

## BMW POWER-ASSISTED RECIRCULATING BALL

528i  
633CSi  
733i

### DESCRIPTION

#### STEERING GEAR

Power steering gear consists of a gear housing containing a sector shaft with sector gear, a power piston with gear teeth in side of piston which is in constant mesh with sector shaft teeth, and a worm shaft connecting steering shaft to power piston through a universal joint coupling. Worm shaft is geared to piston through recirculating ball contact; and a steering valve is incorporated into upper end of worm gear assembly.

#### STEERING PUMP

Power steering pump is a high pressure, belt driven, vane type pump. A fluid reservoir incorporating a filter element supplies hydraulic fluid to pump. Pump maintains hydraulic pressure to power steering gear assembly.

### LUBRICATION

#### CAPACITY

**System Capacity** — 528i & 633CSi: 2.5 pts.  
733i: 3.8 pts.

#### LUBRICANT TYPE

**Initial or Subsequent Filling** — BMW recommends Shell ATF Dexron B (or equivalent).

**Subsequent Filling (Max. ½ pint)** — Veedol Automatic Transmission Fluid Type A Suffix A AQ 1407 A, or suitable equivalent.

#### FILTER REPLACEMENT

**528i & 633CSi** — Remove reservoir cap. Remove spring and filter cover. Replace filter.

**733i** — Remove reservoir cap. Remove nut, washer, spring, fine mesh filter screen and filters. Clean fine mesh filter screen and replace filters.

### ADJUSTMENT

#### PUMP BELT

Loosen adjustment bolts and shift pump to tighten belt. Adjustment is correct when it is possible to press in belt 0.2-0.4" (5-10 mm) with the thumb.

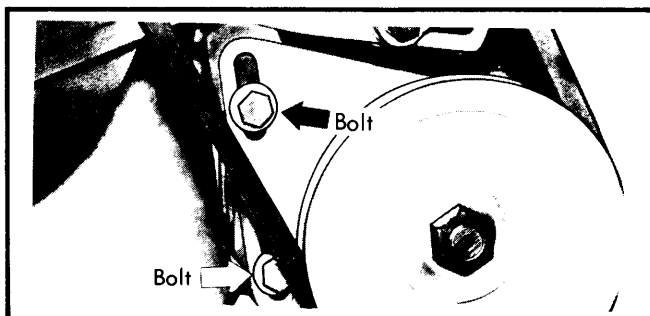


Fig. 1 Power Steering Belt Adjustment Locations

#### HYDRAULIC SYSTEM BLEEDING

- 1) Power steering must be bled whenever system is opened, or oil level falls so low that the vane type pump picks up air. Fill reservoir to upper mark with fluid. Turn engine over with starter and continue to add fluid. When oil level no longer falls, start and run engine at idle speed.
- 2) Turn steering wheel rapidly from lock to lock and back until no further air bubbles rise in reservoir. During this operation, and when completed, fluid level must remain at upper mark.

#### SECTOR SHAFT

**Adjustment (In Vehicle)** — 1) Position front wheels straight ahead. Remove cotter pin and castle nut from tie-rod. Press off center tie-rod from steering arm. Remove BMW emblem from steering wheel. Turn wheel counterclockwise 1 turn from center. Install torque wrench on nut, turn wheel clockwise and read frictional torque.

2) Torque should be 2.7-3.5 INCH lbs. (3.1-4 cmkg). To adjust, turn steering wheel counterclockwise from center 1 turn. Loosen locknut on steering gear and turn adjusting screw clockwise until correct torque is reached when passing through center position. Tighten locknut and recheck adjustment. Replace cotter pin and castle nut.

