

## I.C. ENGINE AND GAS TURBINE

### LEARNING OBJECTIVES

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|--|--|
| 9.1 Introduction   | 9.11 Diesel cycle  |
| 9.1.1 Heat engine  | 9.12 Dual combustion cycle                                     |
| 9.1.2 Essentials of Heat engine                            | 9.13 Comparison of Otto, Diesel and Dual Combustion cycles     |
| 9.1.3 Types of Heat engine                                 | 9.13.1 Same compression ratio and heat addition                |
| 9.1.4 Classification of I.C. engine                        | 9.13.2 Same compression ratio and heat rejection.              |
| 9.1.5 Some Important terms                                 | 9.13.3 Same peak pressure, peak temperature and heat rejection |
| 9.2 Four stroke cycle                                      | 9.13.4 Same maximum pressure and heat input                    |
| 9.2.1 Working Principle of four stroke Petrol engine       | 9.13.5 Same maximum pressure and work output                   |
| 9.2.2 Working principle of four stroke Diesel engine       | 9.14 Gas Turbine   |
| 9.3 Two stroke cycle                                       | 9.15 Types of Gas Turbine                                      |
| 9.3.1 Working Principle of 2-stroke Petrol engine          | 9.15.1 Open cycle Gas Turbine                                  |
| 9.3.2 Working Principle of 2-stroke Diesel engine          | 9.15.2 Closed cycle Gas Turbine                                |
| 9.4 Valve timing Diagram for a four stroke engine          | 9.15.3 Advantages of closed cycle                              |
| 9.4.1 Valve overlap  | 9.16 Application of Gas Turbine                                |
| 9.5 Comparison of Petrol engine and Diesel engine          | 9.17 Comparison of Gas Turbine and I.C. engine                 |
| 9.6 Comparison of four stroke and two stroke cycle engines | 9.18 Comparison of Gas Turbine and steam Turbine               |
| 9.7 Main Components of I.C. engine                         | 9.19 Comparison of closed cycle and open cycle Gas Turbine     |
| 9.8 Introduction of Thermodynamic cycles                   | 9.20 Constant Pressure Gas Turbine cycle                       |
| 9.8.1 Reversible process                                   | Highlights   |
| 9.8.2 Reversible cycle                                     | Short Answer type Questions                                    |
| 9.8.3 Thermal efficiency                                   | Numerical Problems   |
| 9.8.4 Air standard efficiency                              |  |
| 9.9 Carnot cycle   |  |
| 9.10 Otto cycle  |  |

### 9.1 INTRODUCTION

Man has found number of ways by which the sources of energy in nature can be made use of. It is one of the important factors which has contributed a lot towards the development of our society. The source of energy found in nature may be in the form of chemical energy which may be converted into heat energy by its combustion.

There are some other substances found in nature which are the sources of energy. For example,



uranium may also be regarded as a source of energy; as the splitting of the atom has progressed to a large extent. So far there is no method by which the nuclear energy may be directly converted into mechanical energy. Therefore, the heat energy produced by the combustion of chemical fuel or from the atomic reaction can be converted into mechanical energy by the means of a heat engine.

The heat engine can be classified as external combustion and internal combustion engines. In this chapter, we shall study the internal combustion engines.

### 9.1.1 Heat engine

(The engine which converts the heat energy into the mechanical energy is known as heat engine. In other words, the heat engine is a sort of energy transformer.)

(The chemical energy of fuel (Coal, Petrol or Diesel etc.) is converted into heat energy by the combustion of the fuel.)

(The heat energy so produced is converted into mechanical energy by means of heat engines.)

### 9.1.2 Essentials of heat engines

There are three basic essentials of a heat engine:

- (i) Source of heat                      (ii) Working agent                      (iii) Sink

Source of heat means, the source from where the heat energy can be taken and given to the working agent of the engine.

Working agent is that which takes and gives out heat during its expansion and contraction. And the receiver, into which the heat, is rejected is known as sink.

### 9.1.3 Types of heat engines

Heat engines may be broadly divided into two categories, namely;

1. External combustion engines (E.C. Engines)
2. Internal combustion engines (I.C. Engines)

#### External combustion engines

The engines in which the combustion of fuel takes place outside the engine cylinder, is known as external combustion engine.

Steam engines and steam turbines are the examples of external combustion engines. In these engines steam is the working agent.

#### Internal Combustion engines

The engines, in which the combustion of the fuel takes place inside the engine cylinder, is known as internal combustion engine.

Petrol, diesel and gas engines are the examples of internal combustion engines. In these engines, air or mixture of air and fuel is the working agent.

### 9.1.4 Classification of I.C. Engines

The internal combustion engines may be classified into two categories:

1. Reciprocating type I.C. engines
2. Rotary type I.C. engines

#### Reciprocating type I.C. engines

In this type of engines piston moves inside the cylinder with reciprocating (to and fro) motion e.g. petrol and diesel engines.

#### Rotary type I.C. engines

In this type of engines piston moves inside the cylinder with rotary motion, e.g. gas turbines and wankel engines.

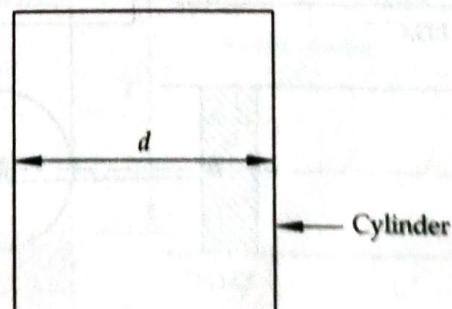
The reciprocating type of I.C. engines may be further classified on the basis of the following:



1. According to the fuel used:
  - (a) Petrol engines.
  - (b) Diesel engines
  - (c) Gas engines.
2. According to the working cycle:
  - (a) Engines based on Otto cycle
  - (b) Engines based on Diesel cycle.
  - (c) Engines based on dual combustion cycle
3. According to the Method of Ignition:
  - (a) Spark ignition engines (S.I. Engines)
  - (b) Compression ignition engines (C.I Engines).
4. According to the method of fuel Injection:
  - (a) Fuel injection with carburettor.
  - (b) Air injection or air blast injection.
  - (c) Airless injection or solid injection.
5. According to the strokes per cycle:
  - (a) Two stroke engine.
  - (b) Four stroke engines.
6. According to the cooling system employed:
  - (a) Air cooled engines.
  - (b) Water cooled engines.
7. According to the number of cylinders:
  - (a) Single cylinder engines.
  - (b) Multi-cylinder engines.
8. According to the valve mechanism:
  - (a) Engines with overhead valve mechanism.
  - (b) Engines with side valve mechanism.
9. According to the speed:
  - (a) Low speed engines.
  - (b) Medium speed engines.
  - (c) High speed engines.
10. According to the cylinder arrangement:
  - (a) Horizontal cylinder engines.
  - (b) Vertical cylinder engines.
  - (c) V-type multi-cylinder engines.
  - (d) In-line multi-cylinder engines.
  - (e) Radial engines.
  - (f) Opposite cylinder engines.
  - (g) Opposite piston engines.
11. According to the field of application:
  - (a) Stationary engines.
  - (b) Automotive engines.
  - (c) Aircraft engines.
  - (d) Marine engines (Ship).
  - (e) Locomotive engines (Diesel).

### 9.1.5 Some important terms

1. **Bore:** The internal diameter of the cylinder of the engine is known as *Bore*. (shown in Fig. 1).



where

$d$  = Internal diameter of the cylinder or Bore

Fig. 1 Bore