Gas turbine power plant

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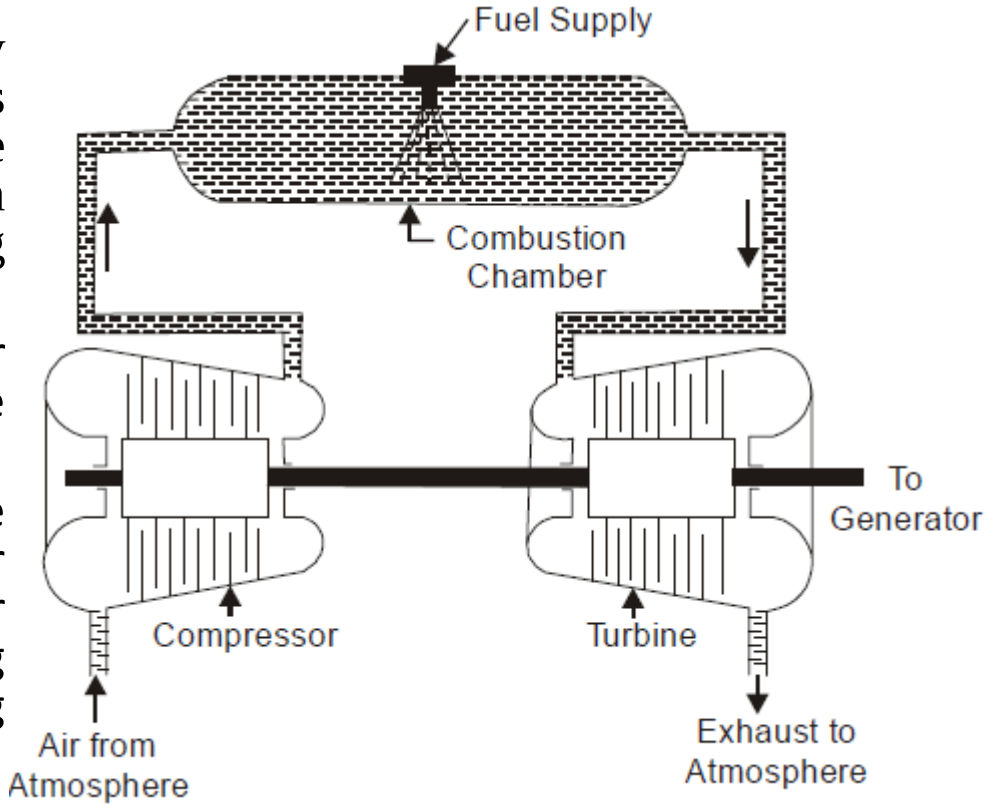
Gas turbine power plant

- The gas turbine obtains its power by utilizing the energy of burnt gases and air, which is at high temperature and pressure by expanding through the several ring of fixed and moving blades.
- The turbine drives the compressor and so it is coupled to the turbine shaft.
- To get a higher temperature of the working fluid a combustion chamber is required where combustion of air and fuel takes place giving temperature rise to the working fluid.
- So work is therefore the difference between the turbine work and work required by the compressor to drive it.
- **Fuels:** oil, natural gas, coal gas, and producer gas, blast furnace and pulverized coal.



APPLICATIONS OF GAS TURBINE

The Major field of application of gas turbines:

1. Aviation
2. Power generation
3. Oil and gas industry
4. Marine propulsion

For the purpose of power plant engineering find the following application s:

- To drive generators and supply peak loads in steam, diesel or hydro-plants.
- To work as a combination plants with conventional steam boilers.
- To supply mechanical drive for auxiliaries.

ADVANTAGES OF GAS TURBINE POWER PLANT

- It is smaller in size and weight as compared to an equivalent steam power plant. If size and weight are the main consideration such as in ships, aircraft engines and locomotives, gas turbines are more suitable.
- The initial cost and operating cost of the plant is lower than an equivalent steam power plant. A thermal plant of 250 mW capacity cost about Rs. 250 crores. Presently whereas a gas turbine plant of that same-size cost nearly 70 crores.
- The plant requires less water as compared to a condensing steam power plant.
- The plant can be started quickly, and can be put on load in a very short time.
- There are no standby losses in the gas turbine power plant whereas in steam power plant these losses occur because boiler is kept in operation even when the turbine is not supplying any load.
- The maintenance of the plant is easier and maintenance cost is low.
- The lubrication of the plant is easy. In this plant lubrication is needed mainly in compressor, turbine main bearing and bearings of auxiliary equipment.
- The plant does not require heavy foundations and building.
- There is great simplification of the plant over a steam plant due to the absence of boilers with their feed water evaporator and condensing system.

DISADVANTAGES

- Major part of the work developed in the turbine is used to derive the compressor. Therefore, network output of the plant is low.
- Since the temperature of the products of combustion becomes too high so service conditions become complicated even at moderate pressures.

