Introduction to the Automobile

Chapter 1

Objectives

- Describe the differences between the unibody design and frame and body design
- Tell how the four-stroke cycle engine operates
- Understand the purposes of the major engine support systems
- Describe the parts of front- and rear-wheel drive powertrains
- Explain major events in the history of the automobile

Introduction

- Automobiles have around more than 100 years
  - Originally called horseless carriages
- Today more than 130 million cars in the U.S.
  - One-third of cars in the world
- Source of employment for one in nine workers
- Americans drive 7,767 miles per year
- Automobiles include several systems
  - Body and suspension, engine, electrical, etc.

Body and Chassis

- Chassis supports the engine and body
  - Suspension
  - Frame
  - Brakes
  - Steering
- Unibody design

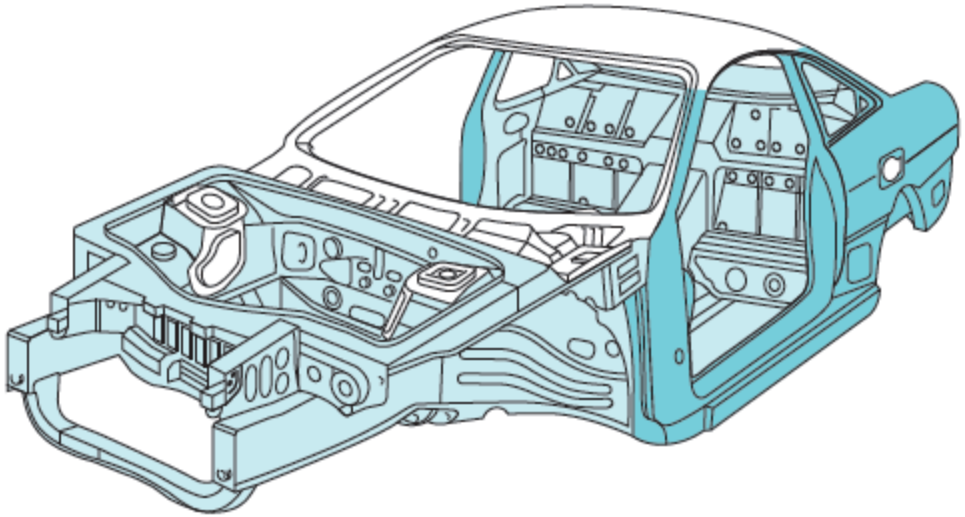

Figure 1.3 Unibody construction.

Engine Parts and Operation

- Most autos use a spark-ignited four-stroke reciprocating gasoline engine
  - Piston compresses air and fuel
  - Air-fuel mixture is ignited
  - Piston pushes rod and forces crankshaft to rotate
  - Rotating crankshaft turns the wheels
  - Burning mixture is sealed into cylinder by cylinder head and head gasket
  - Piston is sealed into cylinder by piston rings

Engine Parts and Operation (cont'd.)

- Four-stroke cycle
  - Intake stroke
    - Piston is pulled down by crankshaft
  - Compression stroke
    - Both valves close and piston moves up
  - Power stroke
    - Burning fuel expands and forces piston down
  - Exhaust stroke
    - Piston moves up and forces exhaust out

