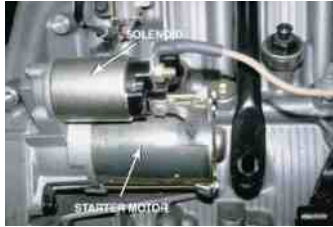


FIGURE 19-1 A typical solenoid-operated starter.



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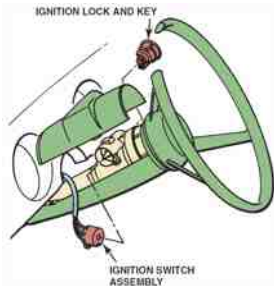
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FIGURE 19-2 Some column-mounted ignition switches act directly on the electrical ignition switch itself, whereas others use a link from the lock cylinder to the ignition switch.



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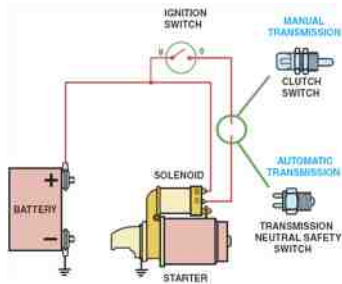
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FIGURE 19-3 To prevent the engine from cranking, an electrical switch is usually installed to open the circuit between the ignition switch and the starter solenoid.



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**FIGURE 19-4** Instead of using an ignition key to start the engine, some vehicles are using a start button which is also used to stop the engine, as shown on this Jaguar.



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**FIGURE 19-5** The top button on this key fob is the remote start button.



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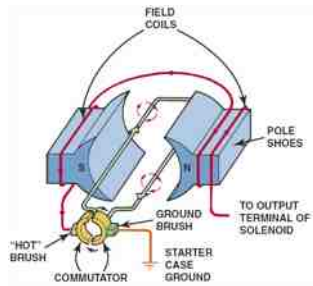
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**FIGURE 19-6** This series-wound electric motor shows the basic operation with only two brushes: one hot brush and one ground brush. The current flows through both field coils, then through the hot brush and the loop winding of the armature, before reaching ground through the ground brush.



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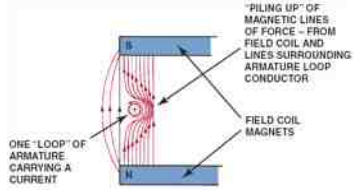
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**FIGURE 19-7** The interaction of the magnetic fields of the armature loops and field coils creates a stronger magnetic field on the right side of the conductor, causing the armature loop to move toward the left.




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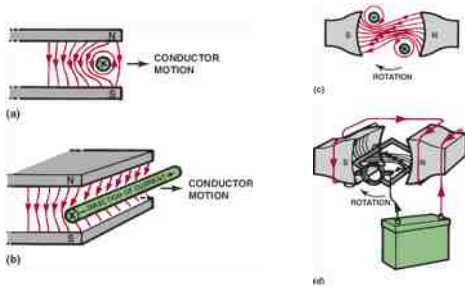
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**FIGURE 19-8** The armature loops rotate due to the difference in the strength of the magnetic field. The loops move from a strong magnetic field strength toward a weaker magnetic field strength.




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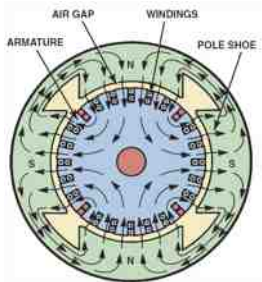
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**FIGURE 19-9** Magnetic lines of force in a four-pole motor.




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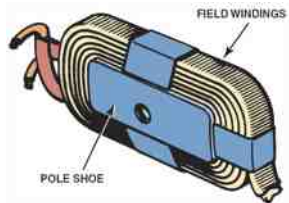
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FIGURE 19-10 A pole shoe and field winding.



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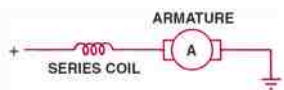
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FIGURE 19-11 This wiring diagram illustrates the construction of a series-wound electric motor. Notice that all current flows through the field coils, then through the armature (in series) before reaching ground.



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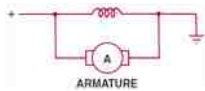
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FIGURE 19-12 This wiring diagram illustrates the construction of a shunt-type electric motor, and shows the field coils in parallel (or shunt) across the armature.



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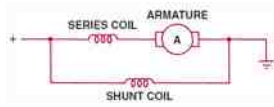
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FIGURE 19-13 A compound motor is a combination of series and shunt types, using part of the field coils connected electrically in series with the armature and some in parallel (shunt).



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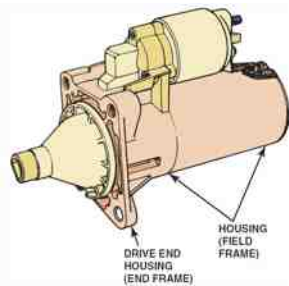
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FIGURE 19-14 A typical starter motor showing the drive-end housing.



