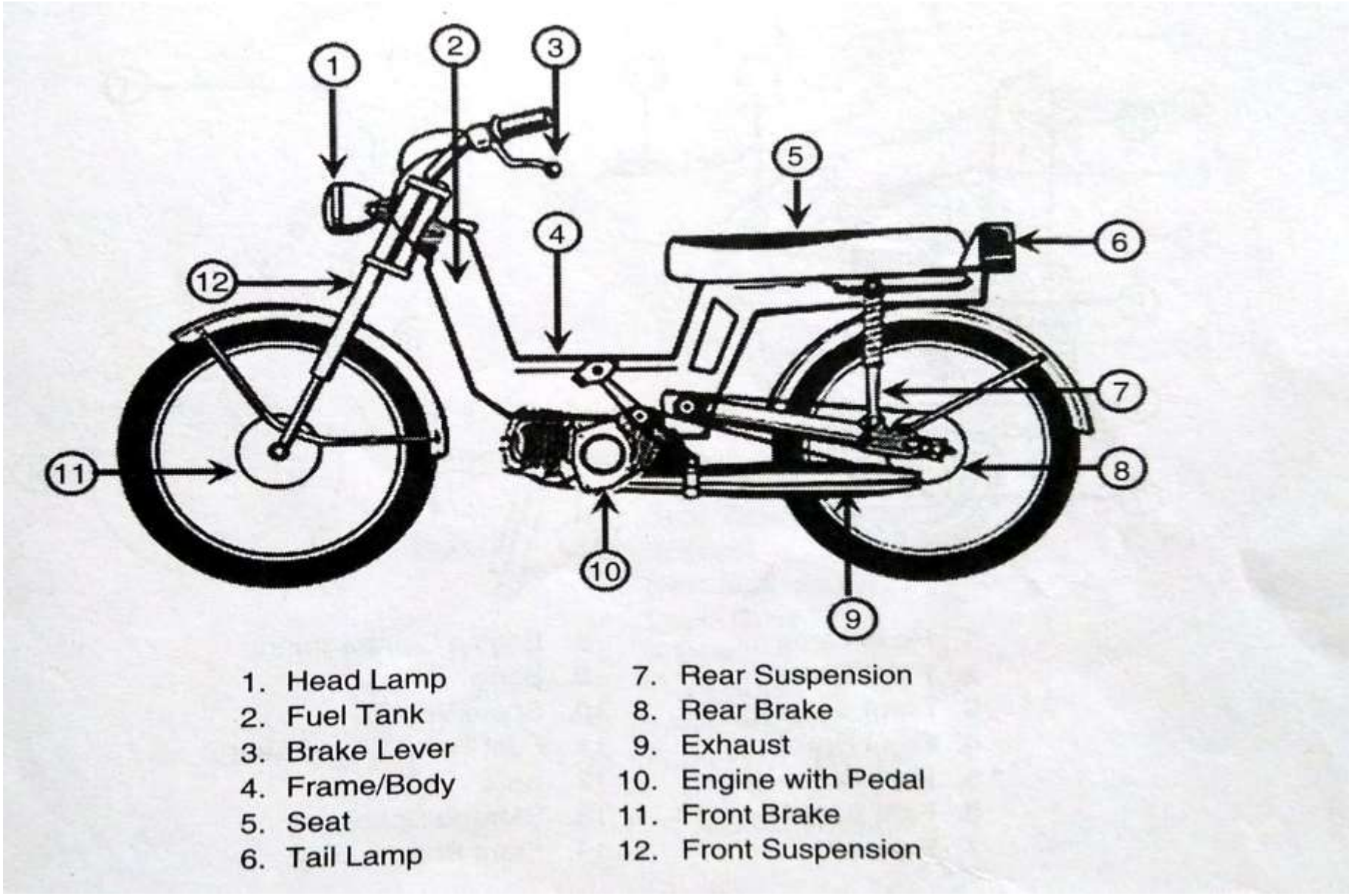
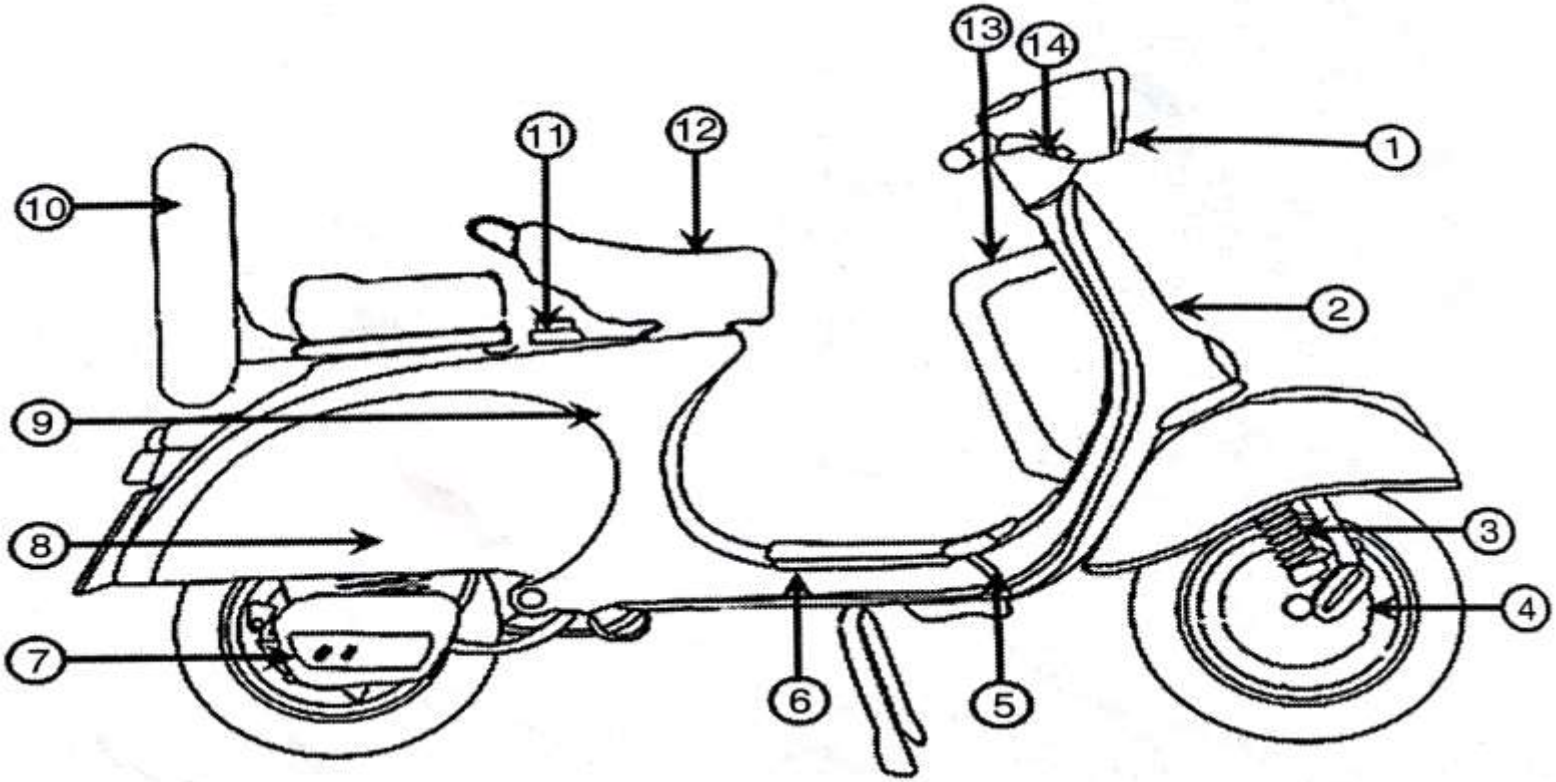
Unit 2

