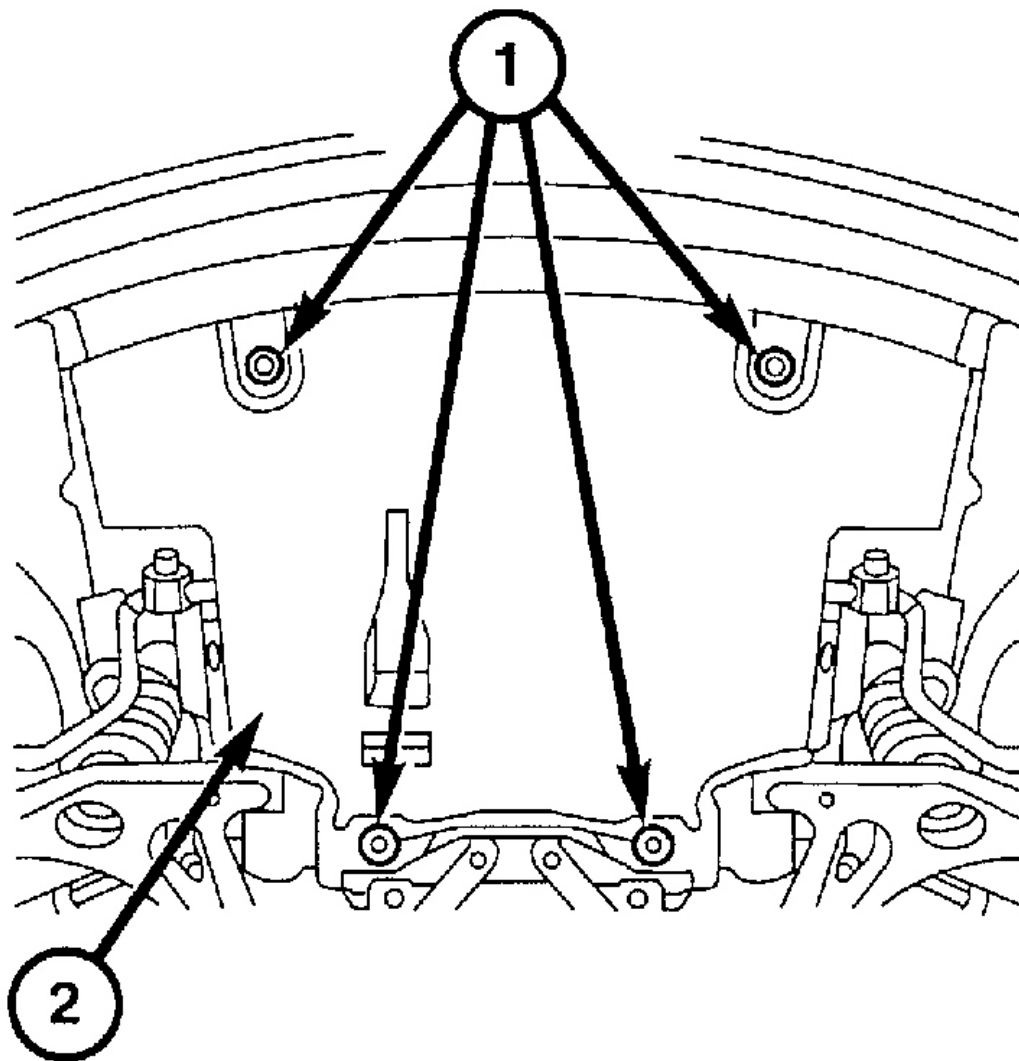
12. Disconnect the fuel supply line (1) at the fuel rail.



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Fig. 12: Disconnecting Fuel Supply Line At Fuel Rail
 Courtesy of DAIMLERCHRYSLER CORP.

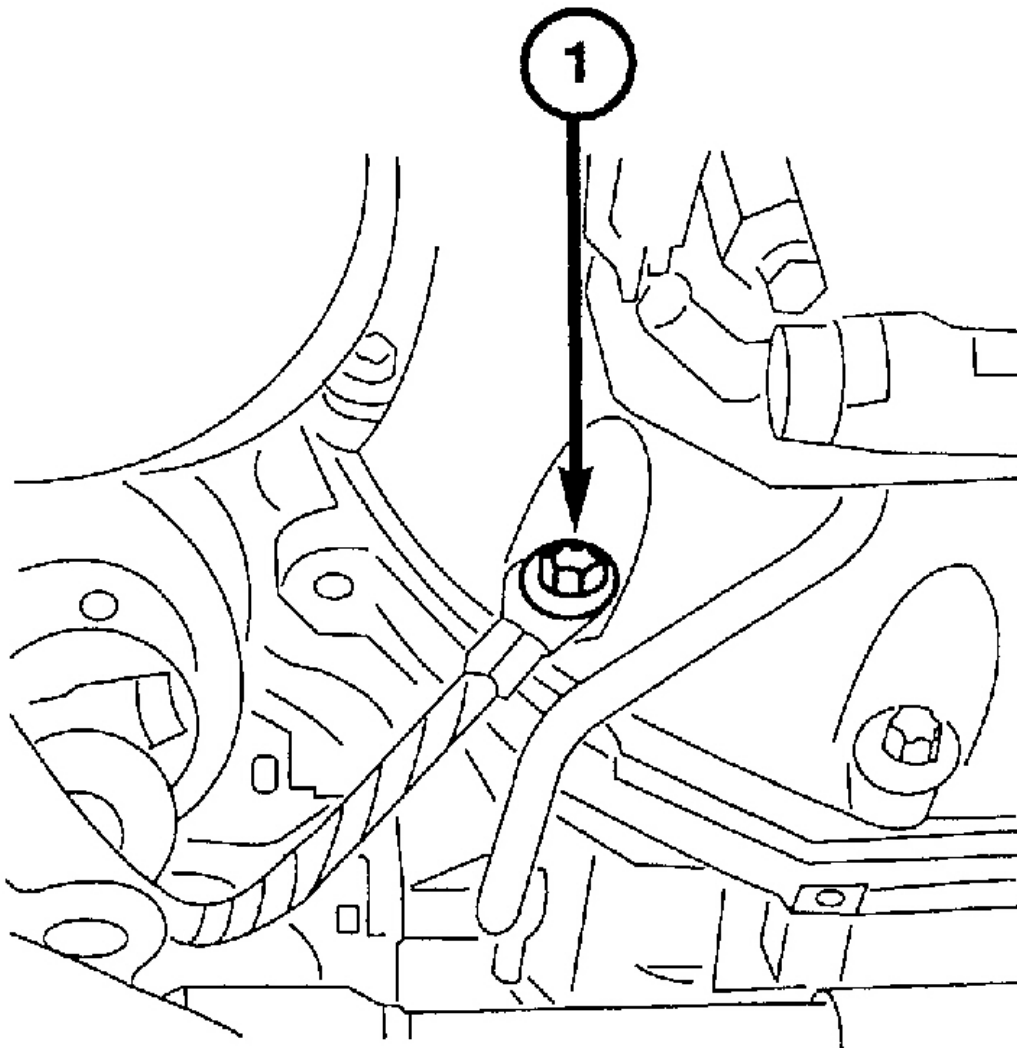
13. Disconnect the engine wire harness.
14. Raise and support the vehicle.
15. Remove the lower splash shield screws (1) and the splash shield.



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Fig. 13: Removing Lower Splash Shield
Courtesy of DAIMLERCHRYSLER CORP.

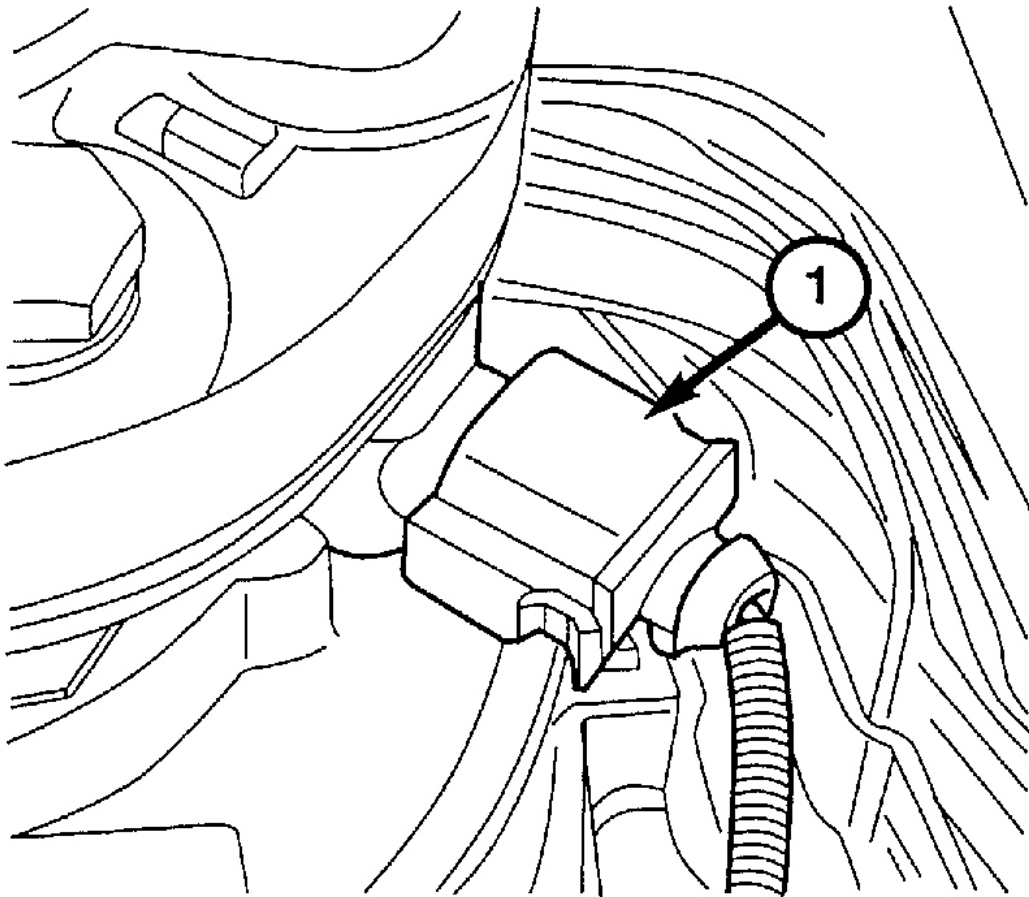
16. Drain the engine oil. See **OIL**.
17. Remove the propeller shaft. See **PROPELLER SHAFT** article.
18. Disconnect the ground cable (1) at the transmission.



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Fig. 14: Disconnecting Ground Cable At Transmission
Courtesy of DAIMLERCHRYSLER CORP.

19. Disconnect the backup lamp switch harness connector (1) (with manual transmission).
20. Disconnect the transmission wire harness connector and the shift selector cable (with automatic transmission).

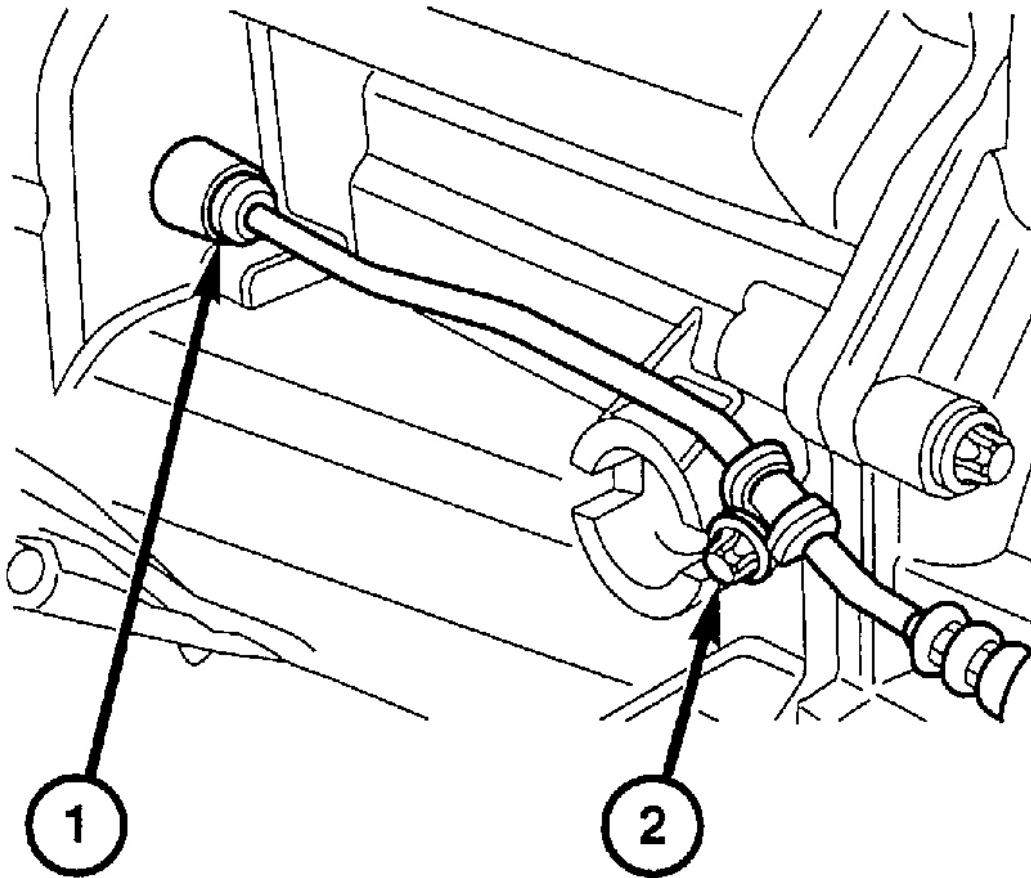


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Fig. 15: Disconnecting Transmission Wire Harness Connector & Shift Selector Cable (With Automatic Transmission)

Courtesy of DAIMLERCHRYSLER CORP.

21. Disconnect the pressure line (1) from the clutch slave cylinder (manual transmission only).

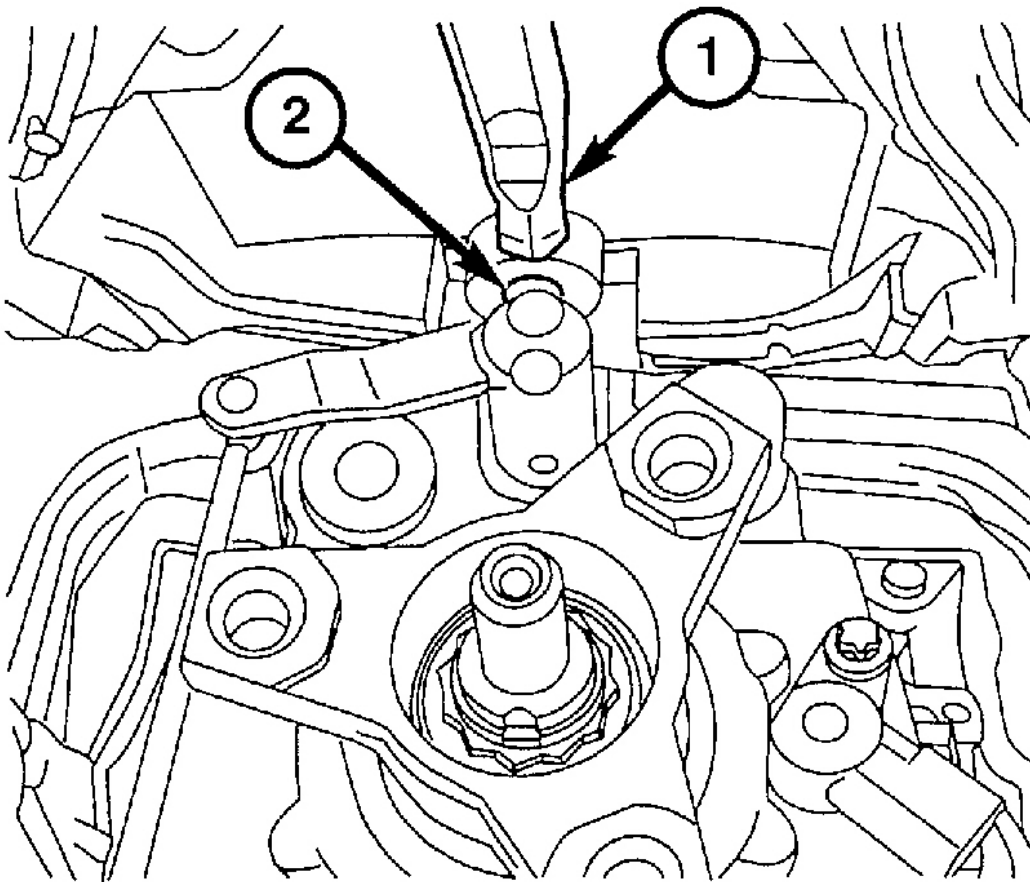


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Fig. 16: Disconnecting Pressure Line & Retaining Bolt From Clutch Slave Cylinder (Manual Transmission Only)

Courtesy of DAIMLERCHRYSLER CORP.

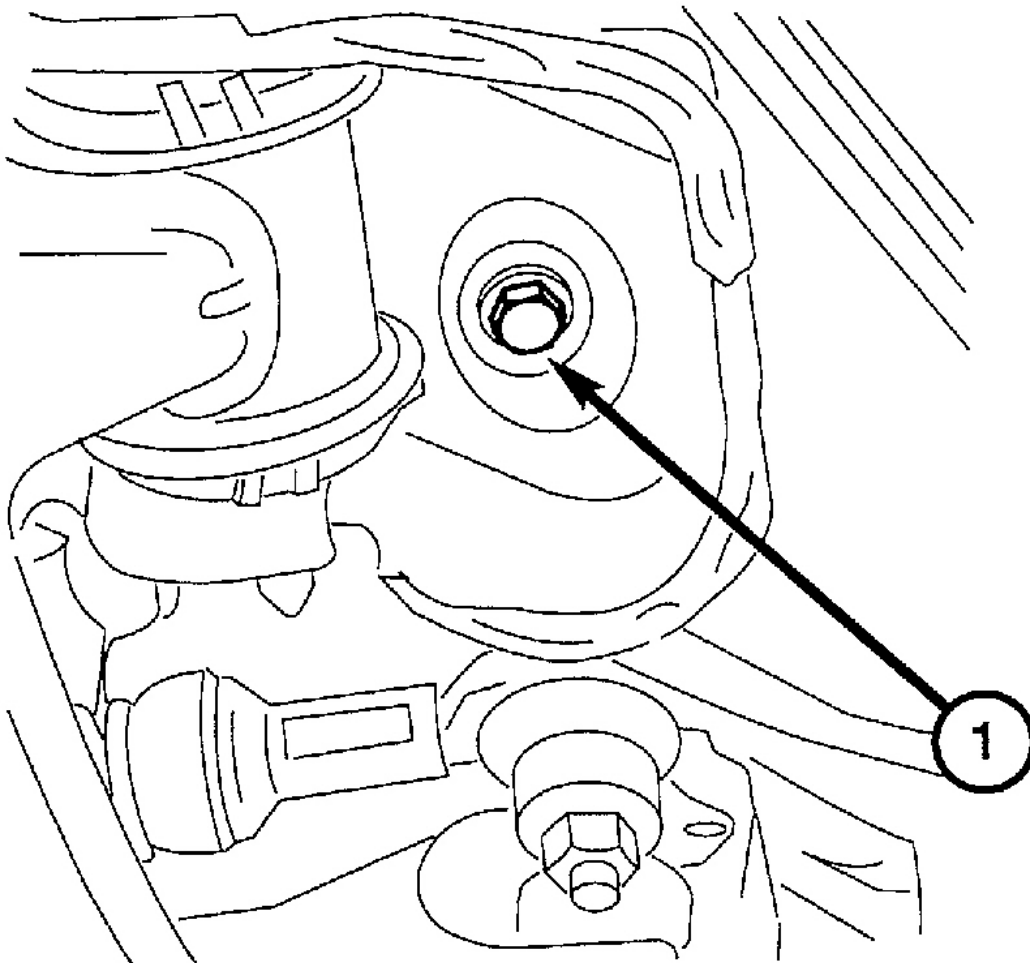
22. Remove the pressure line retaining bolt (2) and position the pressure line aside.
23. Disconnect the reverse lockout cable.
24. Disconnect the shift rod (1) from the ball stud (2) (manual transmission only).



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Fig. 17: Disconnecting Shift Rod From Ball Stud (Manual Transmission Only)
Courtesy of DAIMLERCHRYSLER CORP.

25. Disconnect the starter harness connectors. See **STARTERS** article.
26. Remove the front engine mount bolt (1).



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Fig. 18: Removing Front Engine Mount Bolt
Courtesy of DAIMLERCHRYSLER CORP.

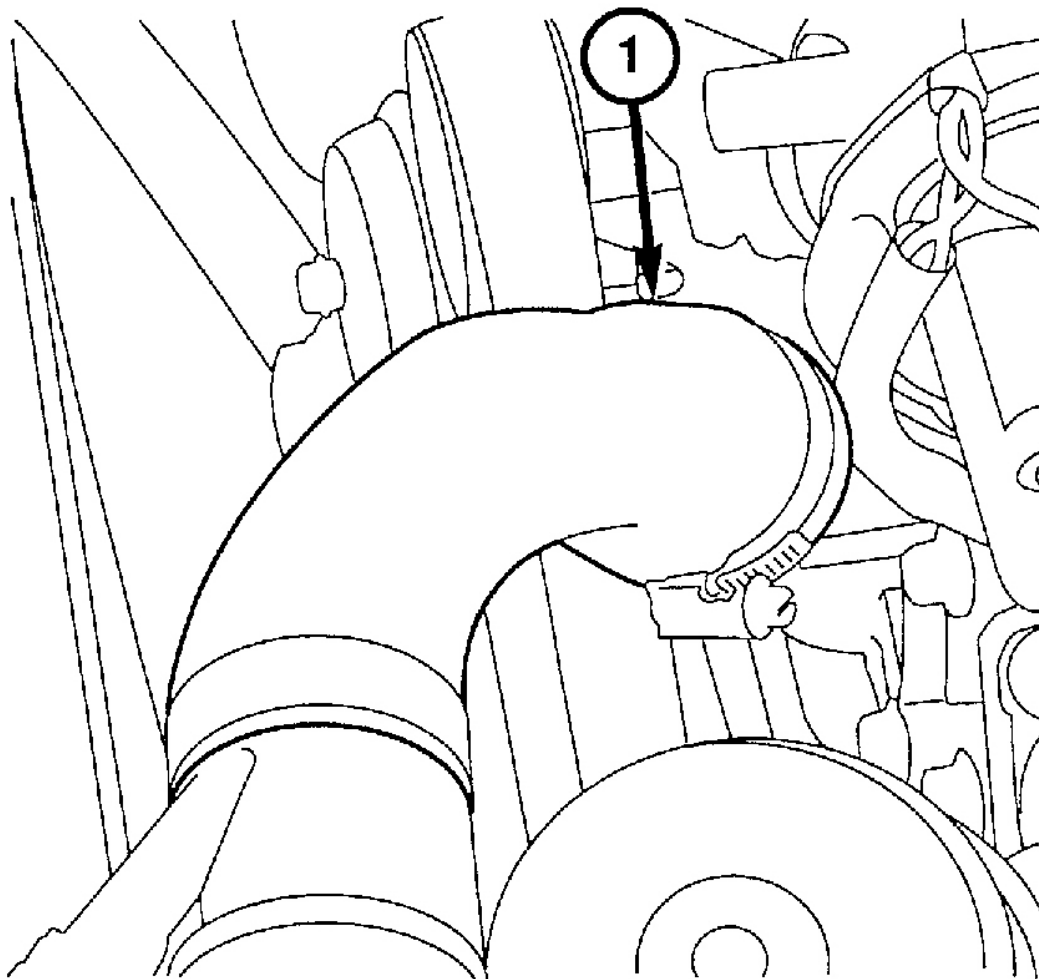
27. Remove the lower radiator hose (1) and the coolant bypass hose (2) from the water pump.



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Fig. 19: Removing Lower Radiator Hose & Coolant Bypass Hose From Water Pump
 Courtesy of DAIMLERCHRYSLER CORP.

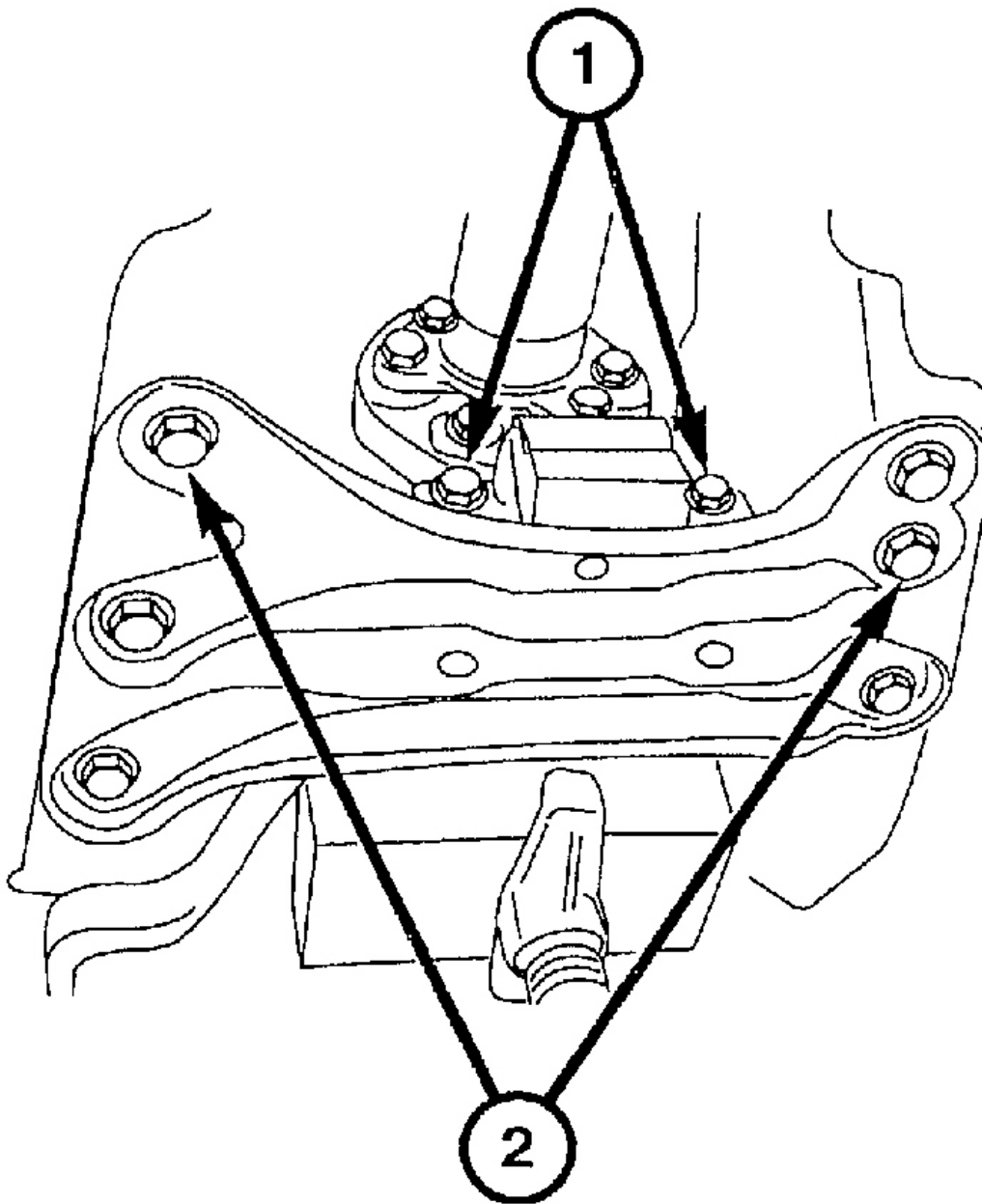
28. Lower the vehicle.
29. Remove the upper radiator hose (1) from the thermostat housing.



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Fig. 20: Removing Upper Radiator Hose From Thermostat Housing
Courtesy of DAIMLERCHRYSLER CORP.

30. Disconnect the heater hoses at the intake manifold and the engine block.
31. Remove the A/C compressor mounting bolts. See **CONTROLS** article.
32. Position the A/C compressor aside with lines attached.
33. Position a floor jack under the transmission and raise the transmission slightly.
34. Remove the transmission mount bolts (1), the crossmember bolts (2) and the transmission mount with crossmember.

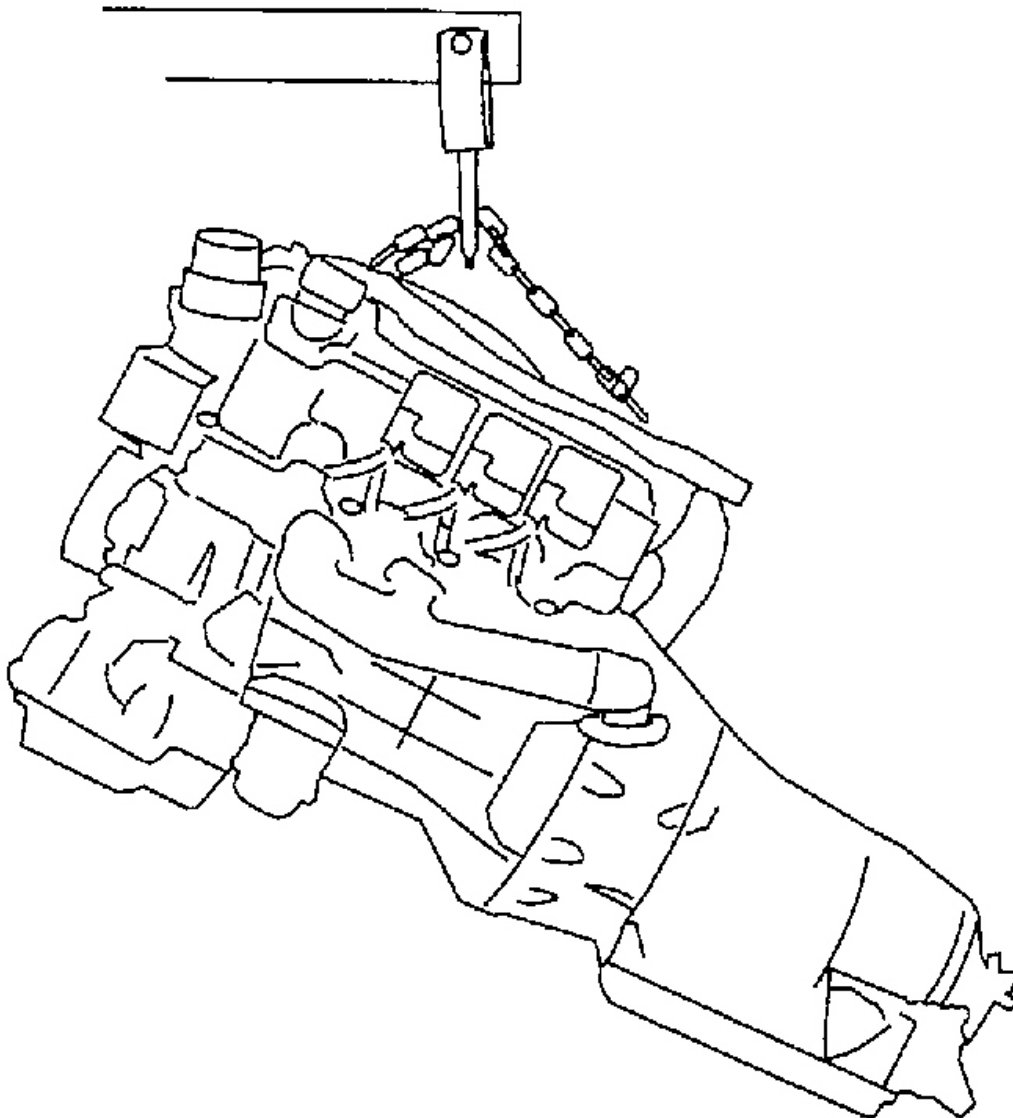


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Fig. 21: Removing Transmission Mount Bolts, Crossmember Bolts & Transmission Mount With Crossmember
Courtesy of DAIMLERCHRYSLER CORP.

35. Attach the engine lifting device to the engine lifting eyes.

36. Lower the rear of the transmission with the floor jack.
37. Remove the engine and transmission assembly from the vehicle.



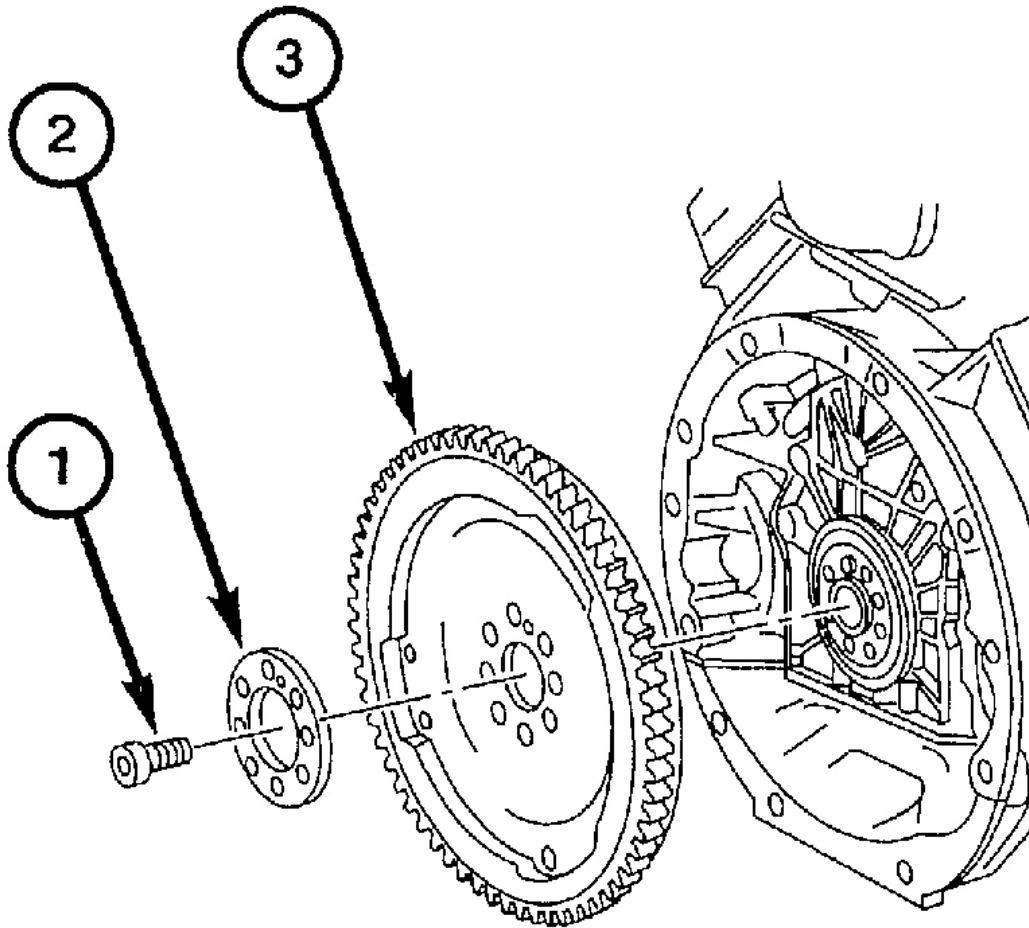
G01861873

Fig. 22: Removing Engine & Transmission Assembly
Courtesy of DAIMLERCHRYSLER CORP.

38. Separate the engine and transmission. For automatic, see **REMOVAL & INSTALLATION** article and

for manual, see **REMOVAL & INSTALLATION** article.

39. Remove the clutch if equipped. See **CLUTCHES** article.
40. Remove the flywheel bolts (1), the spacer (2) and the flywheel (3).



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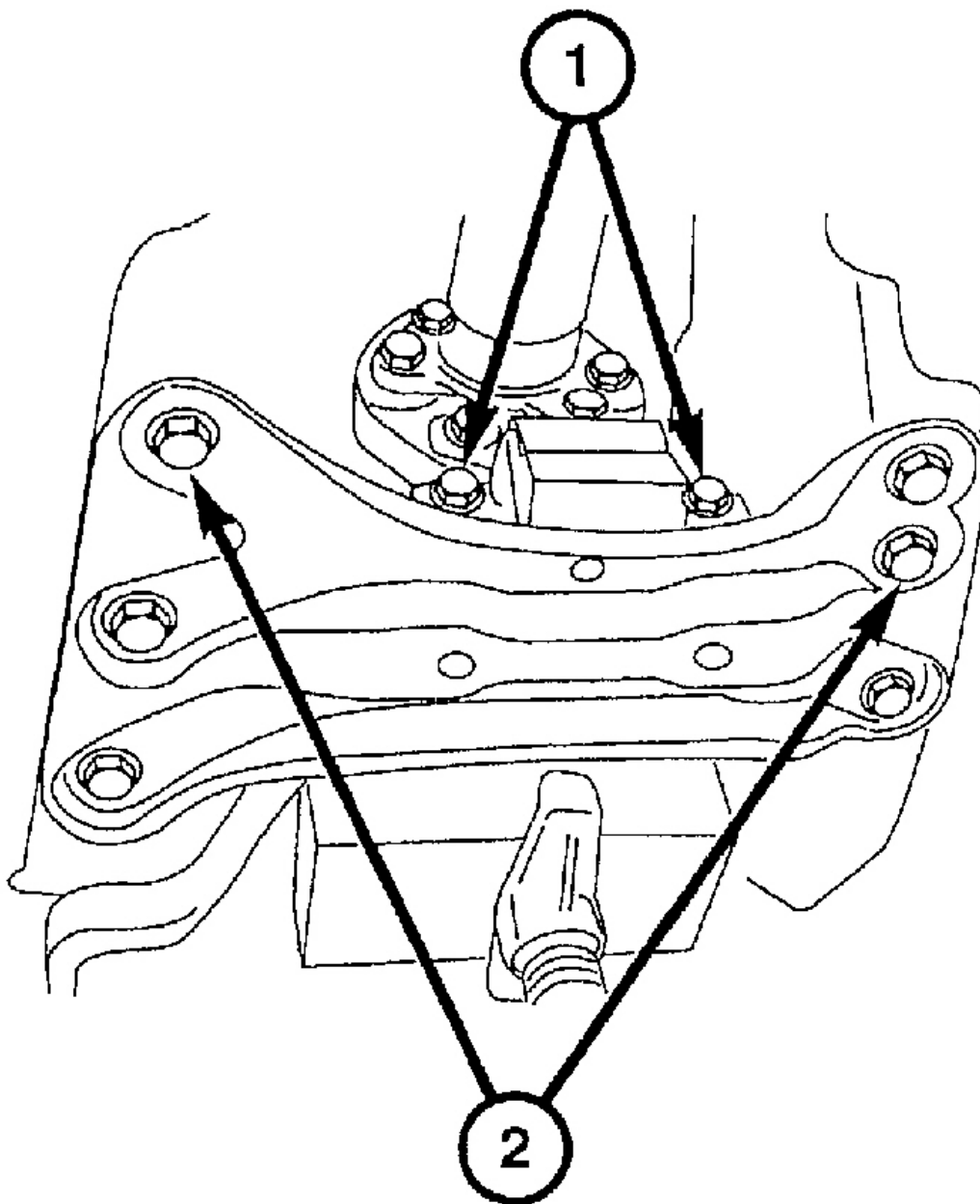
Fig. 23: Removing Flywheel Bolts, Spacer & Flywheel
Courtesy of DAIMLERCHRYSLER CORP.

41. Mount the engine on an engine stand.

INSTALLATION

1. Attach the lifting device to the engine lifting eyes.
2. Remove the engine from the engine stand.

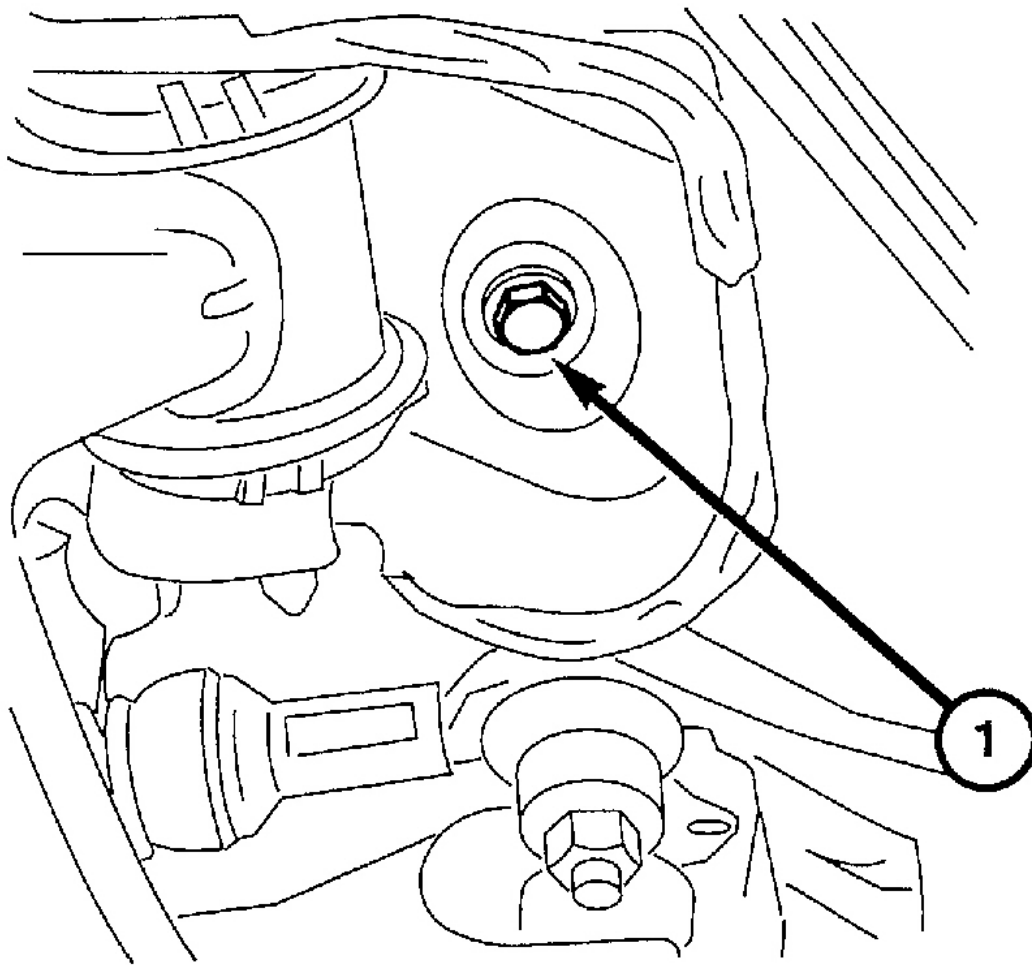
3. Install the flywheel. See **FLEX PLATE/FLYWHEEL**.
4. Install the clutch if equipped. See **CLUTCHES** article.
5. Install the transmission to the engine. For automatic, see **REMOVAL & INSTALLATION** article and for manual, see **REMOVAL & INSTALLATION** article.
6. Install the starter. See **STARTERS** article.
7. Position the engine and transmission in the vehicle on the front axle carrier with the transmission resting on the floor jack.
8. Raise the transmission with the floor jack.
9. Install the transmission mount with crossmember. Install the transmission mount bolts (1) and the crossmember bolts (2)



G01861875

Fig. 24: Installing Transmission Mount With Crossmember
Courtesy of DAIMLERCHRYSLER CORP.

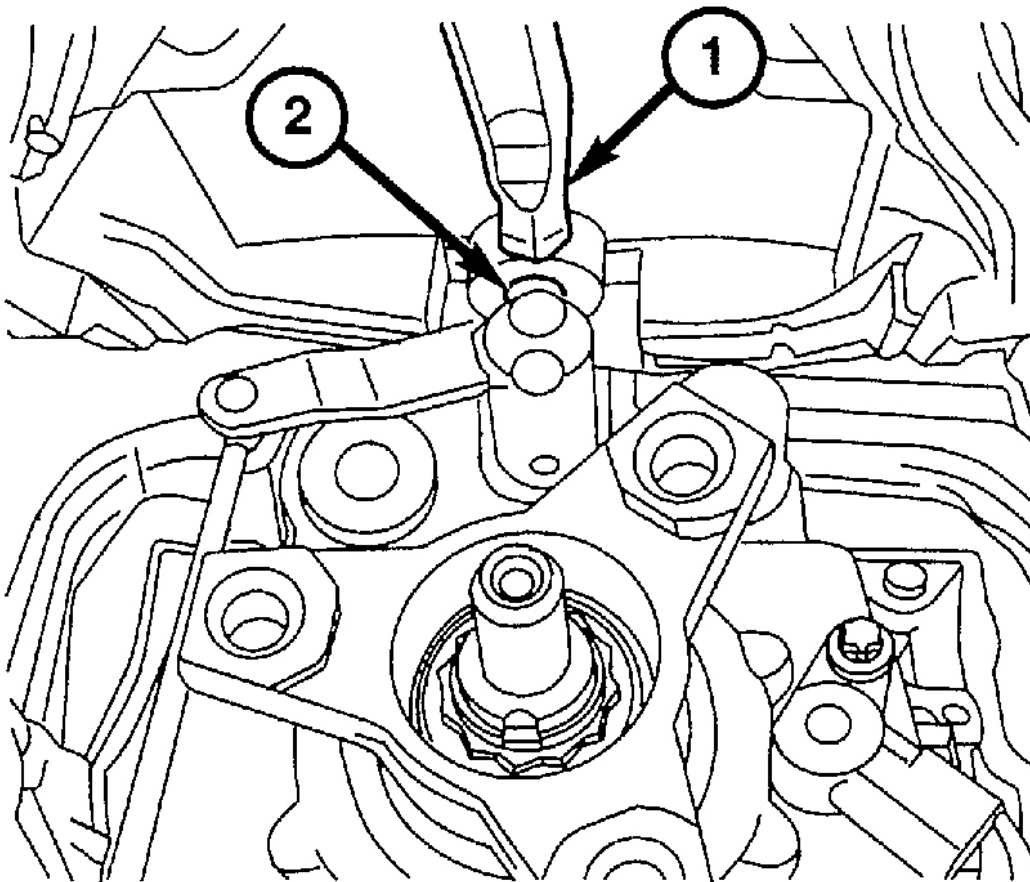
10. Raise and support the vehicle.
11. Install the front engine mount bolt (1).



G01861876

Fig. 25: Installing Front Engine Mount Bolt
Courtesy of DAIMLERCHRYSLER CORP.

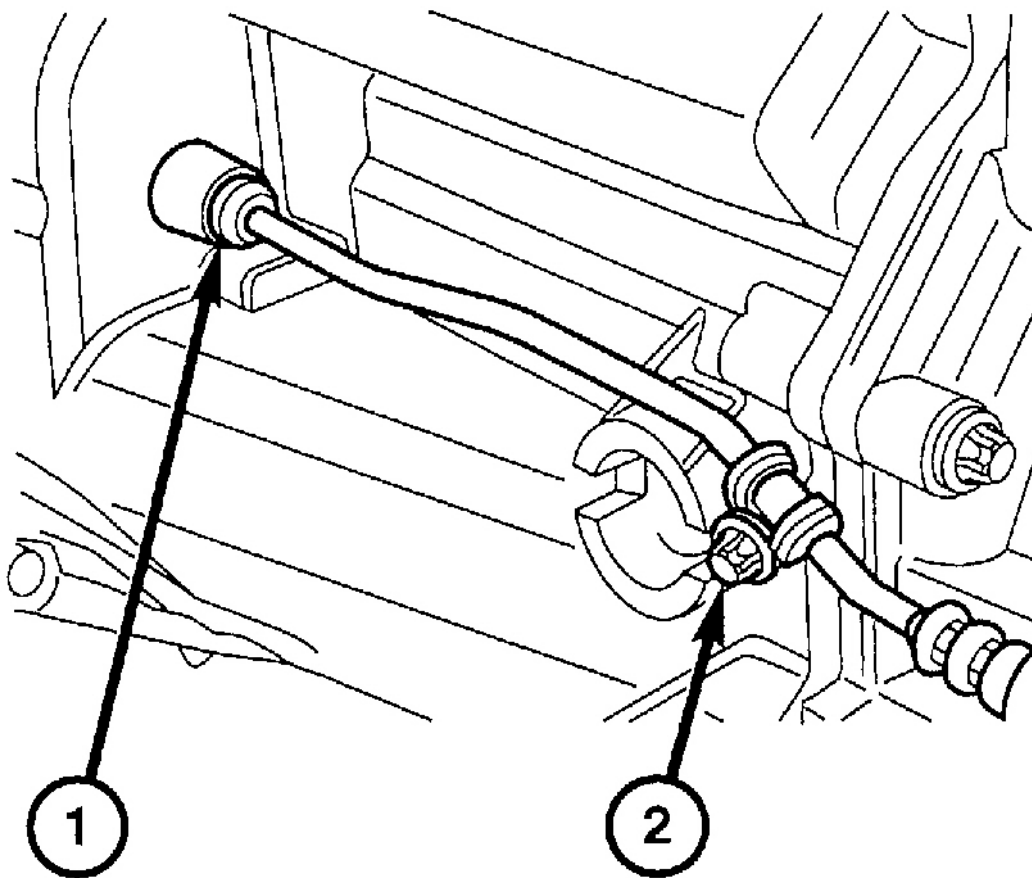
12. Tighten the crossmember to body bolts to 40 N.m (30 ft. lbs.).
13. Tighten the transmission mount to transmission bolts to 50 N.m (36 ft. lbs.).
14. Tighten the engine mount to front axle carrier bolts to 55 N.m (41 ft.lbs.).
15. Bolt on the A/C compressor. See **CONTROLS** article.
16. Connect the shift rod (1) to the ball stud (2). Connect the reverse lockout cable. (manual transmission).



G01861877

Fig. 26: Connecting Shift Rod To Ball Stud
Courtesy of DAIMLERCHRYSLER CORP.

17. Connect the pressure line (1) to the clutch slave cylinder. Install the pressure line retainer bolt (2) and tighten to 15 N.m (11 ft. lbs.) (manual transmission).

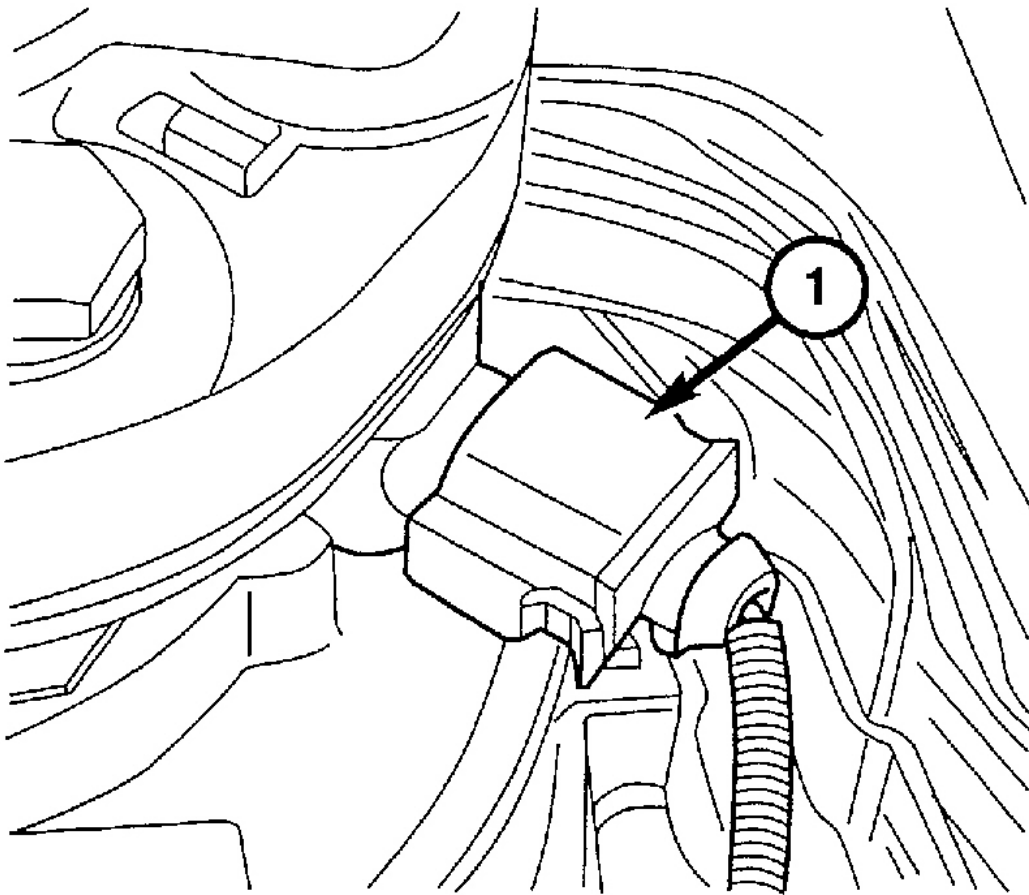


G01861878

Fig. 27: Connecting Pressure Line To Clutch Slave Cylinder & Installing Pressure Line Retainer Bolt

Courtesy of DAIMLERCHRYSLER CORP.

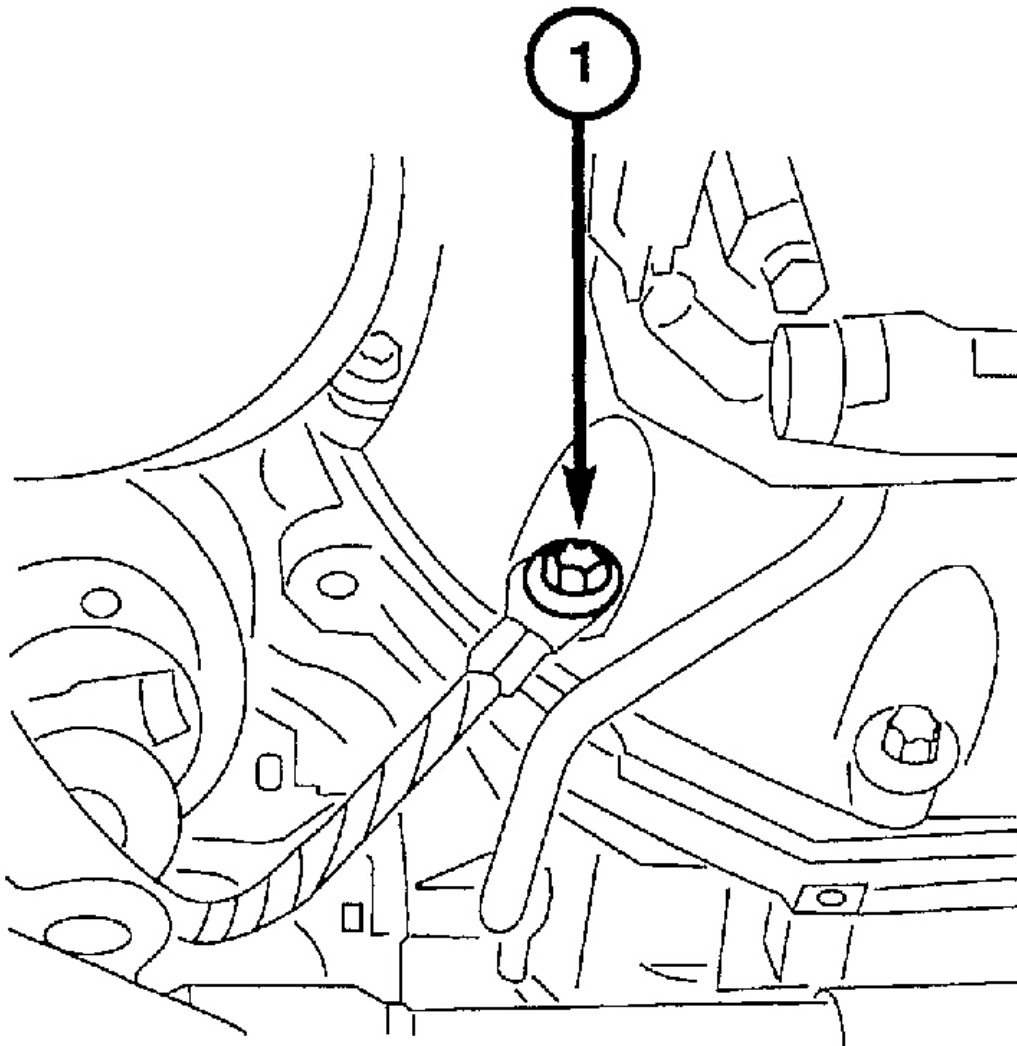
18. Connect the backup lamp switch harness connector (1) (manual transmission). Connect the transmission wire harness connector and the shift selector cable (automatic transmission).



G01861879

Fig. 28: Connecting Backup Lamp Switch Harness Connector
Courtesy of DAIMLERCHRYSLER CORP.

19. Bolt on the ground cable at the transmission and tighten to 40 N.m (30 ft. lbs.).



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Fig. 29: Bolting Ground Cable At Transmission
Courtesy of DAIMLERCHRYSLER CORP.

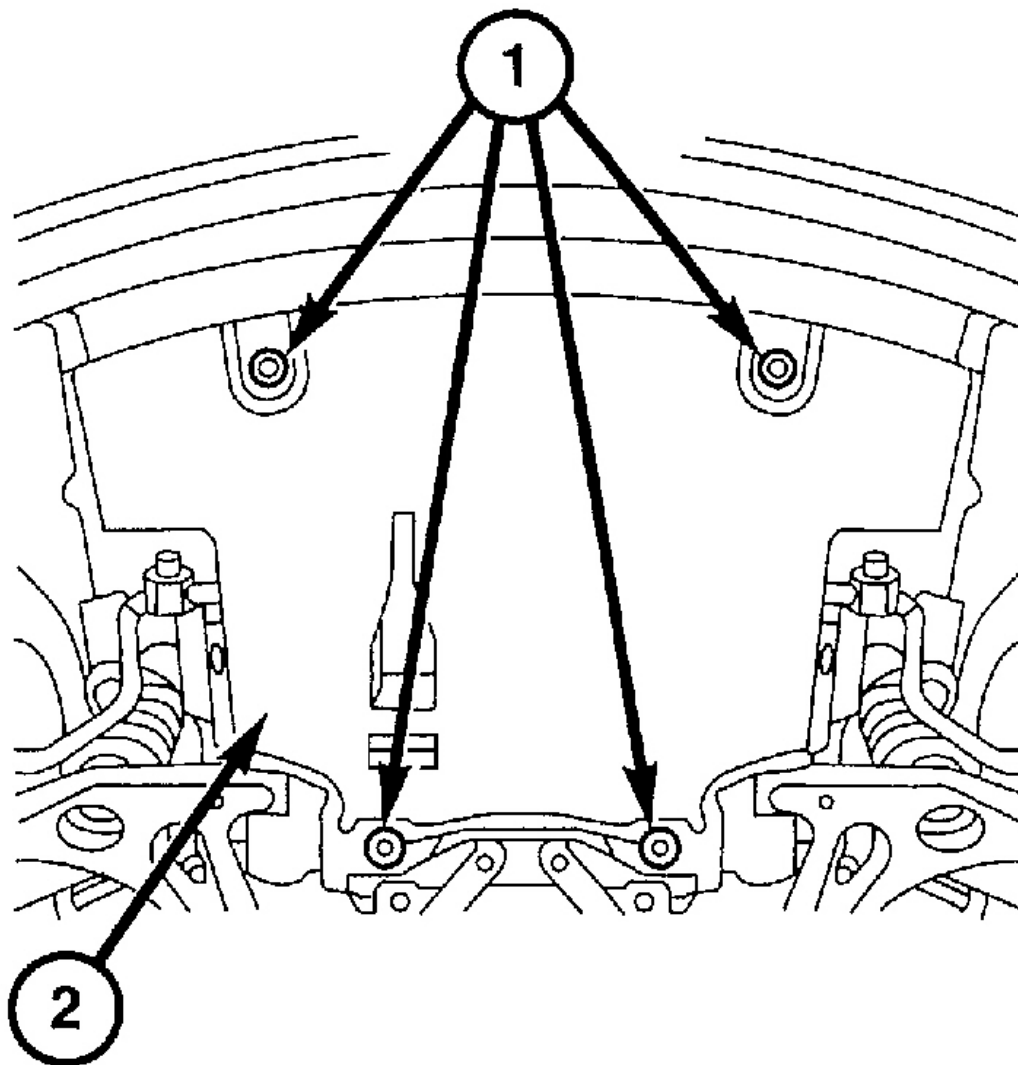
20. Install the propeller shaft. See **PROPELLER SHAFT**.
21. Connect the lower radiator hose (1) and the coolant bypass hose (2) at the water pump.



G01861881

Fig. 30: Connecting Lower Radiator Hose & Coolant Bypass Hose At Water Pump
Courtesy of DAIMLERCHRYSLER CORP.

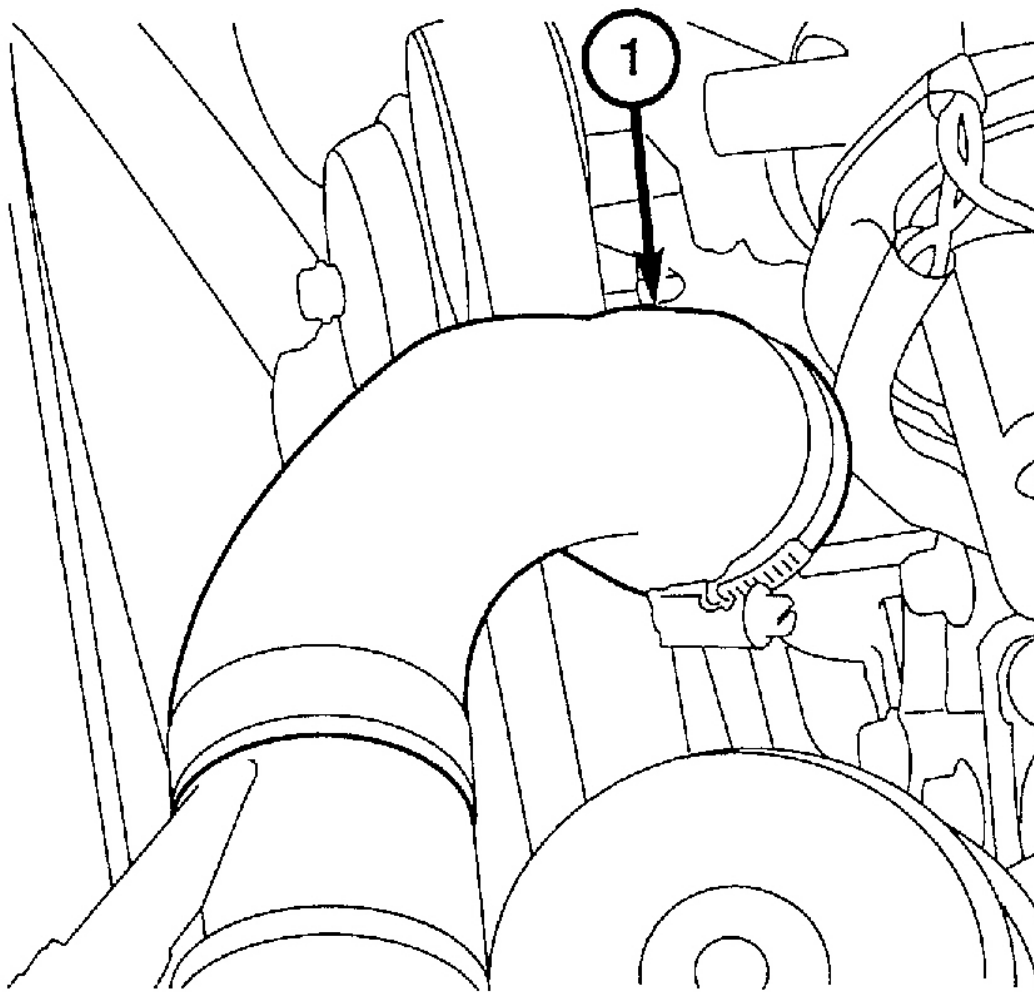
22. Install the lower splash shield (2). Tighten the screws (1) to 5 N.m (44 in. lbs.).



G01861882

Fig. 31: Installing Lower Splash Shield
Courtesy of DAIMLERCHRYSLER CORP.

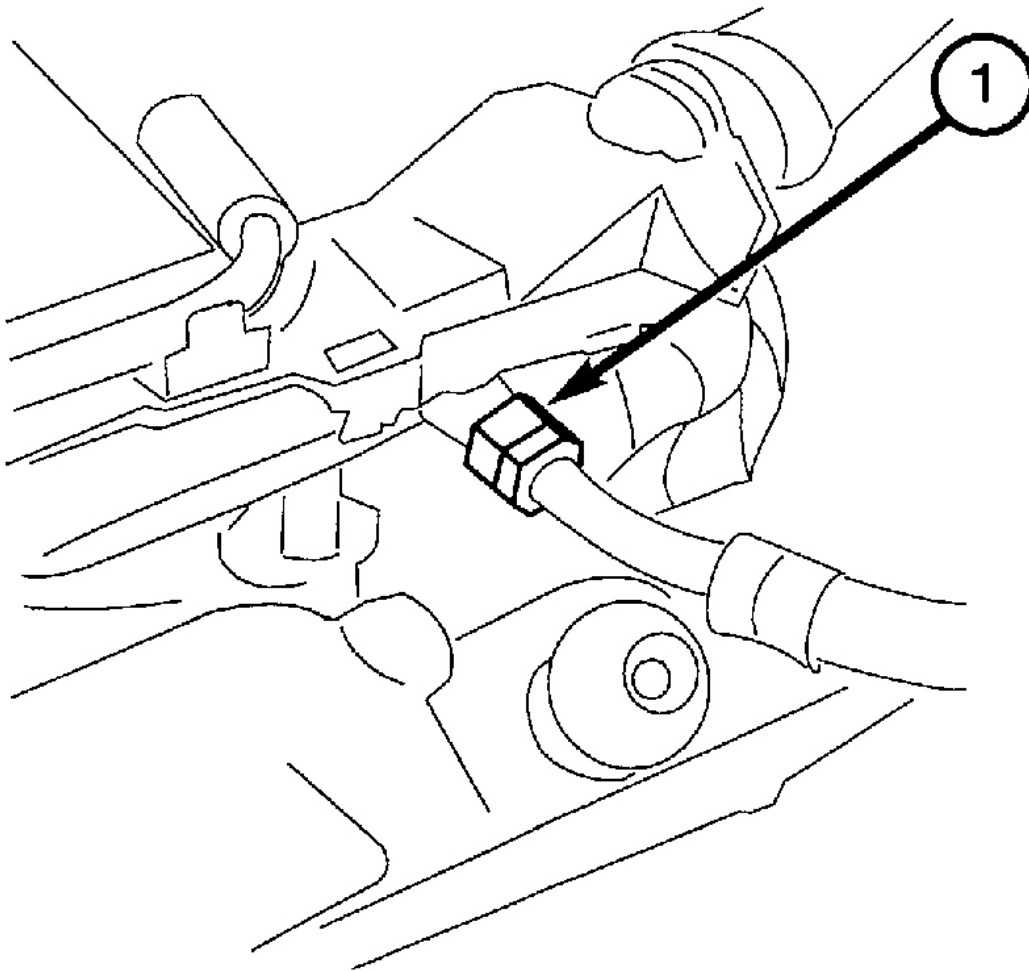
23. Lower the vehicle.
24. Connect the heater hoses at the engine block and the intake manifold.
25. Connect the upper radiator hose (1) at the thermostat housing.



G01861883

Fig. 32: Connecting Upper Radiator Hose At Thermostat Housing
Courtesy of DAIMLERCHRYSLER CORP.

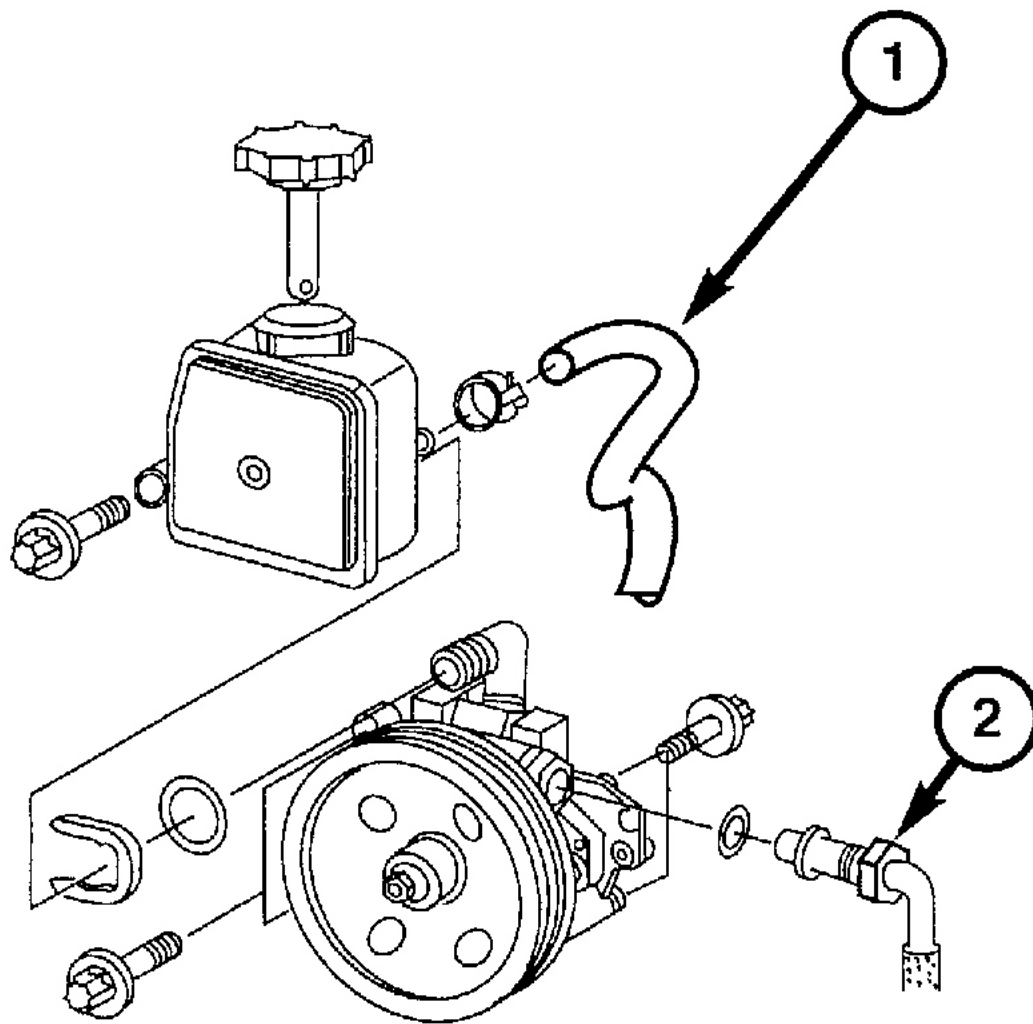
26. Connect the engine wire harness.
27. Connect the fuel supply line (1) at the fuel rail. Tighten the fitting to 38 N.m (28 ft. lbs.).



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Fig. 33: Connecting Fuel Supply Line At Fuel Rail
Courtesy of DAIMLERCHRYSLER CORP.

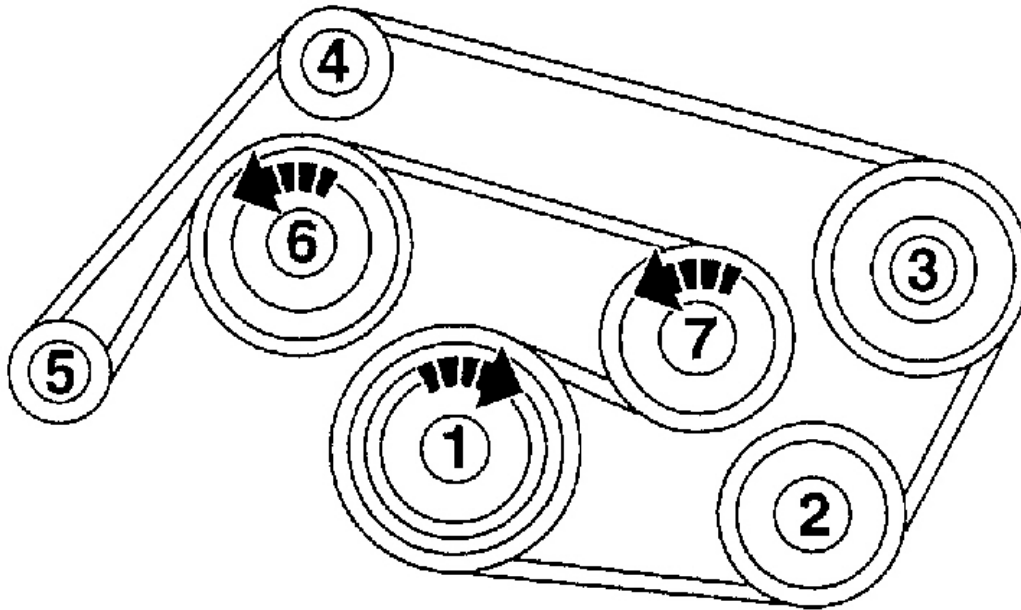
28. Connect the power steering pressure (2) and return line (1) to the power steering pump. Tighten the high pressure fitting to 45 N.m (33 ft. lbs.).



G01860528

Fig. 34: Connecting Power Steering Pressure & Return Line To Power Steering Pump
Courtesy of DAIMLERCHRYSLER CORP.

29. Connect the ground lead at the power steering pump. Tighten the bolt to 25 N.m (18 ft. lbs.).
30. Refill the power steering pump fluid reservoir.
31. Connect the vacuum hoses at the purge valve, brake booster and intake manifold.
32. Install and connect the mass air flow sensor.
33. Install the accessory drive belt.



G01860529

Fig. 35: Installing Accessory Drive Belt
Courtesy of DAIMLERCHRYSLER CORP.

34. Install and connect the radiator with the radiator fan. See **COOLING SYSTEM (MECHANICAL)**.
35. Install the air cleaner. See **AIR CLEANER HOUSING**.
36. Connect the negative battery cable.
37. Fill the cooling system. See **COOLING SYSTEM (MECHANICAL)**.
38. Fill the engine with engine oil. See **OIL**.
39. Start the engine and check for leaks.
40. Recheck all fluid levels.

SPECIFICATIONS

ENGINE SPECIFICATIONS

Engine Specifications

DESCRIPTION	SPECIFICATION
GENERAL SPECIFICATIONS	
Engine Type	90 ° Bank Angle Liquid Cooled with Dual Tuned Intake Manifold and Twin Ignition

2004 Chrysler Crossfire

2004 ENGINES 3.2L V6

Displacement	3.2 L (195.2 cu. in.)
Bore	89.9 mm (3.54 in.)
Stroke	84 mm (3.31 in.)
Valve System	SOHC 2 Intake and 1 Exhaust Valve per Cylinder Roller Rocker Arms
Compression Ratio	10.0:1
Brake Horsepower	215 (160 KW) @ 5700 rpm (67.2 bhp/liter)
Torque	230 lb. ft. (312 N.m) @ 3000 rpm
Firing Order	1-4-3-6-2-5
Lubrication	Pressure Feed - Full Flow Filtration
Cooling System	Reverse Flow - Forced Circulation
Cylinder Block	Cast Aluminum Alloy with Siltec Bore Liners
Crankshaft	Forged Steel
Connecting Rods	Forged Steel
Pistons	Aluminum Alloy - Flat Topped
Compression Pressure	689 kPa(100 psi)
Max. Variation Between Cylinders	172 kPa (25 psi)
CYLINDER BLOCK	
Cylinder Bore Diameter	
Standard	89.900 - 89.915 mm (3.539 - 3.540 in.)
Repair Max.	90.150 - 90.165 mm (3.549 - 3.550 in.)
Out of Round	0.014 mm (.0005 in.)
Taper	0.03 mm (.0011 in.)
PISTONS	
Piston Diameter	89.87 - 89.90 mm (3.538 - 3.539 in.)
Piston Ring Groove Depth No. 1	3.1 mm (0.122 in.)
Piston Ring Groove Depth No. 2	3.1 mm (0.122 in.)
Piston Ring Groove Depth No. 3	3.5 mm (0.137 in.)
PISTON RING GAP	
Compression Ring No. 1	0.20 - 0.35 mm (0.007 - 0.013 in.)
Compression Ring No. 2	0.20 - 0.40 mm (0.007 - 0.015 in.)
PISTON RING WIDTH	
Compression Rings	1.5 mm (0.059 in.)
Oil Ring (Steel Rails)	3.5 mm (0.137 in.)
CONNECTING RODS	
Bearing Clearance	0.026 - 0.054 mm (0.001 - 0.002 in.)
CRANKSHAFT	
Main Bearing Clearance	
Radial	0.030 - 0.052 mm (0.001 - 0.002 in.)
Axial	0.100 - 0.266 mm (0.003 - 0.010 in.)
CYLINDER HEAD VALVE SEAT	
Valve Seat Width	

2004 Chrysler Crossfire

2004 ENGINES 3.2L V6

		Intake	31.000 - 31.016 mm (1.220 - 1.221 in.)
		Exhaust	35.000 - 35.016 mm (1.378 - 1.379 in.)
VALVES			
Face Angle		45° ± 15'	
Stem Diameter	Intake	6.975 mm (0.274 in.)	
	Exhaust	6.974 mm (0.274 in.)	
Head Diameter	Intake	36 ± 0.4 mm (1.417 in.)	
	Exhaust	41 ± 0.1 mm (1.614 in.)	
Length	Intake	119.4 ± 0.2 mm (4.700 in.)	
	Exhaust	122.2 ± 0.2 mm (4.811 in.)	
Valve Margin	Intake	1.2 mm (0.047 in.)	
	Exhaust	1.6 mm (0.062 in.)	

TORQUE SPECIFICATIONS

DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
A/C Compressor Bolts	20	15	177
Balance Shaft Bolts	20	15	177
Body Bolts	40	30	354
Camshaft Bearing Bridge			
Stage One	15	11	133
Stage Two	90° Clockwise		
Camshaft Sprocket Bolts			
Stage One	50	37	443
Stage Two	90° Clockwise		
Connecting Rod Bolts			
Stage One	5	4	44
Stage Two	25	18	159
Stage Three	90° Clockwise		
Cooler Line Bolts	10	7	89

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Fig. 36: Identifying Torque Specifications (1 Of 3)
Courtesy of DAIMLERCHRYSLER CORP.

2004 Chrysler Crossfire

2004 ENGINES 3.2L V6

DESCRIPTION	N.m	Ft. Lbs.	In. Lbs.
Crossmember to Body Bolts	40	30	354
Cylinder Head Cover Bolts	10	7	89
Damper Bolt			
Stage One	200	148	1770
Stage Two	90° Clockwise		
EGR Fitting	40	30	354
End Cover Bolts	10		89
Engine Mount Bolts	30	22	266
Front Engine Mount to Front Axle Carrier Bolts	55	41	487
Engine Mount to Transmission Bolts	50	37	443
Engine Upper Mount Bolt	55	41	487
Engine Lower Mount Bolt	35	26	310
Engine Support Bolts	20	15	177
Exhaust Flange Bolts	20	15	177
Exhaust Manifold to Cylinder Head Bolts	35	26	310
Flywheel Bolts			
Stage One	45	33	398
Stage Two	90° Clockwise		
Fuel Supply Line to Rail	38	28	336
Cylinder Head Bolts			
Stage One	20	15	177
Stage Two	50	37	443
Stage Three	60° - 70° Clockwise		
Stage Four	60° - 70° Clockwise		
Intake Manifold Bolts	20	15	177
Lower Splash Shield Screws	-	5	44
Main Bearing Journal Cap Bolts			
Stage One M8	20	15	177
Stage Two M8	90° Clockwise		
Stage One M10	30	22	266
Stage Two M10	90° Clockwise		
Manifold Bolts	16	12	142
Oil Cooler Bolts	11	8	97
Oil Filter Adaptor Center Bolt	70	52	620
Oil Filter Cap	25	18	97
Oil Indicator Tube Bolt	10	7	89
Oil Pan Bolts Lower	14	10	124

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Fig. 37: Identifying Torque Specifications (2 Of 3)
Courtesy of DAIMLERCHRYSLER CORP.

2004 Chrysler Crossfire

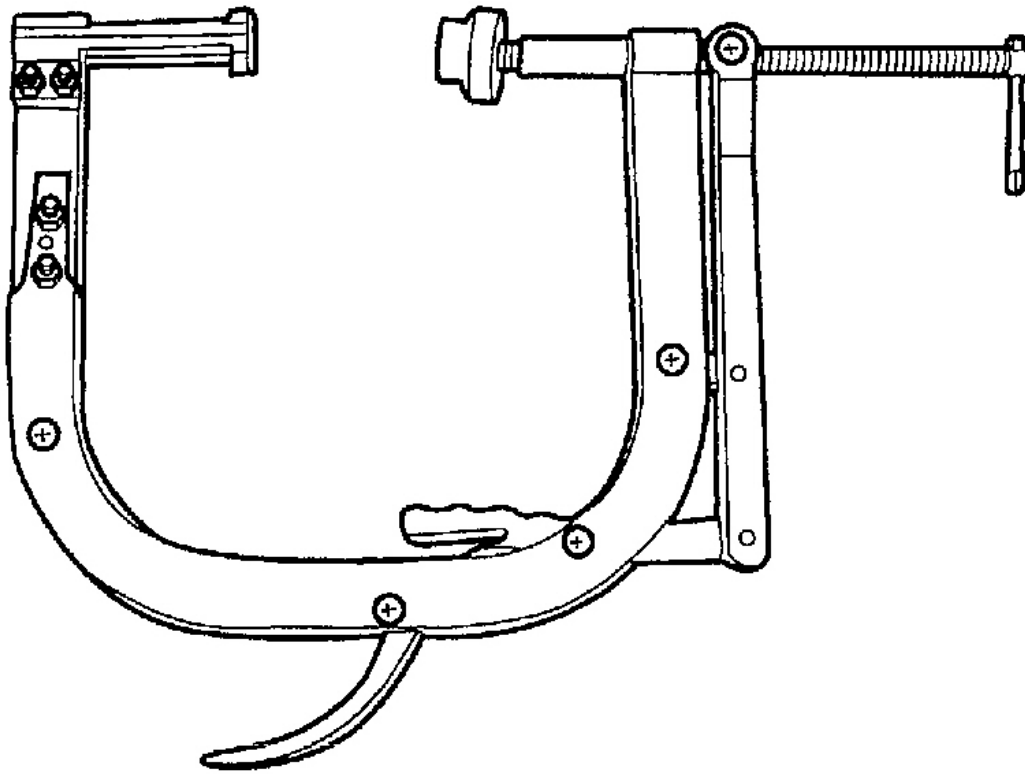
2004 ENGINES 3.2L V6

DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
Oil Pan Bolts Upper			
M6	10	7	89
M8	20	15	177
Oil Pan Drain Plug	30	22	266
Oil Pressure/Level Sensor Screws	10	7	89
Oil Spray Nozzle Bolts	15	11	133
Power Steering Pump Ground Bolt	25	18	97
Power Steering Pump High Pressure Line	45	33	398
Timing Chain Cover Bolts	20	15	177
Timing Chain Tensioner Bolt	80	59	708
Transmission Mount Bolts	40	30	354

G01860534

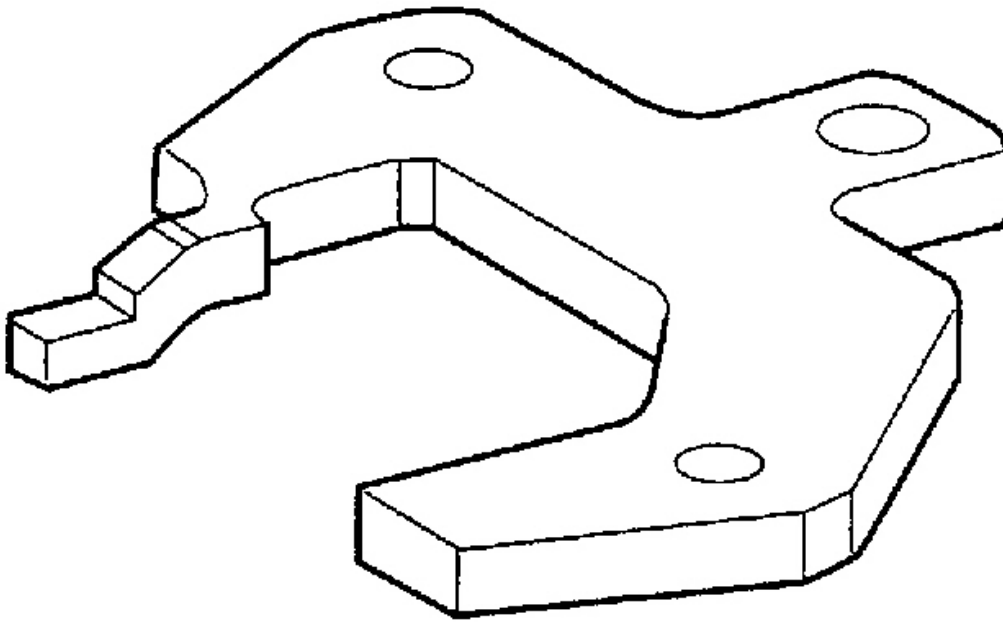
Fig. 38: Identifying Torque Specifications (3 Of 3)
Courtesy of DAIMLERCHRYSLER CORP.

SPECIAL TOOLS



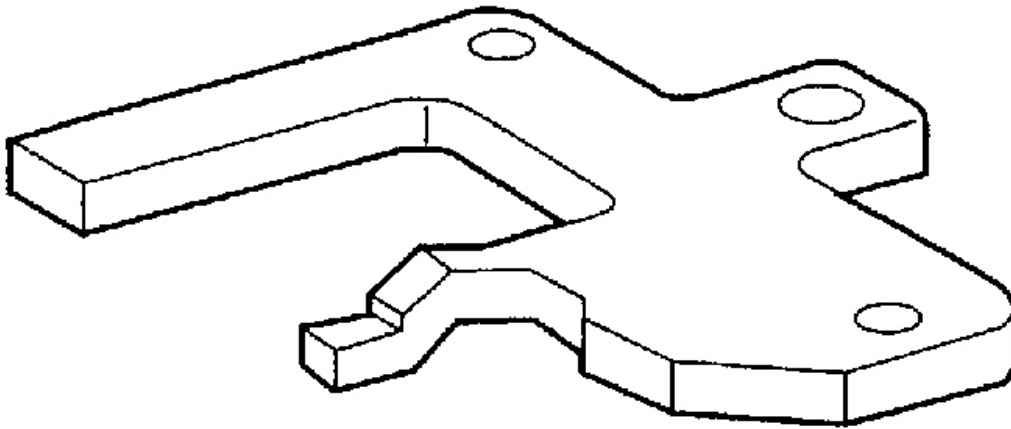
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Fig. 39: Identifying Valve Spring Compressor C-3422-CF
Courtesy of DAIMLERCHRYSLER CORP.



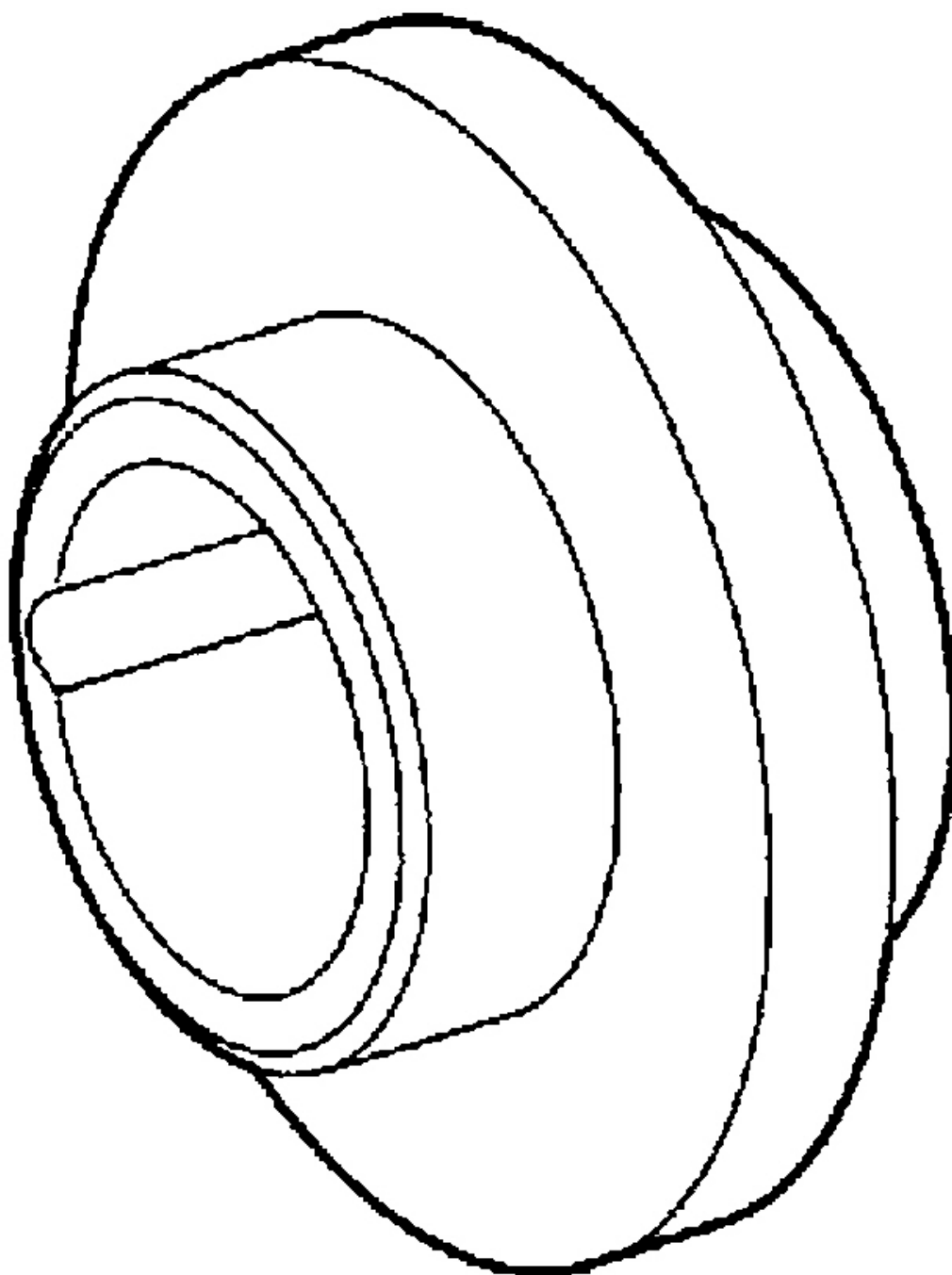
G01860536

Fig. 40: Identifying Right Camshaft Locating Plate 9104
Courtesy of DAIMLERCHRYSLER CORP.



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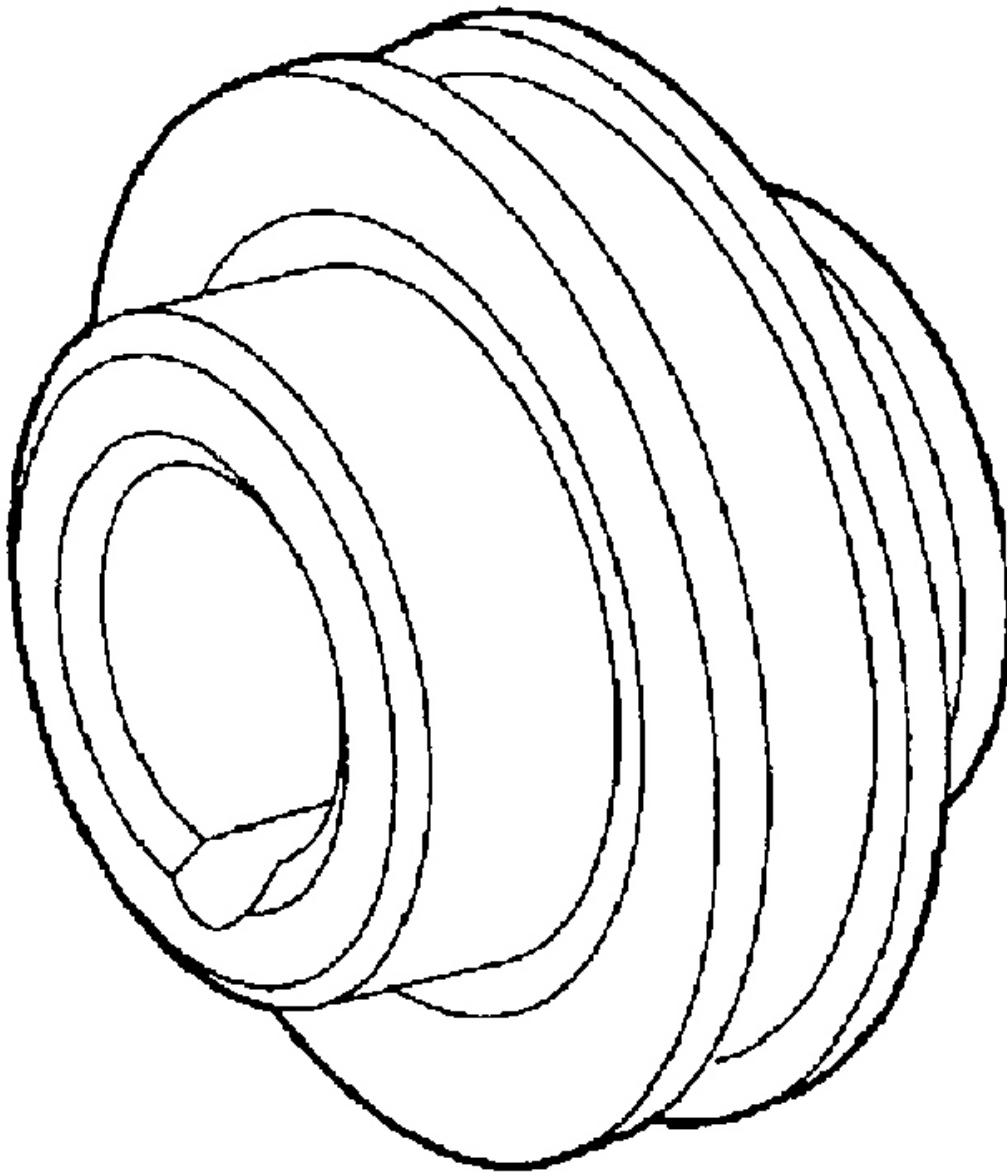
Fig. 41: Identifying Left Camshaft Locating Plate 9105
Courtesy of DAIMLERCHRYSLER CORP.



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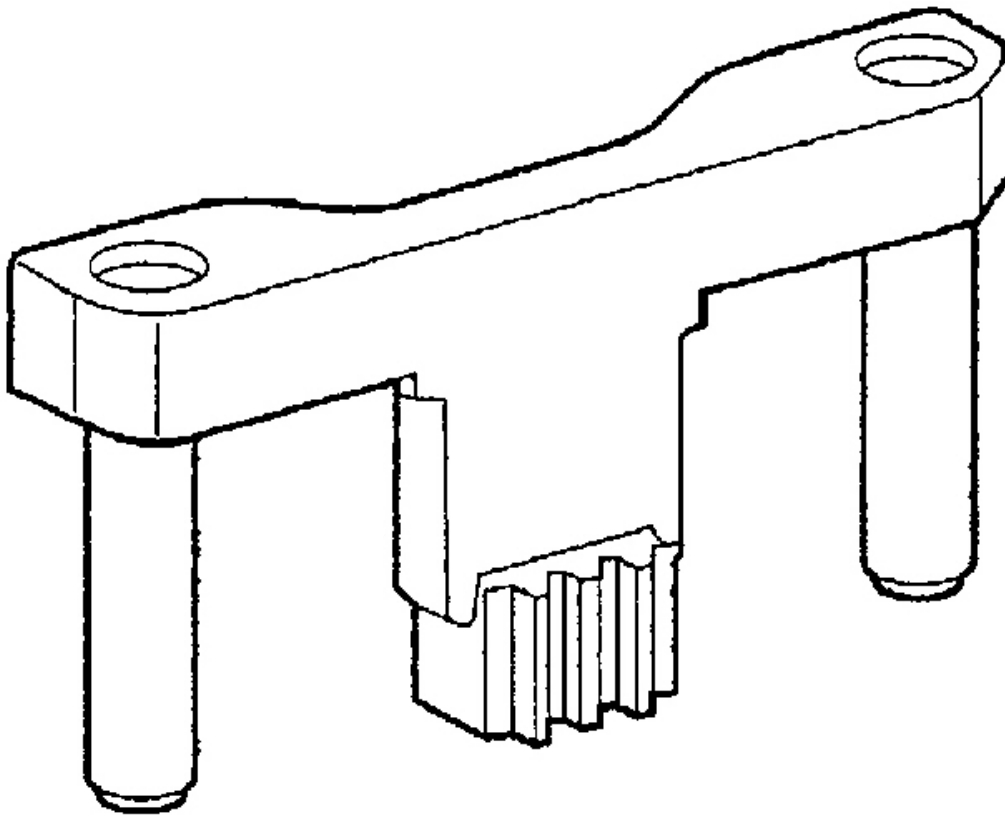
Fig. 42: Identifying Sleeve 9101

Courtesy of DAIMLERCHRYSLER CORP.



