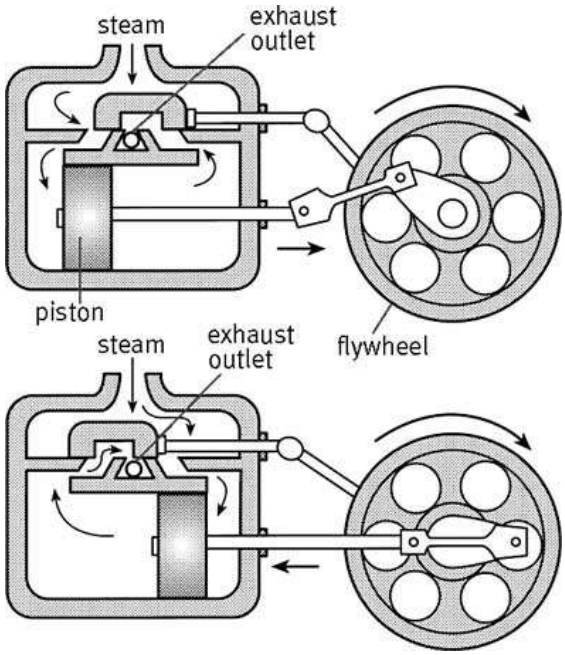
Introduction to Prime mover

Prime mover refers to a machine or device that converts energy from natural sources to mechanical energy. It is typically an engine or turbine.

Steam engines: An engine in which the energy of hot steam is converted into mechanical power, especially an engine in which the force of expanding steam is used to drive one or more pistons. The source of the steam is typically external to the part of the machine that converts the steam energy into mechanical energy.



A Steam engine is a machine for converting the heat energy of pressurized steam into mechanical energy, using steam as a medium, or working fluid. When water is converted into steam it expands, its volume increasing about 1,600 times. The force produced by the conversion is the basis of all steam engines.

The high pressure steam from boiler enters the engine cylinder through the passage uncovered by D-slide valve. Steam exerts pressure on the piston head which pushes it to move to the other end. The linear motion of piston rod is converted into rotary motion of the crank by means of a connecting rod. After reaching the piston to the other end of the cylinder, the passage close to that end opens by D-side valve and the high pressure steam rushes inside the cylinder. The motion to D-slide valve is obtained from the crankshaft by means a valve rod connected to the eccentric. Now steam acts on the other face of the piston to push it towards the other end of cylinder and meanwhile the steam available in the cylinder on the other side of piston is exhausted from the engine cylinder through an exhaust passage. As a result of the to and fro

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motion of piston, the power is made available at crank shaft of the engine that can be used to turn wheels of an automobile.

Steam turbines: Any apparatus which can convert heat energy into mechanical work is called a heat engine Thus; the steam turbine is just as much a heat engine as is a steam or internal combustion engine. The steam turbine is different, however in the manner in which it converts the heat energy into mechanical work.

Steam turbine is a rotary engine in which the kinetic energy of a moving fluid is converted into mechanical energy by causing a bladed rotor to rotate.

- A Turbine is a device which converts the heat energy of steam into the kinetic energy & then to rotational energy.
- The Motive Power in a steam turbine is obtained by the rate of change in momentum of a high velocity jet of steam impinging on a curved blade which is free to rotate.
- The basic cycle for the steam turbine power plant is the Rankine cycle. The modern Power plant uses the rankine cycle modified to include superheating, regenerative feed water heating & reheating.

a) Impulse turbine

- There is no pressure drop across moving blades. Steam energy is transferred to the rotor entirely by the steam jets striking the moving blades. Since there is no pressure drop, negligible thrust is produced.

b) Reaction turbine

- Steam expands in both the stationary & moving blades. Moving blades also act as nozzles. High axial thrust is produced.

c) Combination of Impulse & Reaction turbine

Difference between impulse and reaction turbine

Impulse turbine	**Reaction turbine**
-Pressure drops in nozzles and not in moving blade	-Pressure drops in fixed blade as well as in moving blades
-Constant blade channel area	-Varying blade channel area
-Profile type blades	-Aerofoil type blades
-Restricted round or incomplete admission of steam	-All round or complete admission of steam
-Nozzles impart kinetic energy ton steam Occupies less space for same power	-Fixed blades similar to moving blades casing serve as nozzles and guide the steam
-Higher efficiency in initial stage	-Higher efficiency in final stages.
-Suitable for small power requirements	-Suitable for medium or high power requirements.
-Blade manufacturing is not difficult	-Blade manufacturing process is difficult
-Velocity of steam is high	-Velocity of steam is less.