Classification of Internal combustion engines



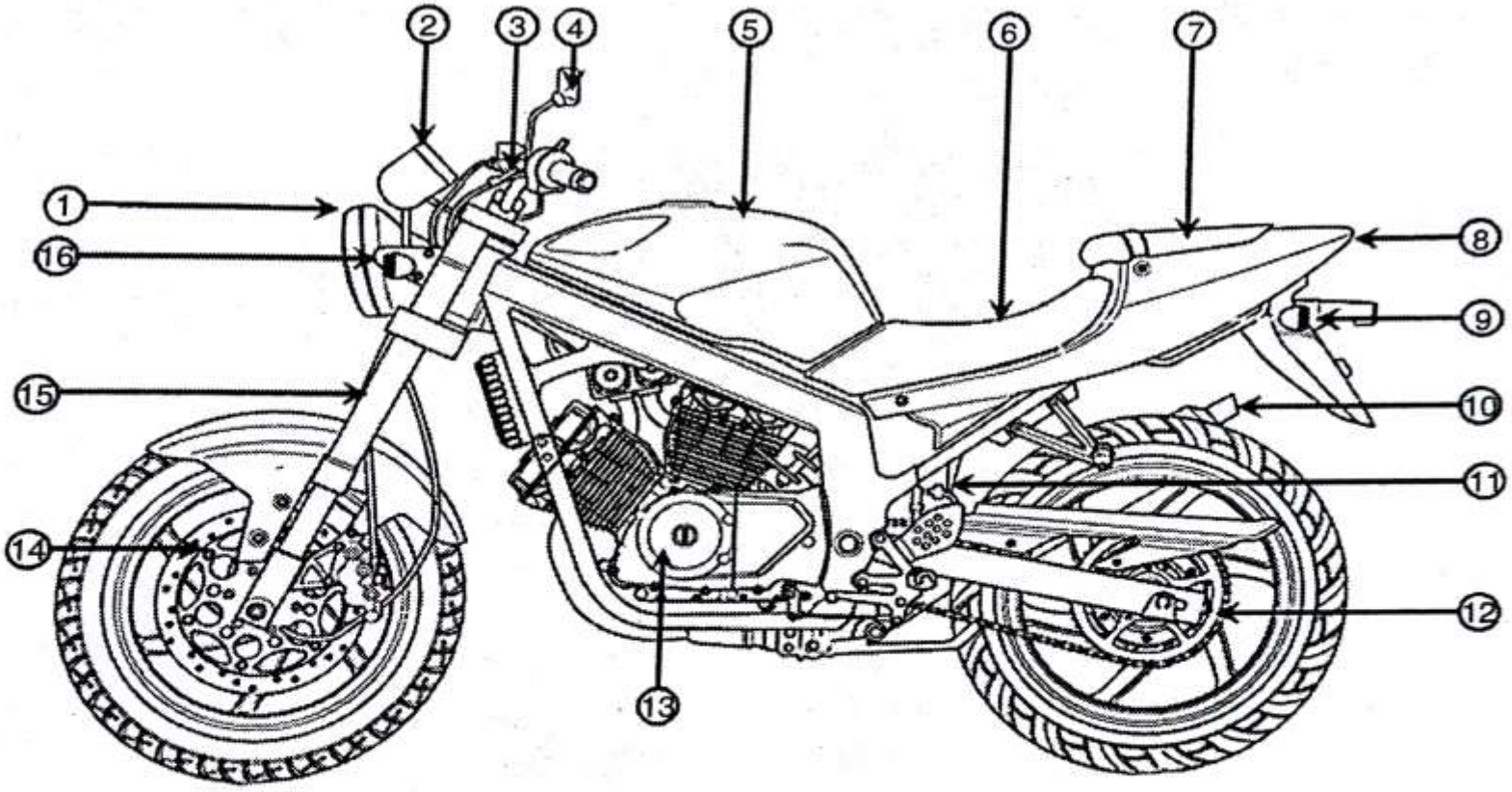
1. Head Lamp
2. Fuel Tank
3. Brake Lever
4. Frame/Body
5. Seat
6. Tail Lamp
7. Rear Suspension
8. Rear Brake
9. Exhaust
10. Engine with Pedal
11. Front Brake
12. Front Suspension