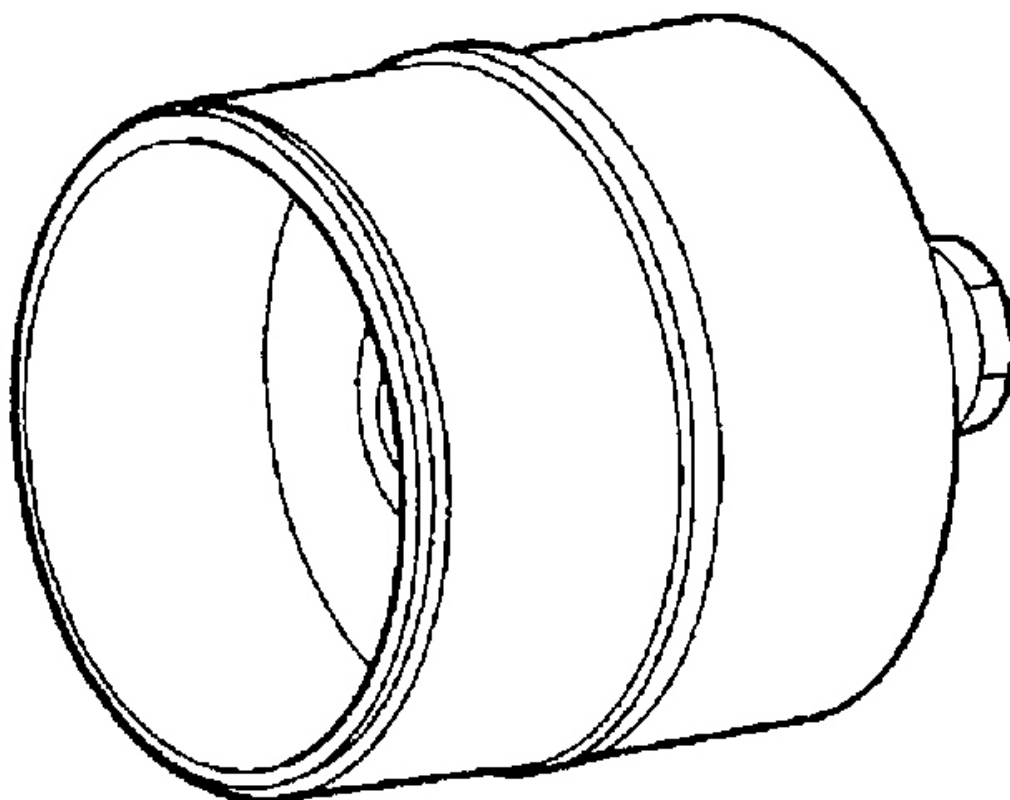
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Fig. 43: Identifying Insertion Tool 9103
Courtesy of DAIMLERCHRYSLER CORP.



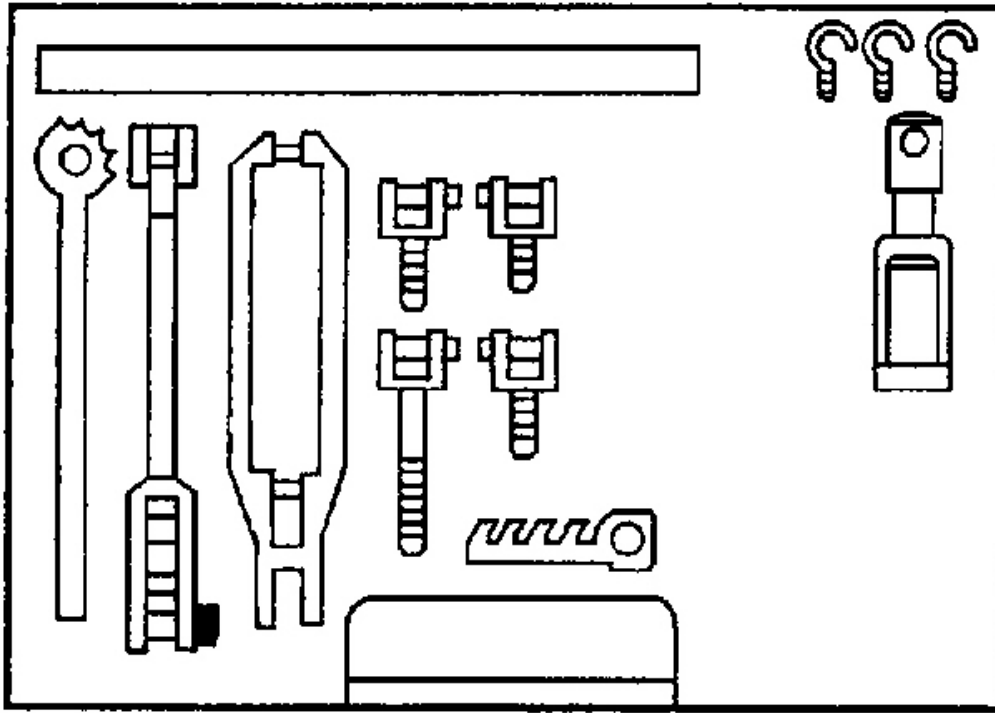
G01860540

Fig. 44: Identifying Flywheel Locking Tool 9102
Courtesy of DAIMLERCHRYSLER CORP.



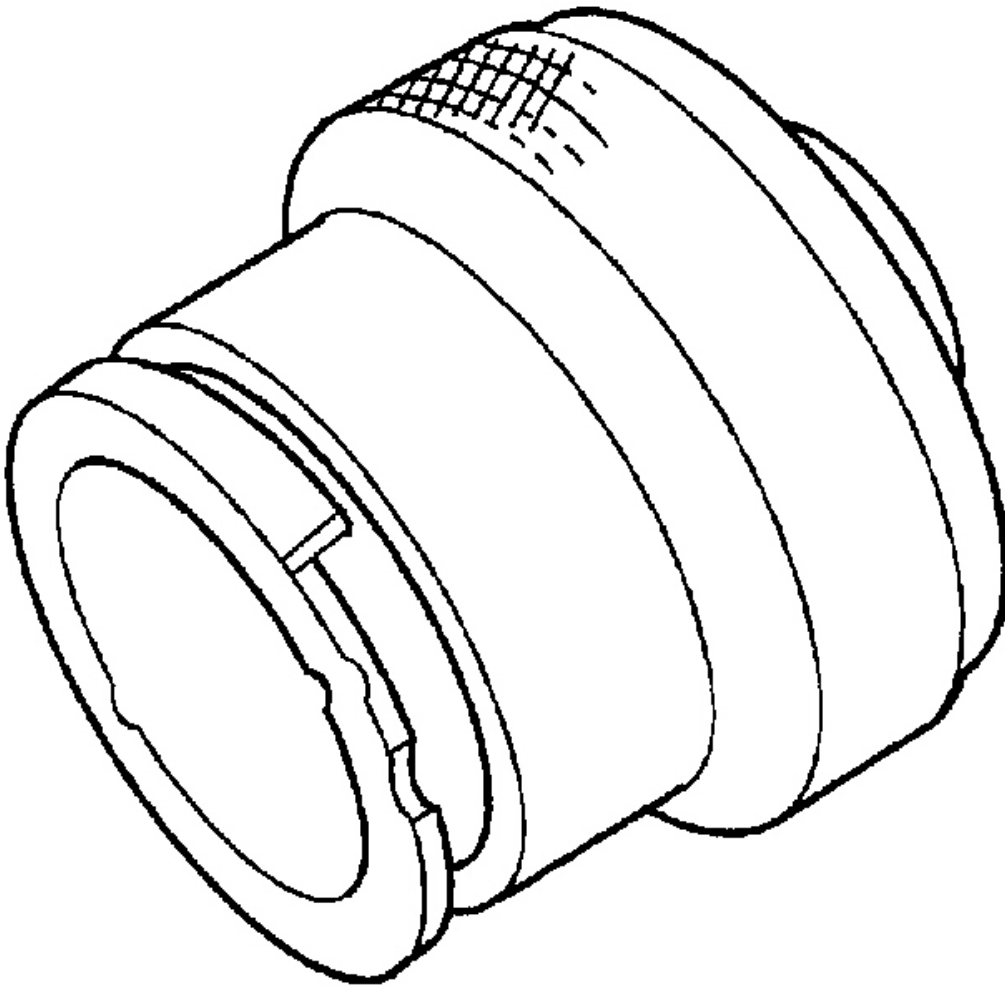
G01860541

Fig. 45: Identifying Rear Seal Installer 9100
Courtesy of DAIMLERCHRYSLER CORP.



G01860542

Fig. 46: Identifying Valve Assembly Tool Case 9106
Courtesy of DAIMLERCHRYSLER CORP.



G01860543

Fig. 47: Identifying Pressure Tester Adaptor 9107
Courtesy of DAIMLERCHRYSLER CORP.

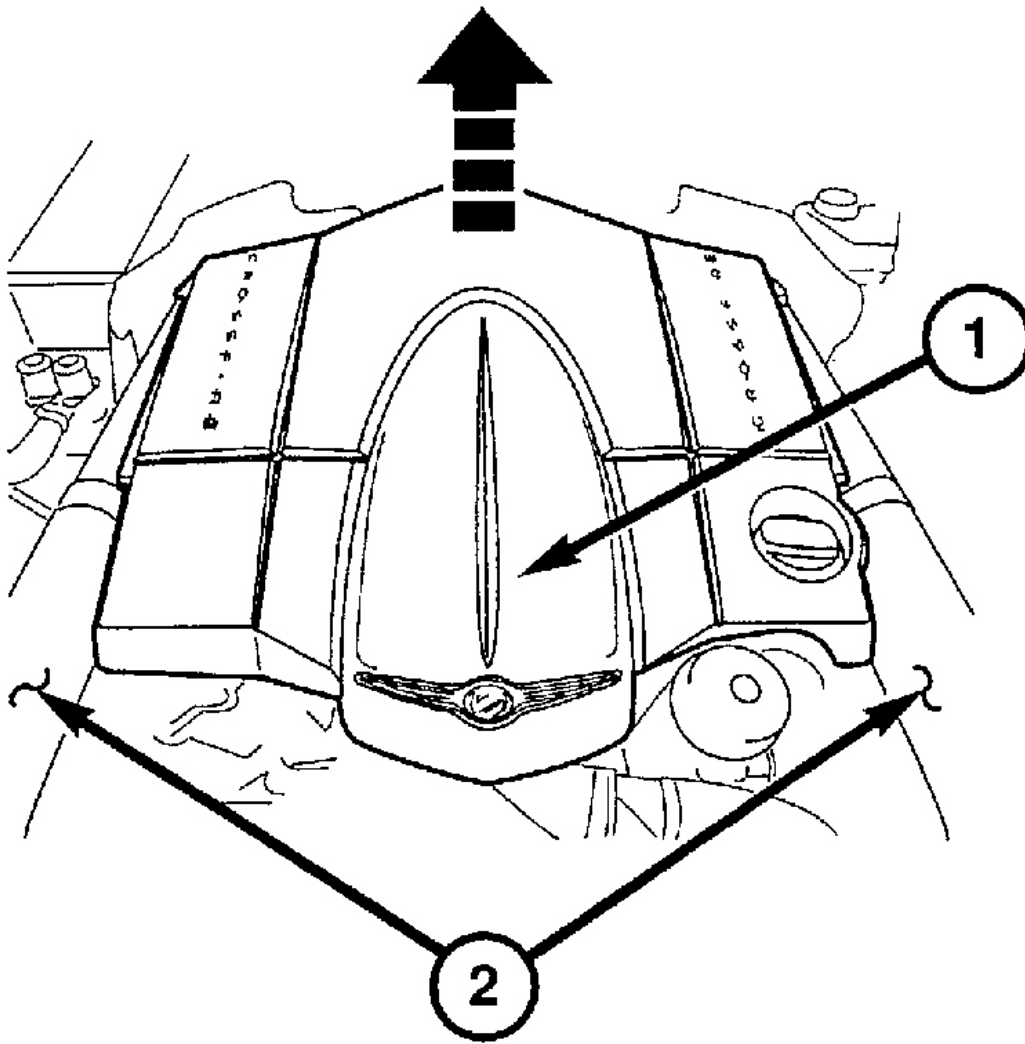
AIR CLEANER HOUSING

REMOVAL

NOTE: The air cleaner is held in place by two rubber grommets and two spring clips.

1. Remove the air inlet tubes (2).

2. Lift the air cleaner housing (1) from the rear first, then from the front and remove it.

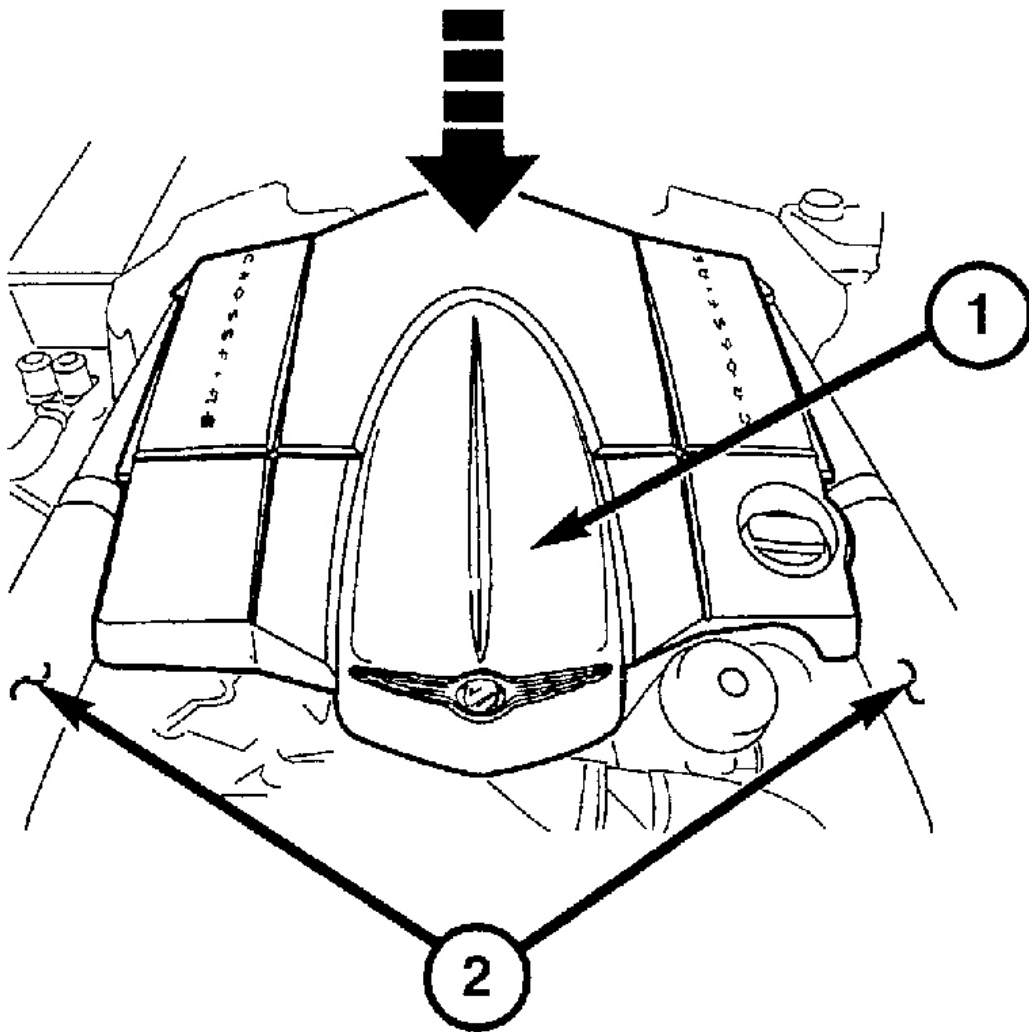


G01860544

Fig. 48: Removing Air Inlet Tubes & Housing
Courtesy of DAIMLERCHRYSLER CORP.

INSTALLATION

1. Position the air cleaner housing (1) on the mounting tabs and push down.
2. Install the air inlet tubes (2).



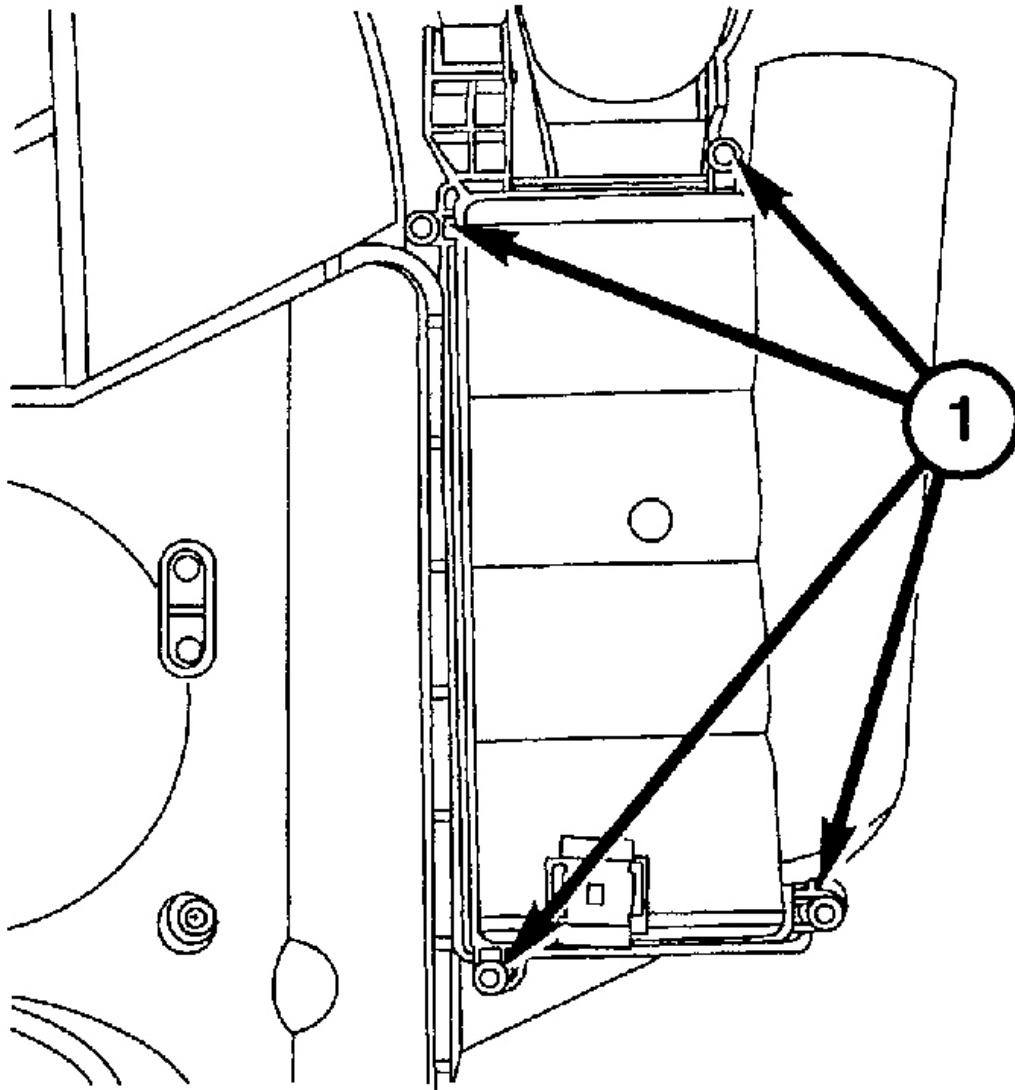
G01860545

Fig. 49: Installing Air Cleaner Housing & Air Inlet Tubes
Courtesy of DAIMLERCHRYSLER CORP.

AIR CLEANER ELEMENT

REMOVAL

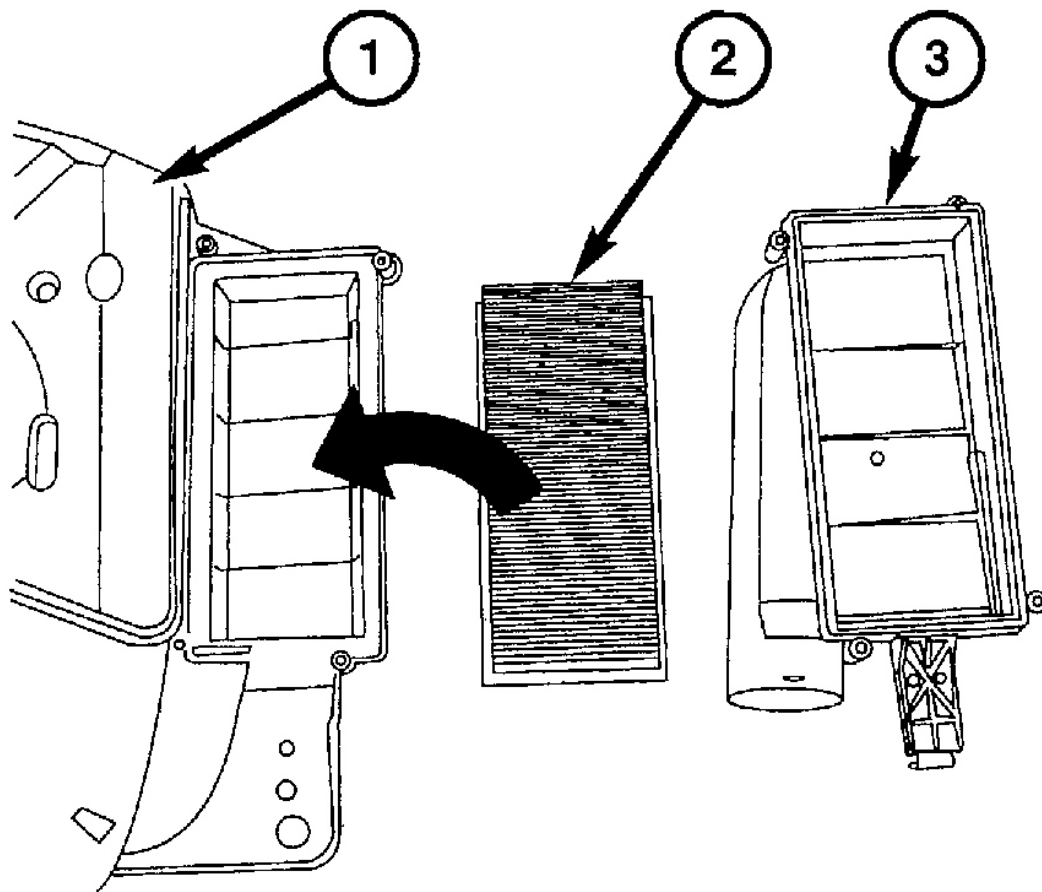
1. Remove the air cleaner housing. See **AIR CLEANER HOUSING**.
2. Remove the screws (1) and the air cleaner element covers. (1 cover on each side of housing.)



G01860546

Fig. 50: Removing Screws & Air Cleaner Element Covers
Courtesy of DAIMLERCHRYSLER CORP.

3. Remove the air cleaner elements (2) from the air cleaner housing (1).



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Fig. 51: Removing Air Cleaner Elements From Air Cleaner Housing
Courtesy of DAIMLERCHRYSLER CORP.

INSTALLATION

1. Position the new air cleaner elements (2) in the air cleaner housing (1).
2. Install the screws in the air cleaner element covers (3).
3. Install the air cleaner housing and air inlet tubes.

CYLINDER HEAD

DESCRIPTION

Extremely compact, single overhead camshaft aluminum alloy cylinder heads have two intake and one exhaust valve per cylinder.

OPERATION

The cylinder heads, having three valves per cylinder minimizes exhaust port surface area, keeping more heat in the exhaust stream to provide fast catalytic converter heating for low emissions and to reduce cooling load. A three-valve configuration also simplifies the engine by allowing use of one cam per bank rather than two and provides room in the combustion chamber for two spark plugs that provide more complete combustion. Valves are set at an included angle of 35.5 degrees, forming a shallow combustion chamber. A central passage in each head that connects with each cylinder delivers either assist air or recirculated exhaust if needed to reduce exhaust emissions. The camshafts turn directly in the head; no bearing inserts are used. Transverse coolant flow within the head provides optimal cooling of the exhaust valve seats while minimizing heat extraction from the exhaust ports to enhance catalytic converter warm up.

DIAGNOSIS AND TESTING

CYLINDER HEAD GASKET

A cylinder head gasket leak can be located between adjacent cylinders or between a cylinder and the adjacent water jacket.

Possible indications of the cylinder head gasket leaking between adjacent cylinders are:

- Loss of engine power
- Engine misfiring
- Poor fuel economy

Possible indications of the cylinder head gasket leaking between a cylinder and an adjacent water jacket are:

- Engine overheating
- Loss of coolant
- Excessive steam (white smoke) emitting from exhaust
- Coolant foaming

CYLINDER-TO-CYLINDER LEAKAGE TEST

To determine if an engine cylinder head gasket is leaking between adjacent cylinders, follow the Cylinder Compression Pressure Test. See **CYLINDER COMPRESSION PRESSURE TEST**. An engine cylinder head gasket leaking between adjacent cylinders will result in approximately a 50-70% reduction in compression pressure.

CYLINDER-TO-WATER JACKET LEAKAGE TEST

WARNING: USE EXTREME CAUTION WHEN THE ENGINE IS OPERATING WITH COOLANT PRESSURE CAP REMOVED.

VISUAL TEST METHOD

With the engine cool, remove the coolant pressure cap. Start the engine and allow it to warm up until thermostat opens.

If a large combustion/compression pressure leak exists, bubbles will be visible in the coolant.

COOLING SYSTEM TESTER METHOD

WARNING: WITH COOLING SYSTEM TESTER IN PLACE, PRESSURE WILL BUILD UP FAST. EXCESSIVE PRESSURE BUILT UP, BY CONTINUOUS ENGINE OPERATION, MUST BE RELEASED TO A SAFE PRESSURE POINT. NEVER PERMIT PRESSURE TO EXCEED 138 kPa (20 psi).

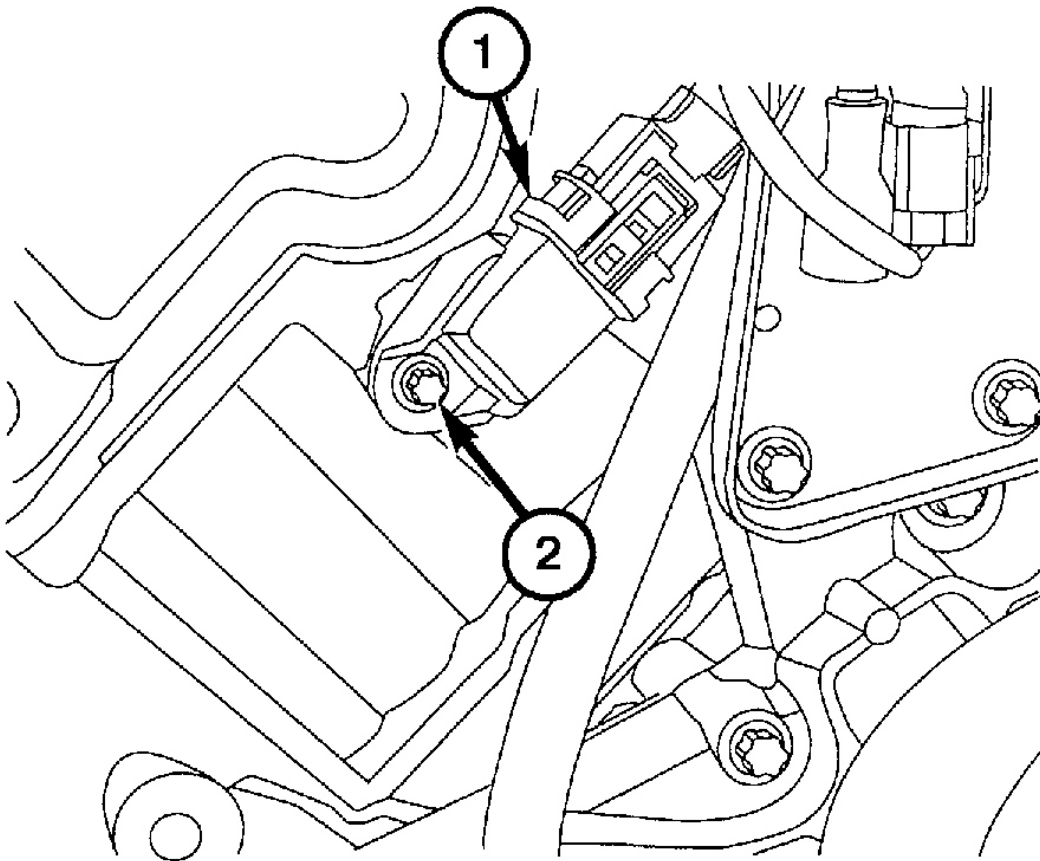
Install cooling system tester 7700 or equivalent and the pressure tester adapter Special Tool 9107 to pressure cap neck. Start the engine and observe the tester's pressure gauge. If gauge pulsates with every power stroke of a cylinder, a combustion pressure leak is evident.

CHEMICAL TEST METHOD

Combustion leaks into the cooling system can also be checked by using the Bloc-Chek® Kit C-3685-A or equivalent. Perform test following the procedures supplied with the tool kit.

REMOVAL

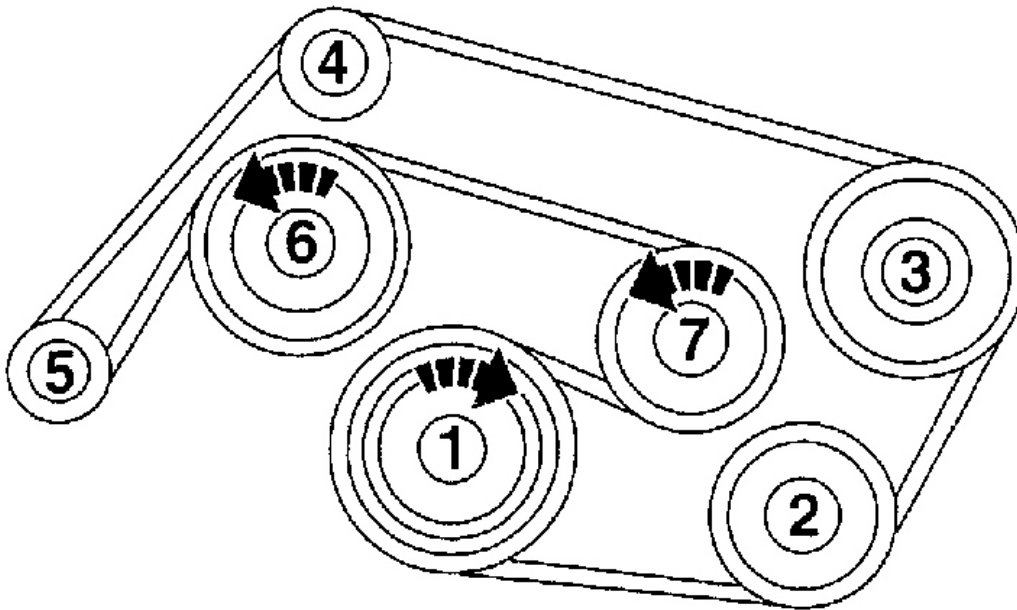
1. Remove the engine air cleaner housing. See **AIR CLEANER HOUSING**.
2. Remove the mass air flow sensor.
3. Drain the engine coolant. See **COOLING SYSTEM (MECHANICAL)** article.
4. Remove the radiator with radiator fan. See **COOLING SYSTEM (MECHANICAL)** article.
5. Disconnect the camshaft position sensor harness connector (1) and remove the bolt (2) and the sensor. (Right side only).



G01860548

Fig. 52: Disconnecting Camshaft Position Sensor Harness Connector & Removing Bolt & Sensor
Courtesy of DAIMLERCHRYSLER CORP.

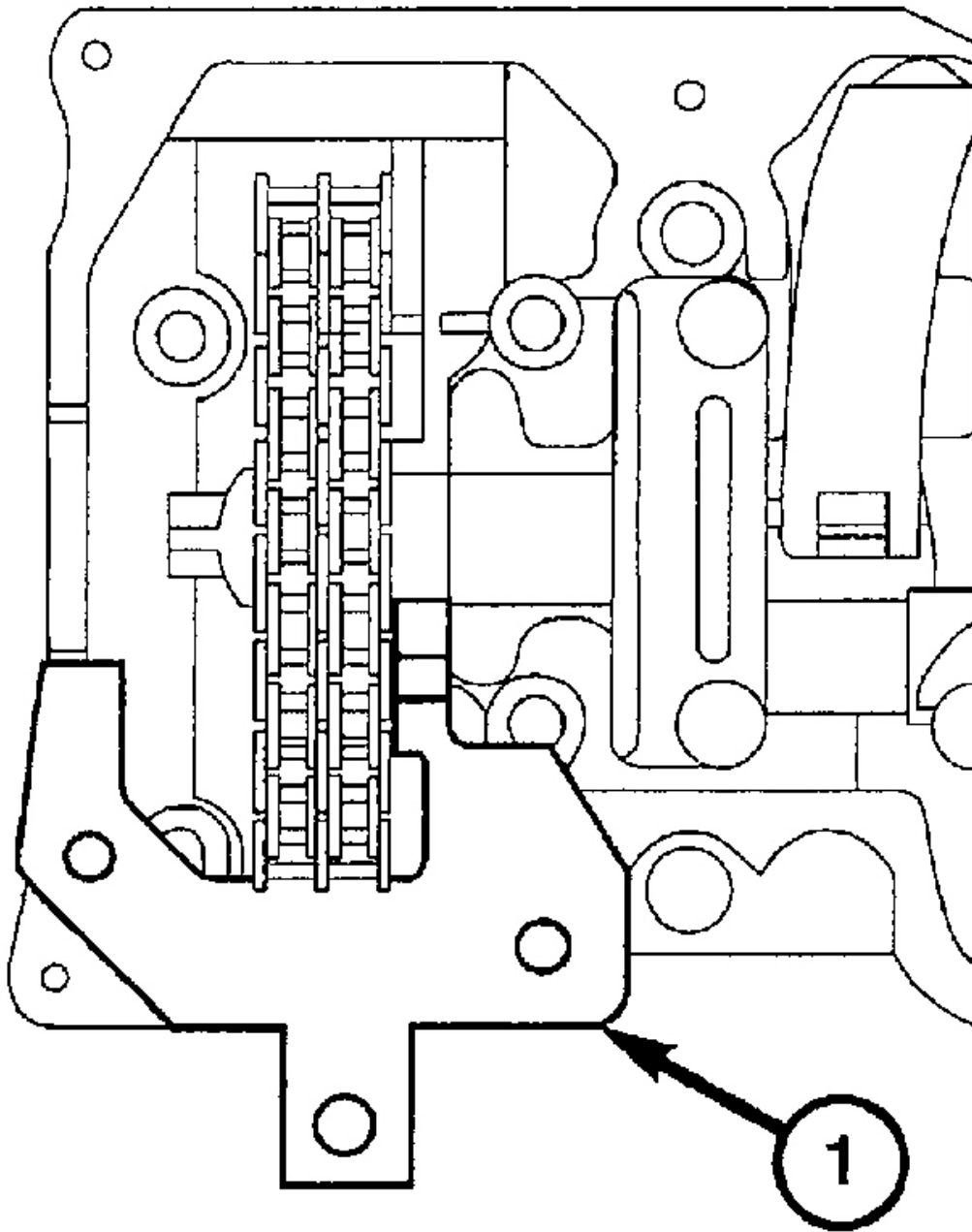
6. Remove the accessory drive belt.



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Fig. 53: Removing Accessory Drive Belt
Courtesy of DAIMLERCHRYSLER CORP.

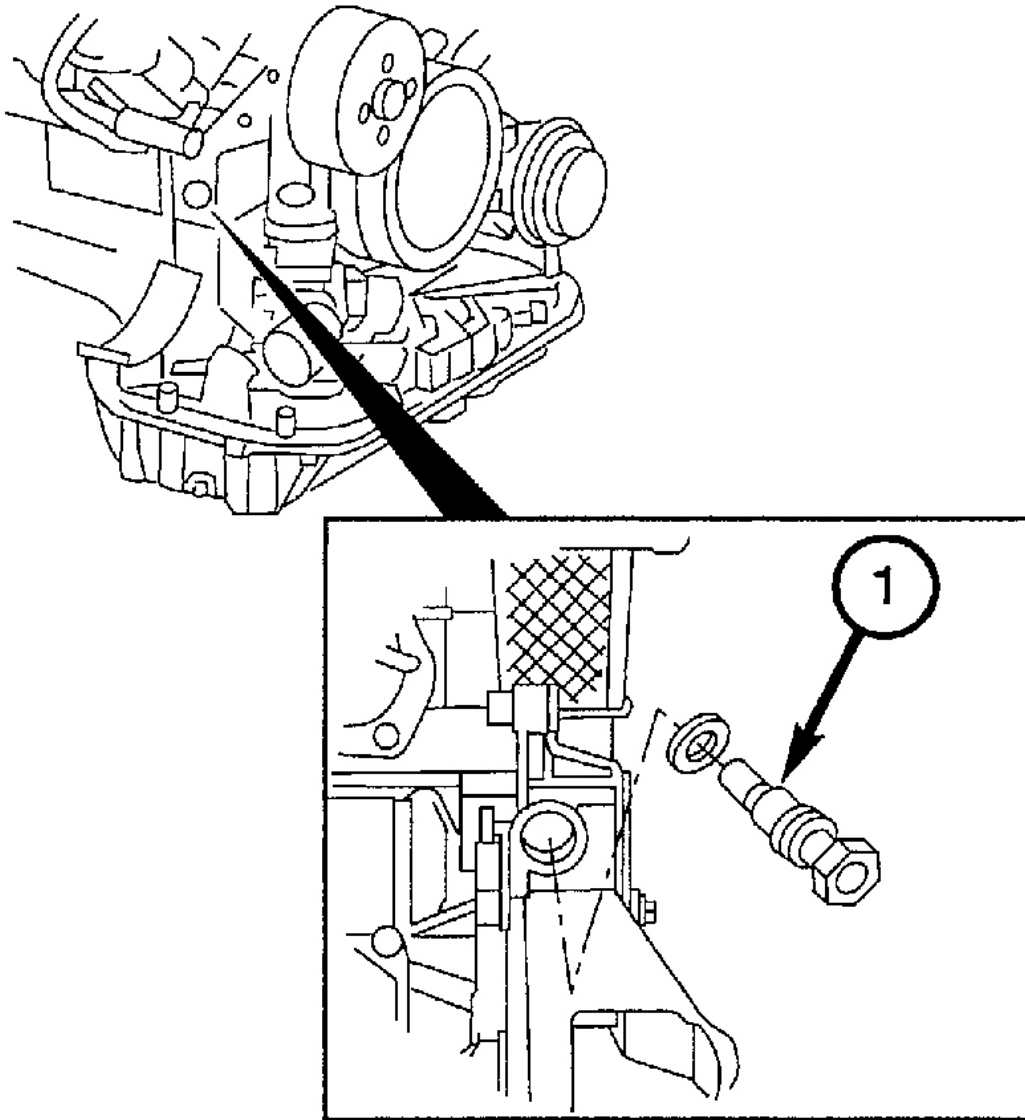
7. Drain the engine oil. See **OIL**.
8. Remove the intake manifold. See **INTAKE MANIFOLD**.
9. Remove the cylinder head cover. See **CYLINDER HEAD COVER**.
10. Disconnect the exhaust system at the exhaust manifolds. See **EXHAUST SYSTEM**.
11. Position the crankshaft 40° ATDC. See **ENGINE TIMING**.
12. Using Special Tools 9104 (1) and 9105 Camshaft Locating Plates, lock the camshafts by placing the tool flush on the cylinder head, and inserting it into the groove in the camshaft.



G01860550

Fig. 54: Locking Camshafts
Courtesy of DAIMLERCHRYSLER CORP.

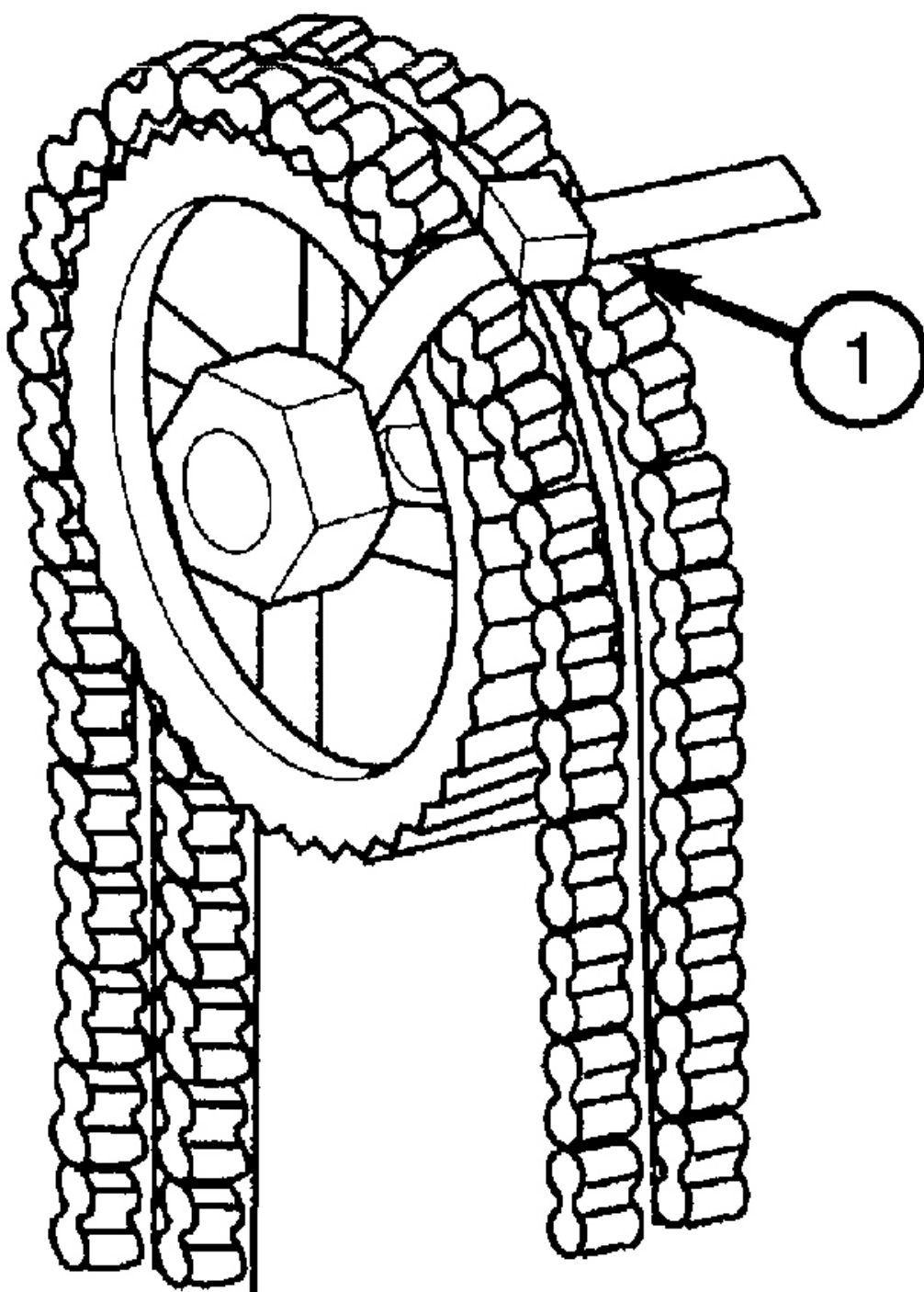
13. Remove the timing chain tensioner (1).



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Fig. 55: Removing Timing Chain Tensioner
Courtesy of DAIMLERCHRYSLER CORP.

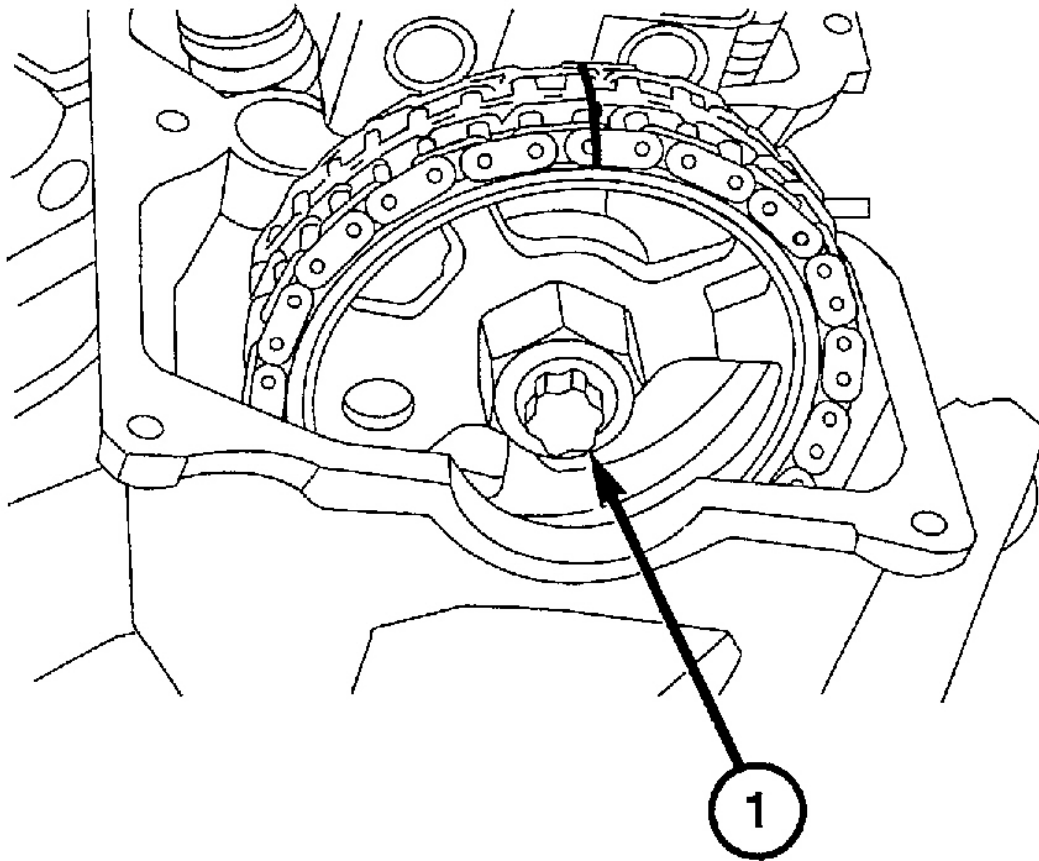
14. Use a cable tie (1) to secure the timing chain to the right hand camshaft sprocket.



G01860552

Fig. 56: Securing Timing Chain To Right Hand Camshaft Sprocket
Courtesy of DAIMLERCHRYSLER CORP.

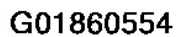
15. Remove the camshaft sprocket bolts (1) and the sprockets.



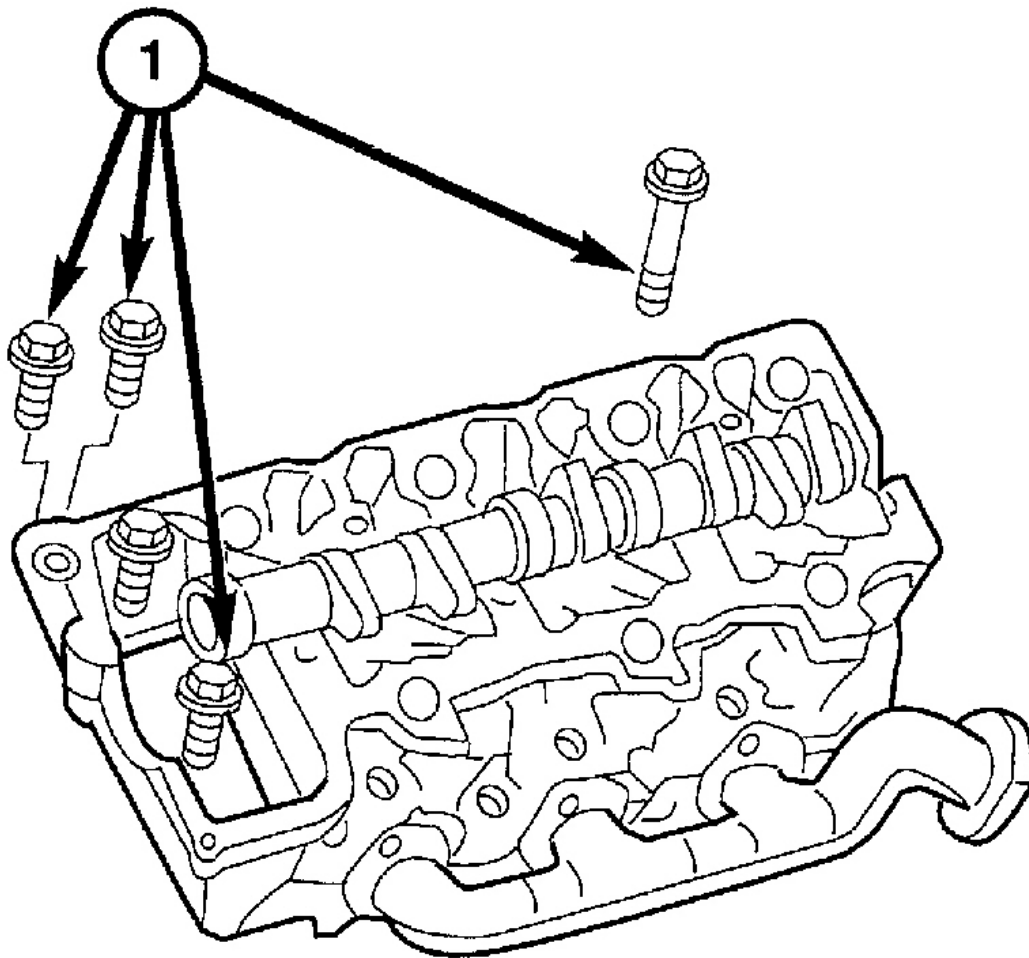
G01860553

Fig. 57: Removing Camshaft Sprocket Bolts & Sprockets
Courtesy of DAIMLERCHRYSLER CORP.

16. Remove Special Tools 9104 and 9105 Camshaft Locating Plates.
17. Remove the camshafts. See **CAMSHAFT**.
18. Loosen the cylinder head bolts using the sequence diagram.



19. Remove the cylinder head bolts (1), the cylinder heads, and the gaskets.



G01860555

Fig. 59: Removing Cylinder Head Bolts
Courtesy of DAIMLERCHRYSLER CORP.

CLEANING

To ensure engine gasket sealing, proper surface preparation must be performed, especially with the use of aluminum engine components and multi-layer steel cylinder head gaskets.

NOTE: Multi-Layer Steel (MLS) head gaskets require a scratch free sealing surface.

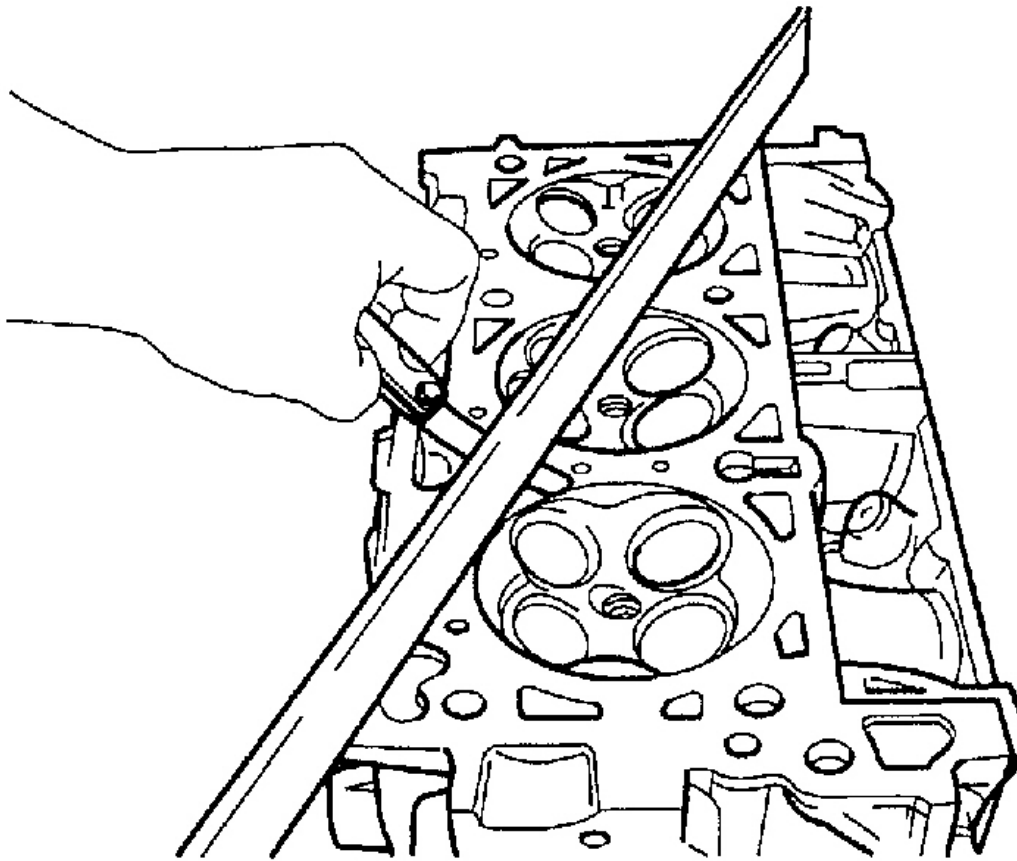
Remove all gasket material from cylinder head and block. See **ENGINE GASKET SURFACE PREPARATION**. Be careful not to gouge or scratch the aluminum head sealing surface.

Clean all engine oil passages.

INSPECTION

1. Before cleaning, check for leaks, damage and cracks.
2. Clean the cylinder head coolant and oil passages.

CAUTION: 0.20 mm (0.008 in.) MAX is a combined total dimension of the stock removal limit from cylinder head and block top surface (Deck) together.



G01860556

Fig. 60: Checking Cylinder Head For Flatness
Courtesy of DAIMLERCHRYSLER CORP.

3. Check the cylinder head for flatness.

4. The cylinder head must be flat within:

- Standard dimension = less than 0.002 inch. (0.05 mm)
- Service Limit = 0.008 inch. (0.2 mm)
- Grinding Limit = Maximum of 0.008 inch. (0.2 mm) is permitted.

INSTALLATION

1. Position the cylinder head gasket and the cylinder head on the engine block dowels.

NOTE: Measure and inspect cylinder head bolts before reuse. Do not reuse bolts that exceed 144 mm (1) in length.

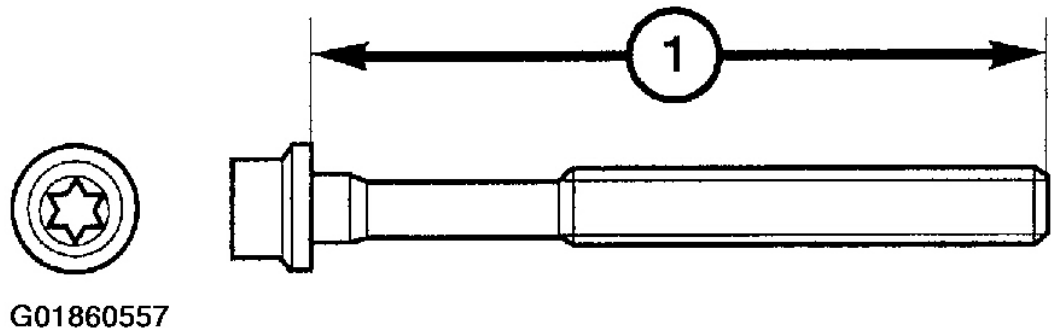
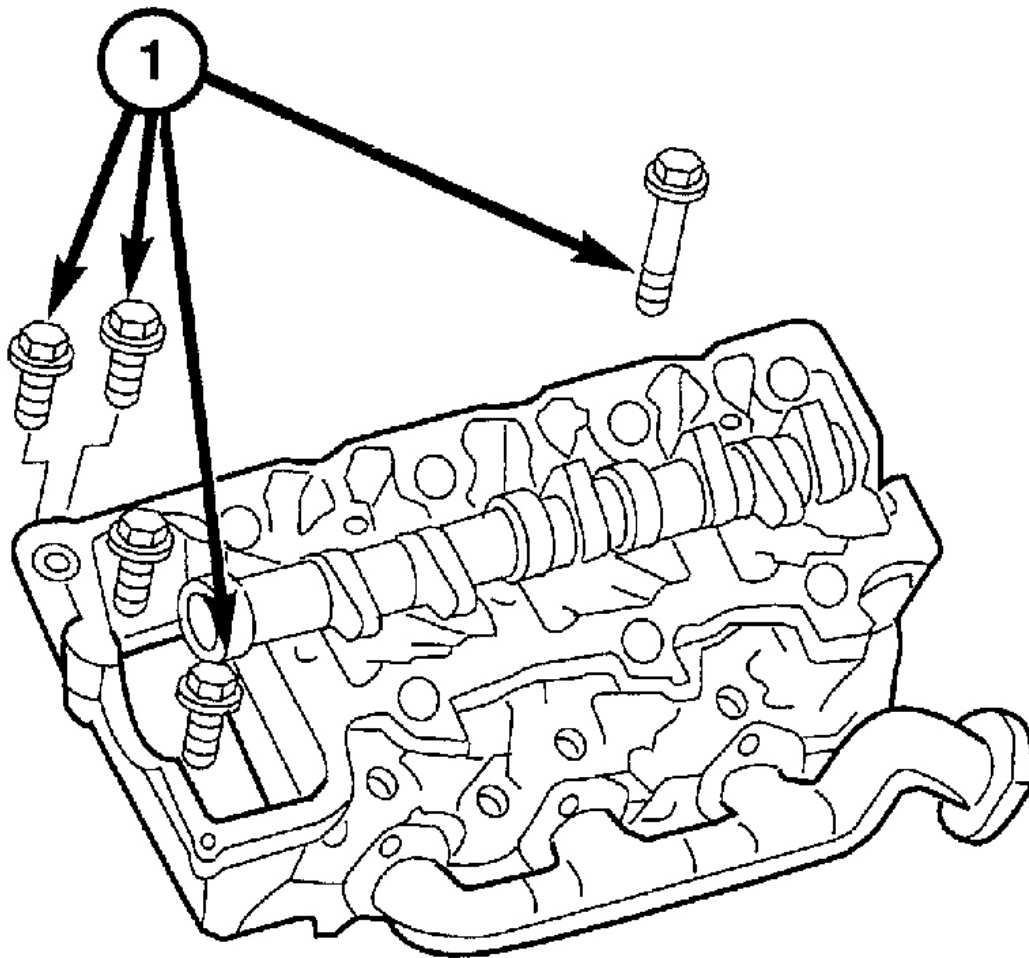


Fig. 61: Measuring Cylinder Head Bolts
Courtesy of DAIMLERCHRYSLER CORP.

NOTE: Apply a thin coat of lubricant to head bolt threads before installing.

2. Install, but do not tighten the cylinder head bolts (1).

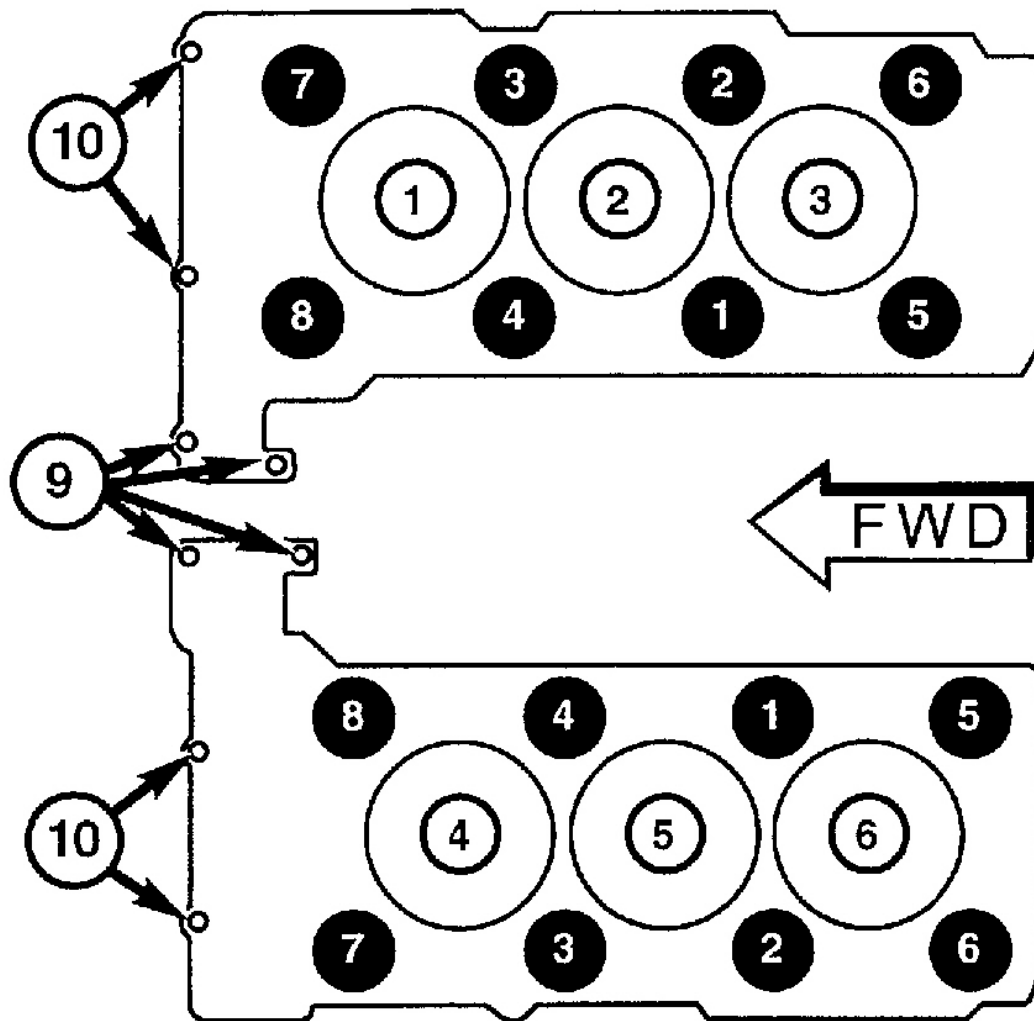


G01860558

Fig. 62: Installing Cylinder Head Bolts
Courtesy of DAIMLERCHRYSLER CORP.

3. Use the tightening sequence chart to tighten the cylinder head bolts.

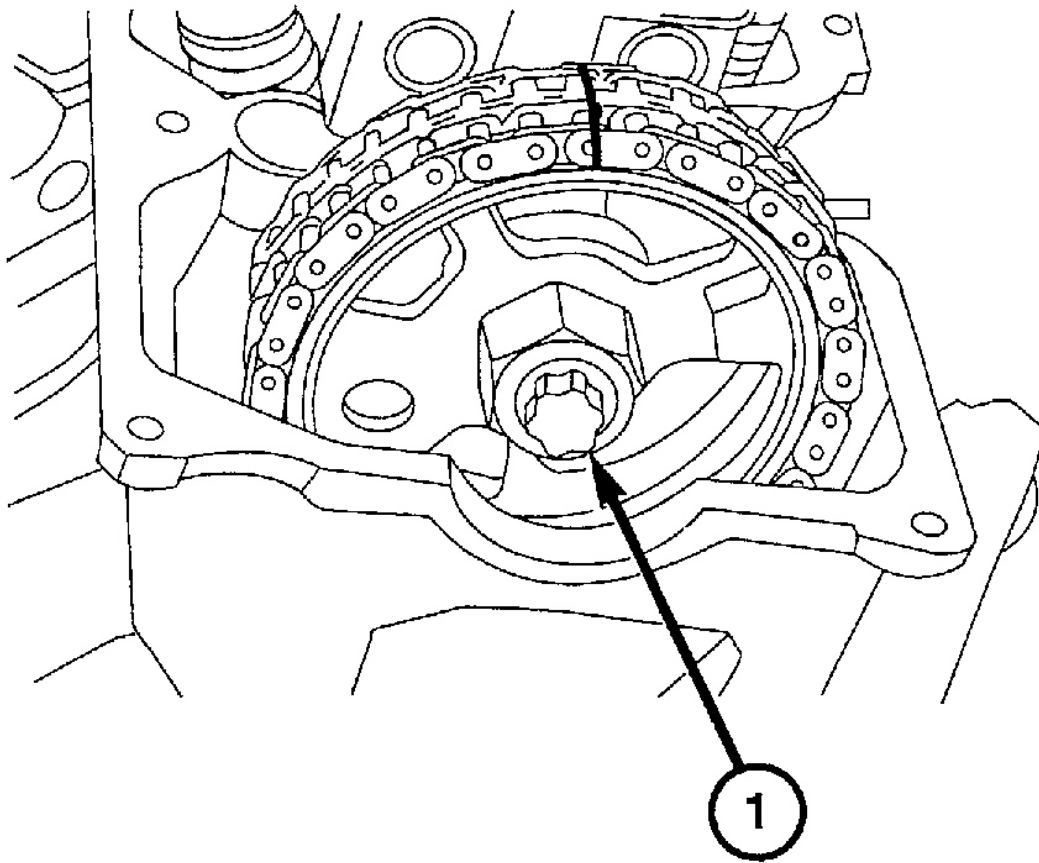
NOTE: Bolts numbered 9 and 10 are timing chain cover bolts. They should be tightened after the cylinder head bolts are tightened.



G01860559

Fig. 63: Identifying Cylinder Head Bolt Tightening Sequence
 Courtesy of DAIMLERCHRYSLER CORP.

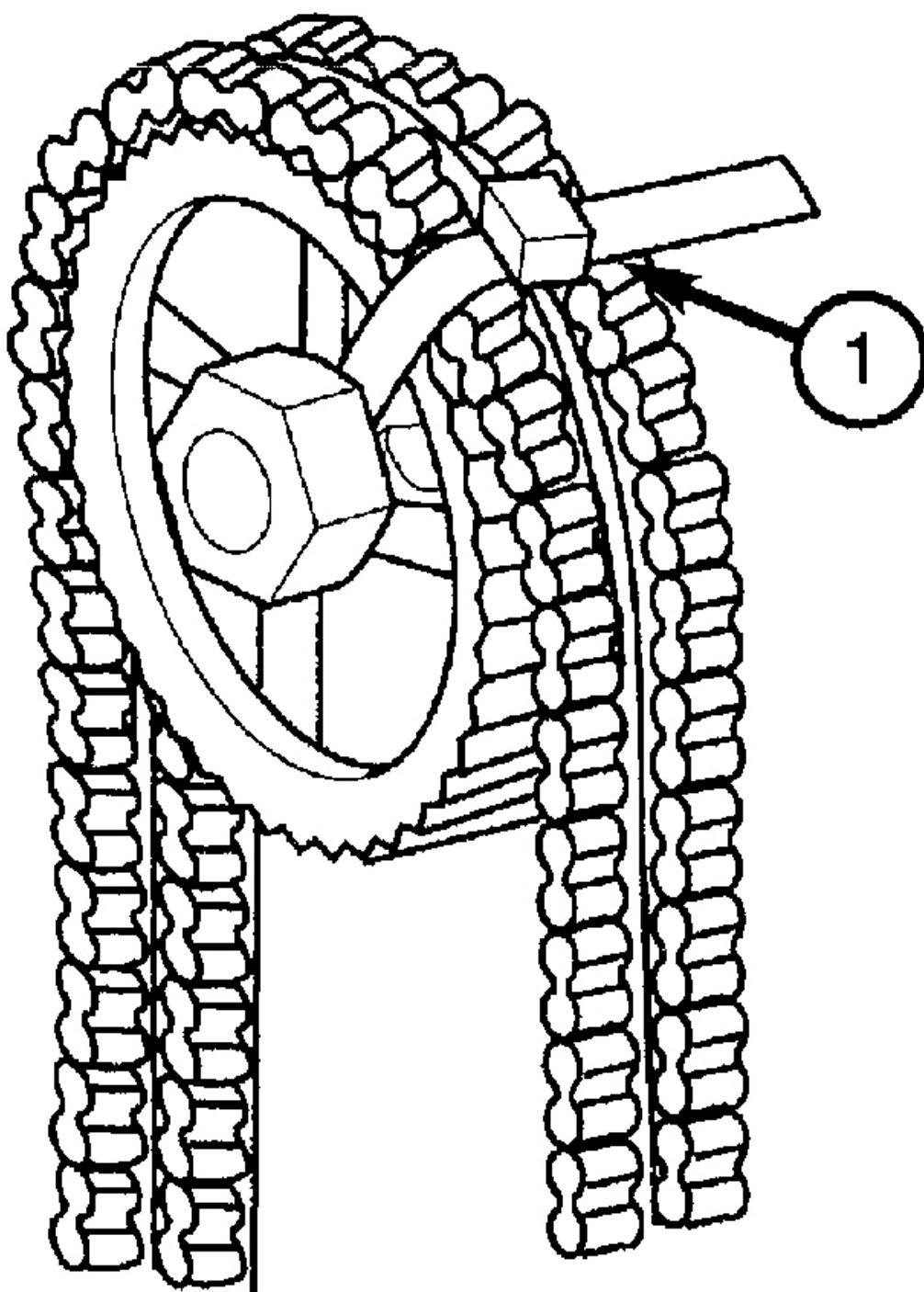
4. Tighten the cylinder head bolts in four stages.
 - Stage one, 20 N.m (15 ft. lbs.)
 - Stage two, 50 N.m (37 ft. lbs.)
 - Stage three, Rotate bolts 60°-70° clockwise.
 - Stage four Rotate bolts 60°-70° clockwise.
 - Tighten bolts 9 and 10 to 25 N.m (18 ft. lbs.).
5. Using Special Tools 9104 and 9105 Camshaft Locating Plates, lock the camshafts.
6. Install the camshaft sprockets and bolts (1).



G01860560

Fig. 64: Installing Camshaft Sprocket Bolt
Courtesy of DAIMLERCHRYSLER CORP.

7. Tighten the camshaft sprocket bolts in two stages.
 - Stage one, 50 N.m (37 ft. lbs.).
 - Stage two, Rotate bolts 90° clockwise.
8. Remove the cable tie (1).

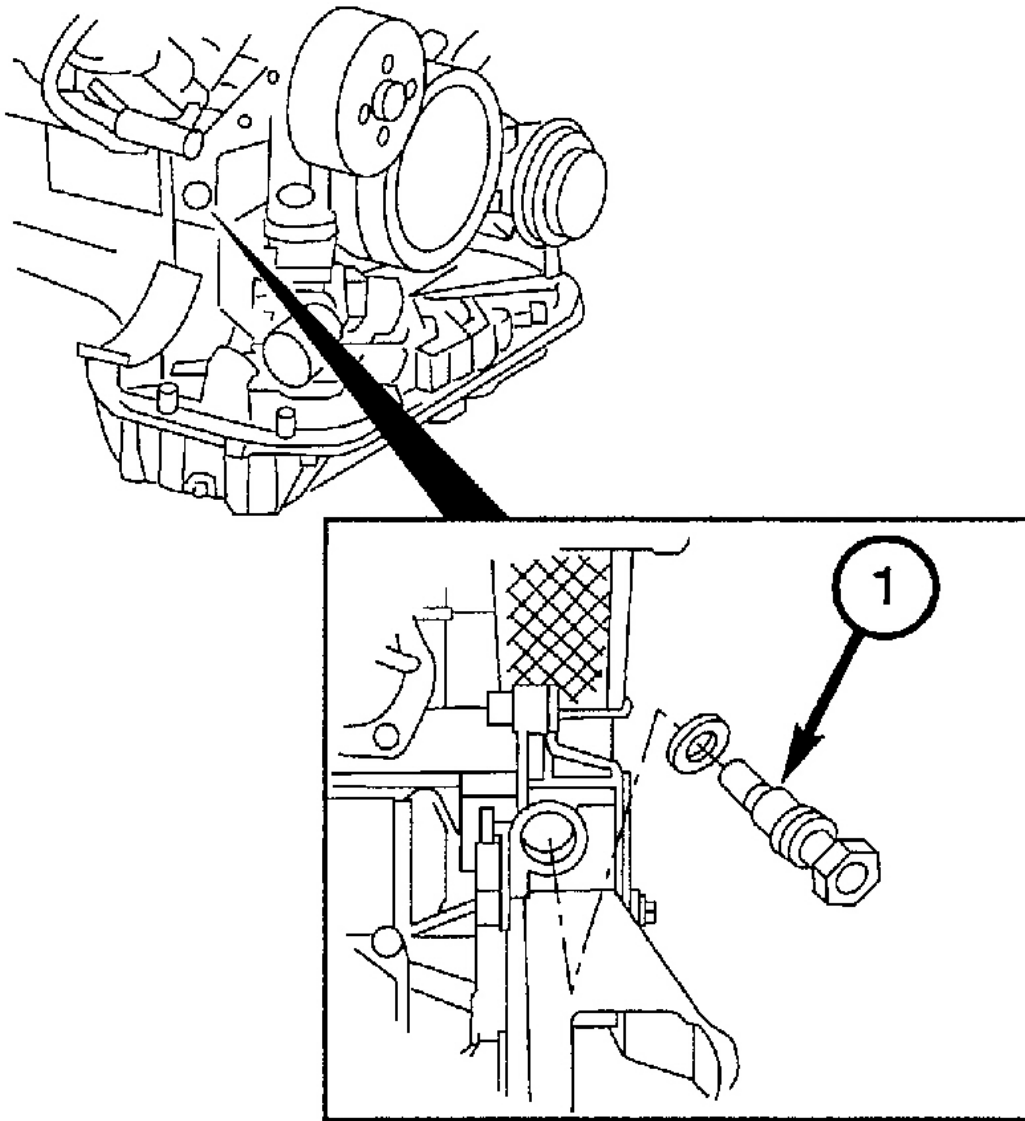


G01860561

Fig. 65: Removing Cable Tie

Courtesy of DAIMLERCHRYSLER CORP.

9. Install the timing chain tensioner (1). Tighten the timing chain tensioner to 80 N.m (60 ft. lbs.).



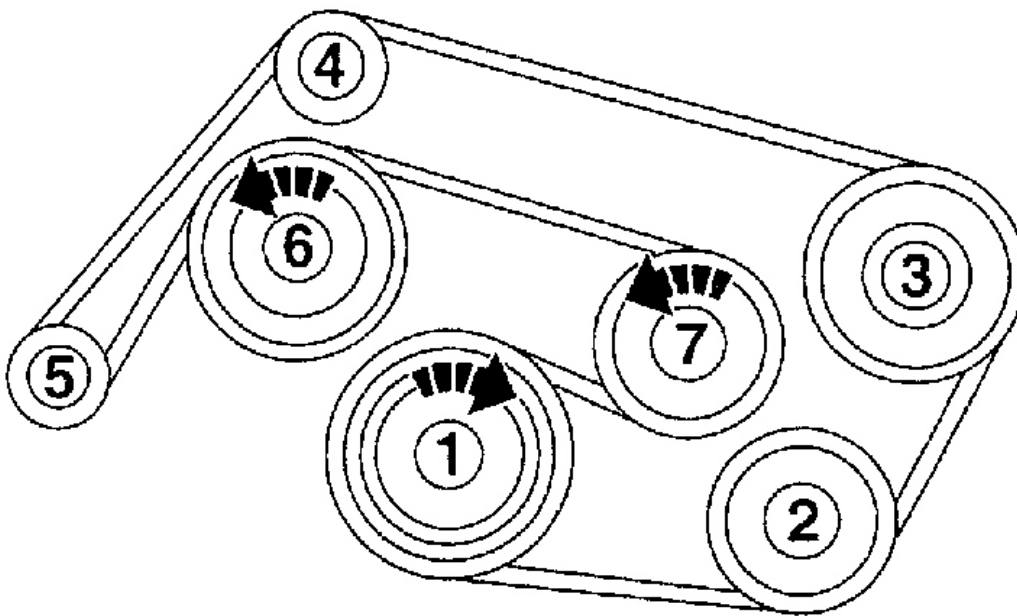
G01860562

Fig. 66: Installing Timing Chain Tensioner

Courtesy of DAIMLERCHRYSLER CORP.

10. Remove Special Tools 9104 and 9105 Camshaft Locating Plates.

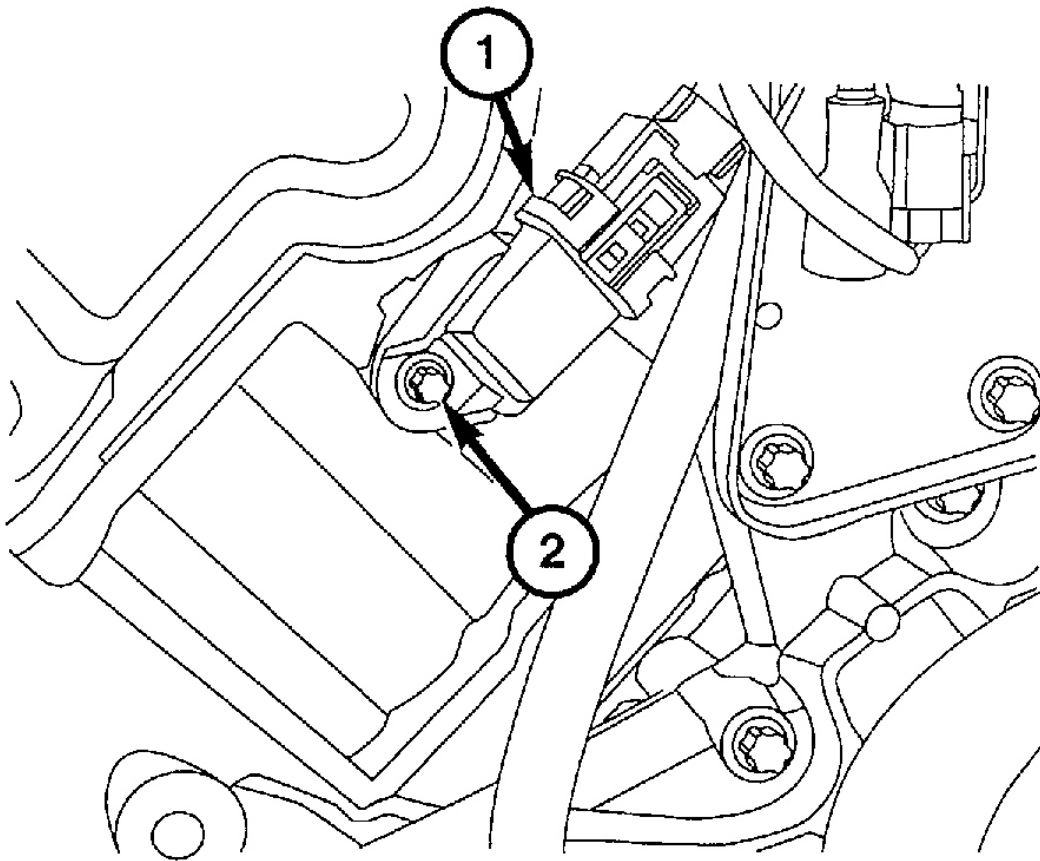
11. Check for a crankshaft position of 40° ATDC. See **ENGINE TIMING**.
12. Connect the exhaust system at the manifold flanges and tighten the exhaust flange bolts to 20 N.m (15 ft. lbs.).
13. Install the cylinder head covers. See **CYLINDER HEAD COVER**.
14. Install the intake manifold. See **INTAKE MANIFOLD**.
15. Install and connect the ignition coils. See **IGNITION SYSTEM**.
16. Install the accessory drive belt.



G01860563

Fig. 67: Installing Accessory Drive Belt
Courtesy of DAIMLERCHRYSLER CORP.

17. Install and connect the radiator fan with the radiator. See **COOLING SYSTEM (MECHANICAL)** article.
18. Install the camshaft position sensor and bolt (2). Connect the camshaft position sensor harness connector (1). Tighten the bolt to 10 N.m (7 ft. lbs.).



G01860564

Fig. 68: Installing Camshaft Position Sensor & Connecting Sensor Harness Connector
Courtesy of DAIMLERCHRYSLER CORP.

19. Install the engine air cleaner housing.
20. Fill the cooling system. See **COOLING SYSTEM (MECHANICAL)** article.
21. Fill the engine oil. See **OIL**.
22. Start the engine and check for leaks during warm up.
23. Recheck all fluid levels.

CYLINDER HEAD COVER

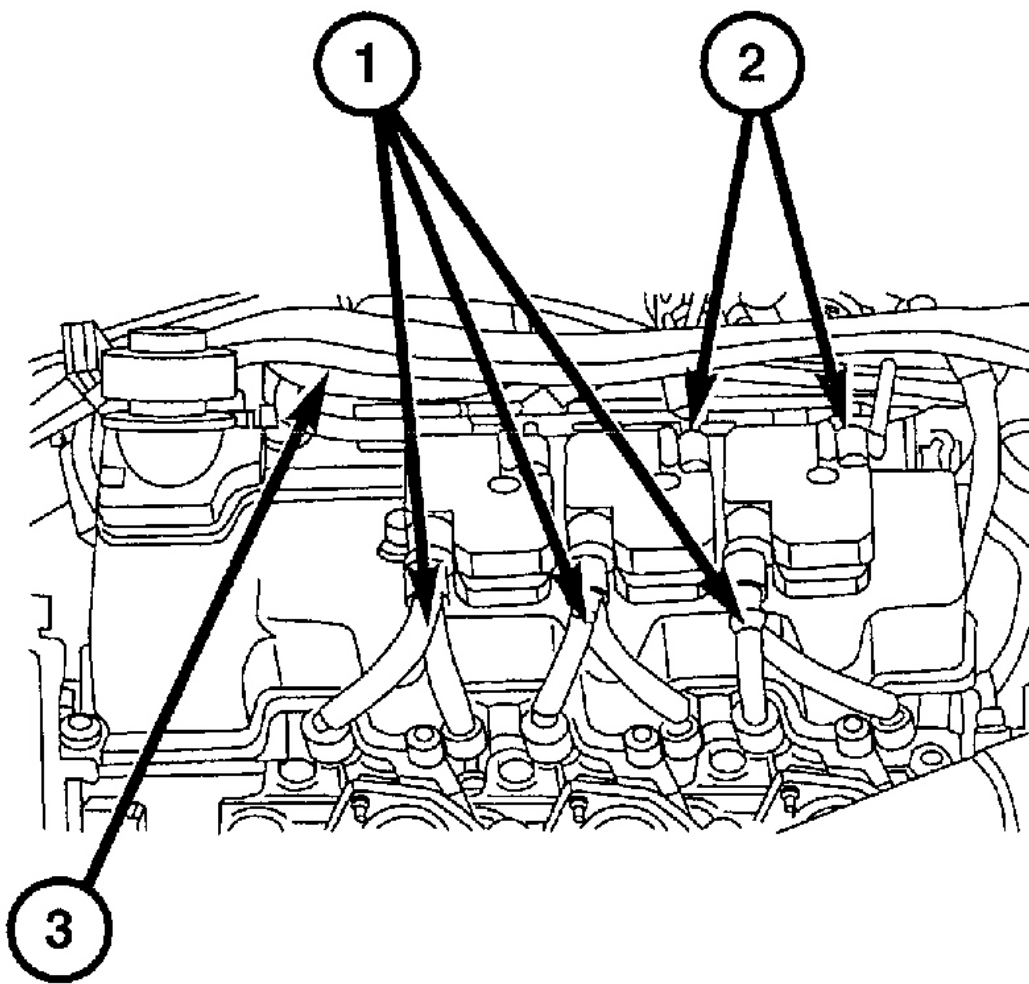
DESCRIPTION

Magnesium cylinder head covers provide trouble-free sealing, are lighter than aluminum and dampen valve noise. They are cast in two pieces to create internal ventilation passages with oil separators for crankcase vapor ventilation. This ventilation system virtually prevents the possibility of oil sludge formation due to the retention

of water vapor in the engine.

REMOVAL

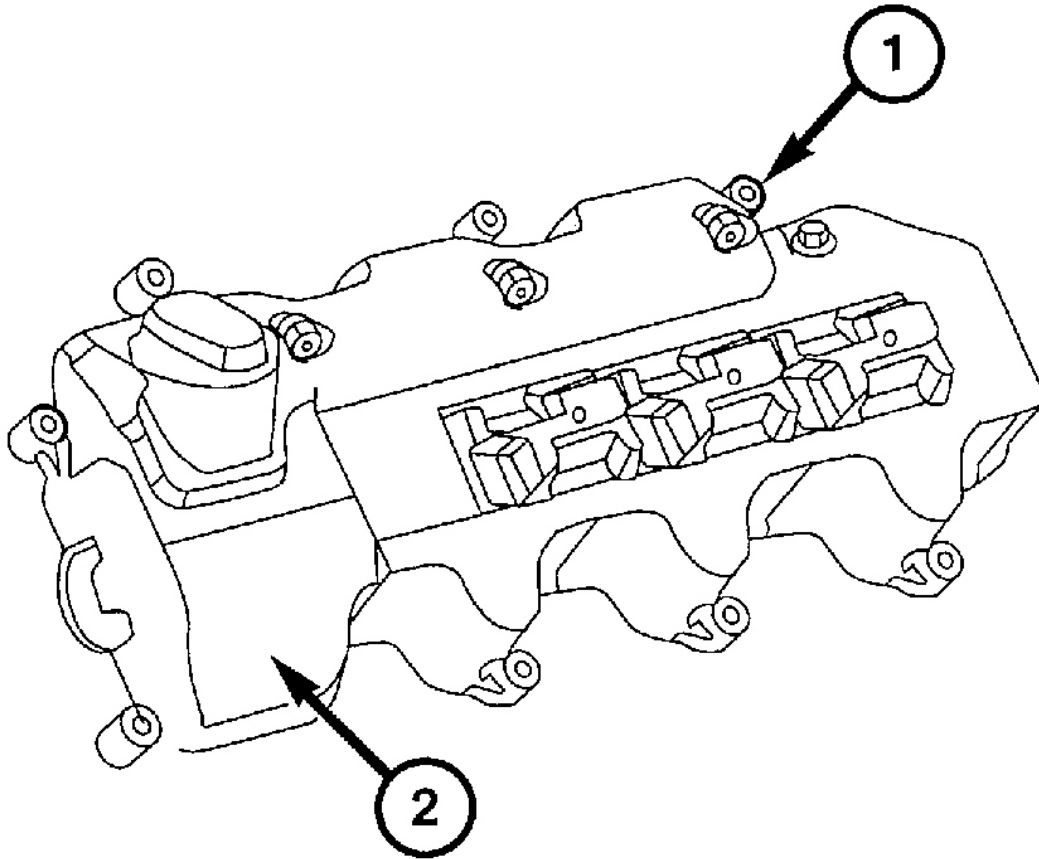
1. Remove the air cleaner housing. See AIR CLEANER HOUSING.
2. Disconnect the ignition coil harness connectors (2).
3. Disconnect the spark plug wires (1) at the spark plugs.
4. Position aside the vacuum hoses at the cylinder head cover retainers (3).



G01860565

Fig. 69: Disconnecting Ignition Coil Harness Connectors & Spark Plug Wires & Positioning Vacuum Hoses At Cylinder Head Cover Retainers
Courtesy of DAIMLERCHRYSLER CORP.

5. Disconnect the crankcase ventilation hose from the left cylinder head cover.
6. Remove the cylinder head cover bolts (1) and the cylinder head covers (2).

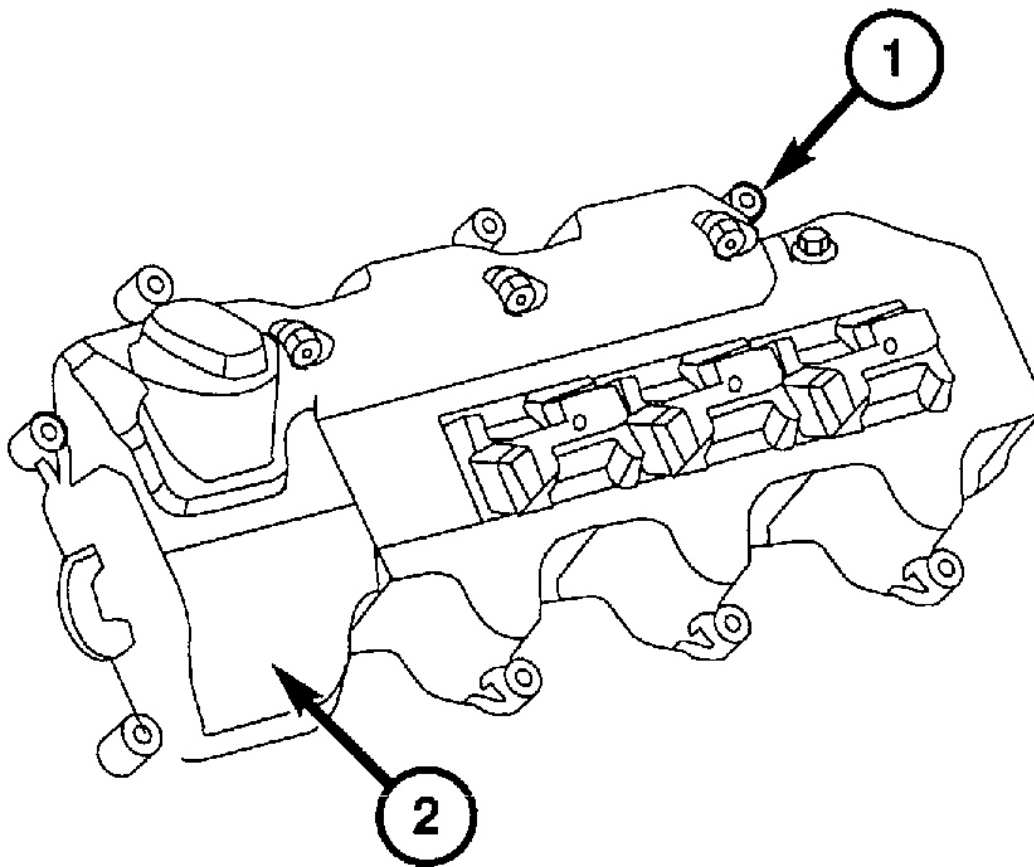


G01860566

Fig. 70: Removing Cylinder Head Cover Bolts & Cylinder Head Covers
Courtesy of DAIMLERCHRYSLER CORP.

INSTALLATION

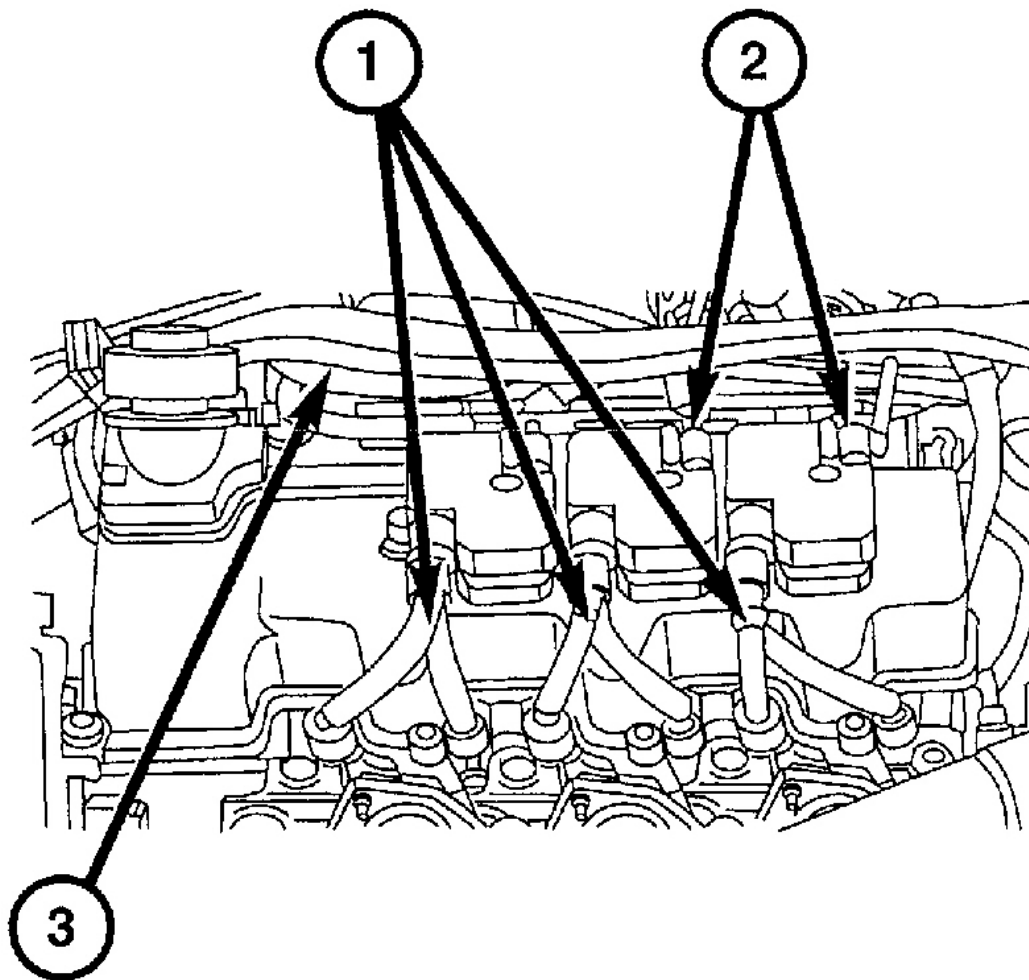
1. Check the gasket for tearing and breakage. If damage is evident, replace the gasket.
2. Position the cylinder head covers (2) on the cylinder head. Install the cylinder head cover bolts (1) and tighten to 10 N.m (7 ft. lbs.).



G01860567

Fig. 71: Installing Cylinder Head Covers
Courtesy of DAIMLERCHRYSLER CORP.

3. Route the engine vacuum hoses on the cylinder head cover retainers (3).
4. Connect the crankcase ventilator hose to the left cylinder head cover, the ignition coils (2), and the spark plug wires (1).



G01860568

Fig. 72: Routing Vacuum Hoses & Connecting Crankcase Ventilator Hose, Ignition Coils & Spark Plug Wires

Courtesy of DAIMLERCHRYSLER CORP.

5. Install the air cleaner housing. See AIR CLEANER HOUSING.

CAMSHAFT BEARING BRIDGE

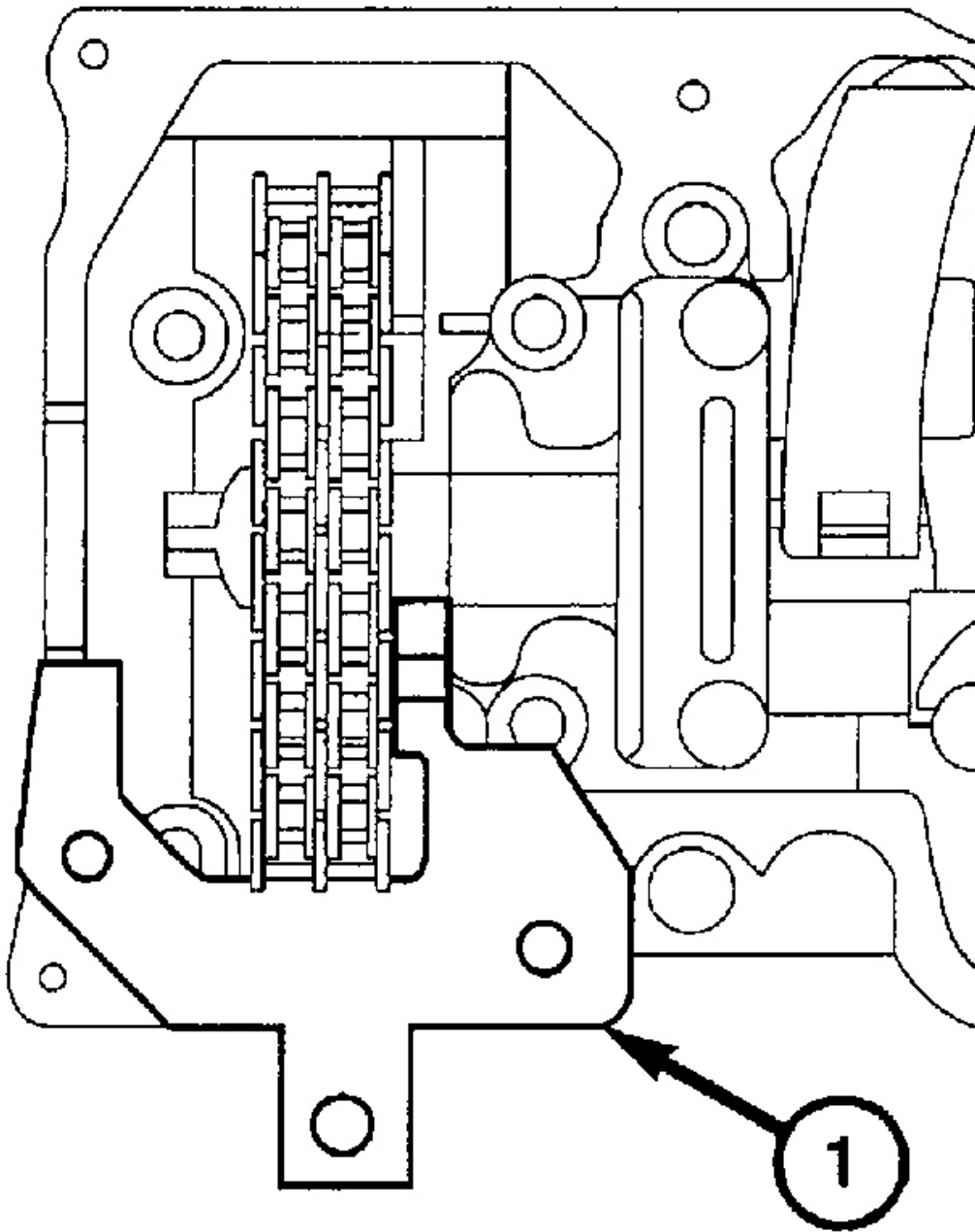
REMOVAL

1. Remove the cylinder head covers. See CYLINDER HEAD COVER.

NOTE: Rotate engine at the crankshaft in running direction until scribe mark 40°

on pulley/vibration damper corresponds with scribe mark on timing chain cover. Grooves in the camshafts must be toward the inside of the wedge.