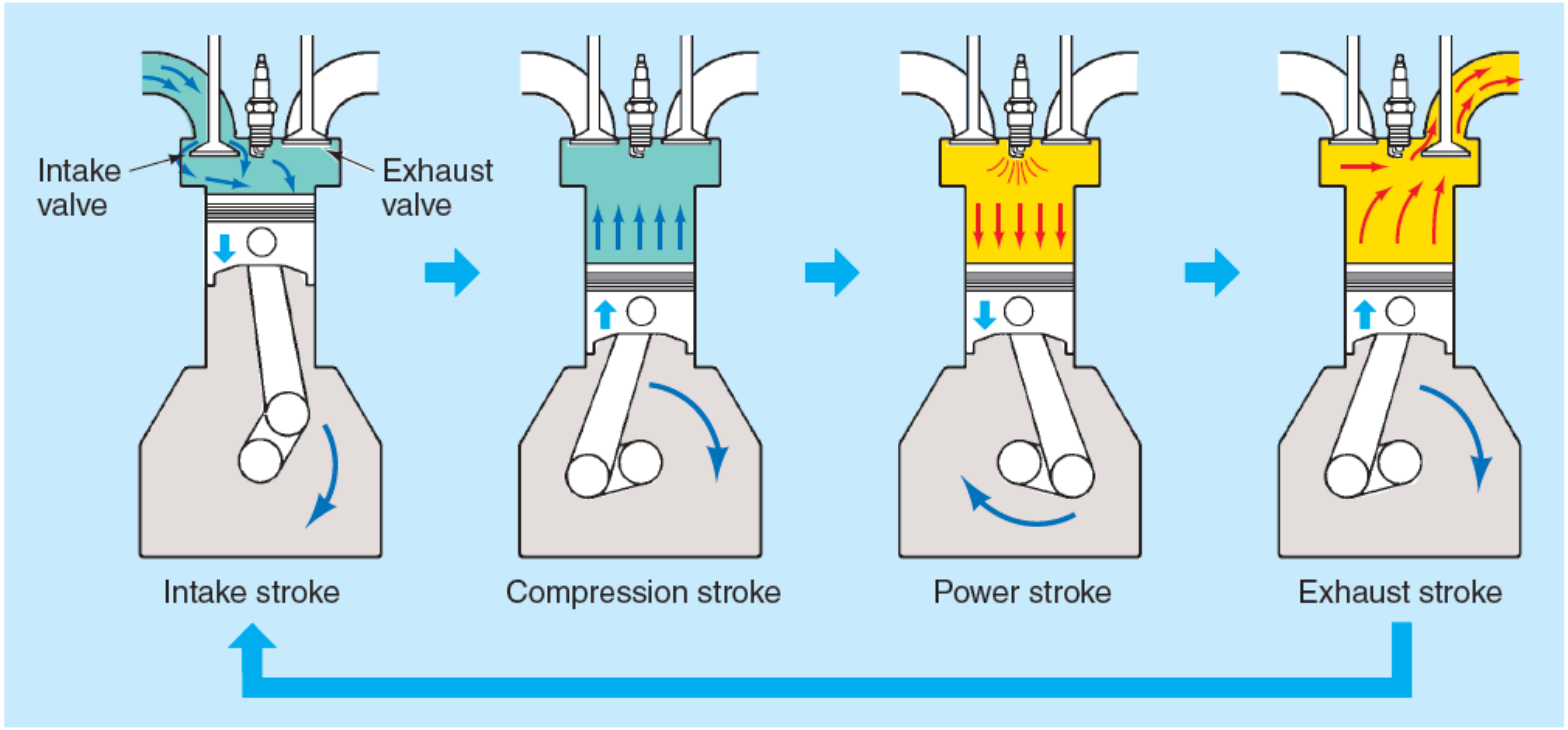

Figure 1.7 The four-stroke cycle.