Layout of Moped



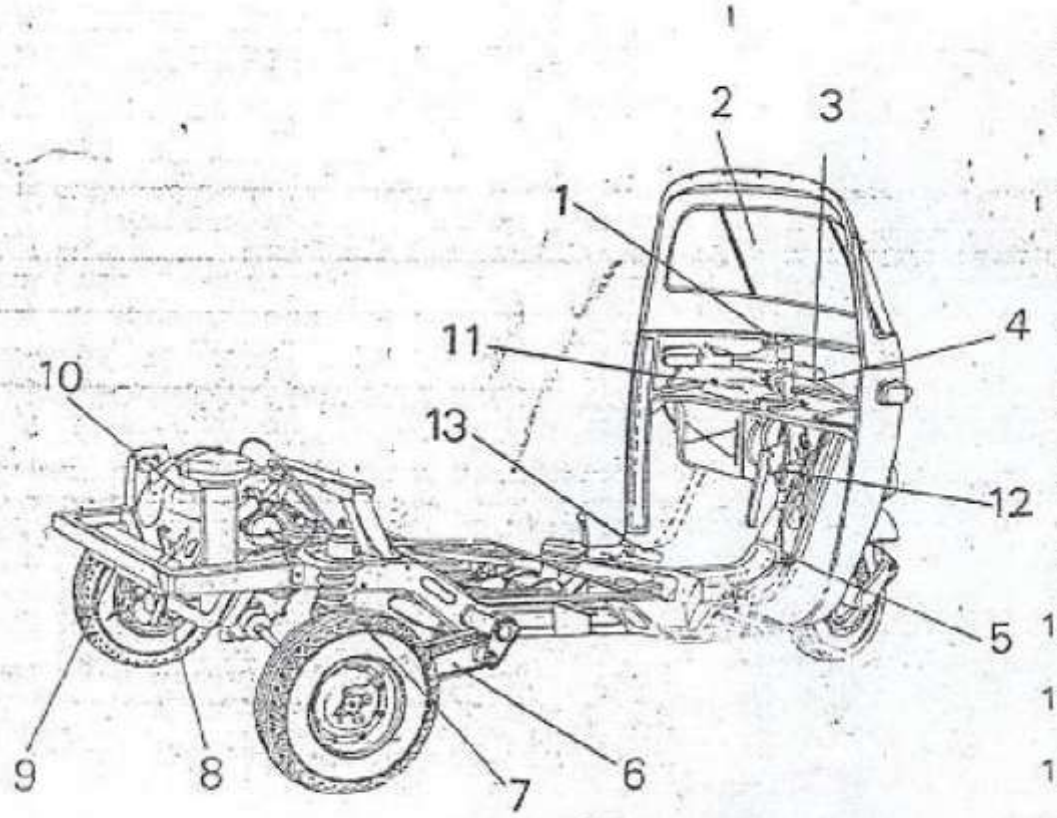
1. Head Lamp
2. Front Dome
3. Front Suspension
4. Front Brake
5. Rear Brake Lever
6. Foot Board
7. Exhaust
8. Engine Compartment
9. Body
10. Spare Wheel
11. Fuel Tank (Below Seat)
12. Seat
13. Storage Space
14. Front Brake Lever