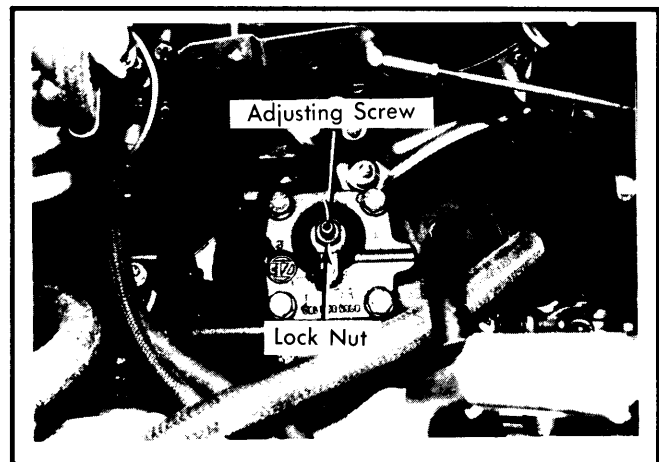


Fig. 2 Sector Shaft Adjusting Screws

### TESTING

#### STEERING PUMP PRESSURE

- 1) Disconnect pressure line from pump. Install pressure line from pressure gauge 32-4-000 (or equivalent) in its place. Connect pump pressure line to gauge. Disconnect pressure line from control regulator and connect it to pressure gauge.
- 2) Shut cut-off valve on gauge. Open shut-off valve on pressure line (See Fig. 6), and bleed system with engine running at idle. After bleeding, close valve in pressure line for 10 seconds maximum and read pressure. On 528i and 633CSi, pressure should be 1400±140 psi (98.5±9.8 kg/cm<sup>2</sup>). On 733i, pressure should be 1560±156 psi (109.5±11 kg/cm<sup>2</sup>). If pressure is not within limits, check belt tightness. Repair or replace pump if belt adjustment does not remedy problem.