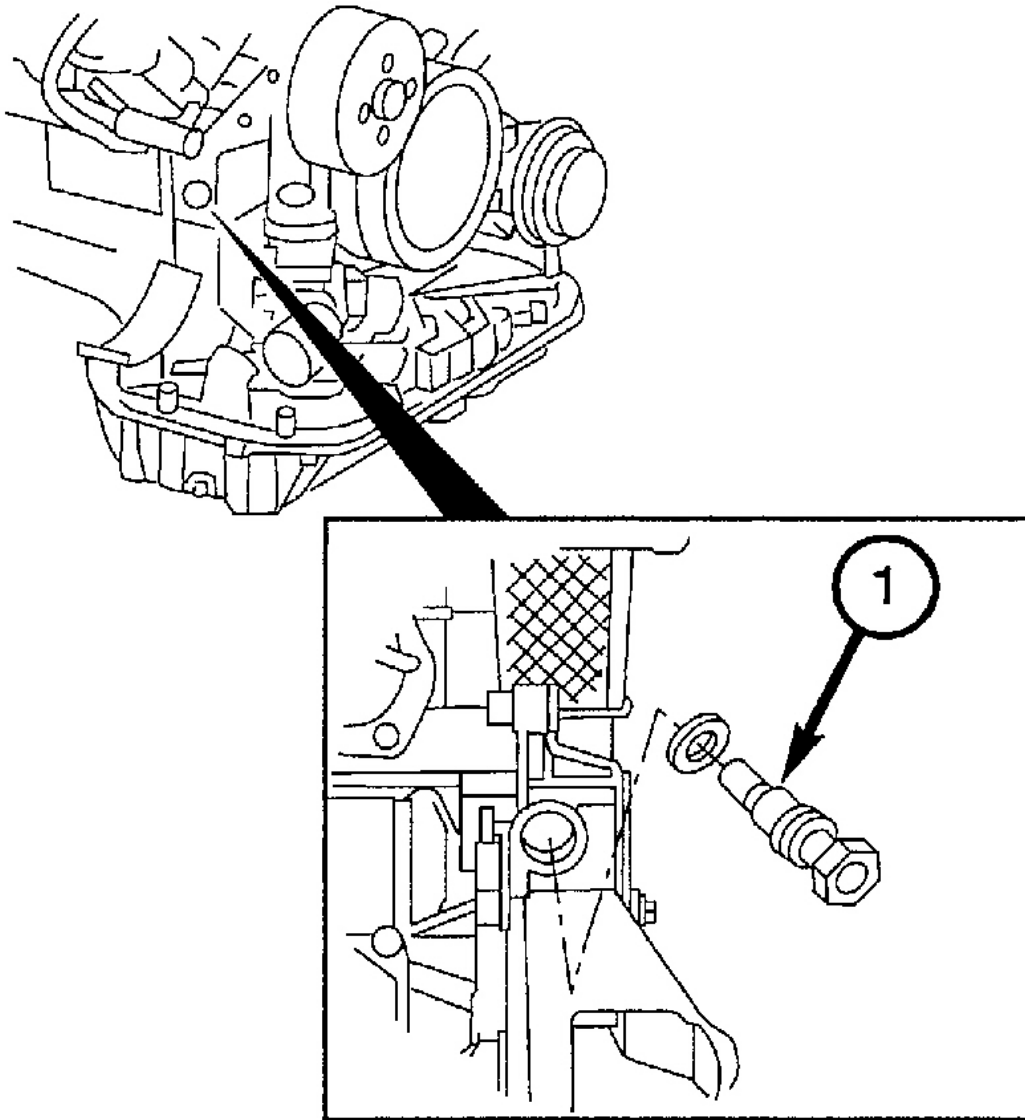
2. Position the engine timing at 40° ATDC. See **ENGINE TIMING**.
3. Using Special Tools 9104 (1) and 9105 Camshaft Locating Plates, lock the camshafts by placing the tool flush on the cylinder head, and inserting it into the groove in the camshaft.



G01860569

Fig. 73: Installing Special Tool 9104
Courtesy of DAIMLERCHRYSLER CORP.

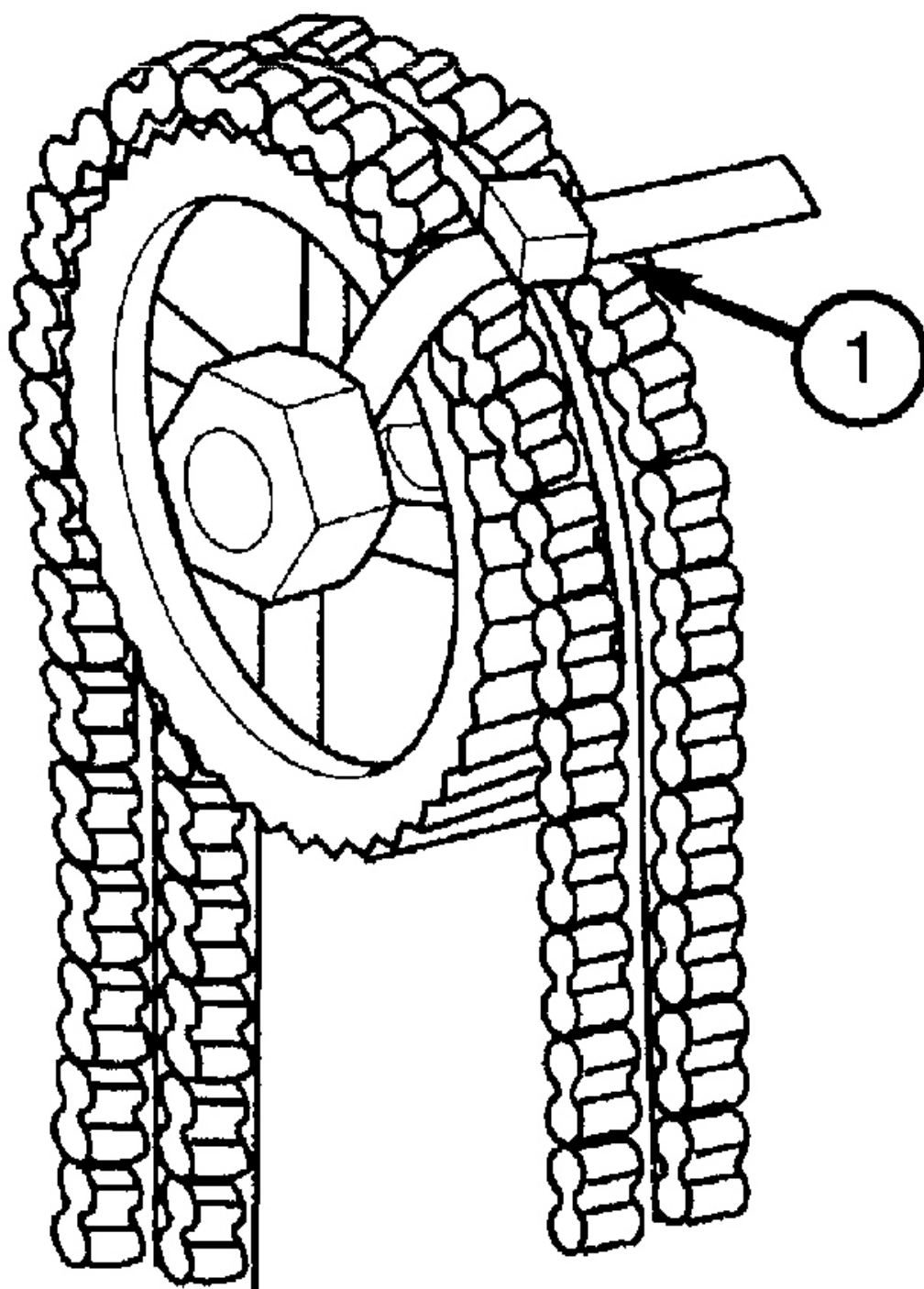
4. Remove the timing chain tensioner (1).



G01860570

Fig. 74: Removing Timing Chain Tensioner
Courtesy of DAIMLERCHRYSLER CORP.

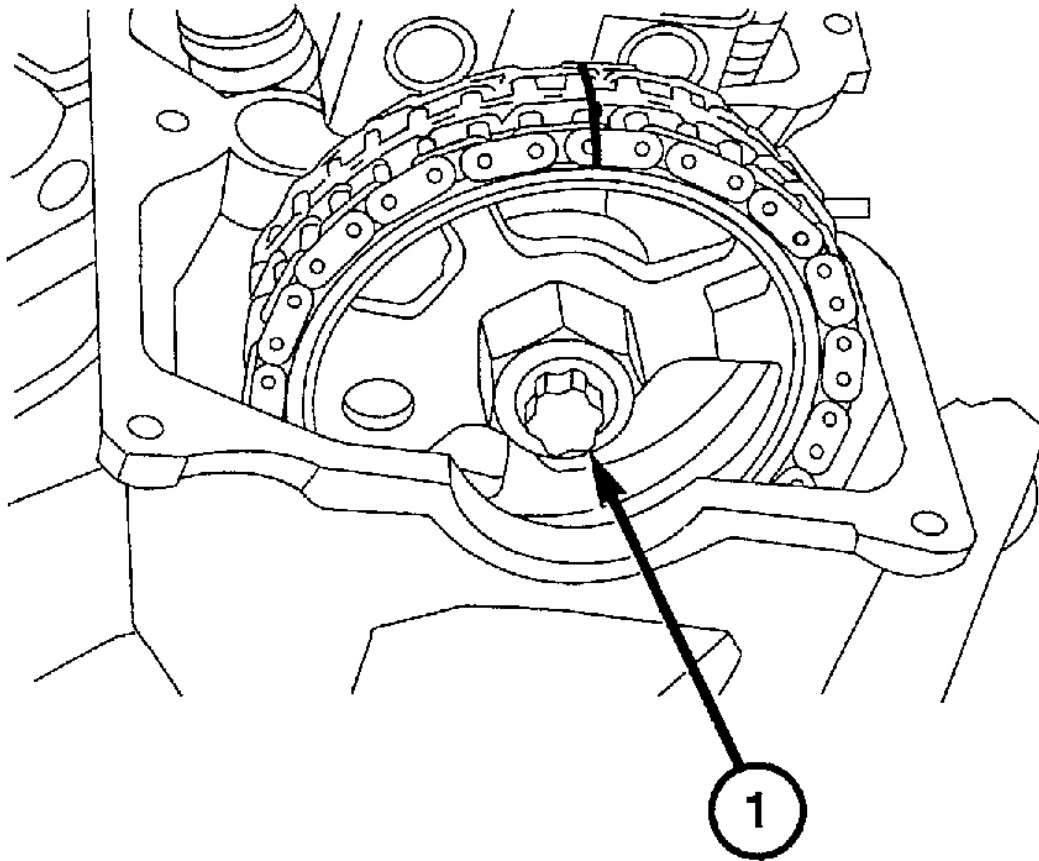
5. Use a cable tie (1) to secure the timing chains to the camshaft sprockets.



G01860571

Fig. 75: Securing Timing Chain To Camshaft Sprocket With Cable Tie
Courtesy of DAIMLERCHRYSLER CORP.

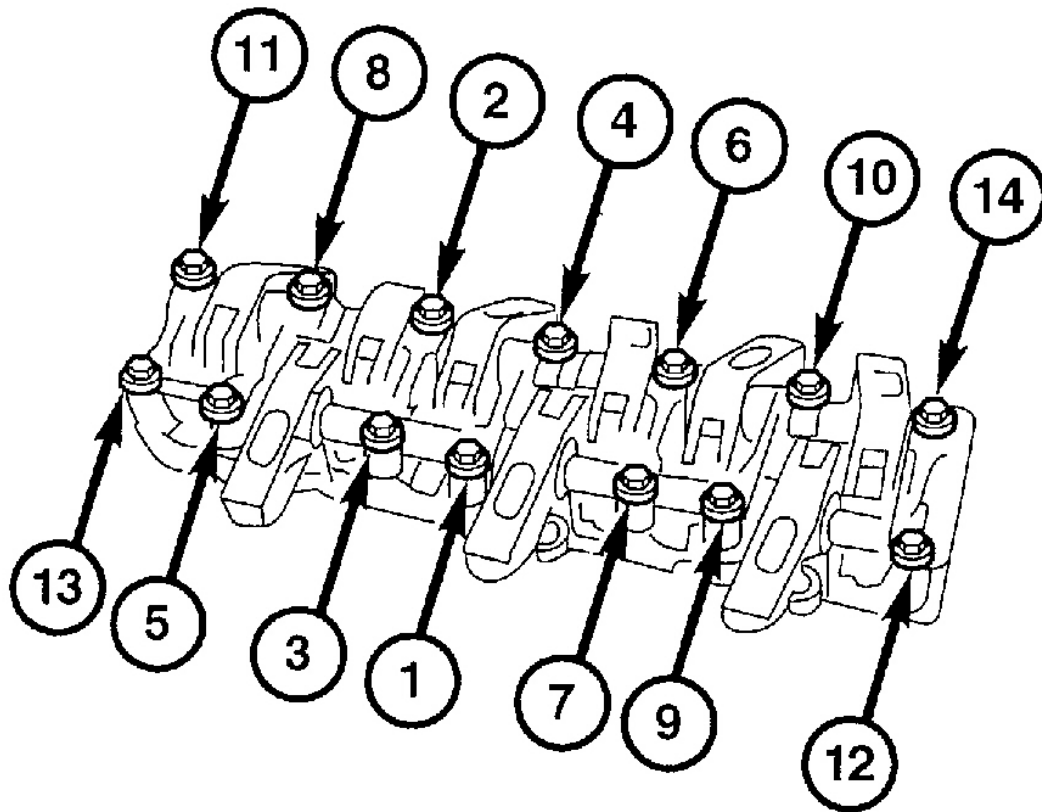
6. Remove the camshaft sprocket bolt (1) and sprocket.



G01860572

Fig. 76: Removing Camshaft Sprocket Bolt & Sprocket
Courtesy of DAIMLERCHRYSLER CORP.

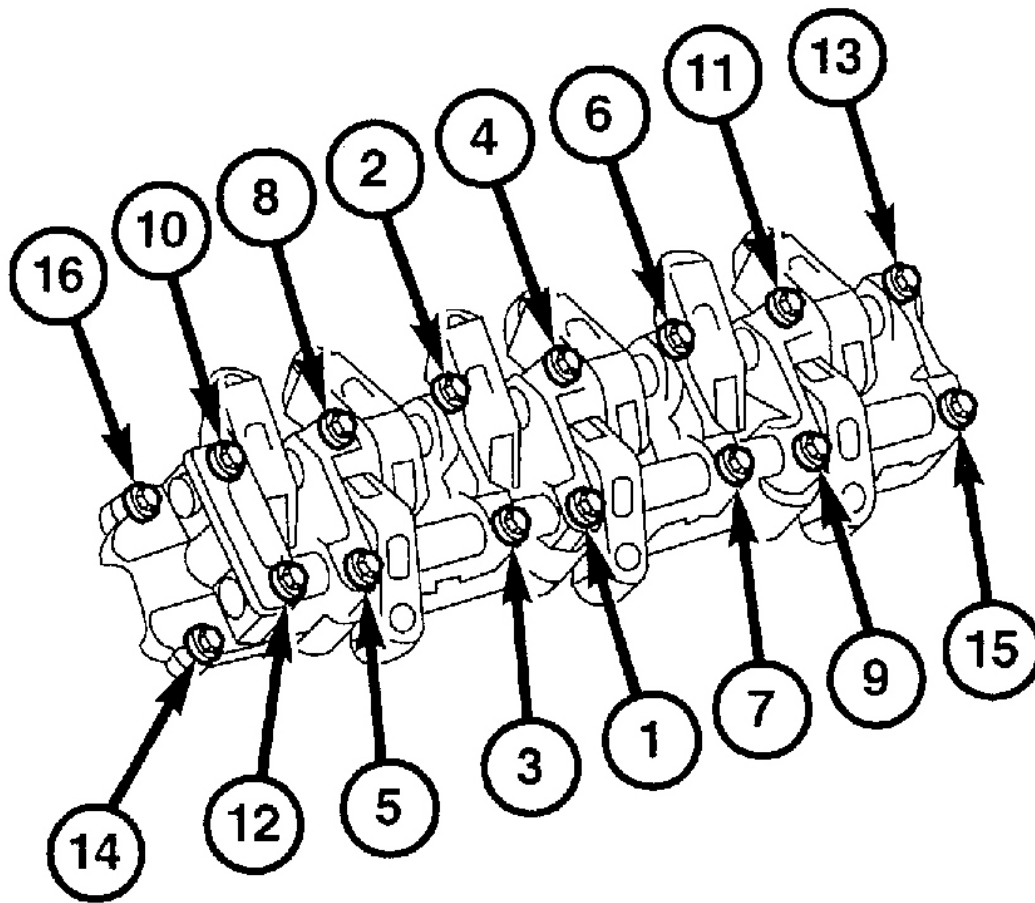
7. Partially loosen the bolts in the sequence shown.



G01860573

Fig. 77: Identifying Bolt Loosening Sequence
Courtesy of DAIMLERCHRYSLER CORP.

8. Loosen and remove the bearing bridge bolts in the sequence shown. Remove the camshaft bearing bridges.

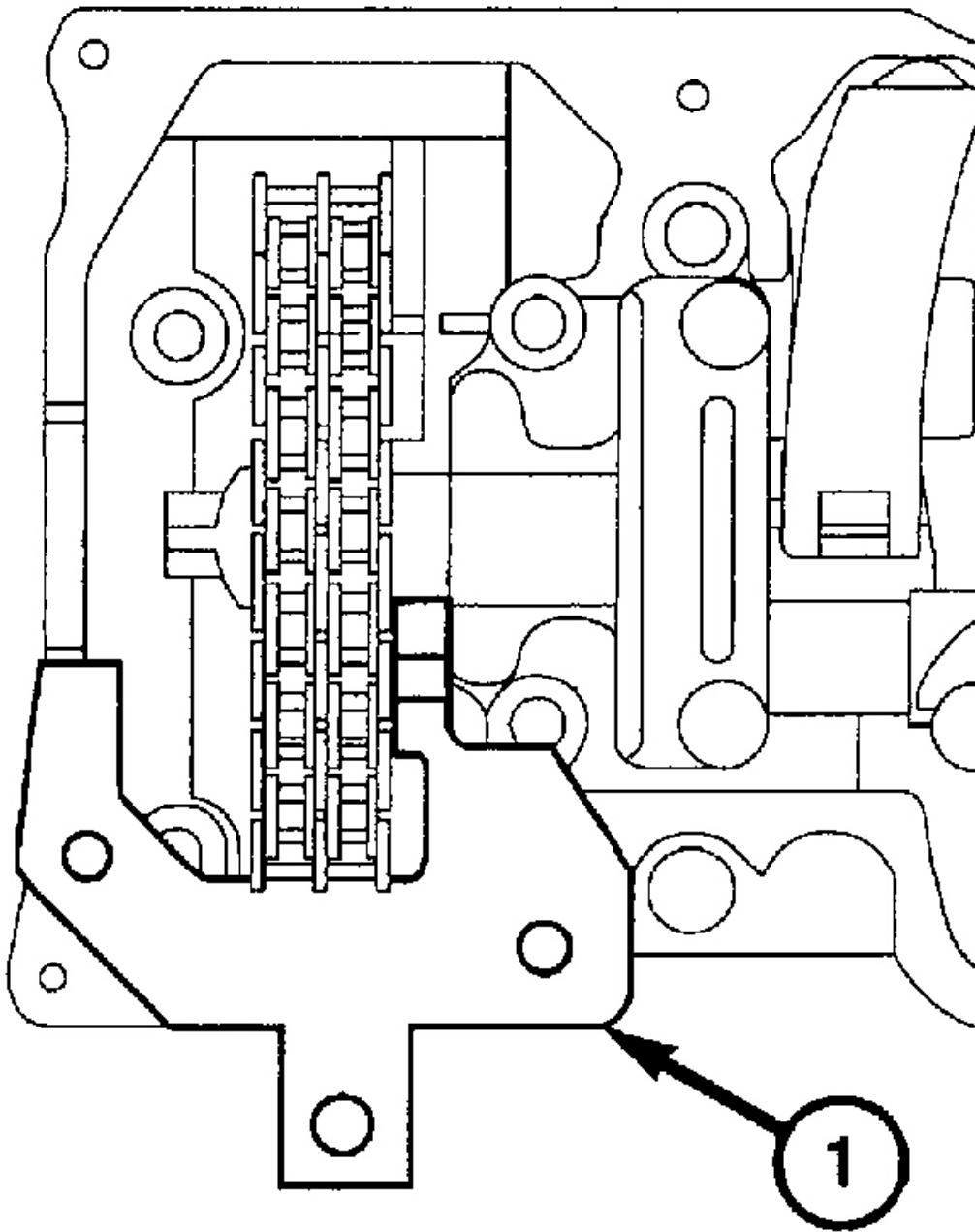


G01860574

Fig. 78: Identifying Bearing Bridge Bolts Removal Sequence
Courtesy of DAIMLERCHRYSLER CORP.

INSTALLATION

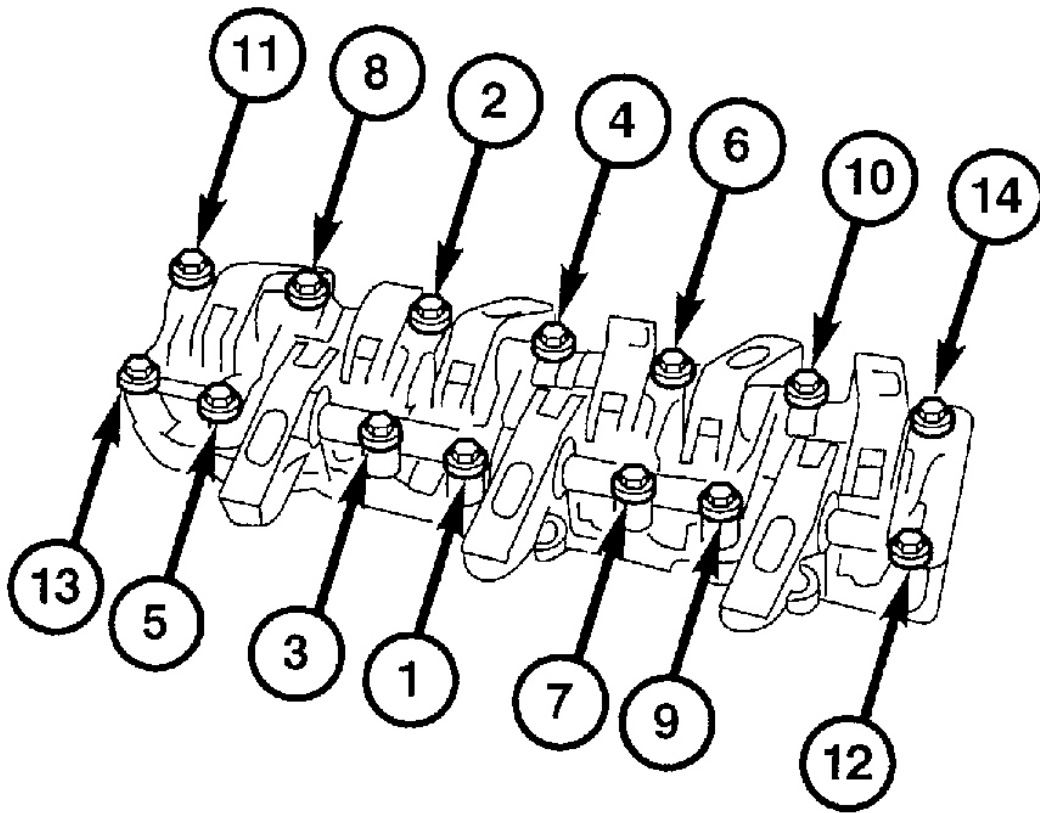
1. Make sure the engine is at 40° ATDC.
2. Position the camshaft bearing bridge on the camshaft.
3. Using Special Tools 9104 (1) and 9105 Camshaft Locating Plates, lock the camshafts by placing the tool flush on the cylinder head, and inserting it into the groove in the camshaft.



G01860575

Fig. 79: Installing Special Tool 9104
Courtesy of DAIMLERCHRYSLER CORP.

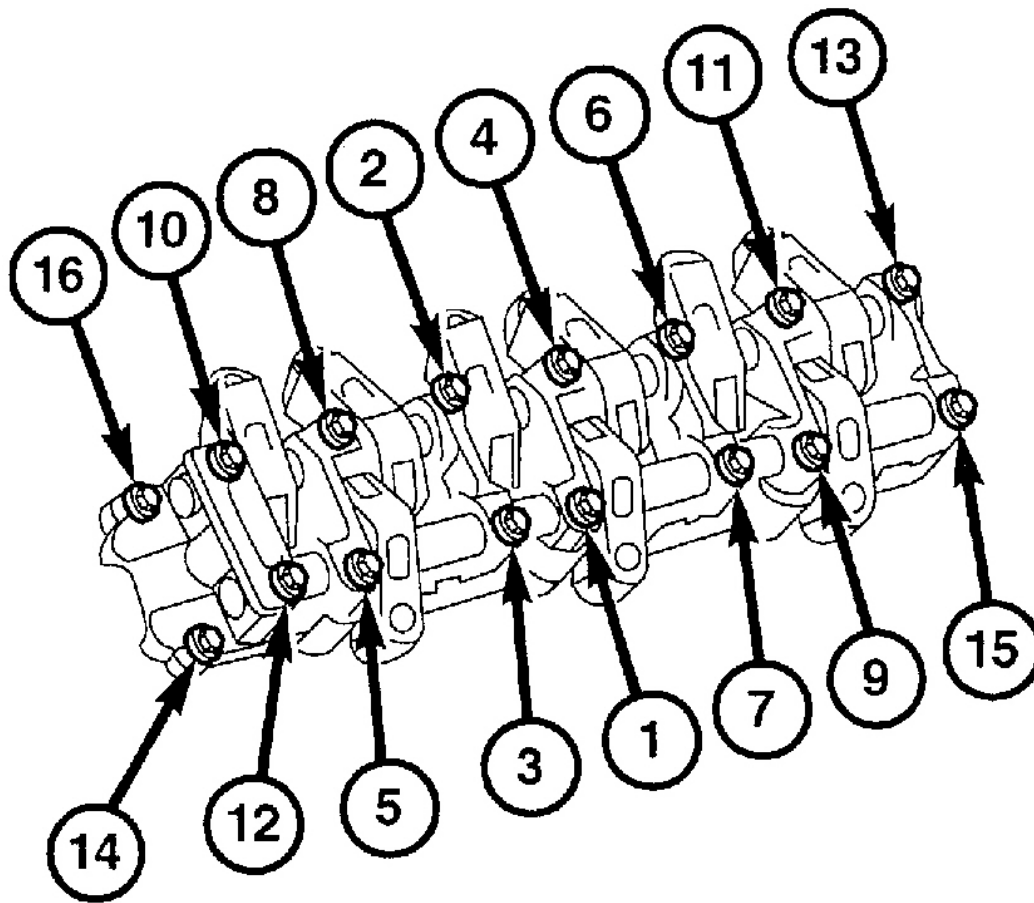
4. Install, but do not tighten the bearing bridge bolts.
5. Tighten the bolts in the sequence shown to 15 N.m (11 ft. lbs.).



G01860576

Fig. 80: Identifying Bolt Tightening Sequence (1 Of 2)
Courtesy of DAIMLERCHRYSLER CORP.

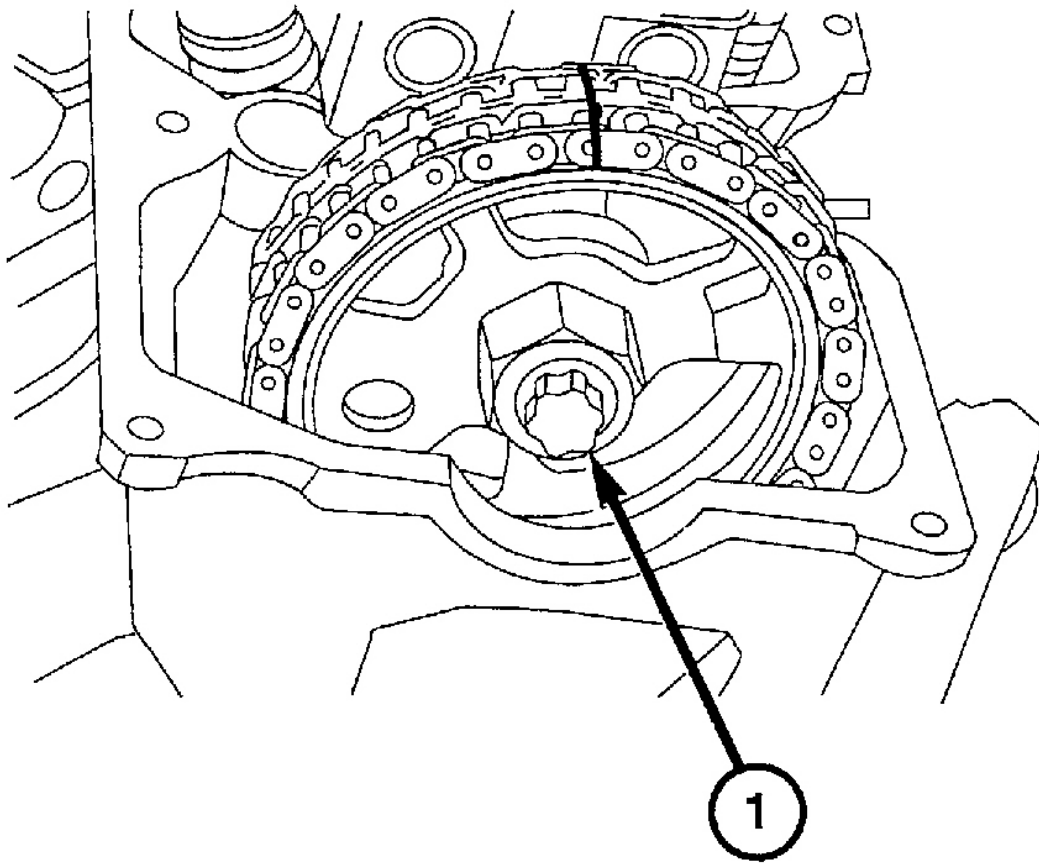
6. Tighten the bolts in the sequence shown an additional 90° clockwise.



G01860577

Fig. 81: Identifying Bolt Tightening Sequence (2 Of 2)
Courtesy of DAIMLERCHRYSLER CORP.

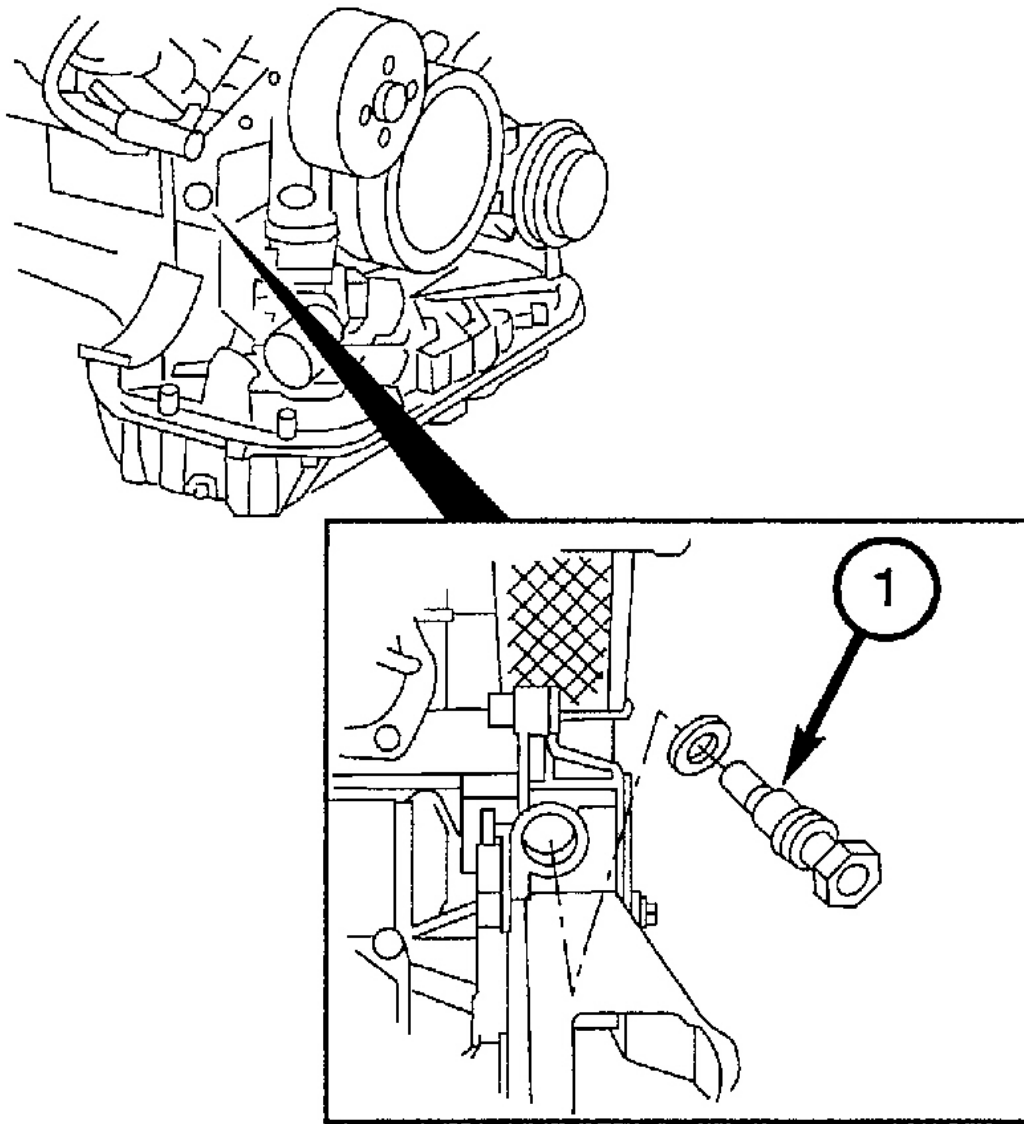
7. Install the camshaft sprockets and bolts (1). Tighten the bolts to 50 N.m (37 ft. lbs.).



G01860578

Fig. 82: Installing Camshaft Sprocket & Bolt
Courtesy of DAIMLERCHRYSLER CORP.

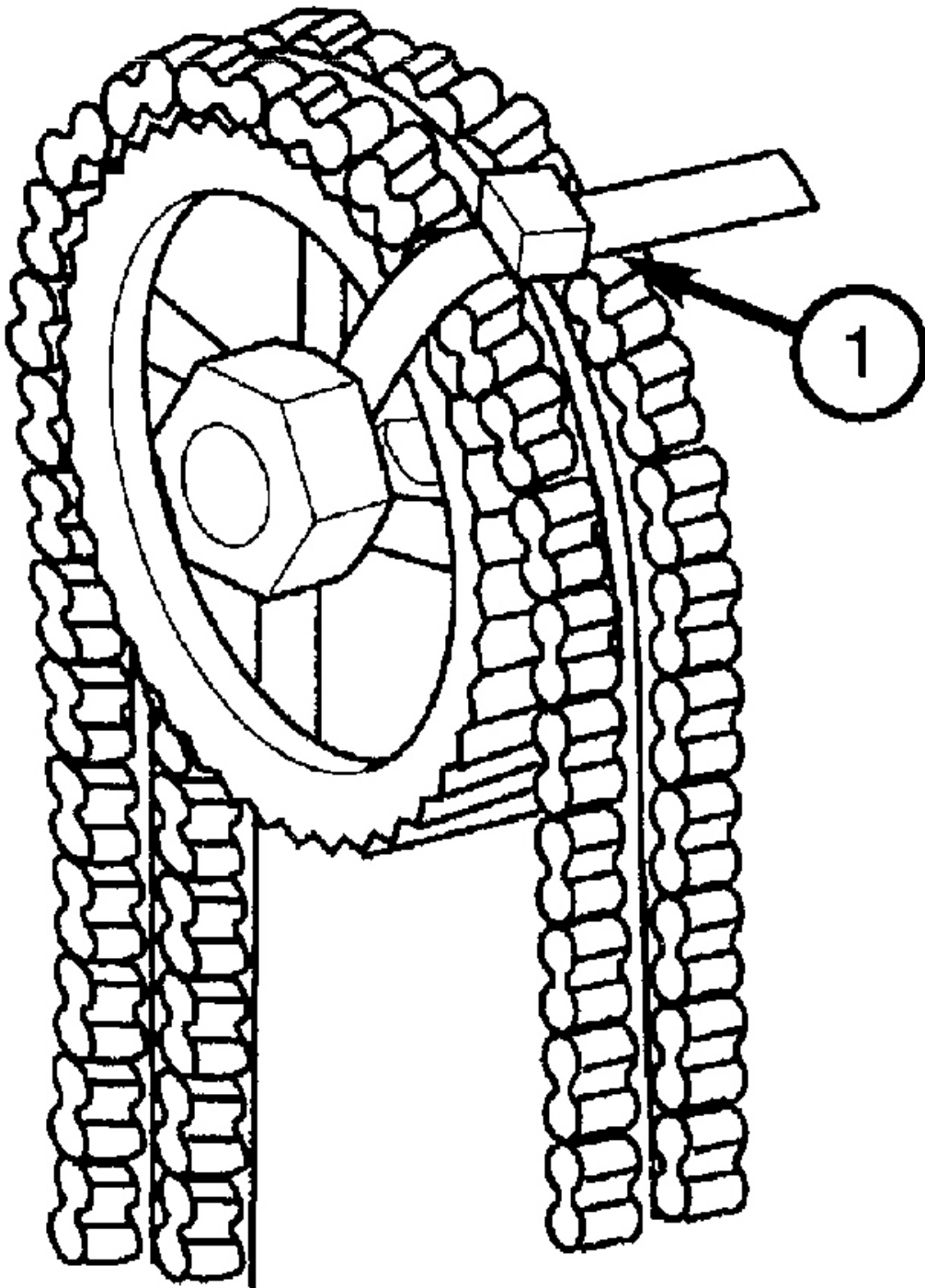
8. Tighten the camshaft sprocket bolts and additional 90° clockwise.
9. Install the timing chain tensioner (1). Tighten the tensioner to 80 N.m (59 ft. lbs.).



G01860579

Fig. 83: Installing Timing Chain Tensioner
Courtesy of DAIMLERCHRYSLER CORP.

10. Remove the cable tie.



G01860580

Fig. 84: Removing Cable Tie**Courtesy of DAIMLERCHRYSLER CORP.**

11. Remove the Special Tools 9104 and 9105 Camshaft Locating Plates.
12. Install the cylinder head covers. See **CYLINDER HEAD COVER**.
13. Install the air cleaner housing. See **AIR CLEANER HOUSING**.

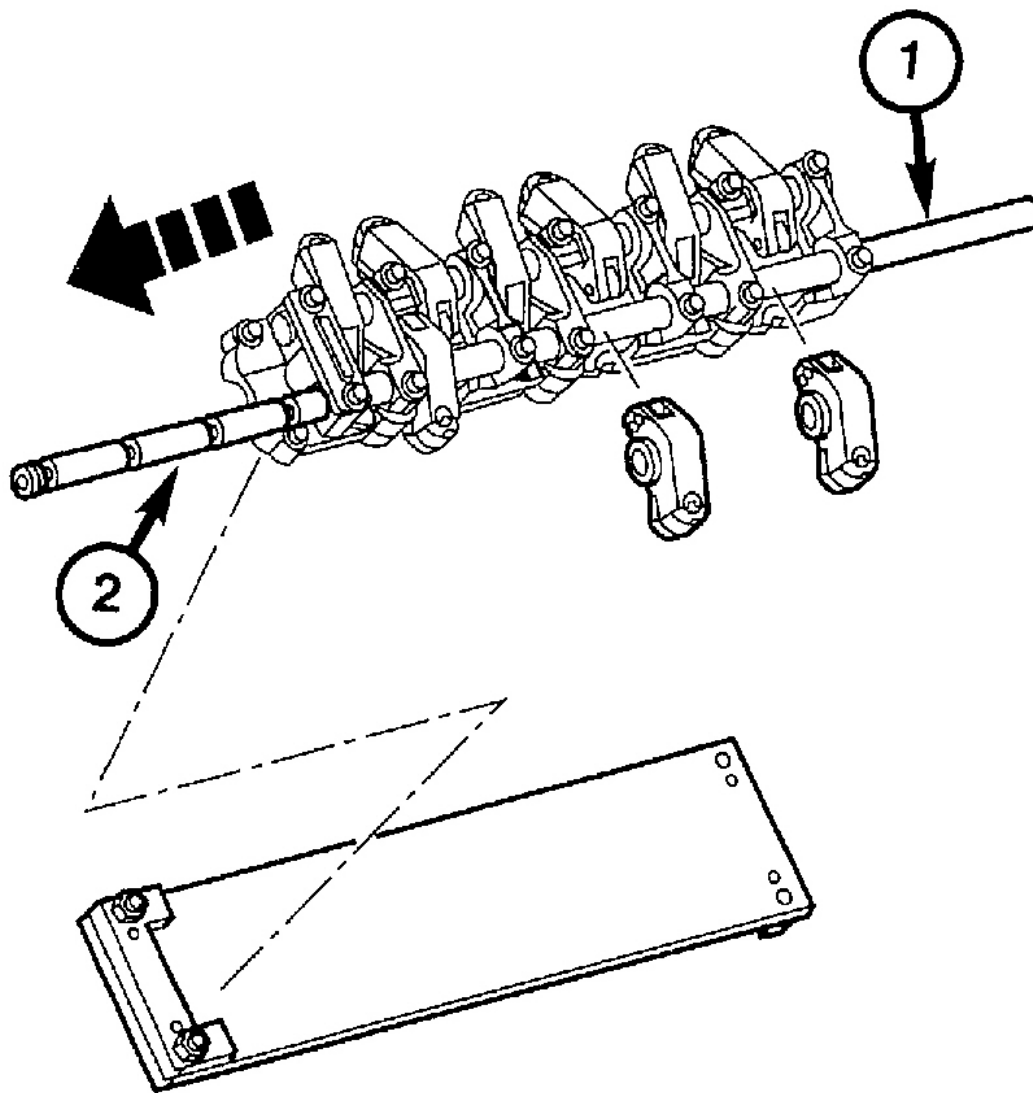
ROCKER ARM/ADJUSTER ASSY**DISASSEMBLY**

NOTE: **Wear protective gloves, protective clothing, and eye protection.**

NOTE: **If shaft is tapped too hard there is a risk of distorting the camshaft bearing bridge and damaging the hollow rocker arm shaft.**

1. Remove the camshaft bearing bridge. See **CAMSHAFT BEARING BRIDGE**.

NOTE: **If resistance is encountered while driving rocker shaft out of the camshaft bearing bridge, the bearing must be heated. Do not exceed 160° C.**



G01860581

Fig. 85: Using Drift To Drive Out Rocker Shaft
Courtesy of DAIMLERCHRYSLER CORP.

2. Use a 16 mm drift (1) to drive out the rocker shaft (2).
3. Remove the rocker arms and inspect the bearing surfaces.
4. If longitudinal scoring is present on rocker arm bearing, replace the rocker arm.
5. Clean all the parts thoroughly.

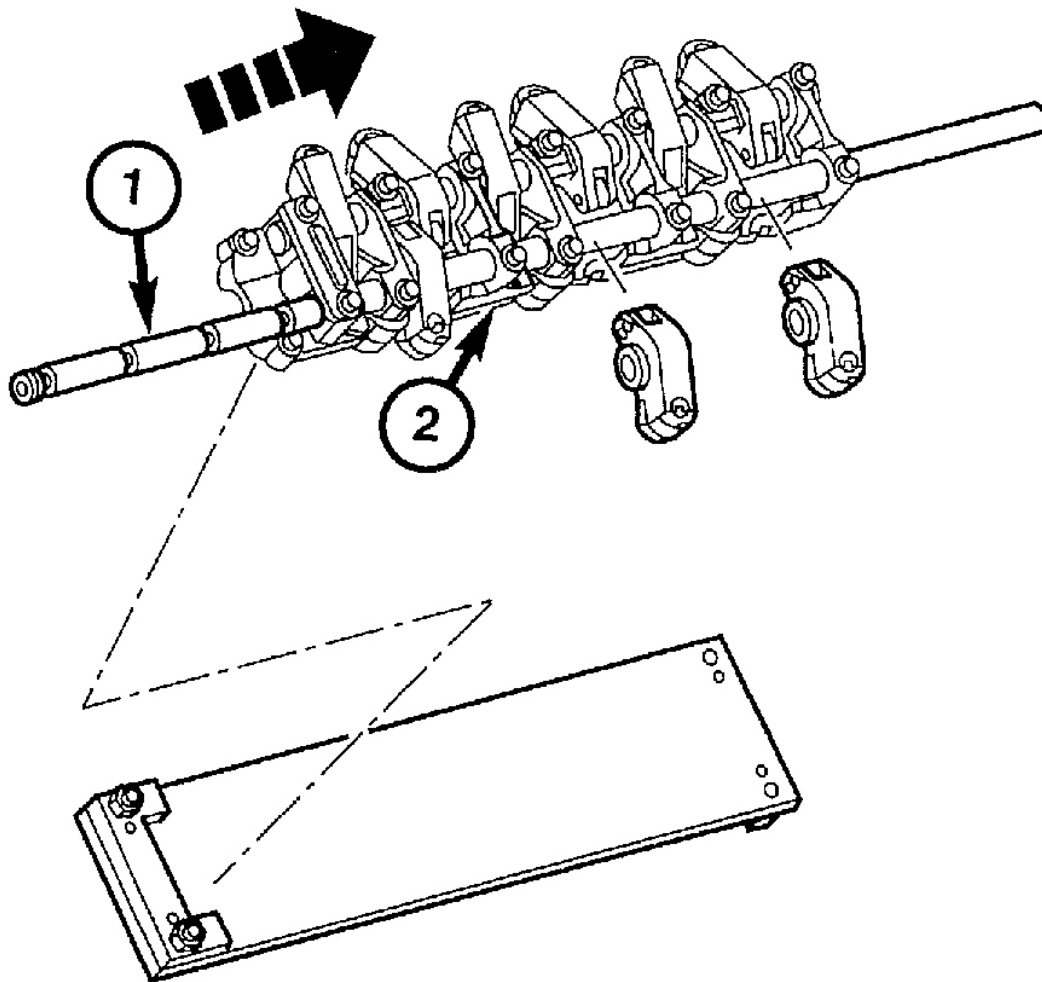
ASSEMBLY

CAUTION: Risk of injury to skin and eyes from handling hot or glowing objects.

NOTE: Wear protective gloves, protective clothing, and eye protection.

NOTE: If resistance is encountered while driving rocker shaft out of the camshaft bearing bridge, the bearing must be heated. Do not exceed 160° C.

1. Cool the rocker arm shaft.
2. Insert the rocker arm shaft (1) into the camshaft bearing bridge (2) and through the rocker arms by tapping it gently with a mallet. Ensure that the rocker arms are not crooked.



G01860582

Fig. 86: Installing Rocker Arm Shaft
Courtesy of DAIMLERCHRYSLER CORP.

3. Insert two camshaft bearing bridge bolts through the attachment holes in the camshaft bearing bridge to align and secure the rocker arm shaft. The oil supply holes in the rocker arm shaft points downward (toward the cylinder head).
4. Install the camshaft bearing bridge. See **CAMSHAFT BEARING BRIDGE**.

CAMSHAFT

DESCRIPTION

The induction-hardened, forged-steel camshafts are hollow to minimize weight. The camshaft and crankshaft sprocket teeth are rubber coated, making chain noise indiscernible from other engine noise.

OPERATION

The camshaft is driven by the crankshaft via drive sprockets and a chain. The camshaft has precisely machined lobes to provide accurate valve timing and duration.

REMOVAL

1. Remove the camshaft bearing bridges. See **CAMSHAFT BEARING BRIDGE**.
2. Remove the camshaft (1).

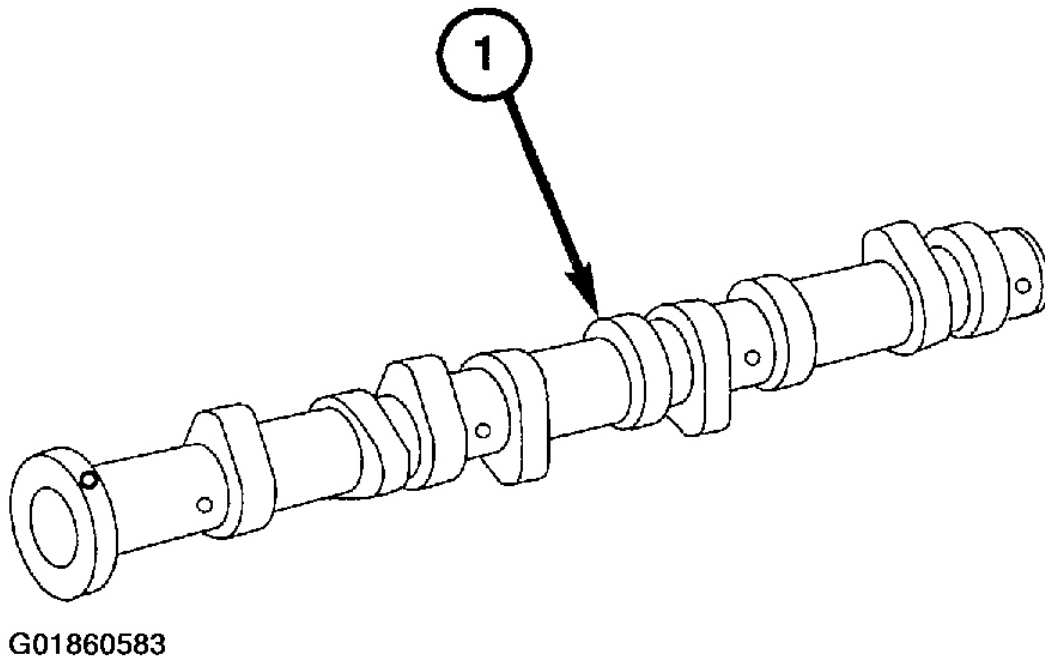


Fig. 87: Removing Camshaft
Courtesy of DAIMLERCHRYSLER CORP.

CLEANING

Clean the camshaft with a suitable solvent.

INSPECTION

1. Inspect the camshaft bearing journals for damage or binding. If the journals are binding, check the cylinder head for damage. Also check the cylinder head oil holes for clogging.
2. Check the camshaft lobe and the bearing surfaces for abnormal wear and damage. Replace the camshaft if it is defective.
3. Measure the lobe actual wear and replace the camshaft if it is out of limit. The standard value is 0.001 in. (0.0254 mm). The wear **limit** is 0.010 in. (0.254 mm).

INSTALLATION

1. Position the camshaft (1) on the cylinder head.
2. Install the camshaft bearing bridges. See **CAMSHAFT BEARING BRIDGE**.

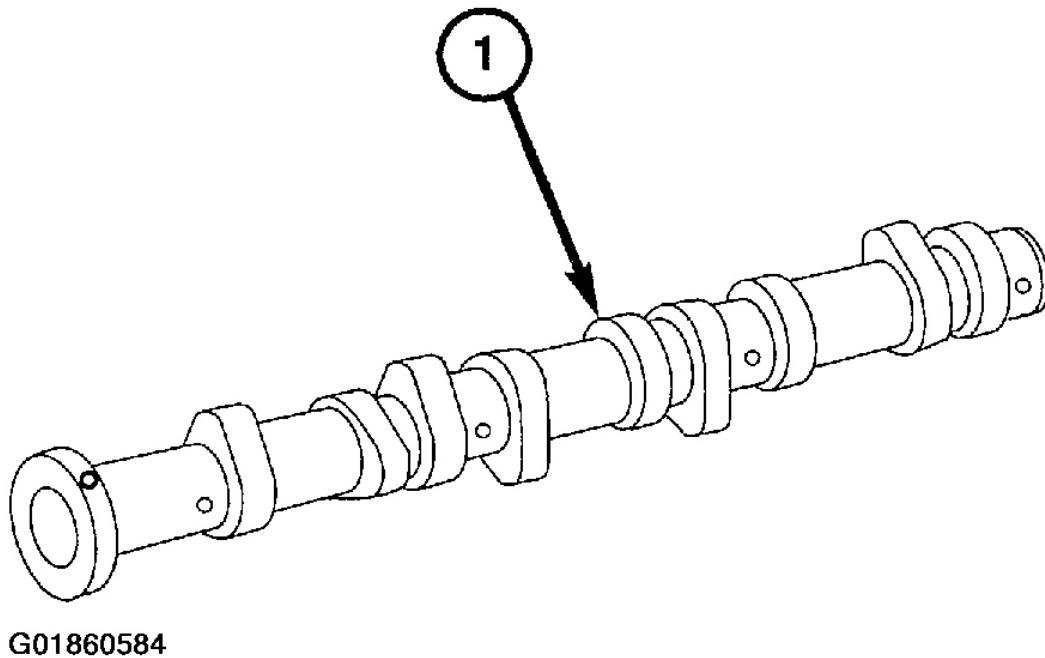


Fig. 88: Installing Camshaft

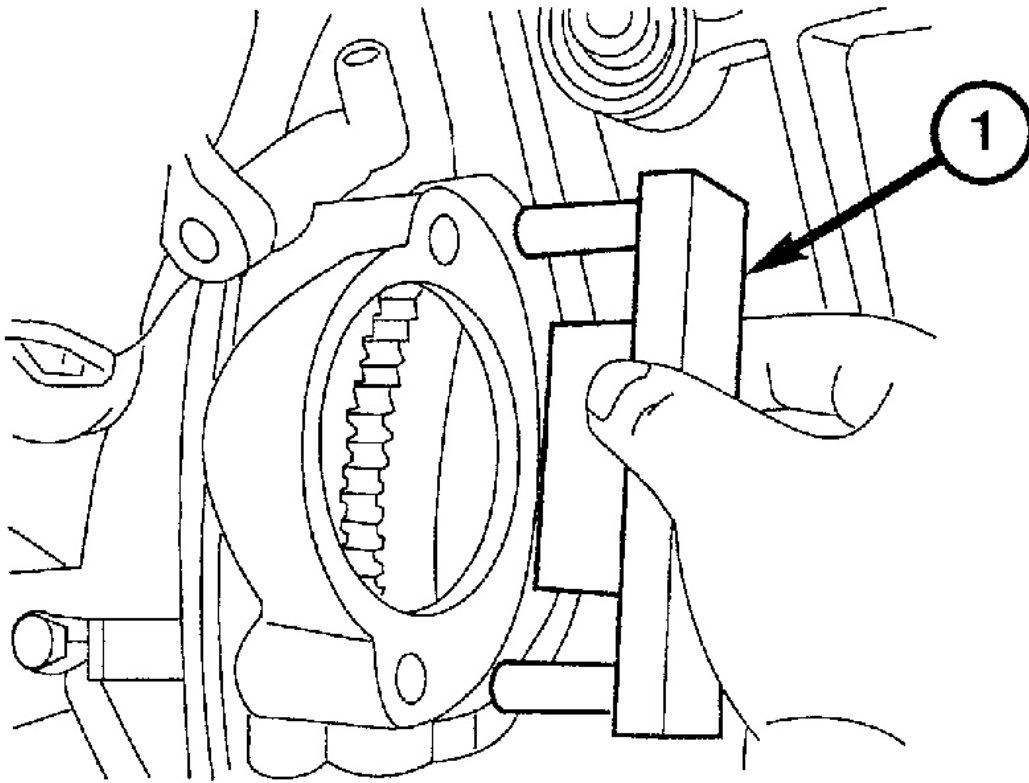
Courtesy of DAIMLERCHRYSLER CORP.

VALVE STEM SEAL

REMOVAL

NOTE: The tools used in these valve stem seal procedures are part of Special Tool 9106 Valve Assembly Tool Case.

1. Remove the starter. See **STARTERS** article.
2. Remove the camshafts. See **CAMSHAFT**.
3. Remove one spark plug from the cylinder to be repaired.
4. Position the cylinder to be repaired to TDC.
5. Using Special Tool 9102 Flywheel Locking Tool, lock the flywheel by inserting the tool into the starter opening.

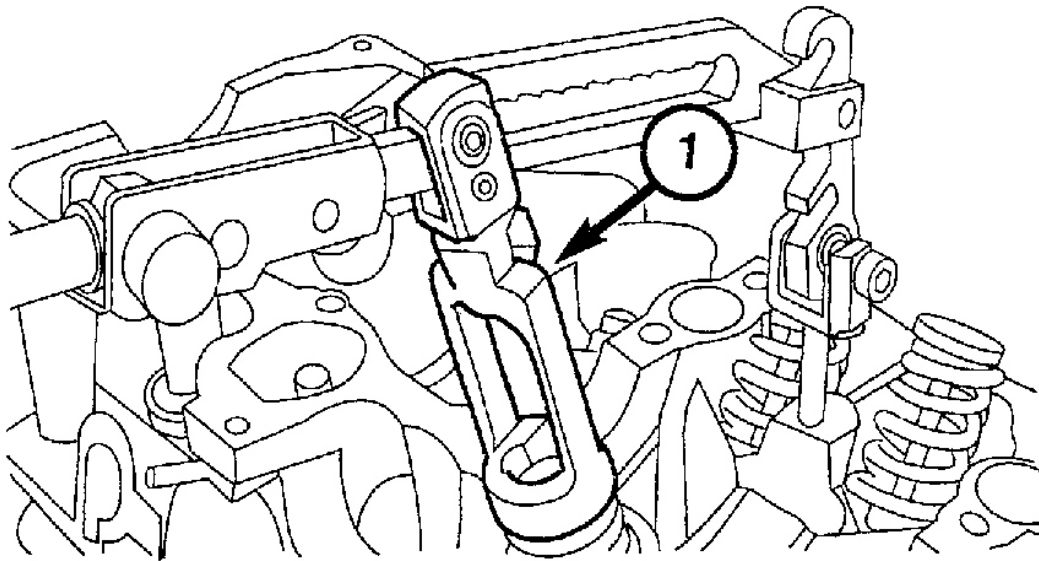


G01860585

Fig. 89: Locking Flywheel

Courtesy of DAIMLERCHRYSLER CORP.

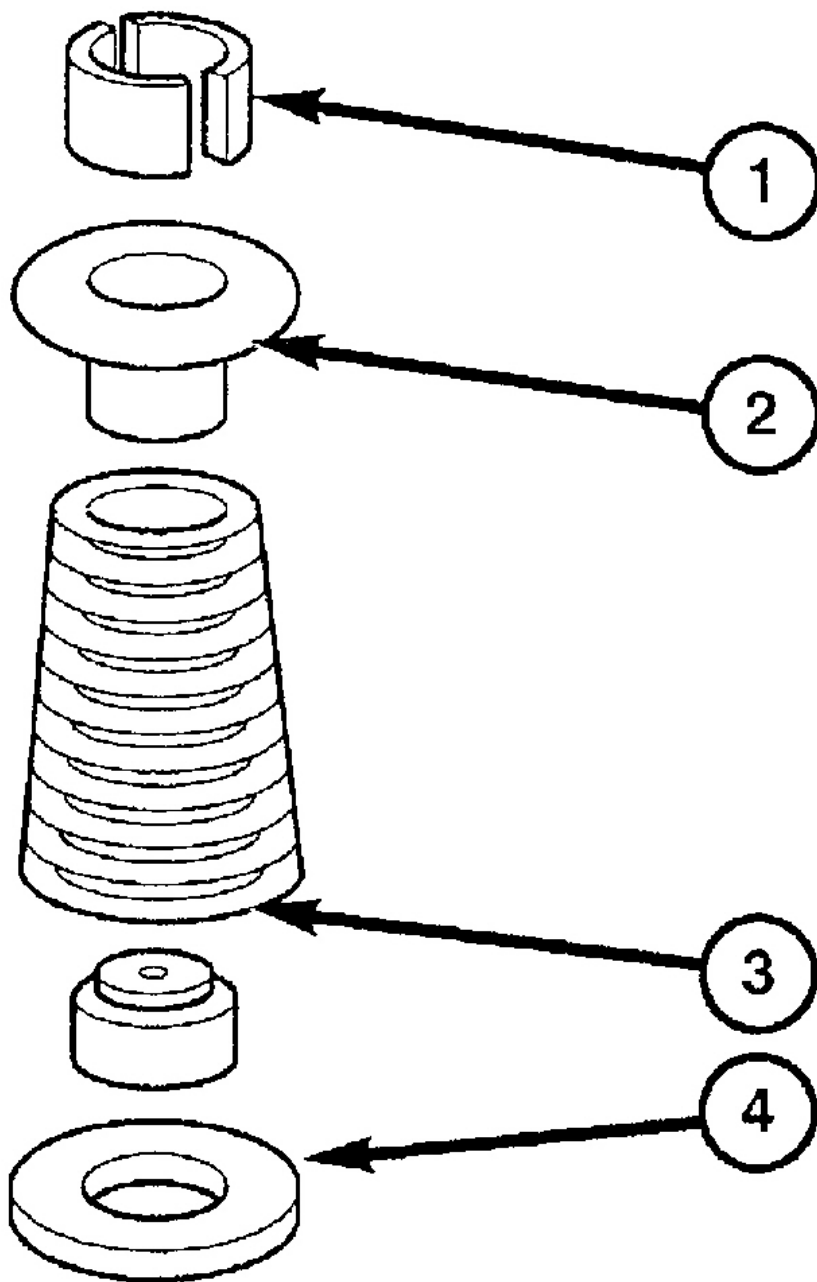
6. Pressurize the combustion chamber. See **CYLINDER COMBUSTION PRESSURE LEAKAGE TEST**.
7. Install the assembly tool (1). Compress the valve spring.



G01860586

Fig. 90: Compressing Valve Spring
Courtesy of DAIMLERCHRYSLER CORP.

8. With the valve spring compressed, remove the collets (1).
9. Release the valve spring and remove the valve spring retainer (2), the spring (3) and spring seat (4).

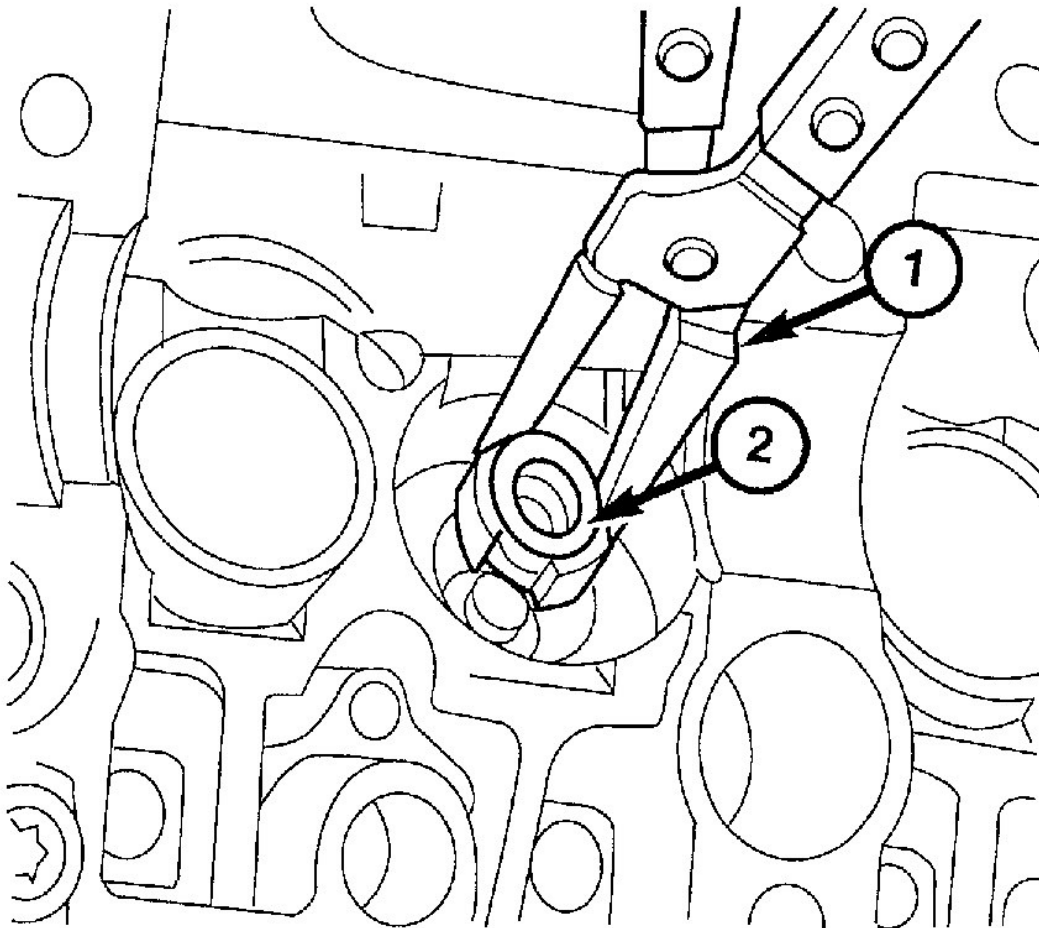


G01860587

Fig. 91: Removing Collets, Spring Retainer, Spring & Spring Seat
Courtesy of DAIMLERCHRYSLER CORP.

NOTE: Assemble the valves completely before removing the air pressure from the

cylinder.



G01860588

Fig. 92: Removing Valve Stem Seal
Courtesy of DAIMLERCHRYSLER CORP.

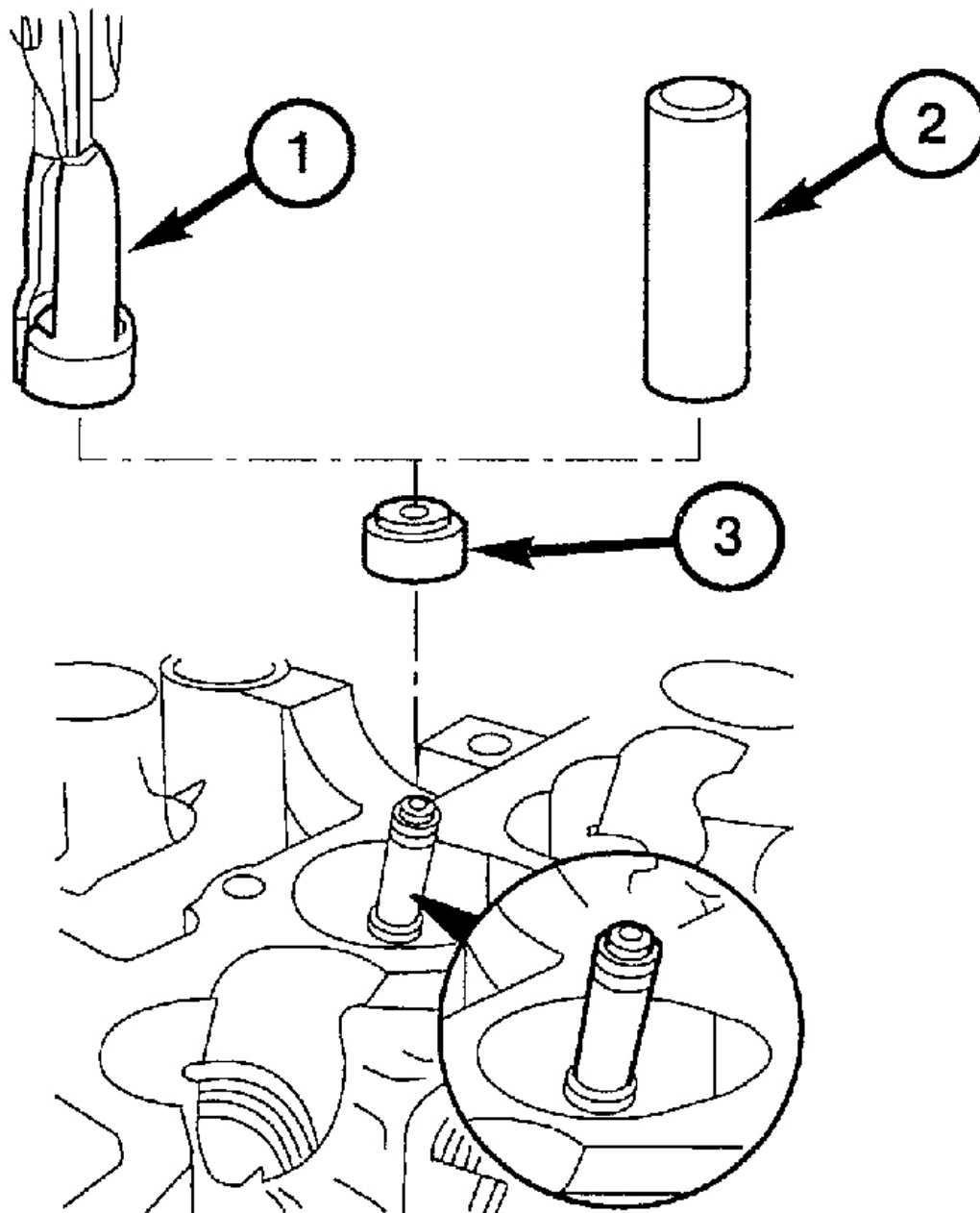
10. Remove the valve stem seal (2) using the seal pliers (1).
11. Repeat these steps for each cylinder required.
12. Inspect all of the valve stems. Damaged valves must be replaced.

INSTALLATION

NOTE: Valves with nicked or burred stems must be replaced.

NOTE: **The tools used in these valve stem seal procedures are part of Special Tool 9106 Valve Assembly Tool Case.**

1. Lubricate the new seal (3) with clean engine oil.
2. Install the protective sleeve (2) over the valve stem.
3. Press the new seal over the sleeve on to the valve stem using the seal pliers (1).

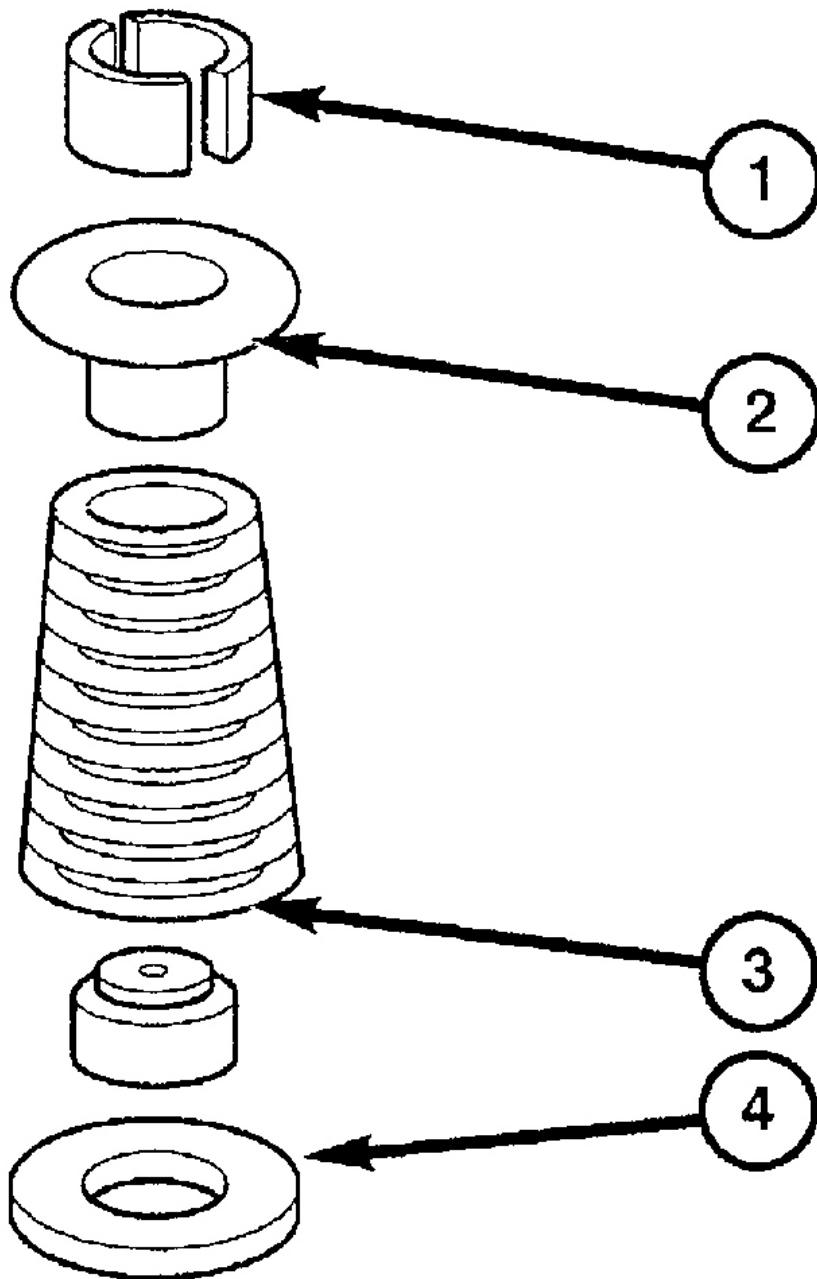


G01860589

Fig. 93: Lubricating New Seal, Installing Protective Sleeve & Pressing New Seal
Courtesy of DAIMLERCHRYSLER CORP.

4. Remove the protective sleeve (2).

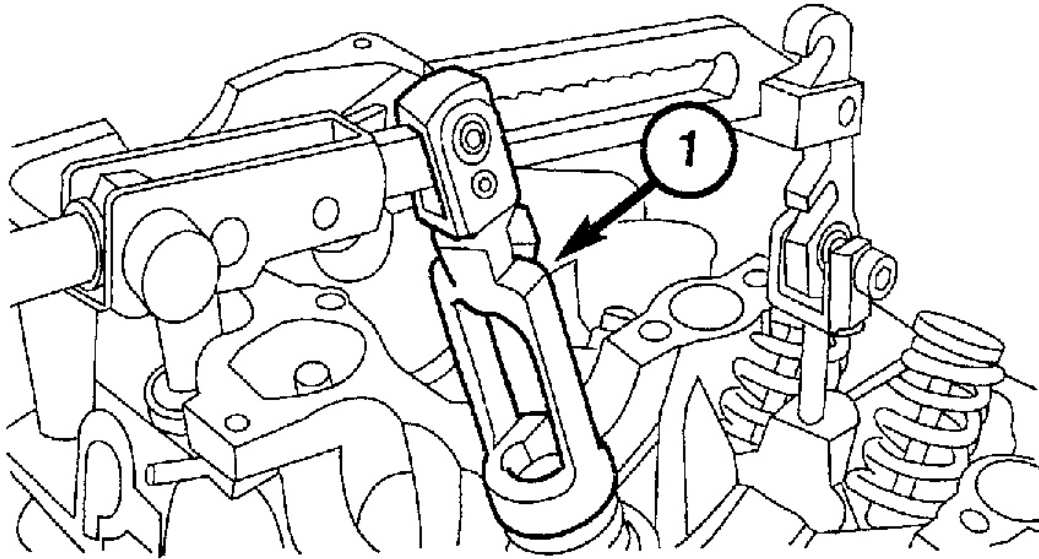
5. Install the valve spring seat (4), valve spring (3), and the valve spring retainer (2).



G01860590

Fig. 94: Installing Valve Spring Seat, Valve Spring & Valve Spring Retainer
Courtesy of DAIMLERCHRYSLER CORP.

6. Compress the valve spring using the assembly tool (1).



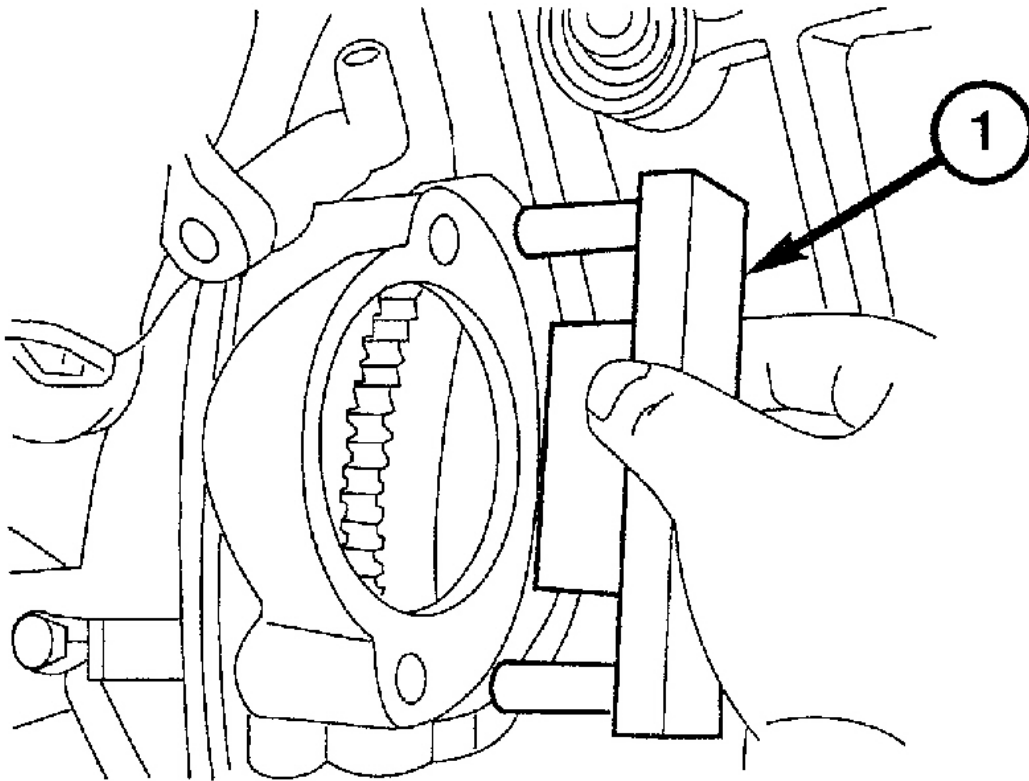
G01860591

Fig. 95: Compressing Valve Spring
Courtesy of DAIMLERCHRYSLER CORP.

7. Install the valve stem collets with the valve spring compressed.
8. Release the valve spring slowly.
9. Be sure that the collets are seated in the valve spring retainer.
10. Remove the assembly tool.

NOTE: Perform this procedure on one cylinder at a time.

11. Repeat the procedure for each valve that is to be serviced.
12. Remove Special Tool 9102 Flywheel Locking Tool (1).



G01860592

Fig. 96: Removing Special Tool 9102
Courtesy of DAIMLERCHRYSLER CORP.

13. Install the starter. See STARTERS article.
14. Install the camshafts. See CAMSHAFT.

INTAKE/EXHAUST VALVES AND SEALS

DESCRIPTION

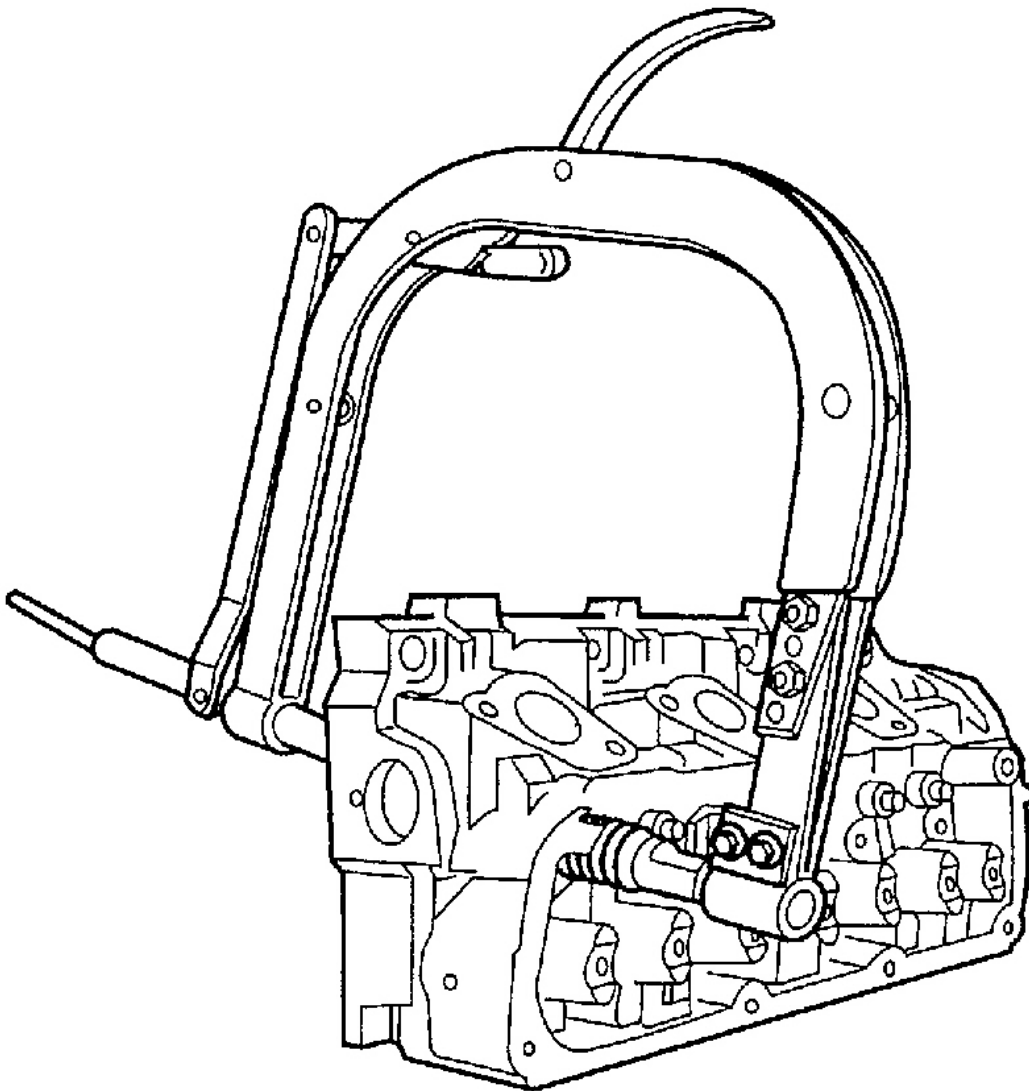
Two 1.42-in. (36-mm) intake valves and a single 1.61-in. (41-mm) exhaust valve per cylinder are operated by a double-width roller chain-driven camshaft per bank using roller rocker arms. Lightweight hydraulic adjusters in the rocker arms at the valves take up valve clearance for quiet operation. For minimum weight and maximum rigidity the compact rocker arms are pressure-cast aluminum. They pivot through roller bearings on rocker shafts bolted to the heads. Using computer-aided measurement and calculation techniques, valve dynamics are equivalent to that achieved by direct valve actuation through in-line tappets, but with far less friction.

OPERATION

The intake valve allows the air/fuel mixture to enter the combustion chamber. The exhaust valve allows the burned air/fuel mixture to exit the combustion chamber. Also, the intake and exhaust valves seal the combustion chamber during the compression and power strokes.

REMOVAL

1. Remove the cylinder head and place on a suitable work bench. See **CYLINDER HEAD**.
2. Using Special Tool C-3422-CF Valve Spring Compressor, compress the valve spring.

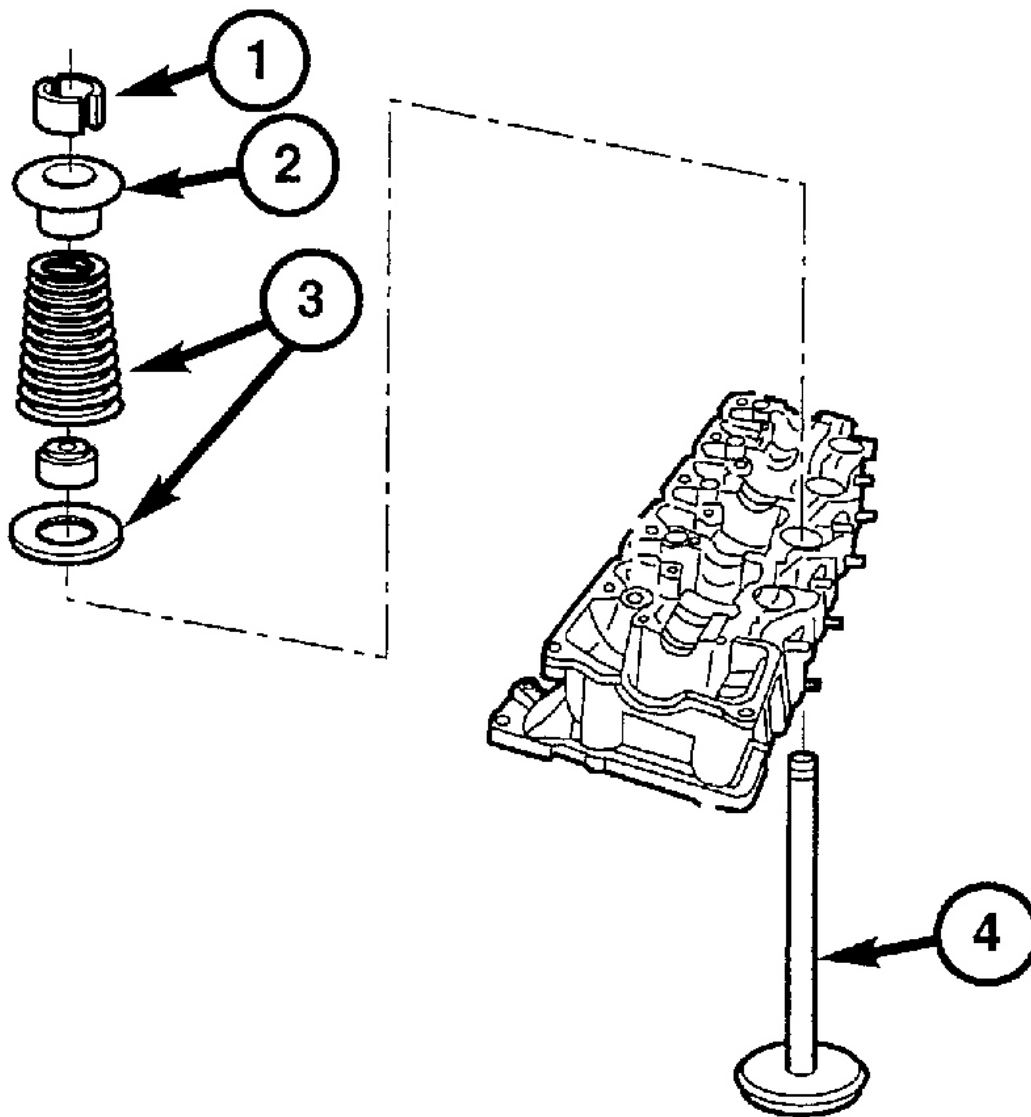


G01860593

Fig. 97: Compressing Valve Spring

Courtesy of DAIMLERCHRYSLER CORP.

3. Remove the collets (1). Release the valve spring compressor and remove the valve retainer (2) and the valve spring (3) with spacer.

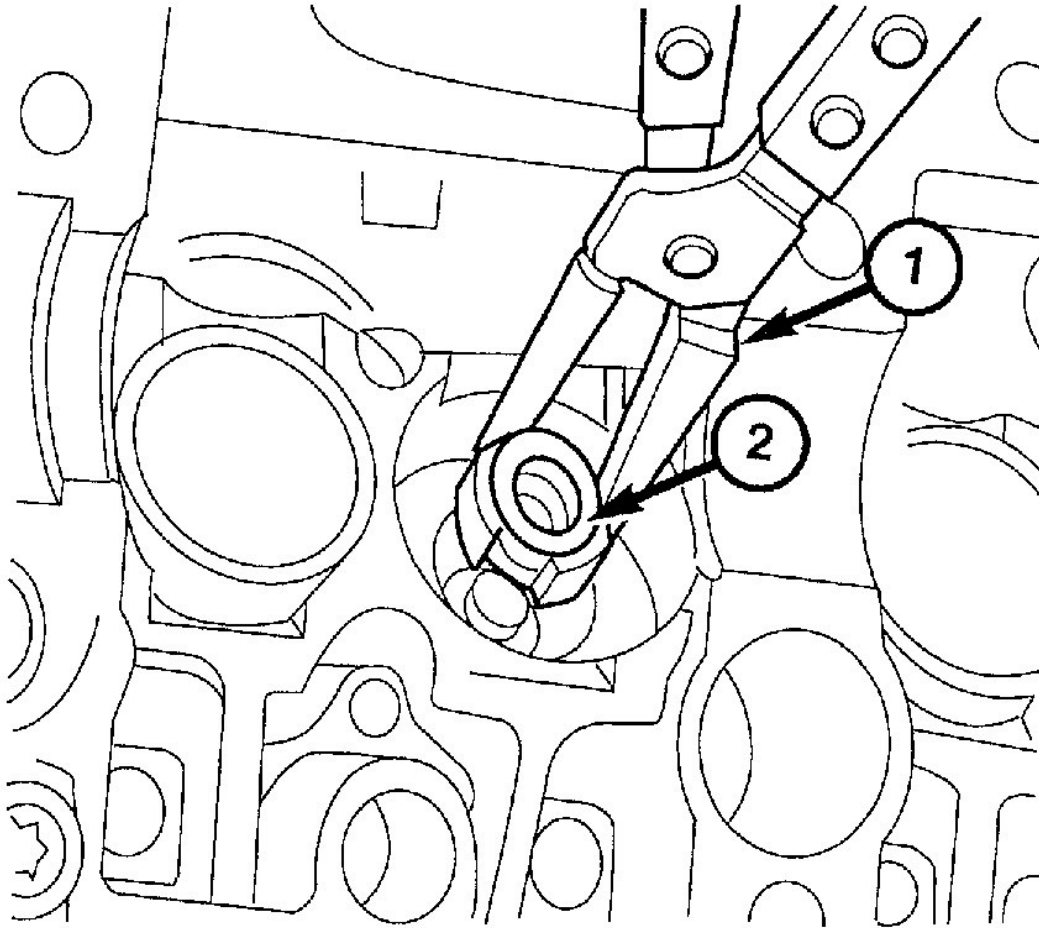


G01860594

Fig. 98: Removing Collets, Releasing Valve Spring Compressor & Removing Valve Retainer & Valve Spring With Spacer

Courtesy of DAIMLERCHRYSLER CORP.

4. Using Special Tool 9106 (1) Valve Assembly Tool Case, remove the valve stem seal (2).



G01860595

Fig. 99: Removing Valve Stem Seal
Courtesy of DAIMLERCHRYSLER CORP.

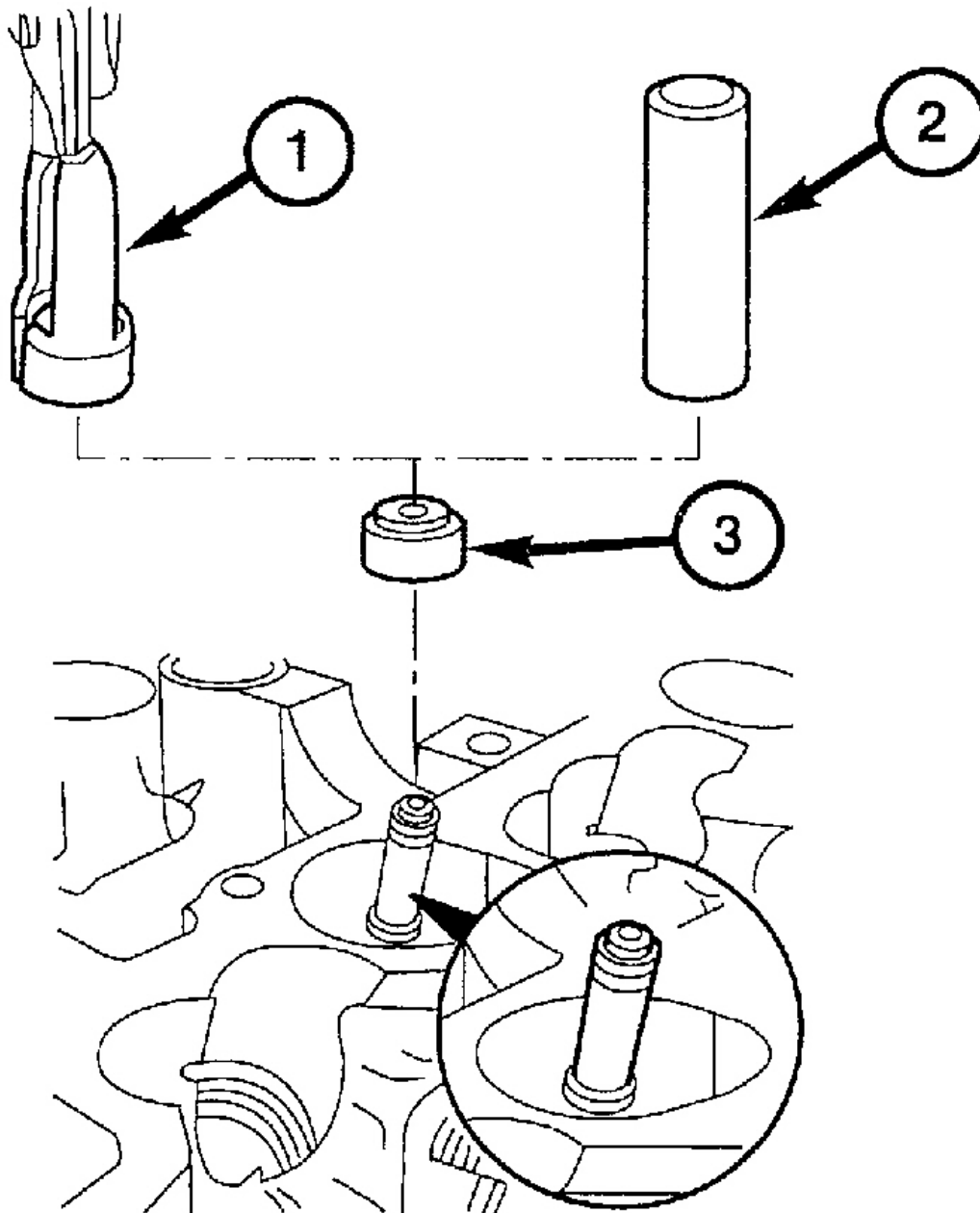
5. Remove the valve (4) from the cylinder head. See **Fig. 98**.
6. Inspect the valve face and the stem for any wear or nicks. Replace damaged valves as required.

CLEANING

Clean all valves thoroughly and discard burned, warped and cracked valves.