Layout of Scooter



1. Head Lamp
2. Instrument Panel
3. ORVM
4. Clutch Lever
5. Fuel Tank
6. Seat
7. Pillion Seat
8. Tail Lamp
9. Rear Turn Indicator
10. Exhaust
11. Rear Suspension
12. Chain Drive
13. Engine
14. Front Brake
15. Front Suspension
16. Front Turn Indicator

Layout of Motorcycle



1. Speedometer
2. Windshield
3. Accelerator twist grip
4. Front brake lever
5. Rear brake pedal
6. Trailing arm
7. Shock-absorber with co-axial spring
8. Silencer
9. Rear Frame
10. Engine
11. Tool box
12. Reverse gear control lever
13. Starter lever

Conventional motorcycle with side-car

Regular side-car for the road

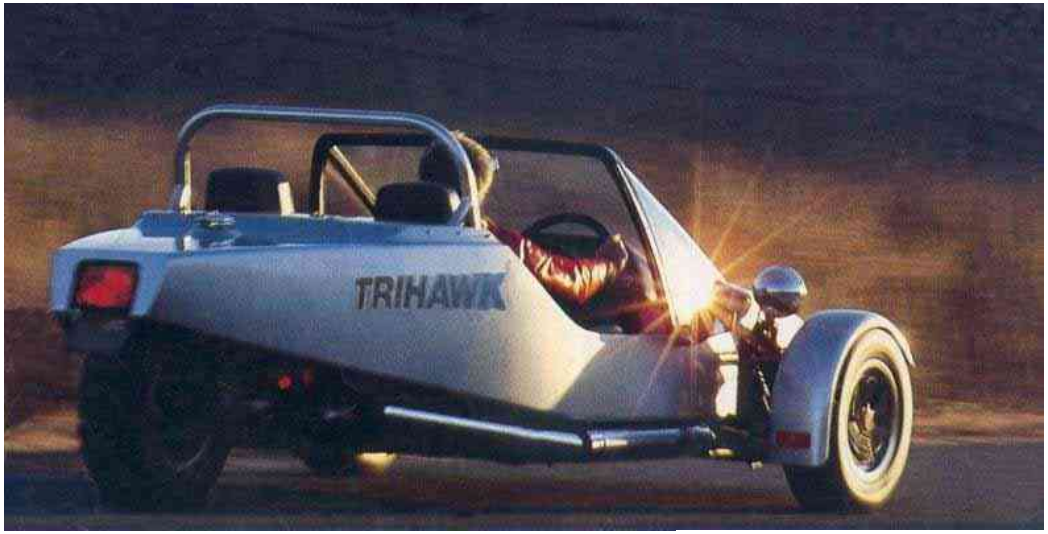
Side-car racers

Single front wheel 3-Wheelers:

Single rear wheel 3-Wheelers

Leaning 3-Wheelers

The 3-Wheelers with two front driving-steering wheels



CLASSIFICATION OF INTERNAL COMBUSTION ENGINES

1. Application
2. Basic Engine Design
3. Operating Cycle
4. Working Cycle
5. Valve/Port Design and Location
6. Fuel
7. Mixture Preparation
8. Ignition
9. Stratification of Charge
10. Combustion Chamber Design
11. Method of Load Control
12. Cooling

