Modern Automotive Technology
Chapter 31
Starting System Fundamentals
Learning Objectives

- Explain the principles of an electric motor.
- Describe the construction and operation of a starting motor.
- Sketch a simple starting system circuit.
- Explain the operation of solenoids.
- List the functions of the main starter drive parts.
- Describe starter drive operation.
- Compare different types of starting motors.
- Describe starting system safety features.
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1. **Neutral Safety Switch** prevents the starting system from working when the transmission is in gear.

2. The **Battery** is the source of energy for the starting system.

3. The **Field Frame** is the center housing that holds field coils and pole shoes.
Neutral Safety Switch

Wired in series with the starter solenoid
Starting Motor

- Bent engagement arm
- Worn plunger
- Weak plunger return spring
- Solenoid coil shorted or open
- Worn pin
- Cracked drive end frame bushing
- Worn bushing
- Worn or damaged C-lock
- Worn pinion gear teeth
- Bad clutch
- Shorted or open armature
- Missing or worn washer
- Worn or dry end frame bushing
- Open or shorted field coil
- Loose through-bolts
- Worn brush
- Brush holder problems
4. The **Starter Overrunning Clutch** locks the pinion gear in one direction and releases it in the other, allowing the pinion gear to turn the flywheel ring gear for starting.

5. The **Brushes** slide on the commutator to carry battery current to spinning windings.
Overrunning Clutch

Sliding action on splines assembly

One-way clutch action

Pinion gear
Permanent-Magnet Starter

Uses special high-strength magnets in place of conventional field windings
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6. A Magnetic Field is made up of invisible lines of force.

7. Starter Pinion Gear moves into and meshes with the flywheel ring gear any time the starter is energized.
Magnetic Field Action

- Magnet
- Direction of current flow through wire
- Fields around wire and in magnet act on each other
Pinion Gear Assembly

Pinion gear assembly slides on the shaft for engagement.
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8. An Ignition Switch allows driver to control starting system operation.

9. A Starting Motor is a high-torque electric motor for turning the engine flywheel or flex-plate.
Ignition Switch

- Ignition switch energizes the solenoid
- Solenoid energizes the starting motor
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10. The Armature is composed of windings, core, starter shaft, and commutator assembly that spins inside a stationary field.

11. The Commutator serves as a sliding electrical connection between the motor windings and the brushes.
Commutator and Brushes

Commutator reverses the electrical connection when the loop rotates around
12. The Field Winding is a stationary set of insulated wire wrapped in a circular shape.

13. The Starter Solenoid is a high-current relay that makes an electrical connection between the battery and the starting motor.
Solenoid Operation

Key switch to start

Magnetic field

Small current from battery

Plunger slides in

Windings form field

Disc still not touching terminals

High current from battery

Plunger fully in

Disc completes battery-to-starter circuit

High current to starter
Starter Solenoid

Plunger movement pulls the disc into contact with two battery terminals to activate the starter.
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14. The **Armature Core** is made of iron and holds the windings in place.

15. The **Shunt-Wound Motor** is a type of motor with less starting torque but more constant torque at varying speeds.
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