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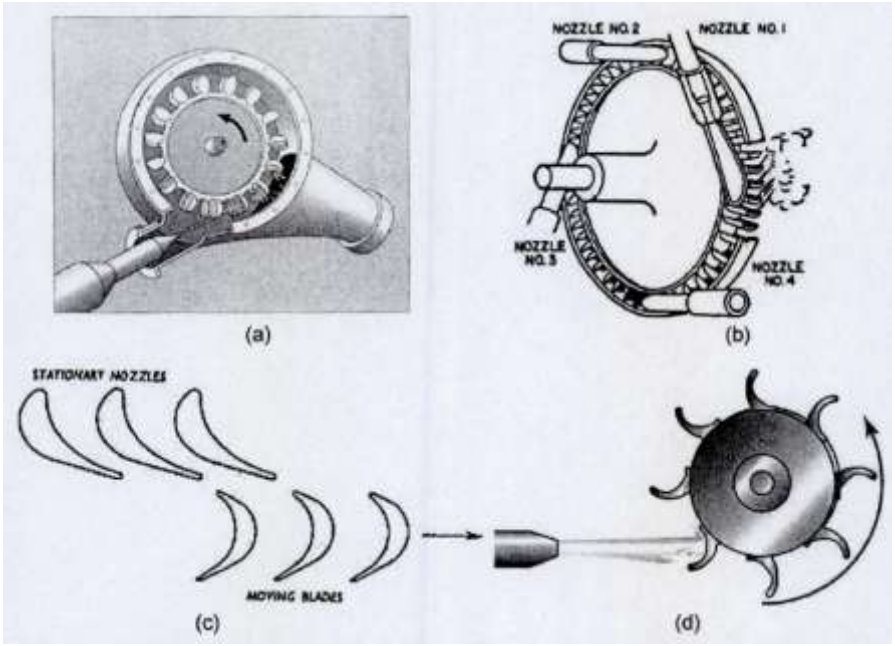
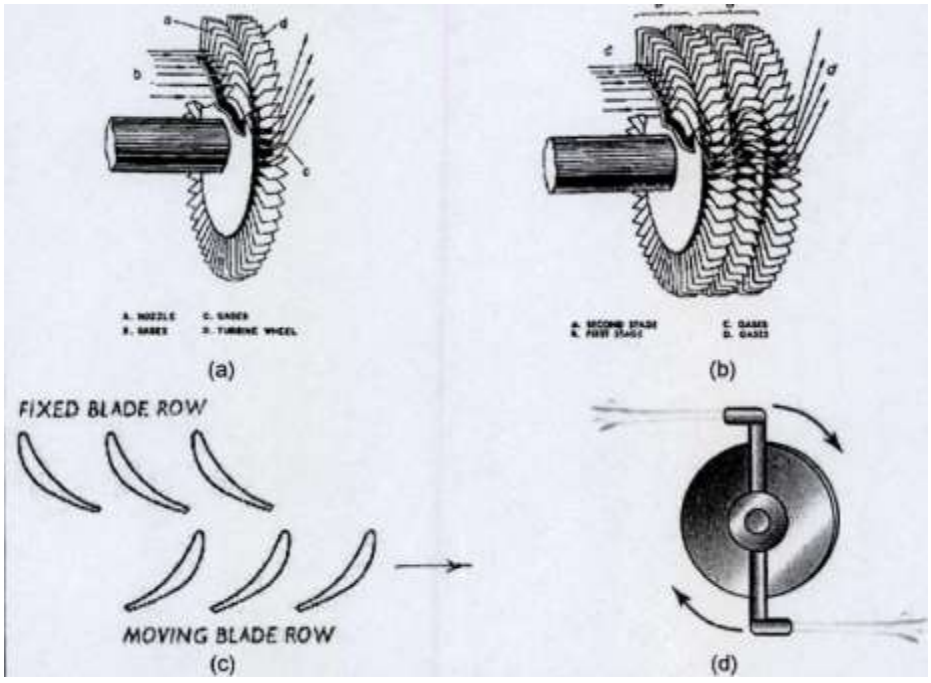


(a) Single-nozzle impulse turbine; (b) four-nozzle impulse turbine; (c) impulse nozzle blade configuration; (d) Pelton wheel



(a) Blades of a single-stage reaction turbine; (b) Blades of a two-stage reaction turbine; (c) reaction nozzle blade configuration; (d) Catherine wheel