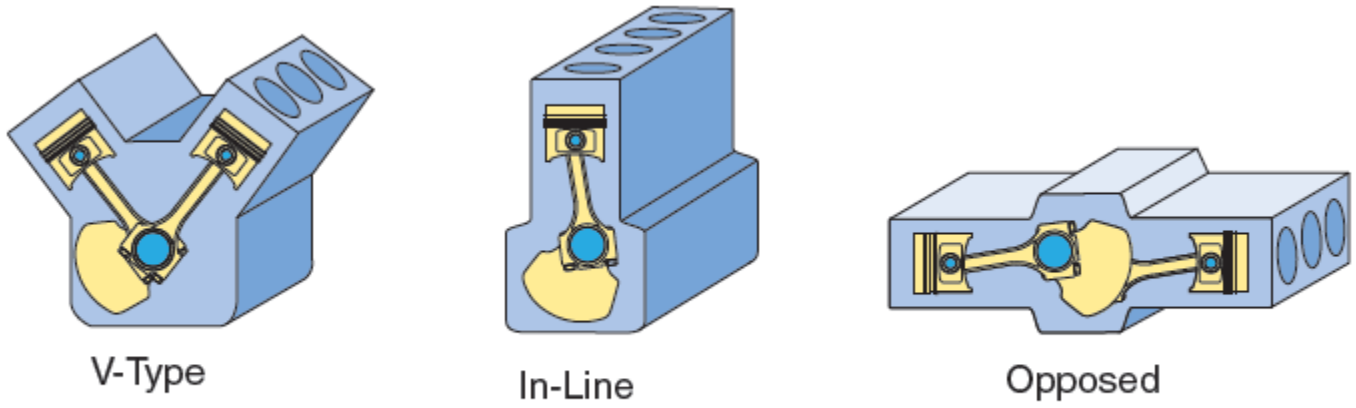

Figure 1.8 Common cylinder block arrangements.

Engine Support Systems

- Cooling system
  - Cools the engine to prevent overheating
- Fuel system
  - Carburetor
  - Gasoline fuel injection
  - Diesel fuel injection
- Lubrication system
  - Moves pressurized oil to all engine areas

Engine Support Systems (cont'd.)

- Electrical system
  - Ignition system
  - Starting system
  - Charging system
  - Computer system
- Exhaust system
  - Carries exhaust from engine to rear of car
- Emission control system
  - Reduces or eliminates pollutants in exhaust