CLASSIFICATION OF INTERNAL COMBUSTION ENGINES

1. Application

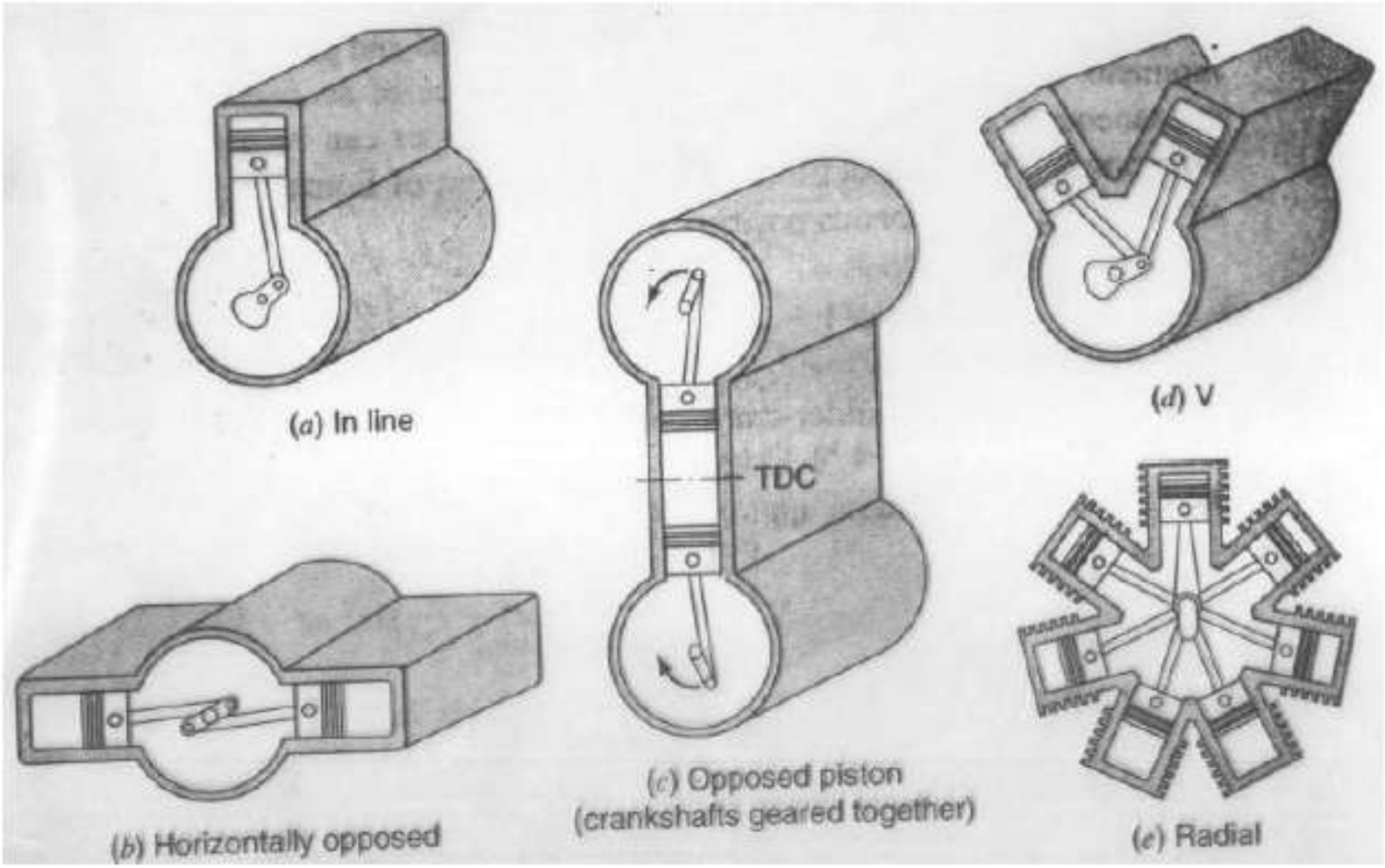
1. Automotive: (i) Car
   (ii) Truck/Bus
   (iii) Off-highway
2. Locomotive
3. Light Aircraft
4. Marine: (i) Outboard
   (ii) Inboard
   (iii) Ship
5. Power Generation: (i) Portable (Domestic)
   (ii) Fixed (Peak Power)
6. Agricultural: (i) Tractors
   (ii) Pump sets
7. Earthmoving: (i) Dumpers
   (ii) Tippers
   (iii) Mining Equipment
8. Home Use: (i) Lawnmowers
   (ii) Snow blowers
   (iii) Tools
9. Others

CLASSIFICATION OF INTERNAL COMBUSTION ENGINES

2. Basic Engine Design:

1. Reciprocating
   - (a) Single Cylinder
   - (b) Multi-cylinder
     - (I) In-line
     - (ii) V
     - (iii) Radial
     - (iv) Opposed Cylinder
     - (v) Opposed Piston
2. Rotary:
   - (a) Single Rotor
   - (b) Multi-rotor

Types of Reciprocating Engines



CLASSIFICATION OF INTERNAL COMBUSTION ENGINES

3. 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)

CLASSIFICATION OF INTERNAL COMBUSTION ENGINES

4. Working Cycle (Strokes)

1. Four Stroke Cycle: (a) Naturally Aspirated
   (b) Supercharged/Turbocharged
2. Two Stroke Cycle: (a) Crankcase Scavenged
   (b) Uniflow Scavenged
      (i) Inlet valve/Exhaust Port
      (ii) Inlet Port/Exhaust Valve
      (iii) Inlet and Exhaust Valve

      May be Naturally Aspirated
      Turbocharged

S.no	Turbocharger	Supercharger
1.	Turbocharger is a forced induction system that compresses the atmospheric gases and sends it to the engine cylinder.	Super charger is also a forced induction system. It compresses the atmospheric air and sends it to the engine cylinder.
2.	It uses exhaust gases for its energy.	It is connected to the crankshaft of the engine for its energy.
3.	It is not directly connected to the engine.	It is directly connected to the engine through belt.
4.	It has smog altering equipment which helps in lowering the carbon emission.	It doesn't have wastegate, so the smog emits from the supercharger.
5.	It spins with a speed upto 150000 rpm.	It spins with a speed upto 50000 rpm.
6.	It is much quieter than supercharger.	It is not so quieter.
7.	It is less reliable.	It is more reliable.
8.	Maintenance is not easy.	Maintenance is easy.
9.	Turbocharger delivers their boost better at high rpm.	Supercharger can deliver their boost at lower rpm.
10.	It is more efficient.	It is less efficient.
11.	The compressed air in turbocharger has high temperature.	The compressed air in supercharger has less temperature.
12.	It requires inter-cooler for the compressed air to lower its temperature.	It may or may not require inter-cooler. But in some types, it requires inter-cooler.
13.	It is more complex.	It is less complex.

