GAS TURBINES

Gas turbines are used mainly for electric power generation and also in jet engines of aircrafts and in turbochargers of internal combustion (IC) engines.

It has limited application in marine engines. Gas turbines have the unique advantage of using any type of fuel, i.e. solid, liquid or gas.

Gas turbines operate either on an open cycle or in a closed cycle.

Working of an Open Cycle Single Stage Gas Turbine

A simple open cycle gas turbine is represented in Fig. 17.3(a).

It consists of a compressor, a combustion chamber and a turbine.

The compressor and turbine co by a common shaft with a suitable flange.

Air from the atmosphere is taken and compressed to a pressure ratio ranging from 2-8 before assing to the combustion chamber where the fuel is injected.

The fuel burns and the temperature is raised at constant pressure. Then, it passes to the turbine where it expands to its original pressure before being exhausted to atmosphere. Fig. 17.3 (b).

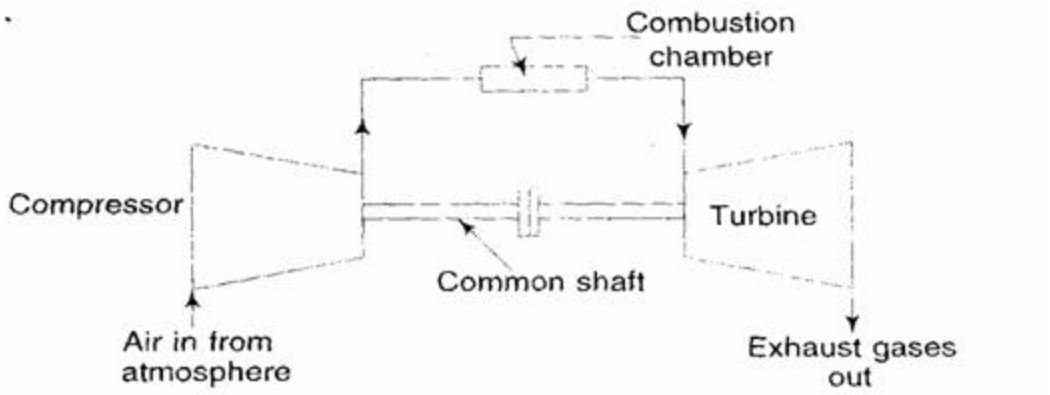
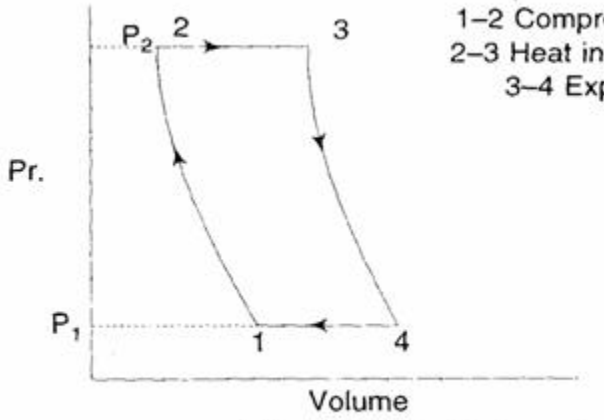


Fig. 17.3(a) *Simple gas turbine*



1–2 Compression in the compressor
2–3 Heat in the combustion chamber
3–4 Expansion in the turbine

Fig. 17.3 (b) *Joule cycle*

Advantages of Gas Turbines

1. Possibility to use any type of fuel.

2. Compact size, less weight and low space requirement.

3. Simple foundation and low installation cost.

4. Less requirement of lubrication oil, water, etc.

5. Vibration is less.

Disadvantages of Gas Turbines

1. High operating temperature in the combustion chamber and in the turbine. So we need special high temperature alloys.

2. Thermal efficiency is very low in the case of simple gas turbine due to high temperature of about 450° C in the waste exhaust gases.
and also for cooling.

Methods to Improve the Thermal Efficiency of a Single Stage Gas Turbine

1.By using a regenerator to heat the compressed air before entering the combustion chamber as in Fig. 17.4 thereby making use of the heat in the exhaust gases before leaving to the atmosphere.