INSTALLATION

1. Install the valve into the cylinder head.
2. Install the protective sleeve (2) over valve stem.

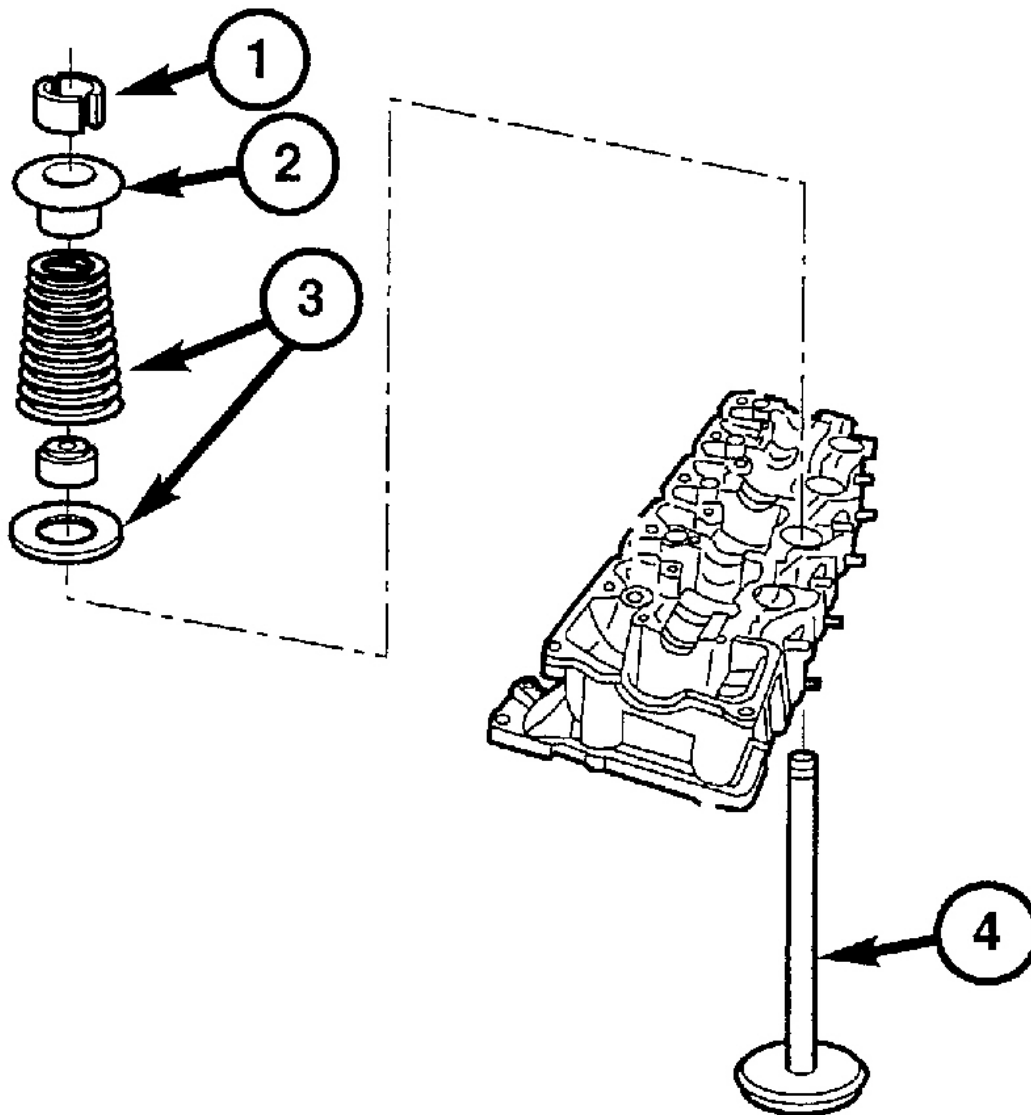


G01860596

Fig. 100: Pressing Valve Stem Seal & Installing Valve Stem

Courtesy of DAIMLERCHRYSLER CORP.

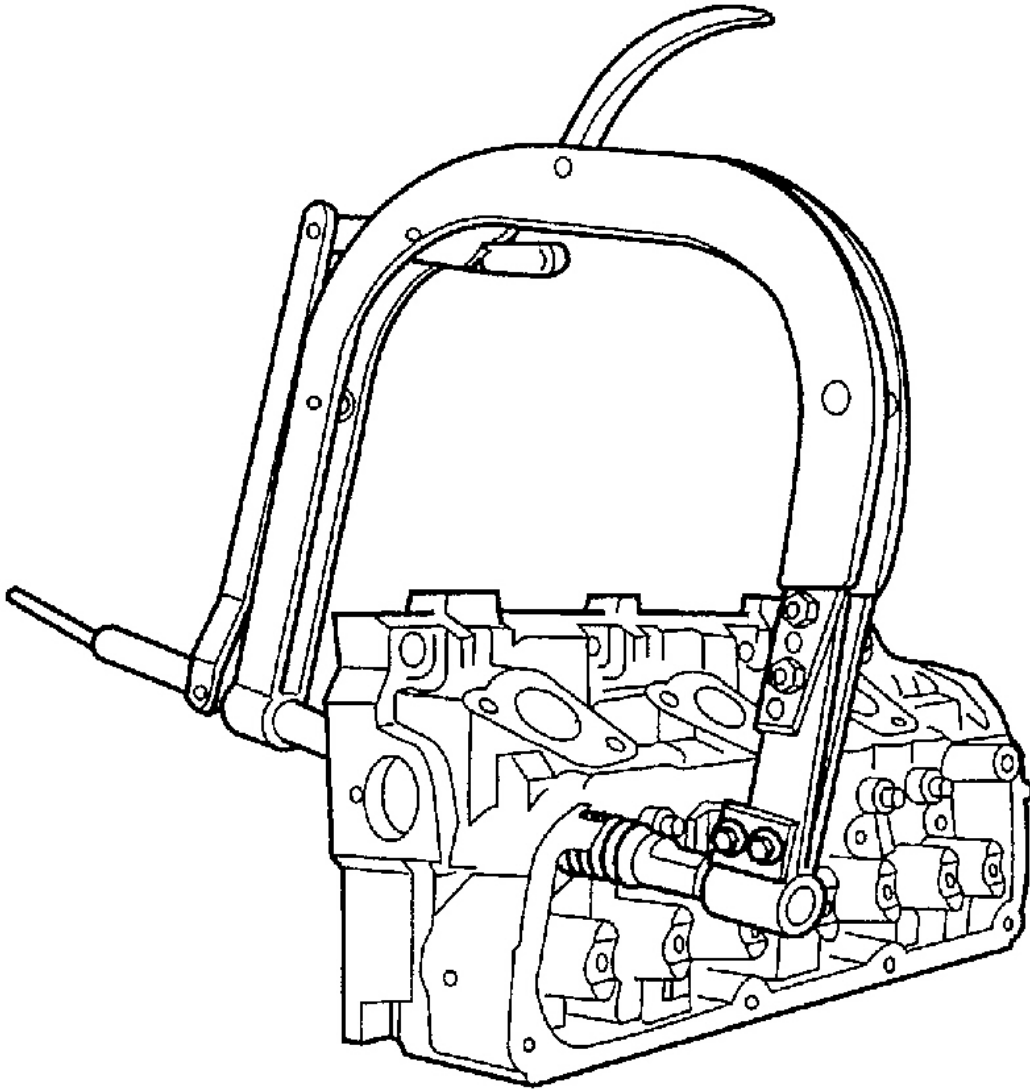
3. Lubricate the valve stem seal before installing.
4. Using Special Tool 9106 (1) Valve Assembly Tool Case, press the valve stem seal (3) onto valve stem.
5. Remove the protective sleeve (2).
6. Install the valve spring spacer, the spring (3), and the valve spring retainer (2), over the valve stem (4).



G01860597

Fig. 101: Installing Valve Spring Spacer, Spring & Valve Spring Retainer Over Valve Stem
Courtesy of DAIMLERCHRYSLER CORP.

7. Using Special Tool C-3422-CF Valve Spring Compressor, compress the valve spring and install the collets (1).



G01860598

Fig. 102: Installing Collets

Courtesy of DAIMLERCHRYSLER CORP.

8. Repeat the process for each valve.
9. Install the cylinder head. See **CYLINDER HEAD**.

VALVE SPRINGS

DESCRIPTION

Valve springs are conical to reduce spring and retainer weight, and the exhaust valve heads are sodium filled to keep them cool for long life.

OPERATION

The valve spring returns the valve against its seat for a positive seal of the combustion chamber.

ENGINE BLOCK

DESCRIPTION

A high-pressure die-cast aluminum alloy block uses cast-in-place cylinder bore liners made of a proprietary "Silitec" material for wear resistance. These aluminum-silicon alloy liners reduce block weight relative to cast iron liners while providing the necessary wear resistance. Block construction features side walls extended below the centerline of the crankshaft, cross-bolted main bearing caps, and a structural cast aluminum oil pan for additional rigidity.

CLEANING

Clean cylinder block thoroughly using a suitable cleaning solvent.

INSPECTION

ENGINE BLOCK

1. Clean cylinder block thoroughly and check all core hole plugs for evidence of leaking.
2. If new core plugs are to be installed. See **ENGINE CORE AND OIL GALLERY PLUGS**.
3. Examine block and cylinder bores for cracks or fractures.
4. Check block deck surfaces for flatness. Deck surface must be within service limit of 0.004 in. (0.1 mm).

CYLINDER BORE

NOTE: The cylinder bores should be measured at normal room temperature, 21°C (70° F).

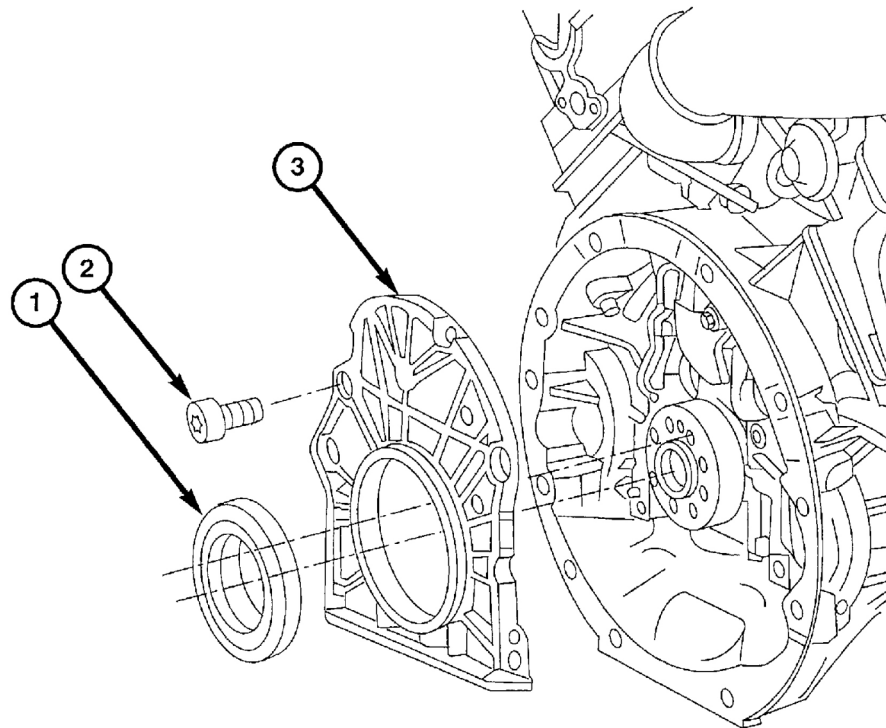
The cylinder walls should be checked for out-of-round and taper. See **SPECIFICATIONS**.

CRANKSHAFT OIL SEAL - REAR

REMOVAL

NOTE: The rear crankshaft oil seal cannot be replaced separately. The end cover and seal are assembled at the factory and must be replaced as a set.

1. Remove the flywheel. See FLEX PLATE/FLYWHEEL.
2. Remove the crankshaft end cover bolts (2).
3. Remove the end cover (3).
4. Discard the end cover (3) and the rear crankshaft oil seal (1)



1 - REAR CRANKSHAFT OIL SEAL
2 - BOLT
G01860599

3 - END COVER

Fig. 103: Removing Crankshaft Oil Seal
Courtesy of DAIMLERCHRYSLER CORP.

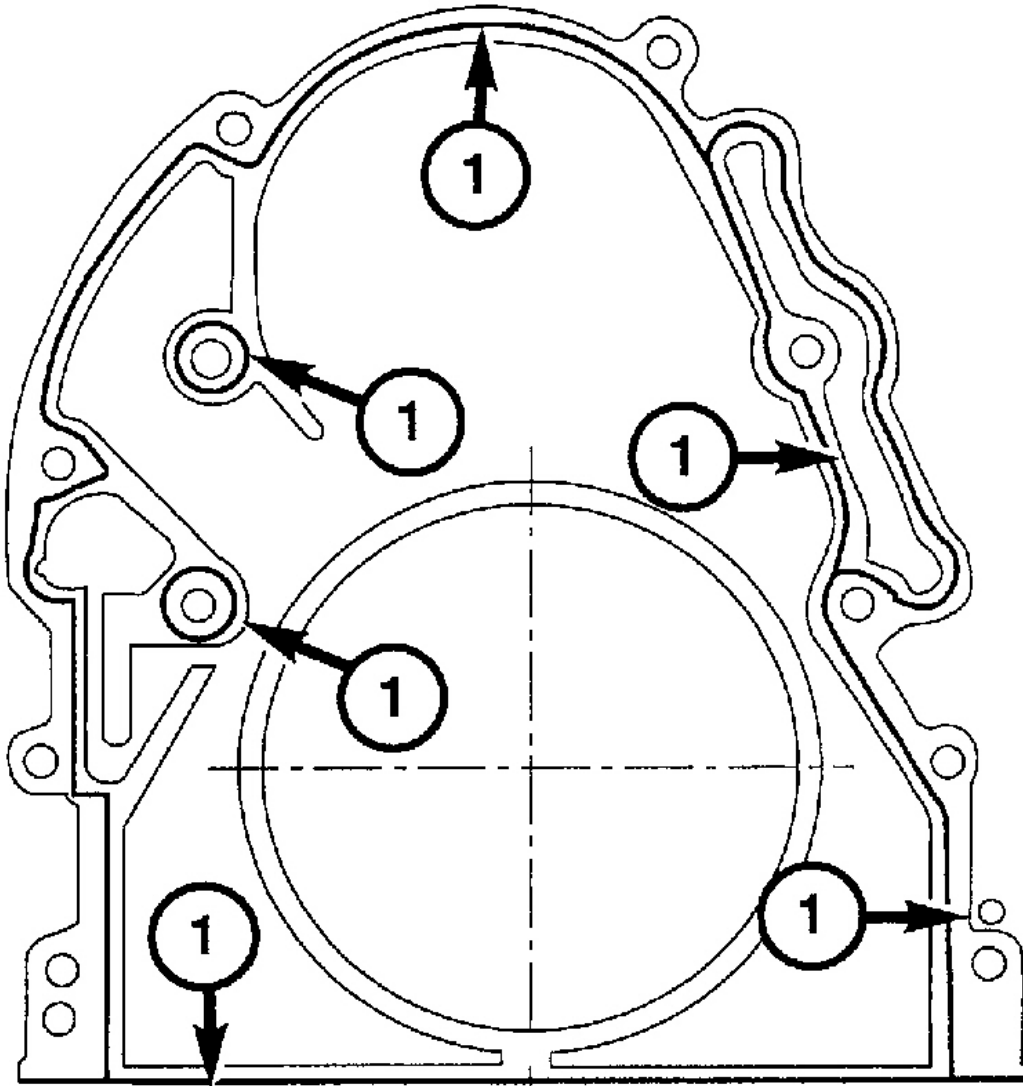
5. Clean the engine block and the oil pan gasket surfaces.

INSTALLATION

NOTE: The rear crankshaft oil seal cannot be replaced separately. The end cover and seal are assembled at the factory and must be replaced as a set.

NOTE: Parts requiring sealer must be assembled within ten minutes after applying sealer.

1. Apply a 1.5 mm to 2 mm bead of Loctite 5203 sealer only where shown (1) on the new end cover.



G01860600

Fig. 104: Applying Sealant

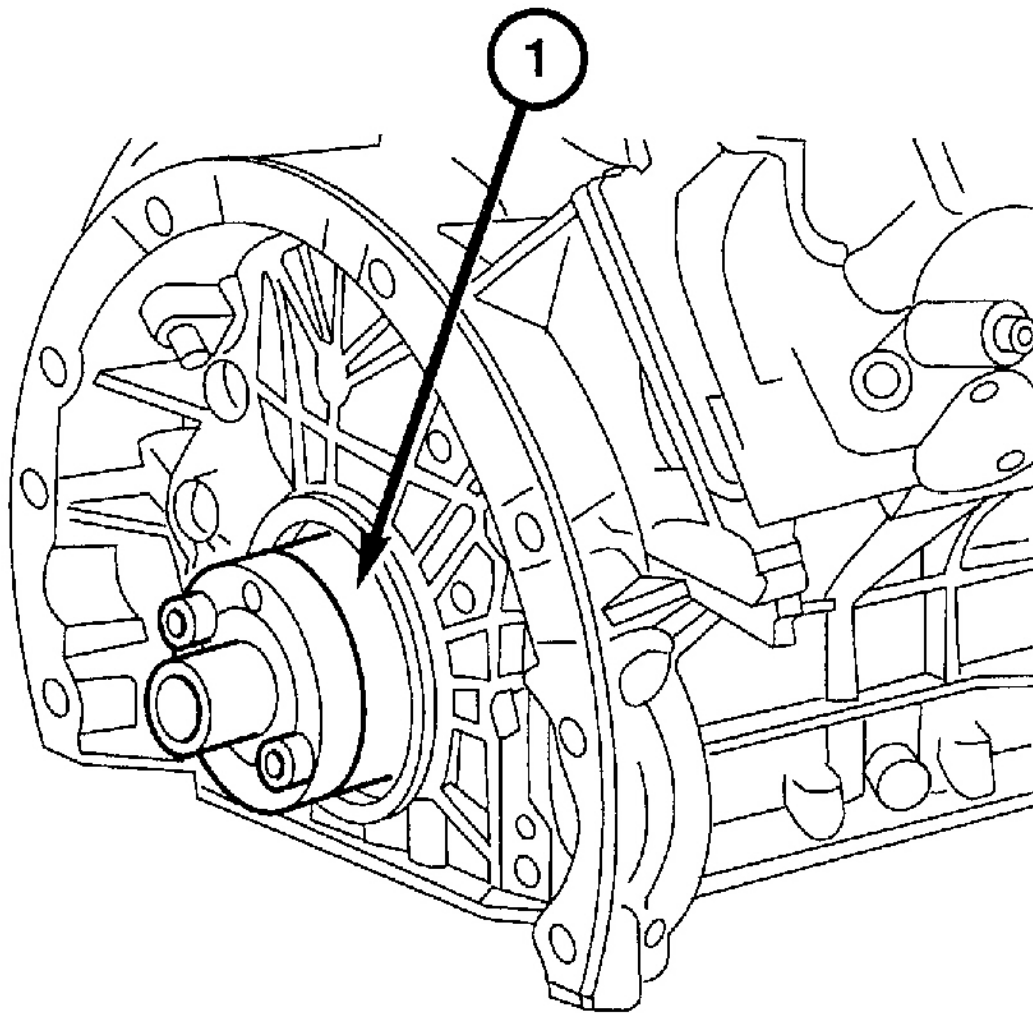
Courtesy of DAIMLERCHRYSLER CORP.

2. Install the new end cover (without seal installed) and the end cover retaining bolts. Tighten the bolts to 10 N.m (89 in. lbs.).

NOTE: Ensure the edge of the mounting hole around the entire circumference for

the rear crankshaft oil seal is clean and free of burrs.

- NOTE:** Ensure that the sealing lip of the rear crankshaft oil seal is not damaged or compressed.
- NOTE:** The circumference and the sealing lip of the rear crankshaft oil seal, as well as the mating contact surface **MUST** be free of oil and grease.
- NOTE:** The rear crankshaft oil seal must be positioned at right angles to the crankshaft to assure proper sealing.
- NOTE:** The distance between the edge of the end cover and the rear crankshaft oil seal must be approximately 1 mm. (.039 in.) around the entire circumference.



G01860601

Fig. 105: Installing Rear Crankshaft Oil Seal
Courtesy of DAIMLERCHRYSLER CORP.

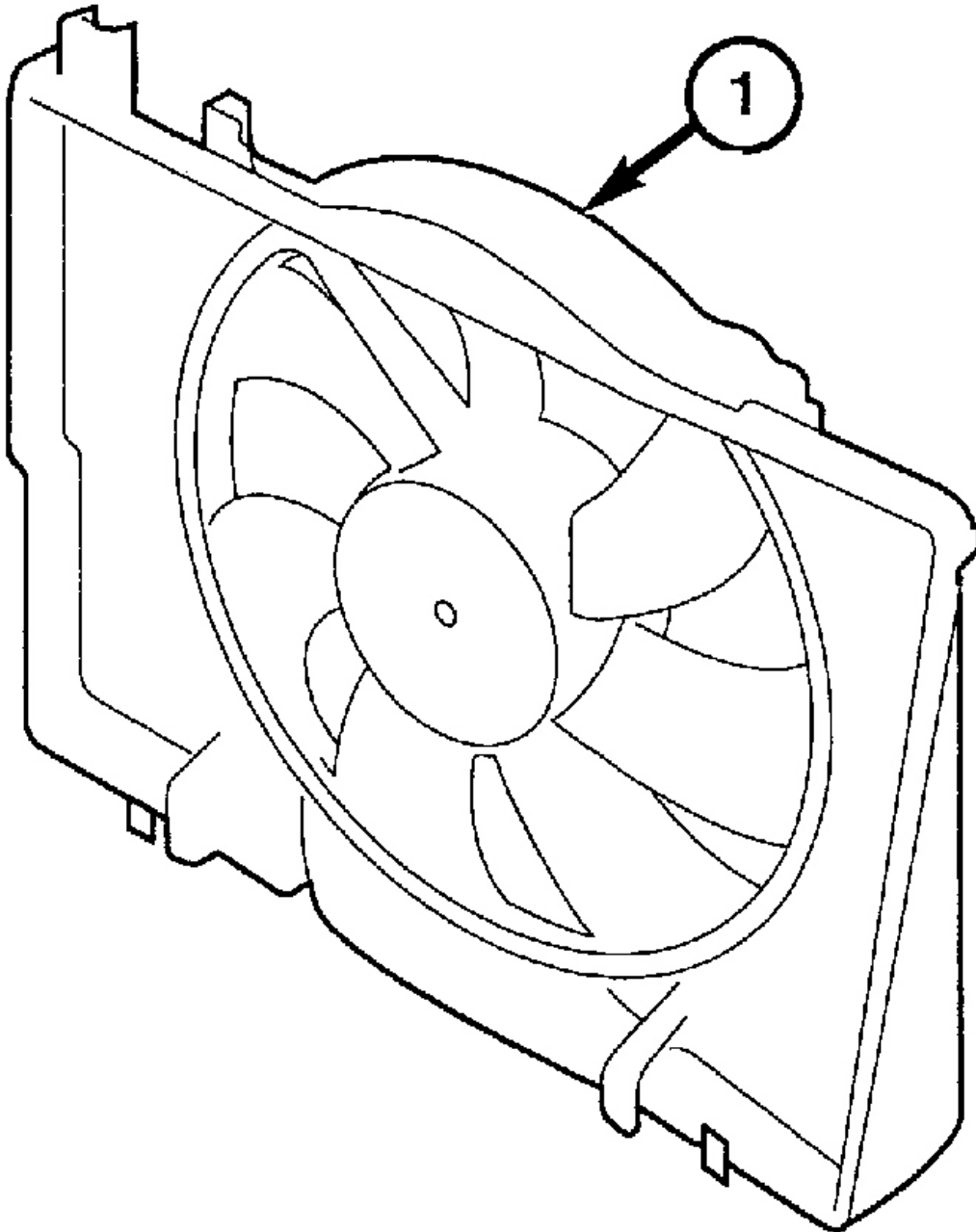
3. Using Special Tool 9100 Rear Seal Installer (1), install the rear crankshaft oil seal into the new end cover.
4. Remove Special Tool 9100 Rear Seal Installer.
5. Install the flywheel. See **FLEX PLATE/FLYWHEEL**.

CRANKSHAFT OIL SEAL - FRONT

REMOVAL

1. Disconnect the negative battery cable.

2. Remove the engine cooling fan and shroud. See COOLING SYSTEM (MECHANICAL) article.

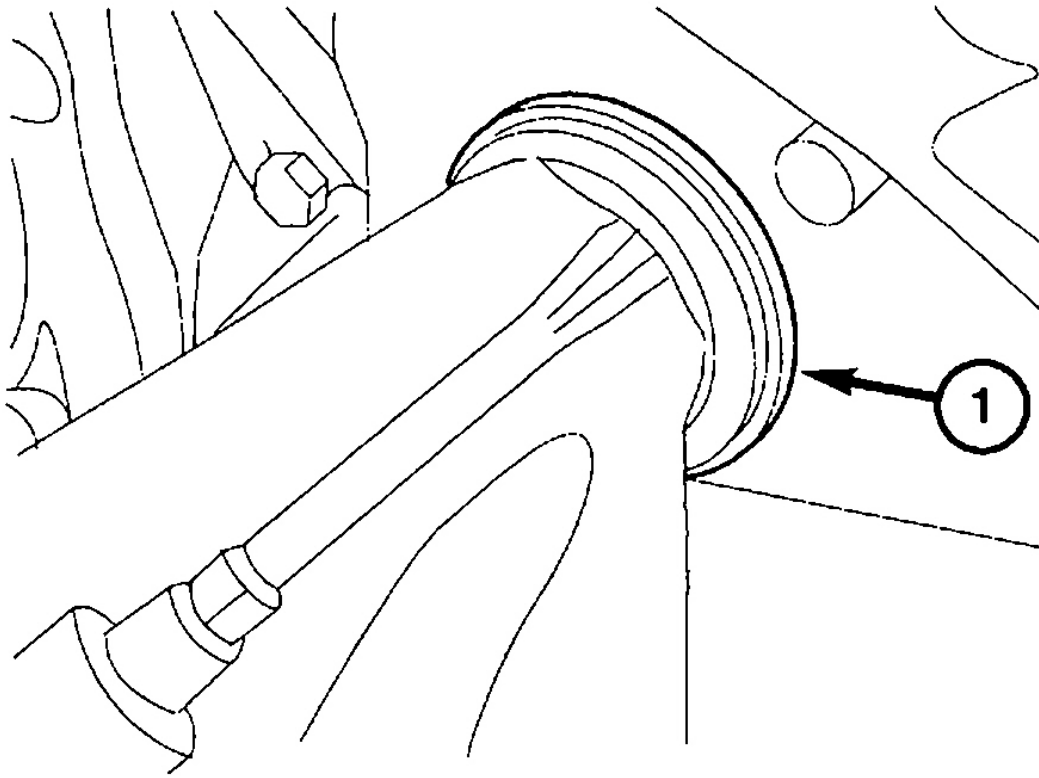


G01860602

Fig. 106: Removing Engine Cooling Fan & Shroud

Courtesy of DAIMLERCHRYSLER CORP.

3. Remove the accessory drive belt. See COOLING SYSTEM (MECHANICAL) .
4. Remove the vibration damper. See VIBRATION DAMPER.
5. Protect the crankshaft with a rag, then pry out the front crankshaft oil seal (1) with a suitable tool.



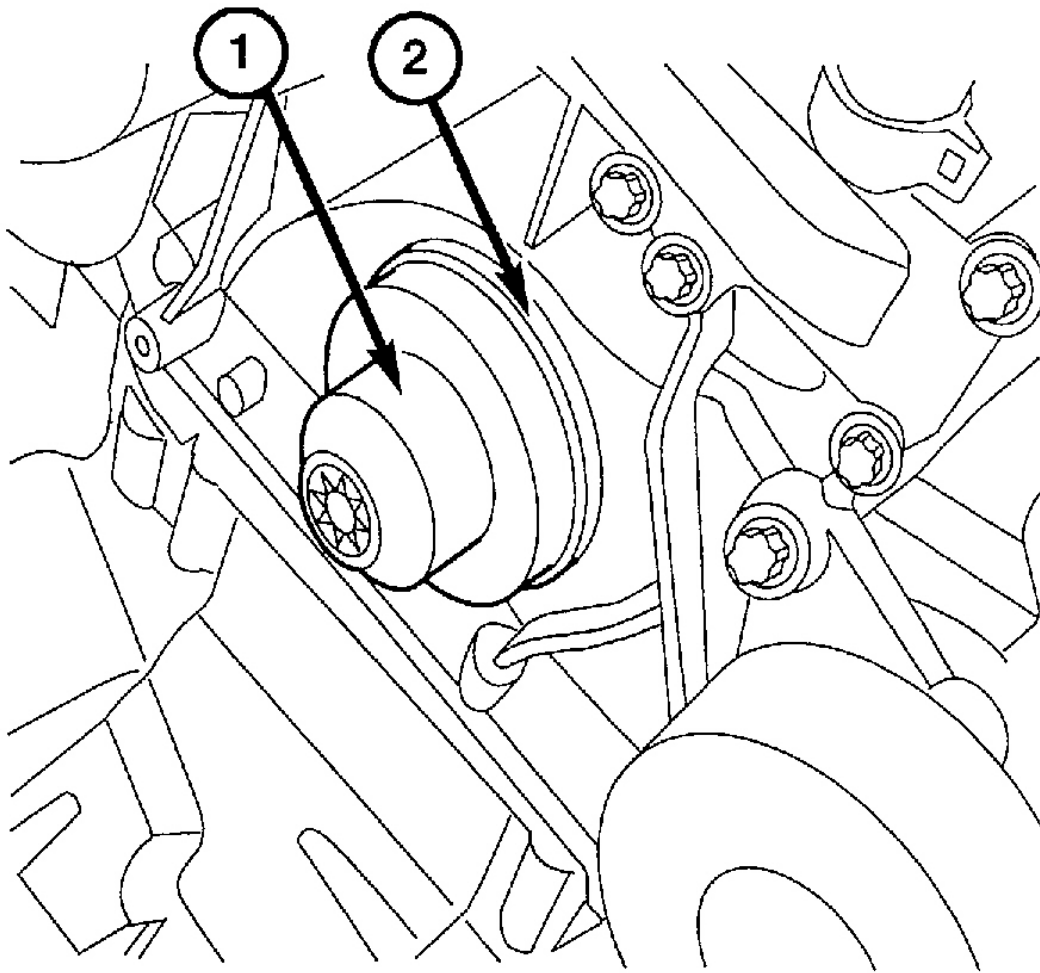
G01860603

Fig. 107: Locating Front Crankshaft Oil Seal
Courtesy of DAIMLERCHRYSLER CORP.

INSTALLATION

NOTE: The circumference and the sealing lip of the front crankshaft oil seal, as well as the mating contact surface **MUST** be free of oil and grease.

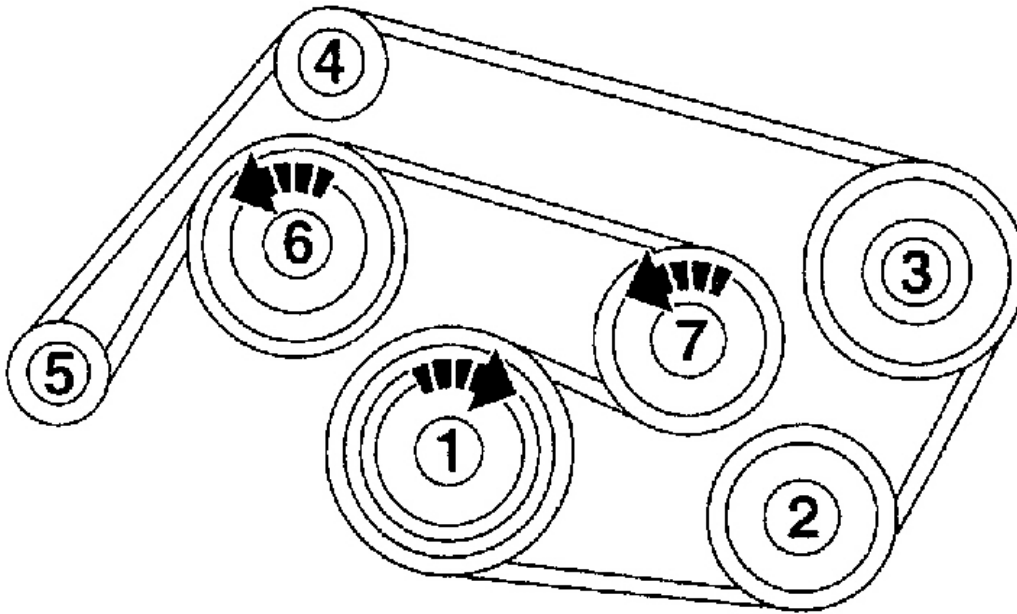
1. Remove any burrs from the seal's mounting surface.
2. Fit the front crankshaft oil seal onto the Special Tool 9103 Insertion Tool (2) as shown in illustration.



G01860604

Fig. 108: Installing Special Tool
Courtesy of DAIMLERCHRYSLER CORP.

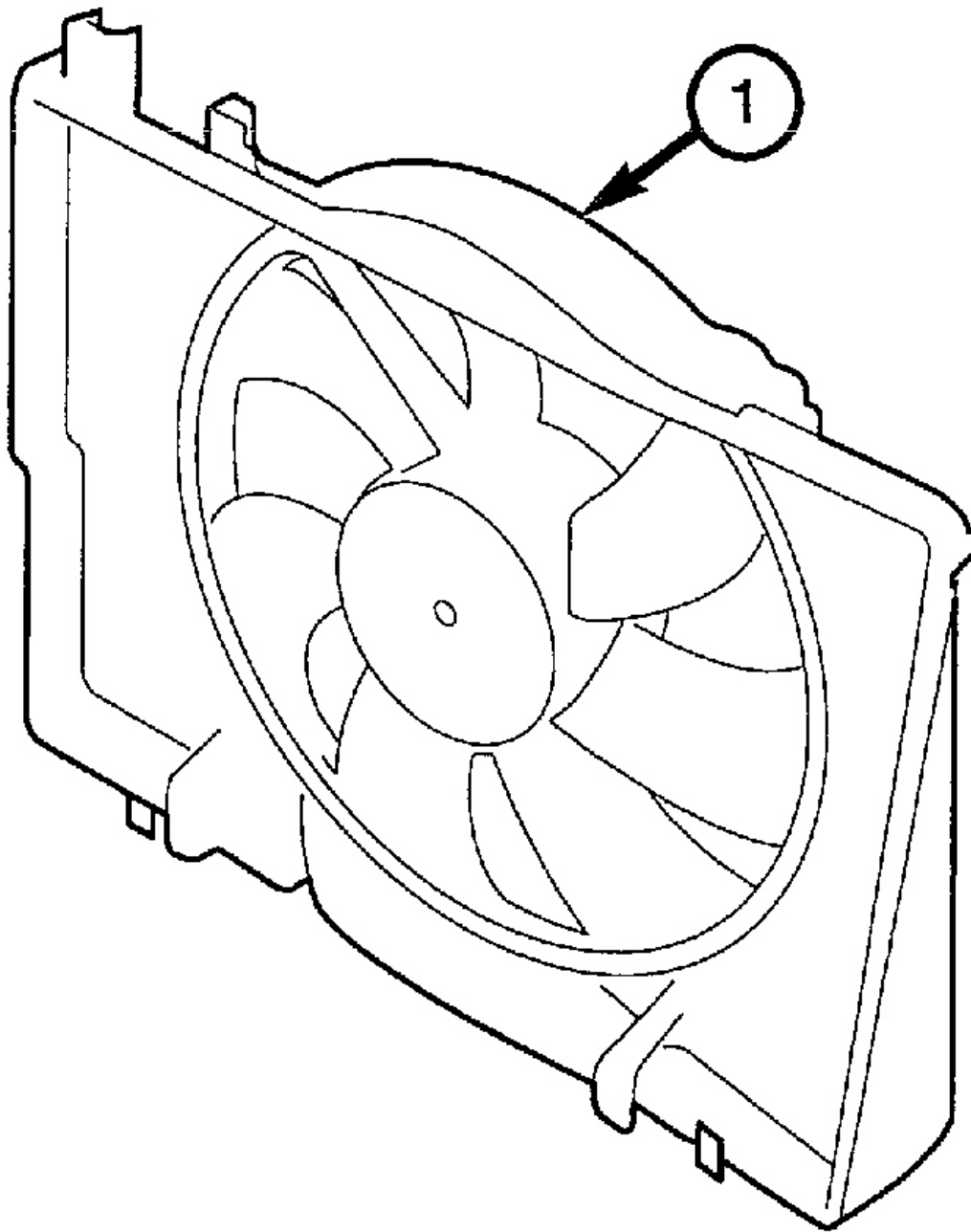
3. Align the slot of the tool with the crankshaft key.
4. Using a suitable tool, tap the insertion tool until the vibration damper bolt can be installed through the insertion tool.
5. Use the vibration damper bolt to push the seal into the timing chain cover until tight.
6. Remove the Special Tools.
7. Install the vibration damper. See **VIBRATION DAMPER**.
8. Install the accessory drive belt.



G01860605

Fig. 109: Installing Accessory Drive Belt
Courtesy of DAIMLERCHRYSLER CORP.

9. Install the engine cooling fan and shroud (1). See **COOLING SYSTEM (MECHANICAL)** article.



G01860606

Fig. 110: Installing Cooling Fan & Shroud
Courtesy of DAIMLERCHRYSLER CORP.

10. Connect the negative battery cable.

CONNECTING ROD BEARINGS

DESCRIPTION

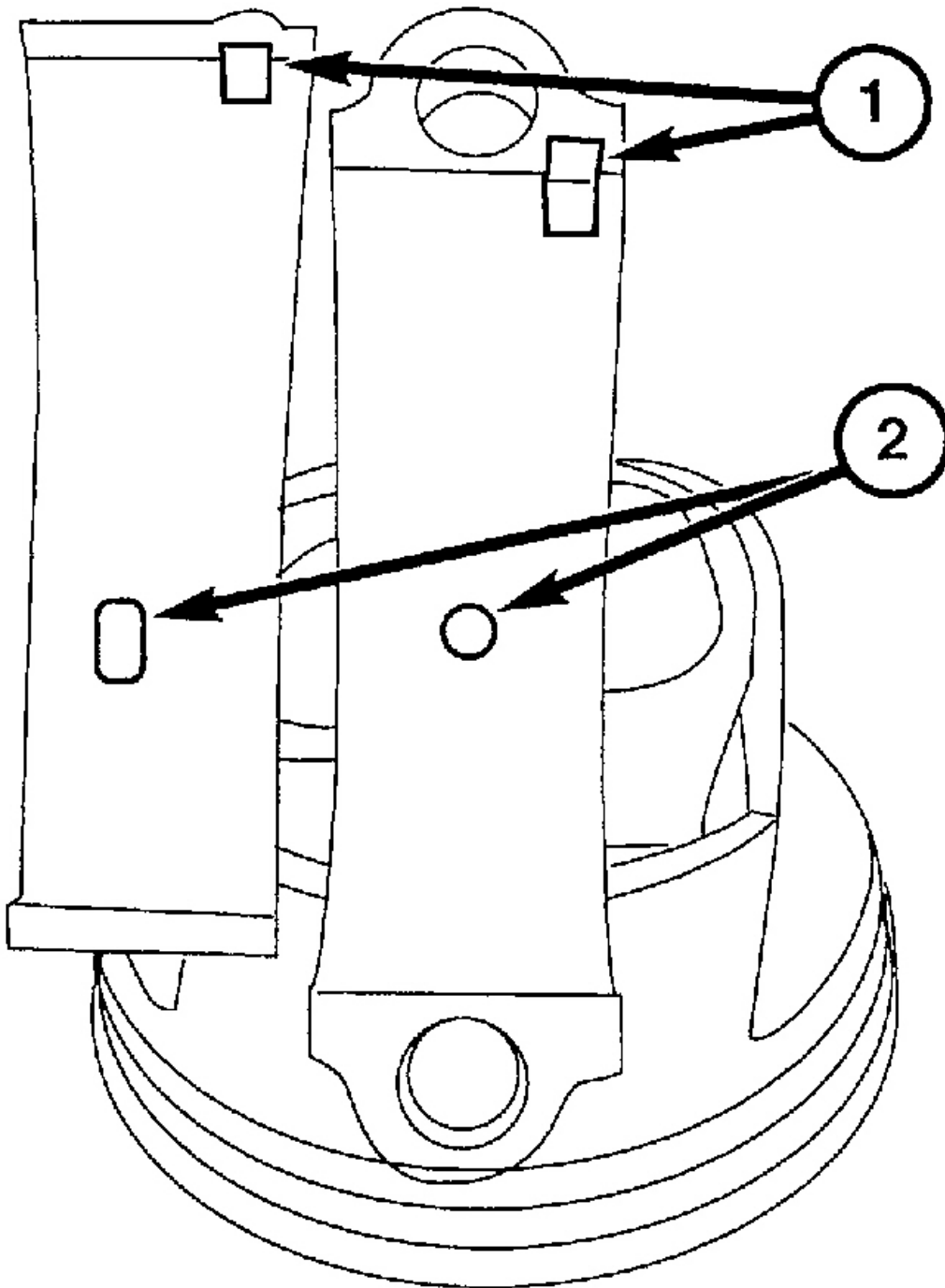
Connecting rods are forged in one piece from steel, and cracked rather than machined along the split line, providing a perfect fit for the two halves and reducing weight by 20 percent compared to a fully machined rod and cap while also greatly reducing machining. The rods are drilled longitudinally to deliver oil under pressure to the wrist pins, minimizing wear for long life. Thirty-degree offset crank pins on the crankshaft provide even, 120-degree, firing intervals for smooth operation. The crankshaft with these split pins has ample strength without adding material between the pins, keeping the engine compact and reducing weight.

STANDARD PROCEDURE - CONNECTING RODS AND BEARINGS

CONNECTING ROD BEARINGS

The bearing caps are not interchangeable and should be marked at removal to insure correct assembly.

The bearing shells must be installed with the tangs (1) inserted into the machined grooves in the rods and caps. Install cap with the tangs on the same side as the rod.



G01860607

Fig. 111: Installing Bearing Shells

Courtesy of DAIMLERCHRYSLER CORP.

Fit all rods on one bank until complete.

Limits of taper or out-of-round on any crankshaft journals should be held to 0.0006 in. (0.015 mm). Bearings are available in standard, 0.001 in. (0.025 mm), and 0.010 in. (0.254 mm) undersizes. **Install the bearings in pairs. Do not use a new bearing half with an old bearing half. Do not file the rods or bearing caps.**

For measuring main bearing clearance and connecting rod bearing clearance, use plastigage for bearing clearance specifications. See **SPECIFICATIONS**.

CONNECTING ROD BOLTS

NOTE: The connecting rod bolts should be examined before reuse. If the threads are necked down, the bolts must be replaced.

1. Examine connecting rod bolts for stretching. Stretching can be checked by holding a scale or straight edge (2) against the threads. If all the threads do not contact the scale (1) the bolt must be replaced.
2. Tighten the connecting rod bolts to specifications.

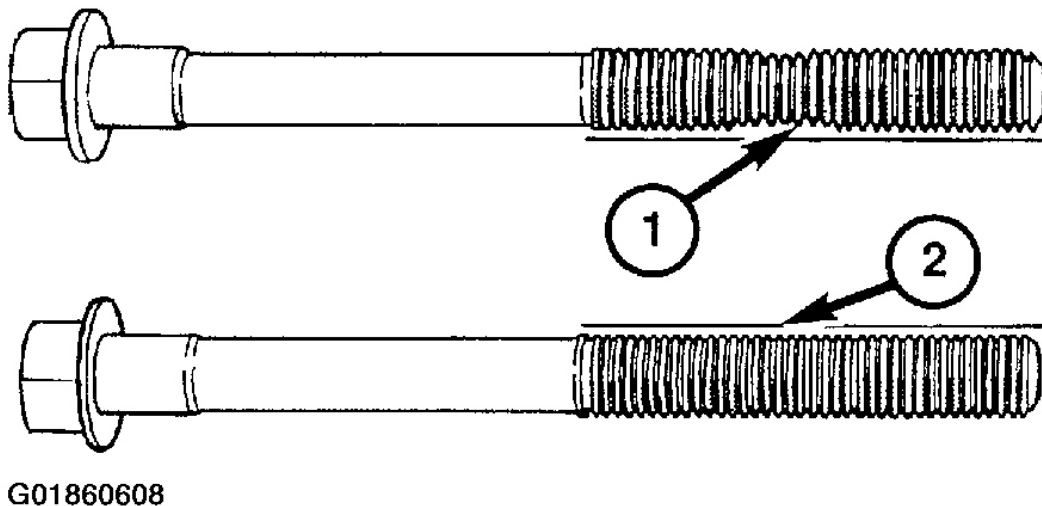


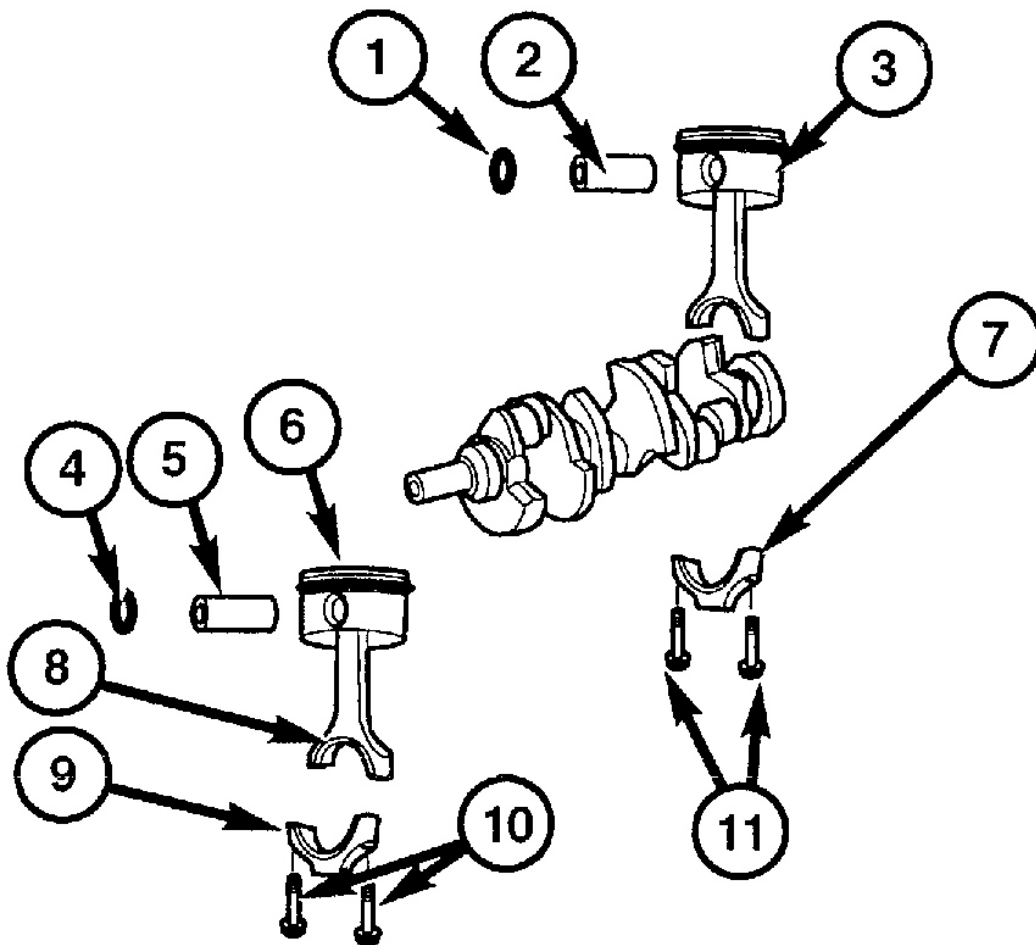
Fig. 112: Examining Connecting Rod Bolts
Courtesy of DAIMLERCHRYSLER CORP.

PISTON AND CONNECTING ROD

DESCRIPTION

Flat-topped aluminum pistons (3 and 6) have machined pockets for valve clearance and asymmetrical skirts for

low-temperature noise control. The pistons are formed from a special aluminum alloy to cope with the high temperatures created by dual ignition. In addition, the upper portions are hard anodized to protect the top ring. For optimal wear protection, the piston skirts receive an iron coating. Three, low-tension piston rings provide compression control with low oil consumption. Forged steel connecting rods (8) and crankshaft provide requisite strength with light weight. Connecting rods are forged in one piece from steel, and cracked rather than machined along the split line, providing a perfect fit for the two halves and reducing weight by 20 percent compared to a fully machined rod and cap while also greatly reducing machining. The rods are drilled longitudinally to deliver oil under pressure to the wrist pins (2 and 5), minimizing wear for long life.



G01860609

Fig. 113: Identifying Piston & Connecting Rod Components
 Courtesy of DAIMLERCHRYSLER CORP.

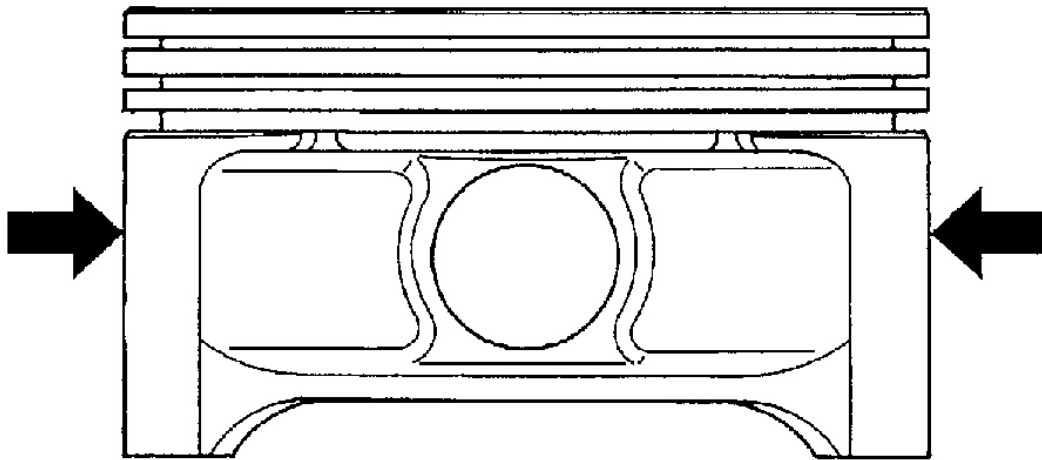
STANDARD PROCEDURE

PISTON FITTING

All pistons are machined to the same weight in grams, to maintain piston balance.

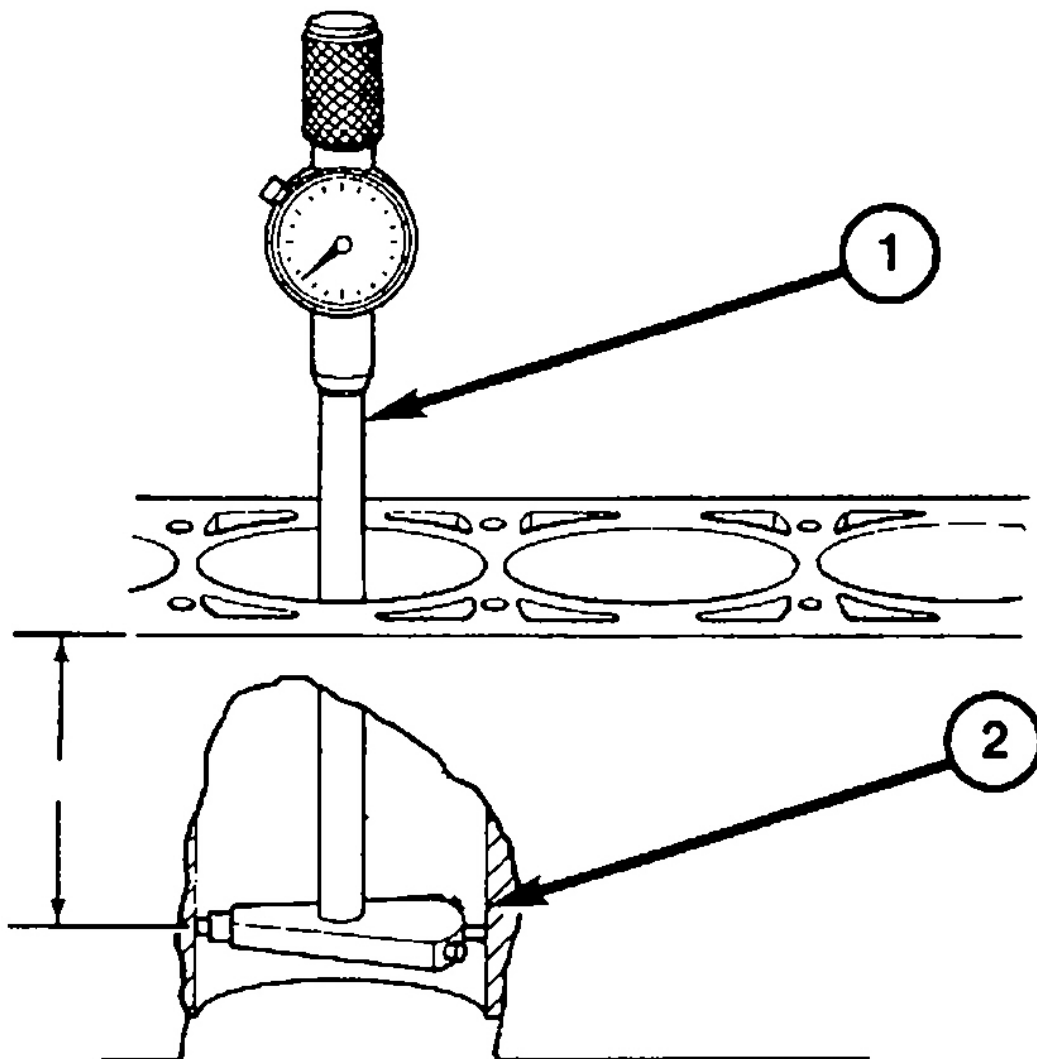
NOTE: **Pistons and cylinder bores should be measured at normal room temperature, 70°F (21°C).**

The piston and cylinder walls must be clean and dry. Piston diameter should be measured 90 degrees to piston pin axis. Cylinder bores should be measured halfway down the cylinder bore (2) and transverse to the engine crankshaft center line.



G01860610

Fig. 114: Identifying Piston
Courtesy of DAIMLERCHRYSLER CORP.

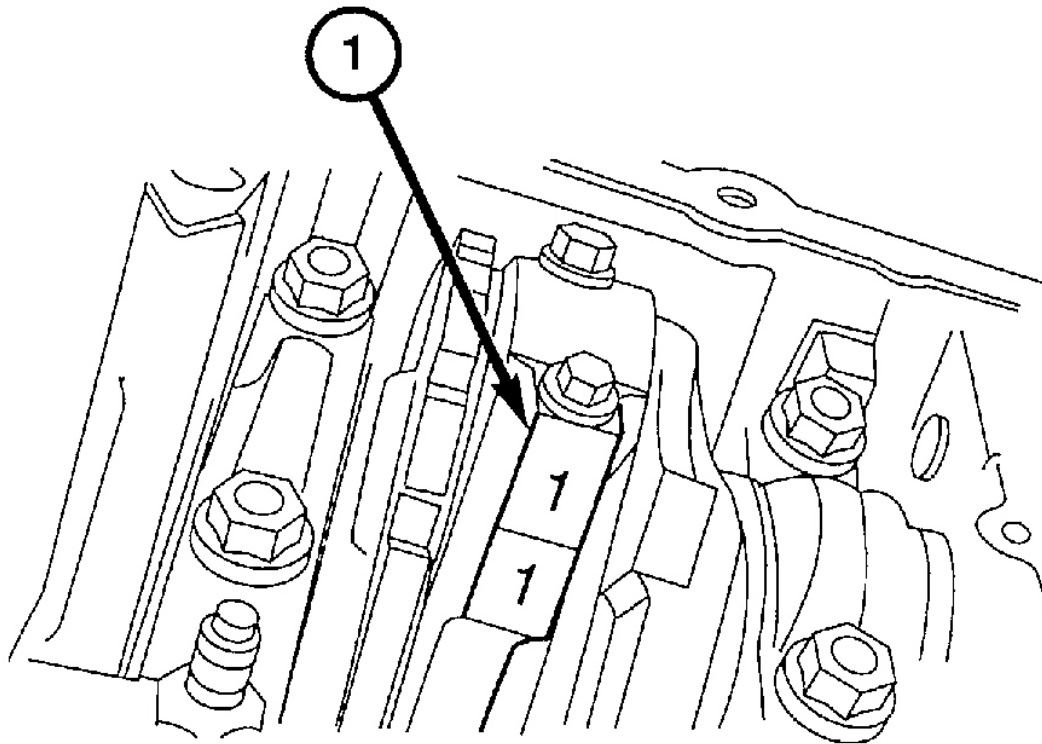


G01860611

Fig. 115: Measuring Piston Diameter
Courtesy of DAIMLERCHRYSLER CORP.

REMOVAL

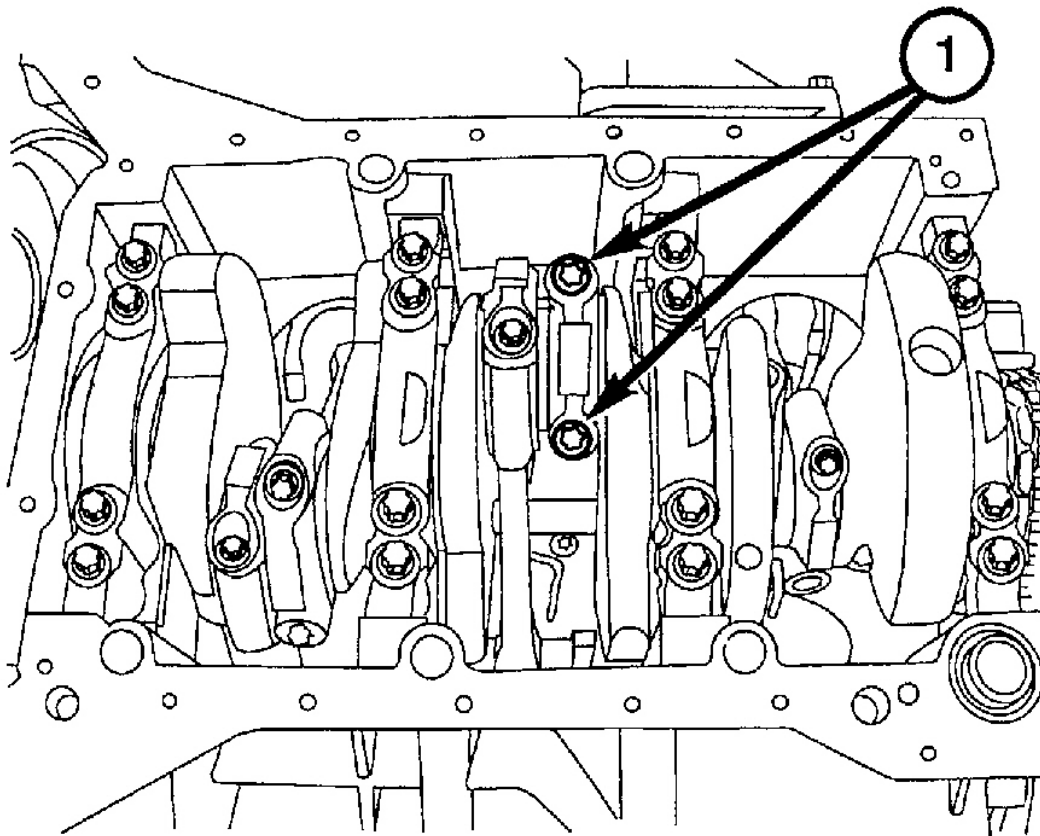
1. Remove the timing chain. See **TIMING CHAIN**.
2. Mark the connecting rods and rod caps (1) for reassembly.



G01860612

Fig. 116: Marking Connecting Rods & Caps
Courtesy of DAIMLERCHRYSLER CORP.

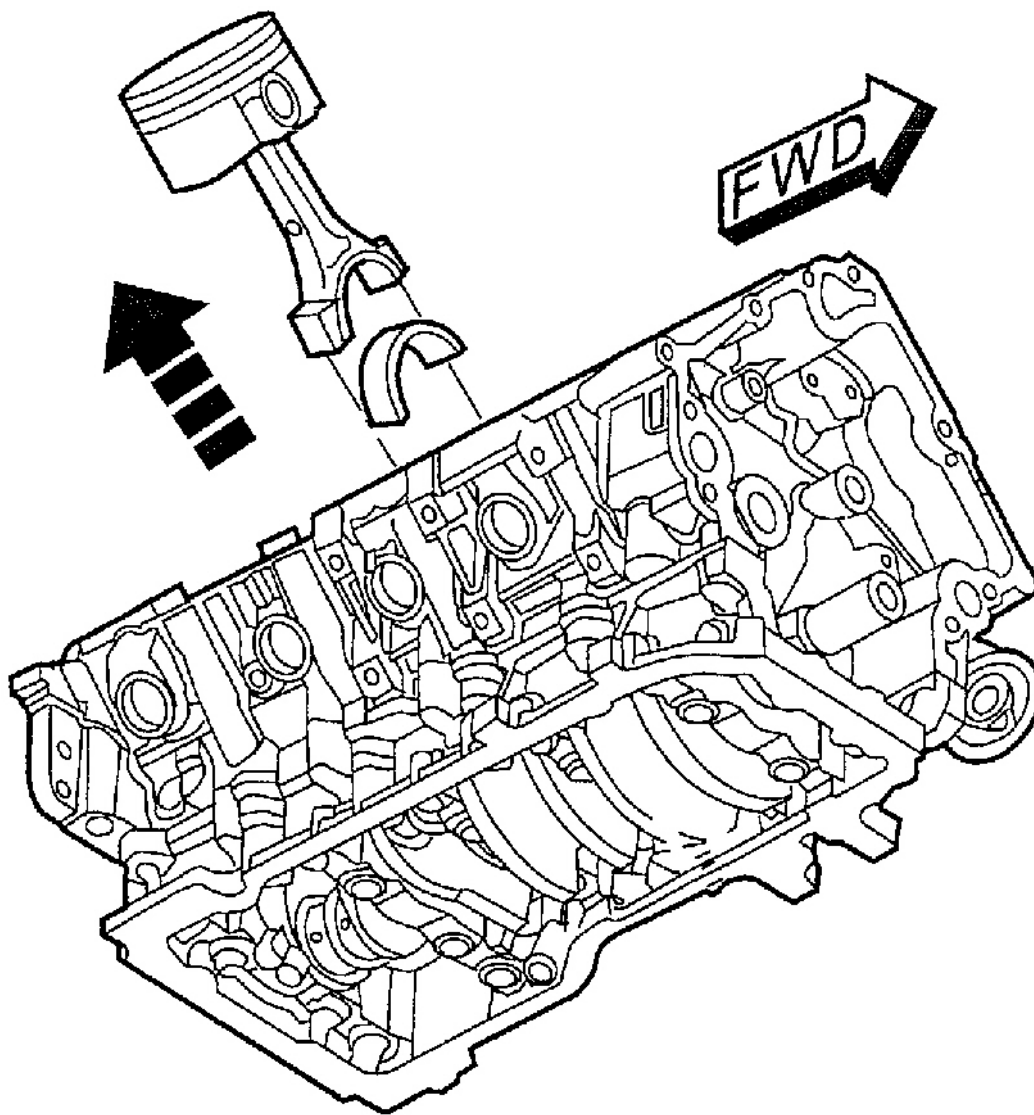
3. Mark the pistons facing direction if arrows are not visible.
4. Remove the connecting rod bolts (1) and the connecting rod caps.



G01860613

Fig. 117: Removing Connecting Rod Bolts & Caps
Courtesy of DAIMLERCHRYSLER CORP.

5. Remove the pistons and connecting rods from top of the engine.

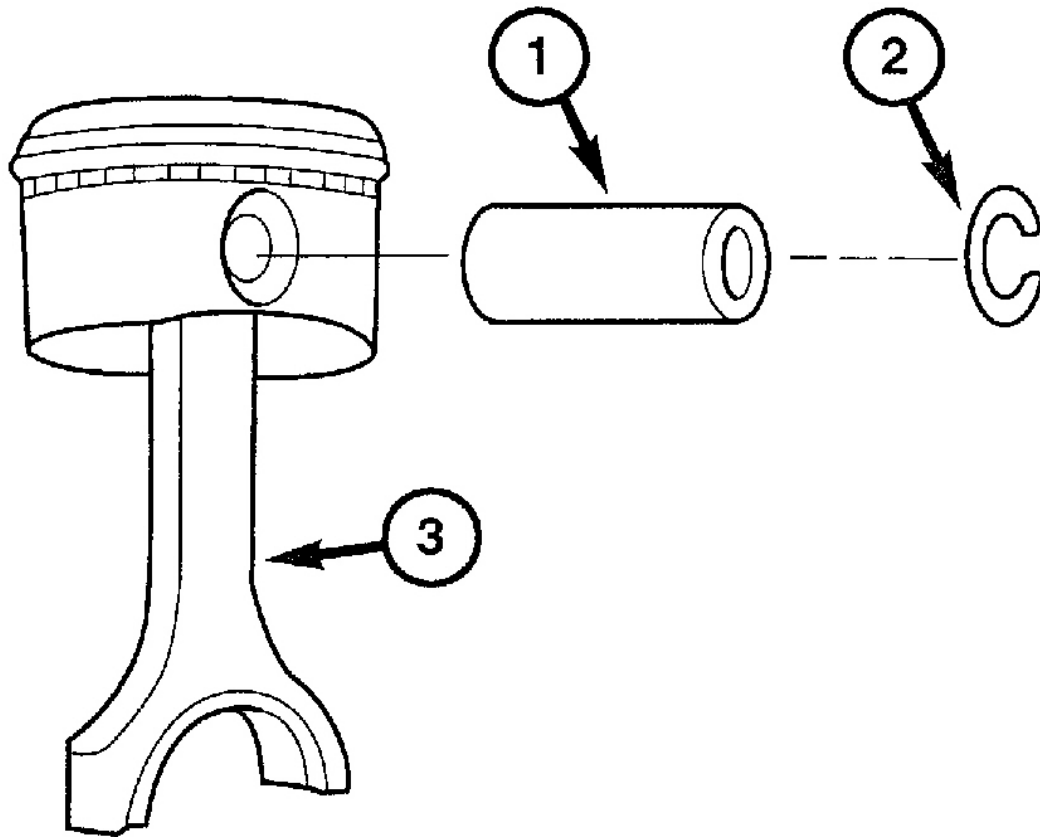


G01860614

Fig. 118: Removing Pistons & Connecting Rods
Courtesy of DAIMLERCHRYSLER CORP.

6. Perform work on a suitable surface to prevent damage to parts.
7. Keep the piston pins matched to the pistons.
8. Remove the snap rings from the pistons (2).
9. Press out the piston pins (1).
10. Remove the piston from the connecting rod (3).

11. Inspect all parts to be reused for damage. Replace as required.



G01860615

Fig. 119: Removing Snap Rings, Piston Pins & Connecting Rods
Courtesy of DAIMLERCHRYSLER CORP.

INSPECTION

CONNECTING ROD

1. Check the connecting rods for any twisting or bending.
2. Check the condition of the large end. Use an oil stone to remove any nicks and burrs.
3. Check the condition of the pin bore in the small end of the connecting rod. Use an oil stone to remove all nicks and burrs.

PISTON PIN

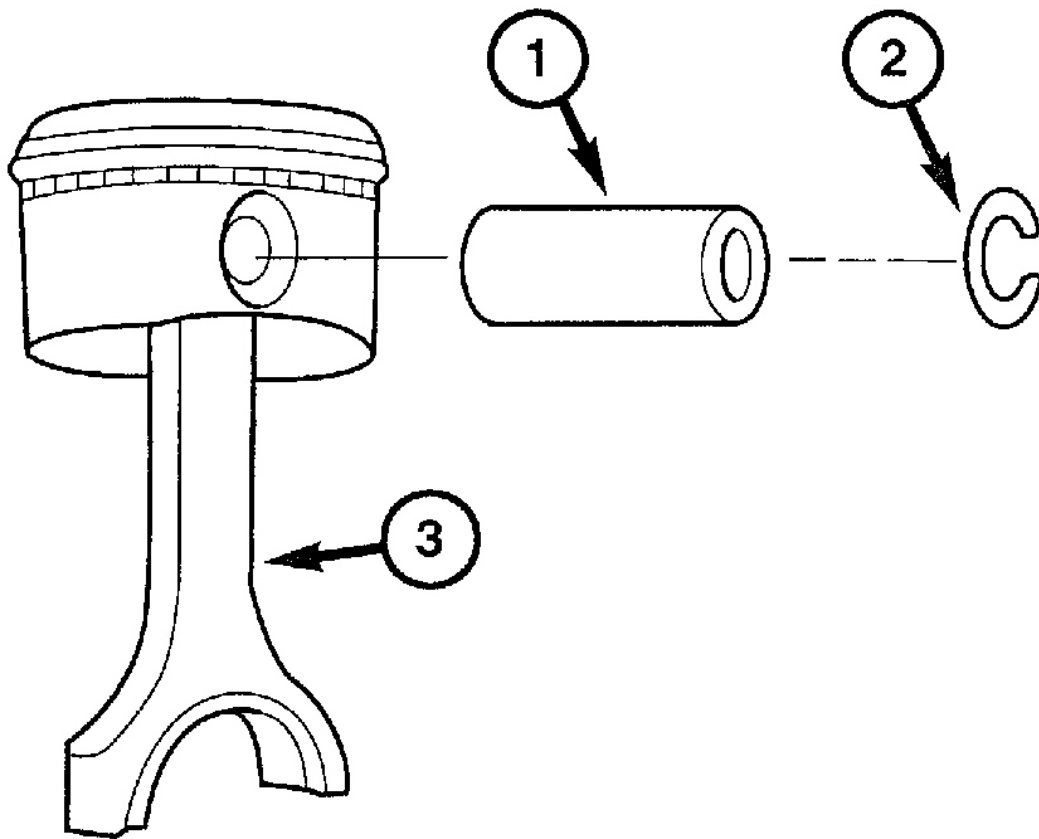
Inspect for free rotation of the wrist pin in the piston.

PISTON

1. Inspect all piston surfaces for nicks and scuffs.
2. Inspect piston and ring grooves for wear.

INSTALLATION

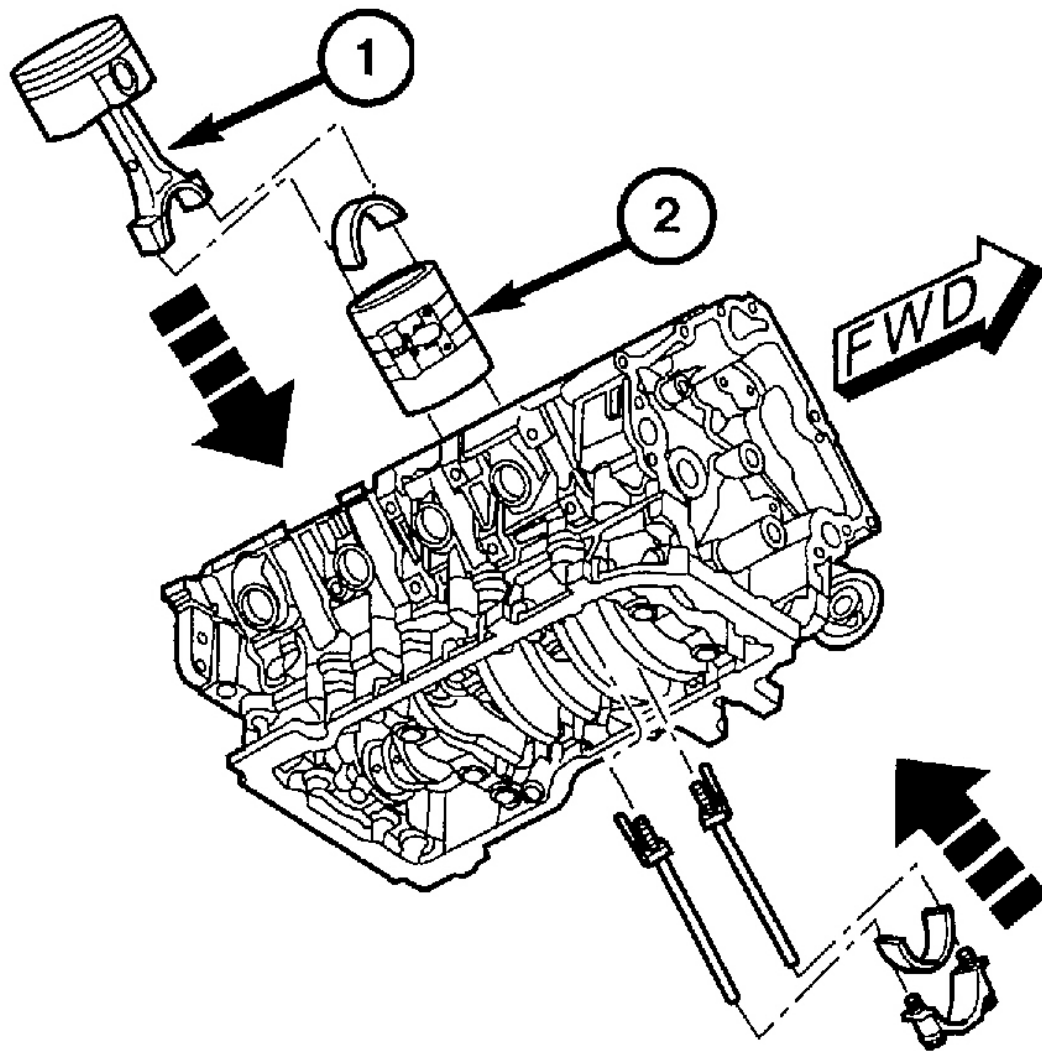
1. Fit the piston onto the connecting rod (3).
2. Press in the piston pin (1).
3. Install the snap rings (2).



G01860617

Fig. 120: Installing Connecting Rod, Piston Pin & Snap Rings
Courtesy of DAIMLERCHRYSLER CORP.

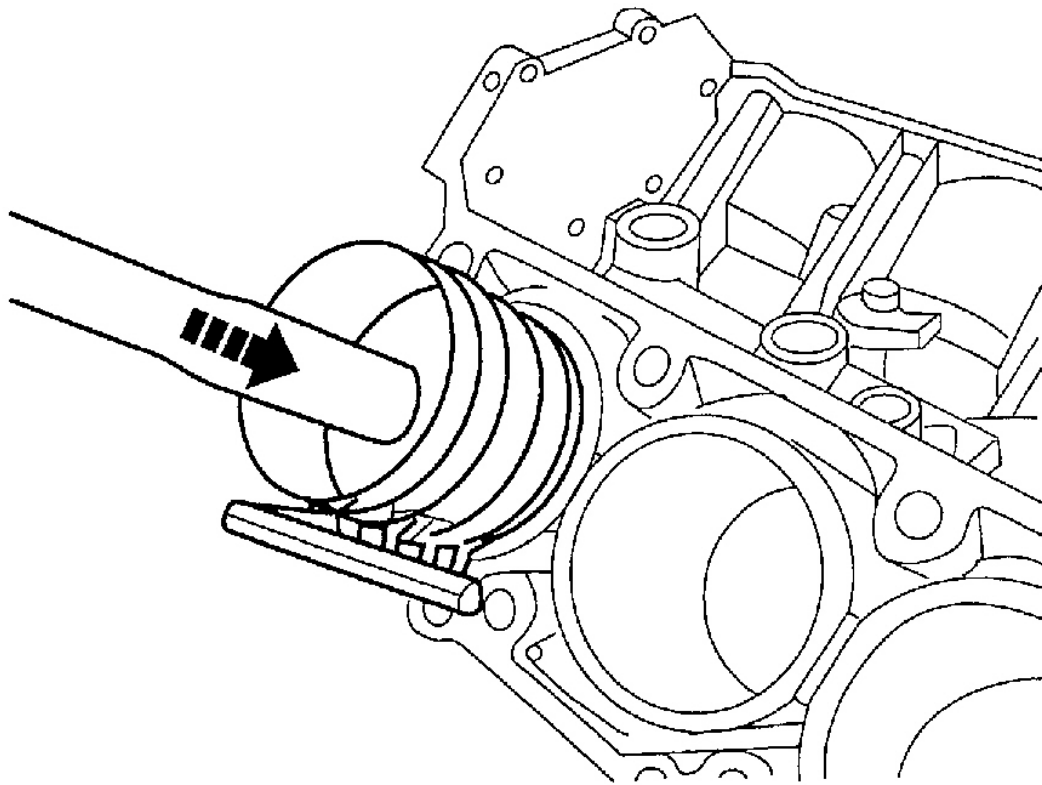
4. Replace the piston rings as required. See **PISTON RINGS**.
5. Load the piston/connecting rod assembly (1) into a ring compressor (2) with light oil lubrication.



G01860618

Fig. 121: Loading Piston/Connecting Rod Assembly Into Ring Compressor
Courtesy of DAIMLERCHRYSLER CORP.

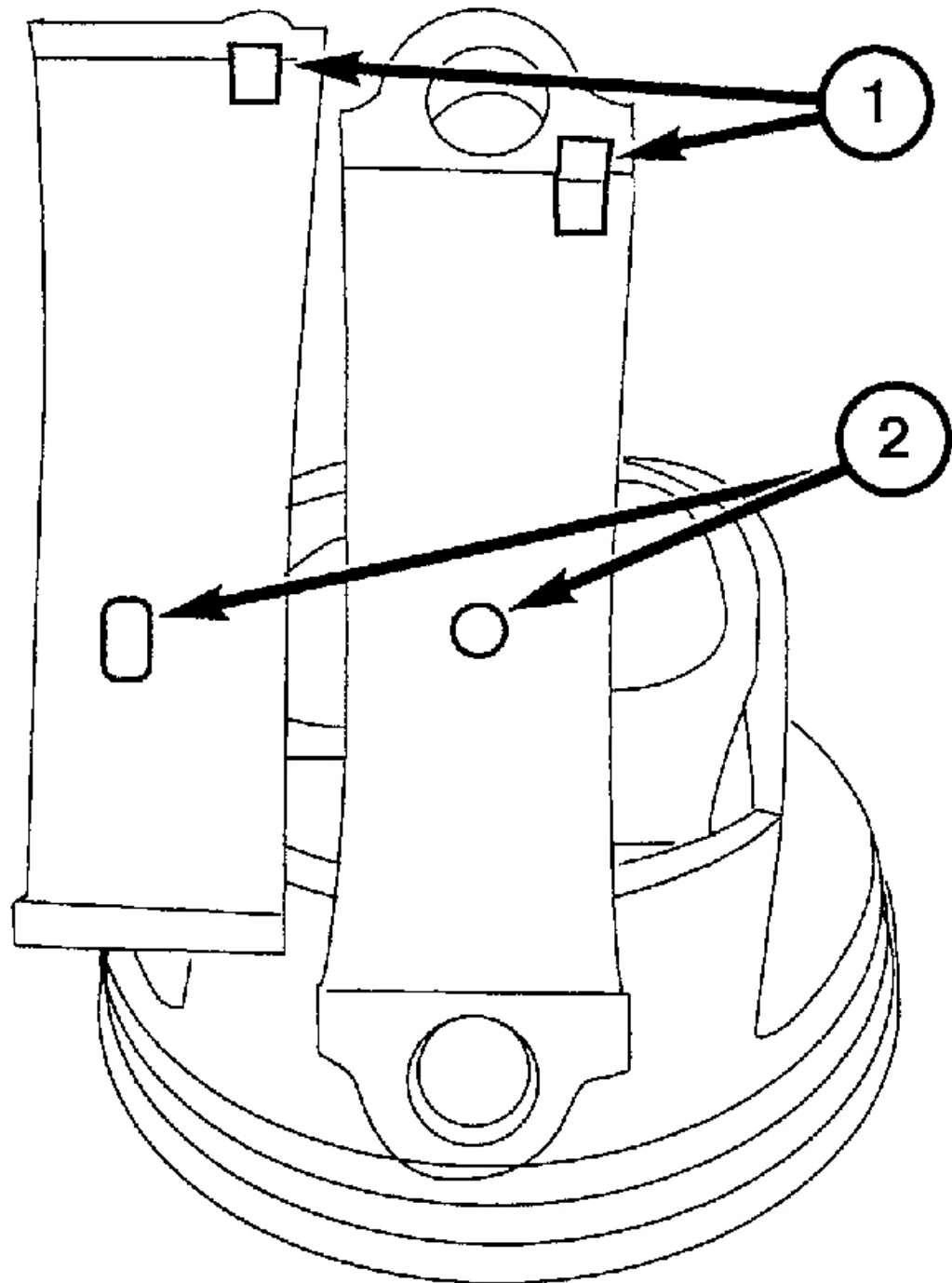
6. Drive the piston into the cylinder using a wooden drift and a mallet.



G01860619

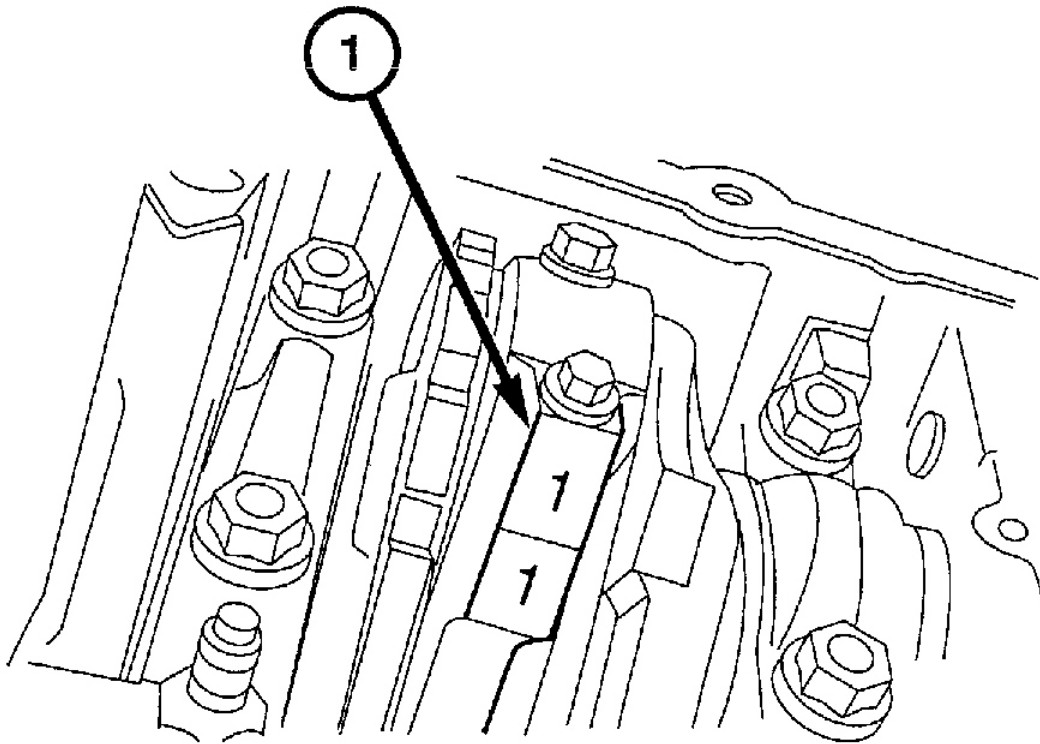
Fig. 122: Driving Piston Into Cylinder
Courtesy of DAIMLERCHRYSLER CORP.

NOTE: The connecting rod bearing shell with the oil drilling (2) must be installed in the connecting rod, otherwise the connecting rod bearings will not be lubricated. The antitwist locks of the connecting rod bearing shells must be located in the slots (1) of the connecting rods and the connecting rod bearing caps.



G01860620

Fig. 123: Locating Connecting Rod Bearing Oil Drilling & Slots
Courtesy of DAIMLERCHRYSLER CORP.



G01860621

Fig. 124: Aligning Connecting Rod Caps With Marks
Courtesy of DAIMLERCHRYSLER CORP.

7. Align the connecting rod caps with the marks (1).
8. Install the connecting rod bolts.
9. Tighten the connecting rod bolts in three stages.
 - Stage one, 5 N.m (44 in. lbs.)
 - Stage two, 25 N.m (18 ft. lbs.)
 - Stage three, rotate bolts 90° clockwise.
10. Test the engine for ease of rotation.
11. Install the timing chain. See **TIMING CHAIN**.

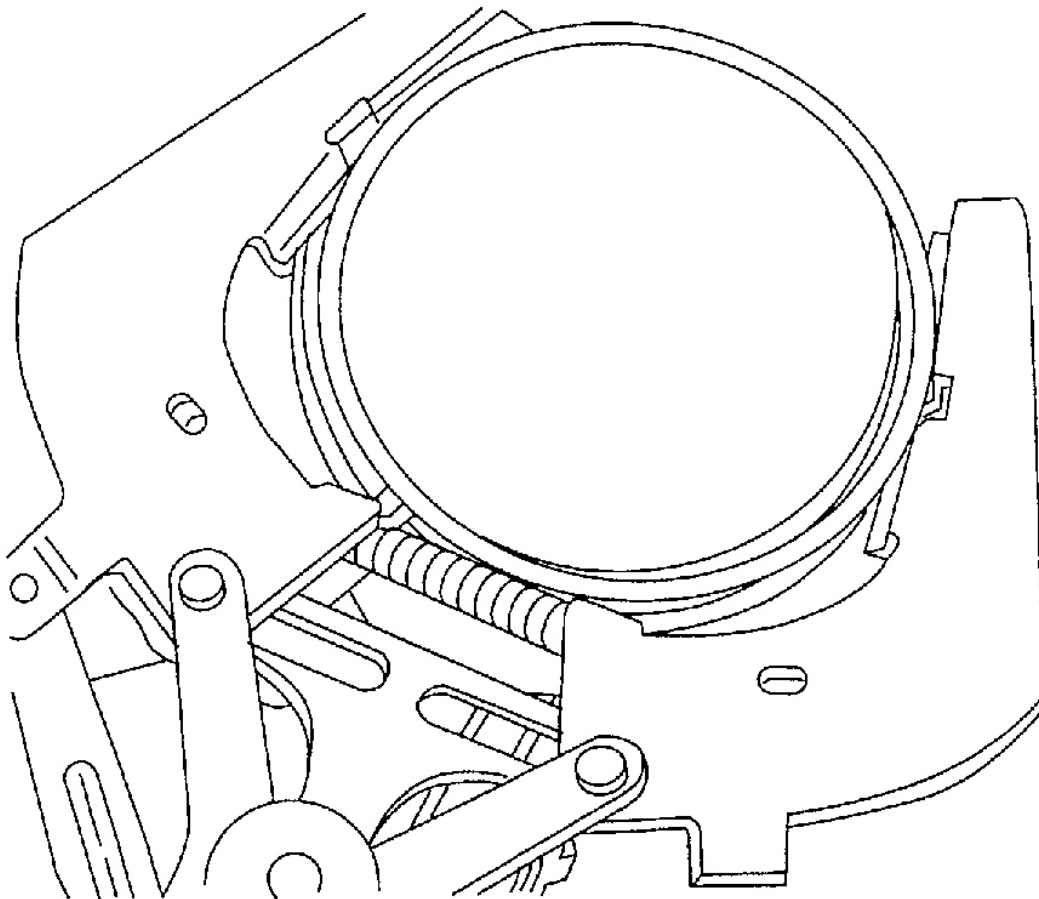
PISTON RINGS

REMOVAL

CAUTION: Do not remove the oil scraper ring with the pliers. The oil scraper ring must be removed and installed by hand.

1. Remove the pistons and connecting rods. See **PISTON AND CONNECTING ROD**.

CAUTION: Do not cut or scratch pistons while cleaning.



G01860622

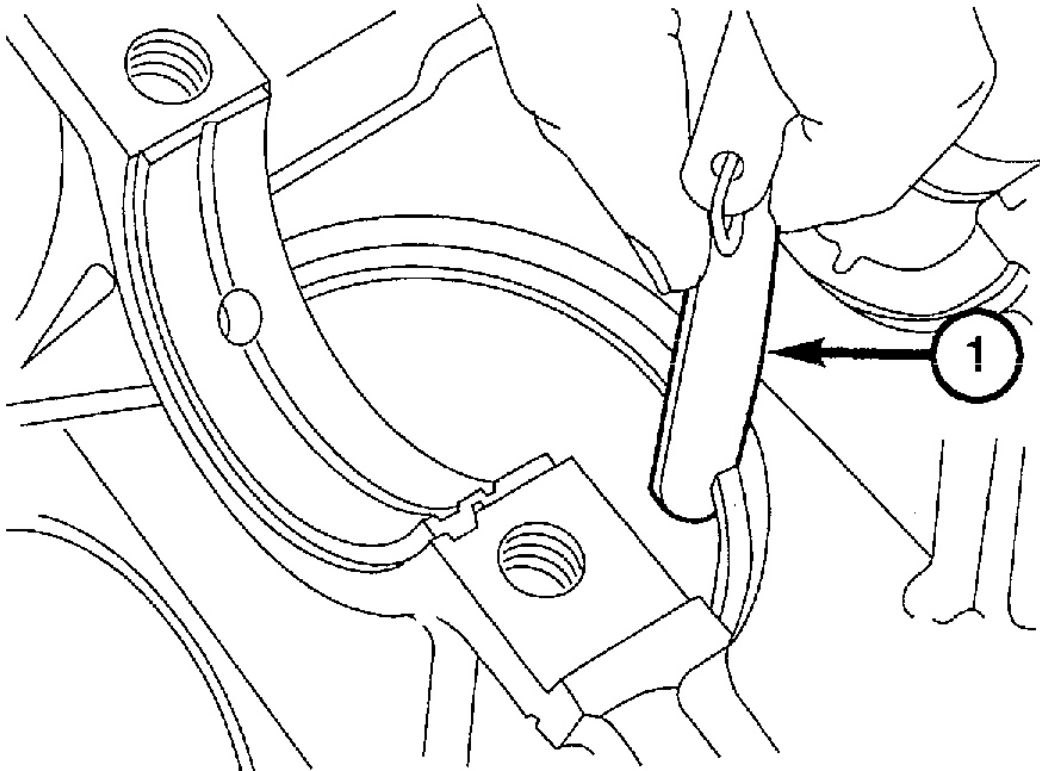
Fig. 125: Removing Piston Rings
Courtesy of DAIMLERCHRYSLER CORP.

2. Using piston ring pliers, remove the piston rings.
3. Use a ring groove cleaner or a broken ring to remove deposits in the ring grooves.
4. Inspect the pistons for heat scoring and distortion at the piston pin openings and piston skirts. Replace as

required.

INSTALLATION

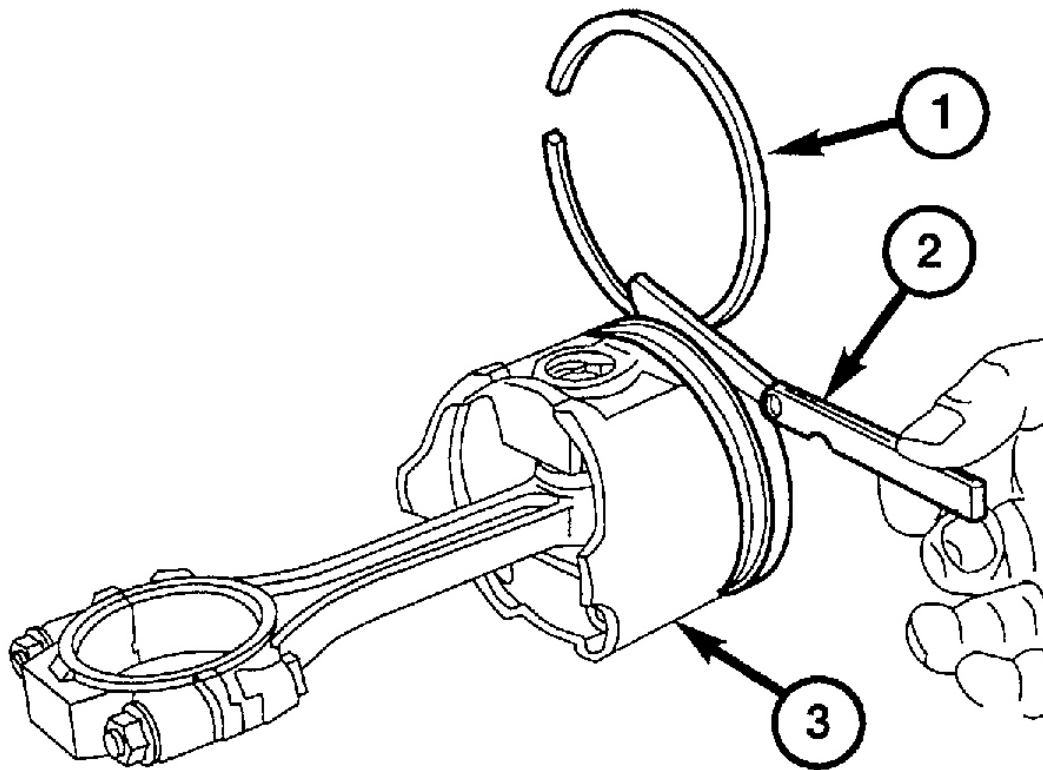
1. Measure the end gap (1) with rings at the bottom of the cylinder.
 - Ring # 1 clearance is .20 mm to .35 mm.
 - Ring # 2 clearance is .20 mm to .40 mm.



G01860623

Fig. 126: Measuring End Gap
Courtesy of DAIMLERCHRYSLER CORP.

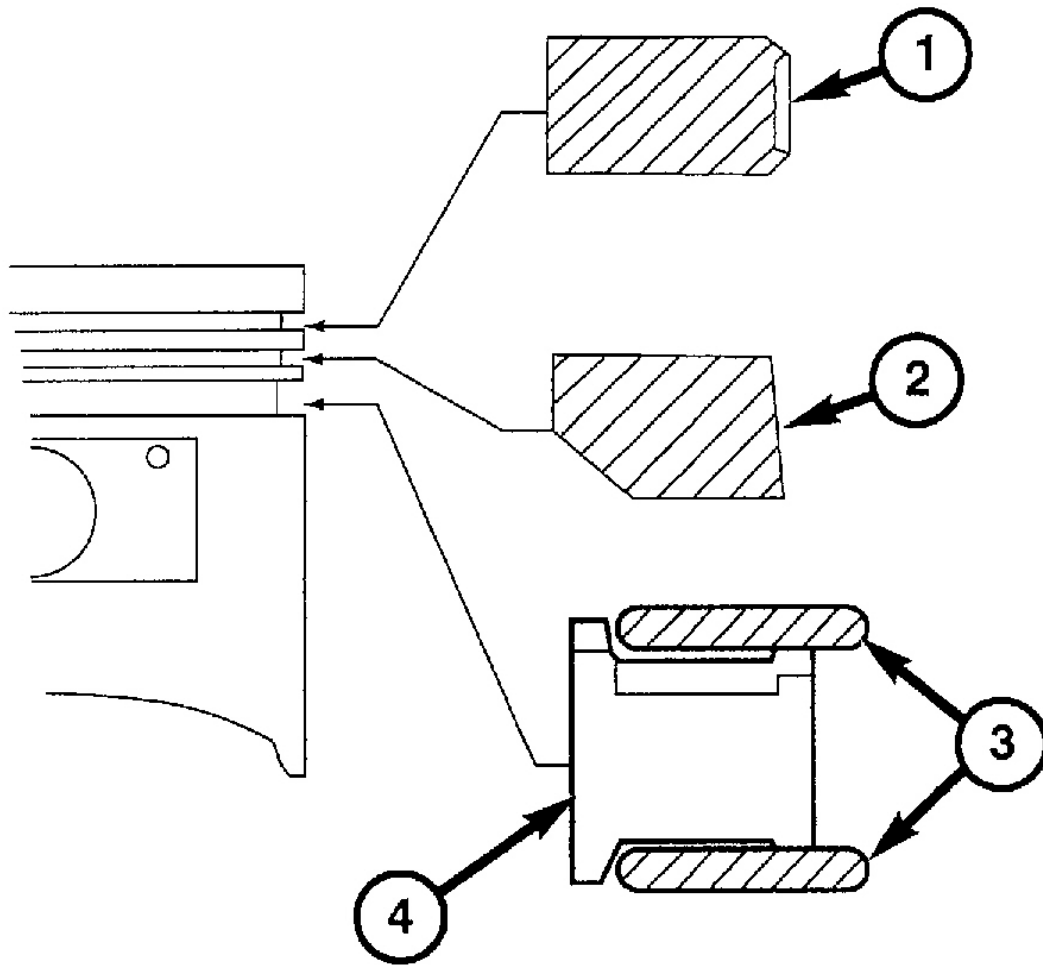
2. Measure the vertical clearance (2) of the piston rings (1).



G01860624

Fig. 127: Measuring Vertical Clearance
Courtesy of DAIMLERCHRYSLER CORP.

3. Ring # 1 clearance is .012 mm to .060 mm.
4. Ring # 2 clearance is .010 mm to .030 mm.
5. Install the rings on the pistons as shown in illustration.
 - Compression ring (1)
 - Sealing ring (2)
 - Oil Ring Rail (3)
 - Oil Ring Expander (4)



G01860625

Fig. 128: Installing Rings On Piston
Courtesy of DAIMLERCHRYSLER CORP.