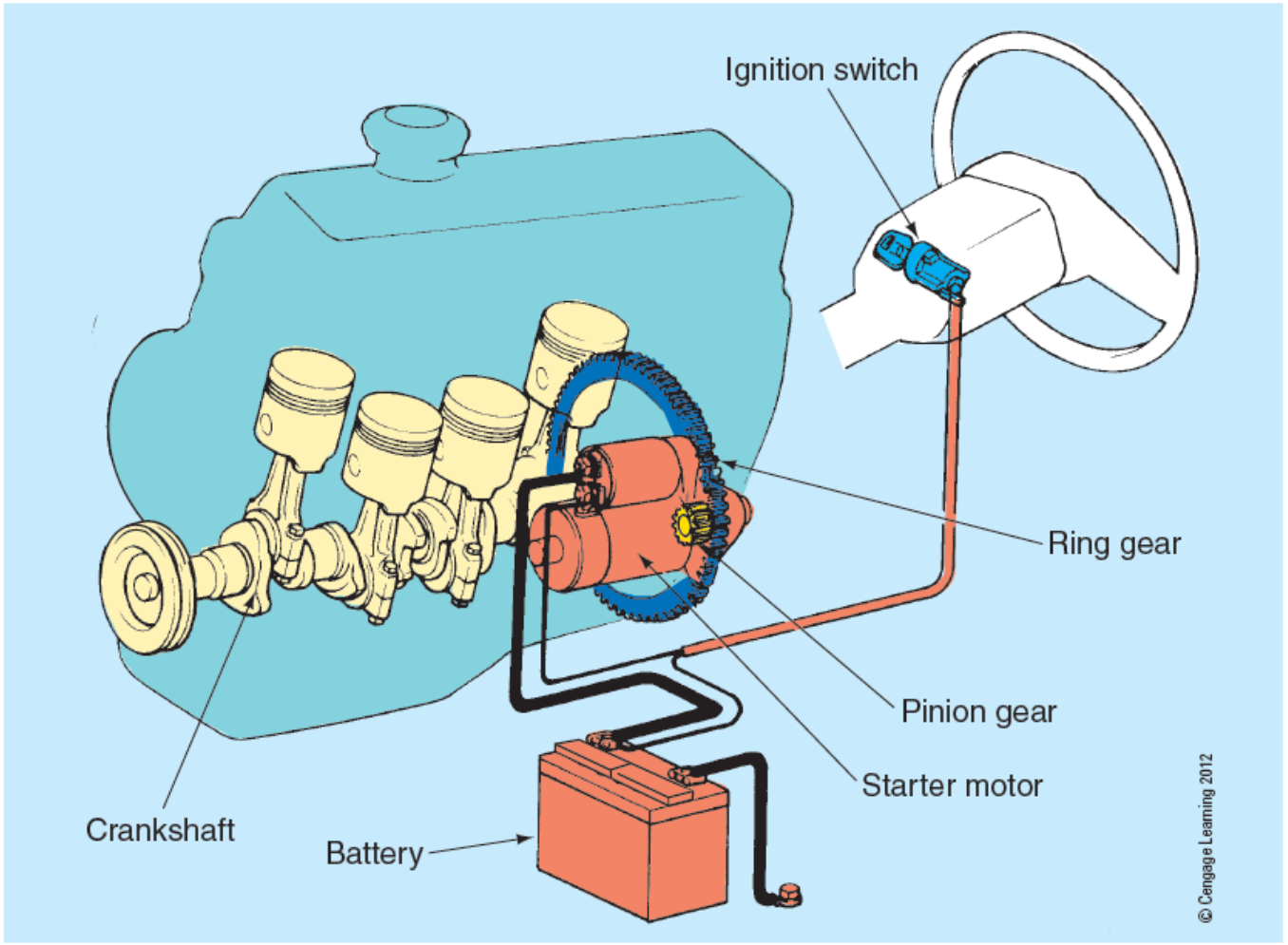

Figure 1.16 The starter motor turns the engine's crankshaft.

The Powertrain

- Transmits engine power to wheels
  - Transmission (transaxle)
  - Clutch
  - Torque converter
  - Differential
  - Axles or half-shafts
- Front-wheel drive, rear-wheel drive, or all-wheel drive
- Manual or automatic

