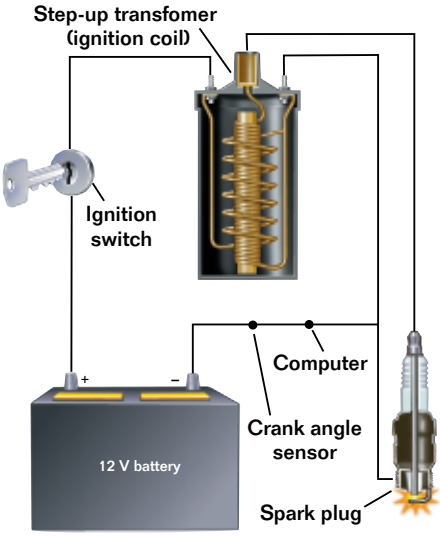

Figure 18
The transformer in an automobile engine raises the potential difference across the gap in a spark plug so that sparking occurs.

The ignition coil in a gasoline engine is a transformer

An automobile battery provides a constant emf of 12 dc volts to power various systems in your automobile. The ignition system uses a transformer, called the *ignition coil,* to convert the car battery's 12 dc volts to a potential difference that is large enough to cause sparking between the gaps of the spark plugs. The diagram in **Figure 18** shows a type of ignition system that has been used in automobiles since about 1990. In this arrangement, called an *electronic ignition,* each cylinder has its own transformer coil.

The ignition system on your car has to work in perfect concert with the rest of the engine. The goal is to ignite the fuel at the exact moment when the expanding gases can do the maximum amount of work. A photoelectric detector, called a *crank angle sensor,* uses the crankshaft's position to determine when the cylinder's contents are near maximum compression.

The sensor then sends a signal to the automobile's computer. Upon receiving this signal, the computer closes the primary circuit to the cylinder's coil, causing the current in the primary to rapidly increase. As we learned earlier in this chapter, the increase in current induces a rapid change in the magnetic field of the transformer. Because the change in magnetic field on the primary side is so quick, the change induces a very large emf, from 40 000 to 100 000 V. The emf is applied across the spark plug and creates a spark that ignites and burns the fuel that powers your automobile.

SECTION REVIEW

1. The rms current that a single coil of an electric guitar produces is 0.025 mA. The coil's resistance is 4.3 kΩ. What is the maximum instantaneous current? What is the rms emf produced by the coil? What is the maximum emf produced by the coil?
2. A step-up transformer has exactly 50 turns in its primary and exactly 7000 turns in its secondary. If the applied emf in the primary is 120 V, what emf is induced in the secondary?
3. A television picture tube requires a high potential difference, which a step-up transformer provides in older models. The transformer has 12 turns in its primary and 2550 turns in its secondary. If 120 V is applied across the primary, what is the output emf?
4. **Critical Thinking** What is the average value of current over one cycle of an ac signal? Why, then, is a resistor heated by an ac current?