# Power Steering

## BMW POWER-ASSISTED RECIRCULATING BALL (Cont.)

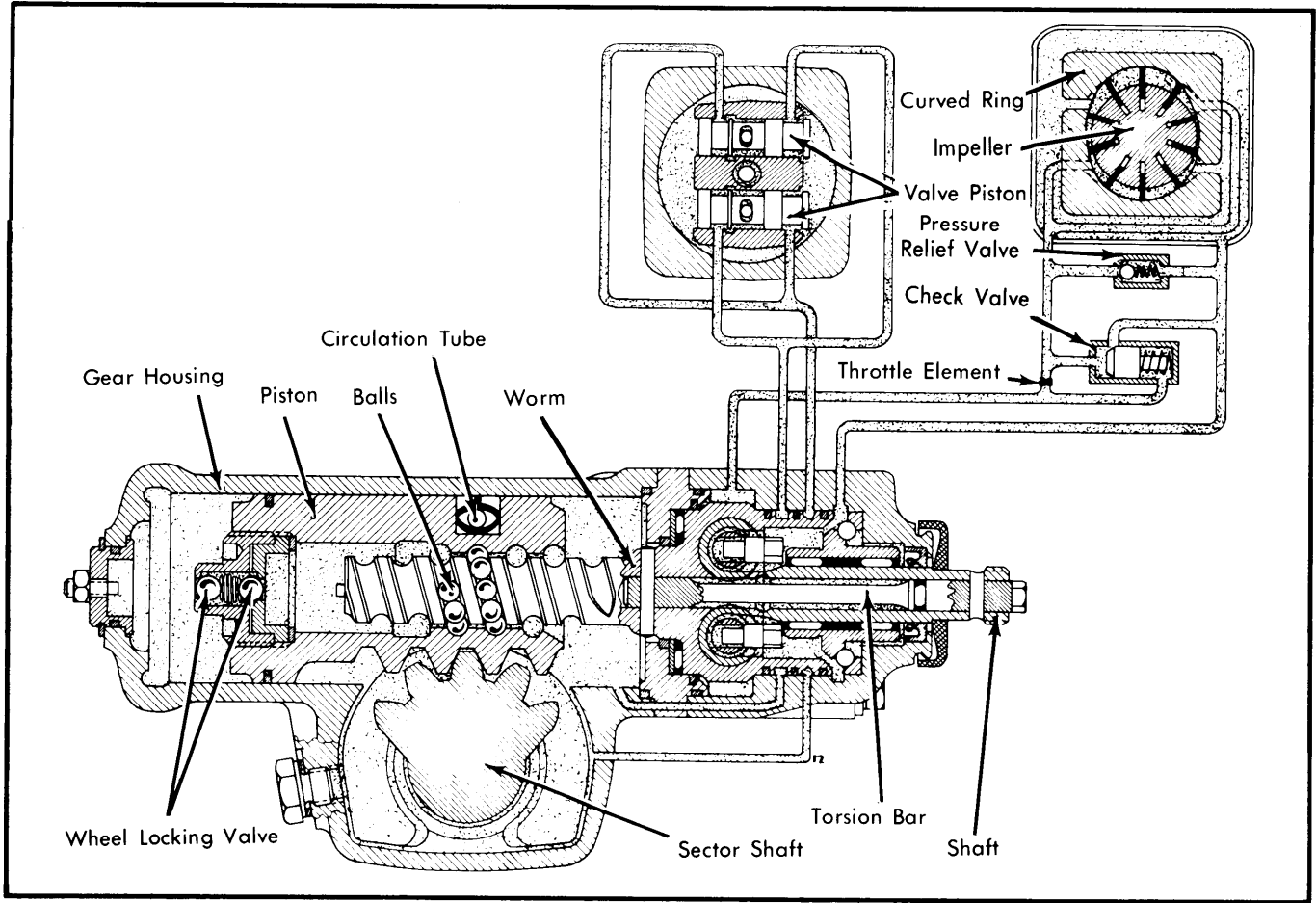


Fig. 3 Cross-Sectional View of Power Steering Gear Assembly

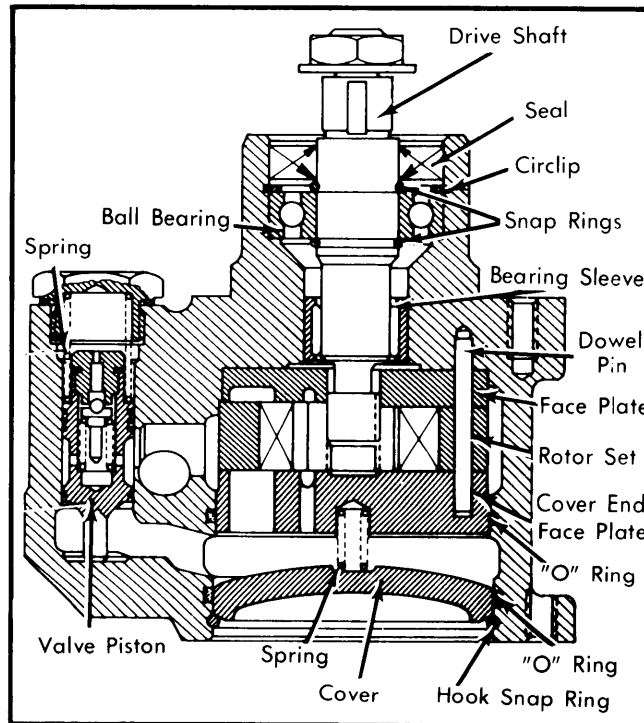


Fig. 4 Cross-Sectional View of Power Steering Pump

## BMW POWER-ASSISTED RECIRCULATING BALL (Cont.)

### STEERING GEAR PRESSURE

**NOTE** — Perform Steering Pump Pressure test before performing this test.

Raise front of car and support with safety stands. Install pressure tester 32-4-000 (or equivalent), in same position as pump pressure test. Limit steering from reaching full lock position by  $\frac{1}{2}$ - $\frac{3}{4}$  turn. With engine running, pull steering wheel against final lock with 22 lbs. (9.9 kg) pressure for 5 seconds. Read pressure. Pressure reading should be within specifications given in Steering Pump Pressure test. Check pressure with gear at opposite lock. Replace steering gear if pressure is not within specifications.