CLASSIFICATION OF INTERNAL COMBUSTION ENGINES

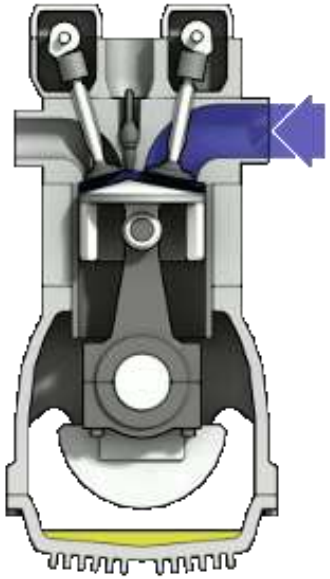
5. (a) Valve/Port Design

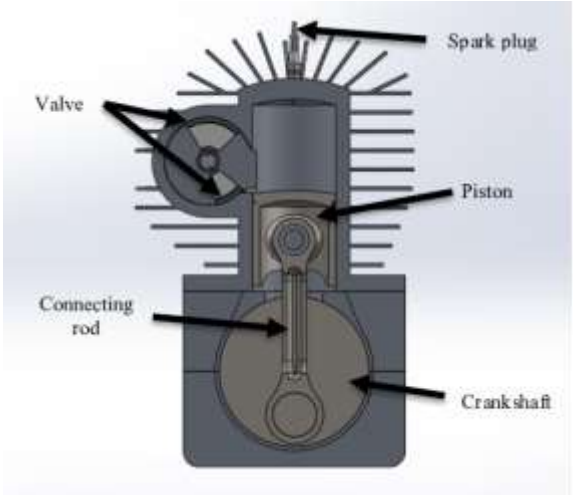
1. Poppet Valve
2. Rotary Valve
3. Reed Valve
4. Piston Controlled Porting

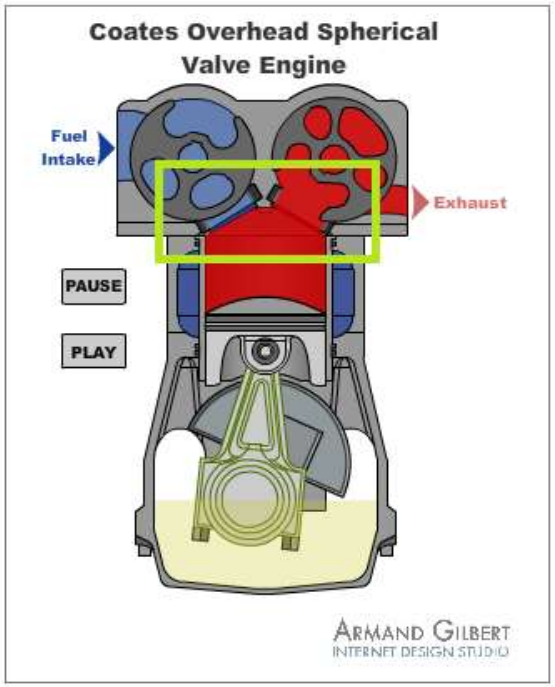
5. (b) Valve Location

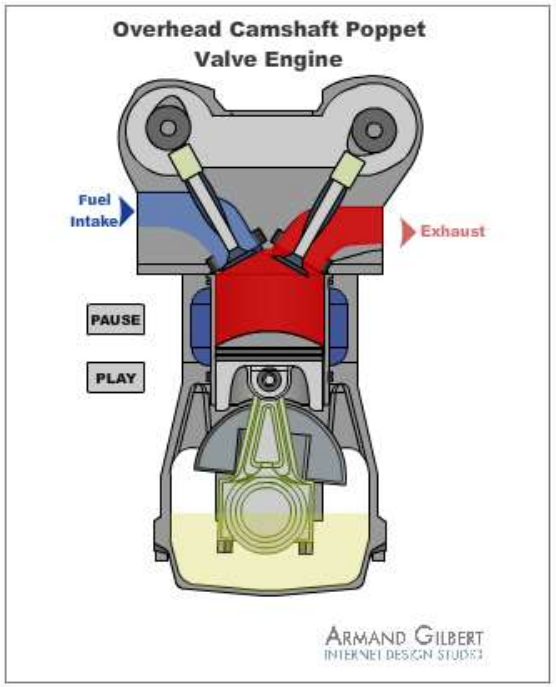
1. The T-head
2. The L-head
3. The F-head
4. The I-head: (i) Over head Valve (OHV)
   (ii) Over head Cam (OHC)