6. The ring gaps when installed must be positioned as shown in illustration
- Ring one (1)
 - Upper side rail (2)
 - Ring two and spacer expander (3)
 - Lower side rail (4)

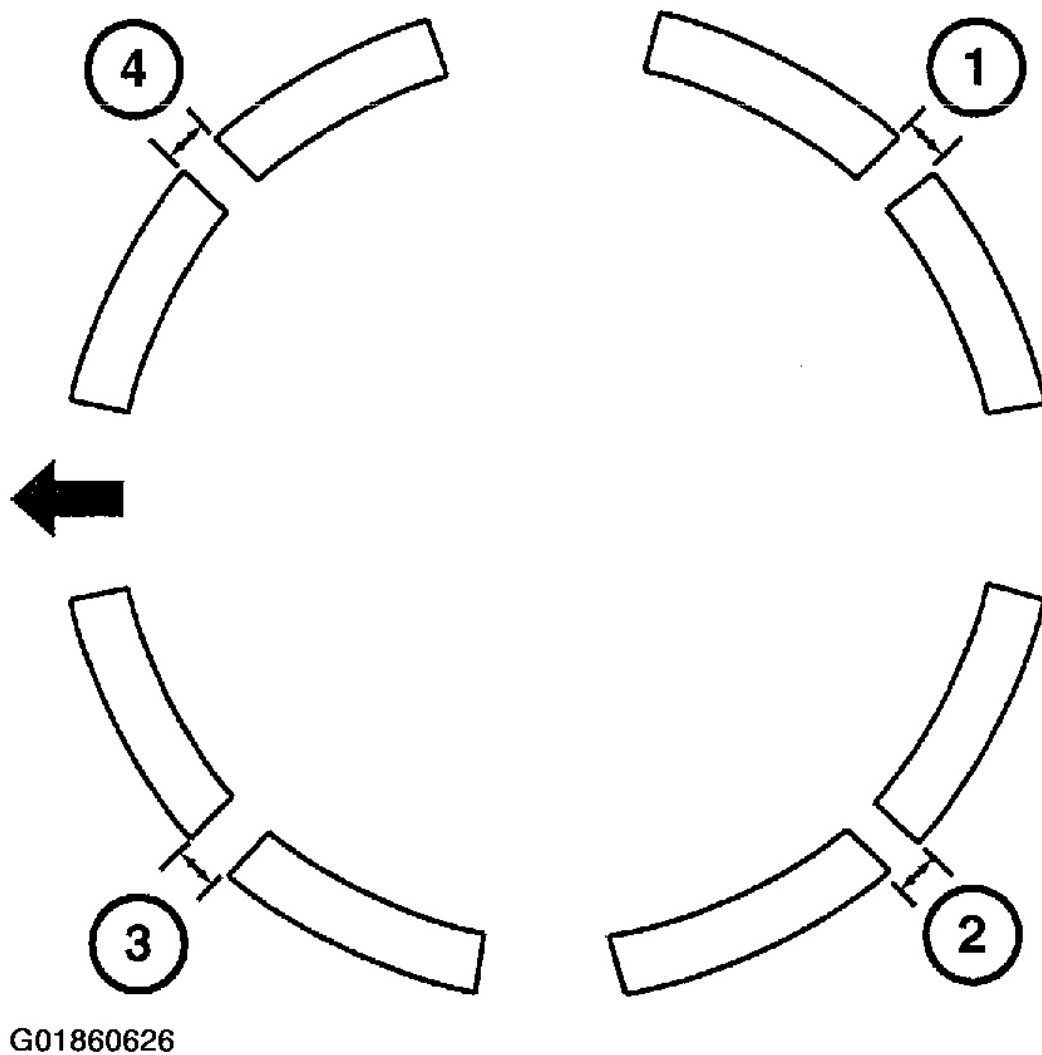


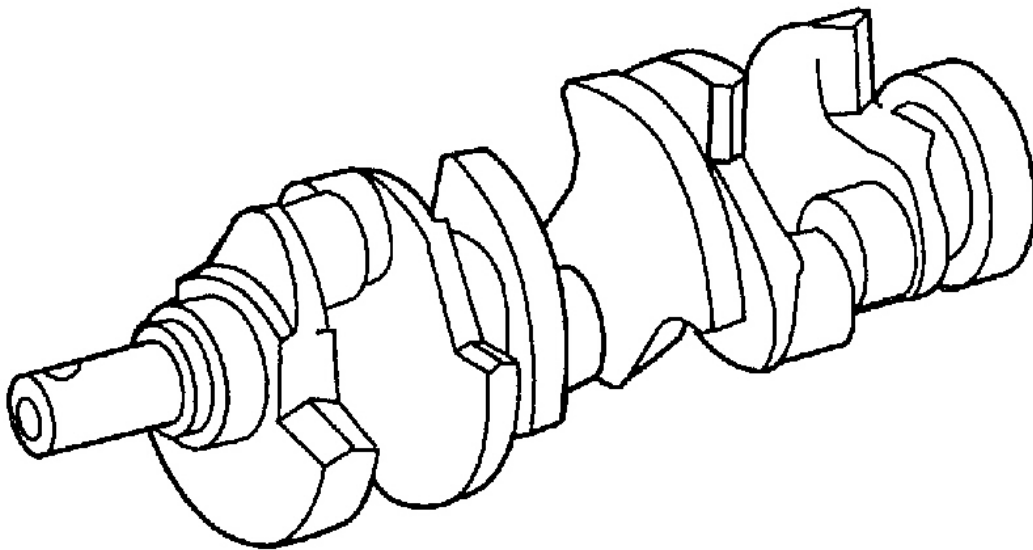
Fig. 129: Positioning Ring Gaps
Courtesy of DAIMLERCHRYSLER CORP.

7. Install the pistons and connecting rods. See PISTON AND CONNECTING ROD.

CRANKSHAFT AND MAIN BEARINGS

DESCRIPTION

Thirty-degree offset crank pins on the crankshaft provide even, 120-degree, firing intervals for smooth operation. The crankshaft with these split pins has ample strength without adding material between the pins, keeping the engine compact and reducing weight.



G01860627

Fig. 130: Identifying Crankshaft With Split Pins
Courtesy of DAIMLERCHRYSLER CORP.

OPERATION

The crankshaft transfers force generated by combustion within the cylinder to the flywheel or flexplate.

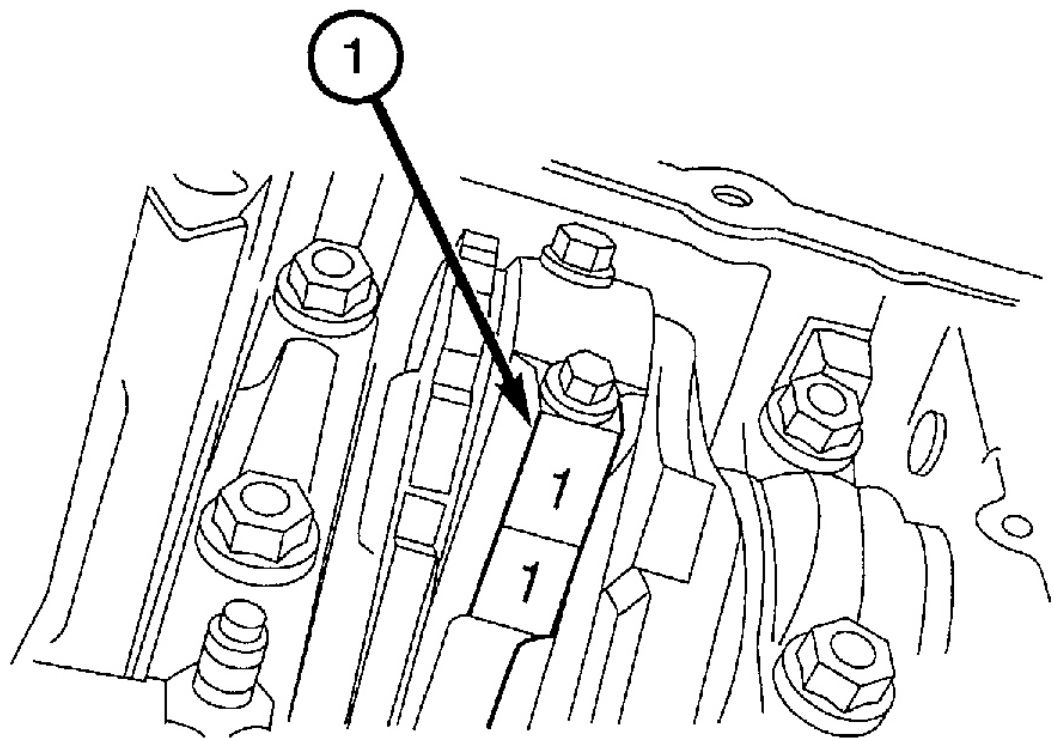
REMOVAL

1. Remove the upper oil pan. See **OIL PAN**.
2. Remove the oil pump. See **OIL PUMP**.
3. Remove the rear crankshaft radial seal. See **CRANKSHAFT OIL SEAL - REAR**.

NOTE: When rotating the crankshaft, ensure that the connecting rods are not twisted.

4. Remove the timing chain. See **TIMING CHAIN**.

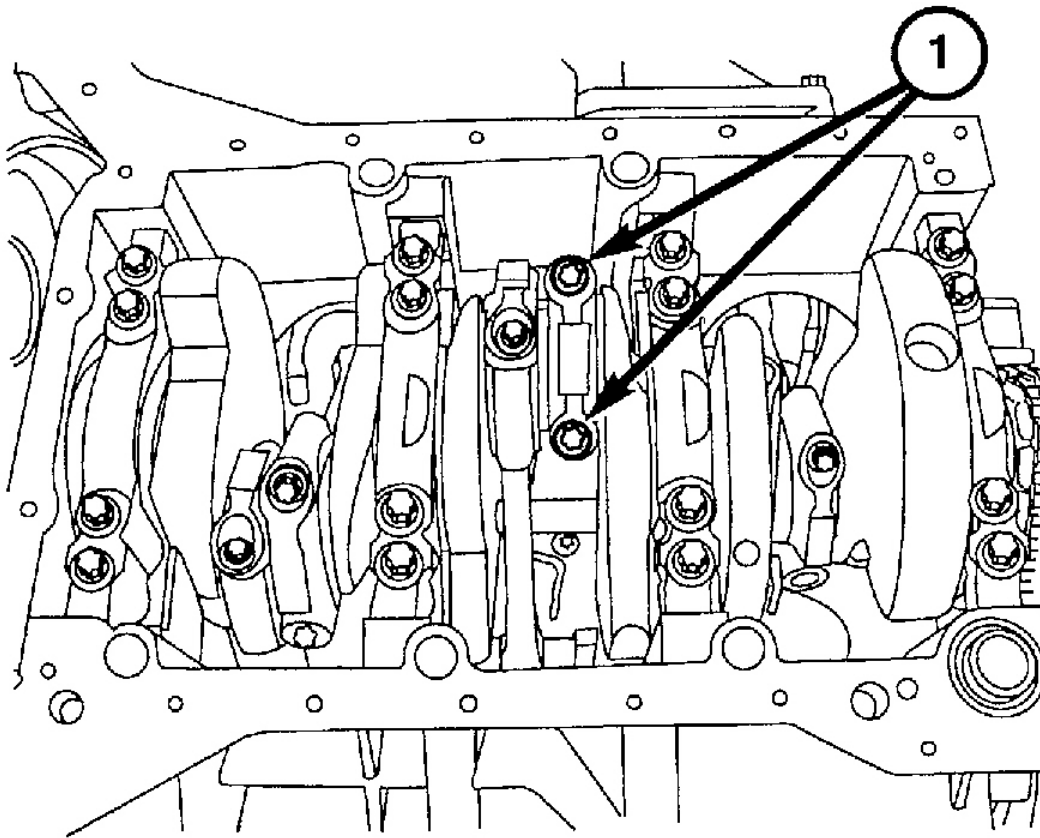
NOTE: Mark the connecting rod and the connecting rod bearing cap (1) on one side next to each other for this step.



G01860628

Fig. 131: Marking Connecting Rod & Bearing Caps
Courtesy of DAIMLERCHRYSLER CORP.

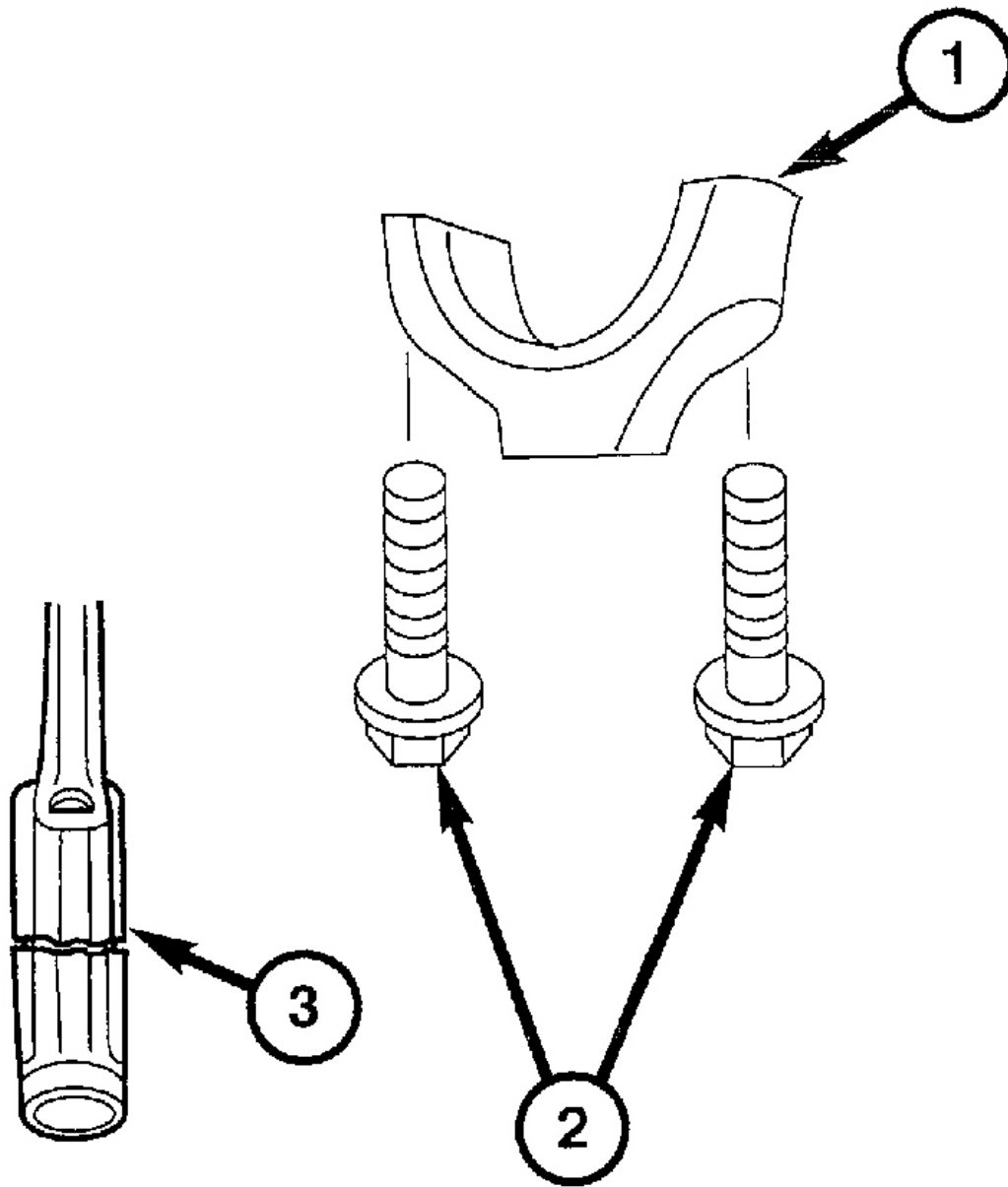
NOTE: Do not dislodge the connecting rod bearings from the connecting rods.



G01860629

Fig. 132: Removing Connecting Rod Bolts
Courtesy of DAIMLERCHRYSLER CORP.

5. Remove the connecting rod bolts (1).
6. Remove the connecting rod caps (1) with the bearings in place.



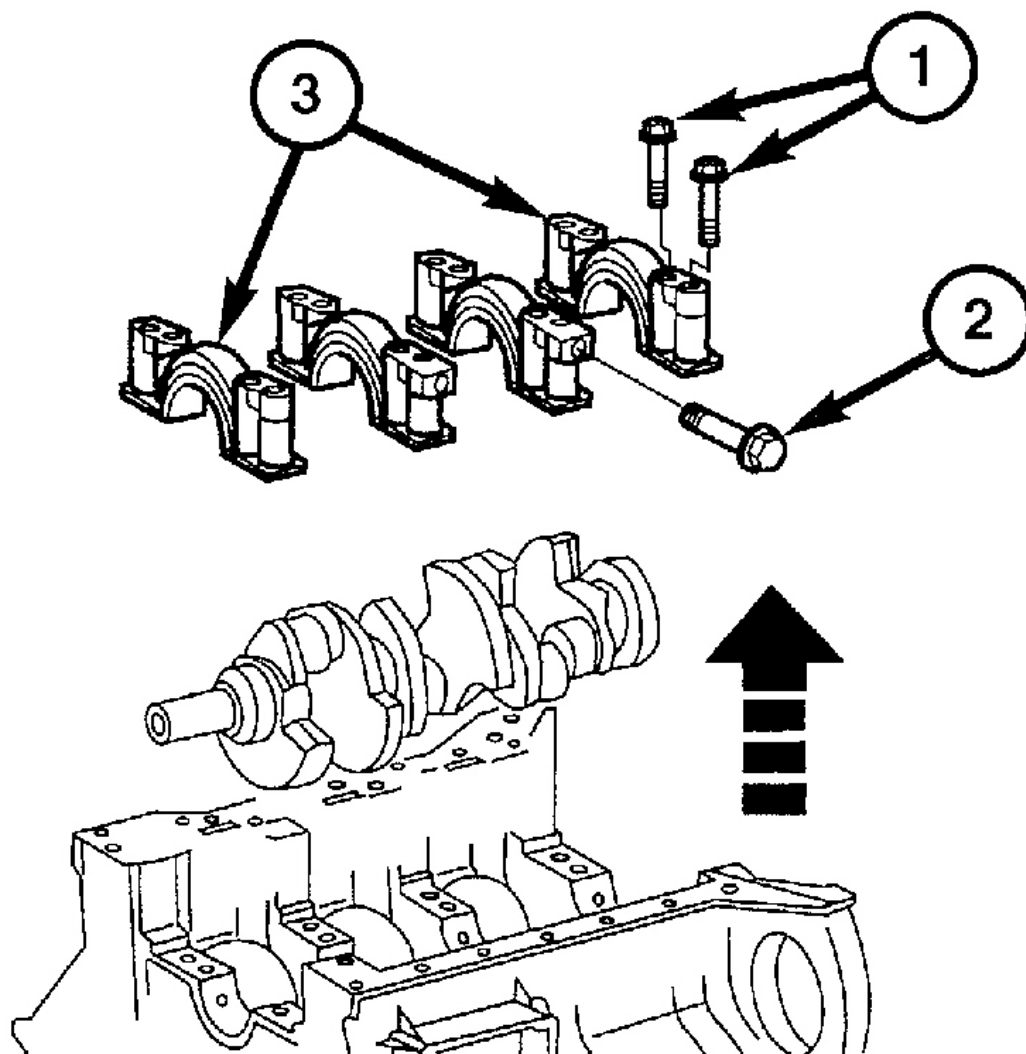
G01860630

Fig. 133: Removing Connecting Rod Caps With Bearings In Place
Courtesy of DAIMLERCHRYSLER CORP.

7. Relocate the connecting rods away from the crankshaft.

CAUTION: Carefully pry out the crankshaft bearing caps.

NOTE: Mark the crankshaft bearing caps before removing.

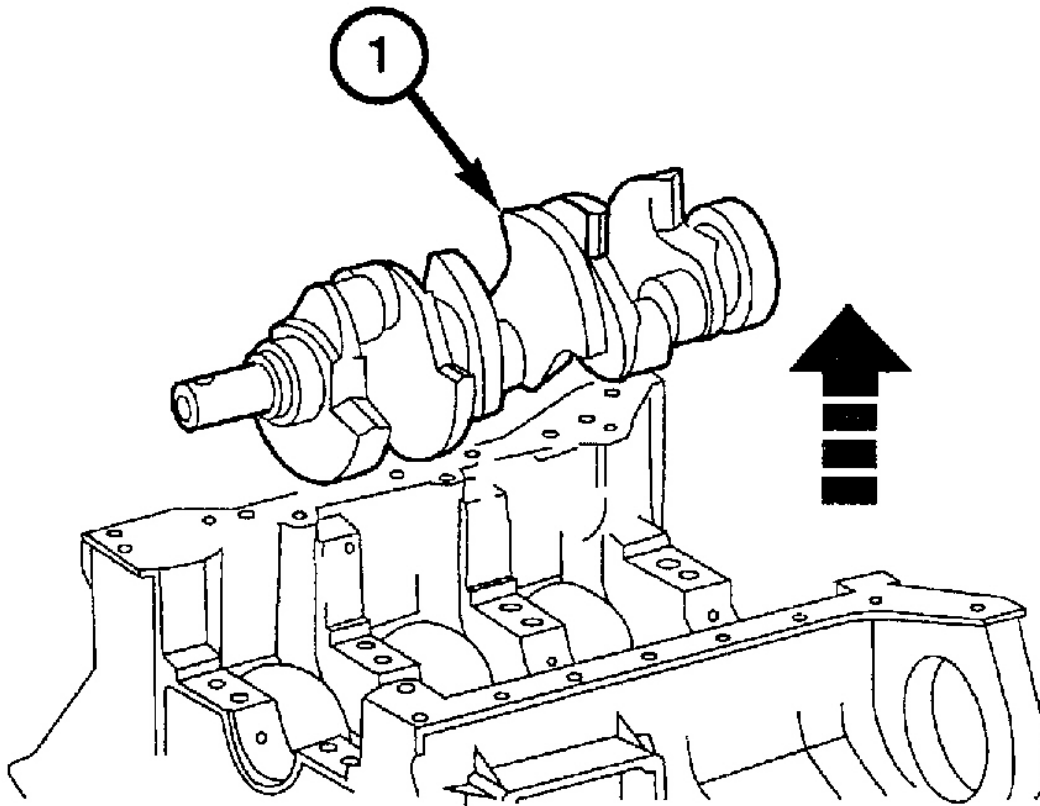


G01860631

Fig. 134: Removing Crankshaft Main Bearing Journal Cap Side Bolts
Courtesy of DAIMLERCHRYSLER CORP.

8. Remove the crankshaft main bearing journal cap side bolts (2).
9. Remove and discard the crankshaft main bearing journal cap bolts (1).

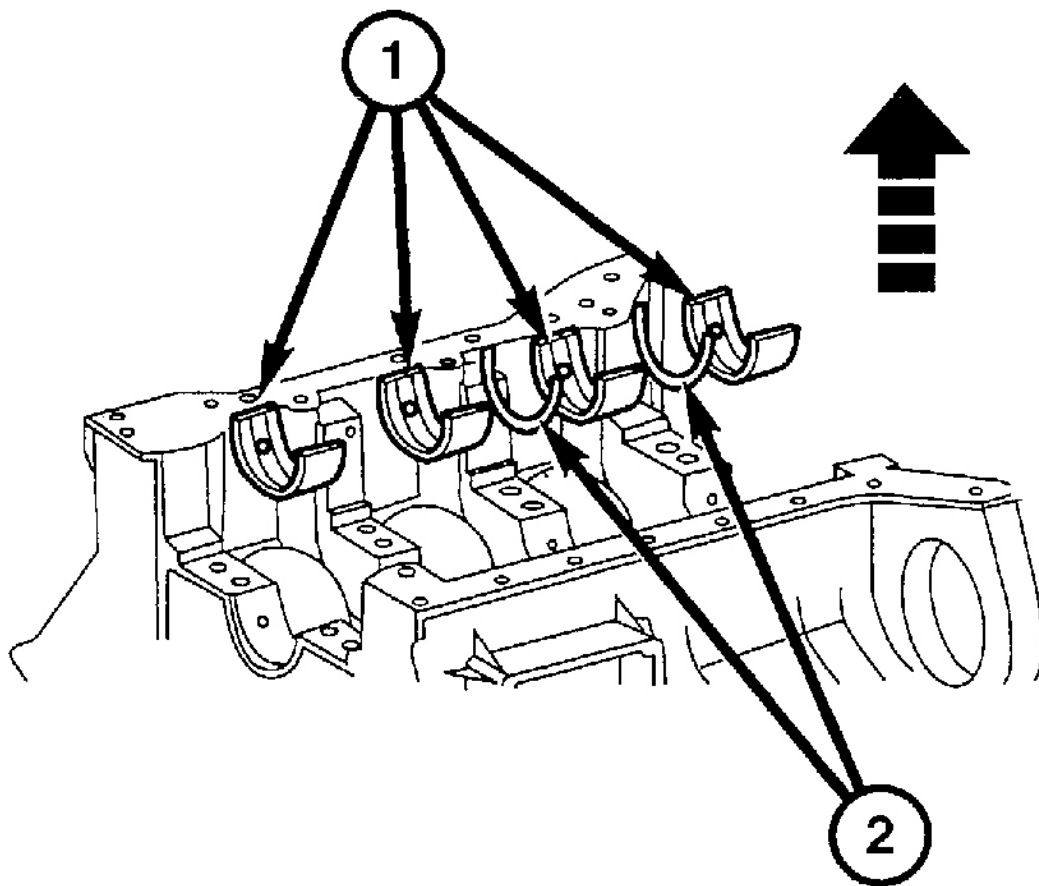
10. Remove the crankshaft main bearing journal cap bolts (3).
11. Remove the crankshaft (1) from the engine block.



G01860632

Fig. 135: Removing Crankshaft From Engine Block
Courtesy of DAIMLERCHRYSLER CORP.

12. Remove the crankshaft main bearing shells (1) and thrust washers (2) from the crankcase.



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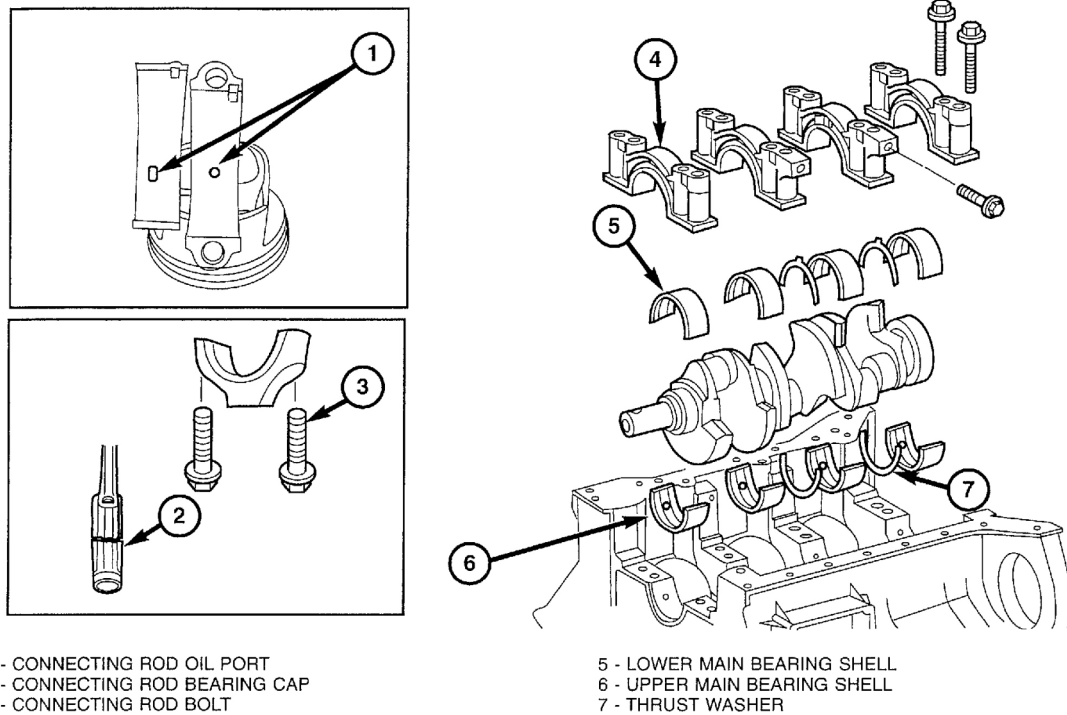
Fig. 136: Removing Crankshaft Main Bearing Shells & Thrust Washers From Crankcase
Courtesy of DAIMLERCHRYSLER CORP.

13. Remove the crankshaft main bearing shells from the crankshaft main bearing journal caps.

INSTALLATION

NOTE: **Clean all the journals with solvent and dry thoroughly before installing bearings.**

1. Fit the upper main bearing shells (6) to the engine block's main journals.
2. Fit the thrust washers (7) into the engine block.
3. Coat the surface of bearing lightly with engine oil.
4. Position the crankshaft in the engine block.
5. Fit the lower main bearing shells (5) into the main bearing journal caps (4).

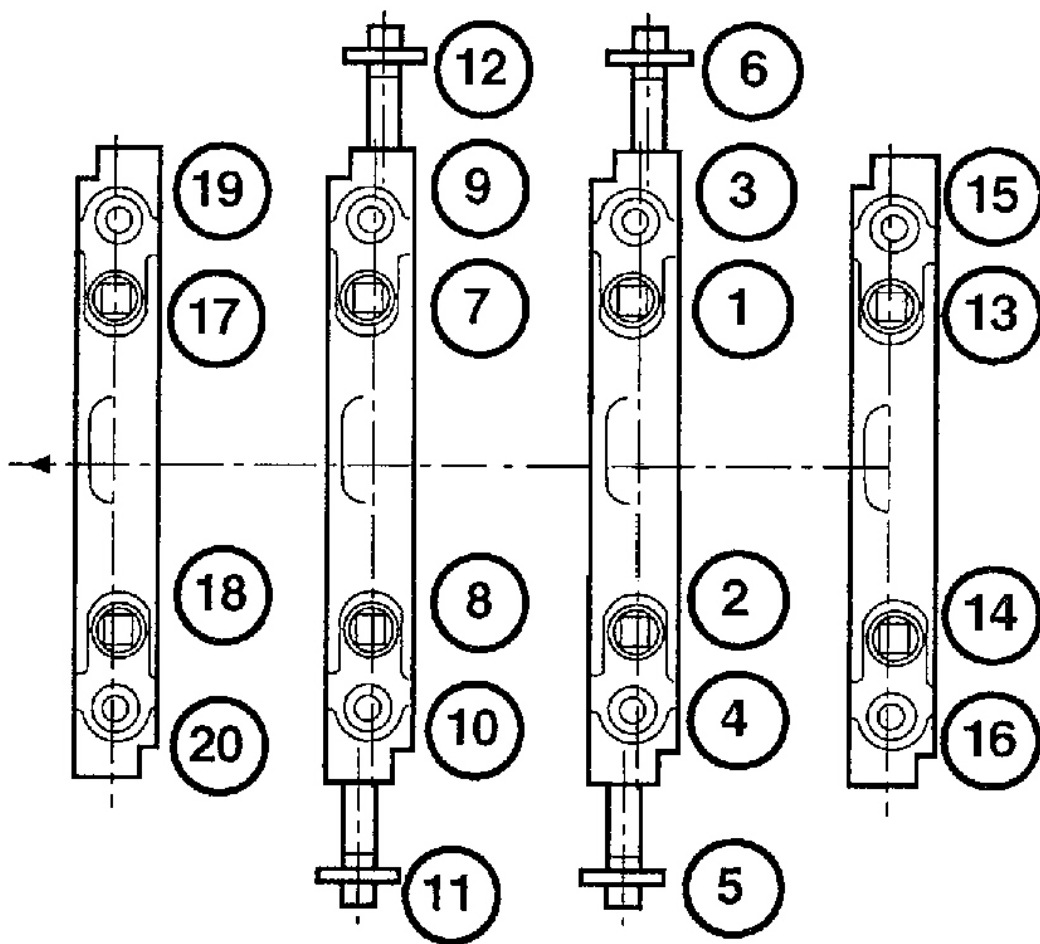


G01860634

Fig. 137: Installing Crankshaft & Main Bearing
 Courtesy of DAIMLERCHRYSLER CORP.

CAUTION: The crankshaft main bearing journal cap bolts M8X75 and M10X90 must always be replaced, otherwise there is a risk of fracture.

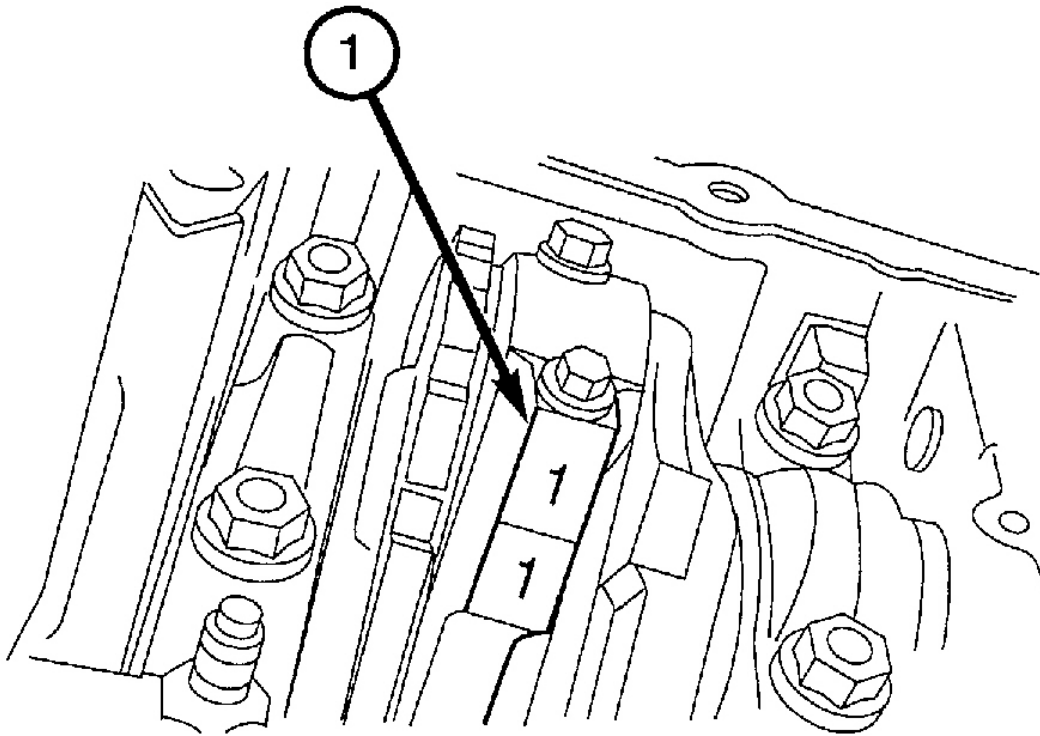
6. Install the main bearing journal caps (4).
7. Follow the torque sequence shown in illustration for the crankshaft main bearing journal cap bolts.
8. Main bearing journal caps must be tightened in two stages.
 - Stage one for m8 bolts, 20 N.m (15 ft. lbs.).
 - Stage two for m8 bolts, rotate 90° clockwise.
 - Stage one for m10 bolts, 30 N.m (22 ft. lbs.).
 - Stage two for m10 bolts, rotate 90° clockwise.



G01860635

Fig. 138: Identifying Crankshaft Main Bearing Journal Cap Bolt Torque Sequence
Courtesy of DAIMLERCHRYSLER CORP.

CAUTION: Connecting rod bolts exceeding 47.6 mm in length must be replaced.



G01860636

Fig. 139: Installing Connecting Rod Caps & Bolts
Courtesy of DAIMLERCHRYSLER CORP.

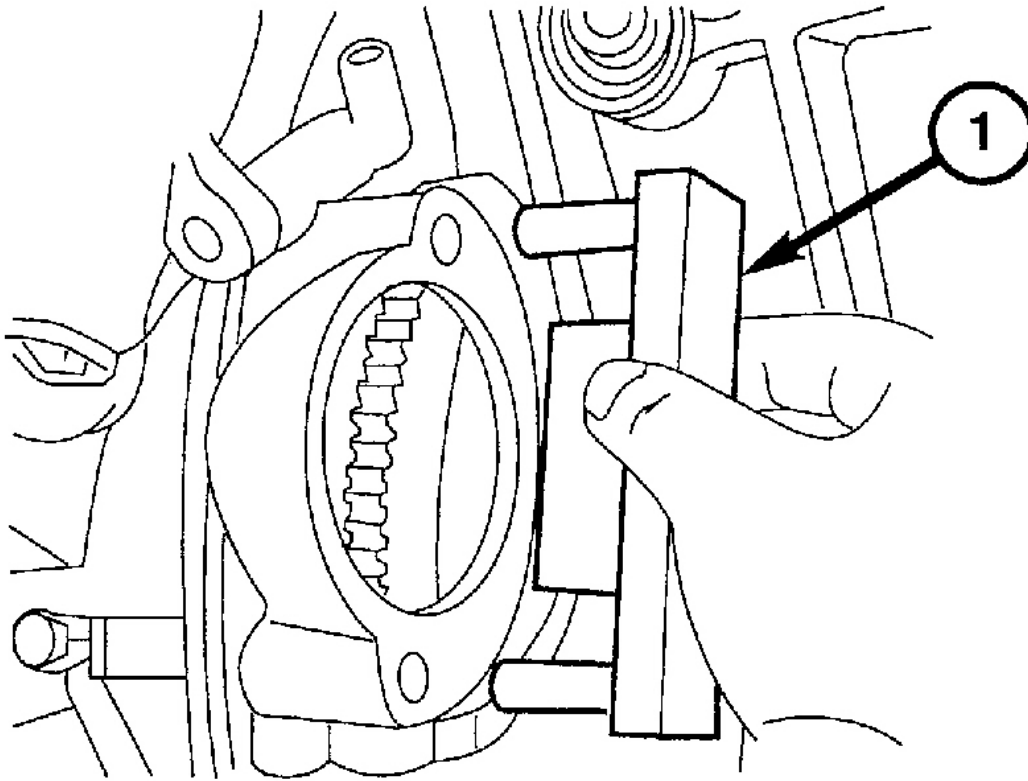
9. Install the connecting rod caps and the bolts to the connecting rod as marked. See **PISTON AND CONNECTING ROD**.
10. Install the oil pump. See **OIL PAN**.
11. Install the upper oil pan. See **OIL PAN**.
12. Install the timing chain. See **TIMING CHAIN**.
13. Install a new crankshaft rear radial seal. See **CRANKSHAFT OIL SEAL - REAR**.

VIBRATION DAMPER

REMOVAL

1. Disconnect the negative battery cable.
2. Drain the cooling system into a suitable container.
3. Remove the radiator fan with the radiator. See **COOLING SYSTEM (MECHANICAL)** article.
4. Remove the accessory drive belt.

5. Remove the starter. See **STARTERS** article.
6. Using Special Tool 9102 Flywheel Locking Tool (1), lock the flywheel by inserting the tool into the starter opening.

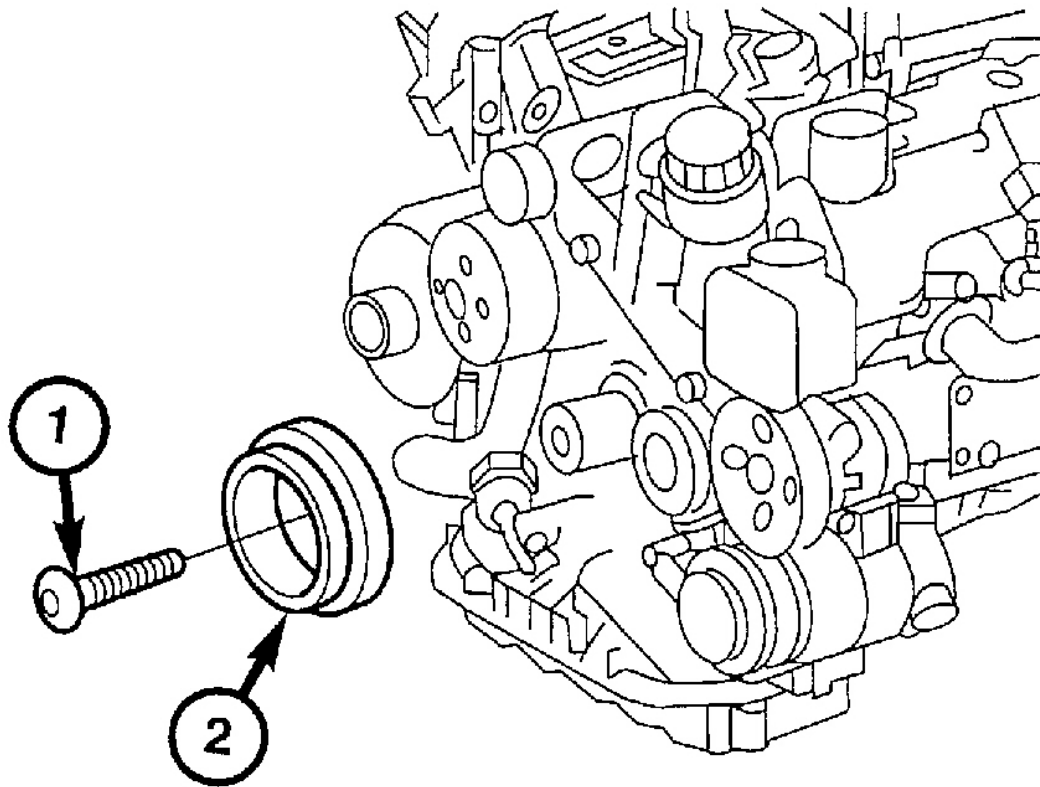


G01860637

Fig. 140: Locking Flywheel

Courtesy of DAIMLERCHRYSLER CORP.

7. Remove the vibration damper bolt (1) and the vibration damper (2) from the crankshaft.

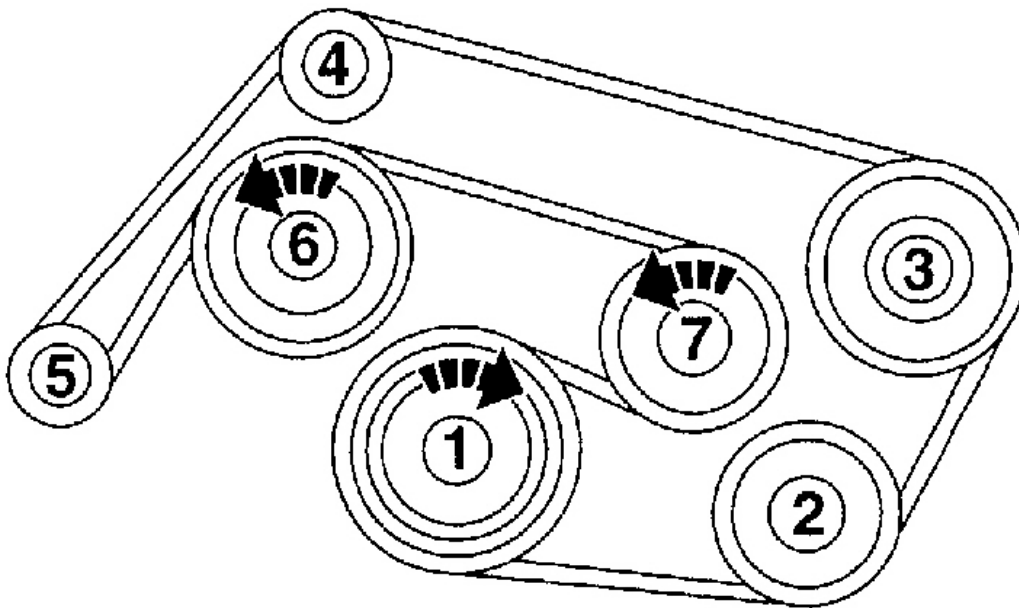


G01860638

Fig. 141: Removing Vibration Damper Bolt
Courtesy of DAIMLERCHRYSLER CORP.

INSTALLATION

1. Inspect for oil leaks at the front crankshaft oil seal.
2. Replace the front crankshaft oil seal if signs of leakage are present.
3. Inspect the sealing surface of the vibration damper. Smooth any roughness with emery paper or an oil stone.
4. Measure the vibration damper bolt. Replace the bolt if length exceeds 78 mm.
5. Position the vibration damper on the front of the crankshaft.
6. Lubricate the bolt threads with engine oil before installing.
7. Install the vibration damper bolt and tighten:
 - 1st to 200 N.m (148 ft. lbs.).
 - Then retighten the bolt an additional 90° clockwise.
8. Install the accessory drive belt.



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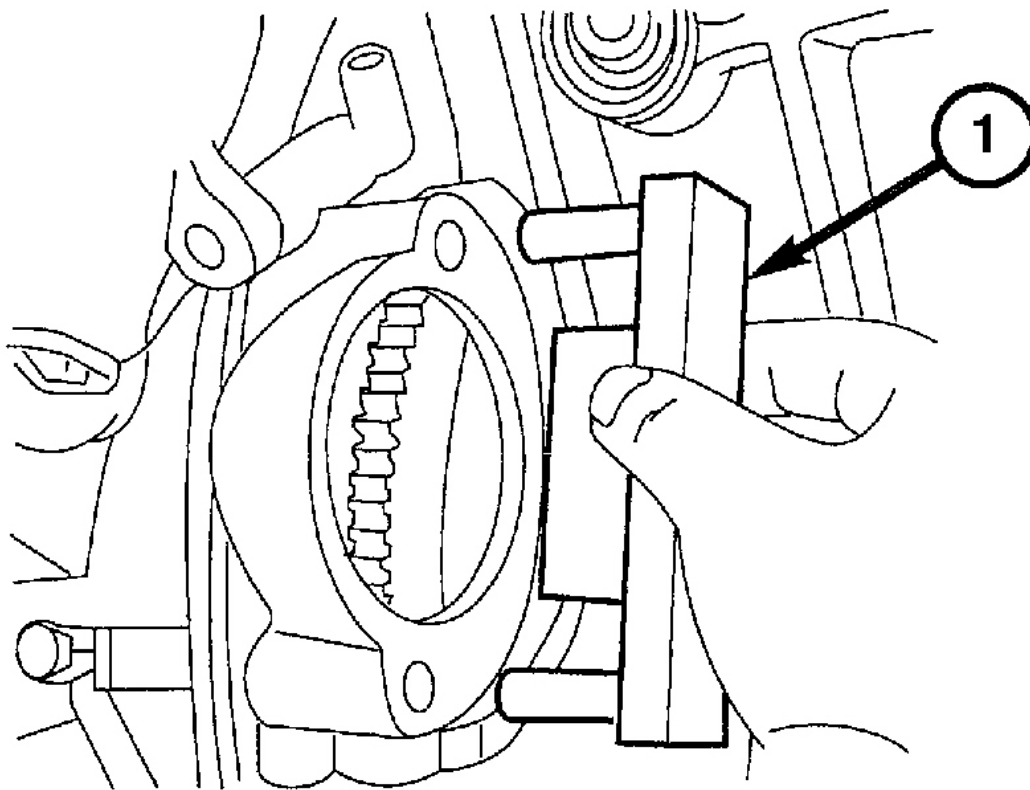
Fig. 142: Installing Accessory Drive Belt
Courtesy of DAIMLERCHRYSLER CORP.

9. Install the radiator with the radiator fan. See **COOLING SYSTEM (MECHANICAL)** .
10. Remove the Special Tool 9102 Flywheel Locking Tool.
11. Install the starter. See **STARTERS** article.
12. Connect the negative battery cable.
13. Start the engine and check for leaks.

FLEX PLATE/FLYWHEEL

REMOVAL

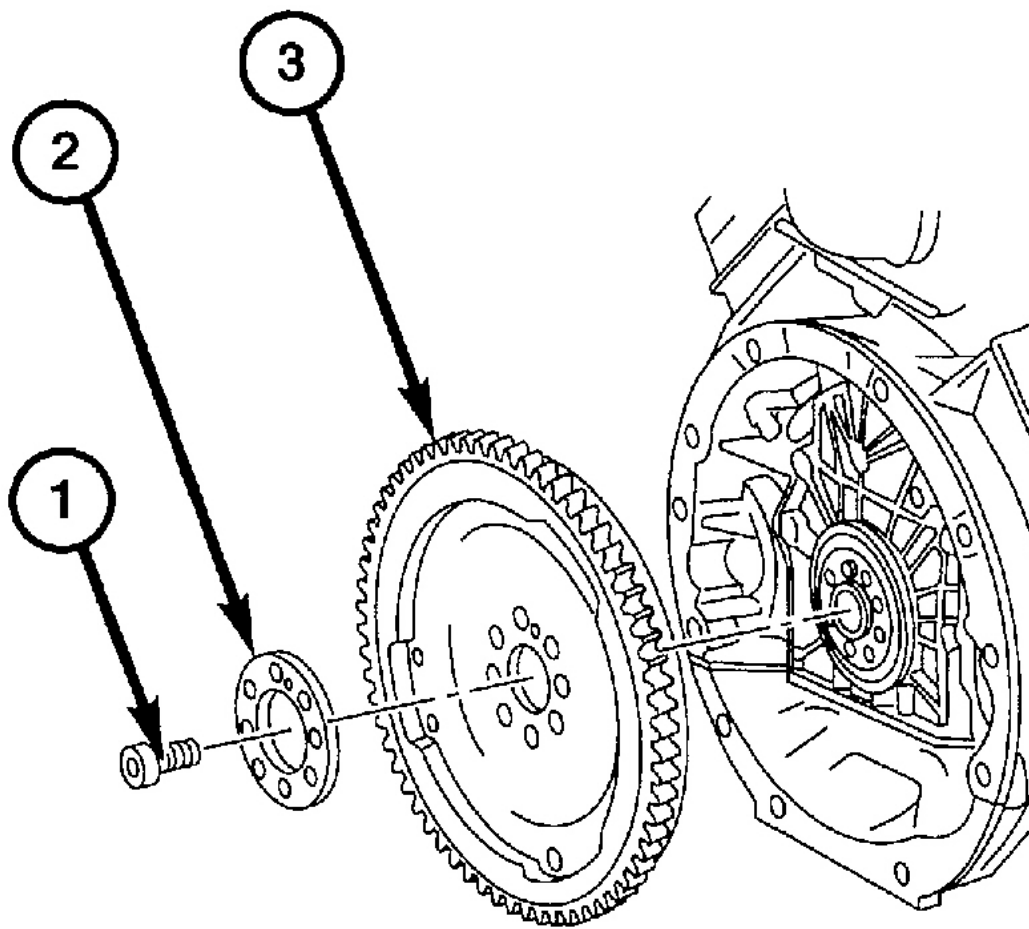
1. Remove the transmission. For automatic, see **REMOVAL & INSTALLATION** article and for manual, see **REMOVAL & INSTALLATION** article.
2. Remove the starter. See **STARTERS** article.
3. Using Special Tool 9102 Flywheel Locking Tool (1), lock the flywheel by inserting the tool in the starter opening.



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Fig. 143: Locking Flywheel**Courtesy of DAIMLERCHRYSLER CORP.**

4. Remove the clutch if equipped. See **CLUTCHES** article.
5. Remove and discard the flywheel bolts (1).
6. Remove the spacer (2) and the flywheel/flexplate (3).
7. Inspect the rear crankshaft oil seal for leakage. Replace if required.



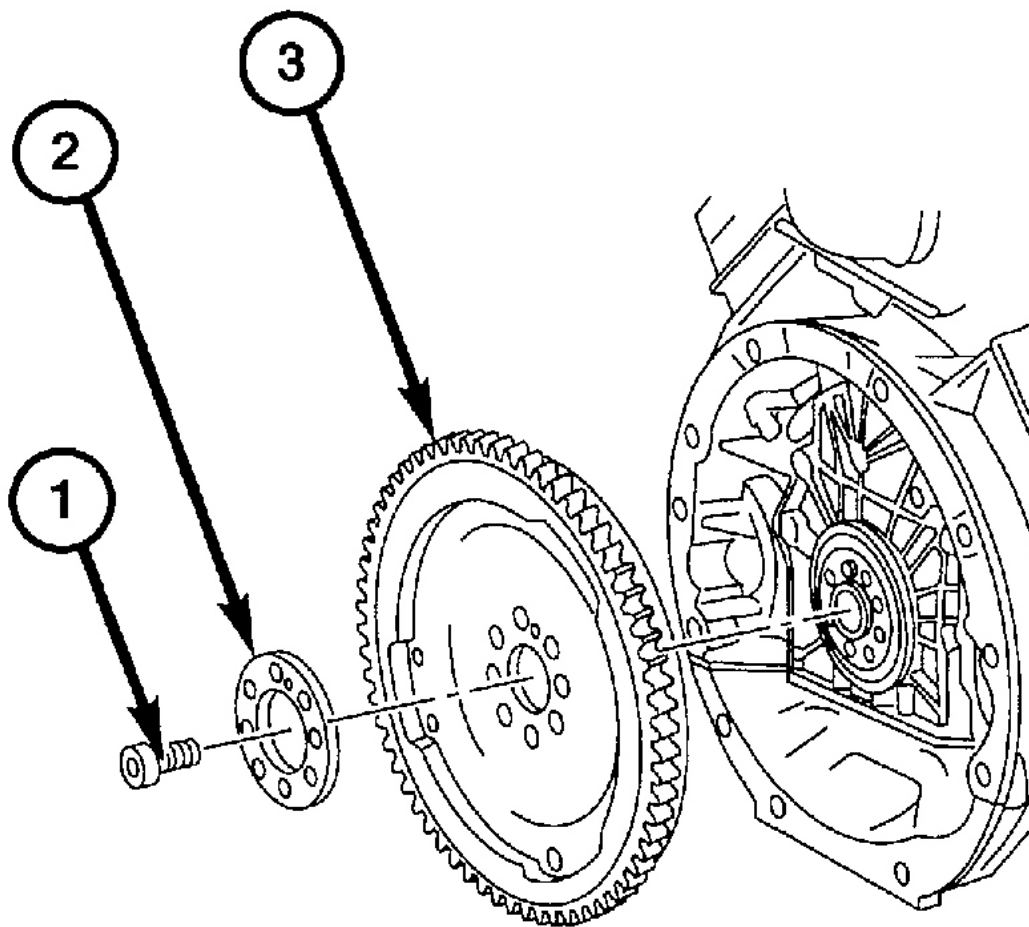
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Fig. 144: Removing Flywheel Bolts, Spacer & Flywheel/Flexplate
Courtesy of DAIMLERCHRYSLER CORP.

INSTALLATION

NOTE: New flywheel/flexplate bolts must be used.

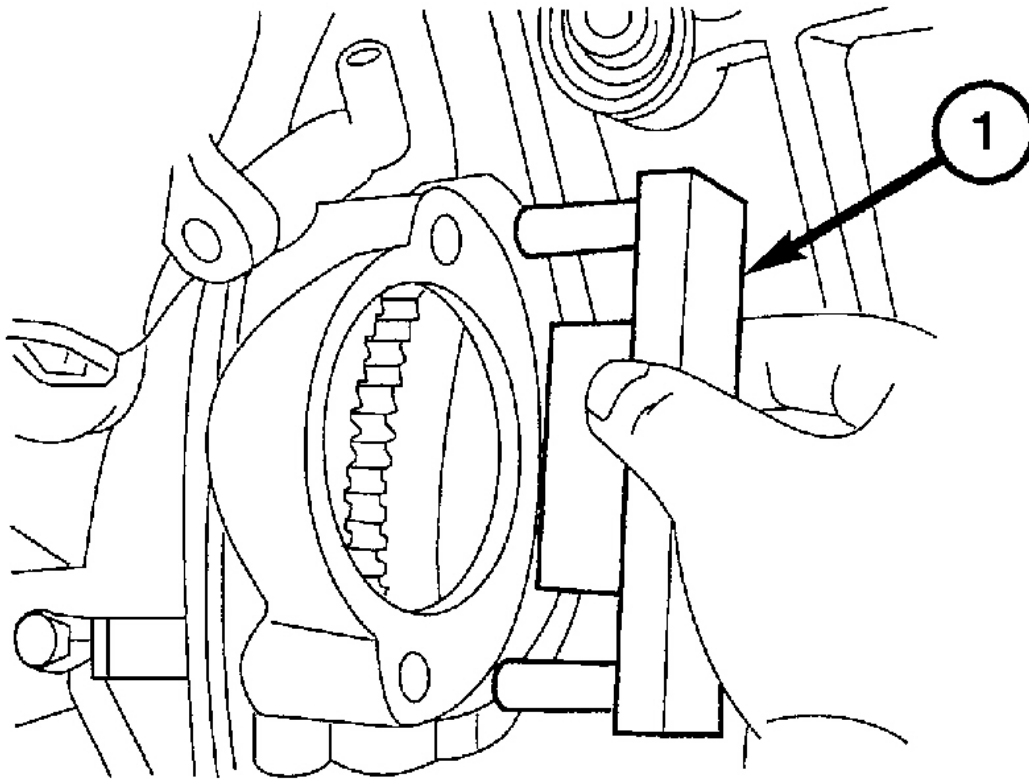
1. Position the flywheel/flexplate (3) and align on the crankshaft pin.
2. Install the spacer and new flywheel/flexplate bolts (1). Tighten bolts to 45 N.m (33 ft. lbs.)



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Fig. 145: Installing Flywheel/Flexplate, Spacer & Bolts
Courtesy of DAIMLERCHRYSLER CORP.

3. Rotate the flywheel/flexplate bolts an additional 90° clockwise.
4. Install the clutch if equipped. See **CLUTCHES** article.
5. Remove Special Tool 9102 Flywheel Locking Tool (1).



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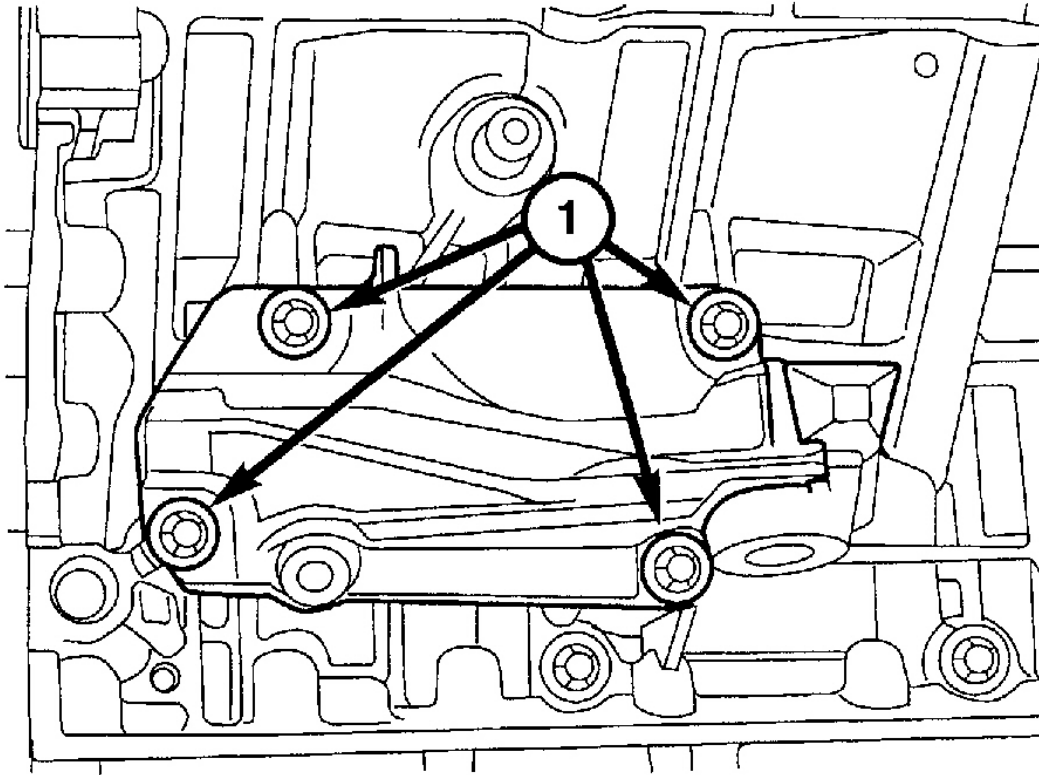
Fig. 146: Removing Flywheel Locking Tool
Courtesy of DAIMLERCHRYSLER CORP.

6. Install the starter. See STARTERS article.
7. Install the transmission. For automatic, see REMOVAL & INSTALLATION article and for manual, see REMOVAL & INSTALLATION article.

ENGINE MOUNT BRACKETS

REMOVAL

1. Remove the engine mount. See FRONT MOUNT.
2. Remove and discard the engine mount bracket bolts (1).
3. Remove the engine mount bracket.

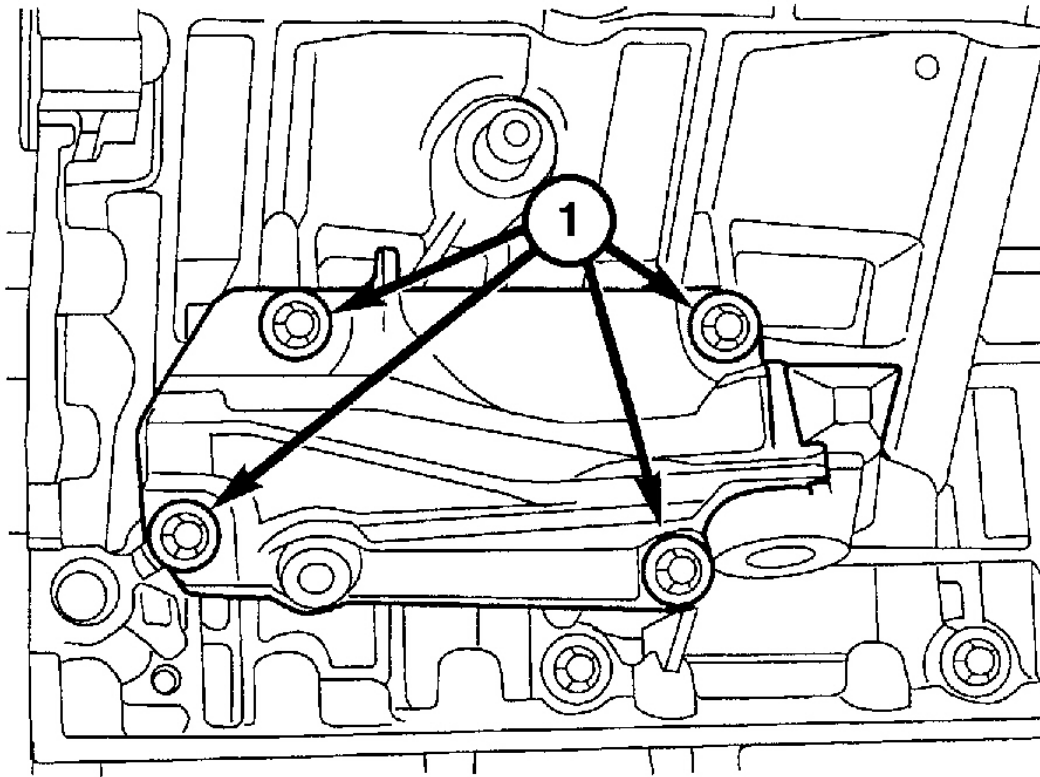


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Fig. 147: Removing Engine Mount Bracket Bolts
Courtesy of DAIMLERCHRYSLER CORP.

INSTALLATION

1. Position the engine mount brackets on the engine block.
2. Install the new bolts (1) and tighten to 20 N.m (15 ft. lbs.)



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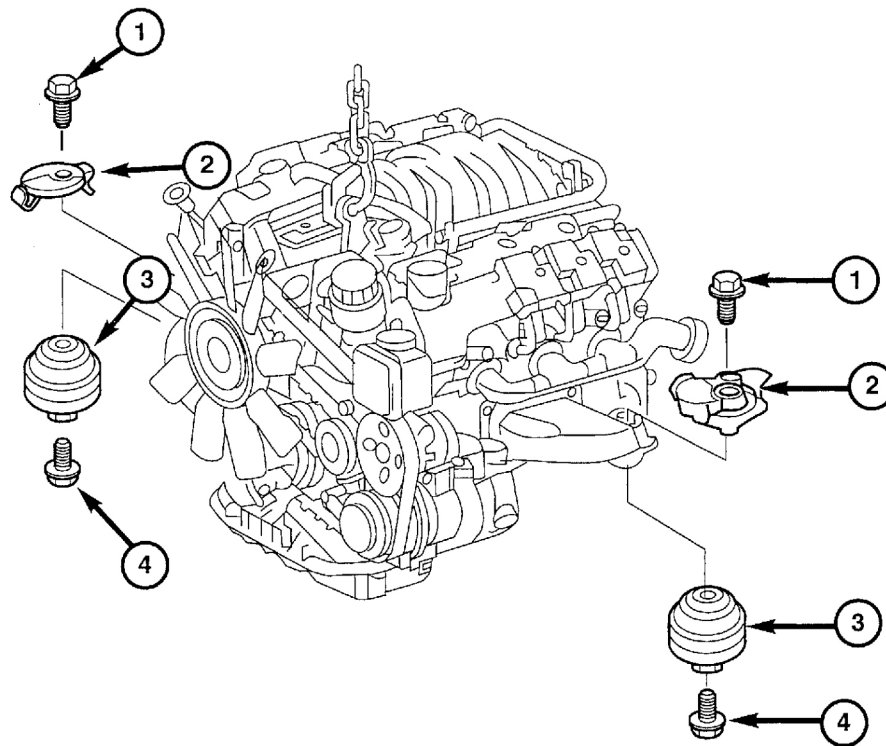
Fig. 148: Installing Engine Mount Bolts
Courtesy of DAIMLERCHRYSLER CORP.

3. Rotate the bolts an additional 90° clockwise.
4. Install the engine mounts. See **FRONT MOUNT**.

FRONT MOUNT

REMOVAL

1. Disconnect the negative battery cable.
2. Remove the air cleaner housing. See **AIR CLEANER HOUSING**.
3. Attach the engine support frame.
4. Remove the engine mount upper bolt (1) and the heat shield (2).



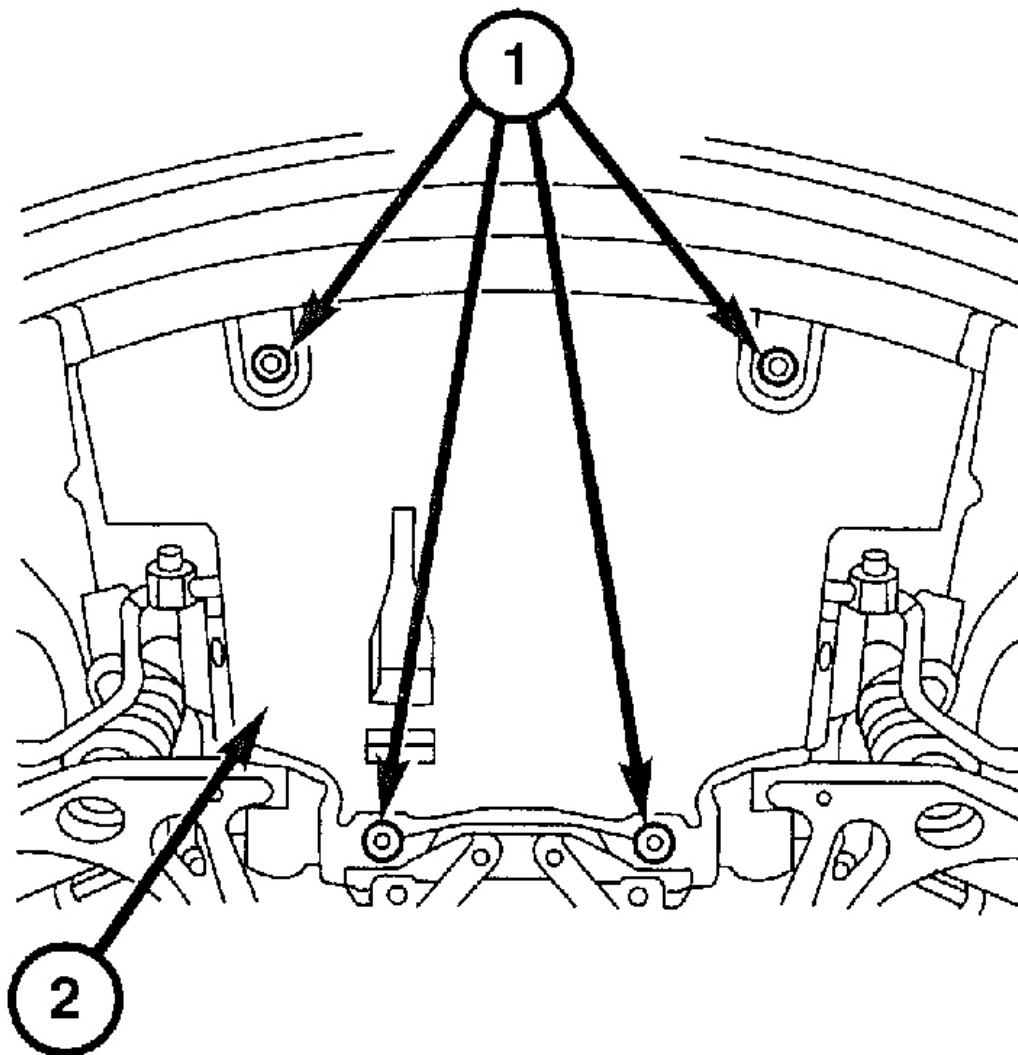
1 - ENGINE MOUNT UPPER BOLT
2 - HEAT SHIELD
G01860646

3 - ENGINE MOUNT
4 - ENGINE MOUNT LOWER BOLT

Fig. 149: Removing Engine Front Mount
Courtesy of DAIMLERCHRYSLER CORP.

CAUTION: Do not stretch lines and hoses while lifting engine.

5. Raise the engine slightly.
6. Raise and support the vehicle.
7. Remove the lower splash shield screws (1) and the splash shield.



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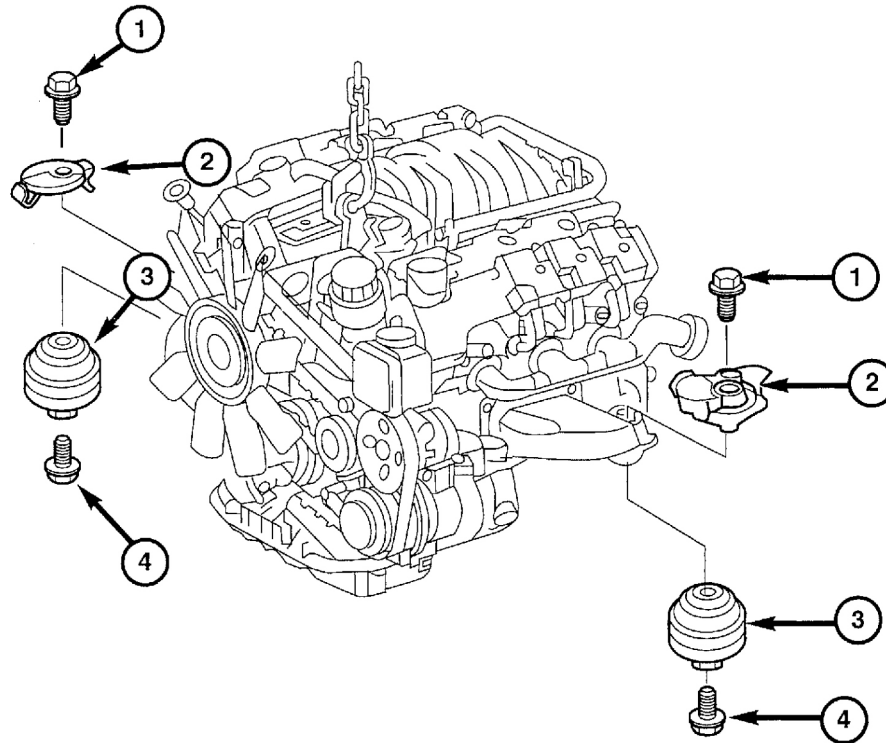
Fig. 150: Removing Lower Splash Shield Screws & Splash Shield
Courtesy of DAIMLERCHRYSLER CORP.

8. Remove the engine mount lower bolt.
9. Remove the engine mount.

INSTALLATION

NOTE: The arrows on the engine mounts must be located in the retaining slots on the engine bracket.

1. Position the engine mount (3) on the crossmember.



1 - ENGINE MOUNT UPPER BOLT
2 - HEAT SHIELD
G01860648

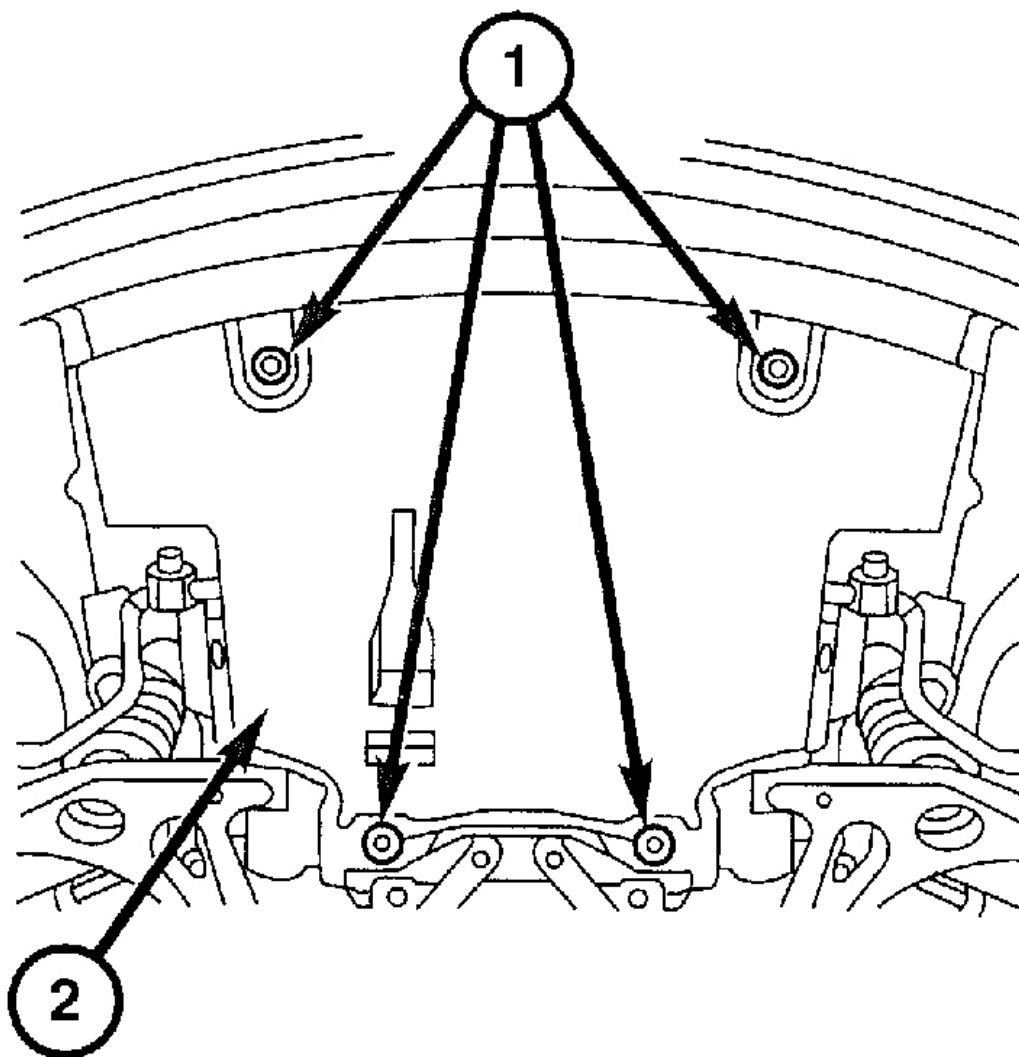
3 - ENGINE MOUNT
4 - ENGINE MOUNT LOWER BOLT

Fig. 151: Installing Engine Front Mount
Courtesy of DAIMLERCHRYSLER CORP.

2. Install the engine mount lower bolt (4). Tighten the bolt to 35 N.m (26 ft. lbs.).

NOTE: The recesses of the heat shield must be located in the anti twist slots of the engine bracket.

3. Lower the engine onto the engine mount. Install the heat shield (2) and the engine mount upper bolt (1).
4. Tighten the engine mount upper bolt (1) to 55 N.m (41 ft. lbs.).
5. Install the lower splash shield and screws (1). Tighten to 7 N.m (5 ft. lbs.).



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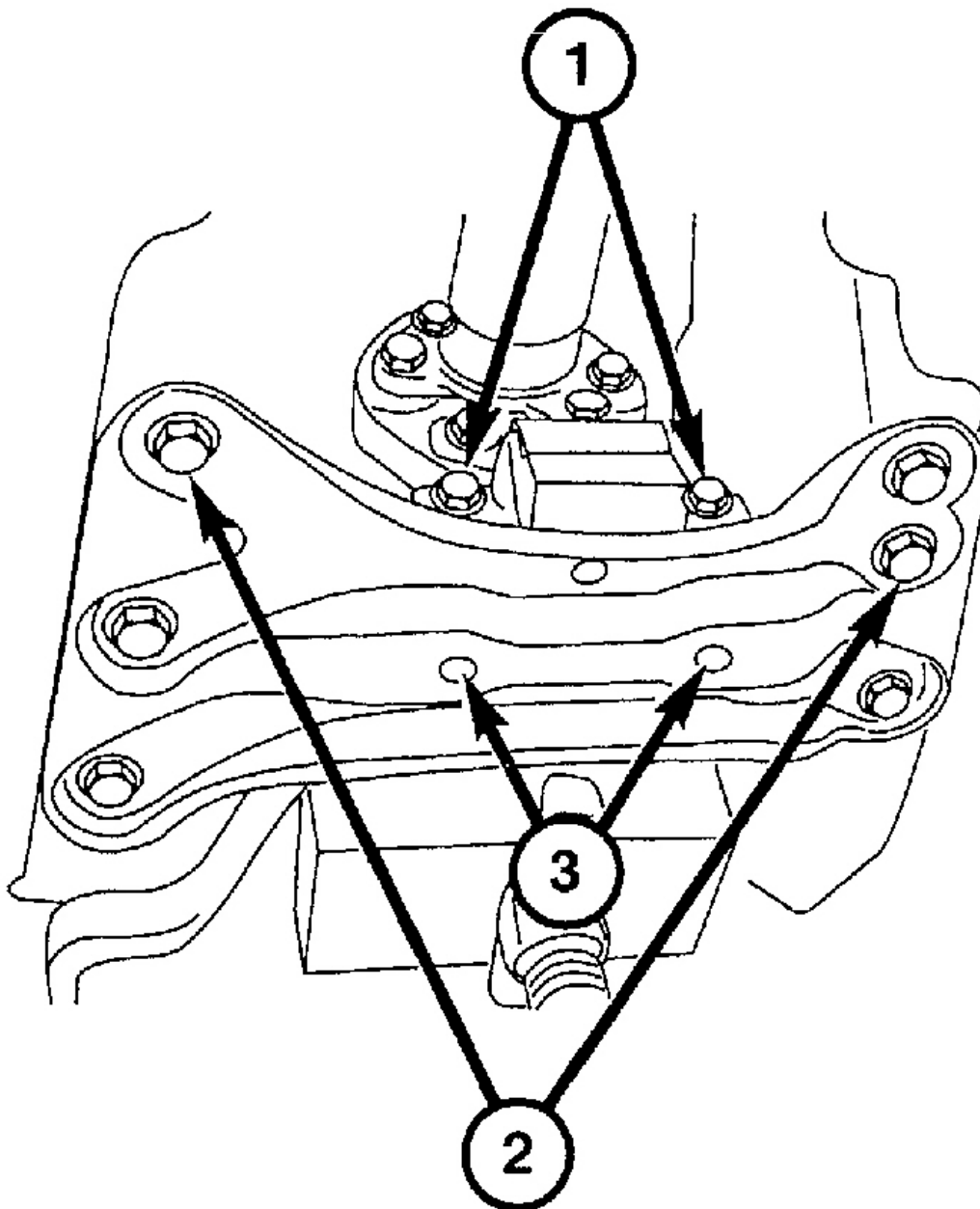
Fig. 152: Installing Lower Splash Shield & Screws
Courtesy of DAIMLERCHRYSLER CORP.

6. Lower the vehicle.
7. Remove the engine support frame from the engine.
8. Install the air cleaner housing. See **AIR CLEANER HOUSING**.
9. Connect the negative battery cable.

REAR MOUNT

REMOVAL

1. Raise and support the vehicle.
2. Support the transmission with a transmission jack.
3. Remove the rear mount lower bolts (3).
4. Raise the transmission slightly off of the rear crossmember.
5. Remove the rear mount upper bolts (1).
6. Remove the rear mount.

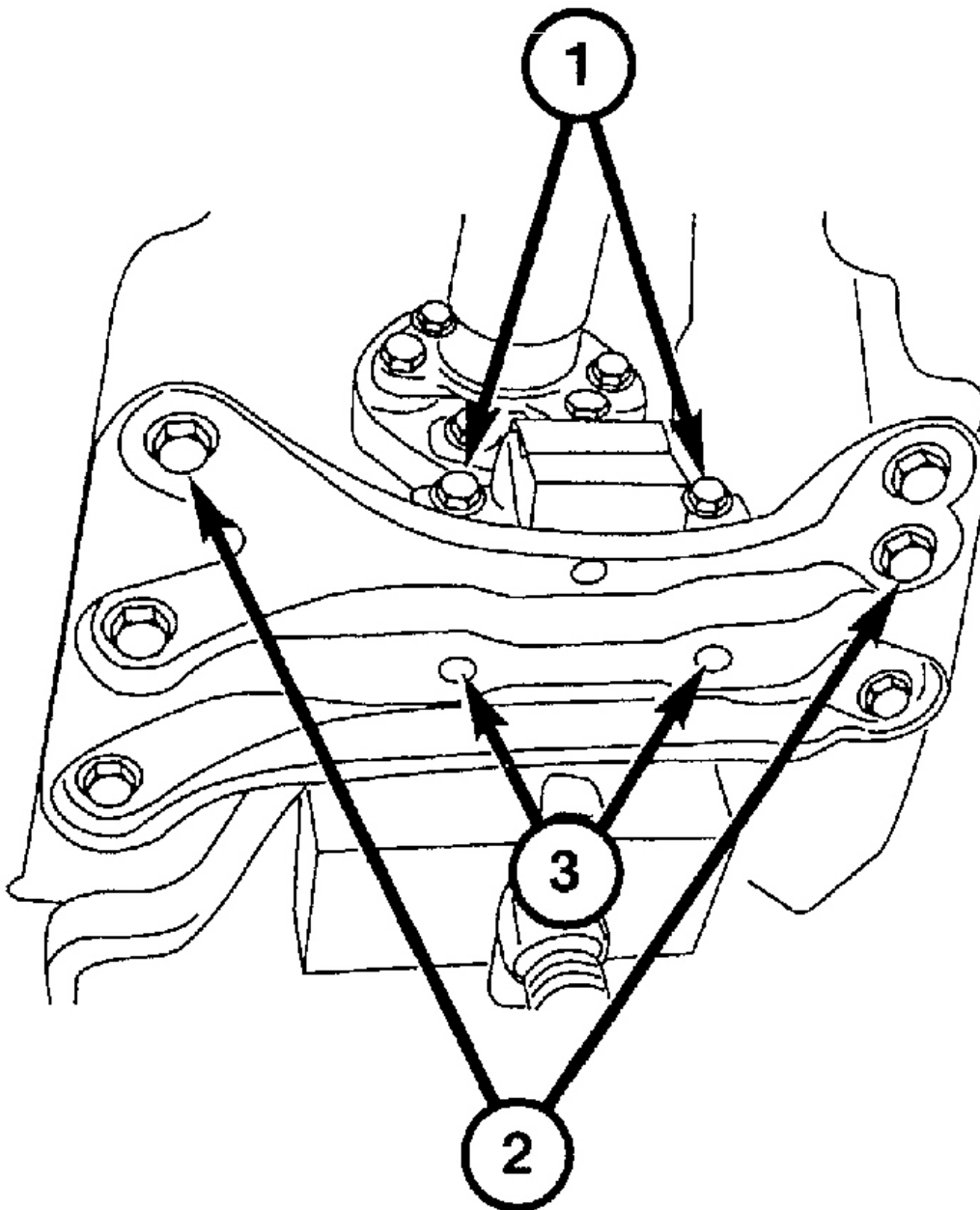


G01860650

Fig. 153: Removing Rear Mount
 Courtesy of DAIMLERCHRYSLER CORP.

INSTALLATION

1. Position the rear mount on the transmission.
2. Install the rear mount upper bolts (1). Tighten the bolts to 40 N.m (30 ft. lbs.).



G01860651

Fig. 154: Installing Rear Mount

Courtesy of DAIMLERCHRYSLER CORP.

3. Lower the transmission on to the rear crossmember.
4. Install the rear mount lower bolts (3). Tighten the bolts to 40 N.m (30 ft. lbs.).
5. Remove the transmission jack.
6. Lower the vehicle.

LUBRICATION**DESCRIPTION**

The engine lubrication system is a full-flow filtration, pressure feed type. The oil pump body is mounted to the engine block. The pump inner rotor is driven by the crankshaft.

DIAGNOSIS AND TESTING**ENGINE OIL LEAK INSPECTION**

Begin with a thorough visual inspection of the engine, particularly at the area of the suspected leak. If an oil leak source is not readily identifiable, the following steps should be followed:

1. Do not clean or degrease the engine at this time because some solvents may cause rubber to swell, temporarily stopping the leak.
2. Add an oil soluble dye (use as recommended by manufacturer). Start the engine and let idle for approximately 15 minutes. Check the oil dipstick to make sure the dye is thoroughly mixed as indicated with a bright yellow color under a black light.
3. Using a black light, inspect the entire engine for fluorescent dye, particularly at the suspected area of oil leak. If the oil leak is found and identified, repair as necessary.
4. If dye is not observed, drive the vehicle at various speeds for approximately 24 km (15 miles), and repeat inspection.
5. **If the oil leak source is not positively identified at this time**, proceed with the air leak detection test method as follows:
 - Disconnect the fresh air hose (make-up air) at the cylinder head cover and plug or cap the nipple on the cover.
 - Remove the vent hose from the cylinder head cover. Cap or plug the nipple on the cover.
 - Attach an air hose with pressure gauge and regulator to the oil level indicator tube.

CAUTION: Do not subject the crankcase to more than 20.6 kpa (3 PSI) of test pressure.

- Gradually apply air pressure from 1 psi to 2.5 psi maximum while applying soapy water at the suspected source. Adjust the regulator to the suitable test pressure that provides the best bubbles which will pinpoint the leak source: If the oil leak is detected and identified, repair per service manual procedures.

- If the leakage occurs at the crankshaft rear seal area, refer to **INSPECTION FOR REAR SEAL AREA LEAKS**.
6. If no leaks are detected, turn off the air supply. Remove the air hose, all plugs, and caps. Install the vent hose and proceed to next step.
 7. Clean the oil off the suspect oil leak area using a suitable solvent. Drive the vehicle at various speeds approximately 24 km (15 miles). Inspect the engine for signs of an oil leak by using a black light.

INSPECTION FOR REAR SEAL AREA LEAKS

Since it is sometimes difficult to determine the source of an oil leak in the radial seal area of the engine, a more involved inspection is necessary. The following steps should be followed to help pinpoint the source of the leak.

If the leakage occurs at the crankshaft radial oil seal area:

1. Disconnect the battery.
2. Raise the vehicle.
3. Remove torque converter or clutch housing cover and inspect rear of block for evidence of oil. Use a black light to check for the oil leak. If a leak is present in this area, remove transmission for further inspection.
 - a. Circular spray pattern generally indicates seal leakage or crankshaft damage.
 - b. Where leakage tends to run straight down, possible causes are a porous block, oil gallery cup plug, bedplate to cylinder block mating surfaces and seal bore. See proper repair procedures for these items.

CAUTION: Do not exceed 20.6 kPa (3 psi).

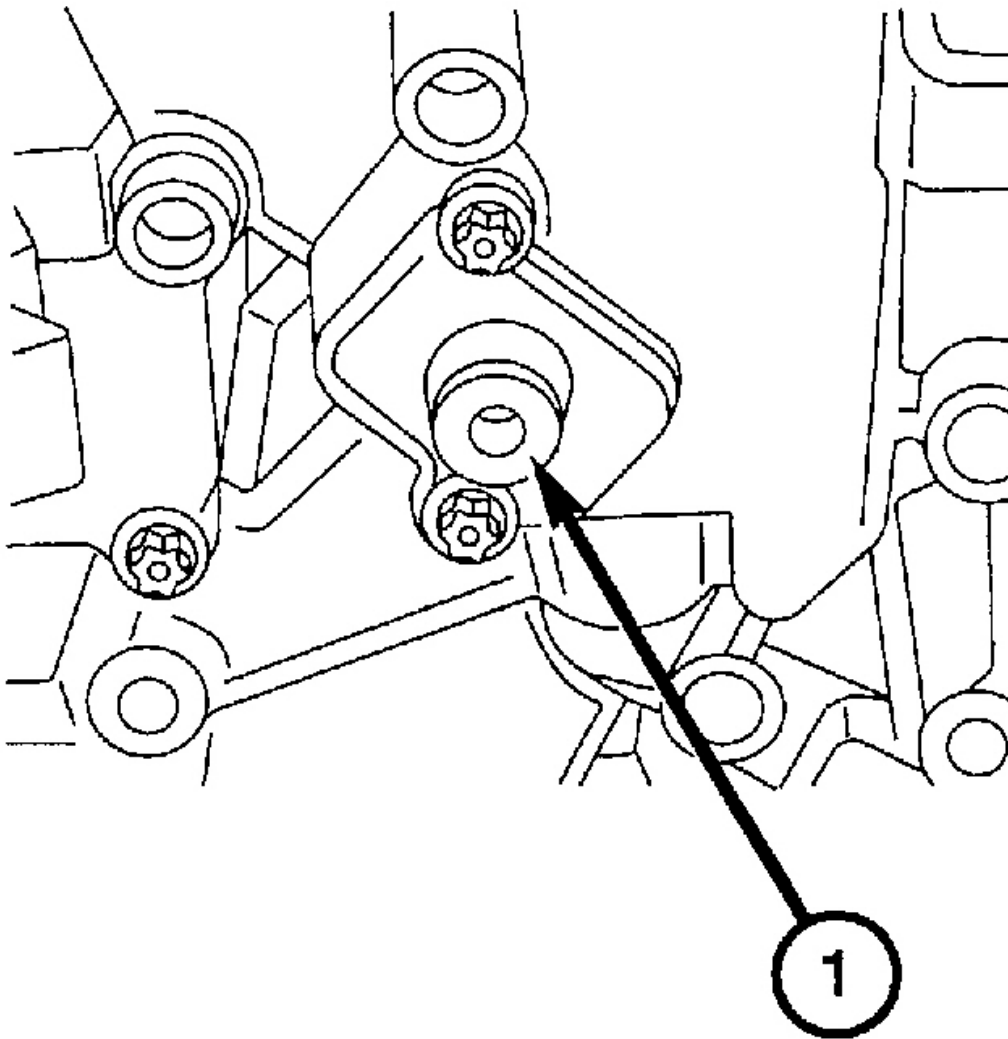
4. If no leaks are detected, pressurize the crankcase as previously described.

CAUTION: Use extreme caution when crankshaft polishing is necessary to remove minor nicks and scratches. The crankshaft radial seal flange is especially machined to complement the function of the rear oil seal.

5. If the leak is not detected, very slowly turn the crankshaft and watch for leakage. If a leak is detected between the crankshaft and seal while slowly turning the crankshaft, it is possible the crankshaft seal surface is damaged. The seal area on the crankshaft could have minor nicks or scratches that can be polished out with emery cloth.
6. For bubbles that remain steady with shaft rotation, no further inspection can be done until disassembled.
7. After the oil leak root cause and appropriate corrective action have been identified, replace component(s) as necessary.

DIAGNOSIS AND TESTING - CHECKING ENGINE OIL PRESSURE

1. Remove the oil pressure testing plug (1) at the base of the oil filter housing.



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Fig. 155: Removing Oil Pressure Testing Plug
Courtesy of DAIMLERCHRYSLER CORP.

2. Install oil pressure test gauge assembly.
3. Start the engine and monitor the gauge readings.

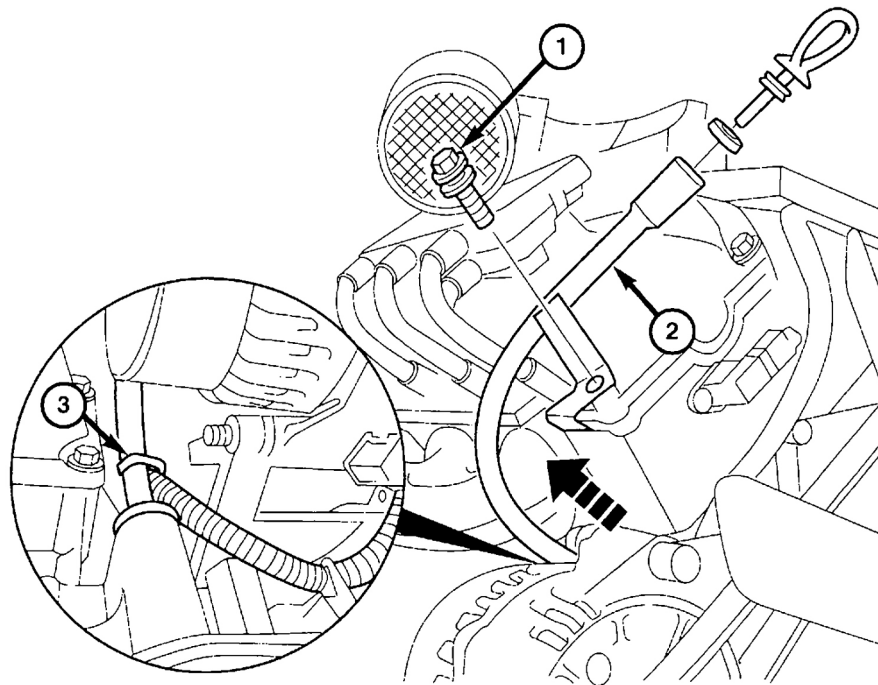
CAUTION: If oil pressure is 0 at idle, Do Not Run engine at 3000 RPM.

4. Oil pressure (engine at operating temperature): **Curb Idle** 34.5 kPa (5 psi) minimum **3000 RPM** 300-724 kPa (45-105 psi).
5. If the oil pressure is 0 psi at idle, shut the off engine and check the pressure relief valve; it may be stuck open or have a clogged oil pickup screen.
6. Install the oil pressure test plug and tighten to 10 N.m (89 in. lbs.) after testing is completed.

OIL LEVEL INDICATOR TUBE

REMOVAL

1. Remove the air cleaner housing. See **AIR CLEANER HOUSING**.
2. Remove the bolt (1) in the cylinder head cover for the oil level indicator tube (2).
3. Remove the cable tie strap (3) holding the wire loom on the oil level indicator tube.
4. Pull up and remove the oil level indicator tube (2) from the engine.



1 - BOLT
2 - OIL LEVEL INDICATOR TUBE
G01860653

3 - CABLE TIE STRAP

Fig. 156: Removing Oil Level Indicator Tube
Courtesy of DAIMLERCHRYSLER CORP.

INSTALLATION

1. Replace the oil level indicator tube seal and lubricate with engine oil.

NOTE: **The oil level indicator tube must be fully seated or oil leaks can occur.**

2. Position the oil level indicator tube (2) and install it in the crankcase.
3. Install the bolt (1) in the cylinder head cover and tighten to 10 N.m (89 in. lbs.).
4. Position the wire harness loom at the oil level indicator tube and fasten with new cable tie (3).
5. Install the air cleaner housing. See **AIR CLEANER HOUSING**.
6. Start the engine and check for leaks.

OIL

DESCRIPTION

For complete engine oil type and capacity specifications, see maintenance section of the Owners Manual.

STANDARD PROCEDURE

ENGINE OIL LEVEL CHECK

The best time to check engine oil level is after it has sat overnight. Or if the engine has been running, allow the engine to be shut off for at least 5 minutes before checking the oil level.

Checking the oil while the vehicle is on level ground will improve the accuracy of the oil level reading. Add only when the level is at or below the ADD mark.