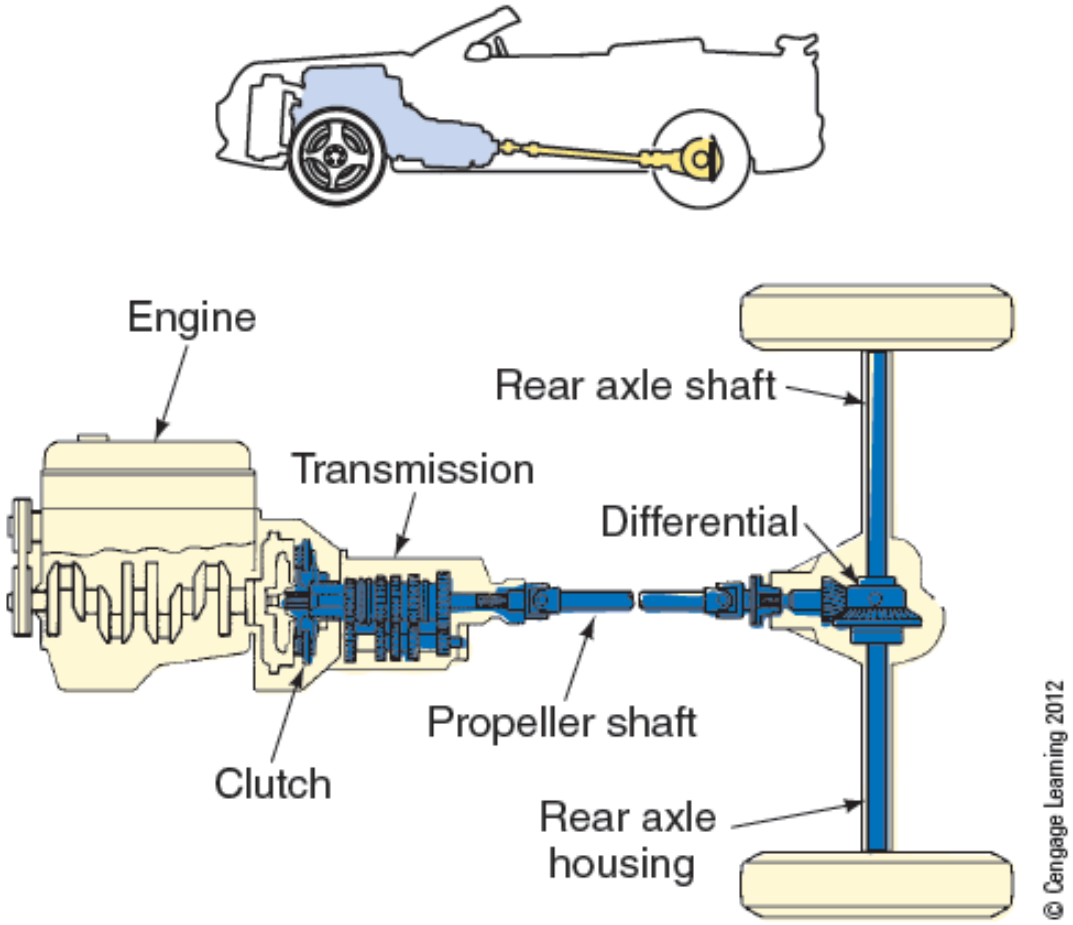

Figure 1.20 Rear-wheel drive.

The Powertrain (cont'd.)

- Manual transmission
  - Gears change leverage or torque
  - Clutch uncouples powertrain from engine
- Automatic transmission
  - Gears shifted based on speed and engine load
- Drive shaft
  - Used on rear-wheel drive cars to transfer power to the rear axle
  - Hollow metal tube with universal joint at each end
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The Powertrain (cont'd.)

- Rear axle assembly
  - Drive axles power each rear wheel and a differential assembly
- Transaxle
  - Used on front-wheel drive vehicles
  - Transmission and differential in one housing

Accessory Systems

- Also called comfort systems
  - Air conditioning
  - Heating
  - Power seats
  - Power windows
  - Cruise control
  - Navigation, sound systems, etc.

History and Development of the Automobile

- Steam-powered vehicles
  - First autos
  - Powered by steam engine
  - Developed in 1698
  - Steam engine is an external combustion engine

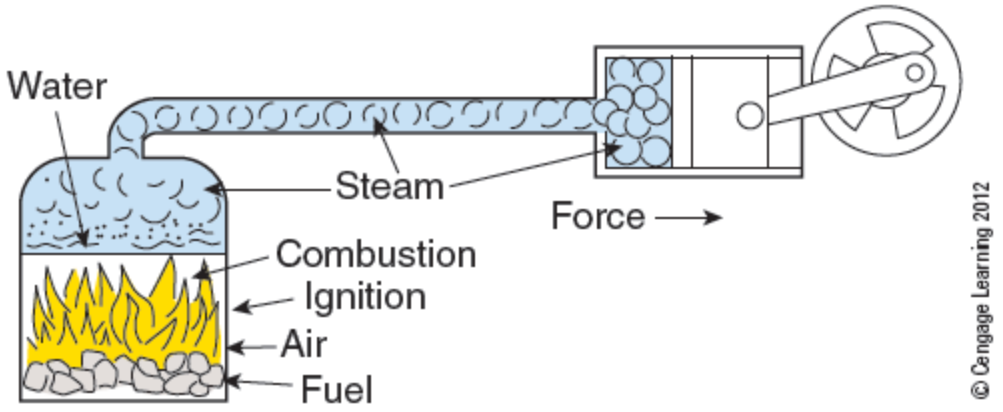


Figure 1.21 An external combustion steam engine.

