Internal Combustion Engine 1

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Lecture Outlines

- Classification of IC Engines

Classification of IC Engines

Classification of IC Engines

Engines can be classified according to the following criteria

- Application
- Basic Engine Design
- Engine Operating Cycle
- Engine Working Cycle
- Valve/Port Design and Location
- Fuel
- Mixture Preparation

- Type of Ignition
- Stratification of Charge
- Combustion Chamber Design
- Method of Load Control
- Cooling
- Method of Increase Inlet Pressure (Power Boosting)

Applications

Applications

- Automotive
- Locomotive
- Light Aircraft
- Marine

- Power Generation
- Agricultural
- Earth-moving
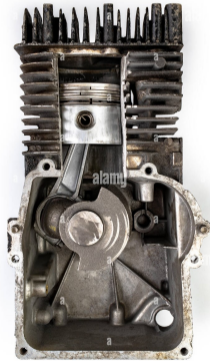- Home Use

Basic Engine Design

Basic Engine Design

- Reciprocating
  - Single Cylinder
  - Multi-cylinder
    - In-line
    - H, U, V, W, & X
    - Radial
    - Opposed Cylinder
    - Opposed Piston

- Rotary
  - Single Rotor
  - Multi-rotor

Single Cylinder

- The engine has one cylinder and piston connected to the crankshaft.

In-Line

- Cylinders are positioned in a straight line, one behind the other along the length of the crankshaft. They can consist of 2 to 11 cylinders or possibly more.

- In-line four-cylinder engines are very common for automobiles and other applications. In-line engines are sometimes called straight (e.g., Straight Six or Straight Eight).
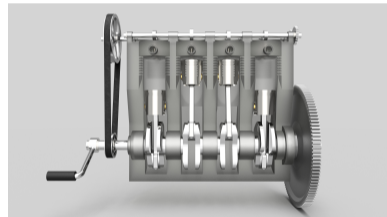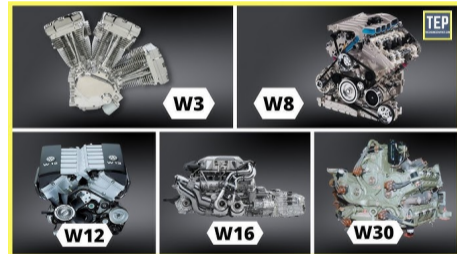
V Engine

- Two banks of cylinders at an angle with each other along a single crankshaft.

- The angle between the banks of cylinders can be anywhere from $15°$ to $120°$, with $60°$ to $90°$ being common. V engines have even numbers of cylinders from 2 to 20 or more.
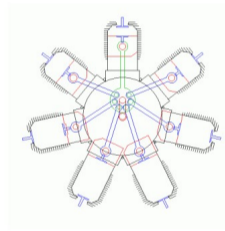
W Engine

- Same as a V engine except with three banks of cylinders on the same crankshaft.
- Not common, but some have been developed for racing automobiles, both modern and historic.
- Usually 12 cylinders with about a 60° angle between each bank.

Radial Engine

- Engine with pistons positioned in a circular plane around the central crankshaft.

- The connecting rods of the pistons are connected to a master rod which, in turn, is connected to the crankshaft.

- A bank of cylinders on a radial engine always has an odd number of cylinders ranging from 3 to 13 or more.

Opposed Cylinder Engine

- Two banks of cylinders opposite each other on a single crankshaft (a V engine with a $180°$ V).
- These are common on small aircraft and some automobiles with an even number of cylinders from two to eight or more. These engines are often called flat engines (e.g., flat four).
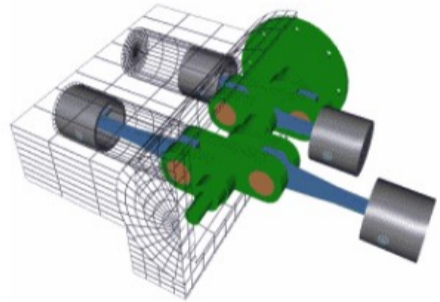
Opposed Piston Engine

- Two pistons in each cylinder with the combustion chamber in the center between the pistons.
- A single-combustion process causes two power strokes at the same time, with each piston being pushed away from the center and delivering power to a separate crankshaft at each end of the cylinder.
- Engine output is either on two rotating crankshafts or on one crankshaft incorporating complex mechanical linkage.
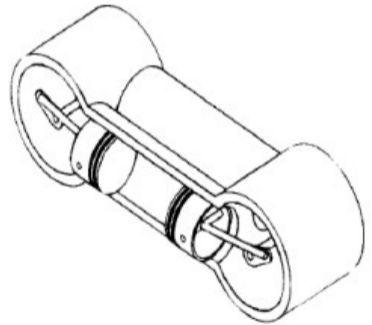
Operating Cycle

Operating Cycle

- Otto (For the Conventional SI Engine)
- Atkinson (For Complete Expansion SI Engine)
- Miller (For Early or Late Inlet Valve Closing type SI Engine)
- Diesel (For the Ideal Diesel Engine)
- Dual (For the Actual Diesel Engine)

Engine Working Cycle

Engine Working Cycle

- Four-Stroke Cycle

  A four-stroke cycle experiences four piston movements over two engine revolutions of each cycle

- Two-Stroke Cycle

  A two-stroke cycle has two piston movements over one revolution for each cycle

End of Lecture 2