1

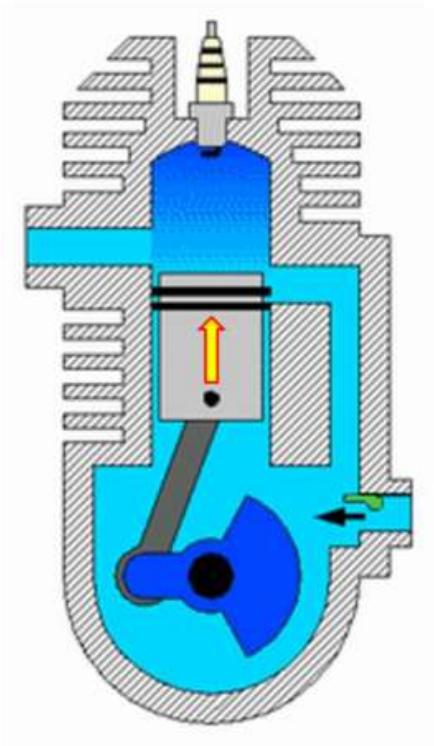


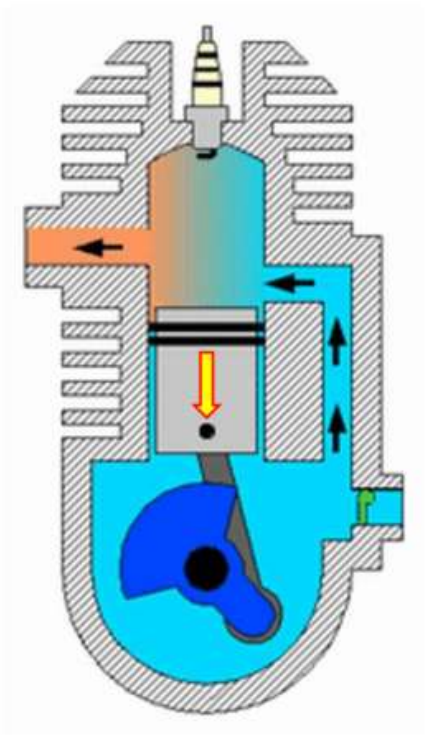

Spark plug
Valve
Piston
Connecting rod
Crankshaft

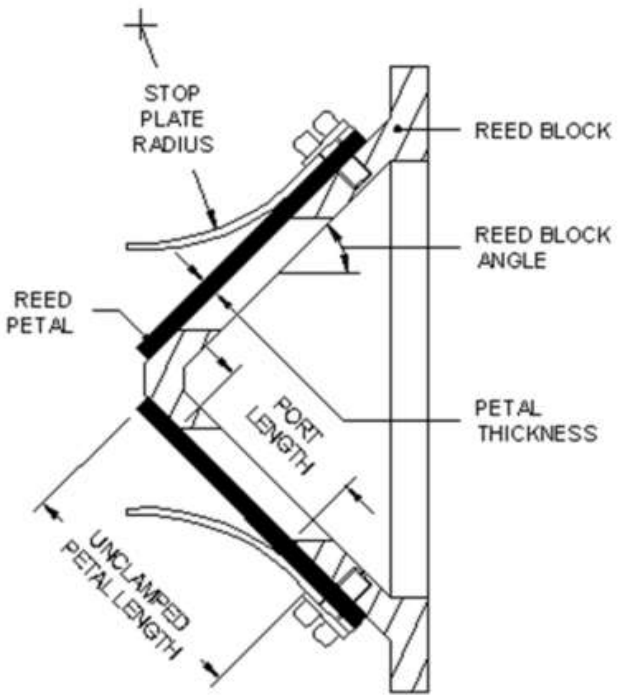

Coates Overhead Spherical Valve Engine
Fuel Intake
Exhaust
PAUSE
PLAY
ARMAND GILBERT
INTERNET DESIGN STUDIO


Overhead Camshaft Poppet Valve Engine
Fuel Intake
Exhaust
PAUSE
PLAY
ARMAND GILBERT
INTERNET DESIGN STUDIO


36mm
52mm
58mm






STOP
PLATE
RADIUS
REED BLOCK
REED BLOCK
ANGLE
REED
PETAL
PORT
LENGTH
PETAL
THICKNESS
UNCLAMPED
PETAL LENGTH

CLASSIFICATION OF INTERNAL COMBUSTION ENGINES

6. Fuel

1.Conventional: (a) Crude oil derived (i) Petrol
(ii) Diesel
(b) Other sources: (i) Coal
(ii) Wood (includes bio-mass)
(iii)Tar Sands
(iv)Shale

2. Alternate: (a) Petroleum derived (i) CNG
(Total Replacement) (ii) LPG
(b) Bio-mass Derived (i) Ethanol
(ii) Vegetable oils
(iii) Producer gas
(iv) Biogas
(iv) Hydrogen

Partial Replacement: 1. Blending
2. Dual fueling

CLASSIFICATION OF INTERNAL COMBUSTION ENGINES

7. Mixture Preparation

1. Carburetion – perhaps soon to be obsolete.
2. Fuel Injection (i) Diesel
   (ii) Gasoline

CLASSIFICATION OF INTERNAL COMBUSTION ENGINES

8. Ignition

1. Spark Ignition - homogeneous charge
   - (a) Conventional
     - (i) Battery
     - (ii) Magneto
   - (b) Other methods
2. Compression Ignition - heterogeneous charge (conventional)
3. Compression ignition - homogeneous charge (hcci)