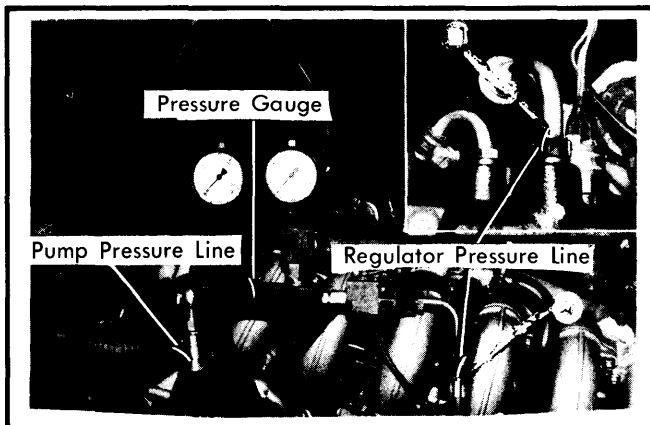


Fig. 5 Power Steering Pump Pressure Gauge Installation

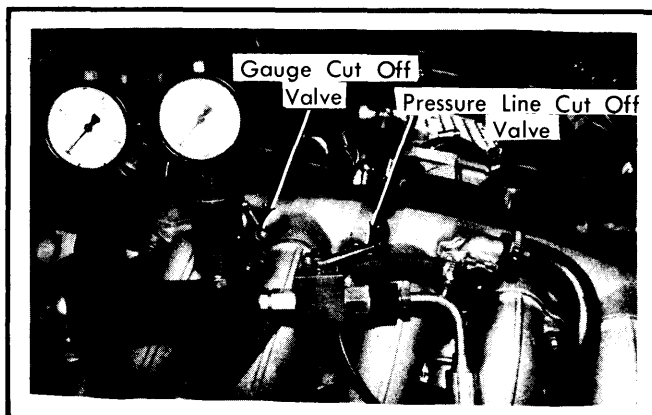


Fig. 6 Power Steering Pump Pressure Check

### REMOVAL & INSTALLATION

#### STEERING GEAR

**Removal** — 1) Turn steering to full left lock. On 733i, discharge hydraulic accumulator by depressing brake pedal 20 times. On all models, detach pressure and return hoses from steering gear and cap openings.

**CAUTION** — Do not reuse fluid drained from system.

2) Remove cotter pin and nut from tie rod end. Press off tie rod from steering arm. Remove bolt from locking groove of steering shaft (See Fig. 7). Push up pivot flange with steering column. Detach steering gear from front axle carrier.

**Installation** — To install, reverse removal procedures, noting the following: Replace hose seals. Position steering wheel straight ahead. Align marks on pivot flange with steering shaft. Make sure bolt is in locking groove of steering shaft. Tighten all connections to proper torque. Bleed system.

#### STEERING PUMP

**Removal** — On 733i, discharge hydraulic accumulator by depressing brake pedal 20 times. On all models, detach hoses from pump. Loosen pump mounting bolts and remove belt. Remove mounting bolts and remove pump.

**Installation** — To install, reverse removal procedures, noting the following: Install hoses so that they do not rub on engine carrier. Torque to specifications. Bleed system.

### OVERHAUL

#### STEERING GEAR

**NOTE** — Power steering gear assembly cannot be repaired except in exceptional cases. BMW recommends replacing the entire unit if malfunctions occur in the steering gear.

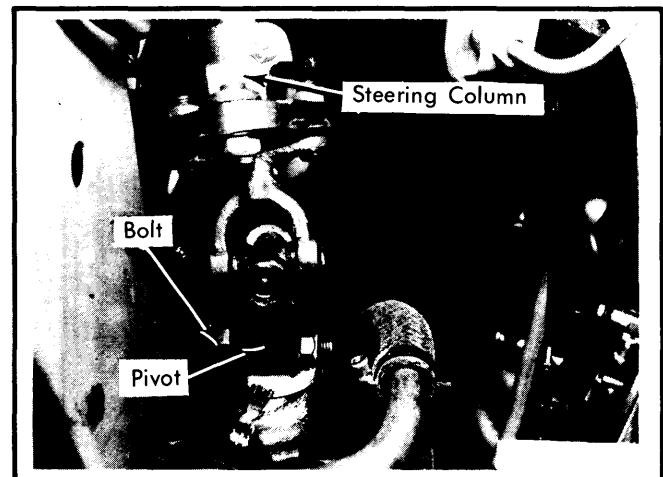


Fig. 7 Removing Steering Shaft Flange

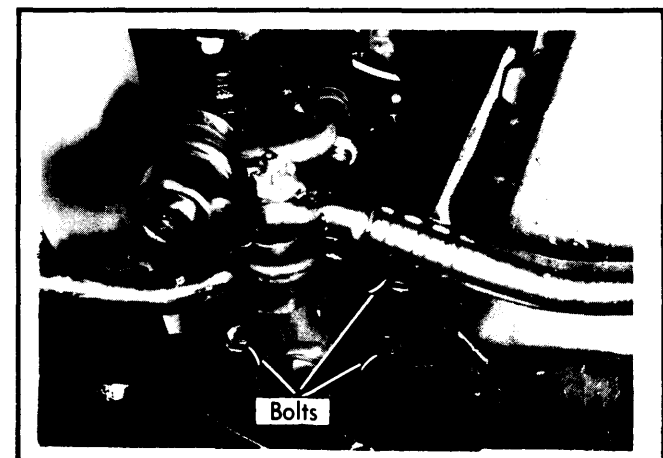


Fig. 8 Steering Gear-to-Front Axle Removal

## BMW POWER-ASSISTED RECIRCULATING BALL (Cont.)

### POWER STEERING PUMP

**NOTE** — Overhaul procedures are for 528i and 633CSi only. For 733i, BMW recommends replacing power steering pump if malfunctions occur.