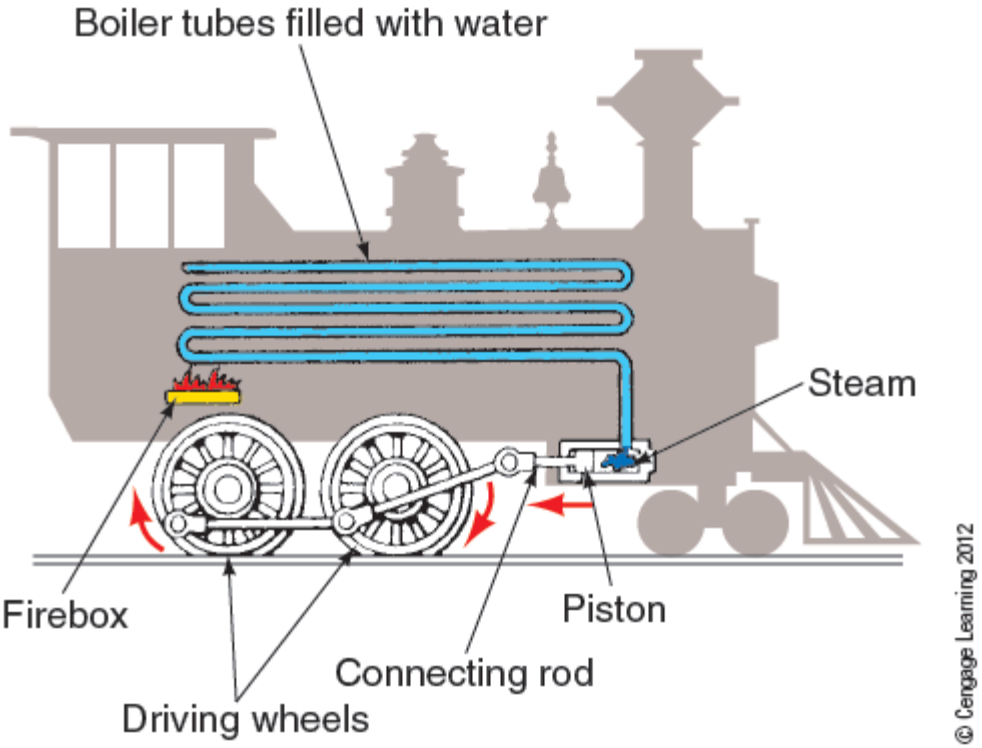


Figure 1.22 A steam-powered locomotive.

History and Development of the Automobile (cont'd.)

- Early gasoline engines
  - 1876: Dr. Nicolas Otto patented the slow-speed, four-stroke, internal combustion engine
  - 1885: Gottlieb Daimler patented high-speed, petroleum engine
  - 1893: Benz shown at the World's Fair in Chicago
  - 1920: 90% of cars looked like carriages
  - 3.8 million miles of road in the U.S. has been developed in less than 100 years

History and Development of the Automobile (cont'd.)