ENGINE OIL AND FILTER CHANGE

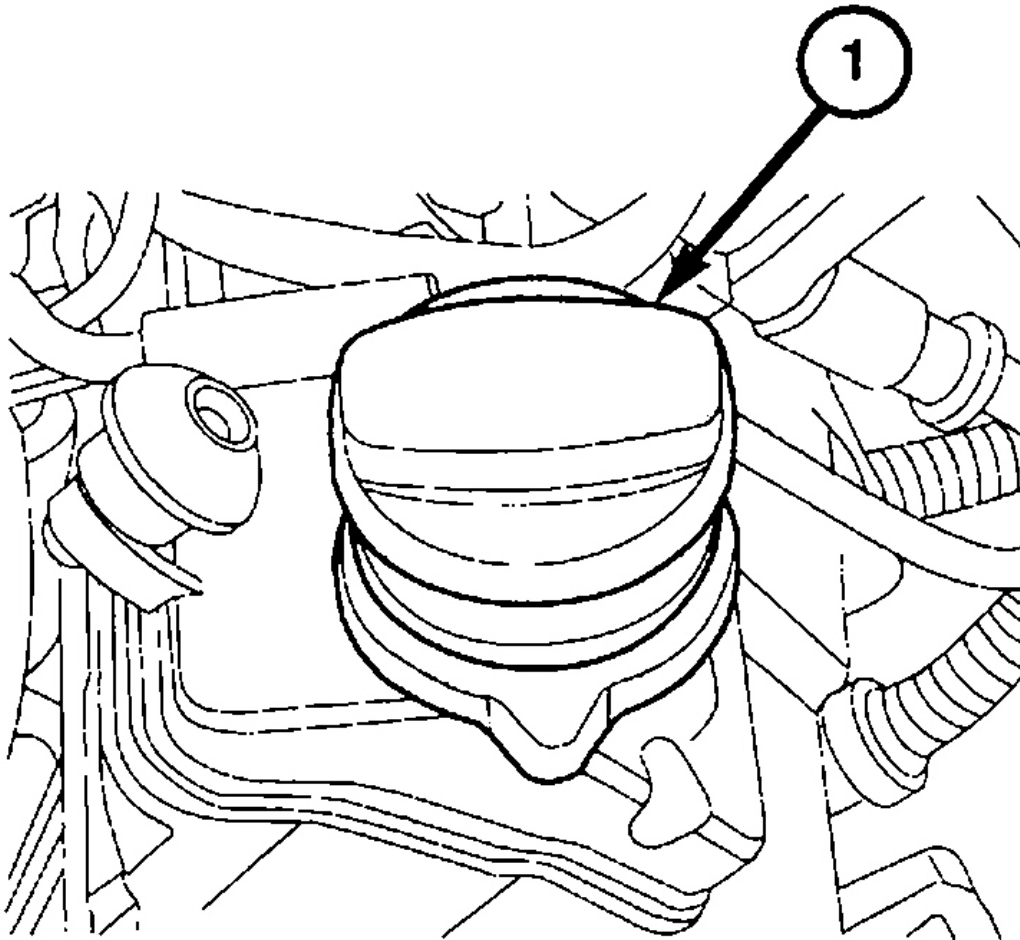
WARNING: NEW OR USED ENGINE OIL CAN BE IRRITATING TO THE SKIN. AVOID PROLONGED OR REPEATED SKIN CONTACT WITH ENGINE OIL. CONTAMINANTS IN USED ENGINE OIL, CAUSED BY INTERNAL COMBUSTION, CAN BE HAZARDOUS TO YOUR HEALTH. THOROUGHLY WASH EXPOSED SKIN WITH SOAP AND WATER. DO NOT WASH SKIN WITH GASOLINE, DIESEL FUEL, THINNER, OR SOLVENTS, HEALTH PROBLEMS CAN RESULT. DO NOT POLLUTE, DISPOSE OF USED ENGINE OIL PROPERLY. CONTACT YOUR DEALER OR GOVERNMENT AGENCY FOR LOCATION OF COLLECTION CENTER IN YOUR AREA.

Change the engine oil at the mileage and time intervals described in the maintenance section of the Owners Manual.

TO CHANGE ENGINE OIL

1. Run the engine until achieving normal operating temperature.
2. Position the vehicle on a level surface and turn the engine off.

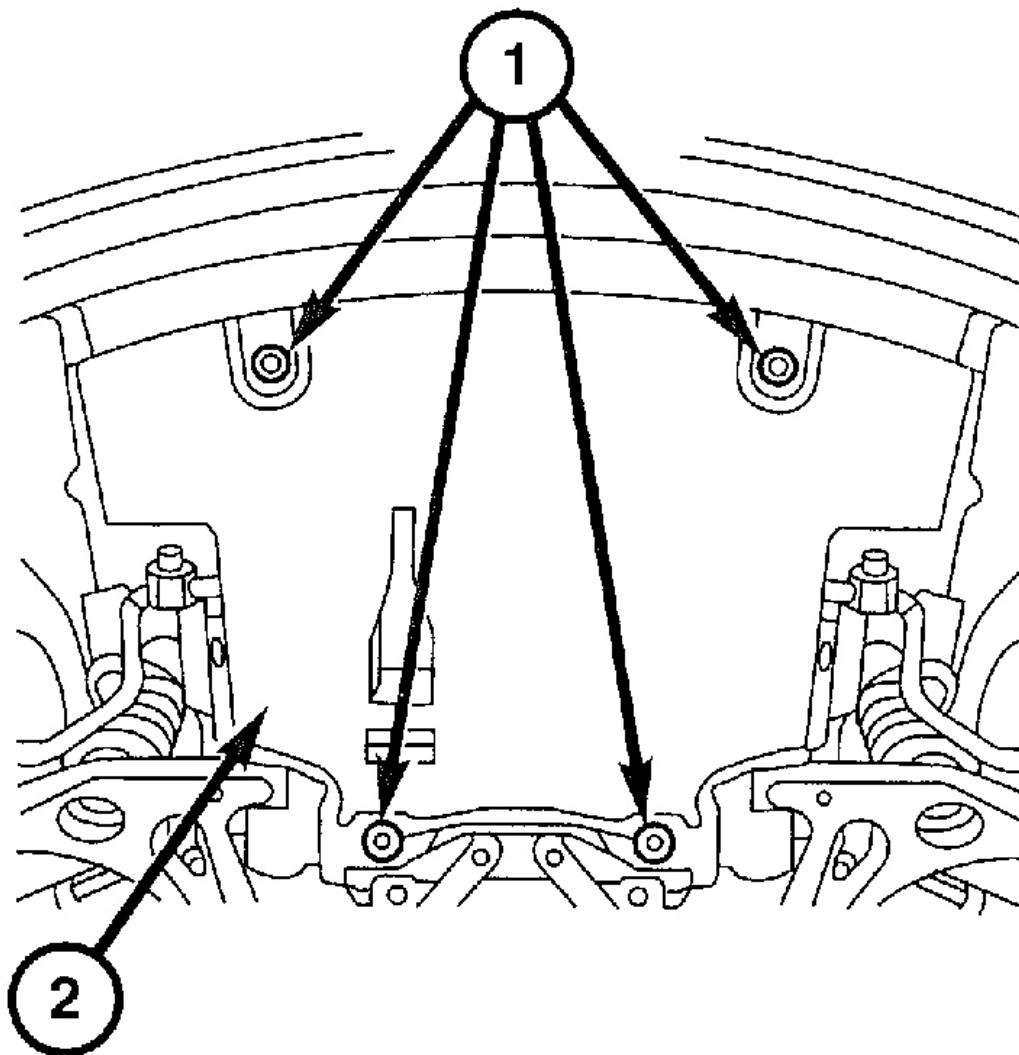
3. Remove the oil filler cap (1).



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Fig. 157: Removing Oil Filler Cap
Courtesy of DAIMLERCHRYSLER CORP.

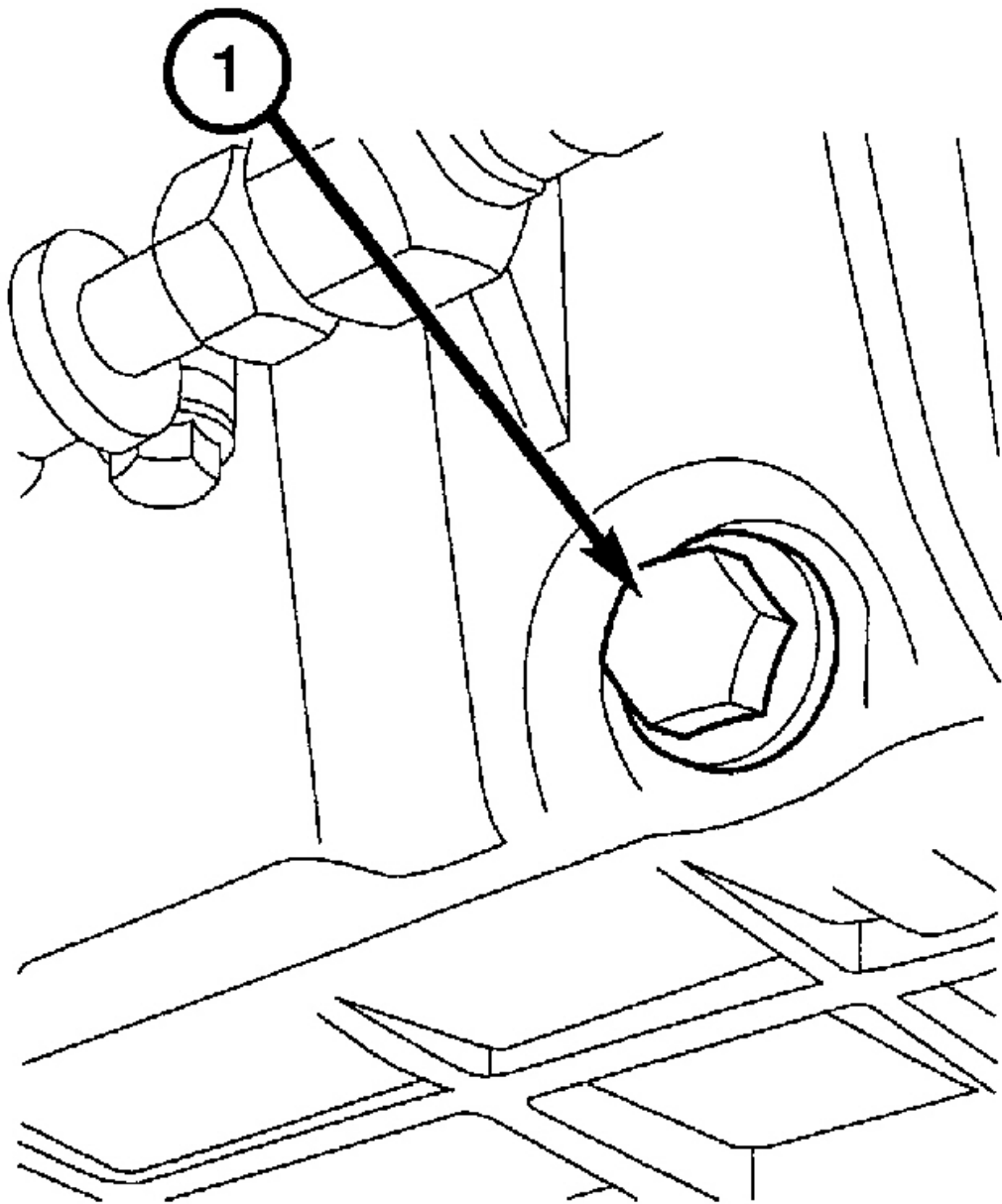
4. Raise and support the vehicle.
5. Remove the lower splash shield screws (1) and the shield.



G01860655

Fig. 158: Removing Lower Splash Shield Screws & Shield
Courtesy of DAIMLERCHRYSLER CORP.

6. Place a suitable drain pan under the crankcase drain.
7. Remove the drain plug from the crankcase and allow the oil to drain into the pan. Inspect the drain plug threads for stretching or other damage. Replace the drain plug and gasket if damaged.
8. Remove the oil filter. See **OIL FILTER**.
9. Install the drain plug (1) and tighten to 30 N.m (22 ft. lbs.).



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Fig. 159: Installing Drain Plug**Courtesy of DAIMLERCHRYSLER CORP.**

10. Install the lower splash shield. Tighten to 7 N.m (5 ft. lbs.).
11. Lower the vehicle and fill the crankcase with specified type and amount of engine oil.

12. Install a new oil filter. See **OIL FILTER**.
13. Install the oil filler cap.
14. Start the engine and inspect for leaks.
15. Turn off the engine and inspect the oil level.

USED ENGINE OIL DISPOSAL

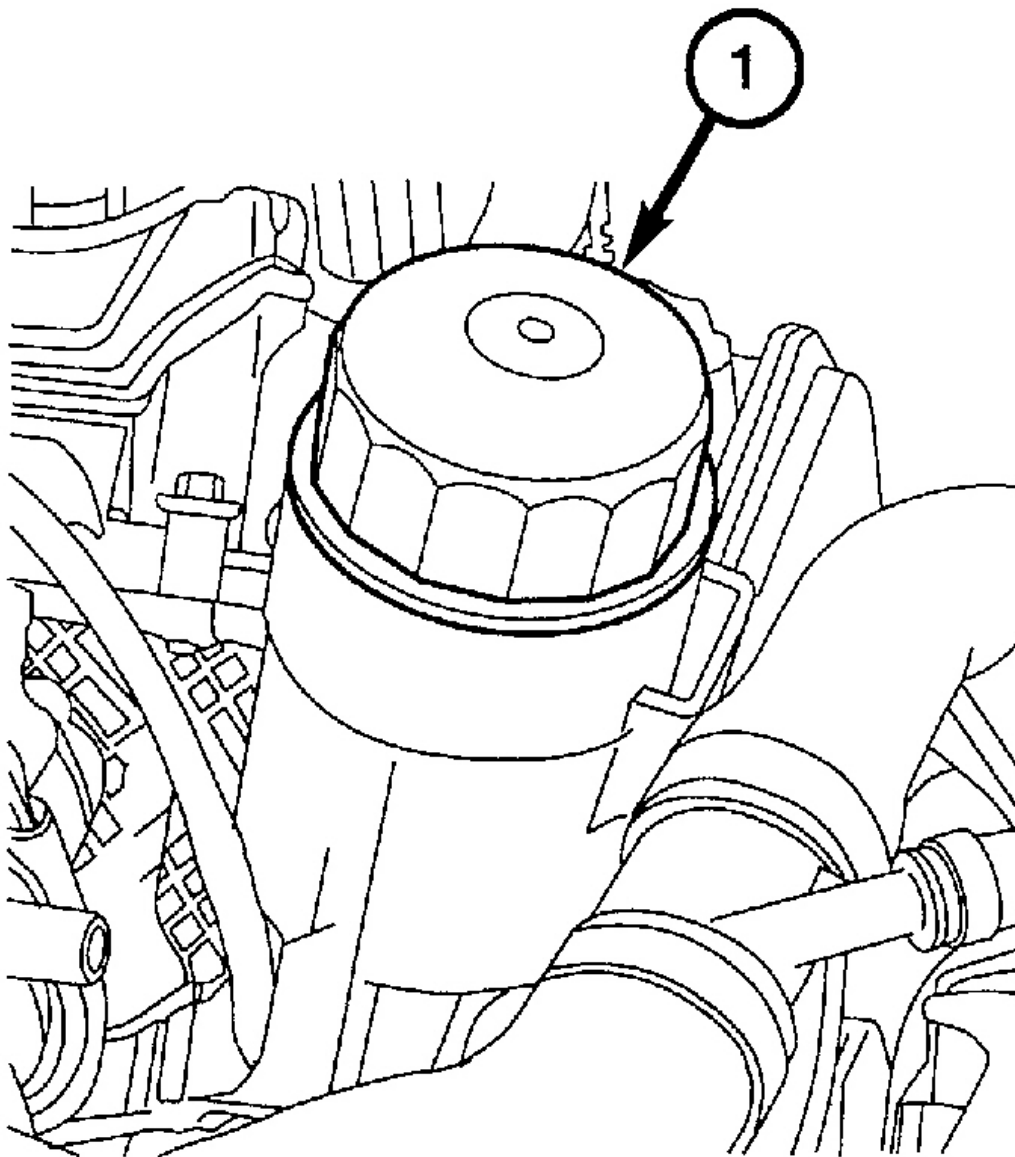
Care should be exercised when disposing used engine oil after it has been drained from a vehicle engine. See the warning above for common practices and recommendations.

OIL FILTER**DESCRIPTION**

The oil filter is mounted on the upper side of the front of the engine. It uses a replaceable element that can be incinerated.

REMOVAL

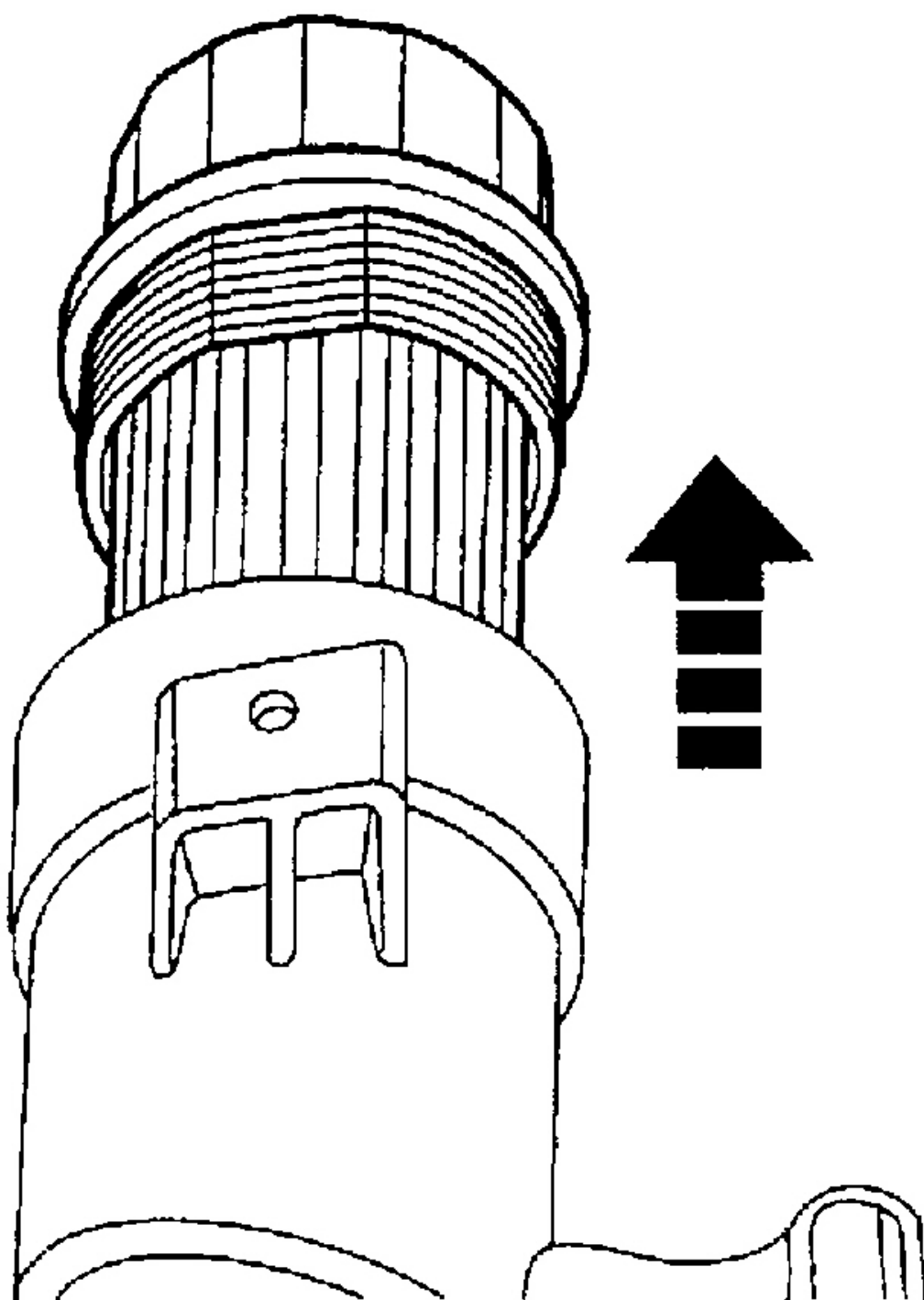
1. Use an oil filter wrench if necessary to remove the oil filter cap (1).



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Fig. 160: Removing Oil Filter Cap
Courtesy of DAIMLERCHRYSLER CORP.

2. Remove oil filter cap with the filter.
3. Remove the oil filter.



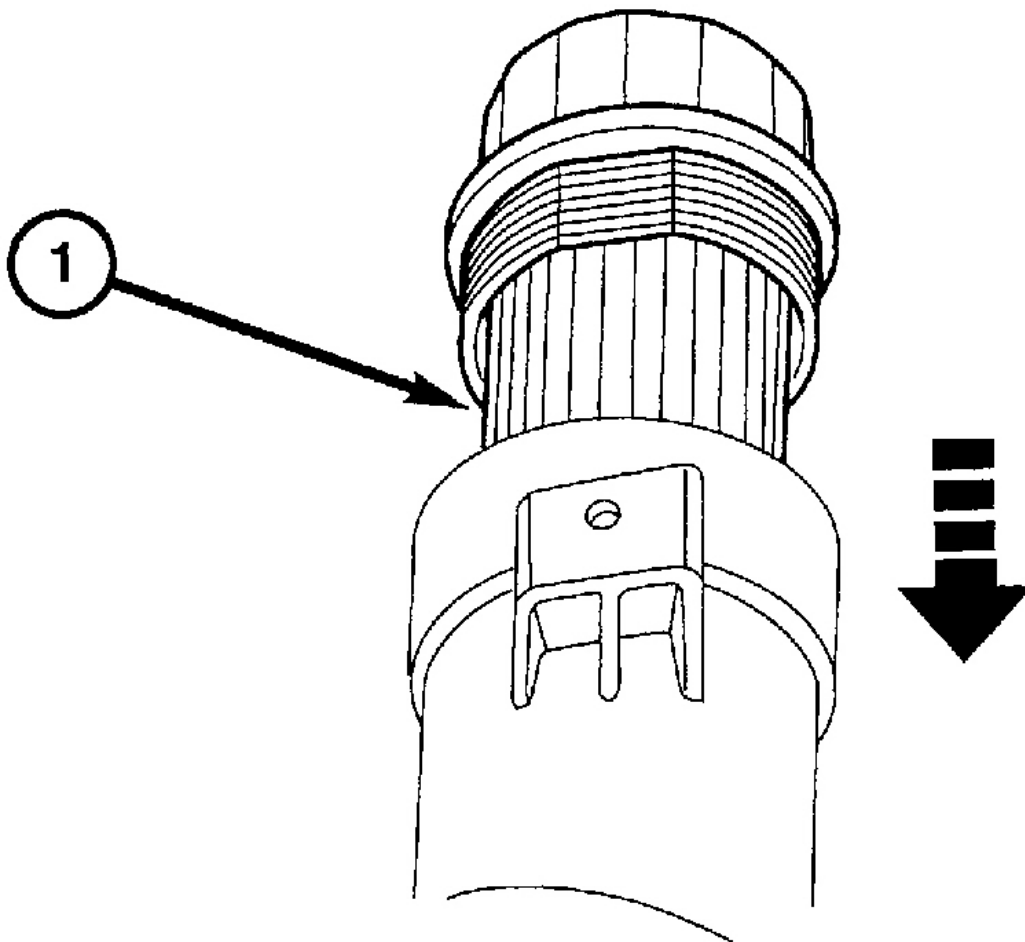
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Fig. 161: Removing Oil Filter

Courtesy of DAIMLERCHRYSLER CORP.

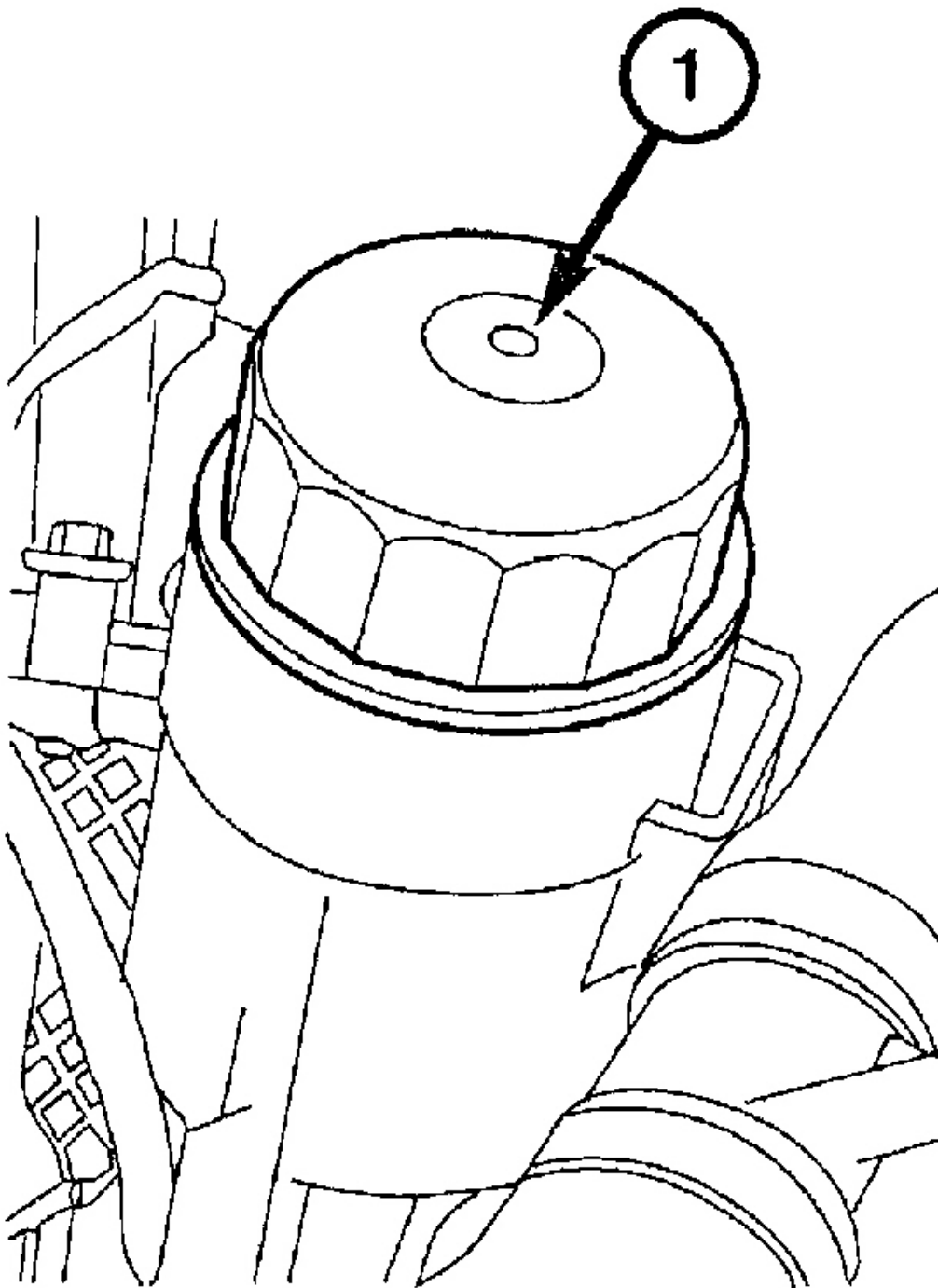
INSTALLATION

1. Replace the oil filter cap seal.
2. Install a new filter (1) in the cap.

**G01860659****Fig. 162: Installing New Filter In Cap**

Courtesy of DAIMLERCHRYSLER CORP.

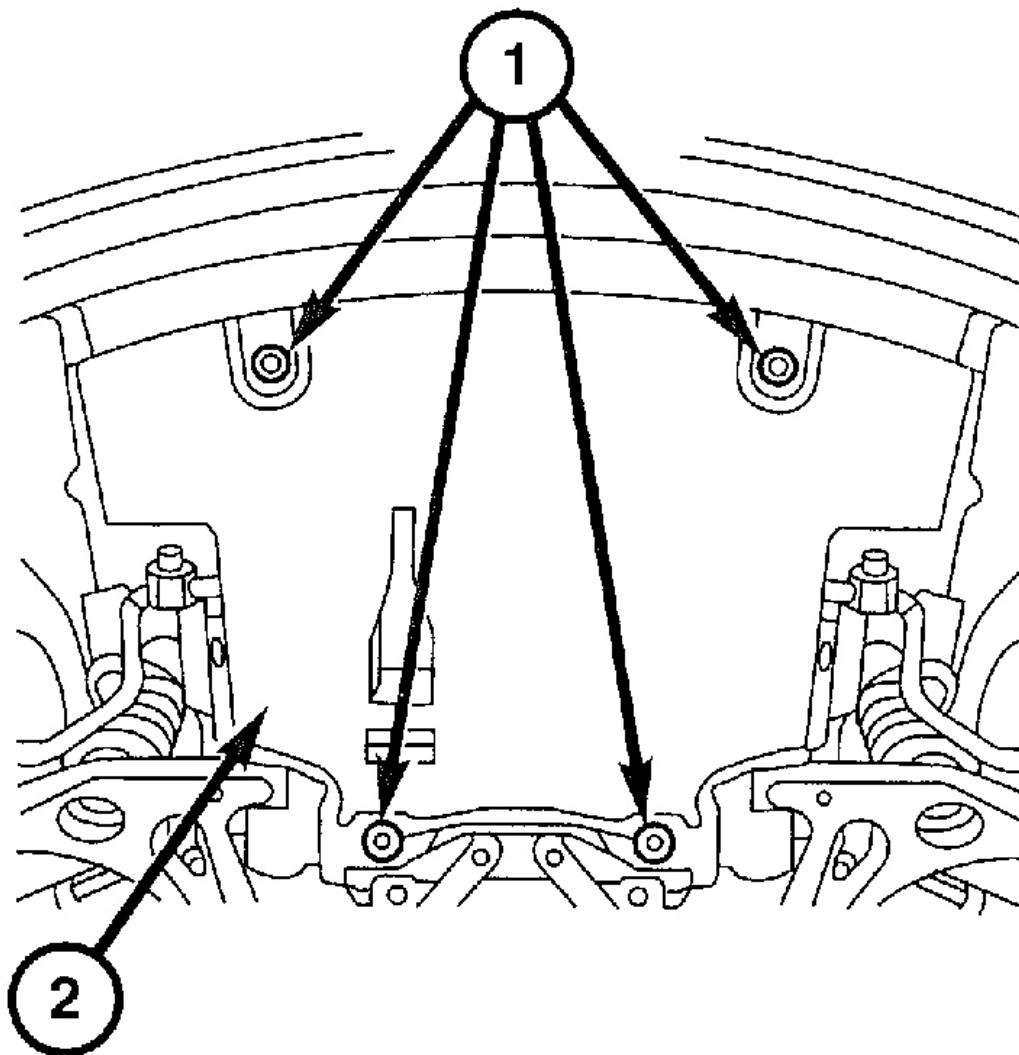
3. Install the filter and cap (1) and tighten to 25 N.m (18 ft. lbs.).



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Fig. 163: Installing Filter & Cap**Courtesy of DAIMLERCHRYSLER CORP.****OIL PAN****REMOVAL****LOWER OIL PAN**

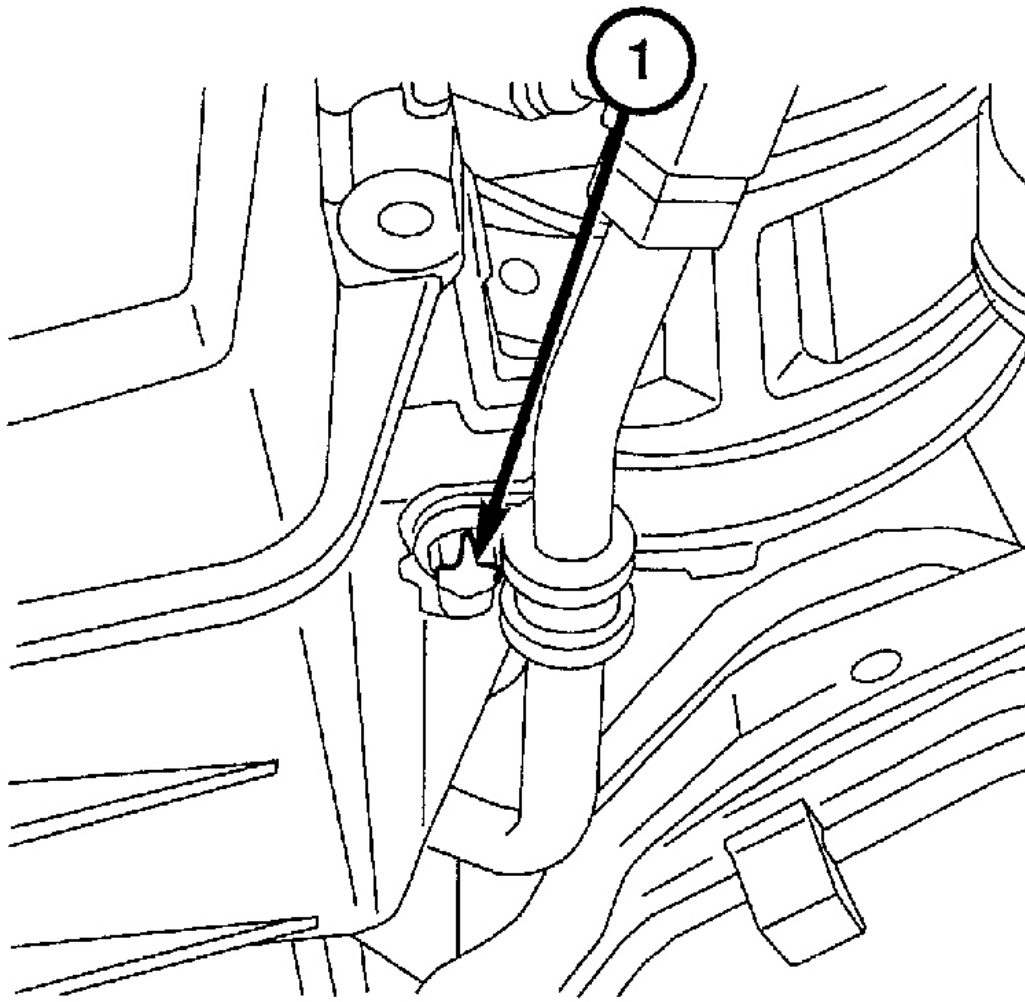
1. Drain the engine oil. See **OIL**.
2. Remove the lower splash shield screws (1) and the splash shield.



G01860661

Fig. 164: Removing Lower Splash Shield Screws & Splash Shield
Courtesy of DAIMLERCHRYSLER CORP.

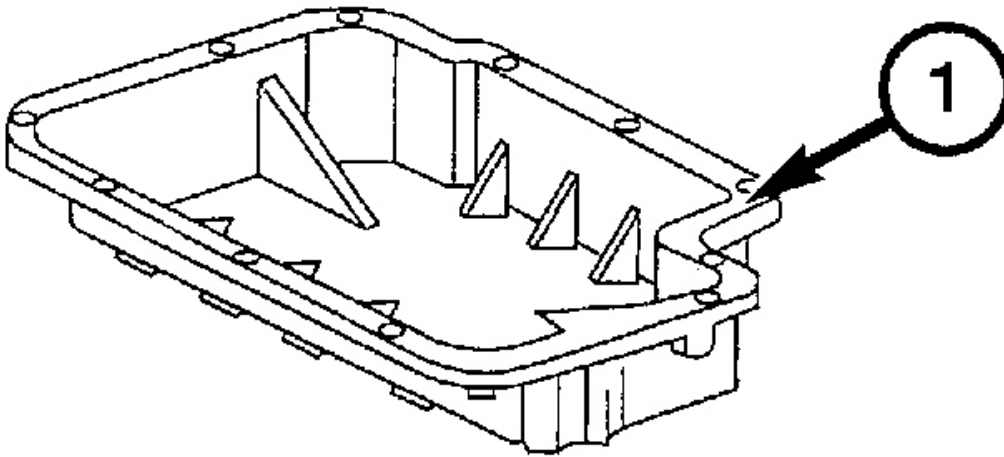
3. Remove the transmission oil cooler line retainer bolts (1) Position the cooler lines aside.



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Fig. 165: Removing Transmission Oil Cooler Line Retainer Bolts
Courtesy of DAIMLERCHRYSLER CORP.

4. Remove the lower oil pan retaining bolts and the lower oil pan (1).

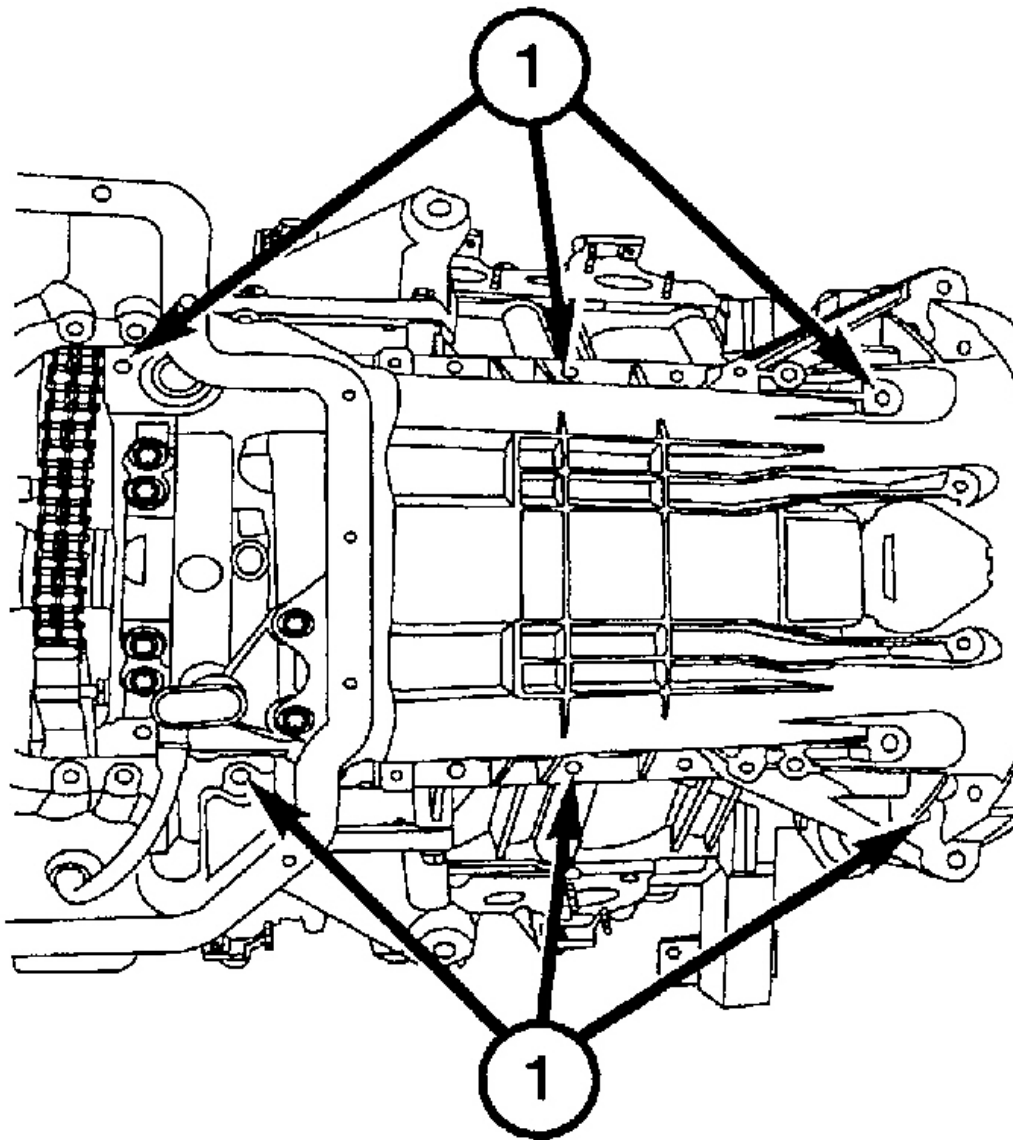


G01860663

Fig. 166: Removing Lower Oil Pan Retaining Bolts & Lower Oil Pan
Courtesy of DAIMLERCHRYSLER CORP.

REMOVAL - UPPER OIL PAN

1. Remove the engine. See **REMOVAL**.
2. Separate the transmission from the engine. For automatic, see **REMOVAL & INSTALLATION** article and for manual, see **REMOVAL & INSTALLATION** article.
3. Remove the clutch if equipped. See **CLUTCHES** article.
4. Mount the engine on an engine stand.
5. Remove the lower oil pan. See **LOWER OIL PAN**.
6. Remove the 24 upper oil pan bolts (1).
7. Separate the upper oil pan from the engine block.



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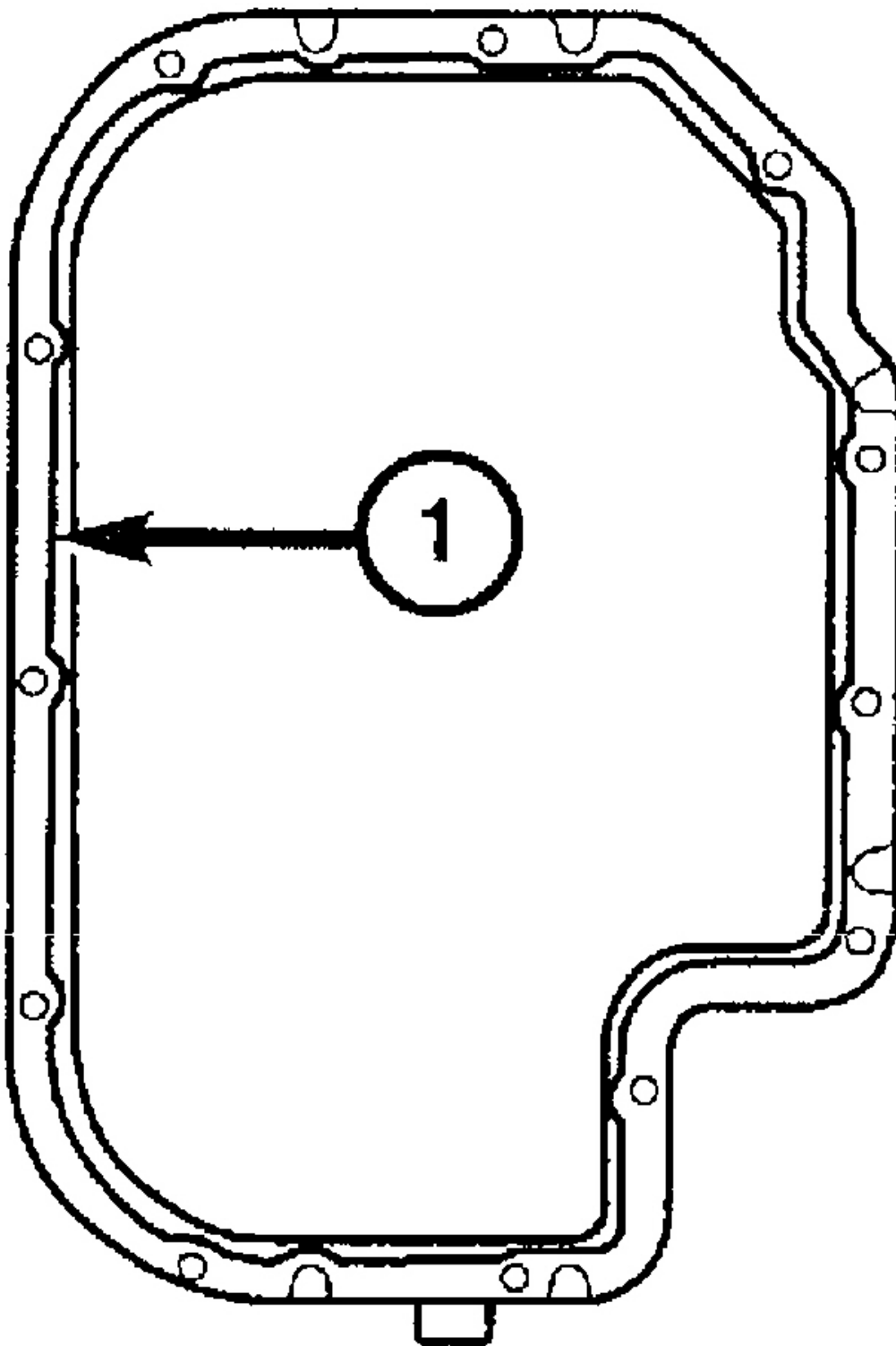
Fig. 167: Removing Upper Oil Pan Bolts
Courtesy of DAIMLERCHRYSLER CORP.

INSTALLATION

LOWER OIL PAN

NOTE: **The components using sealant must be assembled within ten minutes of sealant application.**

1. Clean the lower oil pan and the lower portion of the upper oil pan gasket surfaces thoroughly.
2. Apply a 1.5 mm to 2 mm bead of Loctite 5203 sealant or equivalent to the lower oil pan sealing surface (1) as shown.

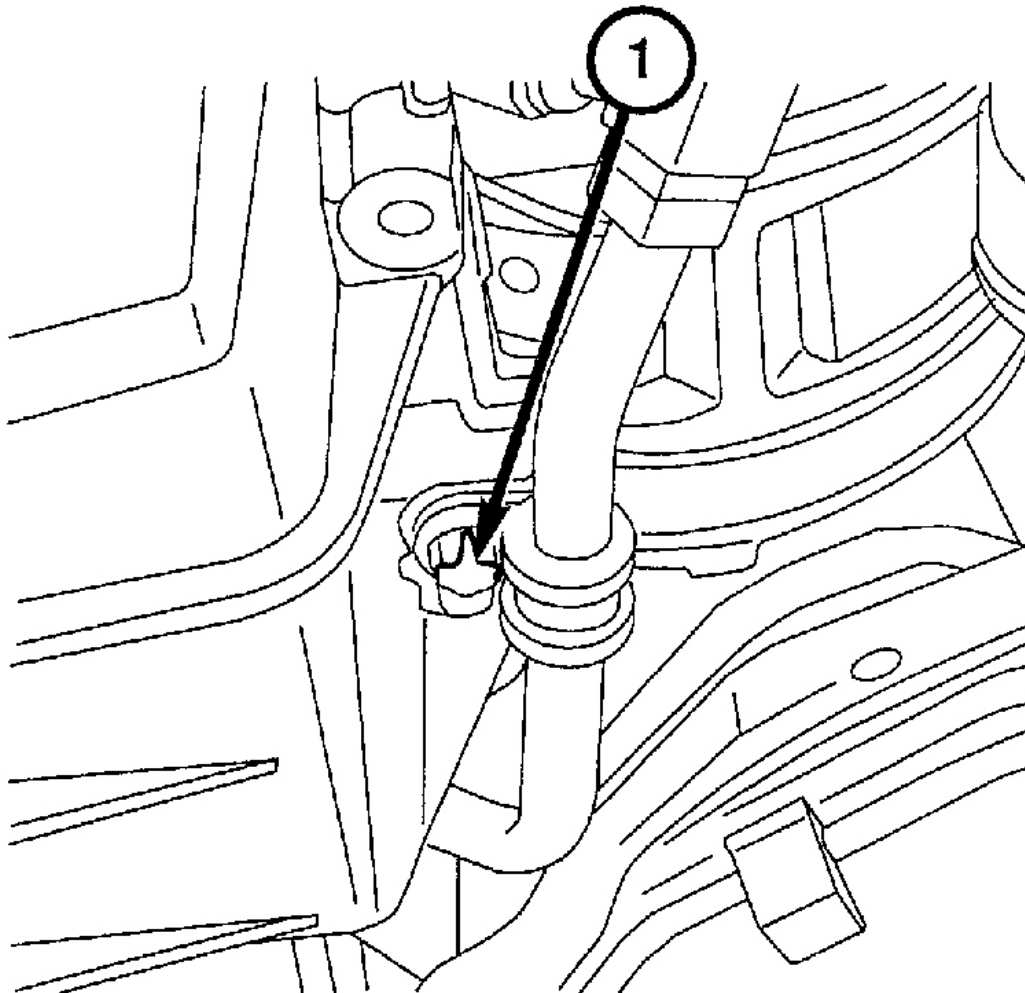


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Fig. 168: Applying Sealant

Courtesy of DAIMLERCHRYSLER CORP.

3. Install the lower oil pan and oil pan bolts. Tighten the lower oil pan bolts to 14 N.m (10 ft. lbs.).
4. Position and install the transmission cooler lines and retainers (1). Tighten the bolts to 10 N.m (7 ft. lbs.).

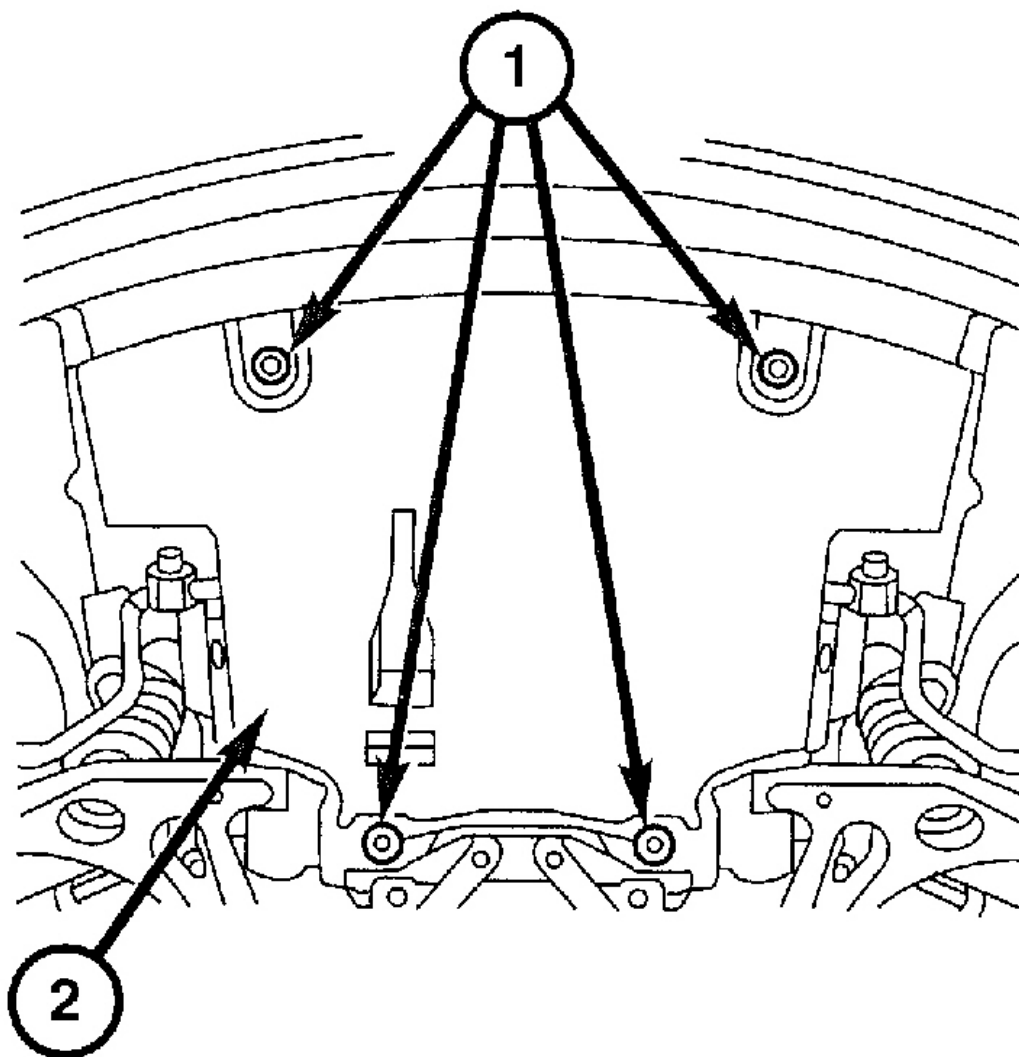


G01860666

Fig. 169: Positioning Transmission Cooler Lines & Retainers

Courtesy of DAIMLERCHRYSLER CORP.

5. Install and tighten the oil pan drain plug to 30 N.m (22 ft lbs.).
6. Install the lower splash shield and screws (1). Tighten the screws to 5 N.m (44 in. lbs.).



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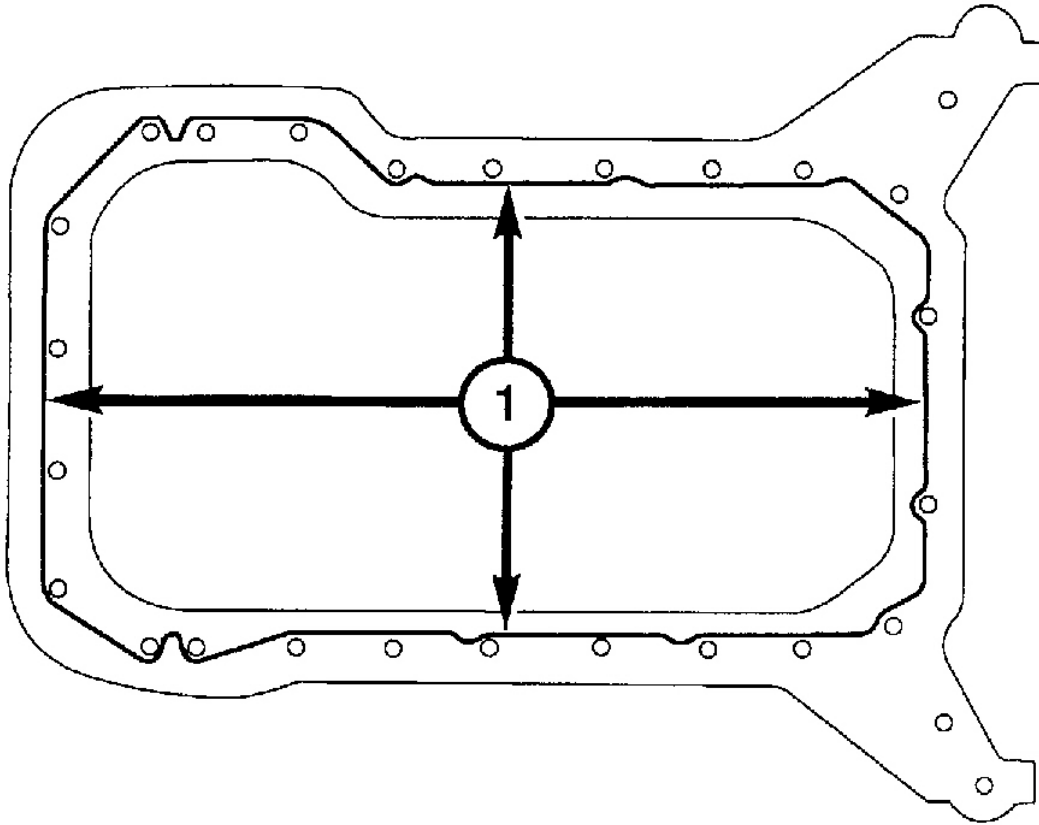
Fig. 170: Installing Lower Splash Shield & Screws
Courtesy of DAIMLERCHRYSLER CORP.

7. Lower the vehicle.
8. Fill the crankcase to the specified oil level.
9. Start the engine and check for leaks.

UPPER OIL PAN

1. Clean the gasket surfaces thoroughly.

NOTE: The components using sealant must be assembled within ten minutes of sealant application.

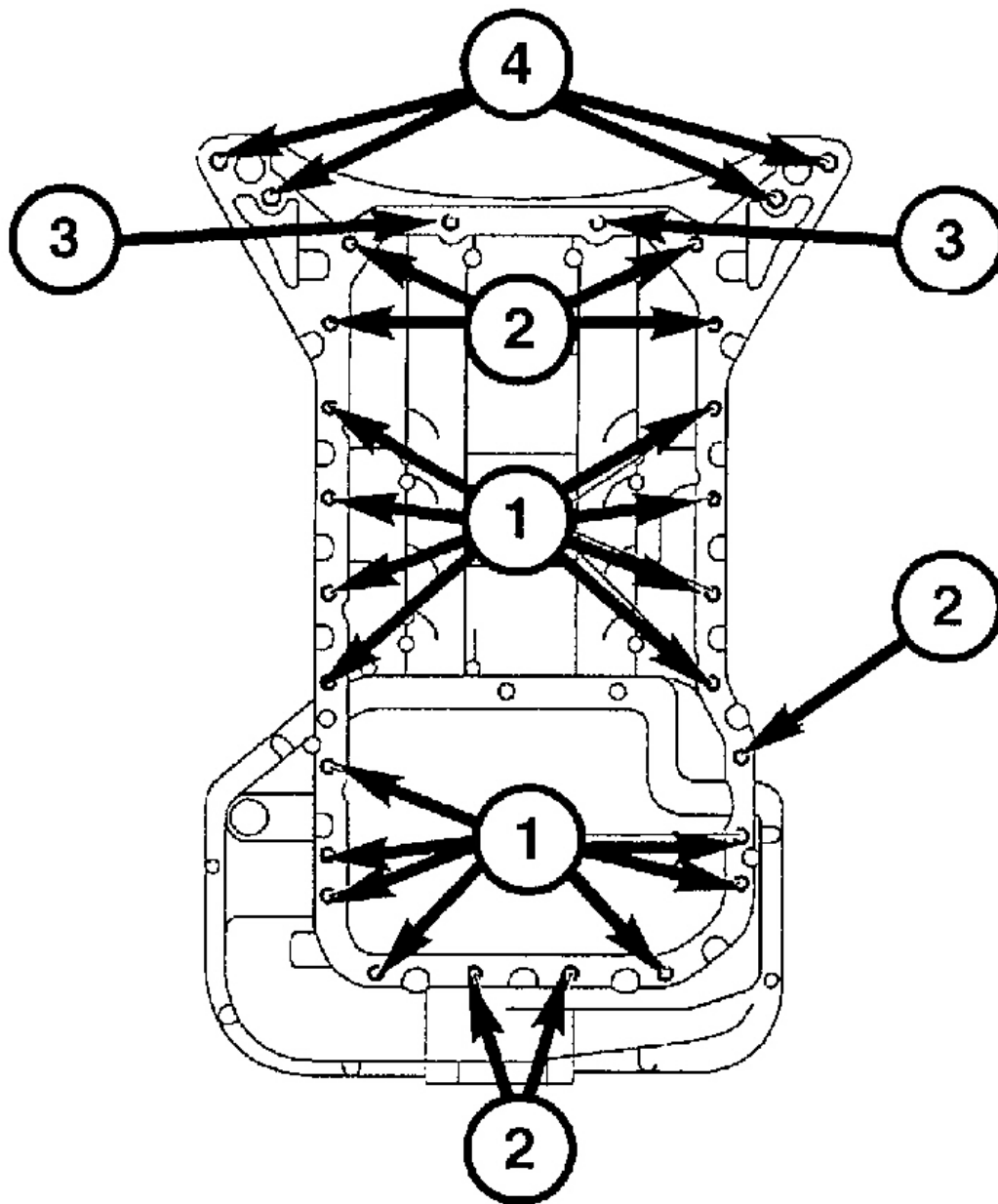


G01860668

Fig. 171: Applying Sealant

Courtesy of DAIMLERCHRYSLER CORP.

2. Apply a 1.5 to 2 mm. bead of Loctite 5203 sealant (1) or equivalent to the oil pan sealing surface as shown.
3. Position the upper oil pan on the engine block.
4. Install the oil pan bolts with the proper size and length bolt in the correct bolt hole.
 - (1) M6 X 20
 - (2) M6 X 40
 - (3) M6 X 90
 - (4) M8 X 30
5. Tighten the M6 size bolts to 10 N.m (89 in. lbs). Follow the tightening sequence diagram shown in illustration.



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Fig. 172: Identifying Tightening Sequence
Courtesy of DAIMLERCHRYSLER CORP.

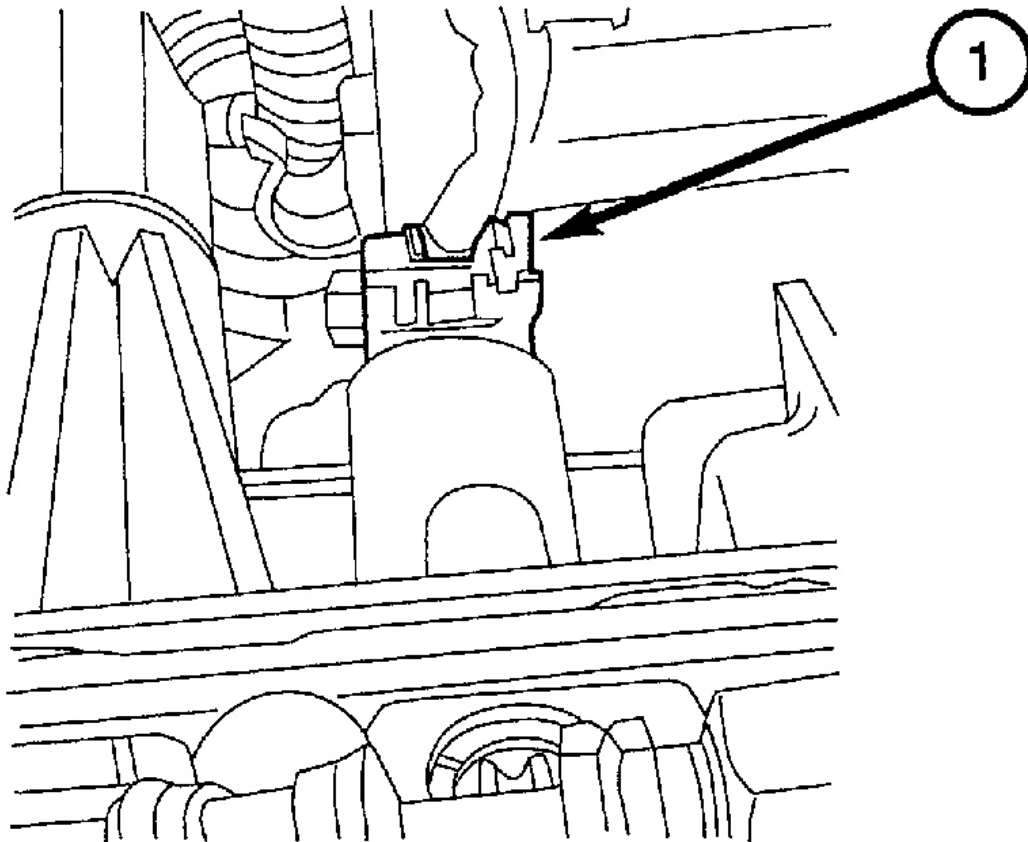
6. Tighten the M8 size bolts to 20 N.m (15 ft. lbs.). Follow the tightening sequence diagram.
7. Install the lower oil pan. See **LOWER OIL PAN**.

8. Install the clutch if equipped. See CLUTCHES article.
9. Install the transmission to the engine. For automatic, see REMOVAL & INSTALLATION article and for manual, see REMOVAL & INSTALLATION article.
10. Install the engine. See INSTALLATION.

OIL LEVEL/TEMPERATURE SENSOR

REMOVAL

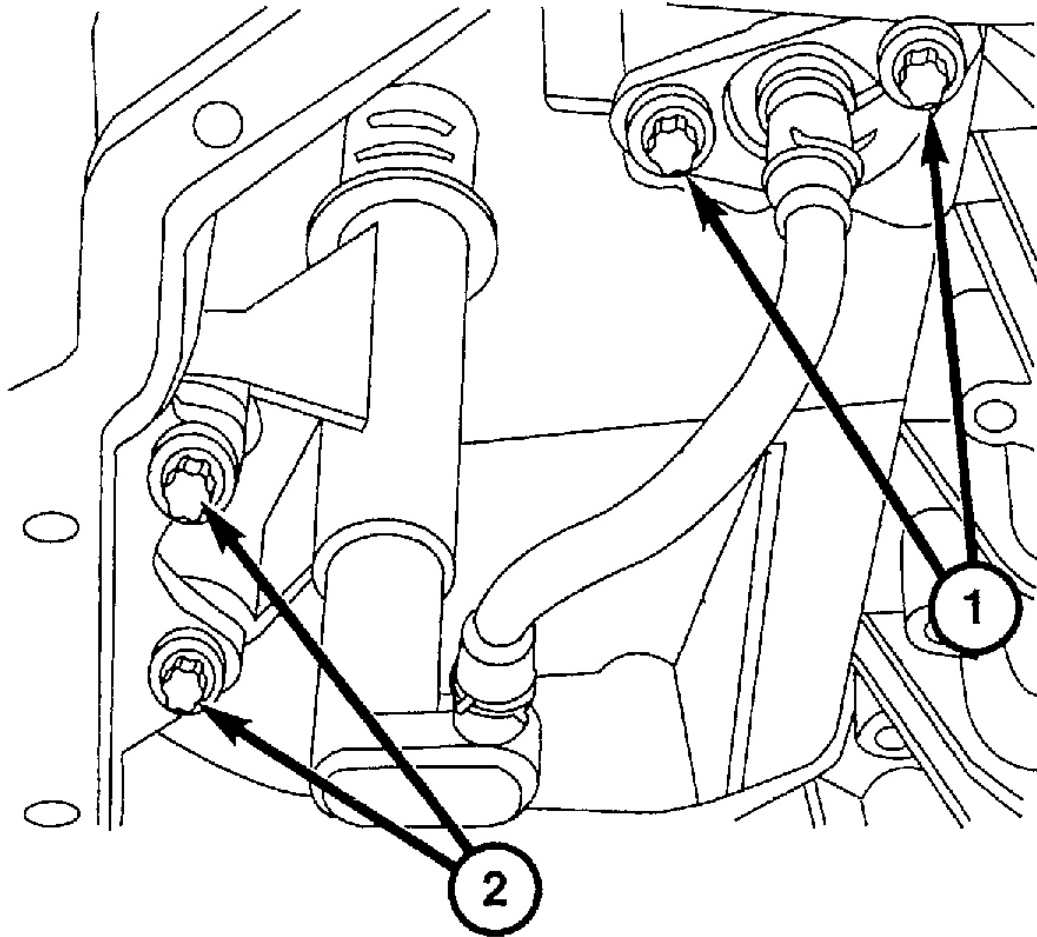
1. Remove the lower oil pan. See OIL PAN.
2. Disconnect the oil level/temperature sensor harness connector (1).



G01860670

Fig. 173: Disconnecting Oil Level/Temperature Sensor Harness Connector
Courtesy of DAIMLERCHRYSLER CORP.

3. Remove the two oil level/temperature sensor screws (1).
4. Remove the two harness retainer screws (2) and the oil level/temperature sensor.

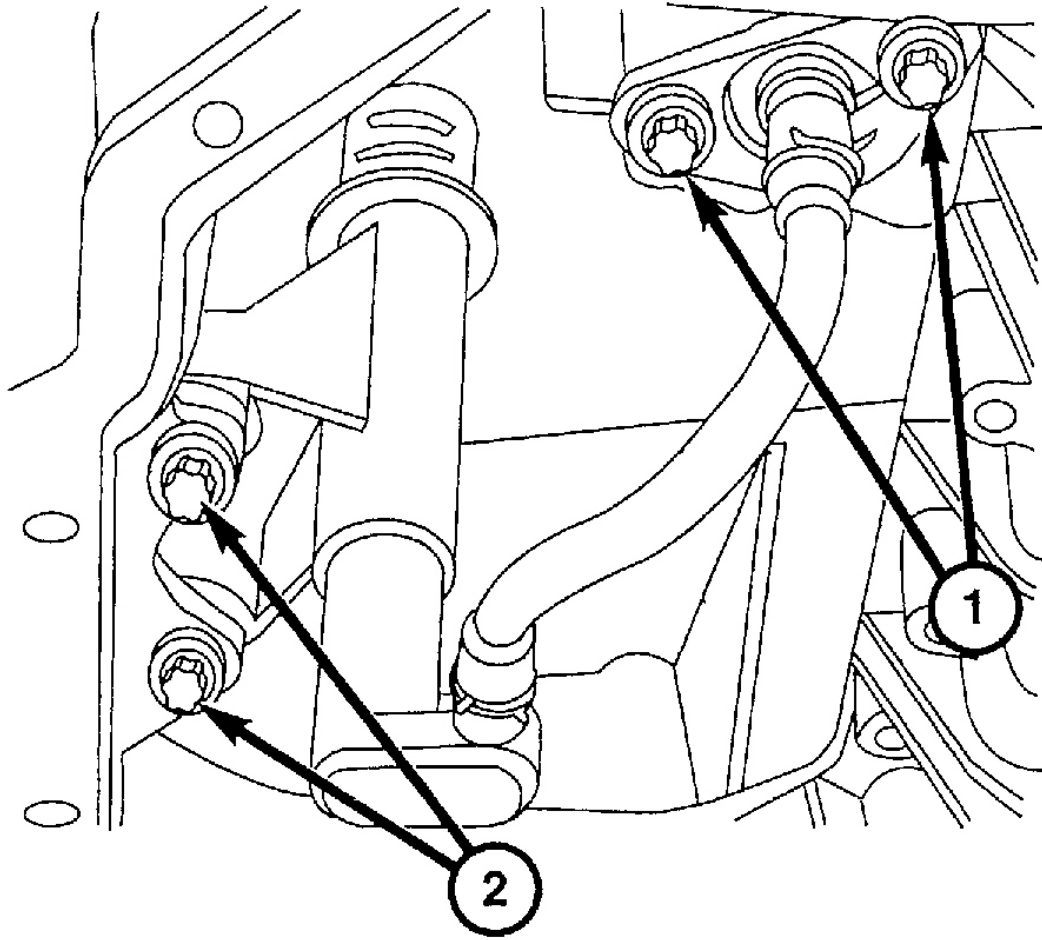


G01860671

Fig. 174: Removing Oil Level/Temperature Sensor & Screws
Courtesy of DAIMLERCHRYSLER CORP.

INSTALLATION

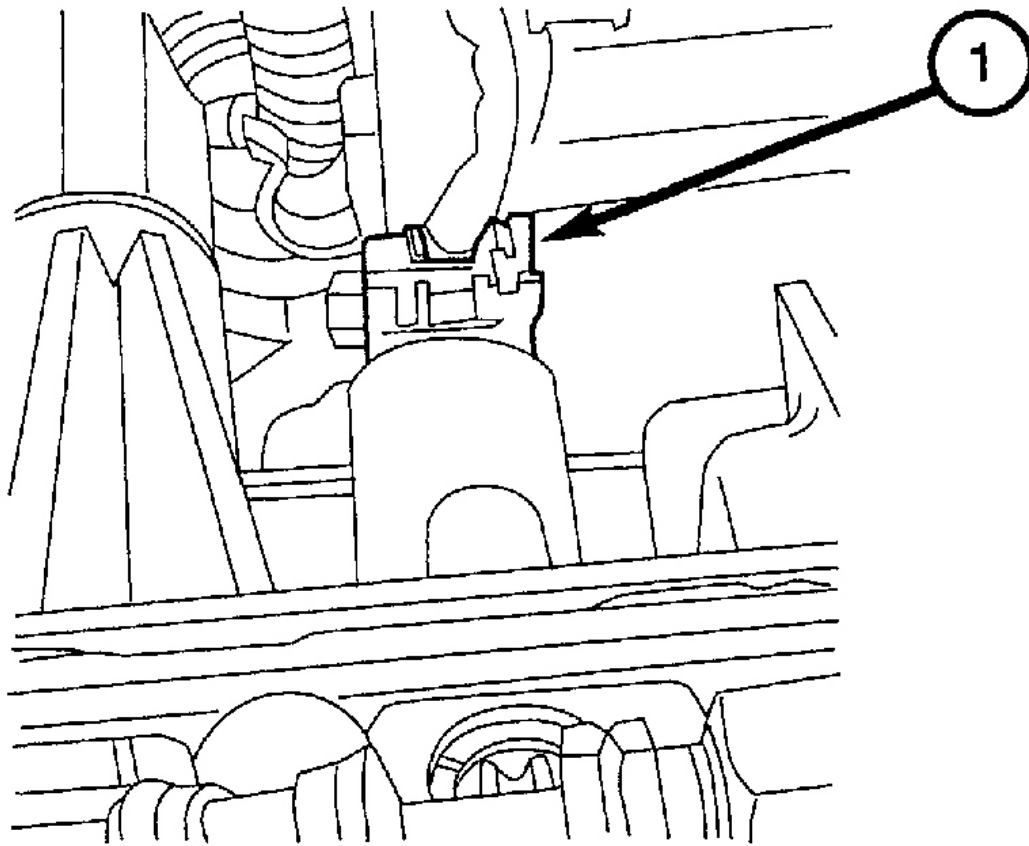
1. Position the oil level/temperature sensor in the upper oil pan with the screws (1).
2. Position the harness retainer in the upper oil pan with the screws (2).



G01860672

Fig. 175: Installing Oil Level/Temperature Sensor & Harness Retainer
Courtesy of DAIMLERCHRYSLER CORP.

3. Tighten all screws for the oil level/temperature sensor to 10 N.m (89 in. lbs.).
4. Connect the oil level/temperature sensor harness connector (1).



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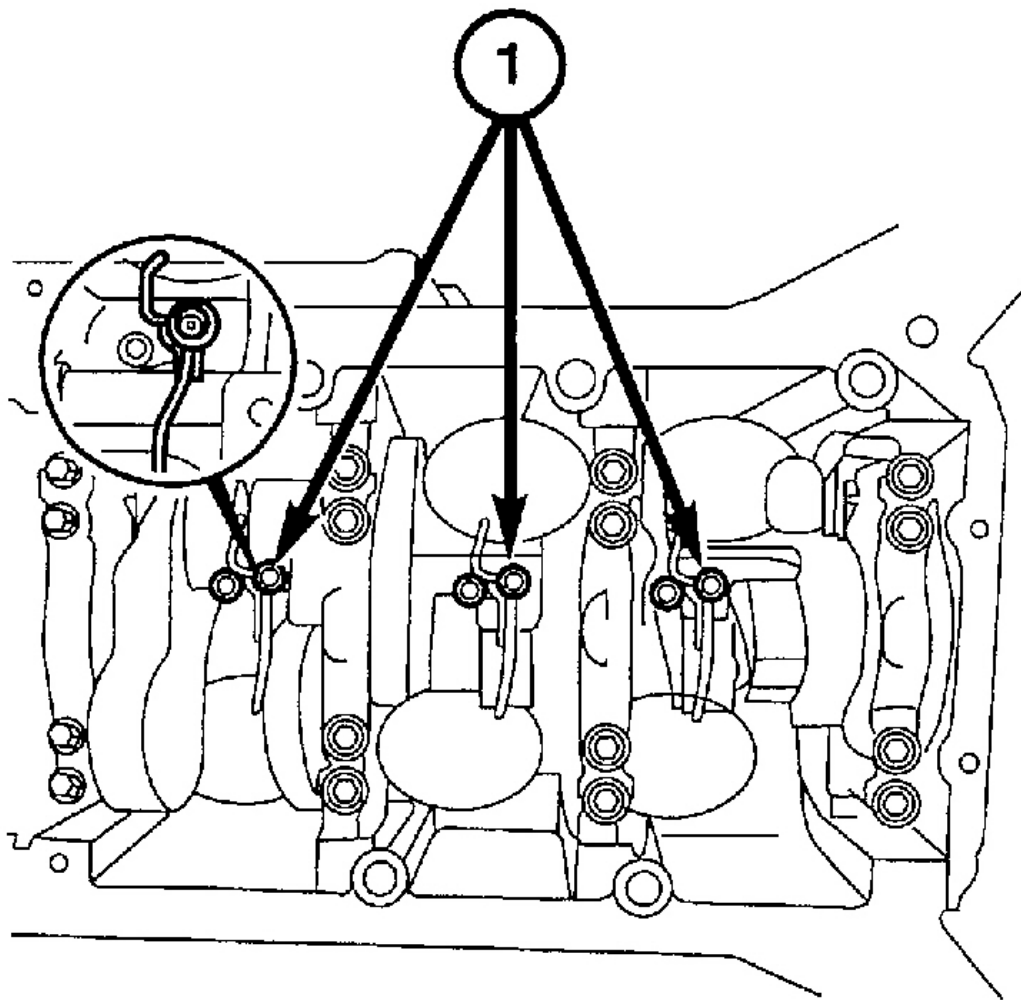
Fig. 176: Connecting Oil Level/Temperature Sensor Harness Connector
Courtesy of DAIMLERCHRYSLER CORP.

5. Install the lower oil pan. See **OIL PAN**.

OIL SPRAY NOZZLES

REMOVAL

1. Remove the upper oil pan. See **OIL PAN**.
2. If necessary, rotate the crankshaft slightly at the vibration damper.
3. Remove the oil spray nozzle bolts (1) and the oil spray nozzles.



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Fig. 177: Removing Oil Spray Nozzle Bolts & Nozzles
Courtesy of DAIMLERCHRYSLER CORP.

NOTE: Do not use hard objects to clean the oil spray nozzles. Replace the oil spray nozzles if they are blocked.

4. Use compressed air only in the oil flow direction to clean the oil spray nozzles.

INSTALLATION

NOTE: Ensure the jet pipes of the oil spray nozzles are not damaged or bent during

installation.

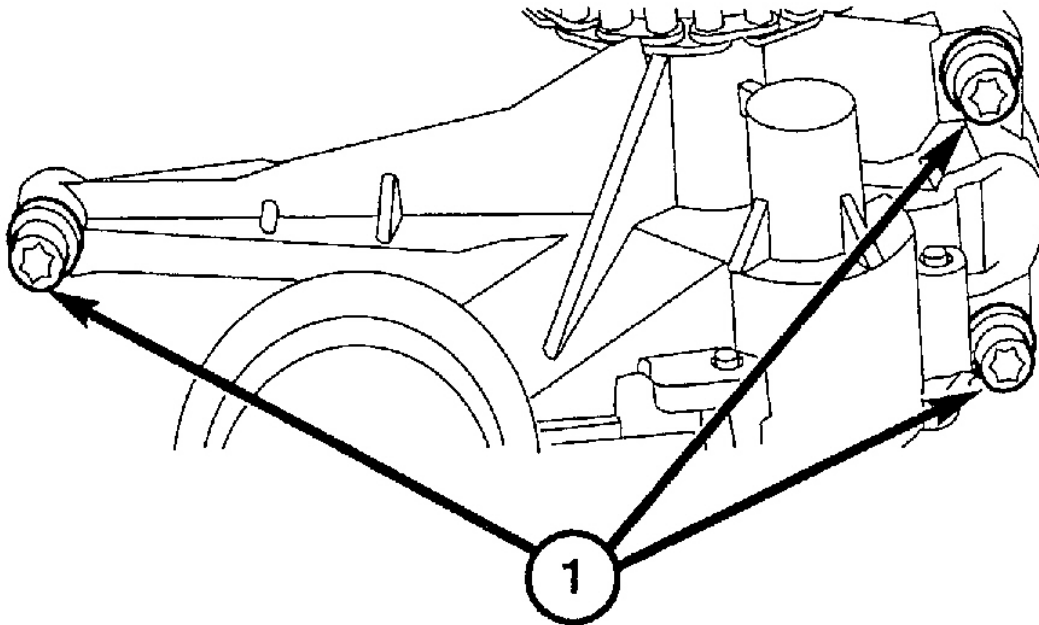
1. Position the oil spray nozzles and bolts in the engine block.
2. Tighten the oil spray nozzle bolts to 15 N.m (11 ft. lbs.).
3. Install the upper oil pan. See **OIL PAN**.

OIL PUMP**DESCRIPTION**

The gear-type oil pump is located below the crankshaft and is driven from the crankshaft by a separate roller chain.

REMOVAL

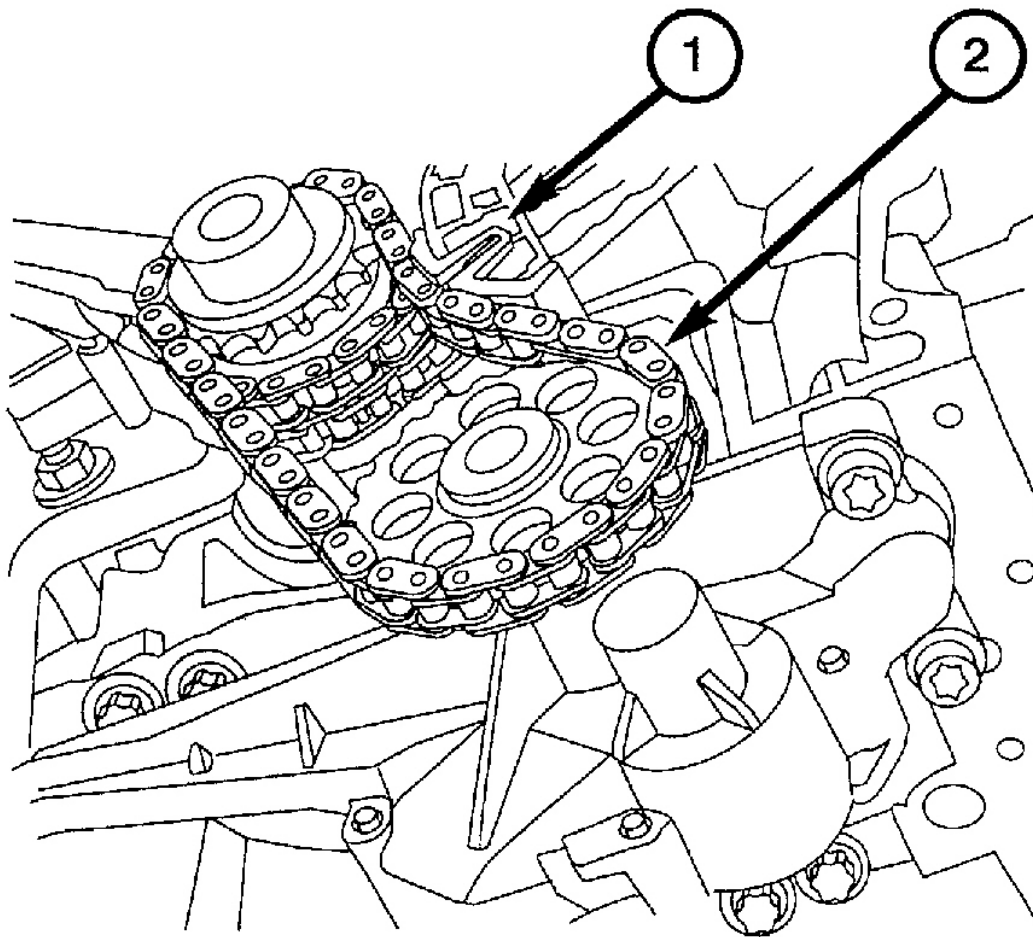
1. Remove the lower oil pan. See **OIL PAN**.
2. Remove the oil pump bolts (1).



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Fig. 178: Removing Oil Pump Bolts
Courtesy of DAIMLERCHRYSLER CORP.

3. Release the oil pump chain tensioner (1) and remove the oil pump from the oil pump drive chain (2).



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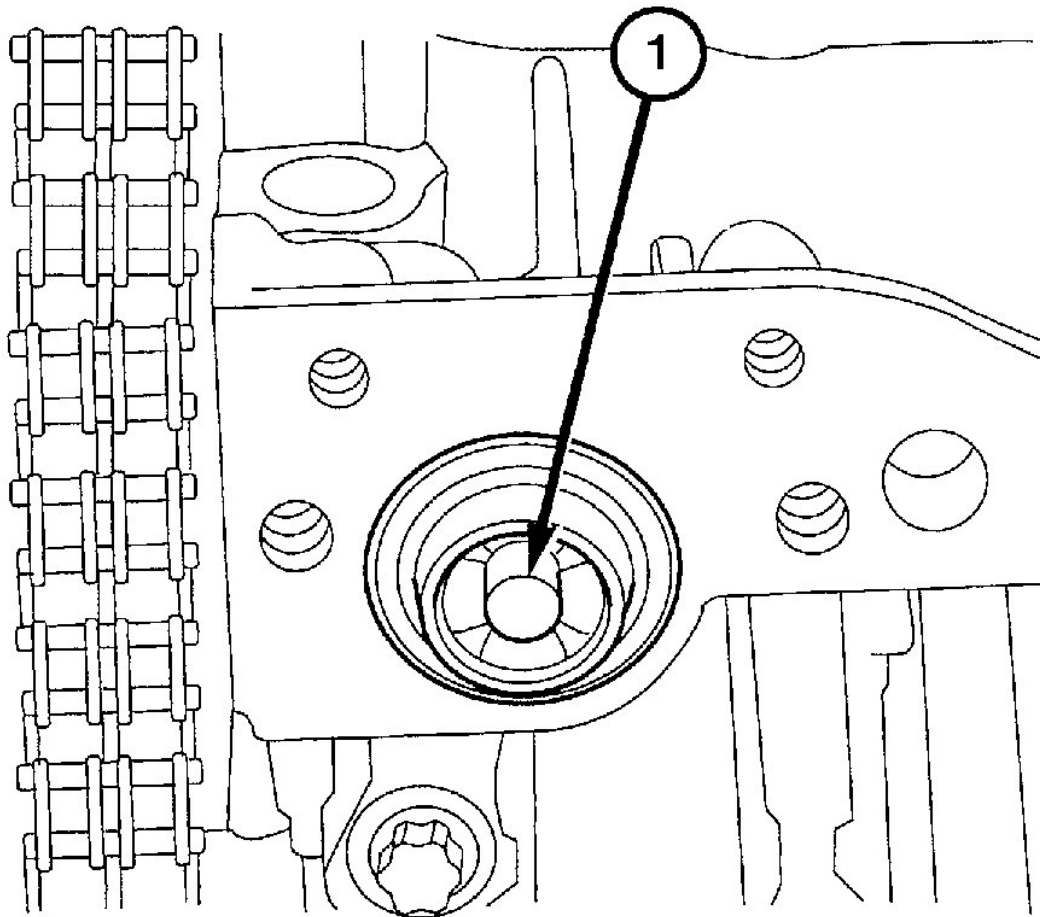
Fig. 179: Releasing Oil Pump Chain Tensioner & Removing Oil Pump
Courtesy of DAIMLERCHRYSLER CORP.

CLEANING

Clean all of the parts thoroughly in a suitable solvent.

INSTALLATION

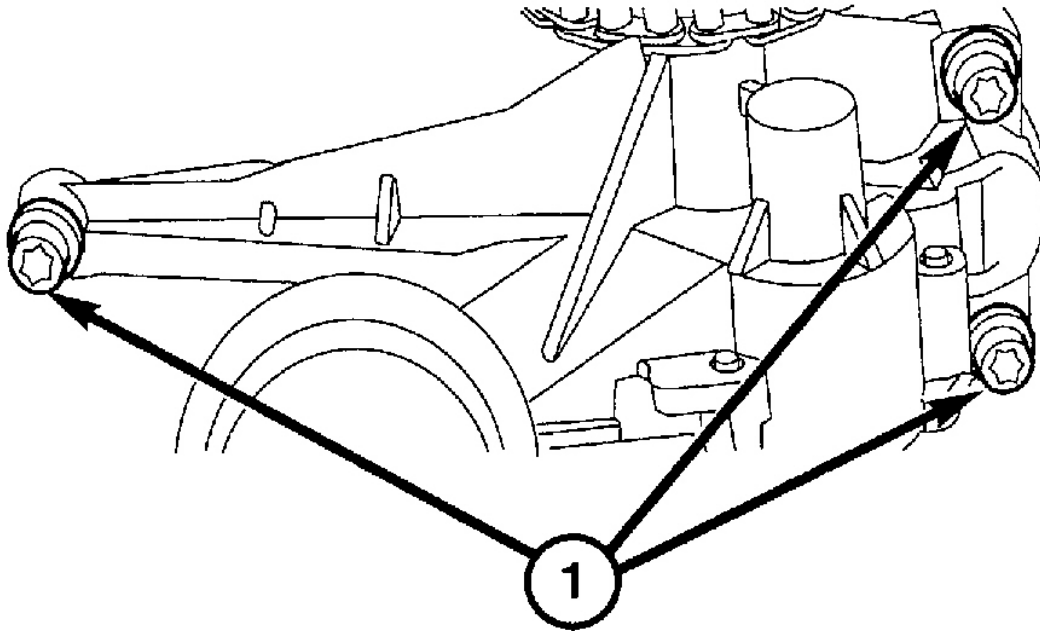
1. Inspect the oil pump check valve. Remove any debris or sealant. Check the operation of the check valve by pressing and releasing the plunger (1).



G01860677

Fig. 180: Pressing & Releasing Plunger
Courtesy of DAIMLERCHRYSLER CORP.

2. Fill the oil pump with engine oil.
3. Check the oil pump drive chain for wear. Replace any worn or damaged parts.
4. Position the oil pump driven sprocket in the drive chain. Position and install the oil pump and bolts. Tighten the bolts to 20 N.m (15 ft. lbs.).



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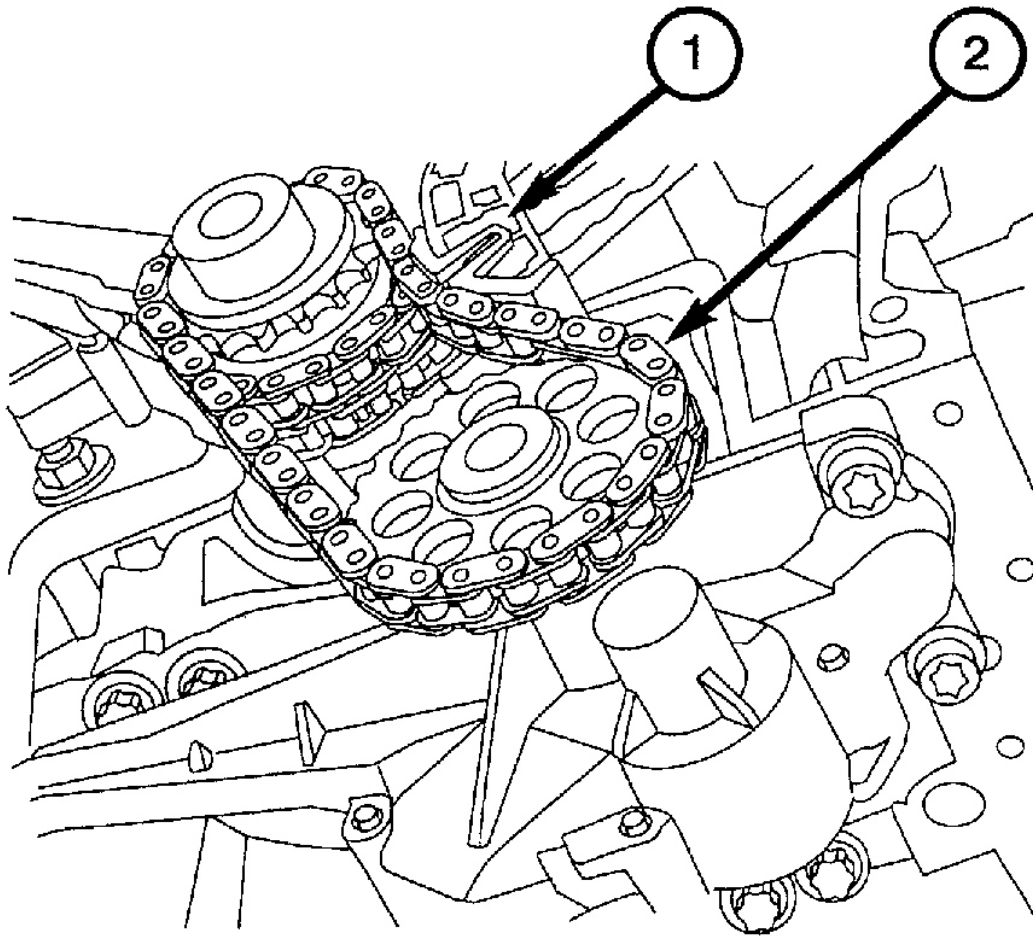
Fig. 181: Installing Oil Pump Bolts
Courtesy of DAIMLERCHRYSLER CORP.

5. Install the lower oil pan. See **OIL PAN**.
6. Refill the engine with motor oil to specified level.
7. Start the engine and check for leaks.

OIL PUMP DRIVE CHAIN

REMOVAL

1. Remove the timing chain cover. See **TIMING CHAIN COVER**.
2. Remove the oil pump. See **OIL PUMP**.
3. Remove the oil pump drive chain (2) and discard. Inspect the oil pump drive chain tensioner spring for wear and replace as necessary.



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Fig. 182: Removing Oil Pump Drive Chain
Courtesy of DAIMLERCHRYSLER CORP.

INSTALLATION

1. Check the oil pump drive chain guide for wear and replace as necessary.
2. Install the new oil pump drive chain and the oil pump. See **OIL PUMP**.
3. Install the timing chain cover. See **TIMING CHAIN COVER**.

OIL PRESSURE RELIEF VALVE

DESCRIPTION

The oil pressure relief valve cannot be adjusted or repaired. If faulty, worn, or damaged, the entire oil pump

assembly must be replaced.

INTAKE MANIFOLD

DESCRIPTION

A magnesium two-stage resonance intake manifold has long runners to enhance low-speed torque and shorter runners for added horsepower. The runners, and the plenum chamber that feeds them, nest between the cylinder banks. Complex components of the multi-piece die-cast manifold are adhesive bonded together.

OPERATION

A variable intake manifold provides a marked supercharging effect to air flow entering the cylinders as the intake valve closes. Long individual tubes for each cylinder that enhance low-speed torque have a tuned length of 32.9 inches (835 mm). This length is achieved by coiling the tubes in the valley of the cylinder block. In these tubes, the air rotates 450 degrees from entry to cylinder head. To achieve a similar effect at higher speeds, a tube length of 18.3 inches (465 mm) is used. Butterfly valves in the walls of the long tubes, operated by the engine control computer, switch the flow between long and short flow paths at approximately 3700 RPM. The engine speed for switchover to the short tubes provides an imperceptible change in engine torque, because the maximum supercharging effect is consistent throughout the 2000 to 5000-RPM speed range.

DIAGNOSIS AND TESTING - INTAKE MANIFOLD LEAKS

An intake manifold air leak is characterized by lower than normal manifold vacuum. Also, one or more cylinders may not be functioning.

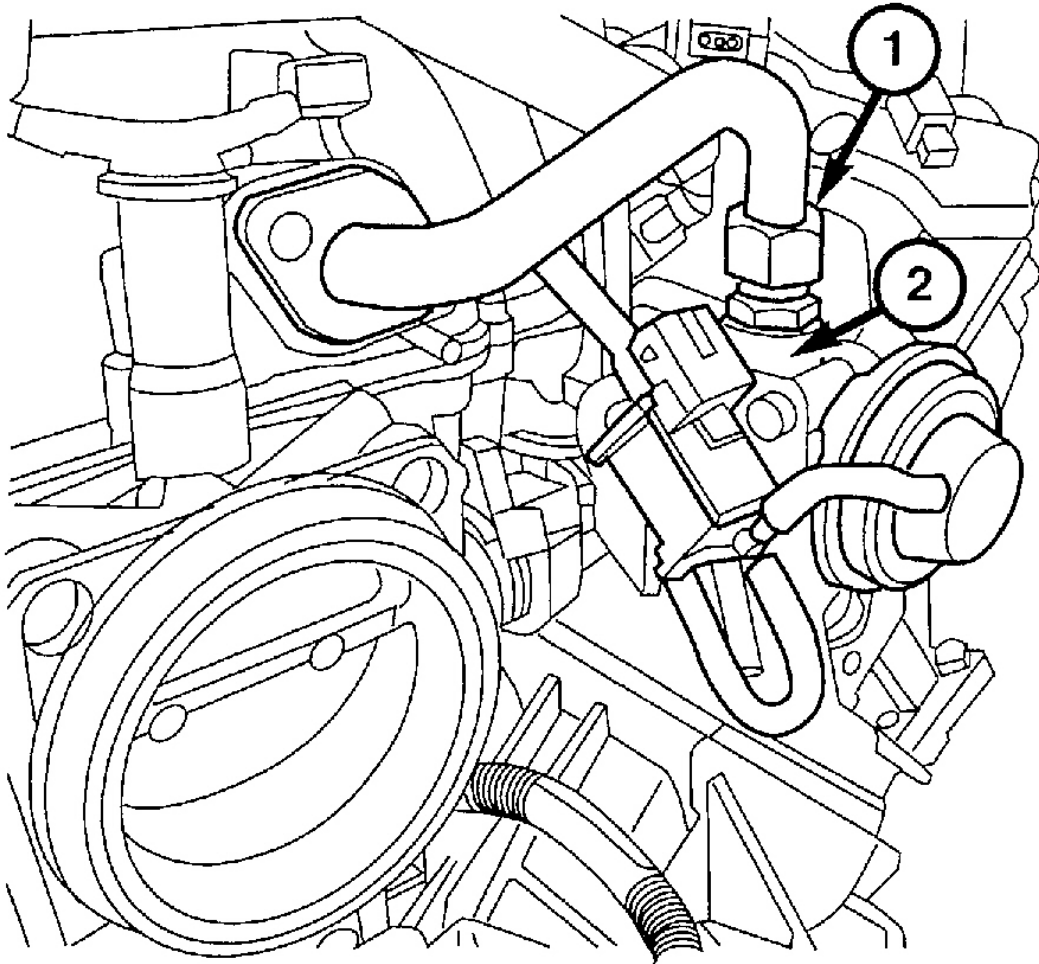
WARNING: USE EXTREME CAUTION WHEN THE ENGINE IS OPERATING. DO NOT STAND IN A DIRECT LINE WITH THE FAN. DO NOT PUT YOUR HANDS NEAR THE PULLEYS, BELTS OR THE FAN. DO NOT WEAR LOOSE CLOTHING.

1. Start the engine.
2. Spray a small stream of water (Spray Bottle) at the suspected leak area.
3. If engine RPM'S change, the area of the suspected leak has been found.
4. Repair as required.