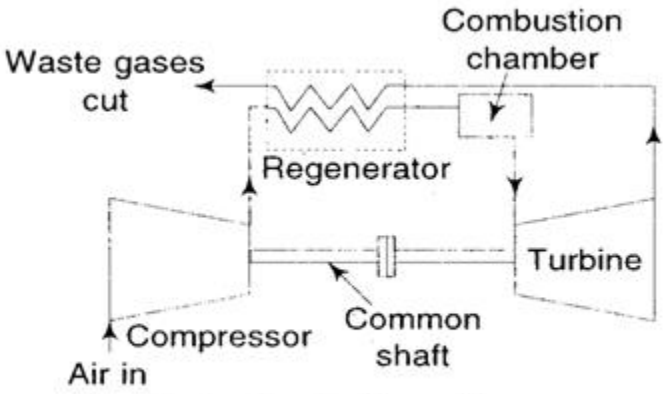


Fig. 17.4 *Gas turbine with regenerator*

2. By using a multistage compressor with intercooling to reduce the work of compression.

3. By using a multistage turbine to reduce the temperature of exhaust gases before leaving the turbine.

Closed Cycle Gas Turbine

The closed cycle plant can use some stable gas with a higher specific heat as the working medium.

Instead of burning the fuel directly in the air steam, an externally fired combustion chamber or furnace is used and heat is transferred to the working medium through a heat exchanger.

Intercooler is also provided to improve the overall efficiency of compressions.

As a multistage turbine is used, the temperature of exhaust gases leaving the turbine is considerably reduced resulting in a higher thermal efficiency.

The regenerator preheats the gas before entering the furnace. By these provisions, the thermal efficiency is further increased to about 30 per cent.

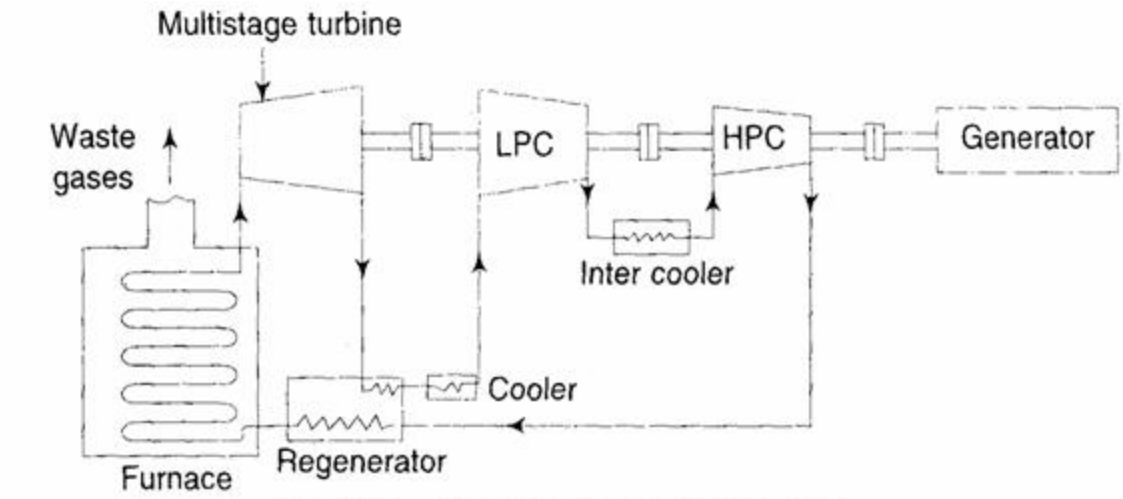


Fig. 17.5 *Closed cycle gas turbine plant*

The closed cycle has the following advantages:

1. Flexibility as to the type of fuel.

2. Uncontaminated working medium, and hence maintenance is easier.

3. Possibility of using a gas having better thermal properties as the working medium. By using an inert gas with high specific heat, the unit will become compact.

Source : http://mediatoget.blogspot.in/2011/10/gas-turbines.html