CLASSIFICATION OF INTERNAL COMBUSTION ENGINES

9. Charge Stratification

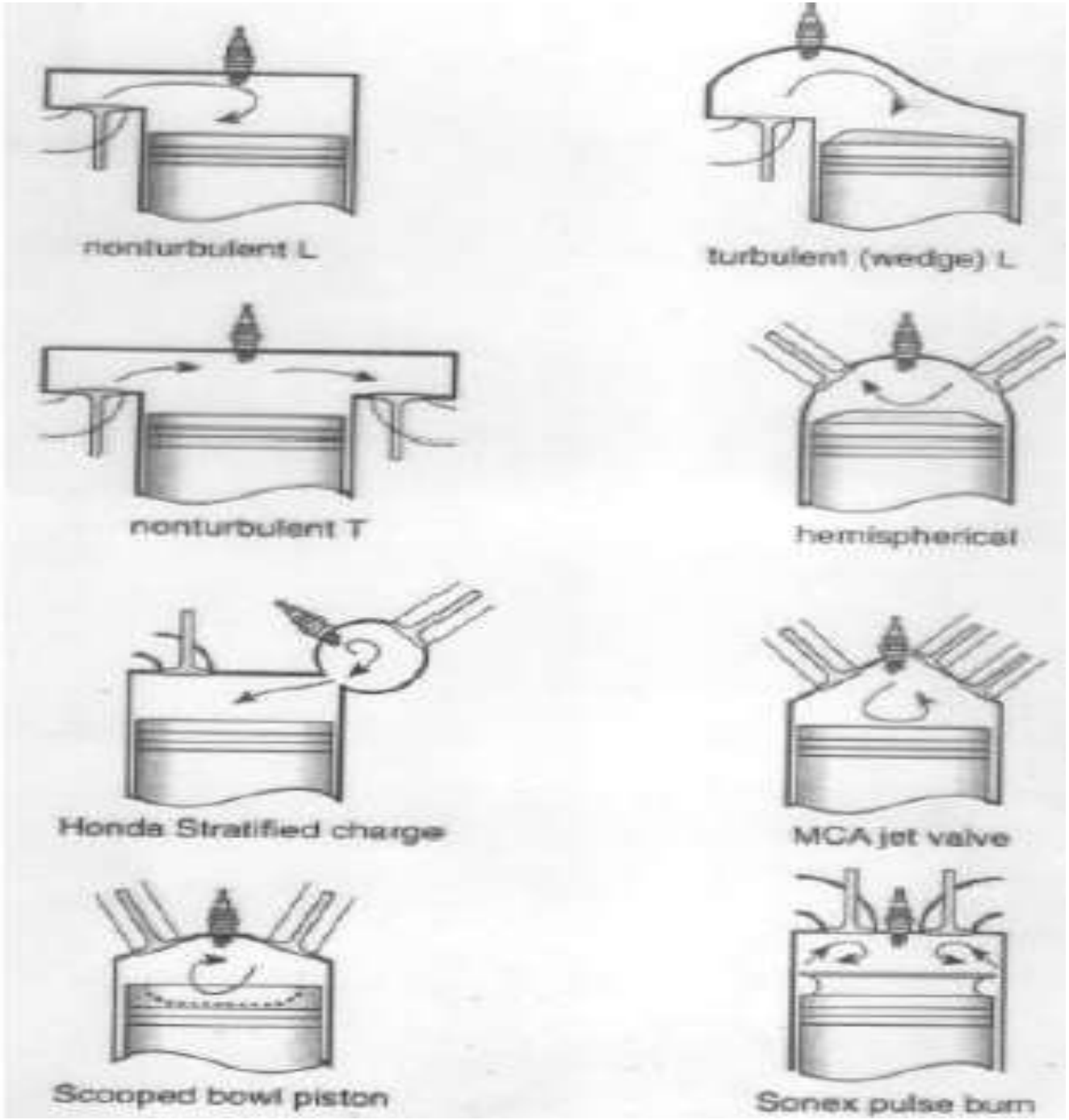
1. Homogeneous Charge (Also Pre-mixed charge)

2. Stratified Charge (i) With carburetion
   (ii) With fuel injection

CLASSIFICATION OF INTERNAL COMBUSTION ENGINES

10. Combustion Chamber Design

1. Open Chamber: (i) Disc type
   (ii) Wedge
   (iii) Hemispherical
   (iv) Bowl-in-piston
   (v) Other design
2. Divided Chamber: (For CI): (i) Swirl chamber
   (ii) Pre-chamber
   (For SI) (i) CVCC
   (ii) Other designs


nonturbulent L
turbulent (wedge) L
nonturbulent T
hemispherical
Honda Stratified charge
MCA jet valve
Scooped bowl piston
Sonex pulse burn

CLASSIFICATION OF INTERNAL COMBUSTION ENGINES

11. Method of Load Control

1. Throttling: (To keep mixture strength constant) Also called Charge Control

   Used in the Carbureted S.I. Engine

2. Fuel Control (To vary the mixture strength according to load)

   Used in the C.I. Engine

3. Combination

   Used in the Fuel-injected S.I. Engine.

CLASSIFICATION OF INTERNAL COMBUSTION ENGINES

12. Cooling

1. Direct Air-cooling
2. Indirect Air-cooling (Liquid Cooling)
3. Low Heat Rejection (Semi-adiabatic) engine.