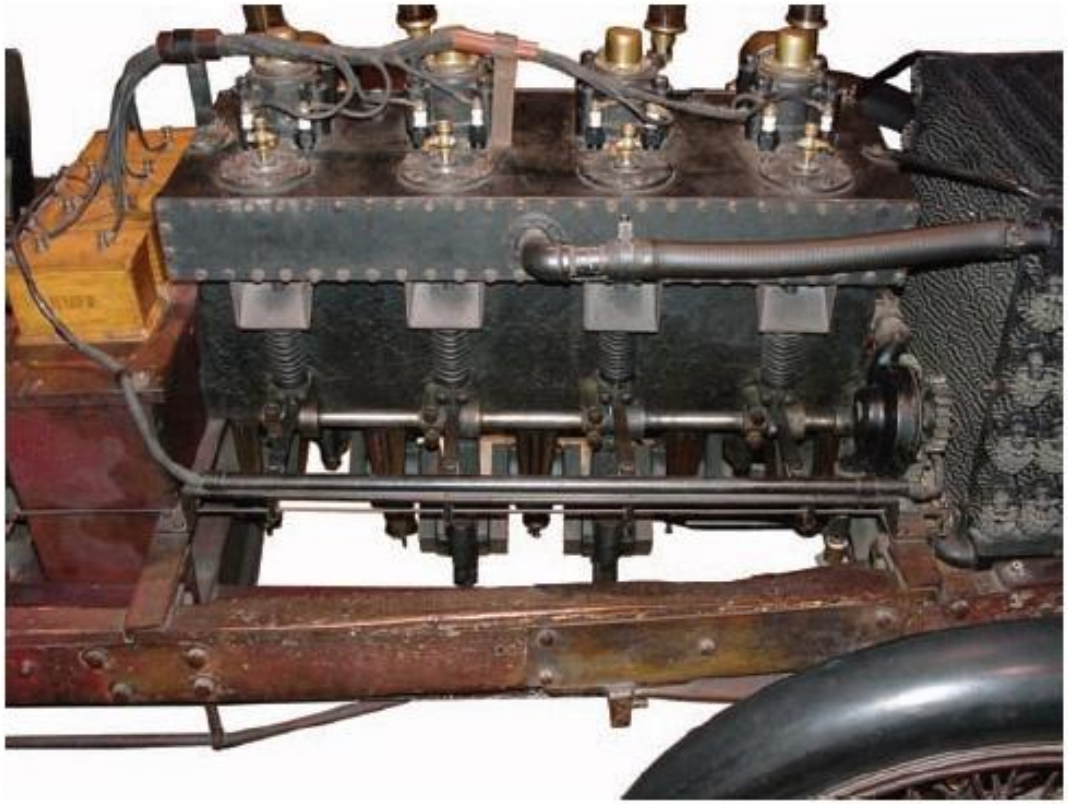
- Early automobile racing
  - 1895: First auto race in Chicago
  - 1913: Indianapolis 500 started
- Early transmissions
  - Early cars had transmission on rear axle
    - Later attached to rear of engine
- Carburetors
  - Early carburetors had a wick saturated with gasoline
    - Later had a bowl full of gasoline

History and Development of the Automobile (cont'd.)

- Fuel pumps
  - 1915: Stewart Warner vacuum tank
  - 1928: Electric and mechanical fuel pumps
- Lubrication systems
  - Early engines used a drip oiler
    - Later cars had mechanical oiling
- Tires
  - 1900: Michelin’s first pneumatic tires
  - 1919: All cars are equipped with cord tires

History and Development of the Automobile (cont'd.)

- Electrical systems
  - Early cars had 8-, 12-, or 24-volt systems
  - 1915: 6-volt battery became standard
  - 1950s: 12-volt batteries became standard
- Starter system
  - Early engines hand cranked to start
  - 1912: Kettering electric starter motor



Tim Gilles

Figure 1.24 This early engine had no valve cover or oil pan. Lubricant was provided by drip oil.

History and Development of the Automobile (cont'd.)

- Early American automobiles
  - 1892: Charles and Frank Duryea build first operational car
  - 1908-1926: Henry Ford produced the Model T
    - Assembly line produced 1000 per day
  - General Motors: Durant wanted to produce a variety of cars
    - Good promoter, but poor business man
    - Removed from GM
  - 1919: Walter Chrysler starts Chrysler Corporation

History and Development of the Automobile (cont'd.)

- Later developments
  - 1950s: American cars became large and powerful
    - Poor fuel economy and high pollution
- Fuel economy standards
  - 1973: Gas prices quadrupled
  - 1975: U.S. Congress passed CAFE
- Modern developments
  - Today's cars benefit from military and space program innovations
  - Advancements have improved safety and reliability