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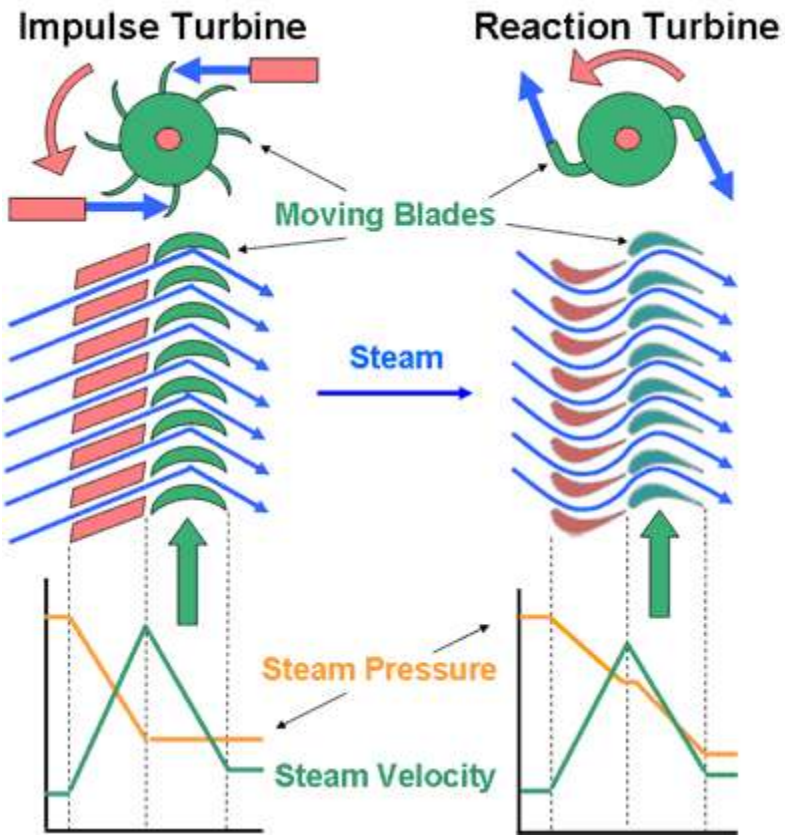

I. C. Engines: The internal combustion engine (ICE) is an engine in which the combustion of a fuel (normally a fossil fuel) occurs with an oxidizer (usually air) in a combustion chamber. In an internal combustion engine the expansion of the high-temperature and pressure gases produced by combustion applies direct force to some component of the engine, such as pistons, turbine blades, or a nozzle. This force moves the component over a distance, generating useful mechanical energy.

The operation of the four-stroke ICE consists of four basic steps that repeat with every two revolutions of the engine:

1. Suction: Combustible mixtures are emplaced in the combustion chamber

2. Compression: The mixtures are placed under pressure

3. Combustion (Power): The mixture is burnt, almost invariably a deflagration, although a few systems involve detonation. The hot mixture is expanded, pressing on and moving parts of the engine and performing useful work.

4. Exhaust: The cooled combustion products are exhausted into the atmosphere.

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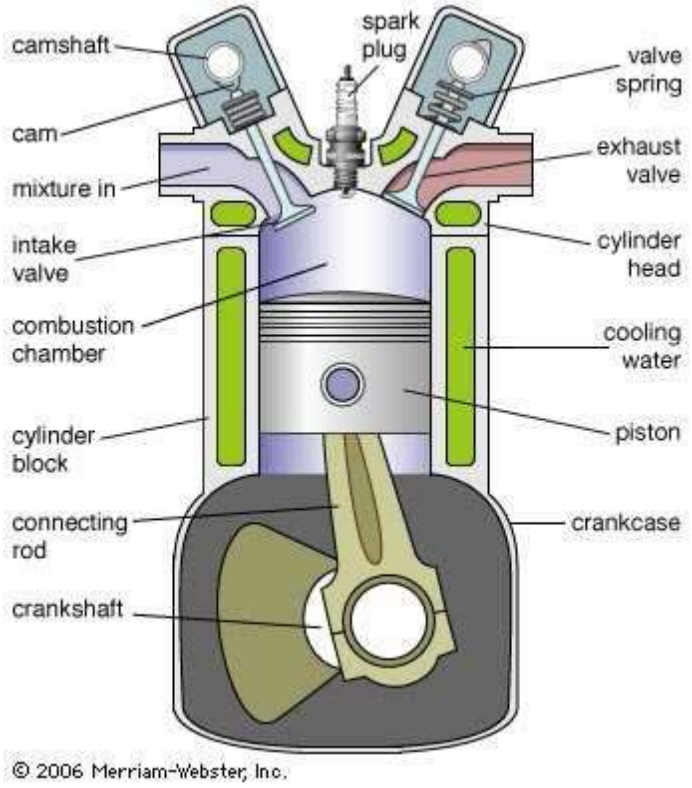