REMOVAL

1. Disconnect the negative battery cable.
2. Remove the air cleaner housing. See **AIR CLEANER HOUSING**.
3. Remove the mass air flow sensor. See **FUEL SYSTEM** article.
4. Remove the fuel rail with fuel injectors. See **FUEL SYSTEM** article.
5. Disconnect the vacuum lines to the EGR valve, brake booster, crankcase ventilator and purge valve from the intake manifold.
6. Disconnect the engine harness connectors.

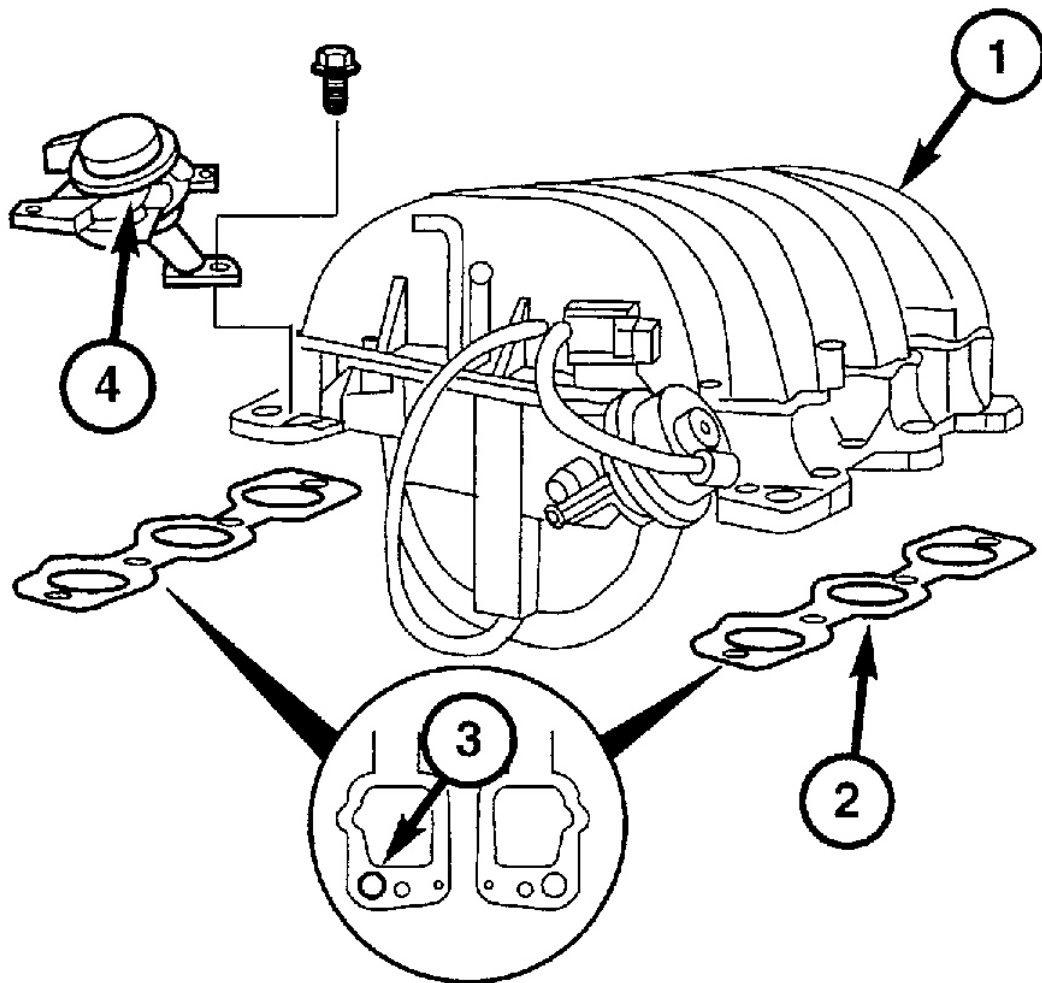
7. Disconnect the EGR pipe (1) at the EGR valve (2).



G01860681

Fig. 183: Disconnecting EGR Pipe At EGR Valve
Courtesy of DAIMLERCHRYSLER CORP.

8. Remove the air pump switchover valves (4).
9. Remove the bolts, the intake manifold (1) and the gaskets (2).

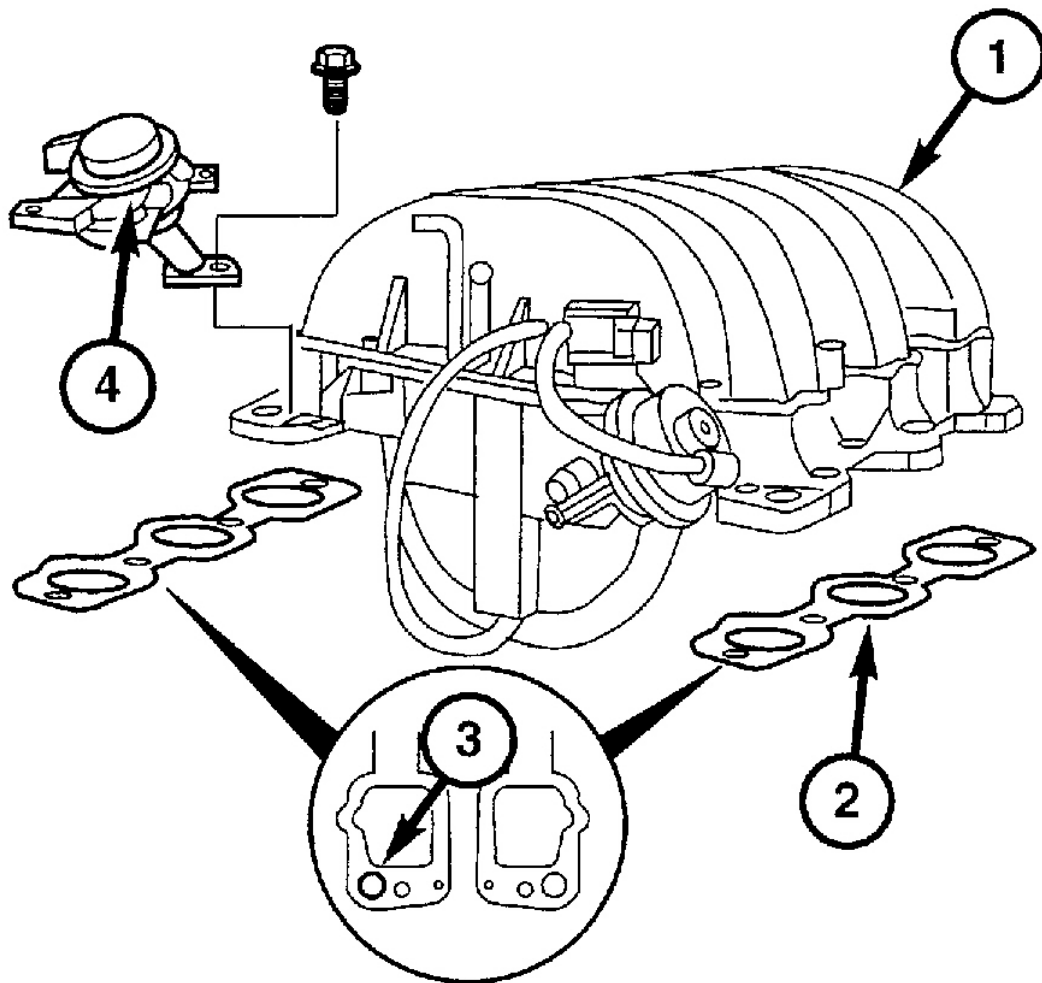


G01860682

Fig. 184: Removing Intake Manifold
Courtesy of DAIMLERCHRYSLER CORP.

INSTALLATION

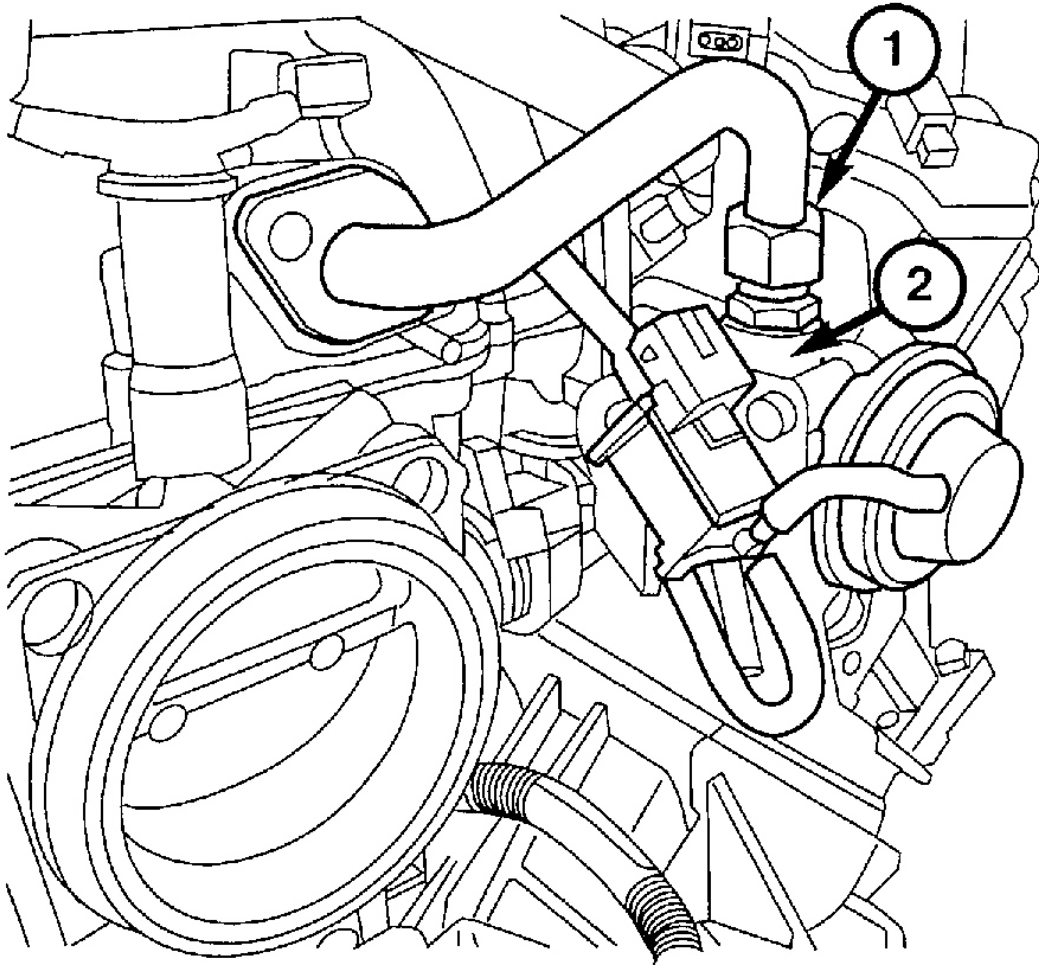
1. Clean the gasket surfaces of the cylinder heads and the intake manifold.
2. Position the intake manifold (1) on the cylinder heads with new gaskets (2) in place.



G01860683

Fig. 185: Installing Intake Manifold
Courtesy of DAIMLERCHRYSLER CORP.

3. Install the intake manifold bolts and tighten to 20 N.m (15 ft. lbs.).
4. Install the air pump switchover valves (4). Tighten the bolts to 20 N.m (15 ft. lbs.).
5. Connect the EGR pipe fitting (1) to the EGR valve (2). Tighten the EGR pipe fitting to 40 N.m (30 ft. lbs.).



G01860684

Fig. 186: Connecting EGR Pipe Fitting To EGR Valve
Courtesy of DAIMLERCHRYSLER CORP.

6. Install the mass air flow sensor. See **FUEL SYSTEM** article.
7. Connect the engine harness connectors.
8. Connect the vacuum lines at the crankcase ventilator, purge valve, EGR valve, and the brake booster.
9. Install the fuel rail with fuel injectors. See **FUEL SYSTEM** article.
10. Install the air cleaner housing. See **AIR CLEANER HOUSING**.
11. Connect the negative battery cable.
12. Start the engine and check for leaks.

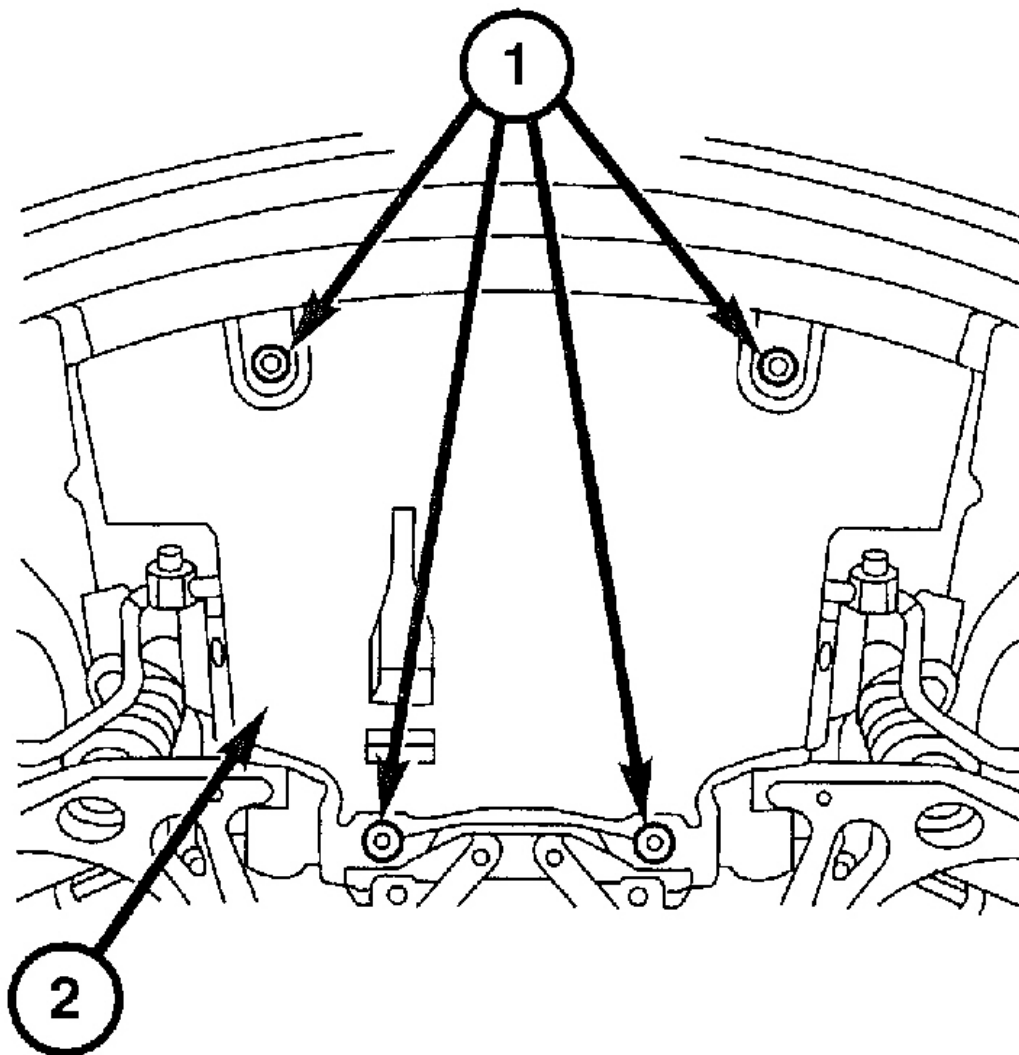
EXHAUST MANIFOLD

DESCRIPTION

Thin-wall air-gap construction for the exhaust manifolds reduces underhood temperature by keeping heat in the exhaust stream. This also allows the catalytic converter to be mounted in a more advantageous position for packaging, under the floor instead of close to the engine. Stainless steel inner manifolds, separated by an air space from two-piece stainless steel outer shells, reduce heat loss to the air in much the same way thermo-pane glass reduces heat loss through windows. Hydro-formed inner manifolds, through which the exhaust flows, provide precise dimensional control. They are assembled to the cylinder head flanges, exhaust pipe flanges and the outer shells by laser welding.

REMOVAL**LEFT SIDE**

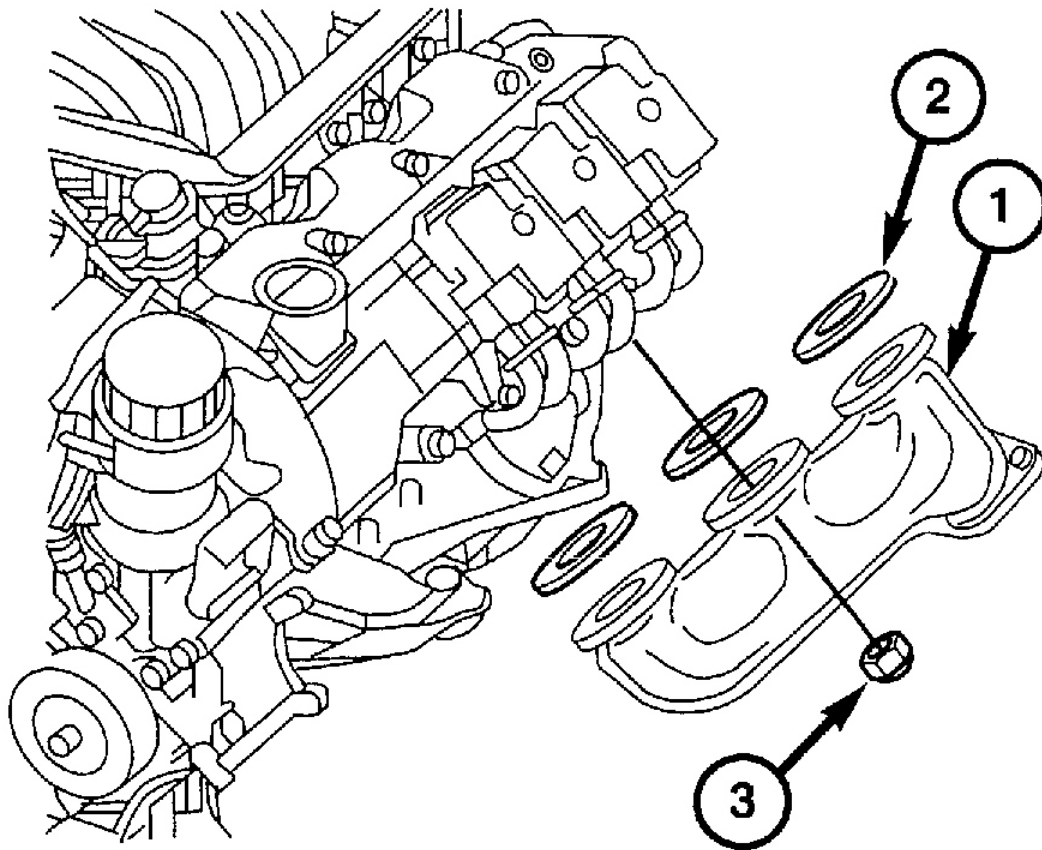
1. Disconnect the negative battery cable.
2. Remove the air cleaner housing. See **AIR CLEANER HOUSING**.
3. Raise and support the vehicle.
4. Remove the lower splash shield screws (1) and the splash shield.



G01860685

Fig. 187: Removing Lower Splash Shield Screws & Splash Shield
Courtesy of DAIMLERCHRYSLER CORP.

5. Remove the left side catalytic converter. See EXHAUST SYSTEM.
6. Remove the exhaust manifold nuts (3).



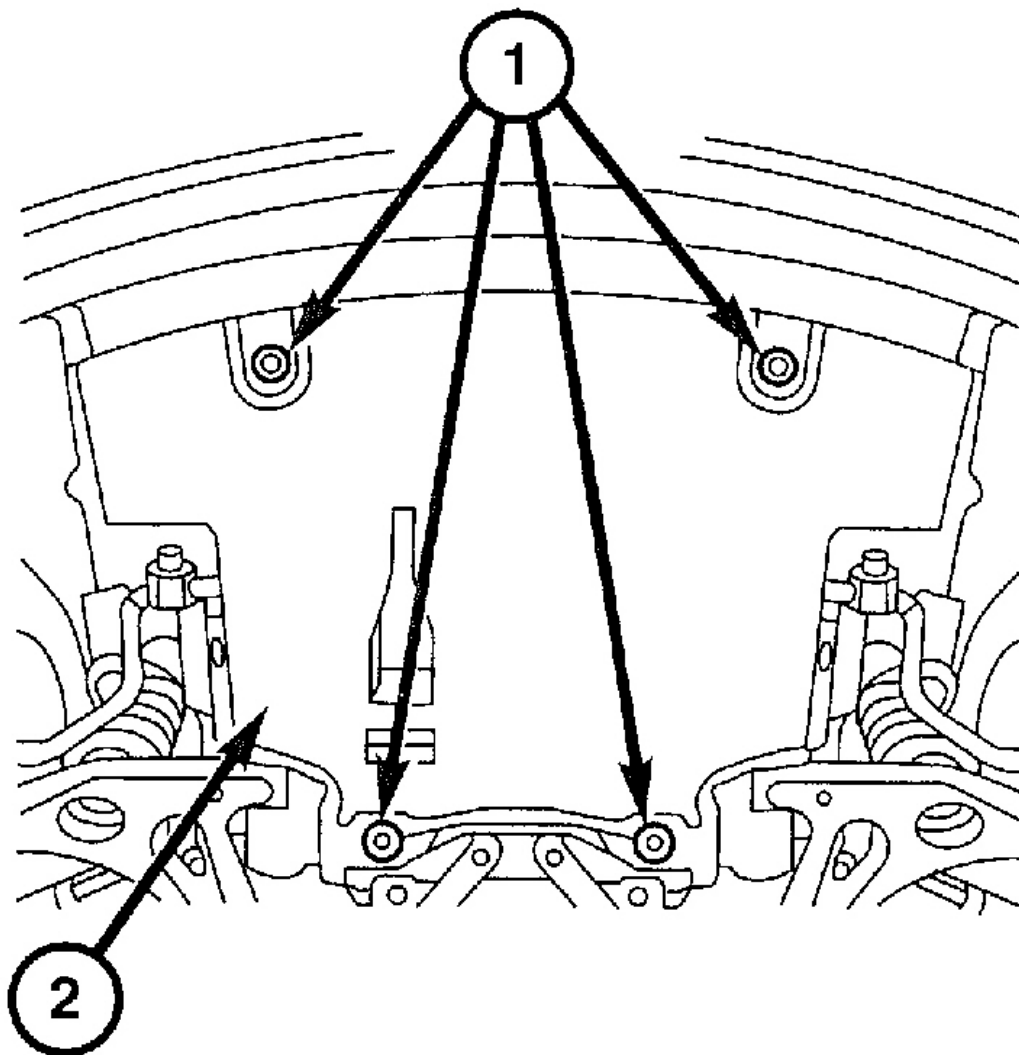
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Fig. 188: Removing Left Side Exhaust Manifold
Courtesy of DAIMLERCHRYSLER CORP.

7. Lower the vehicle.
8. Remove the left side exhaust manifold (1) and gaskets (2) from the engine compartment.

REMOVAL - RIGHT SIDE

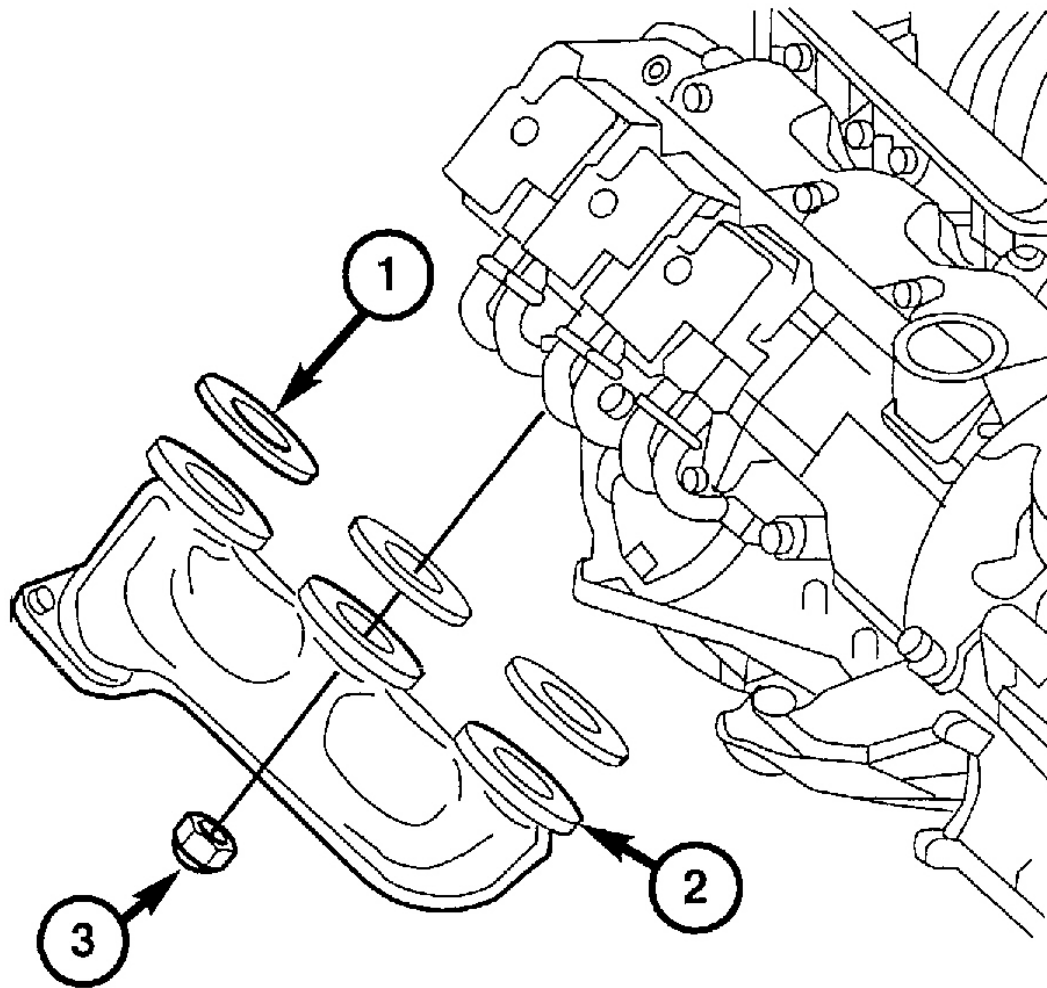
1. Disconnect the negative battery cable.
2. Remove the air cleaner housing. See **AIR CLEANER HOUSING**.
3. Raise and support the vehicle.
4. Remove the lower splash shield screws (1) and the splash shield.



G01860687

Fig. 189: Removing Lower Splash Shield Screws & Splash Shield
Courtesy of DAIMLERCHRYSLER CORP.

5. Remove the right side catalytic converter. See **EXHAUST SYSTEM** article.
6. Remove exhaust manifold nuts (3), the exhaust manifold (2), and the gaskets (1) from below the vehicle.



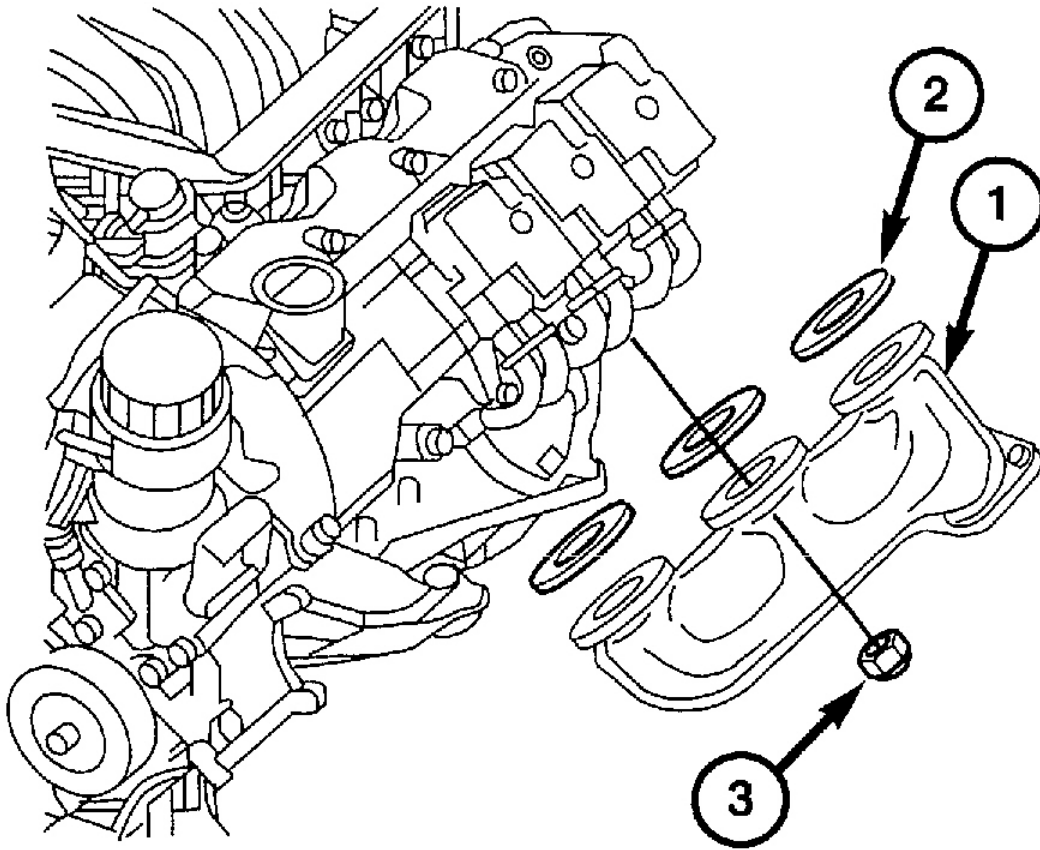
G01860688

Fig. 190: Removing Right Side Exhaust Manifold
Courtesy of DAIMLERCHRYSLER CORP.

INSTALLATION

LEFT SIDE

1. Position the manifold (1) and gaskets (2) on the cylinder head. Install the manifold nuts (3) and tighten to 35 N.m (26 ft. lbs.).



G01860689

Fig. 191: Installing Left Side Exhaust Manifold
Courtesy of DAIMLERCHRYSLER CORP.

2. Install the left side catalytic converter. See **EXHAUST SYSTEM** article.
3. Install the lower splash shield and screws (1). Tighten the screws to 5 N.m (44 in. lbs).

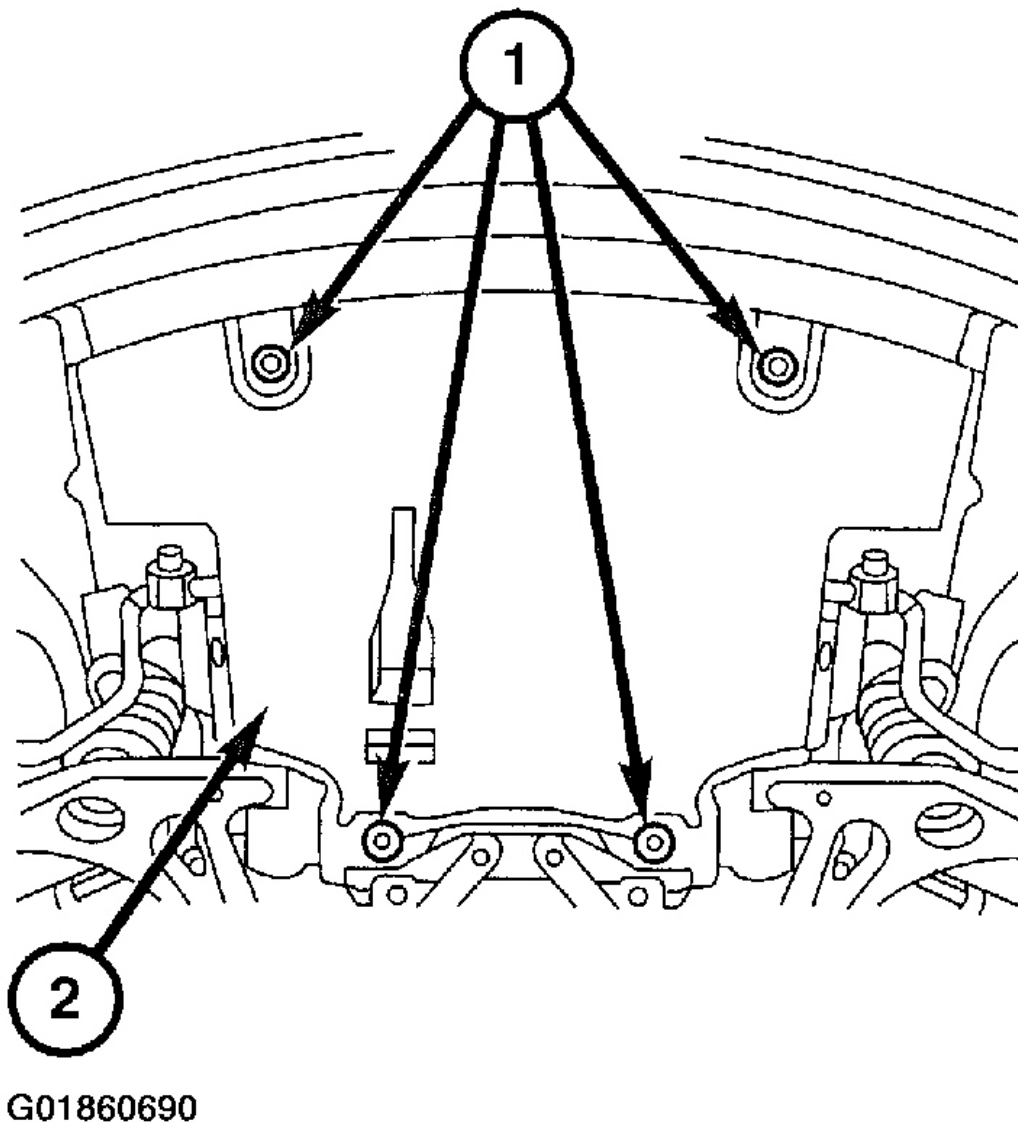
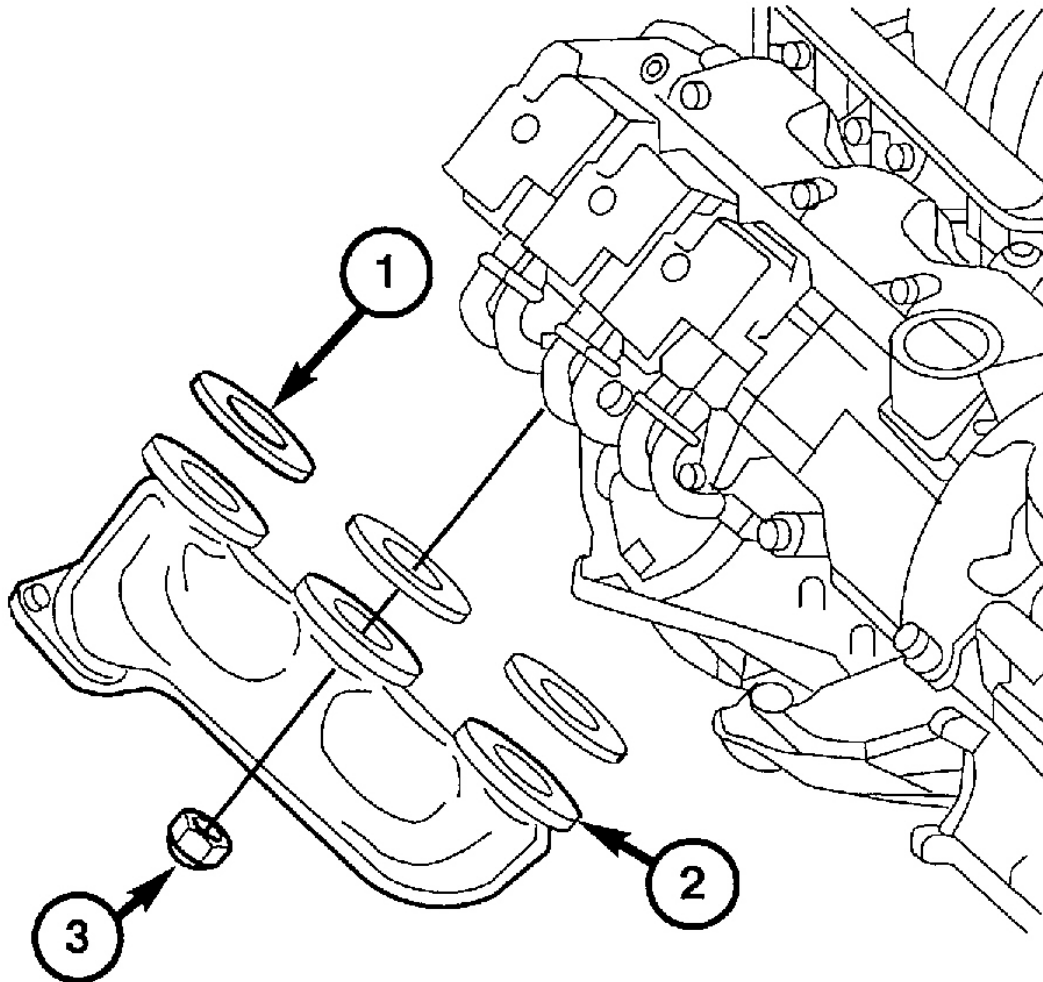


Fig. 192: Installing Lower Splash Shield & Screws
Courtesy of DAIMLERCHRYSLER CORP.

4. Lower the vehicle.
5. Install the air cleaner housing. See **AIR CLEANER HOUSING**.
6. Connect the negative battery cable.
7. Start the engine and check for exhaust leaks.

RIGHT SIDE

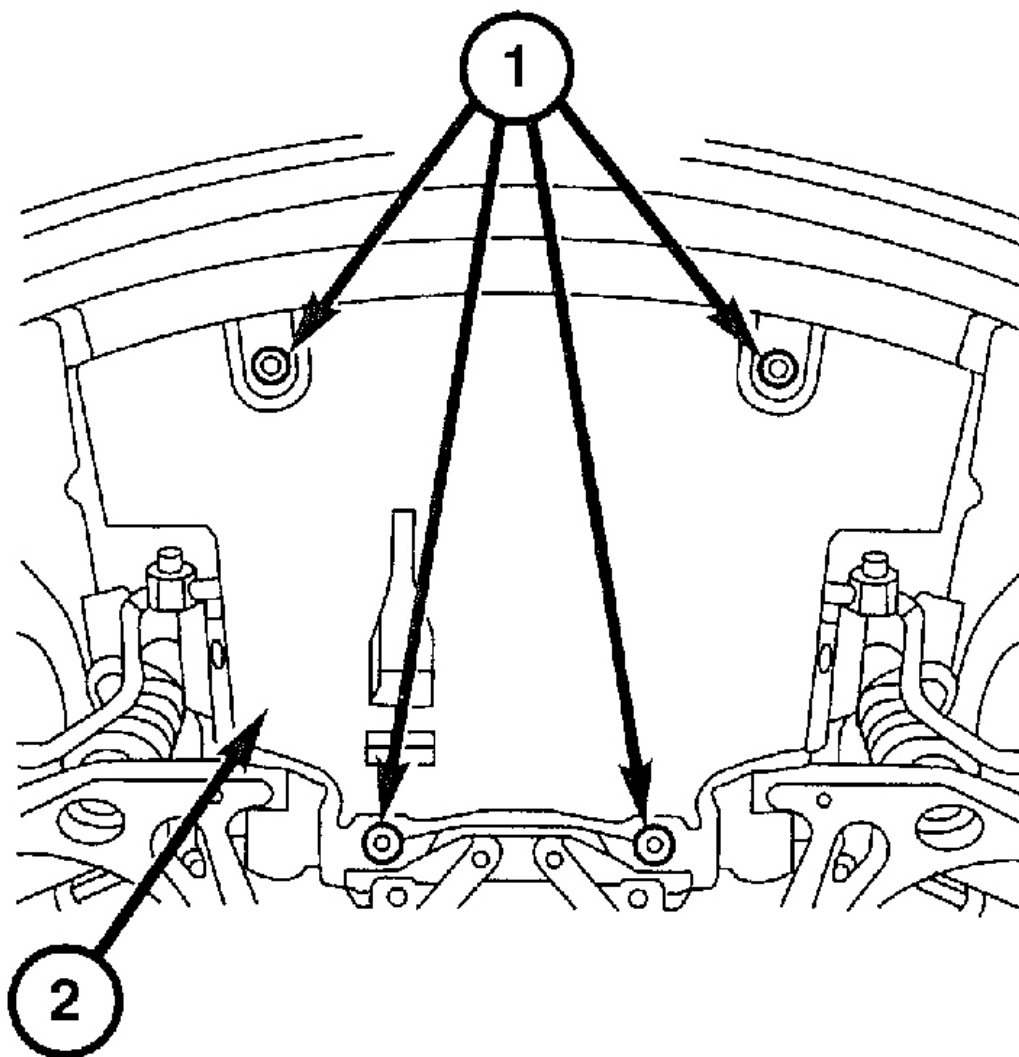
1. Position the manifold (2) and gaskets (1) on the cylinder head.



G01860691

Fig. 193: Installing Right Side Exhaust Manifold
Courtesy of DAIMLERCHRYSLER CORP.

2. Install the manifold nuts (3) and tighten to 35 N.m (26 ft. lbs.).
3. Install the right side catalytic converter. See **EXHAUST SYSTEM** article.
4. Install the lower splash shield and screws (1). Tighten the screws to 5 N.m (44 in. lbs.).



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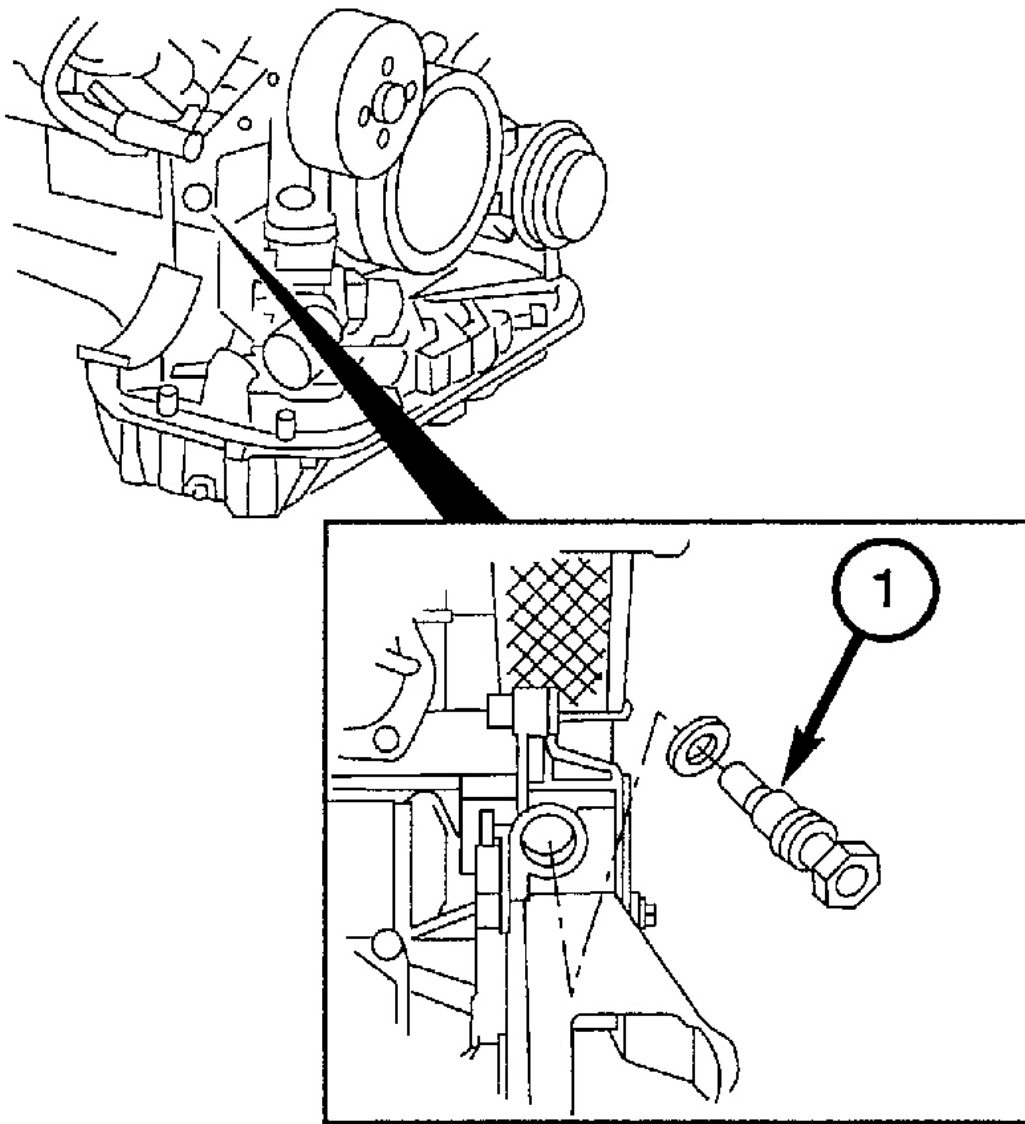
Fig. 194: Installing Lower Splash Shield & Screws
Courtesy of DAIMLERCHRYSLER CORP.

5. Lower the vehicle.
6. Install the air cleaner. See **AIR CLEANER HOUSING**.
7. Connect the negative battery cable.
8. Start the engine and check for exhaust leaks.

TIMING CHAIN TENSIONER

REMOVAL

1. Remove the generator. See **GENERATORS & REGULATORS** article.
2. Remove the timing chain tensioner (1).



G01860693

Fig. 195: Removing Timing Chain Tensioner
Courtesy of DAIMLERCHRYSLER CORP.

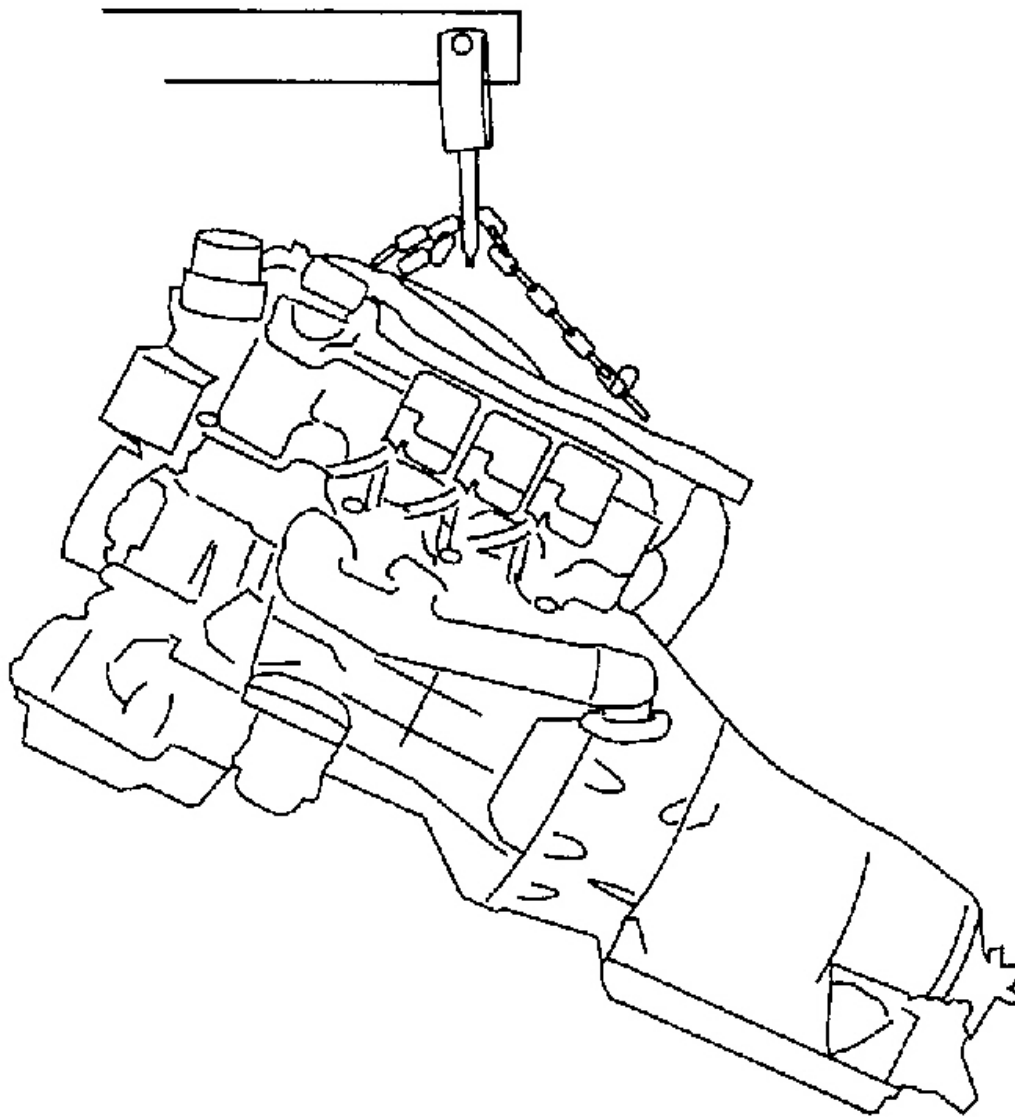
INSTALLATION

1. Install the timing chain tensioner. Tighten the timing chain tensioner to 80 N.m (59 ft. lbs.).
2. Install the generator. See **GENERATORS & REGULATORS** article.

TIMING CHAIN COVER

REMOVAL

1. Remove the engine from the vehicle. See **REMOVAL**.

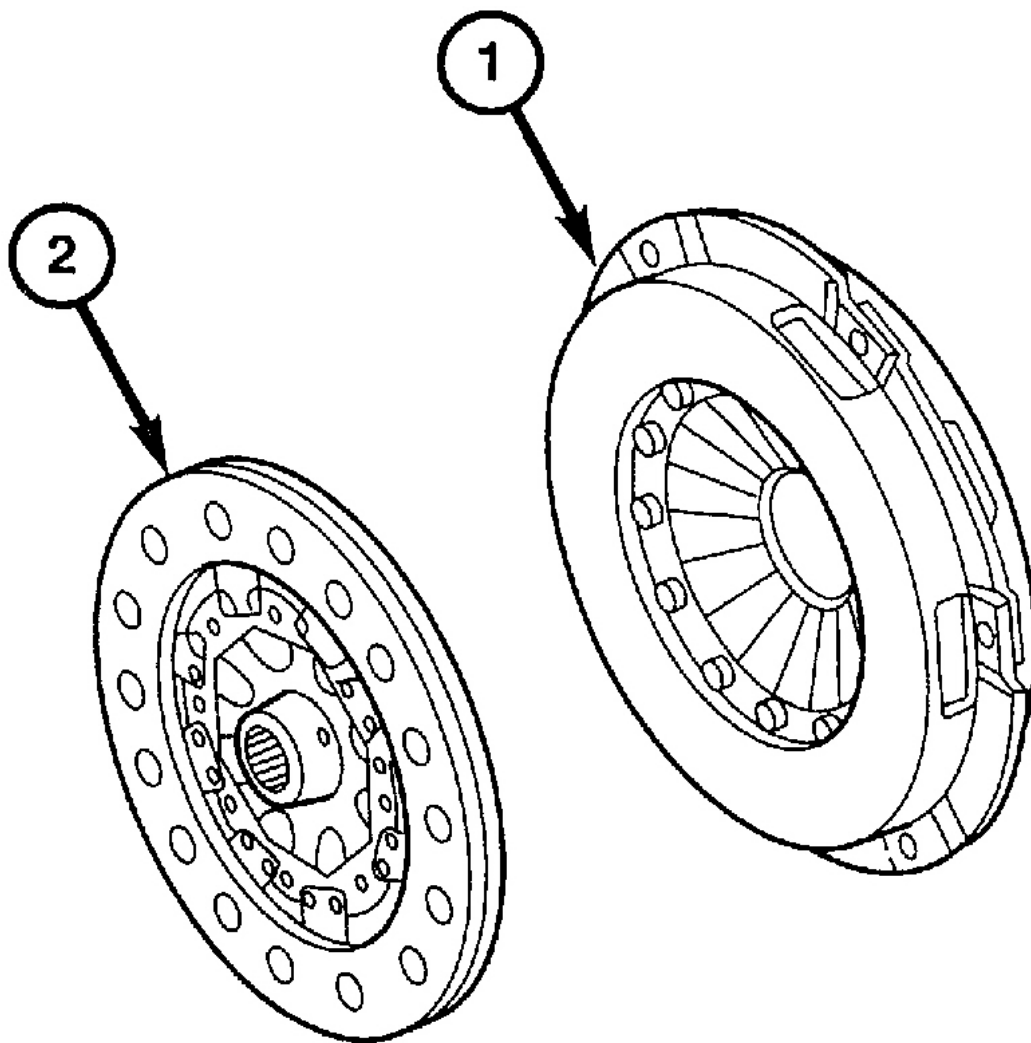


G01860694

Fig. 196: Removing Engine

Courtesy of DAIMLERCHRYSLER CORP.

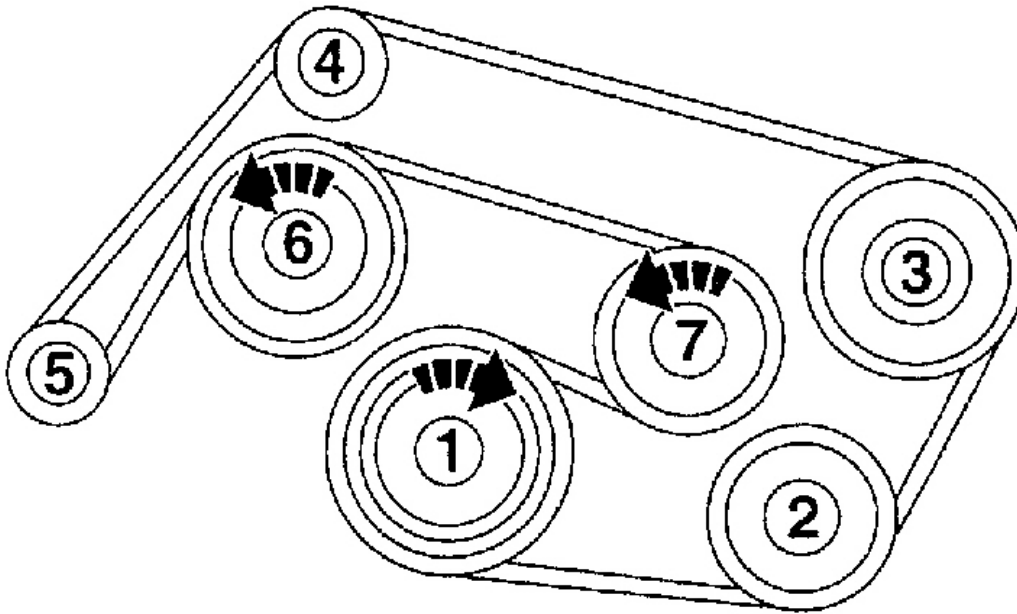
2. Separate the engine from the transmission. For automatic, see **REMOVAL & INSTALLATION** article and for manual, see **REMOVAL & INSTALLATION** article.
3. Remove the clutch cover (1) and the clutch (2) if equipped. See **CLUTCHES** article.



G01860695

Fig. 197: Removing Clutch Cover & Clutch
Courtesy of DAIMLERCHRYSLER CORP.

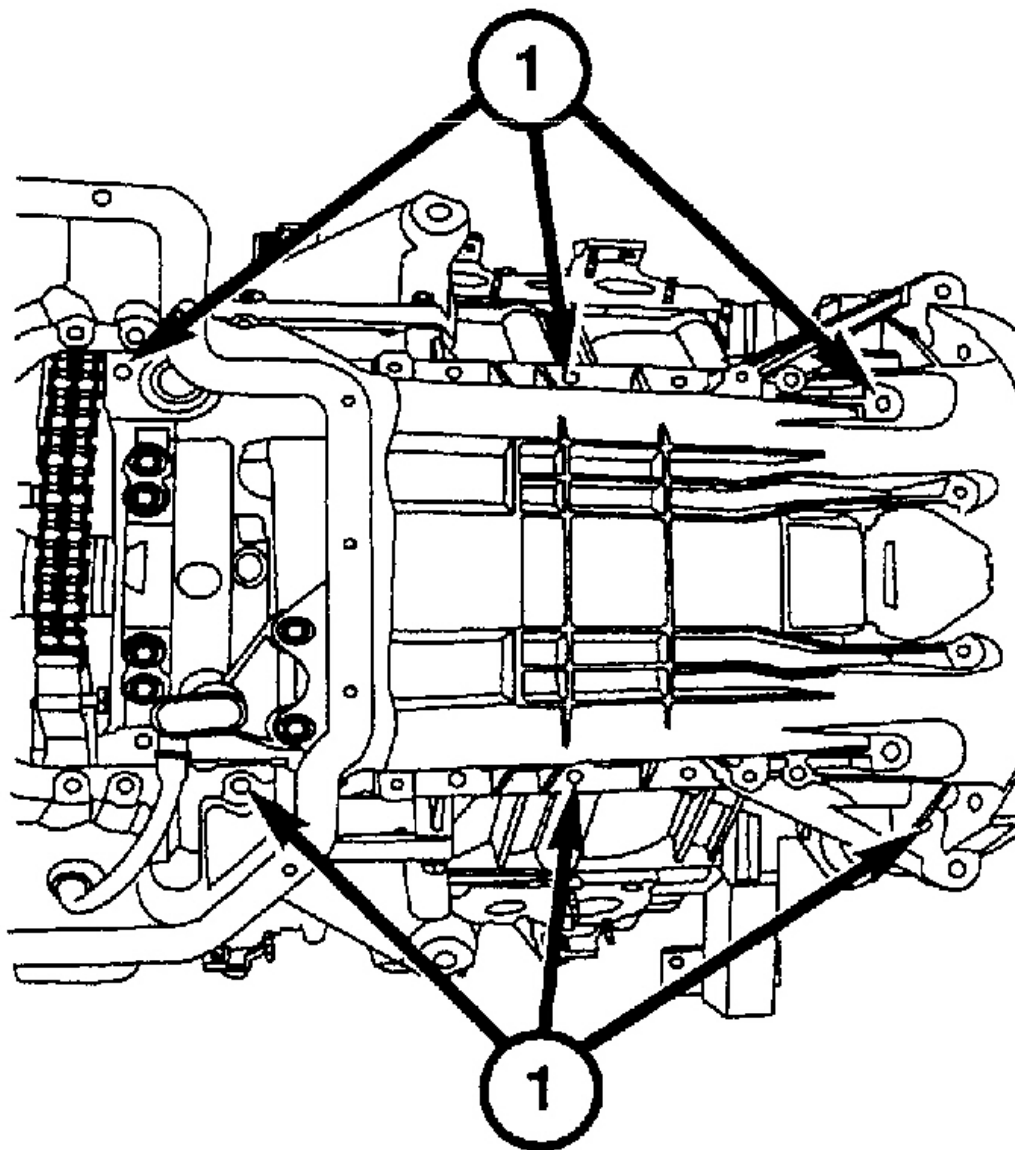
4. Mount the engine on a stand.
5. Remove the accessory drive belt. See **COOLING SYSTEM (MECHANICAL)** article.



G01860696

Fig. 198: Removing Accessory Drive Belt
Courtesy of DAIMLERCHRYSLER CORP.

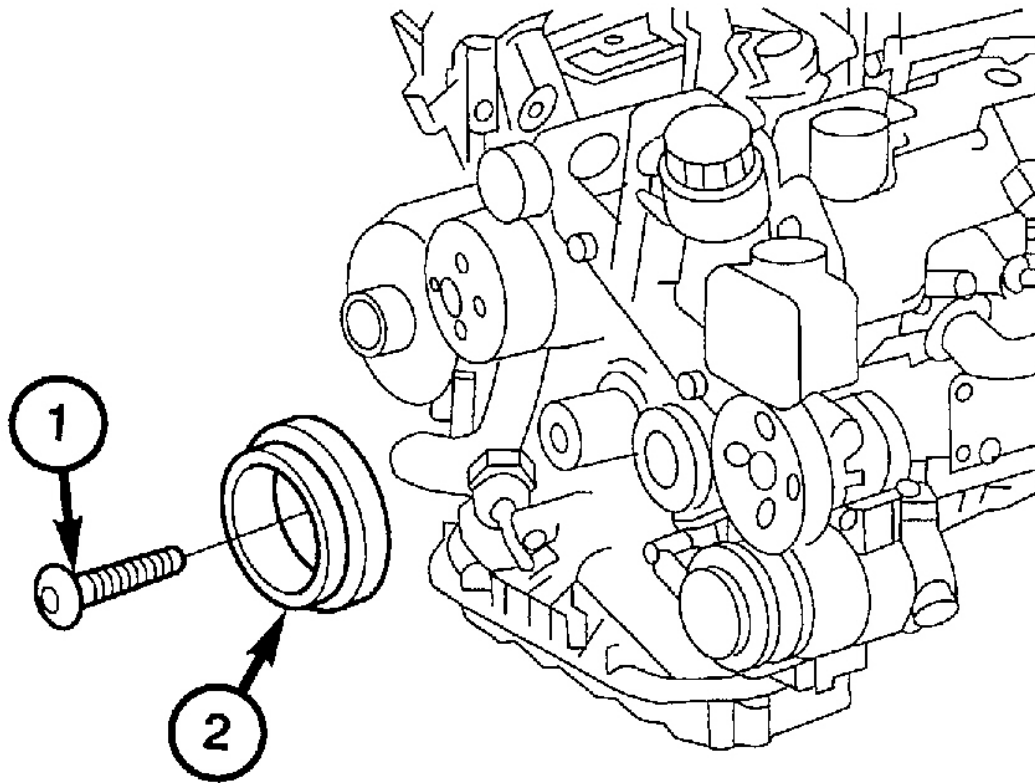
6. Remove the lower oil pan. Remove the bolts (1) and remove the upper oil pan. See **OIL PAN**.



G01860697

Fig. 199: Removing Upper Oil Pan Bolts
Courtesy of DAIMLERCHRYSLER CORP.

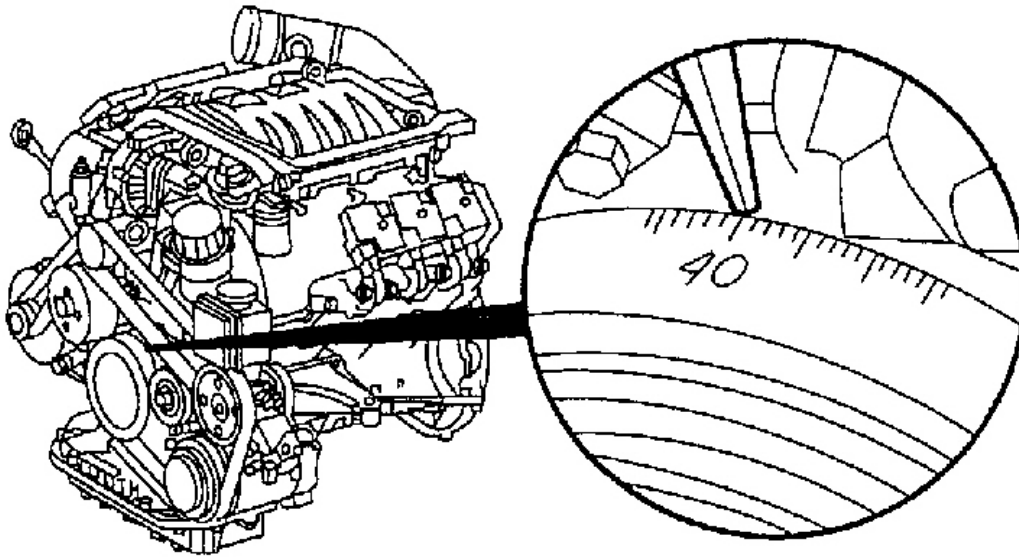
7. Remove the power steering pump. See **MANUAL & POWER STEERING** article.
8. Remove the idler pulley.
9. Remove the bolt (1) and remove the vibration damper (2). See **VIBRATION DAMPER**.



G01860698

Fig. 200: Removing Vibration Damper
Courtesy of DAIMLERCHRYSLER CORP.

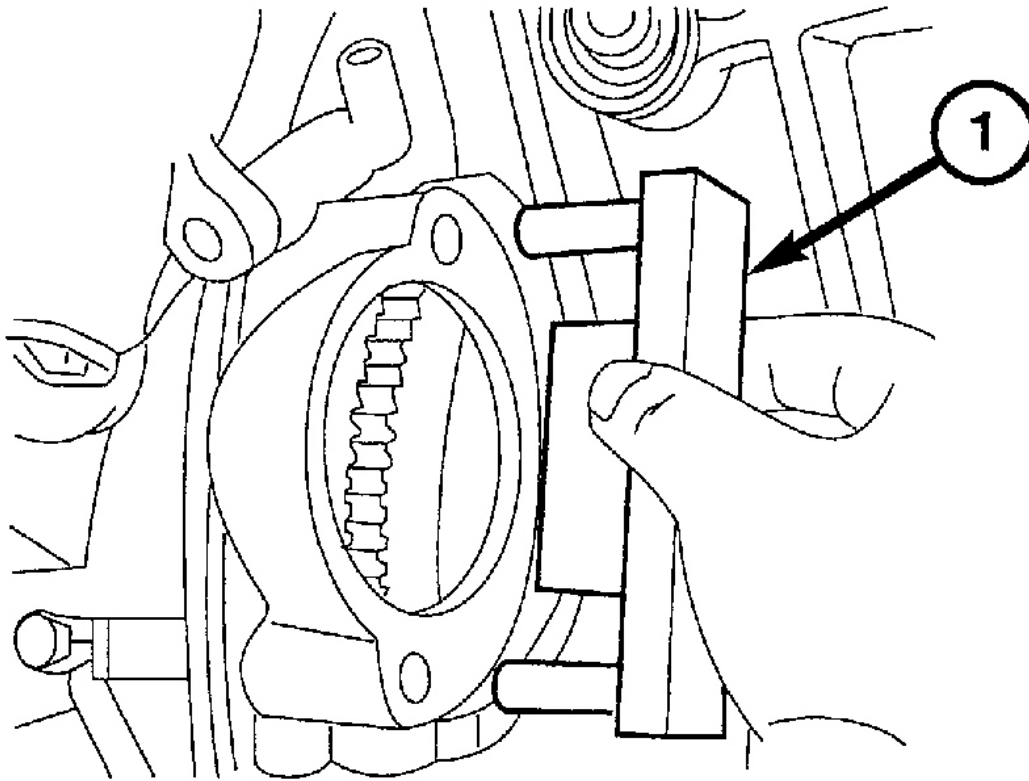
10. Remove the generator. See **GENERATORS & REGULATORS** article.
11. Rotate the crankshaft to 40° ATDC.



G01860699

Fig. 201: Rotating Crankshaft
Courtesy of DAIMLERCHRYSLER CORP.

12. Remove the starter. See **STARTERS** article.
13. Using Special Tool 9102 (1) Flywheel Locking Tool, lock the flywheel by inserting the tool into the starter opening.

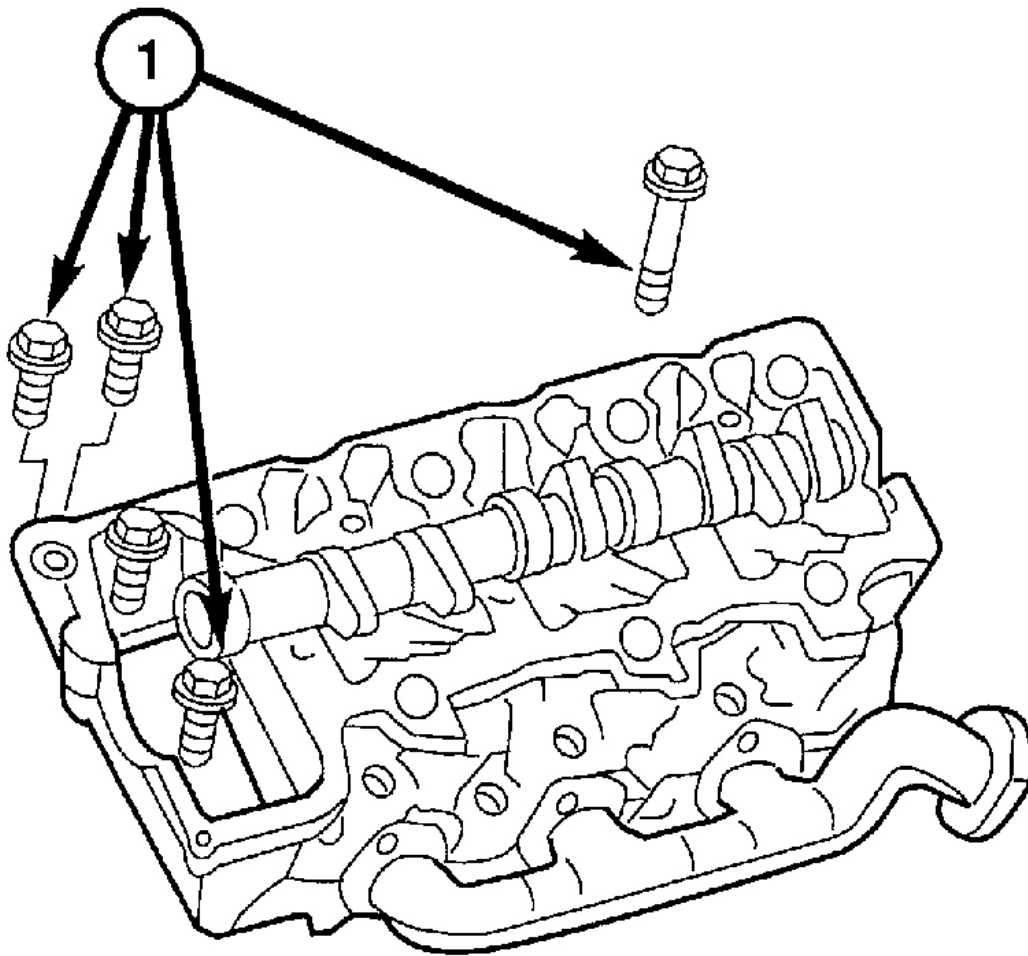


G01860700

Fig. 202: Locking Flywheel

Courtesy of DAIMLERCHRYSLER CORP.

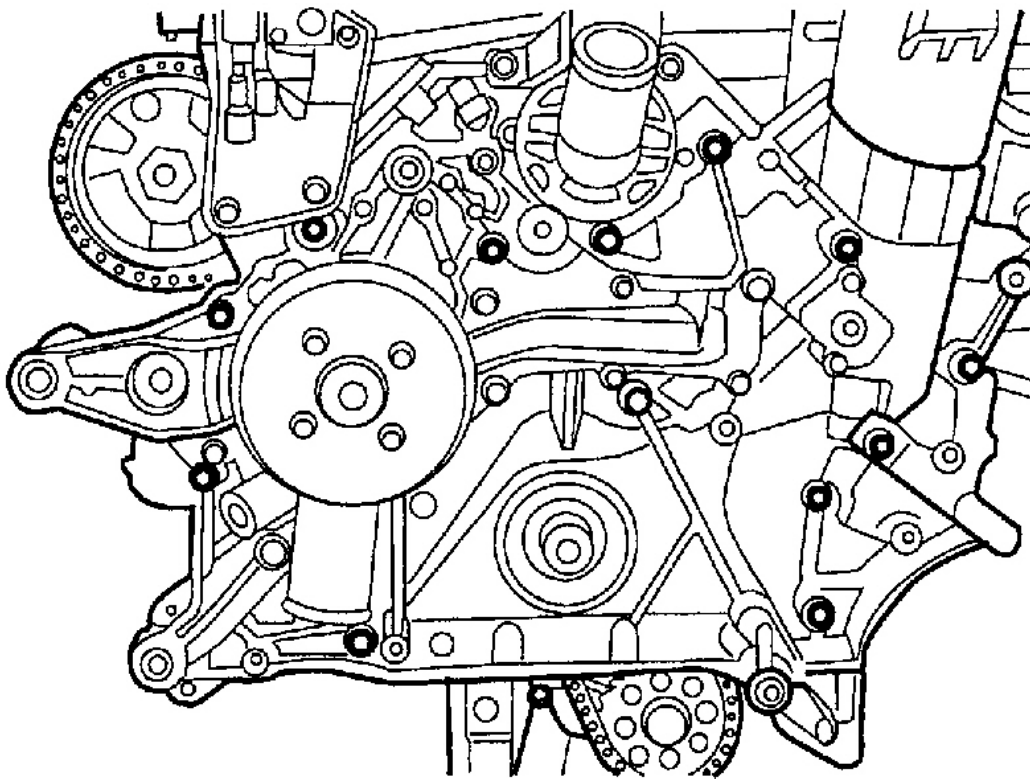
14. Remove the cylinder head bolts (1) and remove the cylinder heads. See **CYLINDER HEAD**.



G01860701

Fig. 203: Removing Cylinder Head Bolts & Cylinder Head
Courtesy of DAIMLERCHRYSLER CORP.

15. Remove the timing chain tensioner. See **TIMING CHAIN TENSIONER**.
16. Remove the timing chain cover bolts as shown in illustration. Remove the timing chain cover.



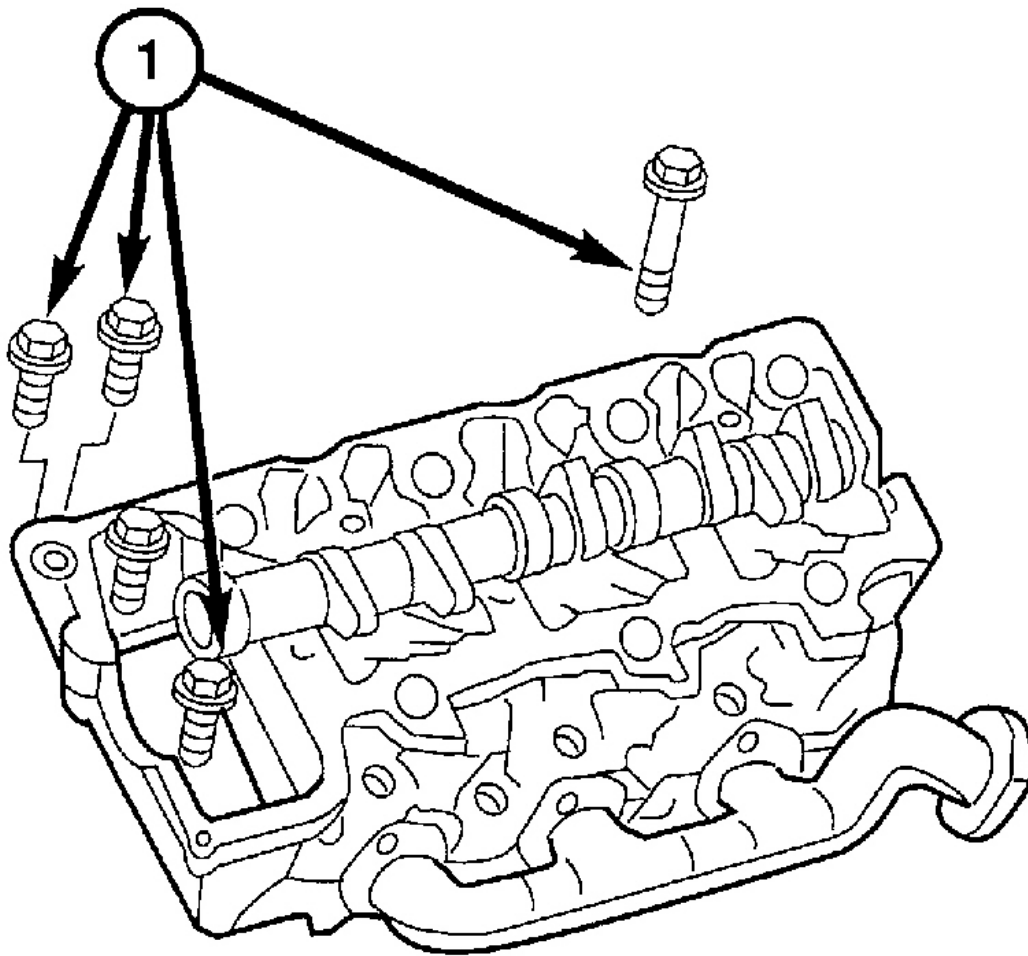
G01860702

Fig. 204: Removing Timing Chain Cover
Courtesy of DAIMLERCHRYSLER CORP.

INSTALLATION

NOTE: Ensure all sealing surfaces have been cleaned and prepared properly for effective repair. Multi-Layer Steel (MLS) gaskets require a scratch free sealing surface.

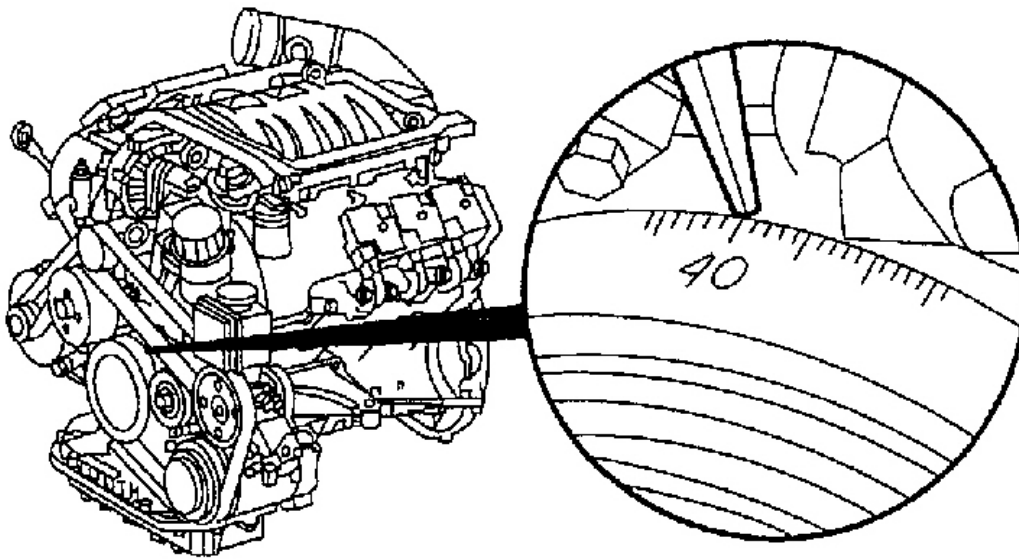
1. Install the cylinder heads, and install the bolts (1). See CYLINDER HEAD.



G01860703

Fig. 205: Installing Cylinder Head
Courtesy of DAIMLERCHRYSLER CORP.

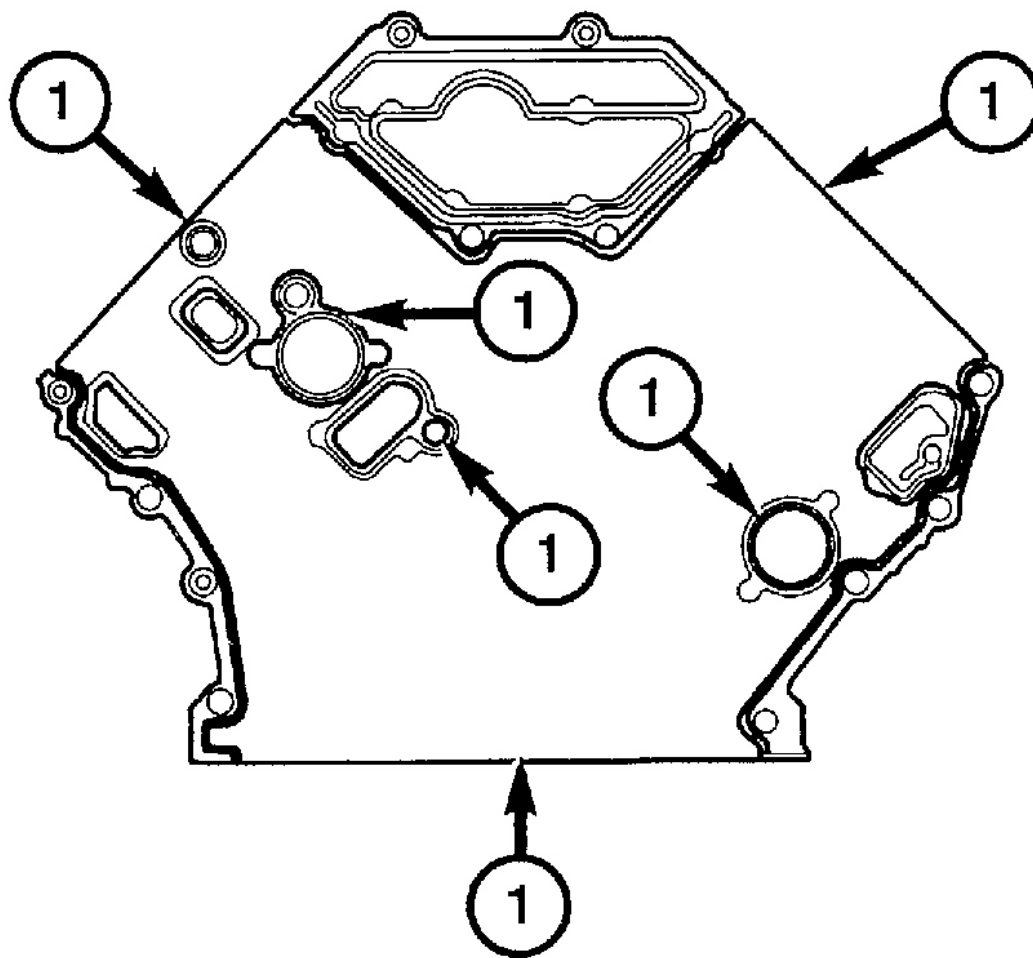
2. Align the basic valve timing to 40 deg. ATDC. See **TIMING CHAIN**.



G01860704

Fig. 206: Aligning Basic Valve Timing
Courtesy of DAIMLERCHRYSLER CORP.

NOTE: Apply sealer **ONLY** to the area marked (1) as shown. If porous points are visible at the cylinder heads or at the rear of the engine near the sealing surface of the cylinder head gasket, apply sealant at these points. The sealant must be applied only as a 2.0 mm +/- 0.5 mm bead, assembled within 10 minutes, and not be flattened or spread.



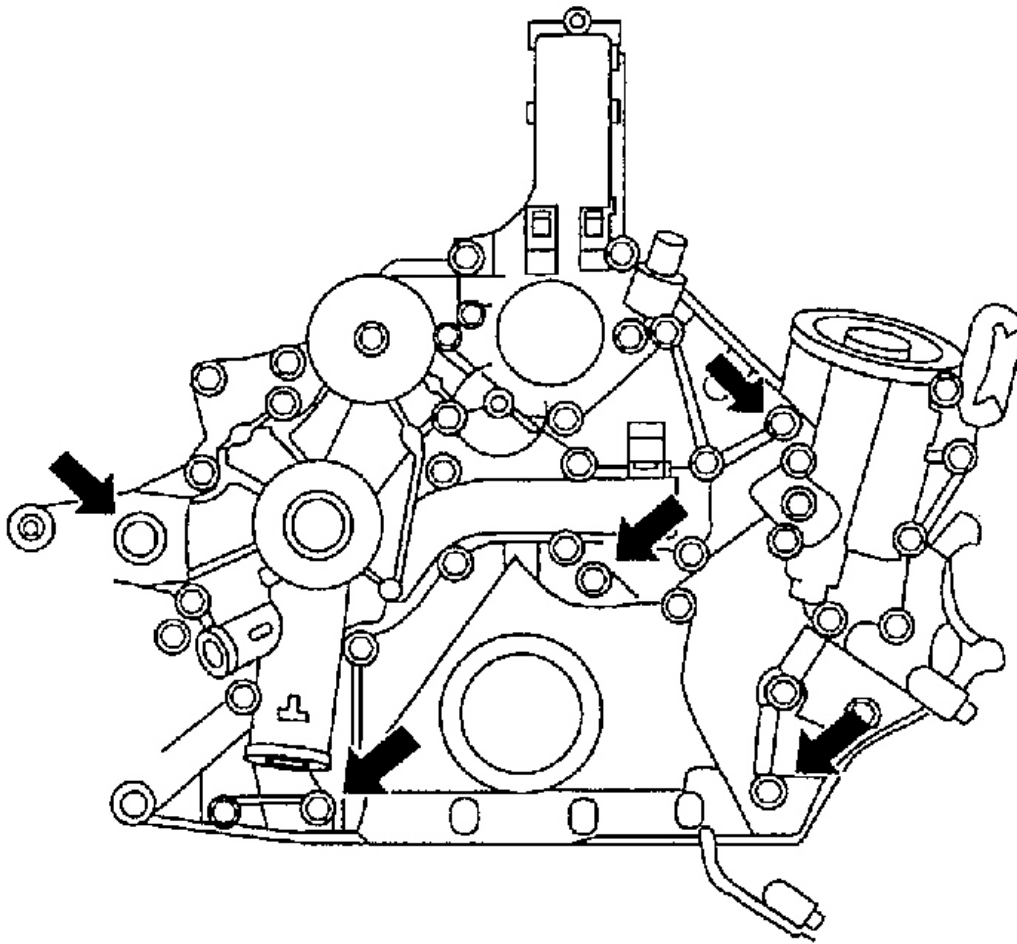
G01860705

Fig. 207: Applying Sealant

Courtesy of DAIMLERCHRYSLER CORP.

3. Apply a 1.5 to 2.0 mm bead of Loctite 5203 or equivalent sealer to the area marked (1) as shown in illustration.
4. Position the timing chain cover on the front of the engine.

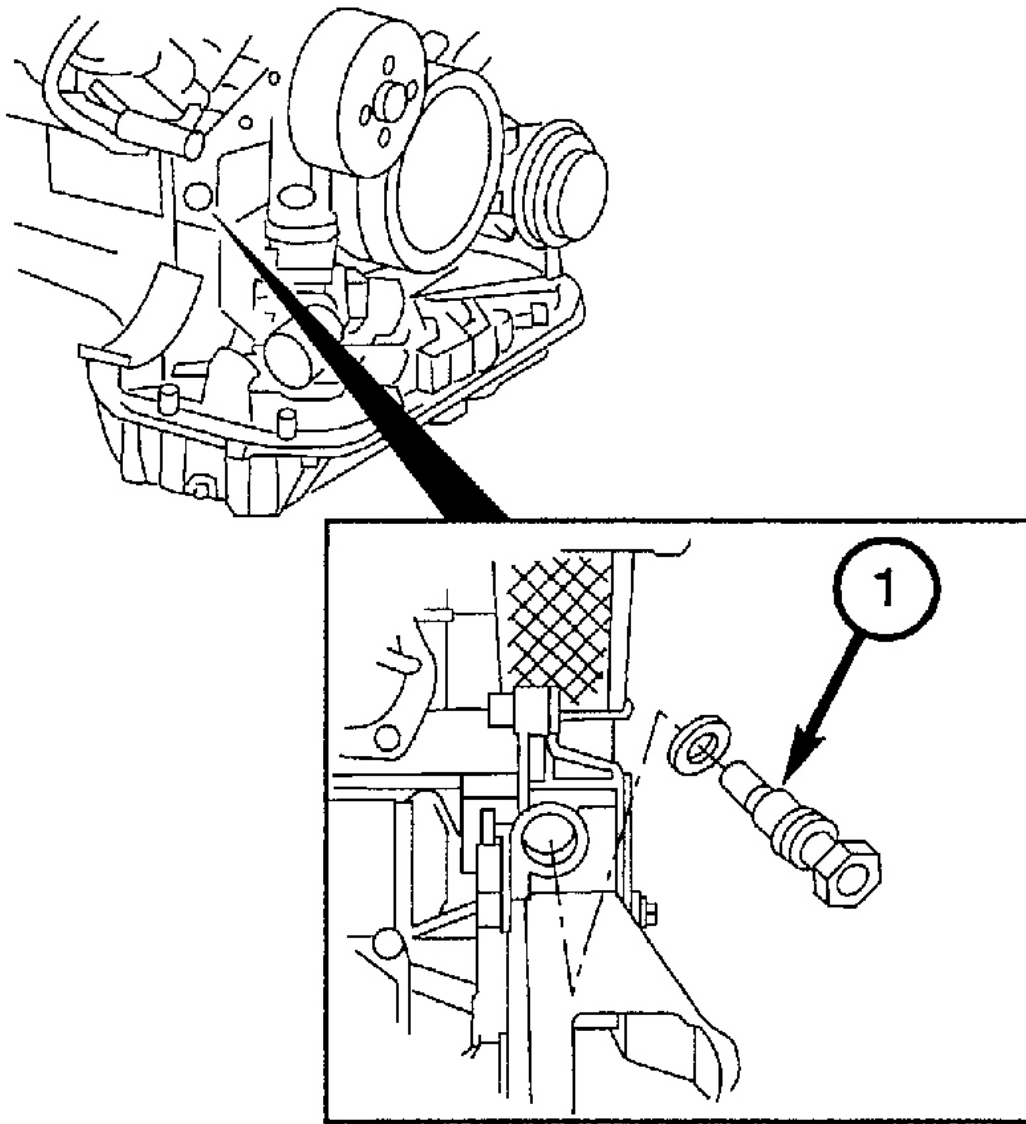
NOTE: Ensure that the bolts indicated by the arrows in illustration are installed with tread sealer prior to assembly.



G01860706

Fig. 208: Installing Timing Chain Cover Bolts
Courtesy of DAIMLERCHRYSLER CORP.

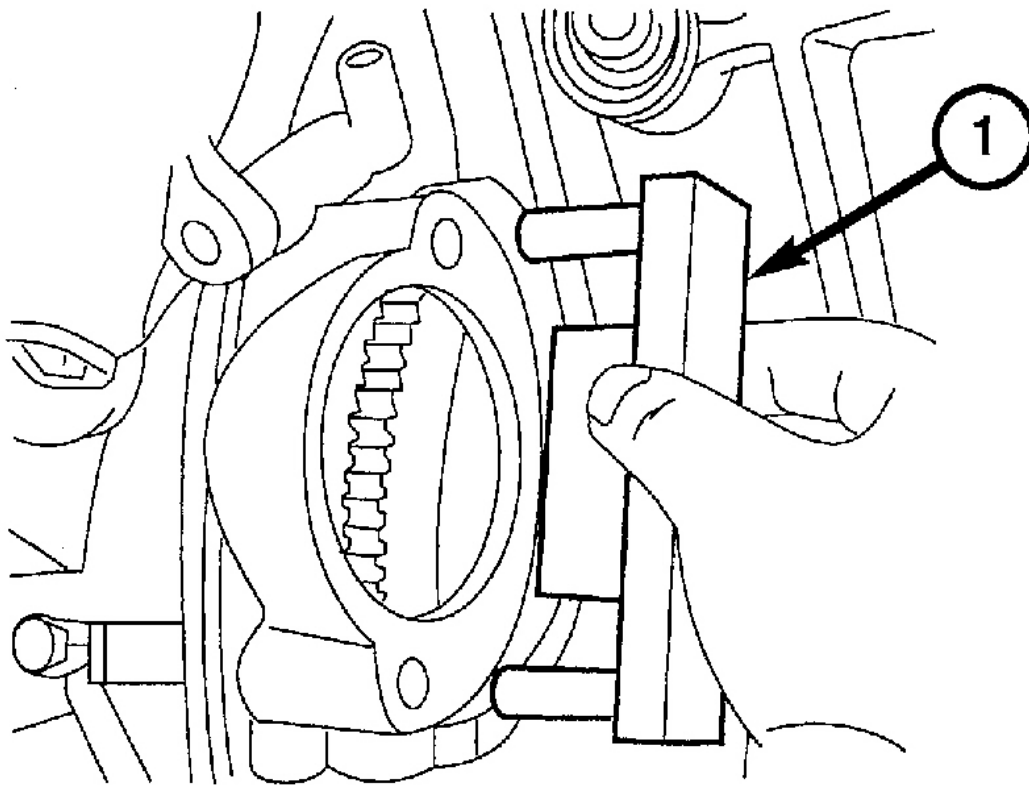
5. Install the timing chain cover bolts and tighten to 20 N.m (15 ft. lbs.).
6. Install the timing chain tensioner (1), tighten to 80 N.m (59 ft. lbs.). See **TIMING CHAIN TENSIONER**.



G01860707

Fig. 209: Installing Timing Chain Tensioner
Courtesy of DAIMLERCHRYSLER CORP.

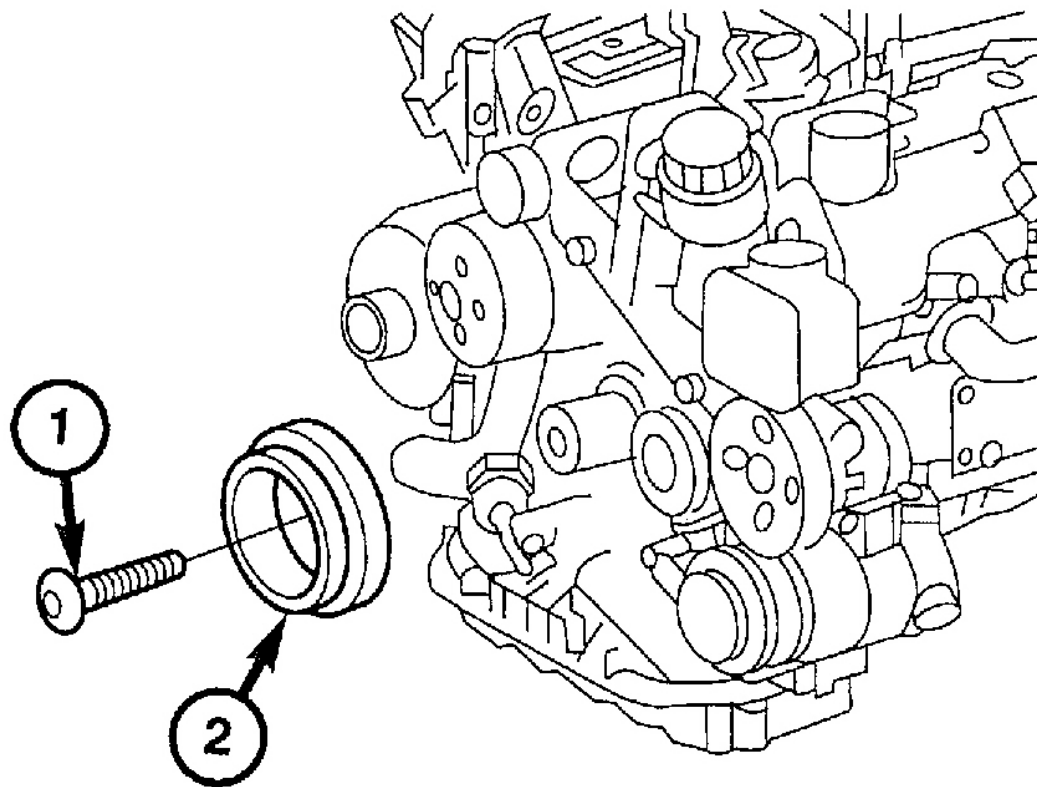
7. Remove Special Tool 9102 Flywheel Locking Tool (1) from the engine.



G01860708

Fig. 210: Removing Flywheel Locking Tool
Courtesy of DAIMLERCHRYSLER CORP.

8. Install the starter. See **STARTERS** article.
9. Install a new front crankshaft radial oil seal. See **CRANKSHAFT OIL SEAL - FRONT**.
10. Install the generator. See **GENERATORS & REGULATORS** article.
11. Install the vibration damper. See **VIBRATION DAMPER**.



G01860709

Fig. 211: Installing Vibration Damper
Courtesy of DAIMLERCHRYSLER CORP.

12. Install the idler pulley. See **COOLING SYSTEM (MECHANICAL)** article.
13. Install the power steering pump, return hose (1), and pressure hose (2). See **MANUAL & POWER STEERING** article.

