Modern Automotive Technology
Chapter 69
Steering System Fundamentals
Learning Objectives

- Identify the major parts of a steering system.
- Explain the operating principles of steering systems.
- Compare the differences between a linkage steering and a rack-and-pinion steering system.
- Describe the operation of hydraulic and electric-assist power steering systems.
- Explain the operation of four-wheel steering systems.
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1. A Steering Wheel is used by driver to rotate steering shaft that passes through steering column.

2. Steering Linkage connects steering gearbox to steering knuckles and wheels.
Collapsible Column Operation

Forces before collision

1st stage (primary collision)

2nd stage (secondary collision)
Steering Linkage

Basic Linkage Steering

Basic Rack-and-Pinion Steering
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3. The Steering Column supports the steering wheel and steering shaft.

4. The Power Steering Pump produces the hydraulic pressure for steering system operation.
Steering Column Components

- Steering wheel
- Steering shaft
- Tilt mechanism
- Steering column
- Dash mount
- Firewall mount
- Lower bearing
- Universal joints
- Locknut
- Splines
- Upper column and bearing assembly
Integral-Piston Linkage

- Fluid reservoir
- Return hose
- Pump
- Steering linkage
- Pressure hose
- Hydraulic valve and piston in gearbox
- Power steering gear
- Pitman arm
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5. The Power Piston is formed by attaching a hydraulic piston to the center of the rack.

6. The Steering Shaft transfers turning motion from steering wheel to steering gearbox.
Basic Power Steering

- Reservoir
- Pump develops hydraulic pressure
- Valve is shifted, directing oil as shown
- Control valve
- Oil pressure moves piston and load
- This oil returns to reservoir
Power Rack-and-Pinion Steering
Power Rack-and-Pinion System
Chapter 69

7. Ball Sockets allows linkage arms to swivel up and down for suspension action and from left to right for turning.

8. The Pressure-Relief Valve used in a power steering system controls maximum oil pressure.
Ball Sockets

A. Idler arm
B. Tie-rod end
C. Tie-rod inner end
D. Tie-rod (rack-and-pinion)
Pressure-Relief Valve

- Bushing lubrication
- From reservoir
- To reservoir
- Output to gearbox
- Output
- Bypass
- Pressure-relief valve
- Gears
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9. A Power Cylinder is a precisely machined tube designed to accept the power piston in rack-and-pinion steering systems.

10. The Steering Gearbox changes turning motion into straight line motion to the left or right.
Power Rack-and-Pinion

Diagram of a Power Rack-and-Pinion system with labeled parts:
- Pinion shaft
- Control valve
- Gear housing
- Hydraulic lines from pump
- Hydraulic piston
- Boot
- Tie-rod
- Frame member
Steering Gear

- Gear housing
- Adjusting screw
- Thrust spring
- O-ring seal
- Flexible coupling
- Steering shaft
- Pinion shaft
- Rack
- Pinion gear
- Sintered bronze shell
- Pinion bushing
- Needle bearing
- O-ring seal
Spool Valve-Type Gear

- Port sealing ball
- Spool valve
- Pivot lever
- Center thrust bearing race
- Worm shaft balancing ring
- Reaction seal
- Right-turn reaction ring
- Right-turn reaction spring
- Dowel pin
- Cylinder head ferrule
- Left-turn reaction spring
- Left-turn reaction ring
- O-ring
- Sector shaft to pitman arm
- Power piston
- Left-turn power chamber
- Recirculating ball guide
- Recirculating ball guide
- Worm shaft
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