

Lectures

3rd Semester M. Tech. - Mechanical Systems Design

Mechanical Engineering Department

Subject: Advanced Engine Design

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Topic: Engine Classification

Dated: 10-09-2020

Internal Combustion Engines Can Be Classified By:

1. Application.

Automobile, Truck, Locomotive, Light Aircraft, Marine, Portable Power System, Power Generation

2. Basic Engine Design.

(a) Reciprocating Engines:

Subdivided By Arrangement Of Cylinders:

(i) **In-Line** – (multi-cylinder engine design – all cylinders on the same centre line passing through the center of each cylinder)

(ii) **V** - (multi-cylinder engine design – half the number of cylinders form one bank on a same center line passing through their centers and other half the number of cylinders form one more bank on a same centre line passing through their centers.

The two banks of cylinders are arranged in a V fashion with connecting rods being connected to the cranks of single crank shaft only.

(iii) **Radial** – (multi-cylinder engine design – using single crank shaft at the center with many number of cylinders arranged radially in all directions of the center line of the crank shaft.

(iv) **Opposed** – (multi-cylinder engine design – using single crank shaft at the center with half the number of cylinders forming a bank on one side of the center line of crank shaft and other half the number of cylinders forming one more bank on the opposite side at an angle of 180 degrees.

(b) Rotary Engines:

Wankel And Other Geometries (not in commercial use – see video from you-tube on www to understand its working principle)

3. Working Cycle.

(a) Four Stroke Cycle:

(i) Naturally aspirated (admitting atmospheric air – say at a density of 1.18kg/m^3)

(ii) Supercharged (admitting pre-compressed fresh mixture using a compressor driven by the crankshaft – say at a density of 1.98kg/m^3) and

(iii) Turbocharged (admitting fresh mixture compressed in a compressor driven by exhaust gas turbine – say at a density of 3.3kg/m^3 for heavy duty truck application)

(b) Two Stroke Cycle:

- (i) Crank Case Scavenged (using crank case for admitting fresh mixture and pre-compressing it before being transferred through transfer port to scavenge the exhaust gas from the cylinder from the previous cycle and replace it)
- (ii) Supercharged and
- (iii) Turbocharged

4. Valve and Port Design and location

Four stroke cycle engine design application

- (a) Overhead (or I-head) valve location and design
- (b) Under head (or L-head) valve location and design
- (c) rotary valve design

Two stroke cycle engine design application

- (a) cross scavenged porting (inlet and exhaust ports on opposite sides of the center line of the cylinder)
- (b) loop-scavenged porting (inlet and exhaust ports on the same side of the center line of cylinder)
- (c) through or uniflow-scavenged (inlet and exhaust ports or valves at different ends of cylinder. Say inlet port on the cylindrical surface side of cylinder and exhaust port and exhaust valve on the cylinder head at the top.

5. Fuel.

- (a) Gasoline or Petrol
- (b) Fuel oil or Diesel
- (c) Natural Gas – CNG, LNG
- (d) Liquefied Petroleum Gas – LPG
- (e) Alcohols – Methanol, Ethanol – based on renewable crops having starch – sugarcane, potatoes etc - (possible fuel for engines in future)
- (f) Hydrogen – (possible fuel for engines in future) - (if manufacture economically by electrolysis of water)
- (g) Dual Fuel – Any two suitable fuels
- (h) Biodiesel – Based on edible and non-edible vegetable oils - Soybean Methyl Ester Biodiesel etc - (possible fuel for engines in future)

6. Method of Mixture Preparation.

- (a) Carburetion
- (b) Fuel Injection System
 - (i) Manifold Fuel Injection
 - (j) Port Fuel Injection System – SI Engines
 - (k) In-cylinder Fuel Injection System – CI Engines, SI Engines

7. Method of Ignition

- (a) Spark Ignition System – Petrol engine etc
- (b) Compression Ignition System
 - (i) Diesel engines – Self Ignition
 - (ii) Gas Engines – By Pilot injection of Diesel

8. Combustion Chamber Design

(a) Open Chamber – Single Chamber - Many designs as per the shape of piston top given below:

- (i) Disc
- (ii) Wedge
- (iii) Hemisphere
- (iv) Bowl-in-piston

(b) Divided Chamber – Two Chambers – Small and Auxiliary Chambers – Many Designs

- (i) Swirl Chamber
- (ii) Pre-chamber

9. Method of Load Control

(a) Throttling air-fuel mixture – constant air-fuel ratio

(b) Control of fuel flow alone – varying air-fuel ratio - **constant speed engine** - engines used for **power generation**

(c) A combination of above two methods – **variable speed engine** - **automotive engines**

10. Method of Cooling:

(a) Water cooled – using low temperature freezing point type coolants in practice – all four stroke cycle engines

(b) Air cooled – using fins – using motorcycle speed or a fan for circulation of air over fins – small four stroke cycle engines and small two stroke cycle engines

(c) Un-cooled – basically using fins and natural convection and radiation for cooling – engines used by grass cutters

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Text Book:

Internal Combustion Engine Fundamentals

By John B Heywood

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