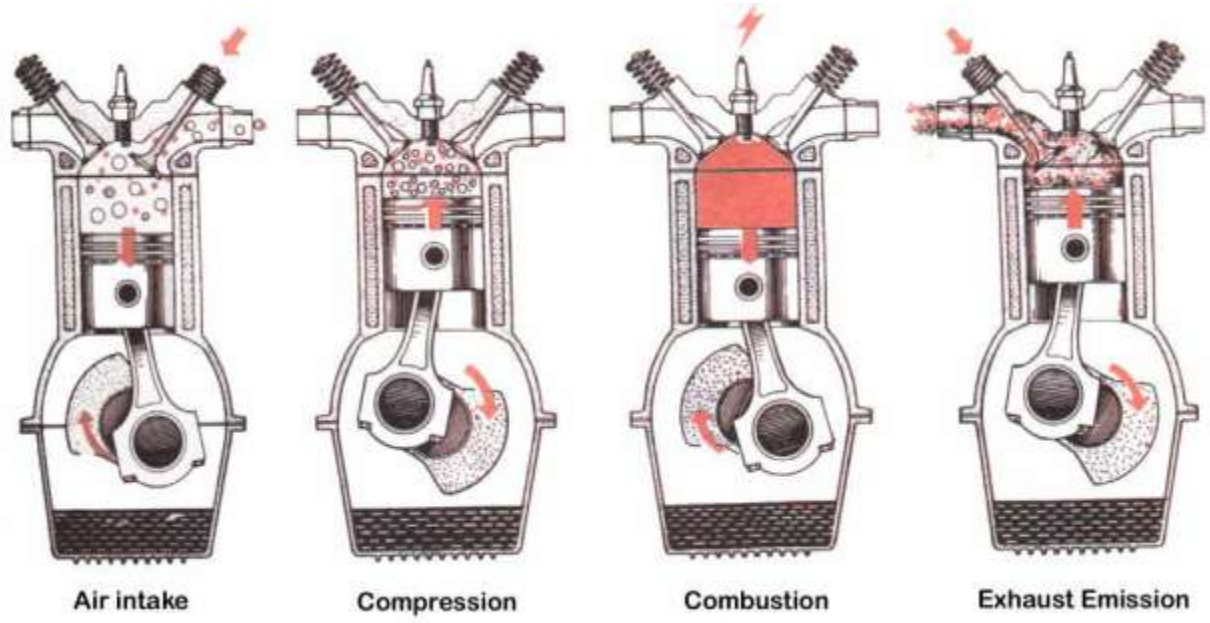

Gas turbines: A gas turbine, also called a combustion turbine, is a type of internal combustion engine. It has an upstream rotating compressor coupled to a downstream turbine, and a combustion chamber in-between.

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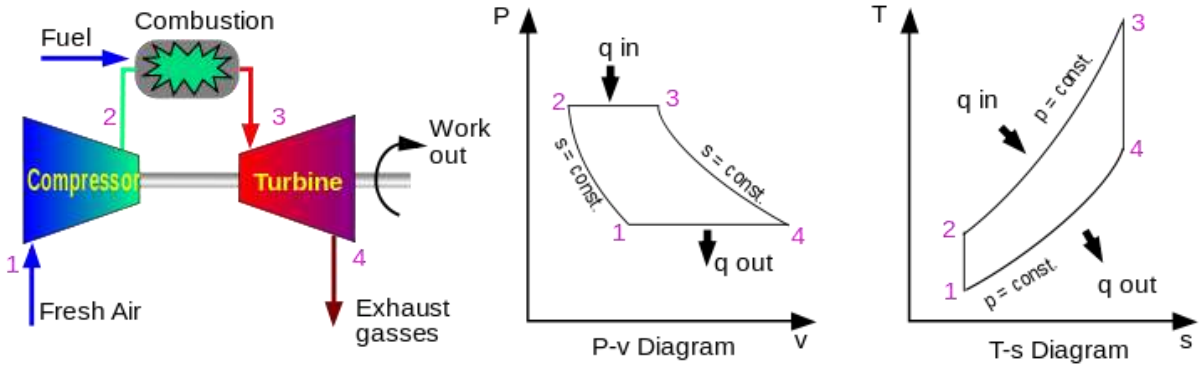
The basic operation of the gas turbine is similar to that of the steam power plant except that air is used instead of water. Fresh atmospheric air flows through a compressor that brings it to higher pressure. Energy is then added by spraying fuel into the air and igniting it so the combustion generates a high-temperature flow. This high-temperature high-pressure gas enters a turbine, where it expands down to the exhaust pressure, producing a shaft work output in the process. The turbine shaft work is used to drive the compressor and other devices such as an electric generator that may be coupled to the shaft. The energy that is not used for shaft work comes out in the exhaust gases, so these have either a high temperature or a high velocity. The purpose of the gas turbine determines the design so that the most desirable energy form is maximized. Gas turbines are used to power aircraft, trains, ships, electrical generators, or even tanks



Electric motors: An electric motor is an electric machine that converts electrical energy into mechanical energy.

In normal motoring mode, most electric motors operate through the interaction between an electric motor's magnetic field and winding currents to generate force within the motor. In certain applications, such as in the transportation industry with traction motors, electric motors can operate in both motoring and generating or braking modes to also produce electrical energy from mechanical energy.

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