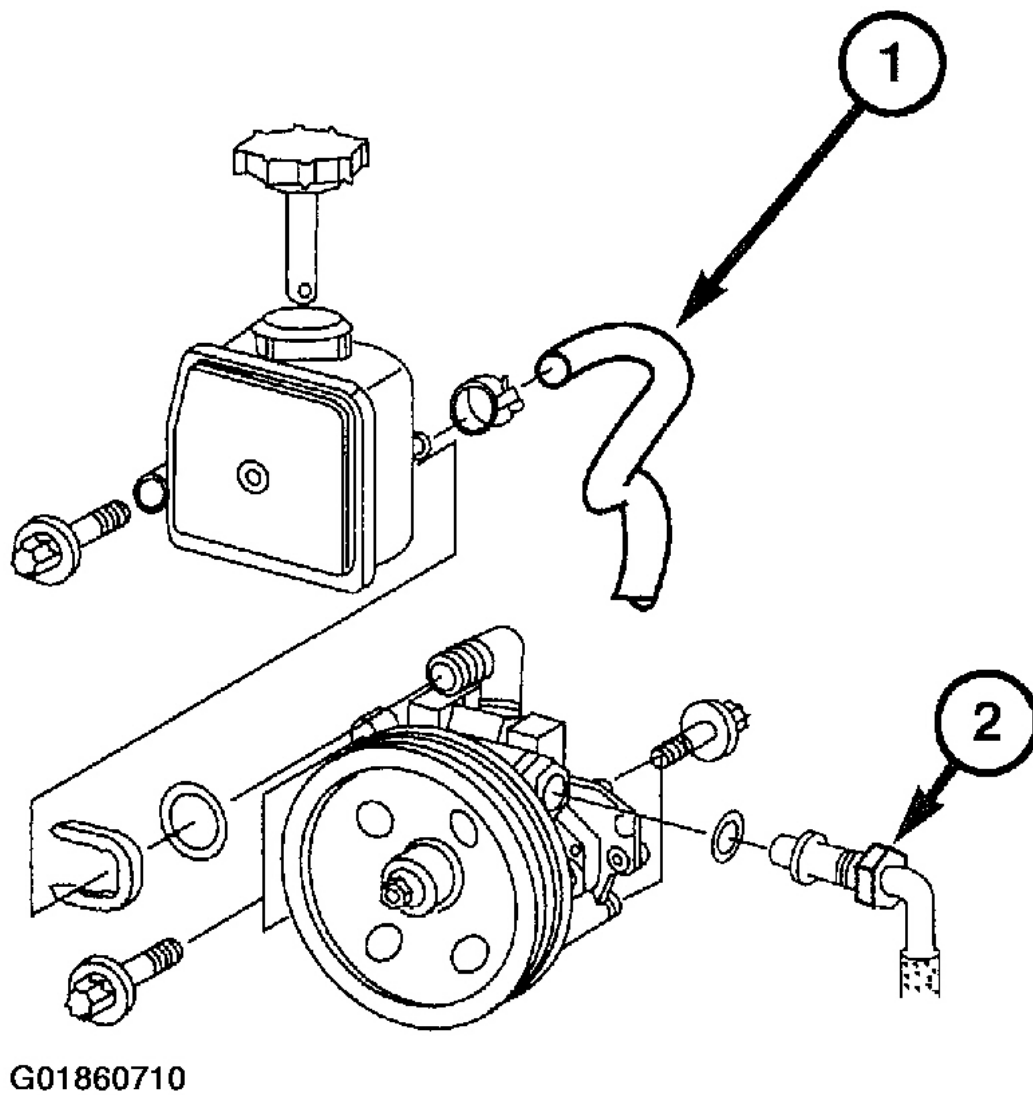
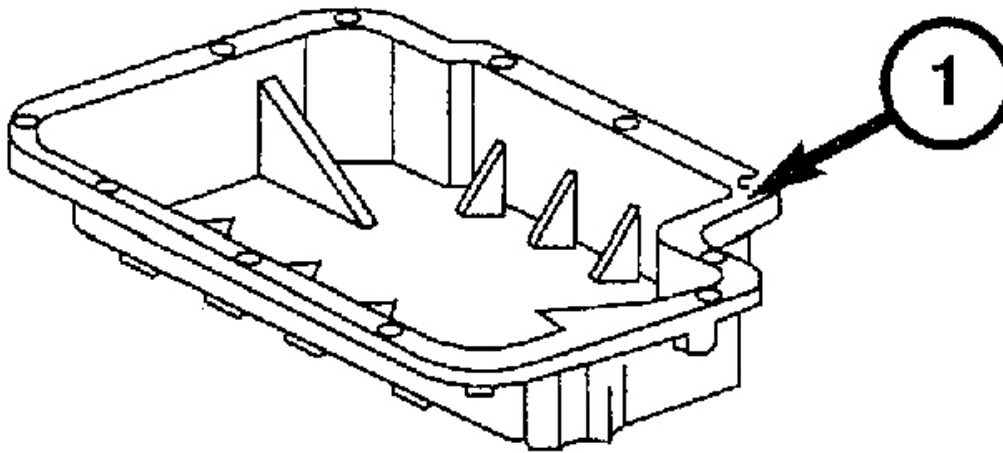


Fig. 212: Installing Power Steering Pump, Return Hose & Pressure Hose
Courtesy of DAIMLERCHRYSLER CORP.

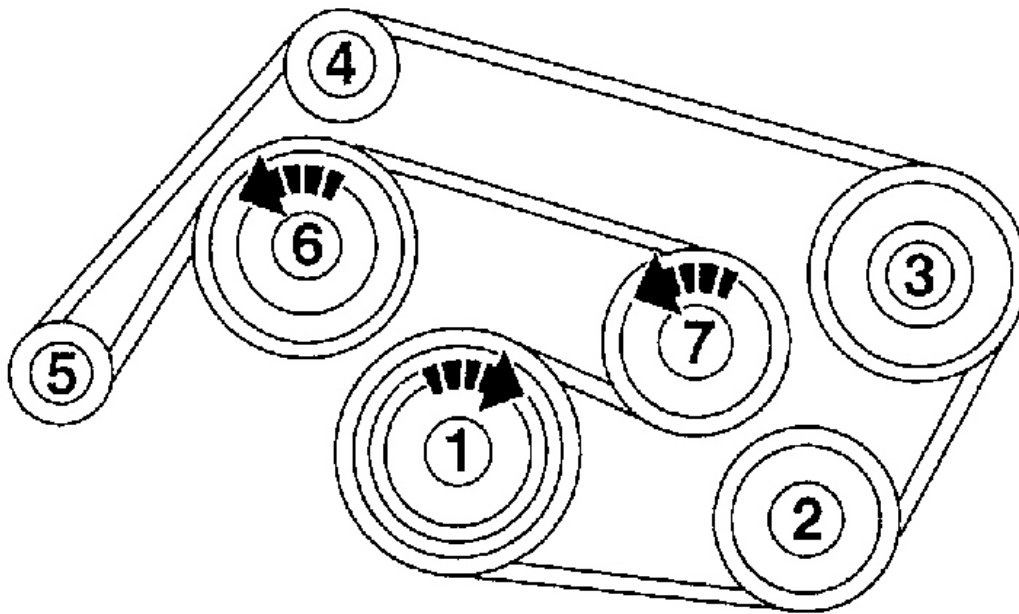
14. Install the upper and lower (1) oil pan. See OIL PAN.



G01860711

Fig. 213: Installing Lower Oil Pan
Courtesy of DAIMLERCHRYSLER CORP.

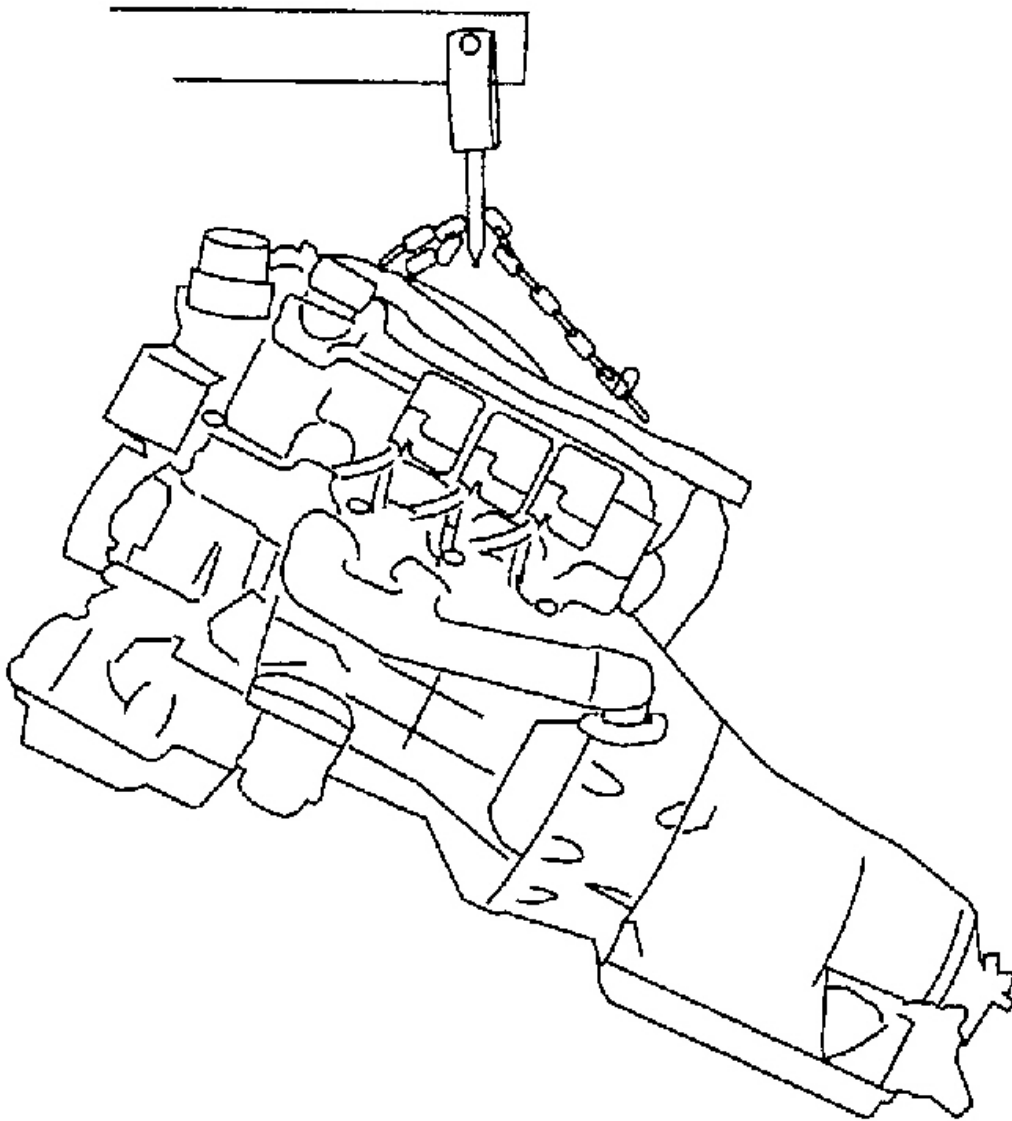
15. Install the accessory drive belt. See **COOLING SYSTEM (MECHANICAL)** article.



G01860712

Fig. 214: Installing Accessory Drive Belt
Courtesy of DAIMLERCHRYSLER CORP.

16. Remove the engine from the stand.
17. Install the clutch if equipped. See **CLUTCHES** article.
18. Install the transmission on the engine. For automatic, see **REMOVAL & INSTALLATION** article and for manual, see **REMOVAL & INSTALLATION** article.
19. Install the engine in the vehicle. See **INSTALLATION**.



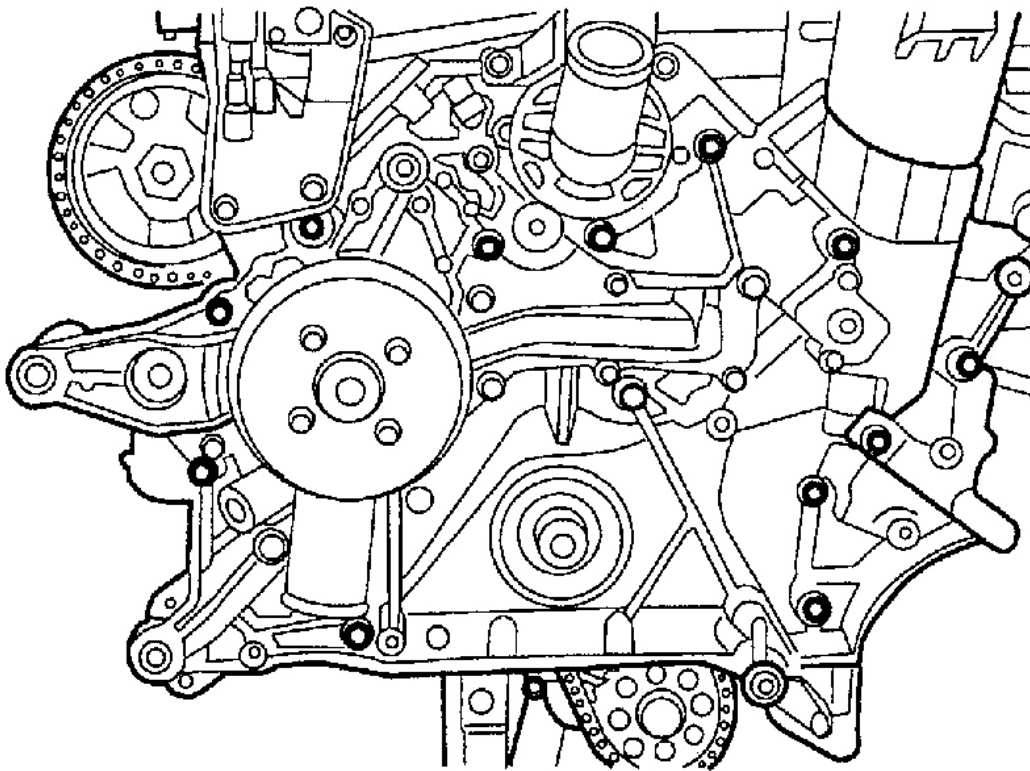
G01860713

Fig. 215: Installing Engine
Courtesy of DAIMLERCHRYSLER CORP.

TIMING CHAIN

REMOVAL

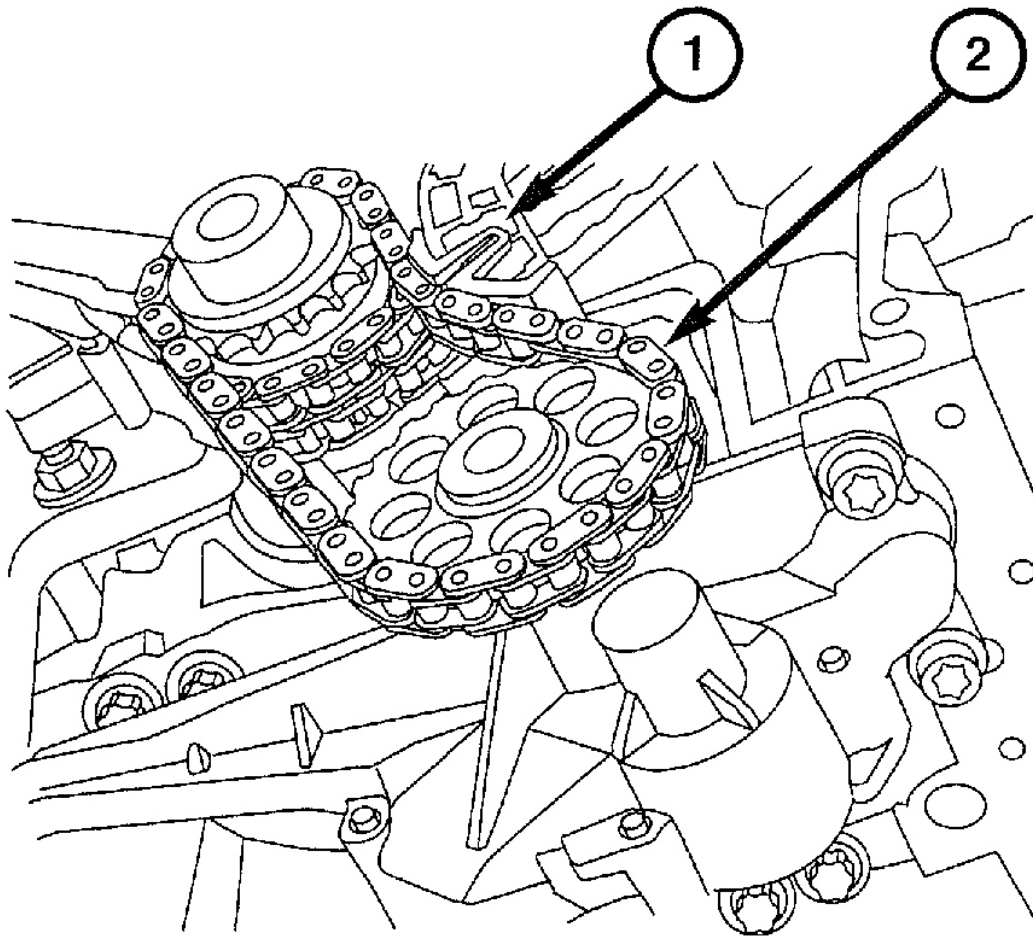
1. Remove the timing chain cover. See **TIMING CHAIN COVER**.



G01860714

Fig. 216: Removing Timing Chain Cover
Courtesy of DAIMLERCHRYSLER CORP.

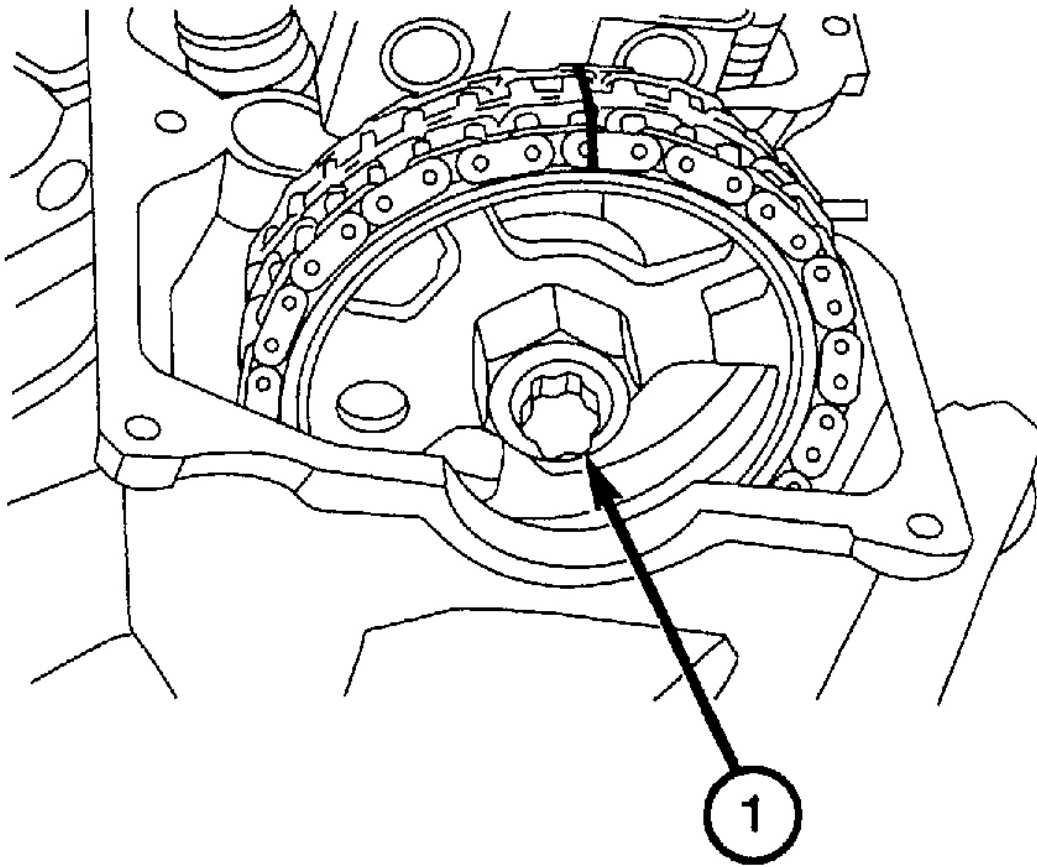
2. Remove the oil pump drive chain (2) and tensioner (1). See **OIL PUMP**.



G01860715

Fig. 217: Removing Oil Pump Drive Chain & Tensioner
Courtesy of DAIMLERCHRYSLER CORP.

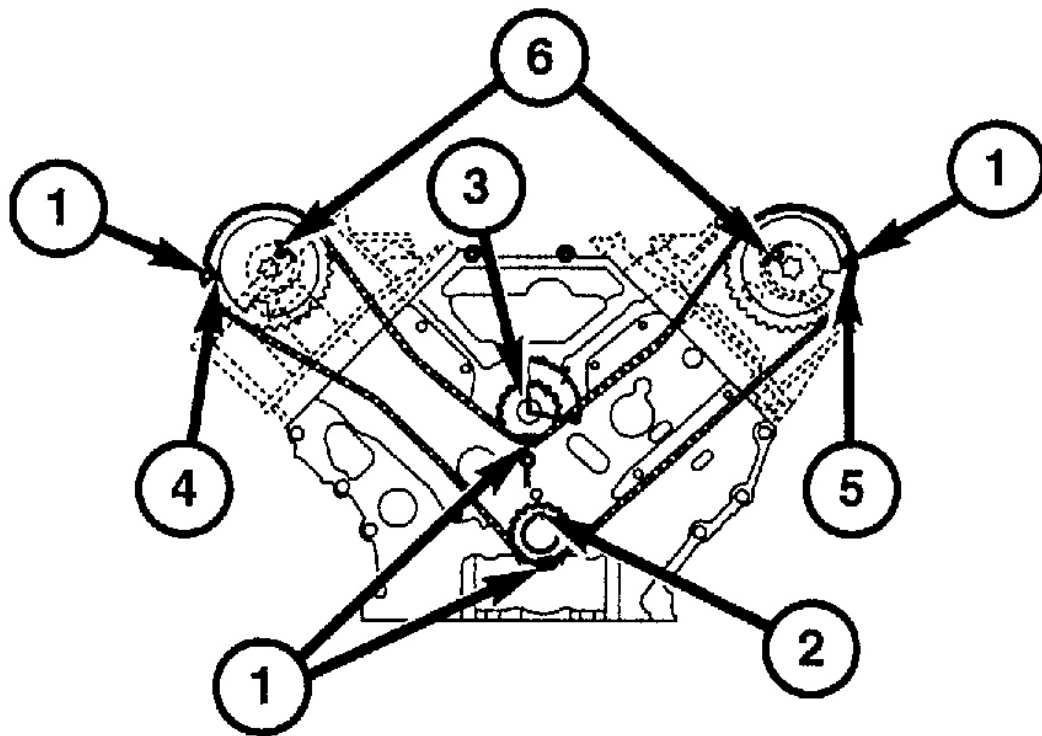
3. Remove the left and right camshaft sprocket bolts (1).



G01860716

Fig. 218: Removing Left & Right Camshaft Sprocket Bolts
Courtesy of DAIMLERCHRYSLER CORP.

4. Remove the timing chain and camshaft sprockets.
5. Remove the timing chain crankshaft sprocket (2).



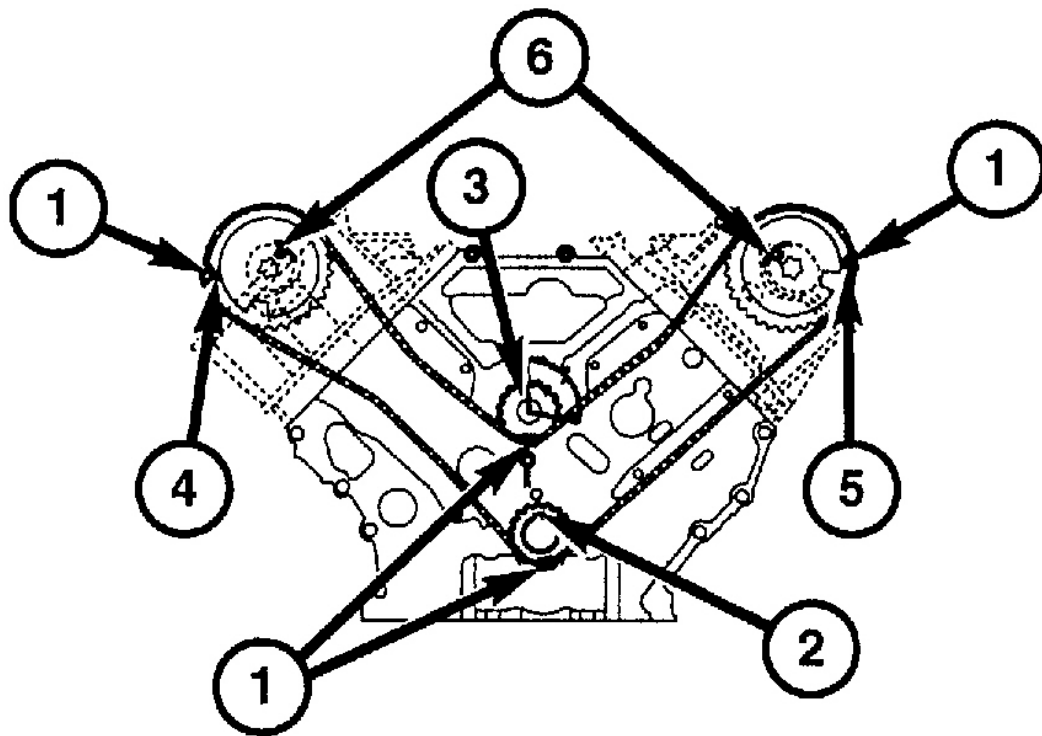
G01860717

Fig. 219: Removing Timing Chain Crankshaft Sprocket**Courtesy of DAIMLERCHRYSLER CORP.**

6. Clean and inspect all gasket surfaces, chain guides, and sprockets for wear or damage. Repair or replace as necessary.

INSTALLATION

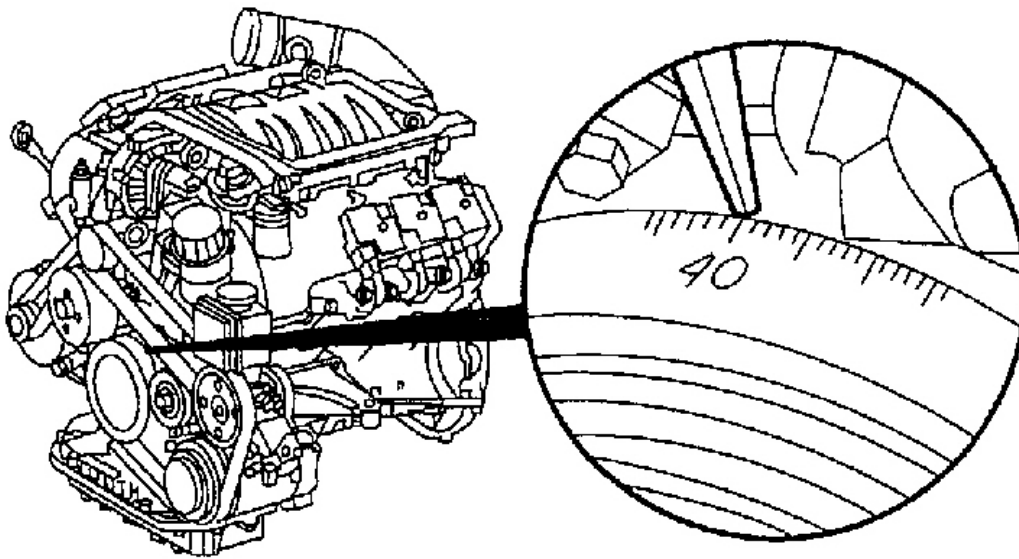
1. Invert the engine on the engine stand.
2. Install the crankshaft sprocket (2).



G01860718

Fig. 220: Installing Crankshaft Sprocket
Courtesy of DAIMLERCHRYSLER CORP.

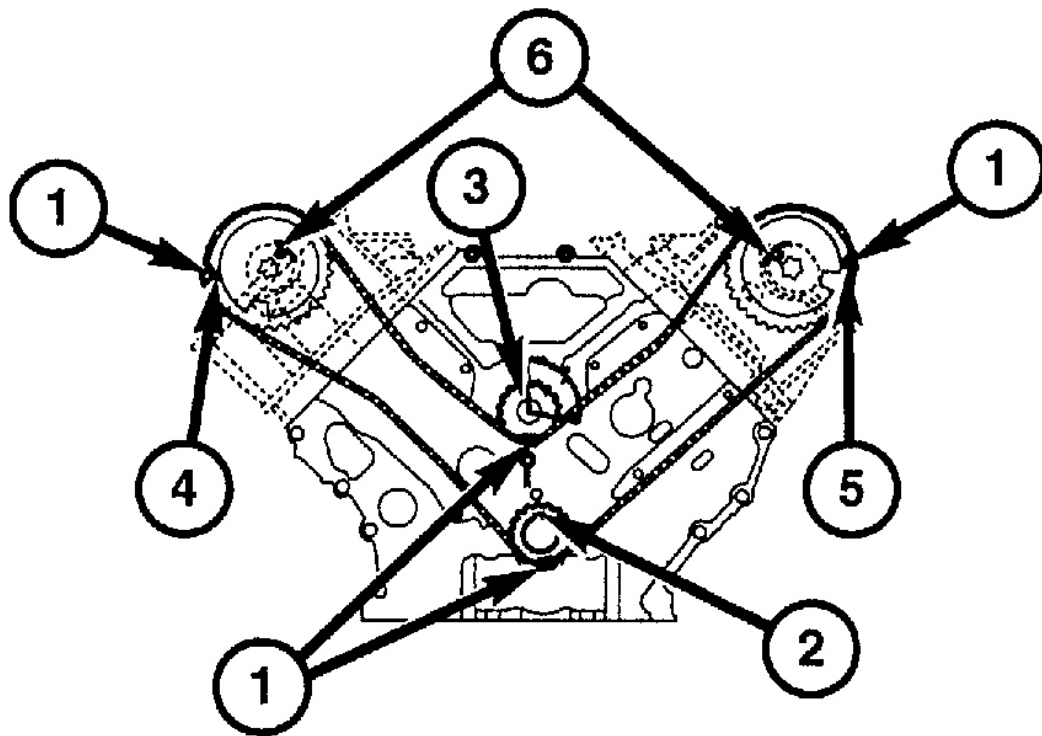
3. Ensure the crankshaft has maintained 40 degrees ATDC. If not, rotate until aligned with 40 degree marking.



G01860719

Fig. 221: Aligning Crankshaft
Courtesy of DAIMLERCHRYSLER CORP.

4. Align the balance shaft sprocket with the timing mark (3) and the copper teeth (1) of the timing chain.

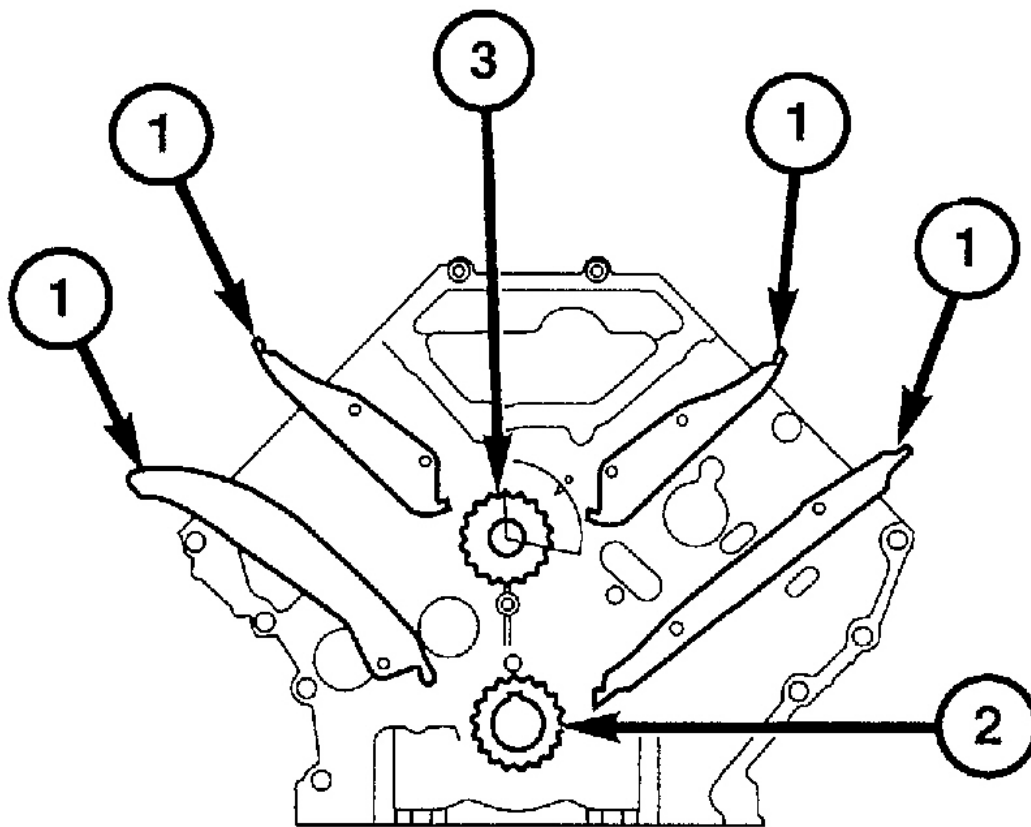


G01860720

Fig. 222: Aligning Balance Shaft Sprocket With Timing Mark & Inserting & Aligning Camshaft Sprockets

Courtesy of DAIMLERCHRYSLER CORP.

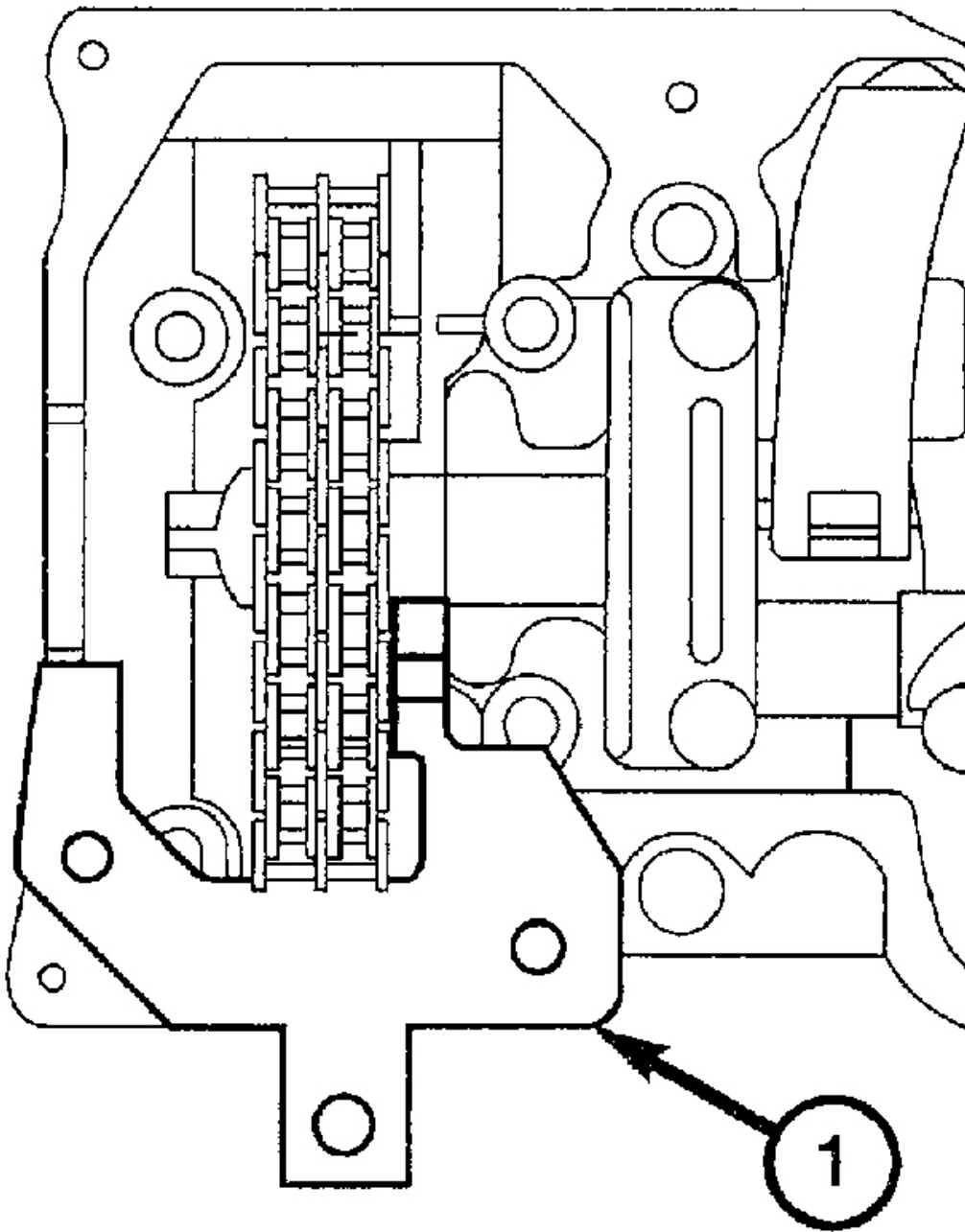
5. Insert the camshaft sprockets (6) into the timing chain and align the camshaft sprocket timing marks (4) and (5) with the copper teeth (1) of the timing chain.
6. Install the timing chain with the sprockets and route within in the timing chain guides (1).



G01860721

Fig. 223: Installing Timing Chain With Sprockets
Courtesy of DAIMLERCHRYSLER CORP.

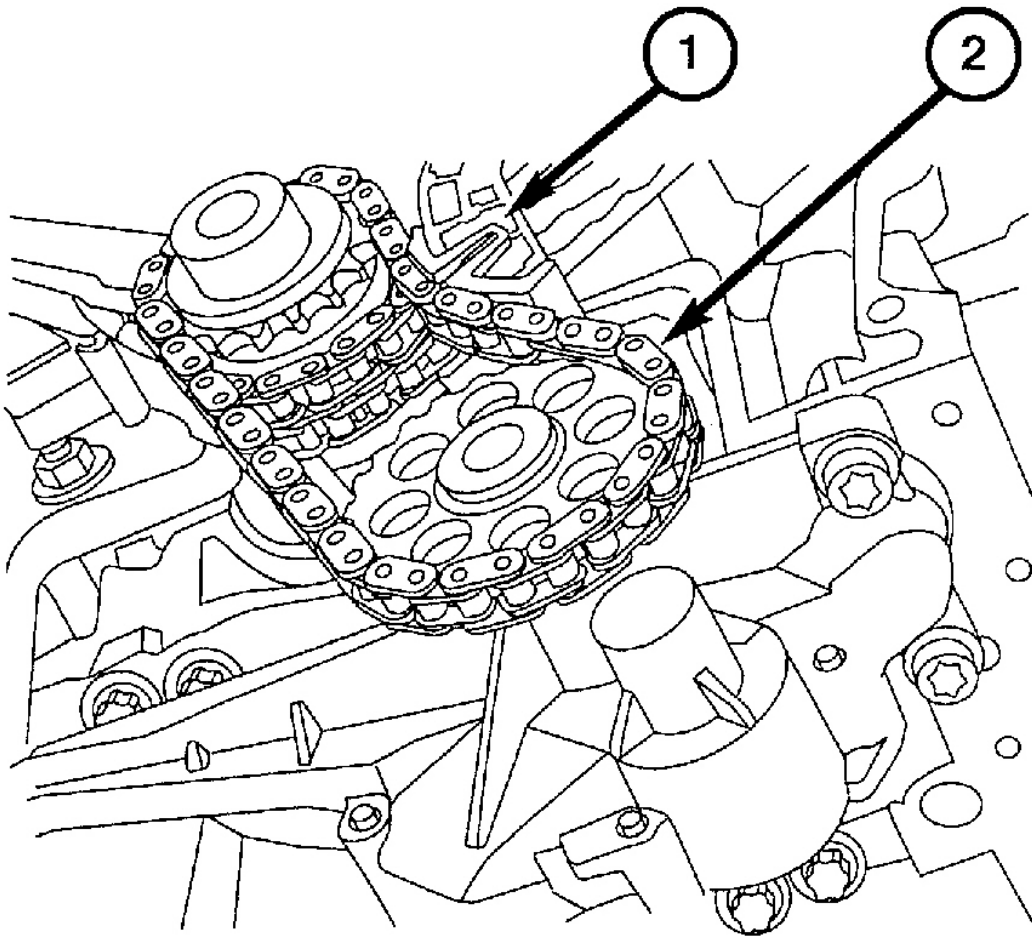
7. Using Special Tools 9104 (1) and 9105 Camshaft Locating Plates, lock the camshaft sprockets.



G01860722

Fig. 224: Locking Camshaft Sprockets
Courtesy of DAIMLERCHRYSLER CORP.

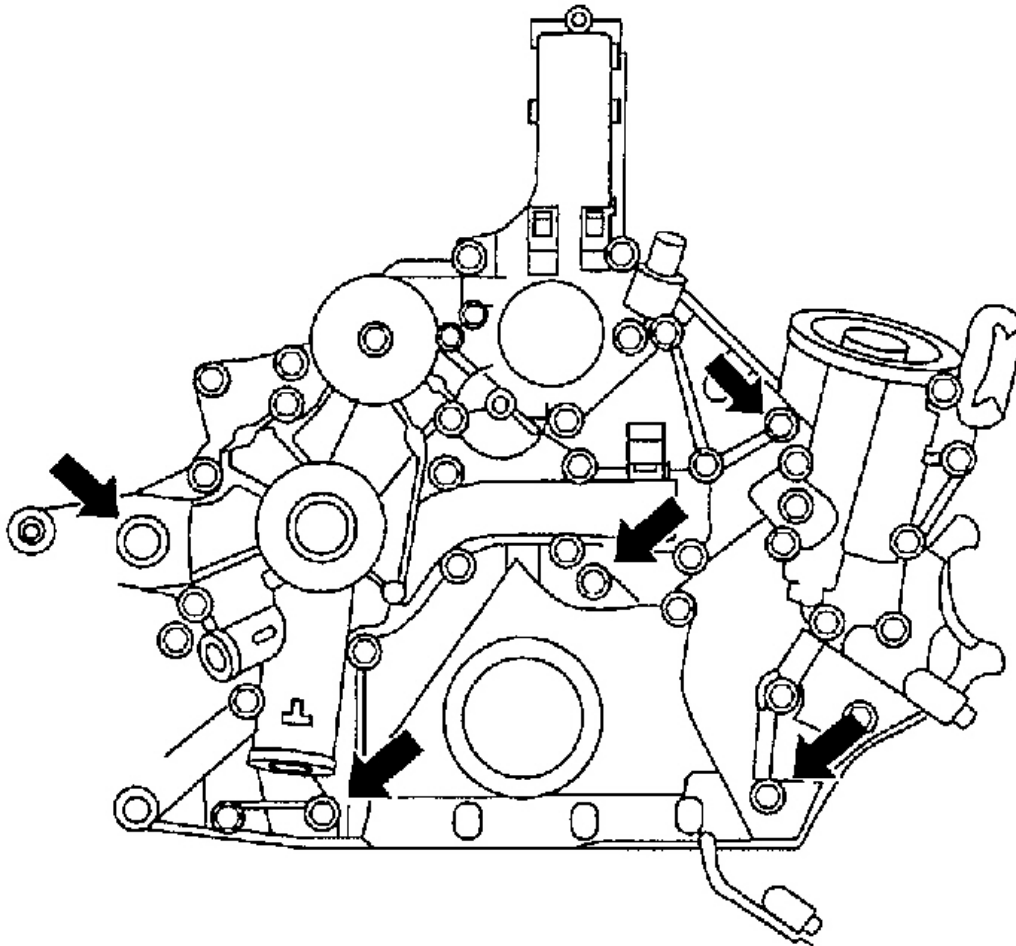
8. Install the oil pump, the oil pump drive chain (2) and the oil pump drive chain tensioner (1). See **OIL PUMP**.



G01860723

Fig. 225: Installing Oil Pump, Oil Pump Drive Chain & Oil Pump Drive Chain Tensioner
Courtesy of DAIMLERCHRYSLER CORP.

9. Rotate the engine to the upright position.
10. Install the timing chain cover. Tighten the bolts to 20 N.m (15 ft. lbs.). See **TIMING CHAIN COVER**.



G01860724

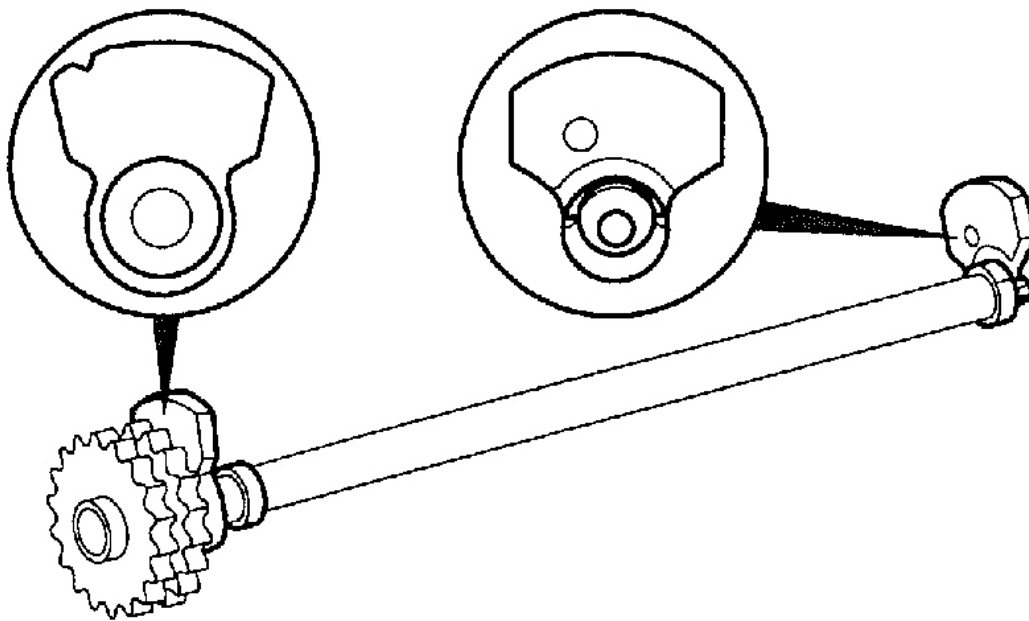
Fig. 226: Tightening Timing Chain Cover Bolts
Courtesy of DAIMLERCHRYSLER CORP.

11. Remove Special Tools 9104 and 9105 Camshaft Locating Plates from the camshaft sprockets.

BALANCE SHAFT

DESCRIPTION

A balance shaft is used to compensate for the rocking motion inherent in a 90-degree V-6 engine. It rotates at engine speed in the opposite direction. Mounted above the crankshaft in the cylinder block, it is driven by the timing chain.

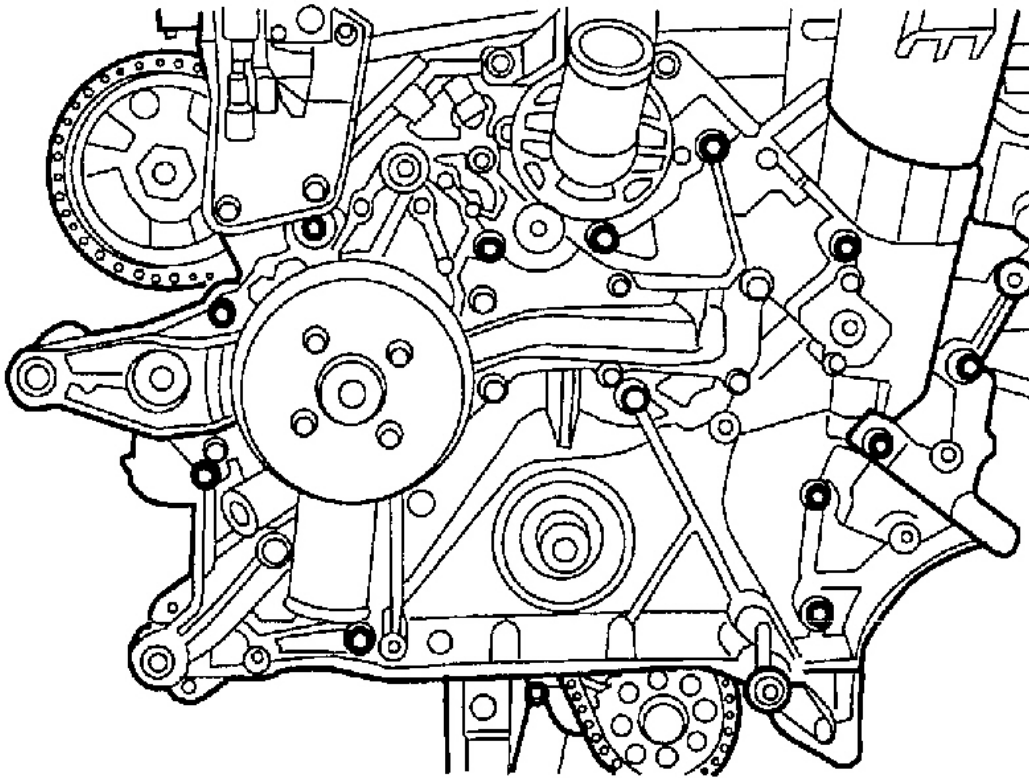


G01860725

Fig. 227: Identifying Balance Shaft
Courtesy of DAIMLERCHRYSLER CORP.

REMOVAL

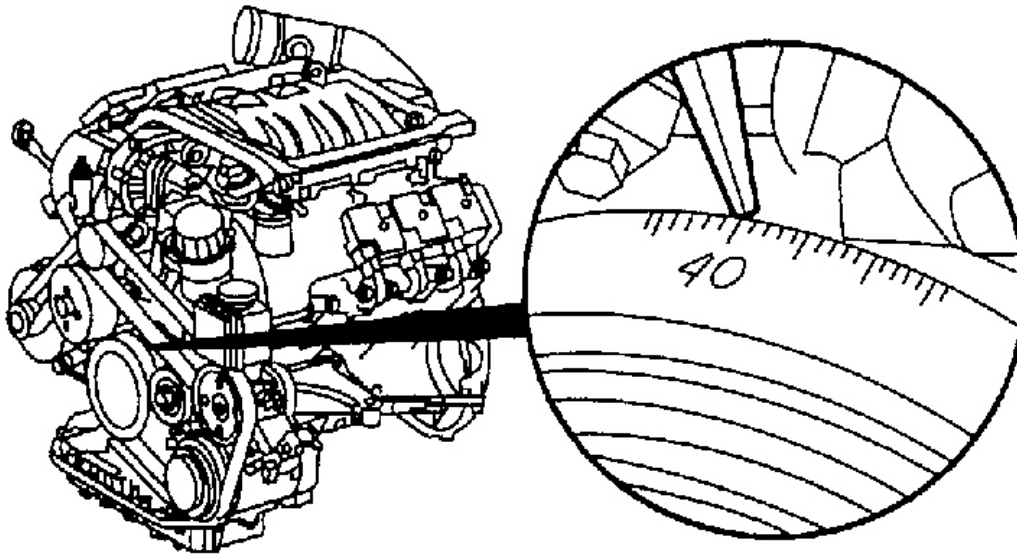
1. Remove the timing chain cover. See **TIMING CHAIN COVER.**



G01860726

Fig. 228: Removing Timing Chain Cover
Courtesy of DAIMLERCHRYSLER CORP.

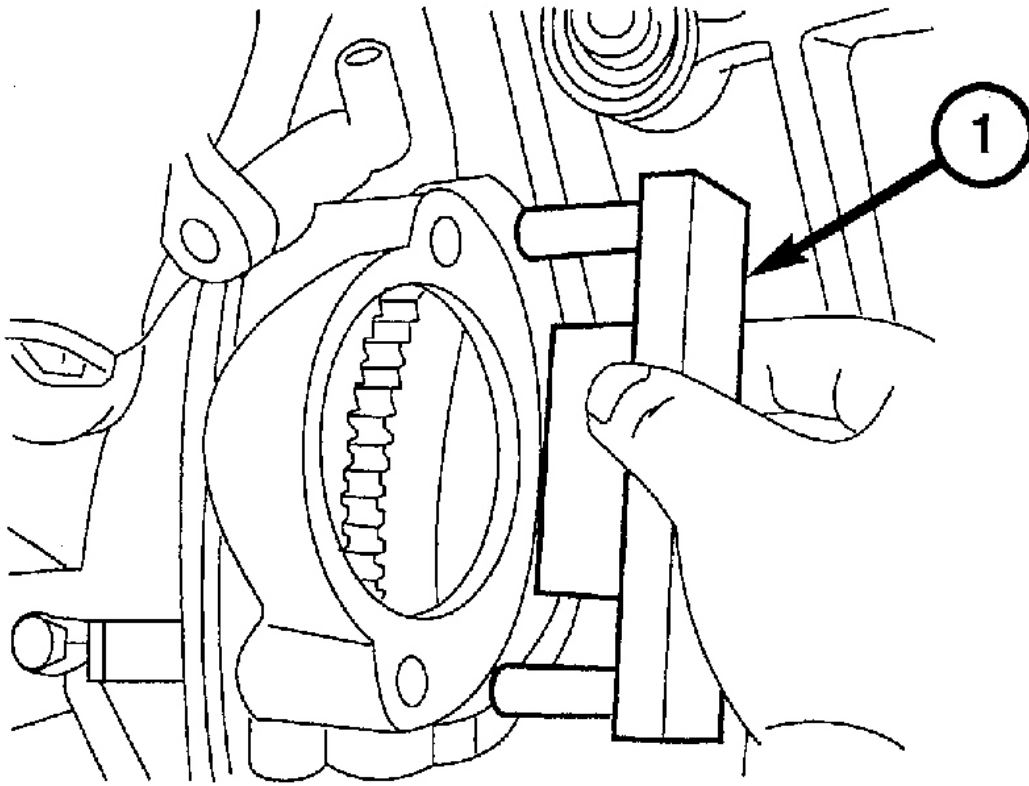
2. Rotate the crankshaft and align the basic valve timing to 40 degrees ATDC.



G01860727

Fig. 229: Rotating Crankshaft & Aligning Basic Valve Timing
Courtesy of DAIMLERCHRYSLER CORP.

3. Remove the starter. See **STARTERS** article.
4. Using Special Tool 9102 Flywheel Locking Tool (1), lock the flywheel.

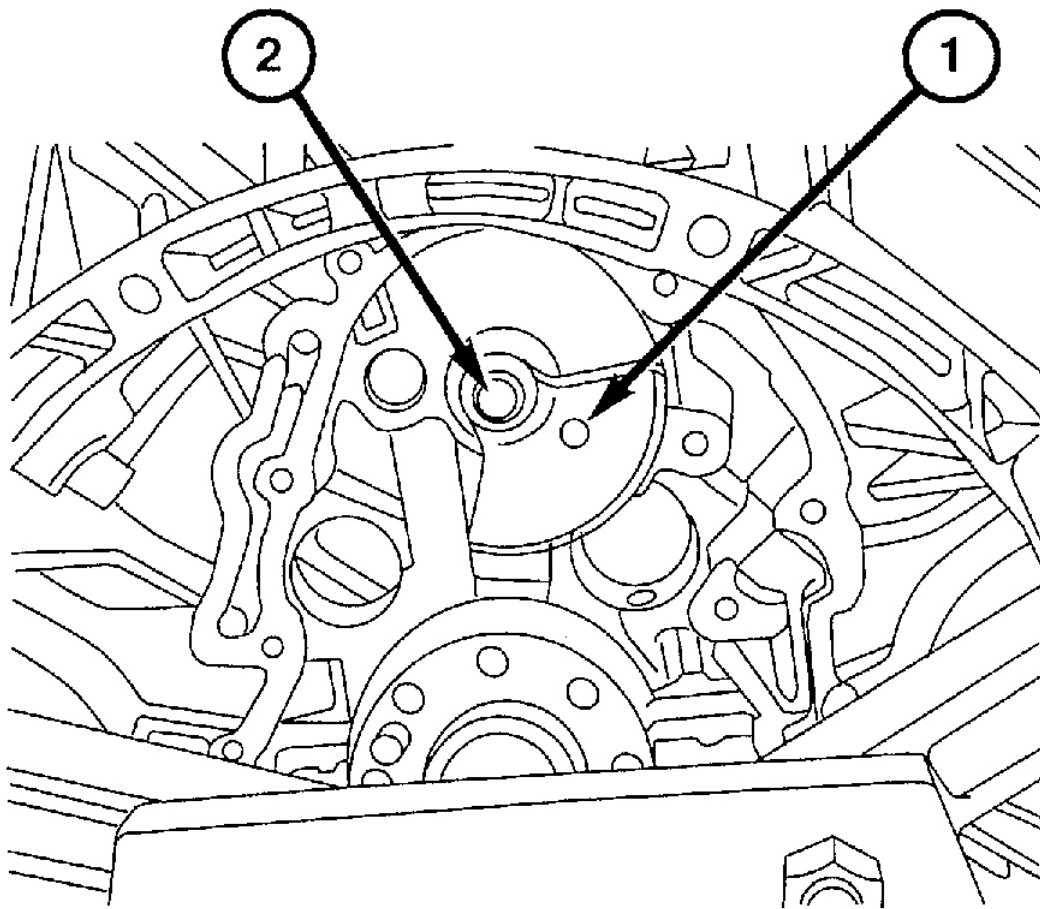


G01860728

Fig. 230: Locking Flywheel

Courtesy of DAIMLERCHRYSLER CORP.

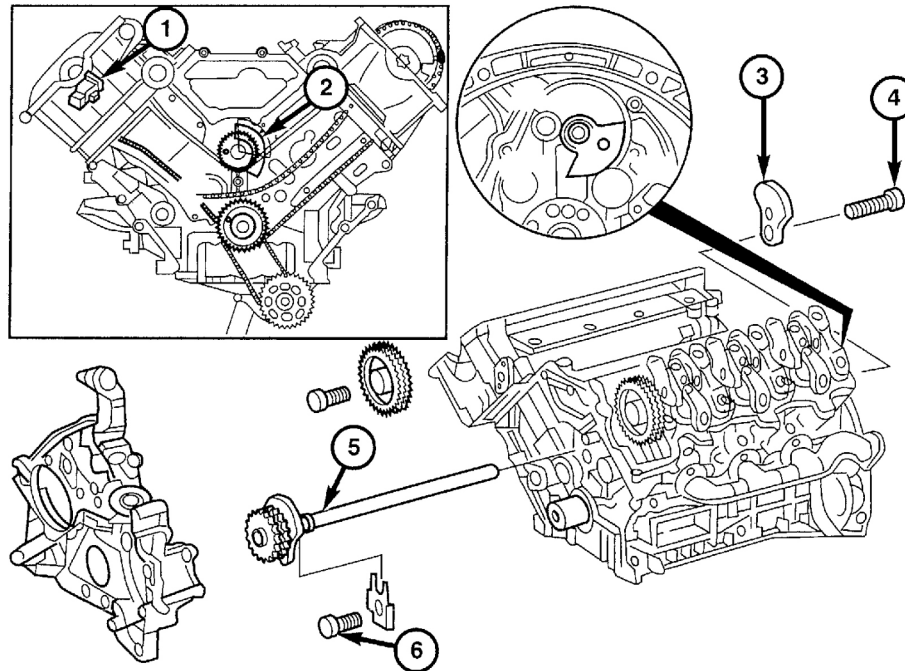
5. Remove the timing chain. See **TIMING CHAIN**.
6. Remove the rear crankshaft oil seal. See **CRANKSHAFT OIL SEAL - REAR**.
7. Hold the balance shaft rear counter weight (1) with a drift, remove the rear retaining bolt (2).



G01860729

Fig. 231: Removing Rear Retaining Bolt & Balance Shaft Counter Weight
Courtesy of DAIMLERCHRYSLER CORP.

8. Remove the balance shaft rear counter weight (1) from the balance shaft.
9. Remove the balance shaft locking plate bolt (6) and locking plate at the front of the engine block.
10. Remove the balance shaft (5) from the front of the engine.



- 1 - CAMSHAFT POSITION SENSOR
- 2 - BALANCE SHAFT FRONT COUNTER WEIGHT
- 3 - BALANCE SHAFT REAR COUNTER WEIGHT

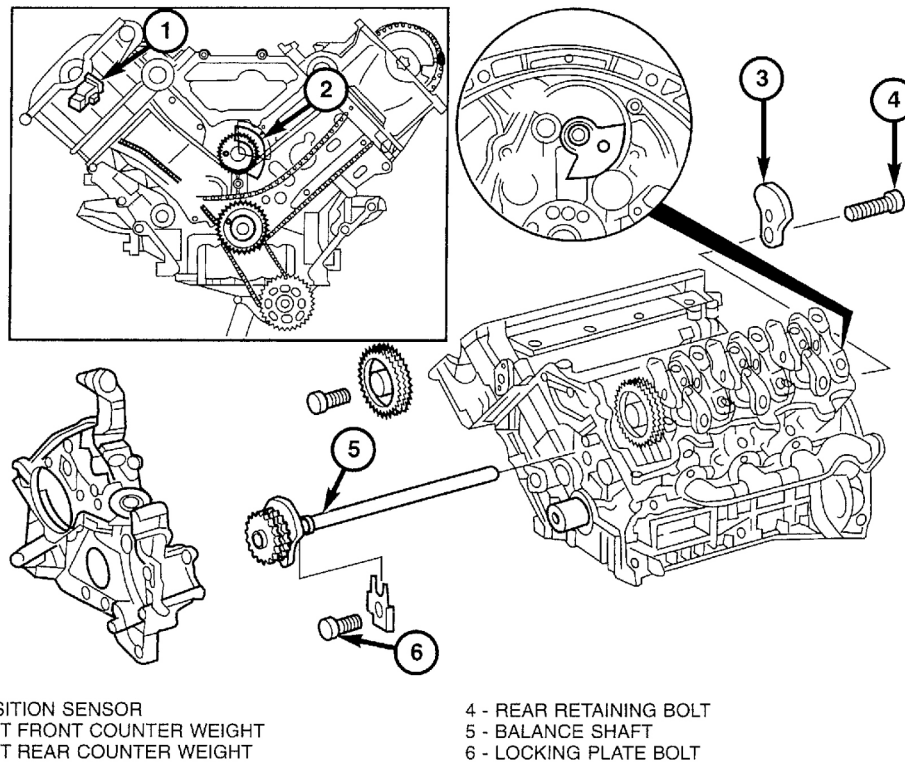
G01860730

- 4 - REAR RETAINING BOLT
- 5 - BALANCE SHAFT
- 6 - LOCKING PLATE BOLT

Fig. 232: Removing Balance Shaft
 Courtesy of DAIMLERCHRYSLER CORP.

INSTALLATION

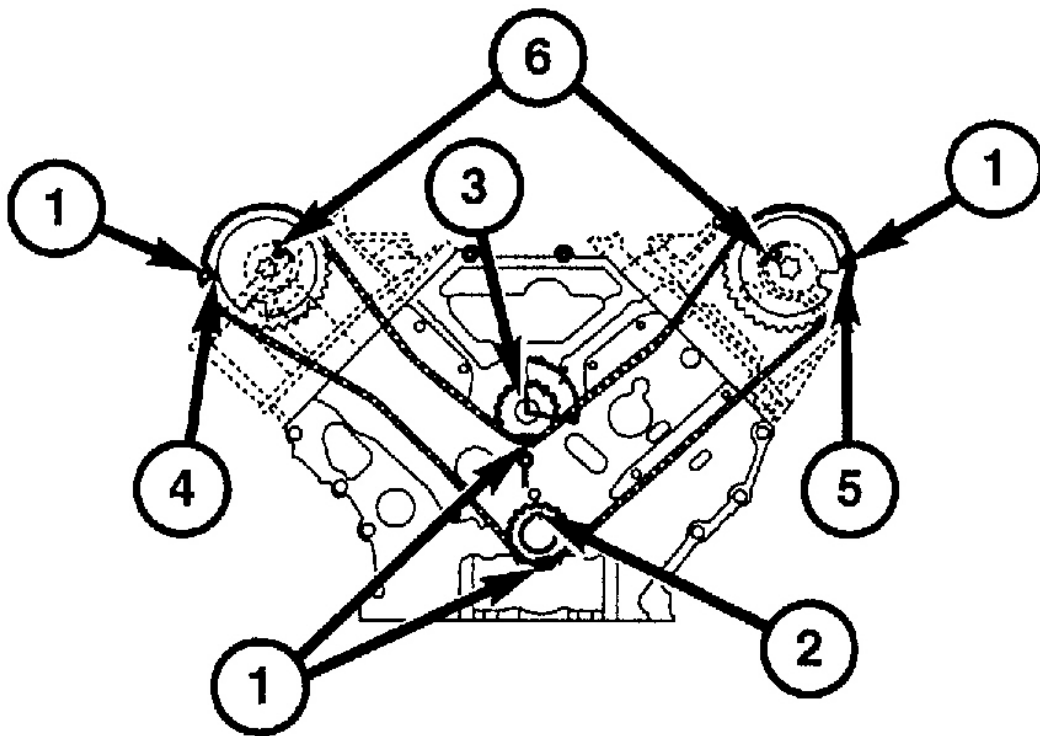
NOTE: Balance shaft rear retaining bolt (4) must be replaced if length exceeds 50 mm.



G01860731

Fig. 233: Installing Balance Shaft
 Courtesy of DAIMLERCHRYSLER CORP.

1. Position the balance shaft (5) into the engine balance shaft bore from the front.
2. Install the balance shaft rear counter weight (3) onto the balance shaft (5) and install the rear retaining bolt (4). Tighten the bolt to 20 N.m (15 ft. lbs.). Rotate the bolt (4) an additional 90°.
3. Install the balance shaft locking plate and locking plate bolt (6). Tighten the balance shaft locking plate bolt to 20 N.m (15 ft. lbs.).
4. Install the crankshaft rear radial oil seal. See **CRANKSHAFT OIL SEAL - REAR.**
5. Install the timing chain. See **TIMING CHAIN.**

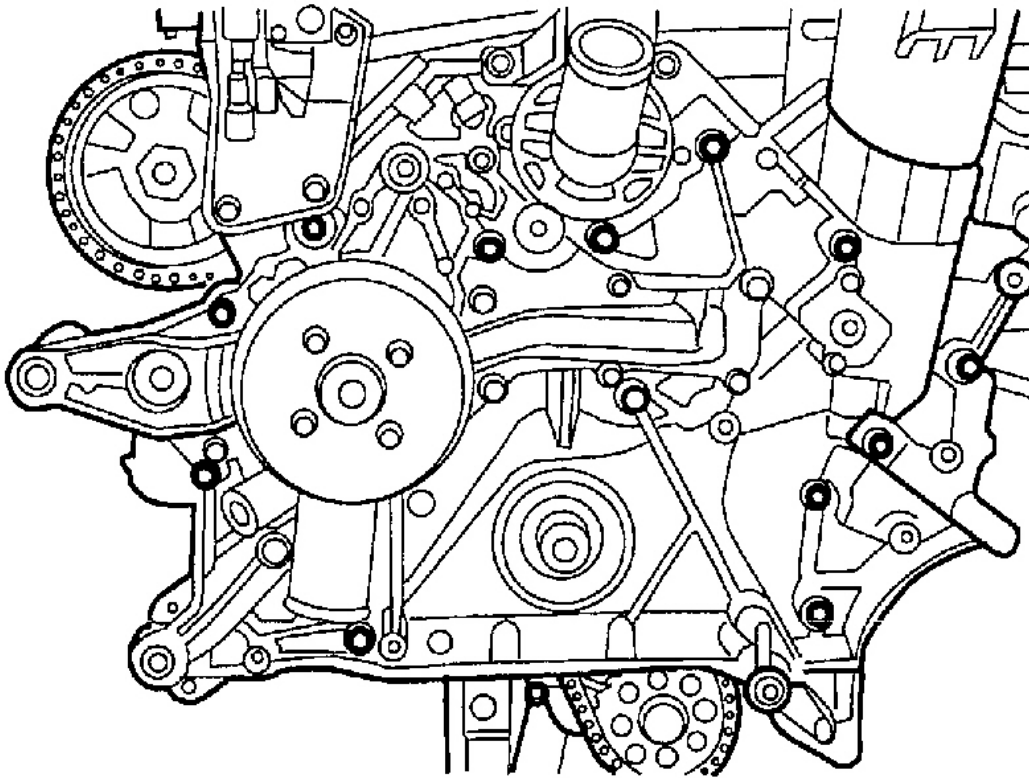


G01860732

Fig. 234: Installing Timing Chain

Courtesy of DAIMLERCHRYSLER CORP.

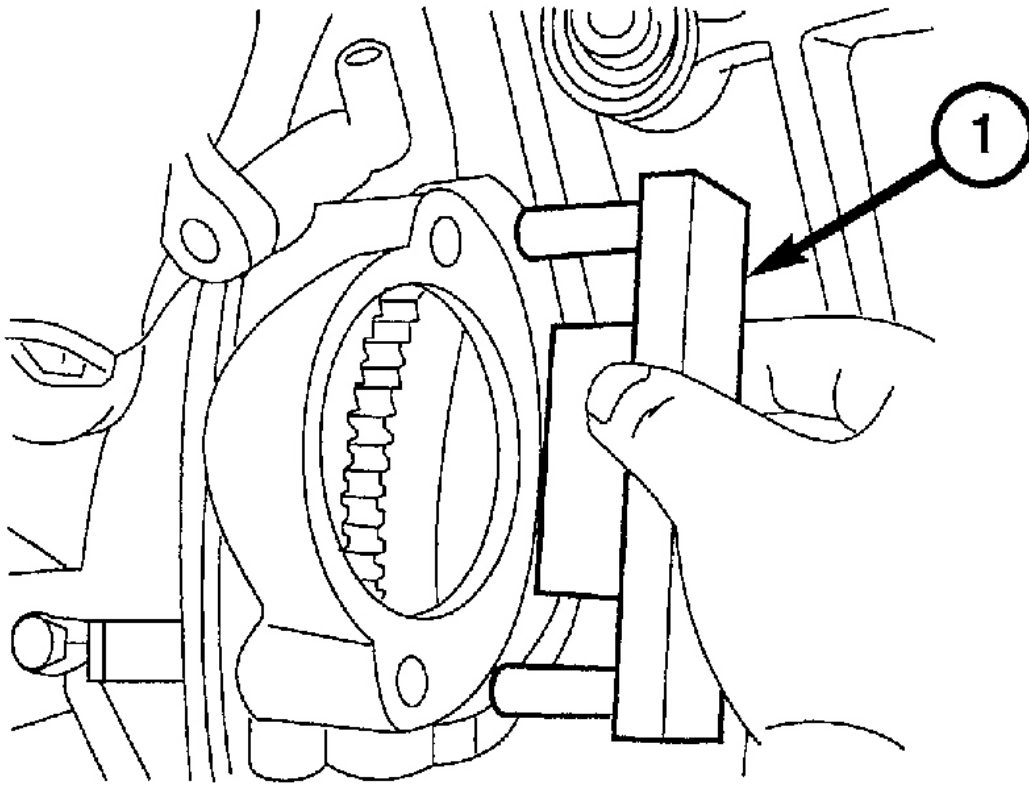
6. Install the timing chain cover. See **TIMING CHAIN COVER**.



G01860733

Fig. 235: Installing Timing Chain Cover
Courtesy of DAIMLERCHRYSLER CORP.

7. Remove the Special Tool 9102 Flywheel Locking Tool (1) from the engine and install the starter. See **STARTERS** article.



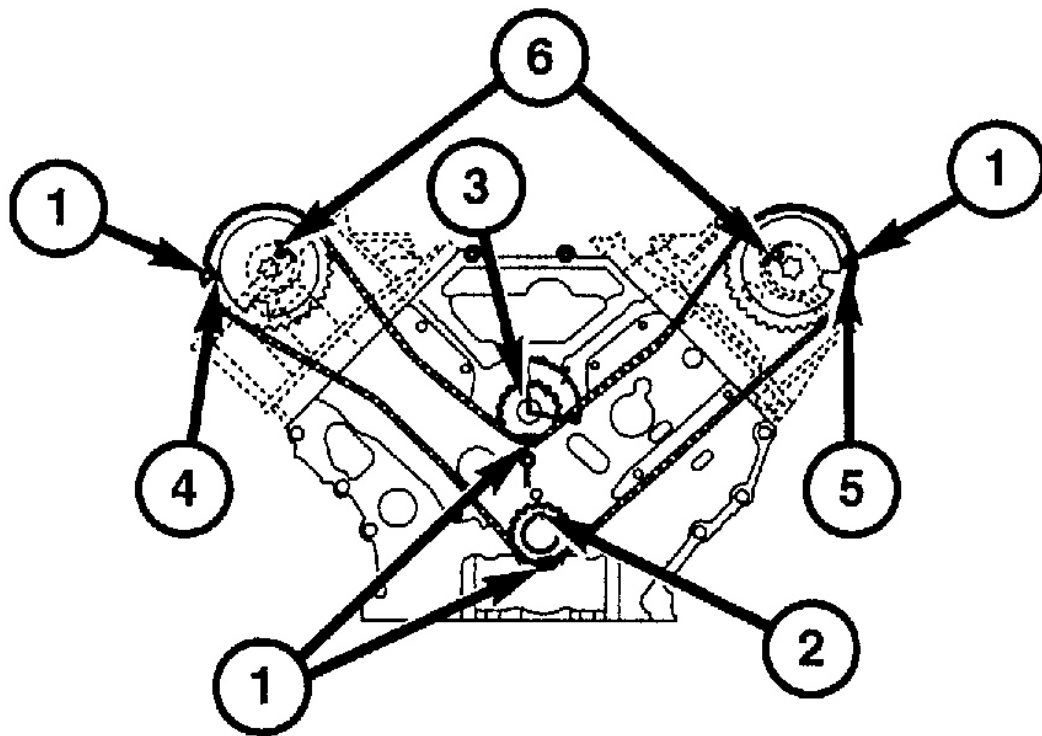
G01860734

Fig. 236: Removing Special Tool 9102 Flywheel Locking Tool
Courtesy of DAIMLERCHRYSLER CORP.

TIMING CHAIN GUIDES

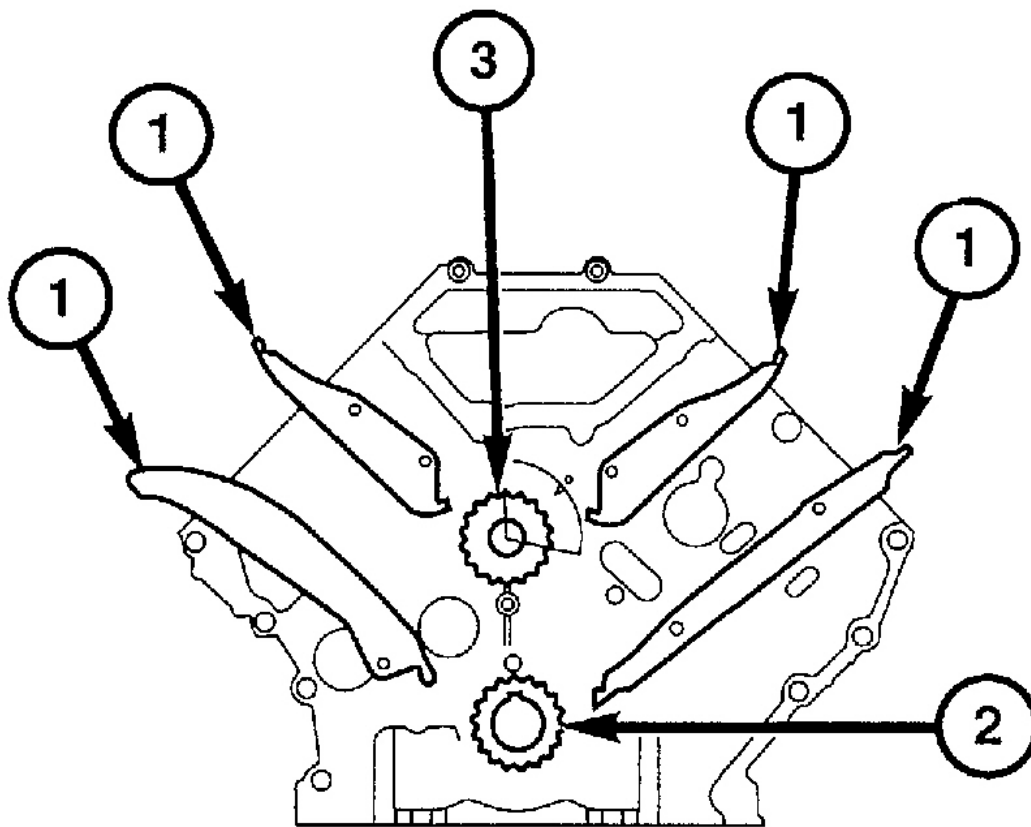
REMOVAL

1. Remove the timing chain (1). See **TIMING CHAIN**.
2. Remove the timing chain guides (1) off of the mounting pins. Inspect and replace worn or damaged guides as required.



G01860735

Fig. 237: Removing Timing Chain
Courtesy of DAIMLERCHRYSLER CORP.



G01860736

Fig. 238: Removing Timing Chain Guides
Courtesy of DAIMLERCHRYSLER CORP.

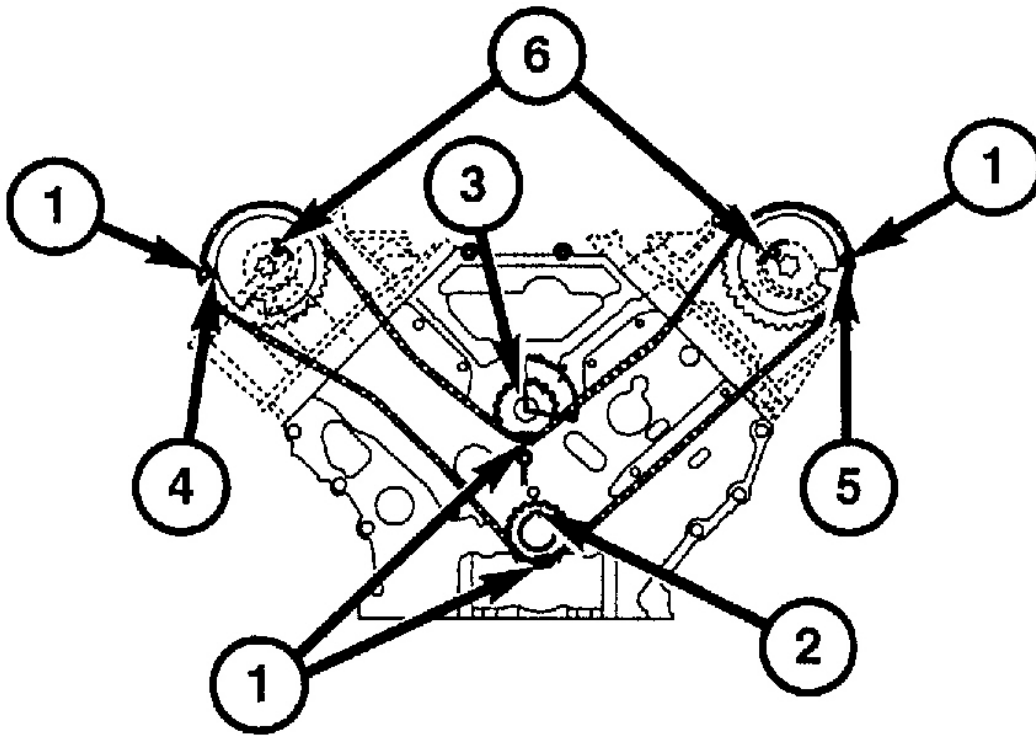
INSTALLATION

1. Install the timing chain guides on the mounting pins. Lubricate surface with engine oil.
2. Install the timing chain. See **TIMING CHAIN**.

ENGINE TIMING

OPERATION

The crankshaft driven timing chain maintains camshaft (6) and balance shaft (3) operation and timing. Timing marks on the crankshaft (2), balance shaft (3) and camshafts (5) are aligned with copper links (1) in the timing chain to keep symmetrical valve and ignition performance.



G01860737

Fig. 239: Identifying Engine Timing Operation

Courtesy of DAIMLERCHRYSLER CORP.

TORQUE SPECIFICATIONS

TORQUE SPECIFICATIONS

Application	Ft. Lbs. (N.m)
A/C Compressor Bolt	15 (20)
Balance Shaft Bolt	15 (20)
Camshaft Bearing Bridge ⁽¹⁾	
Step 1	11 (15)
Step 2	Plus Torque Angle 90 Degrees
Camshaft Sprocket Bolt	
Step 1	37 (50)
Step 2	Plus Torque Angle 90 Degrees
Connecting Rod Cap Bolt	

2004 Chrysler Crossfire

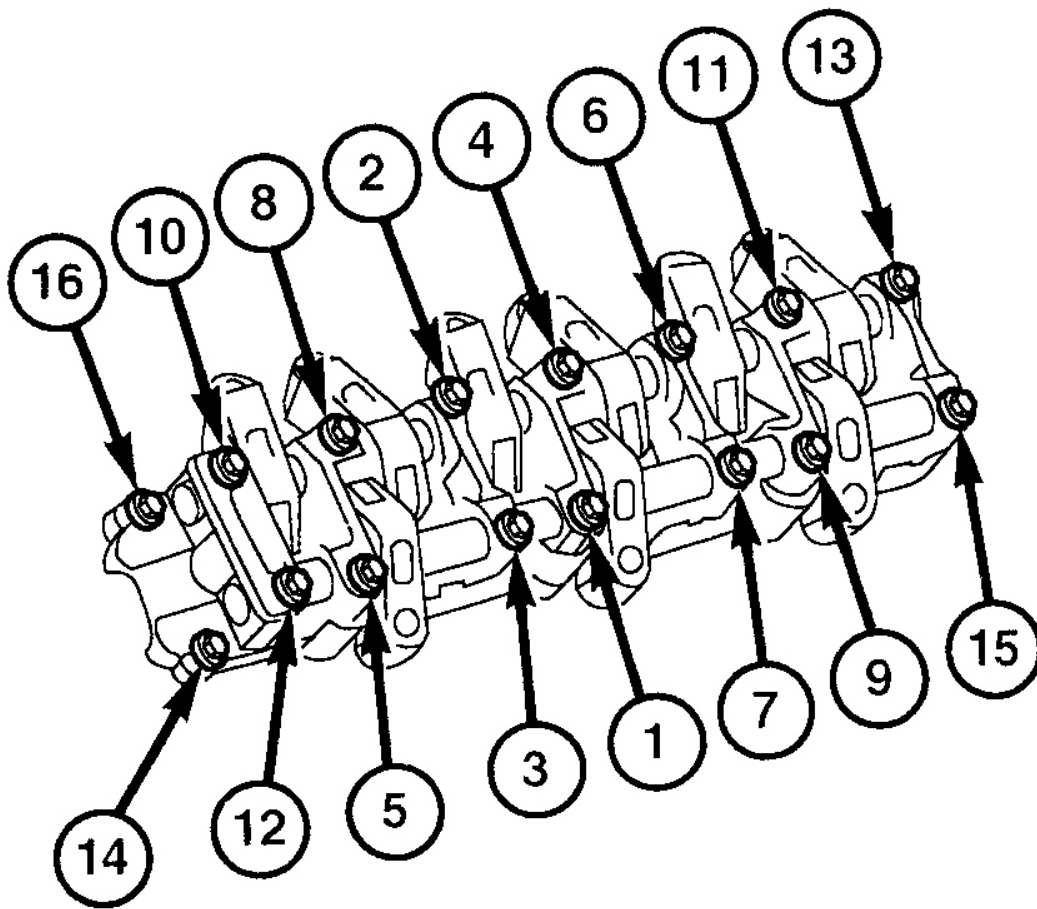
2004 ENGINES 3.2L V6

Step 1	(2)
Step 2	18 (25)
Step 2	Plus Torque Angle 90 Degrees
Crankshaft Main Bearing Cap Bolt ⁽³⁾	
Step 1 M8 Bolt	15 (20)
Step 2 M8 Bolt	Plus Torque Angle 90 Degrees
Step 3 M10 Bolt	22 (30)
Step 4 M10 Bolt	Plus Torque Angle 90 Degrees
Cylinder Head Bolt ⁽⁴⁾	
Step 1 Bolts 1-8	15 (20)
Step 2 Bolts 1-8	37 (50)
Step 3 Bolts 1-8	Plus Torque Angle 60-70 Degrees
Step 4 Bolts 1-8	Plus An Additional Torque Angle 60-70 Degrees
Step 5 Bolts 9-10	18 (25)
EGR Fitting	30 (40)
Engine Lower Mount Bolt	26 (35)
Engine Mount-To-Front Axle Carrier Bolt	41 (55)
Engine Mount-To-Transmission Bolt	37 (50)
Engine Support Bolt	15 (20)
Engine Upper Mount Bolt	41 (55)
Exhaust Manifold Flange Bolt	15 (20)
Exhaust Manifold-To-Cylinder Head Nuts	26 (35)
Flywheel Bolt	
Step 1	33 (45)
Step 2	Plus Torque Angle 90 Degrees
Fuel Injection Supply Line-To-Rail Fitting	28 (38)
Intake Manifold Bolt	15 (20)
Oil Filter Adapter Center Bolt	52 (70)
Oil Filter Cap Screw	18 (25)
Oil Pan Bolt-Lower Pan	10 (14)
Oil Pan Bolt-Upper Pan ⁽⁵⁾	
Oil Pan-To-Crankcase M6 Bolt	(6)
Oil Pan-To-Crankcase M8 Bolt	15 (20)
Oil Pan Drain Plug	22 (30)

2004 Chrysler Crossfire

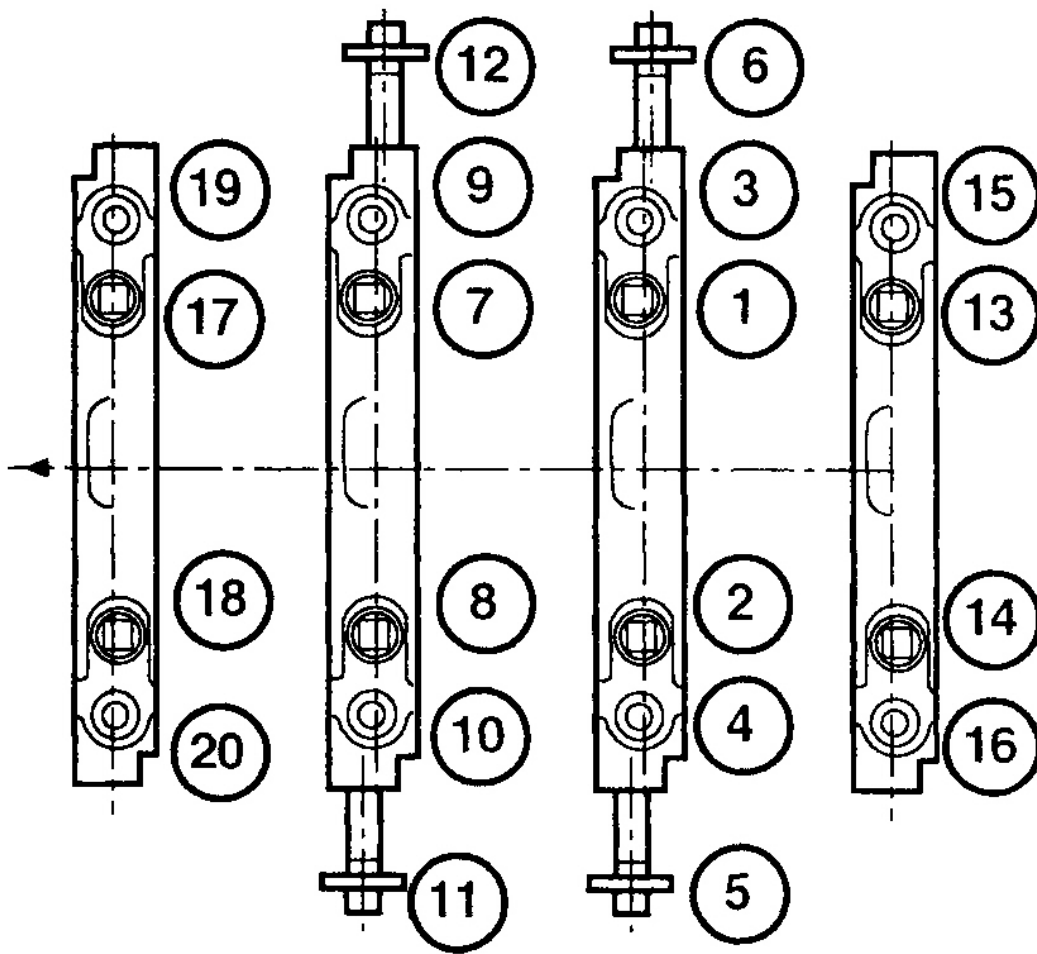
2004 ENGINES 3.2L V6

Oil Spray Nozzle Bolts	11 (15)
Power Steering Pump Ground Bolt	18 (25)
Power Steering Pump High Pressure Line Fitting	33 (45)
Timing Chain Tensioner Bolt	59 (80)
Timing Cover Bolt	15 (20)
Transmission Mount Bolt	30 (40)
Vibration Damper Bolt	
Step 1	148 (200)
Step 2	Plus Torque Angle 90 Degrees
INCH Lbs. (N.m)	
Cooler Line Bolts	89 (10)
Cylinder Head Cover Bolts	89 (10)
End Cover Bolt	89 (10)
Oil Cooler Bolts	97 (11)
Oil Indicator Tube Bolt	89 (10)
Oil Pressure Level Sensor Screws	89 (10)
(1) For camshaft tightening sequence, see <u>Fig. 240</u>	
(2) Tighten bolts to 44 INCH lbs. (5 N.m)	
(3) For crankshaft main bearing cap tightening sequence, see <u>Fig. 241</u>	
(4) For cylinder head bolt tightening sequence, see <u>Fig. 242</u>	
(5) Tighten in sequence. See <u>Fig. 243</u>	
(6) Tighten in sequence to 89 INCH lbs. (10 N.m). See <u>Fig. 243</u>	



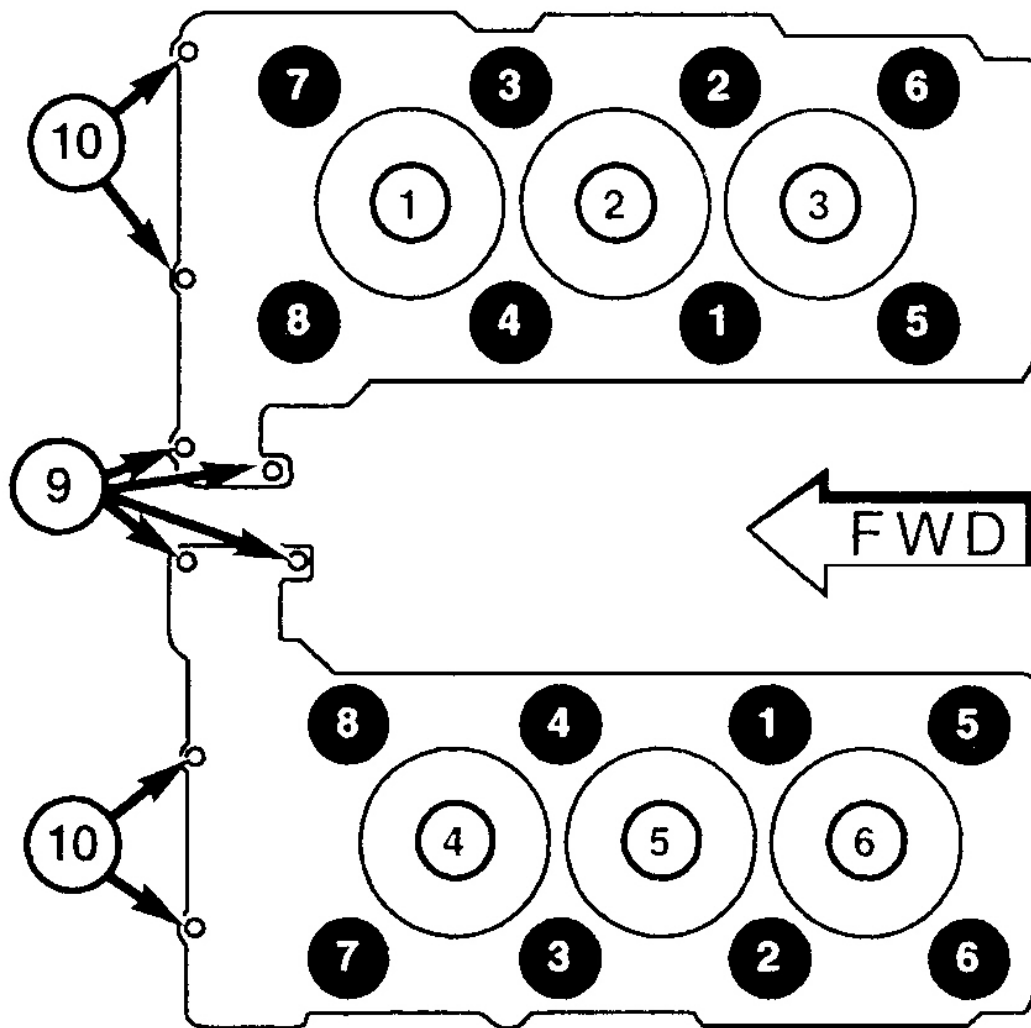
G00351822

Fig. 240: Camshaft Bearing Bridge Bolt Tightening Sequence
Courtesy of DAIMLERCHRYSLER CORPORATION



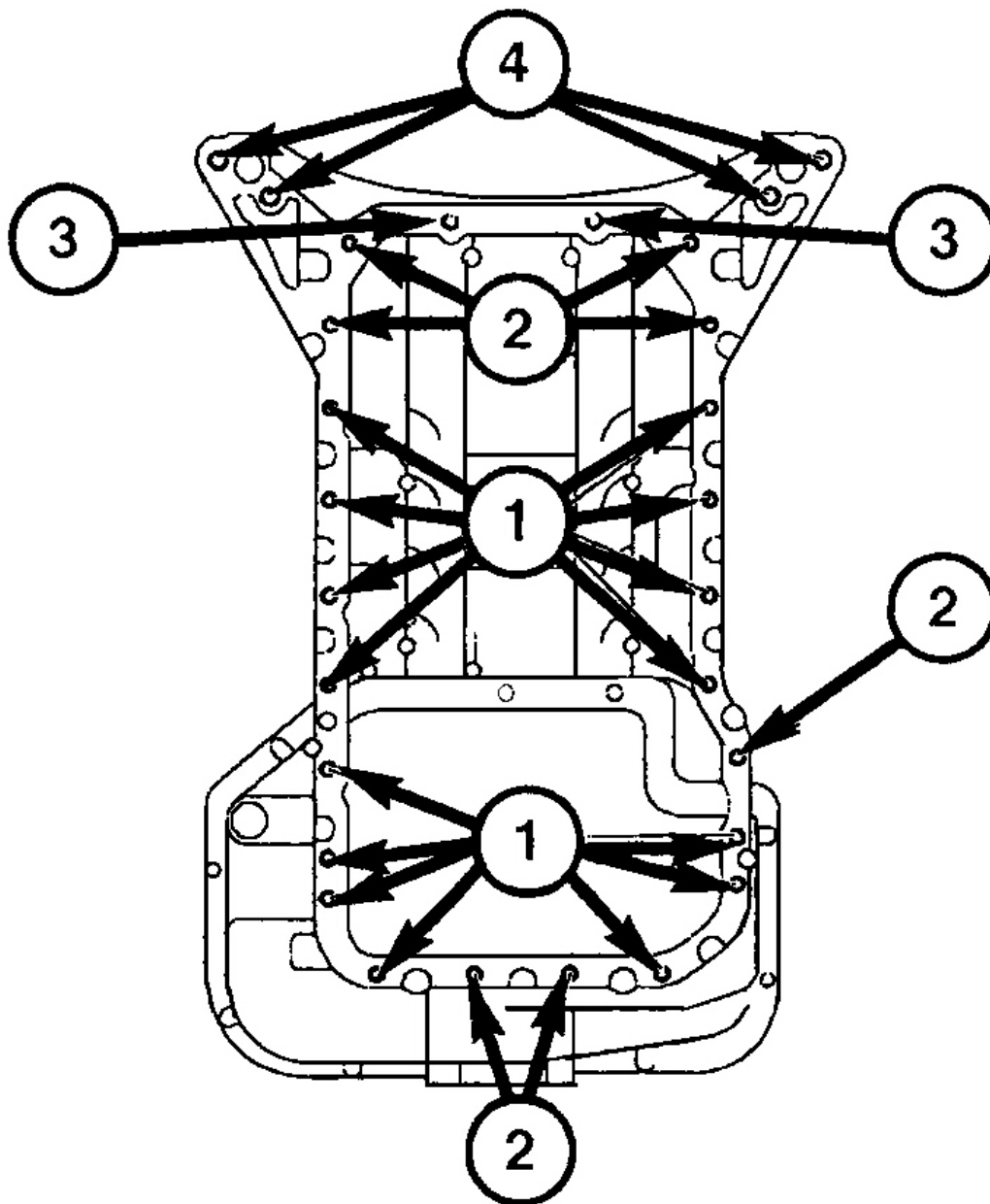
G00351824

Fig. 241: Crankshaft Main Bearings Cap Bolt Tightening Sequence
Courtesy of DAIMLERCHRYSLER CORPORATION



G00351823

Fig. 242: Cylinder Head Bolt Tightening Sequence
Courtesy of DAIMLERCHRYSLER CORPORATION



- (1) M6 X 20
- (2) M6 X 40
- (3) M6 X 90
- (4) M8 X 30

G00351825

Fig. 243: Oil Pan Bolt Upper Pan Identification & Tightening Sequence
Courtesy of DAIMLERCHRYSLER CORPORATION