### DISASSEMBLY

1) Press cover in slightly and remove retaining ring. Remove cover, coil spring and "O" ring. Remove end plate and "O" ring, noting location of pin in one of the small holes in end plate.

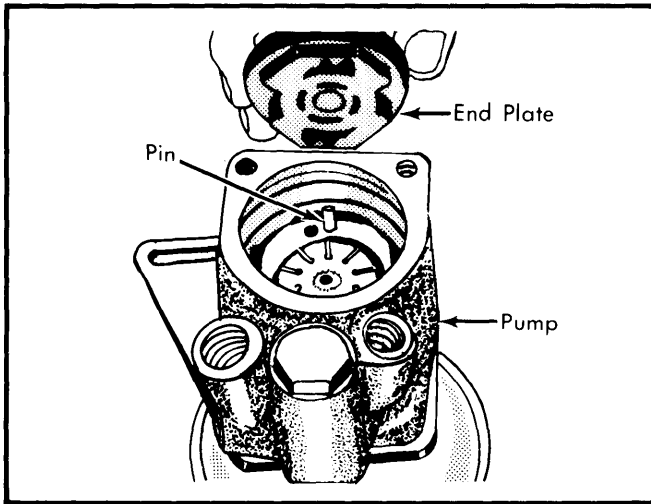


Fig. 9 Pin Location Inside of Pump Housing

2) Tilt housing and remove cam ring and rotor. Note that side of rotor with recessed hole faces drive shaft, the rounded off side of rotor faces cam ring, and the cast-in half arrow indicates direction of rotor rotation.

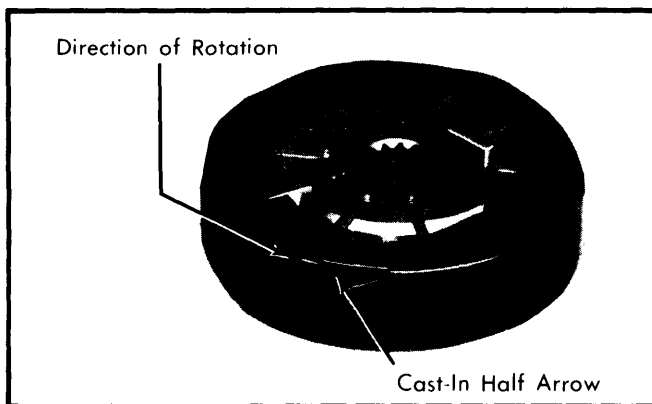


Fig. 10 Mark Showing Direction of Rotation

3) Remove drive end face plate and "O" ring. If it should be necessary to remove input shaft, proceed as follows: Remove pulley, shaft seal, and snap ring from housing. Remove circlip and press ball bearing off of shaft. Using a mandrel, press bearing sleeve out of housing.

4) Remove plug from pressure valve bore, then remove coil spring and valve piston. Note that threaded section on valve piston faces coil spring.

**CAUTION** — Do not alter length of coil spring or thickness of plug sealing ring.

5) The valve tolerance group (1 or 2) is stamped into housing adjacent to pressure valve bore and valve barrel should be scribed with one or two marks (lines) agreeing with group number stamped into housing.

**CAUTION** — If valve must be replaced, install valve of same tolerance group.

6) Clean and inspect all parts. Clean restrictor insert in pump outlet passage. Valve piston may be disassembled for cleaning. **CAUTION** — When disassembling piston, do not clamp across the sliding surfaces. A pressure valve is located inside valve piston (flow limit valve), and thickness of washers determines cut-in range of pressure valve. Maximum pump pressure should not be more than 10% below the value stated on manufacturer's plate attached to pump.

### REASSEMBLY

To reassemble, reverse disassembly procedure, replacing all seals and worn components.

### TIGHTENING SPECIFICATIONS

Application	Ft. Lbs. (mkg)
Steering Gear to Front Axle .....	32-35 (4.4-4.8)
Worm End Cover .....	25 (3.5)
Sector Shaft End Cover .....	23 (3.1)
Adjusting Screw Counternut .....	22 (3.0)
Adjusting Screw Lock Nut for Piston Movement .....	4 (.5)
Steering Pump Mounting .....	17 (2.4)
Hose Connections .....	33-37 (4.5-5.1)