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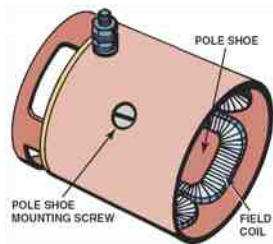
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FIGURE 19-15 Pole shoes and field windings installed in the housing.



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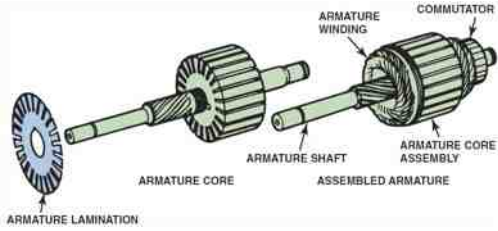
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**FIGURE 19-16** A typical starter motor armature. The armature core is made from thin sheet metal sections assembled on the armature shaft, which is used to increase the magnetic field strength.




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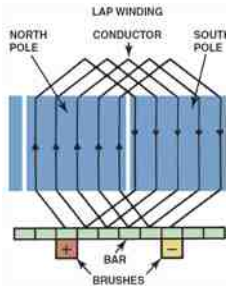
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**FIGURE 19-17** An armature showing how its copper wire loops are connected to the commutator.




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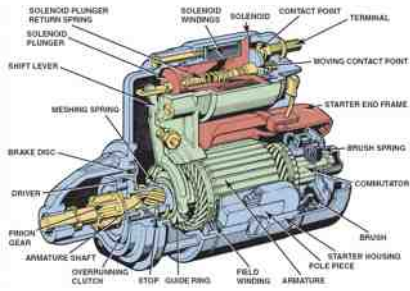
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**FIGURE 19-18** A cutaway of a typical starter motor showing the commutator, brushes, and brush spring.




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**FIGURE 19-19** This starter permanent magnet field housing was ruined when someone used a hammer on the field housing in an attempt to "fix" a starter that would not work. A total replacement is the only solution in this case.




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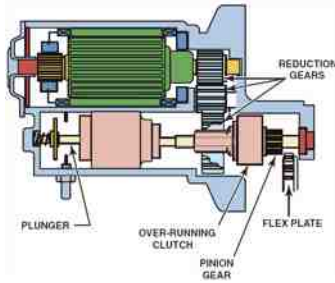
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**FIGURE 19-20** A typical gear-reduction starter.




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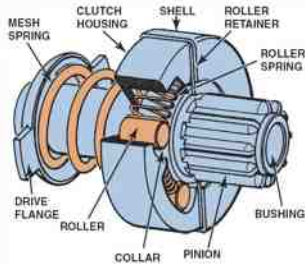
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**FIGURE 19-21** A cutaway of a typical starter drive showing all of the internal parts.




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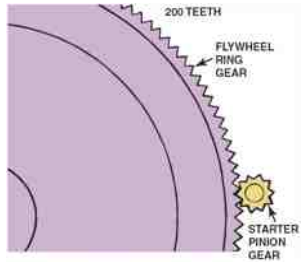
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FIGURE 19-22 The ring gear to pinion gear ratio is usually 15:1 to 20:1.




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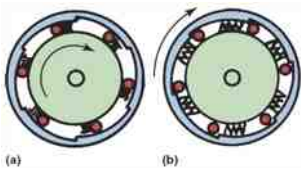
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FIGURE 19-23 Operation of the overrunning clutch. (a) Starter motor is driving the starter pinion and cranking the engine. The rollers are wedged against spring force into their slots. (b) The engine has started and is rotating faster than the starter armature. Spring force pushes the rollers so they can rotate freely.




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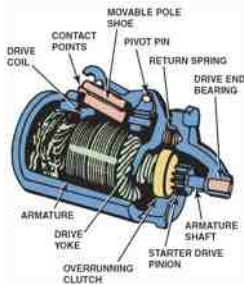
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FIGURE 19-24 A Ford movable pole shoe starter.




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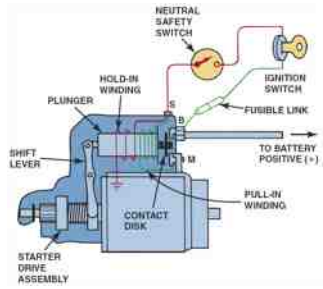
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**FIGURE 19-25** Wiring diagram of a typical starter solenoid. Notice that both the pull-in winding and the hold-in winding are energized when the ignition switch is first turned to the "start" position. As soon as the solenoid contact disk makes electrical contact with both the B and M terminals, the battery current is conducted to the starter motor and electrically neutralizes the pull-in winding.




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**FIGURE 19-26** A palm-size starter armature.




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