11.3 MAIN COMPONENTS OF IC ENGINES

[May 2009, 2012; Nov 2012, Regulation 2008; May 2014; Apr 2015, Regulation 2013]

A simple sectional elevation of a 4-stroke engine is given in Fig. 11.1(a) indicating the various components.

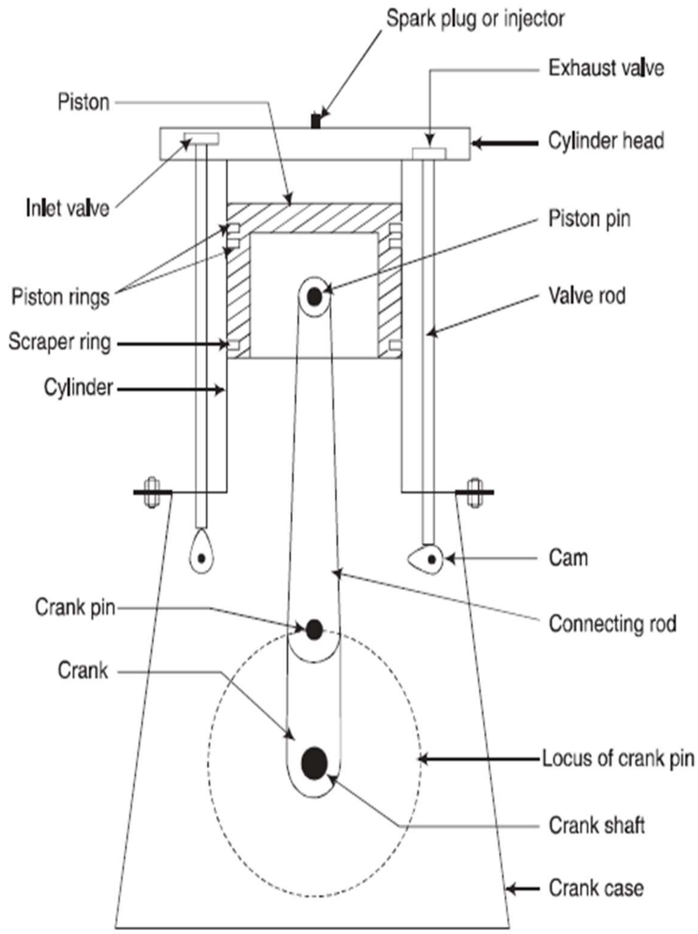

Fig. 11.1(a) *Four-stroke engine*

1. Cylinder The cylinder allows the piston to move to and fro. The cylinder is made of cast iron or steel or an aluminium alloy. Sometimes, a liner made of alloy cast iron is inserted into the cylinder which can be replaced when worn out.

2. Cylinder Head It is fitted on the top of the cylinder. A gasket is provided between the cylinder and the cylinder head to prevent the leakage of hot gases. The cylinder head also accommodates the inlet valve, the exhaust valve, and the spark plug or injector.

3. Piston It transmits the force exerted by the burning gases to the connecting rod and finally to the crank shaft. The piston is usually made of cast iron or steel or aluminium alloy. There is an interesting and complex science behind the design and manufacture of a piston of an IC engine. The diameter of a piston in a large marine engine is about 1 m.

4. Piston Rings Two different types of piston rings are housed in the circumferential grooves provided on the outer surface of the piston. The function of upper rings known as compression rings is to provide gas-tight sealing to maintain the compression pressure inside the cylinder and to prevent the leakage of burnt gases into the crank case. The function of the lower rings is to scrap the used lubricating oil into the crank case. These rings are called scraper rings.

5. Connecting Rod This transmits the force from the piston to the crank shaft. It also helps in converting the reciprocating motion of the piston into the rotary motion of the crank shaft. For the lubrication of the piston pin in the connecting rod, a small hole is provided from the big end to the small end. The small end of the connecting rod is attached to the piston by a gudgeon pin.

6. Crank Shaft Great care should be taken in the proper design of the crank shaft. Alloy steels are used for the crank shaft to withstand the high stress and strain. The crank shaft is provided with suitable holes to help in the lubrication system. The crank case serves as a sump for the lubricating oil.

7. Flywheel It is mounted on the crank shaft. The flywheel stores the excess energy during the power stroke of the engine and helps the movement of the piston during the remaining idle strokes.

8. Cams Properly designed cams control the opening and closing of the inlet and exhaust valves in the case of four-stroke engines. Cams are rotated by a cam shaft driven by the crank shaft through gears.

WORKING OF A FOUR-STROKE PETROL ENGINE

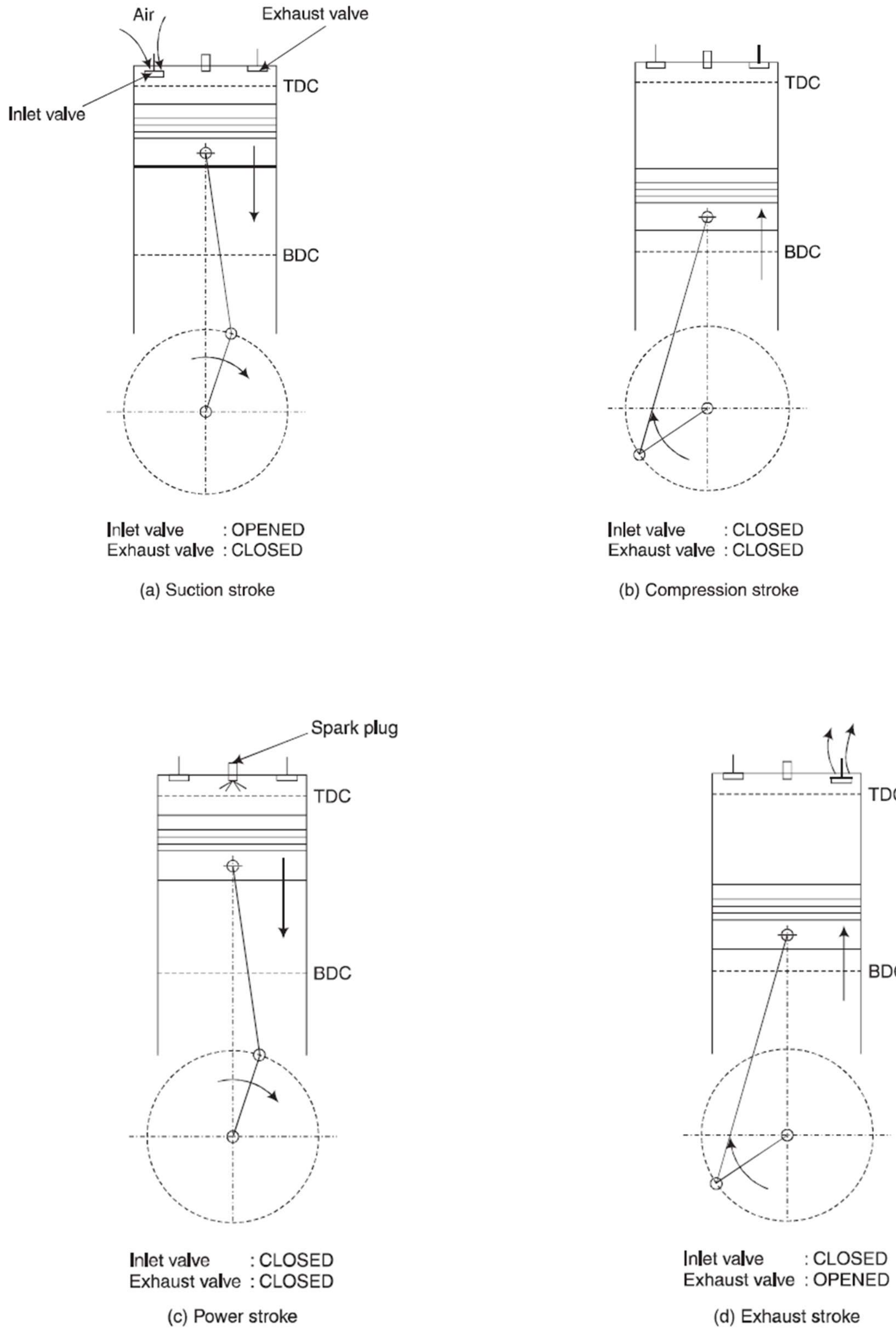

Fig. 11.2 *4-stroke cycle petrol engine*

WORKING OF A FOUR-STROKE DIESEL ENGINE

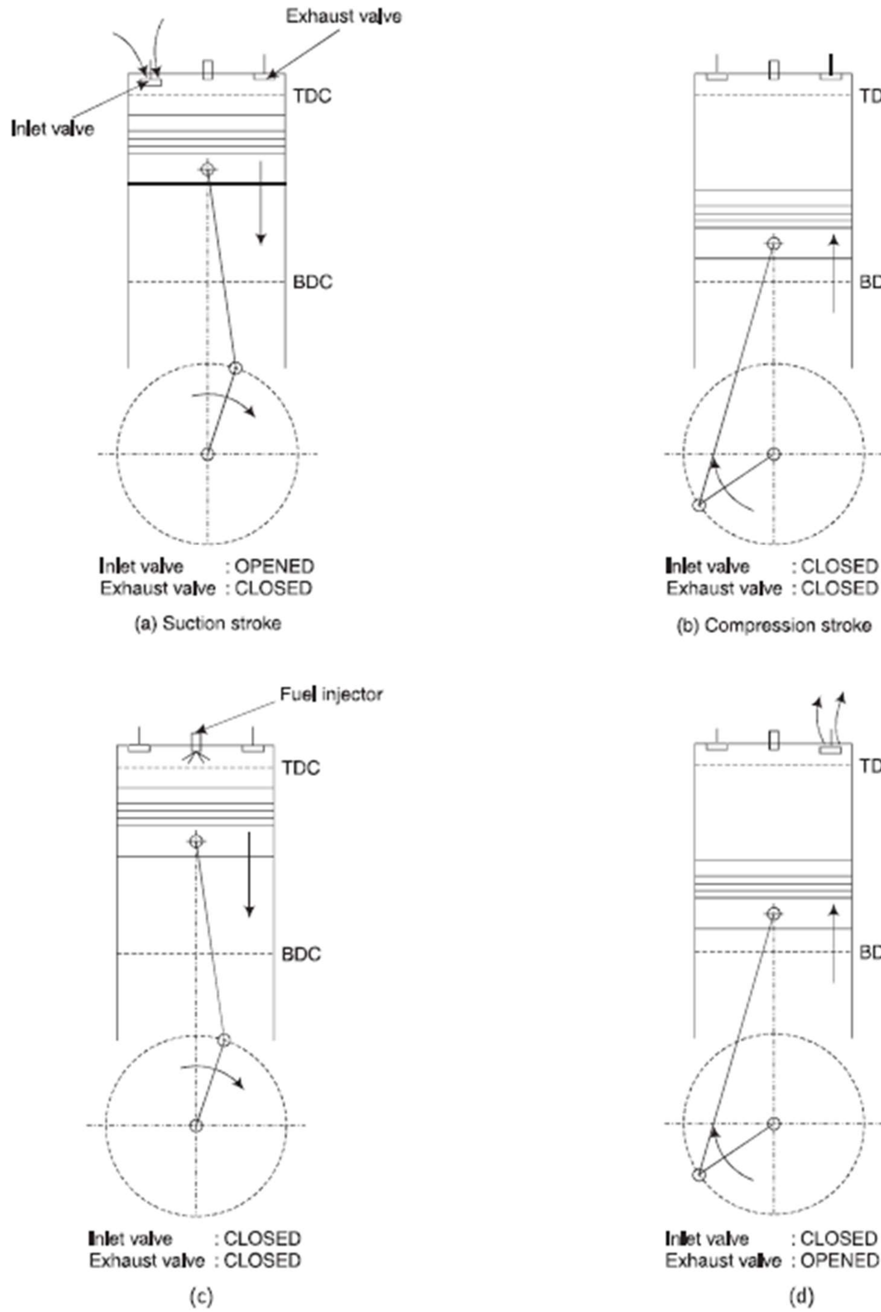

Fig. 11.3 *4-stroke cycle diesel engine*

11.6 DIFFERENCES BETWEEN PETROL ENGINES AND DIESEL ENGINES

[May 2012, Regulation 2008]

Table 11.1

	Petrol engines	*Diesel engines*
1.	Compression ratio is 7–10.	Compression ratio is 15–20.
2.	Petrol–air mixture is compressed.	Only air is compressed.
3.	Compression pressure is 15–20 bar.	Compression pressure is 30–40 bar.
4.	Compression temperature is about 400°C.	Compression temperature is above 550°C.
5.	Peak pressure is in the range of 50–70 bar.	Peak pressure is high in the range of 80–100 bar.
6.	Thermal efficiency is low in range of 20–25% due to low compression ratio.	Thermal efficiency is high in the range of 25–30% due to high compression ratio.
7.	Spark plug is necessary to ignite the fuel-air mixture.	No need for spark plug as compression temperature is enough to ignite.
8.	Due to low peak pressure, thickness of parts is less.	Due to high pressure, thickness of parts is more.
9.	Weight of the engine is less.	Weight of the engine is more.
10.	Cost of the engine is less.	Cost of the engine is more.
11.	Operating cost per km is high due to high cost of petrol and low thermal efficiency.	Operating cost per km is considerably low due to low cost of diesel and higher thermal efficiency.
12.	Due to better mixing of air and petrol, air–fuel ratio is less. For normal operation, it is in the range of 17–18.	Due to poor mixing of air and fuel, air–fuel ratio is very high (25–40). Mixing becomes poor due to lack of time.