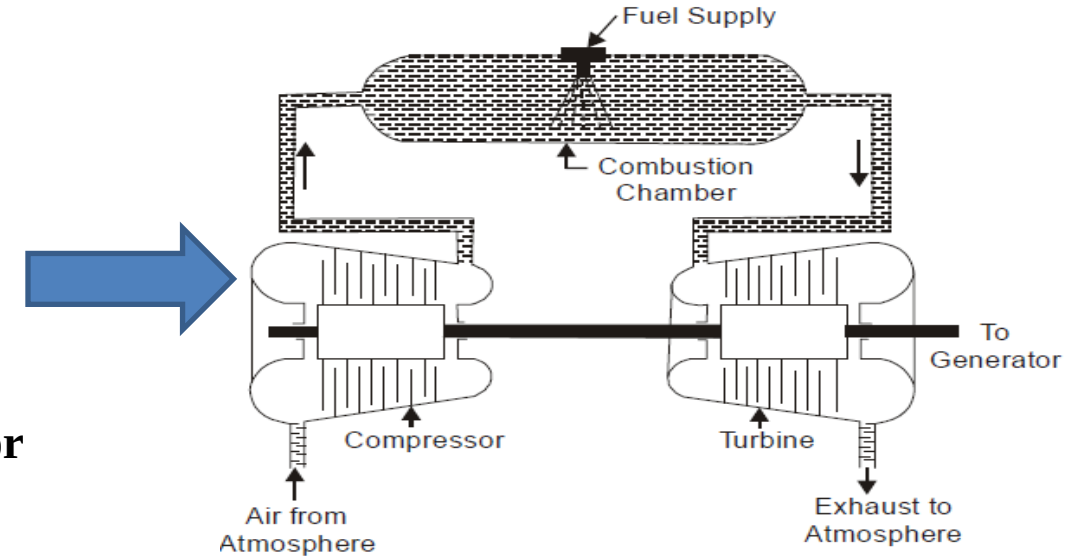
CLASSIFICATION OF GAS TURBINE POWER PLANT

The gas turbine power plants which are used in electric power industry are classified into two groups as per the cycle of operation.

(*a*) Open cycle gas turbine.

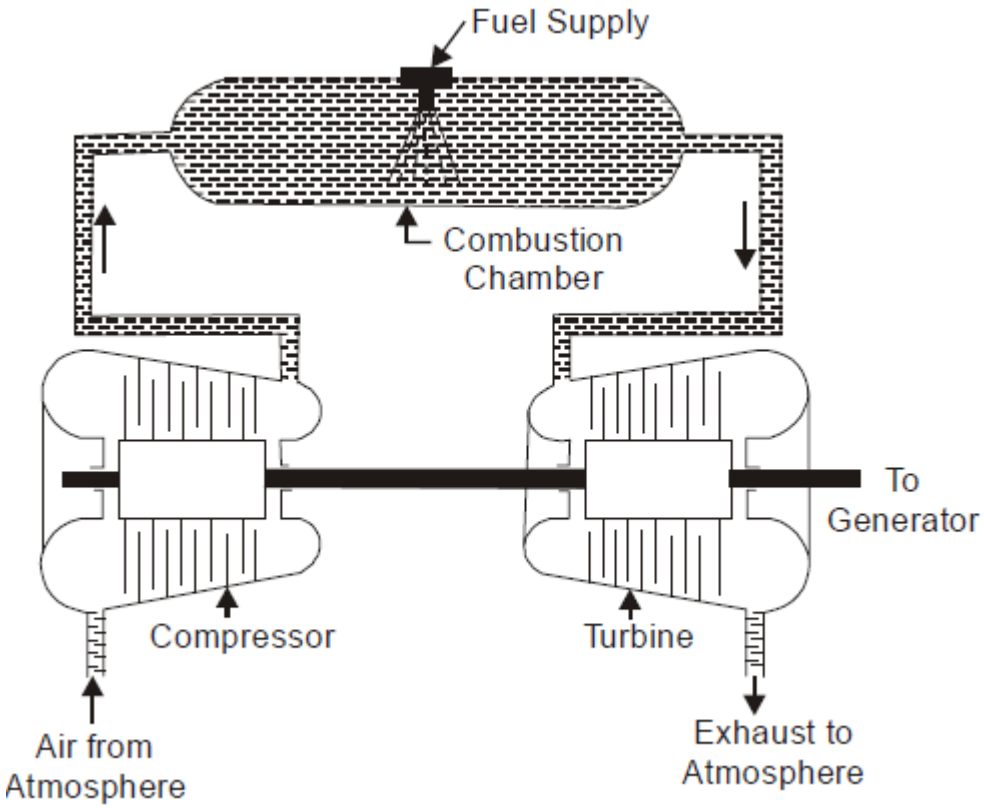
(*b*) Closed cycle gas turbine.

Open cycle gas turbine



Note: Refers the class notes for Efficiency calculations

Open cycle gas turbine



Elements of gas turbine power plants

The main component of a gas turbine power plant are (see the class notes or refers the books for details):

- Gas turbine
- Compressors
- Combustion Chamber or Combuster
- Auxiliaries

Combined cycle power plants

It has been found that a considerable amount of heat energy goes as a waste with the exhaust of the gas turbine. This energy must be utilized. The complete use of the energy available to a system is called the total energy approach. The objective of this approach is to use all of the heat energy in a power system at the different temperature levels at which it becomes available to produce work, or steam, or the heating of air or water, thereby rejecting a minimum of energy waste. The best approach is the use of combined cycles.

- Combined gas turbine and steam turbine

- Heating feed water to exhaust gas
- Employing the gases from a supercharged boiler to expand in the gas turbine
- Employing gases as combustion air in the steam boiler

- Combined gas turbine and diesel power plant

- Turbo-charging
- Gas-generator
- Compound Engine

- Fig. shows a combination of an open cycle gas turbine and steam turbine. The exhaust of gas turbine which has high oxygen content is used as the inlet gas to the steam generator where the combustion of additional fuel takes place. For a given total power output the energy input is reduced (*i.e.*, saving in fuel) and the installed cost of gas turbine per unit of power output is about one-fourth of that of steam turbine. In other words, the combination cycles exhibit higher efficiency.

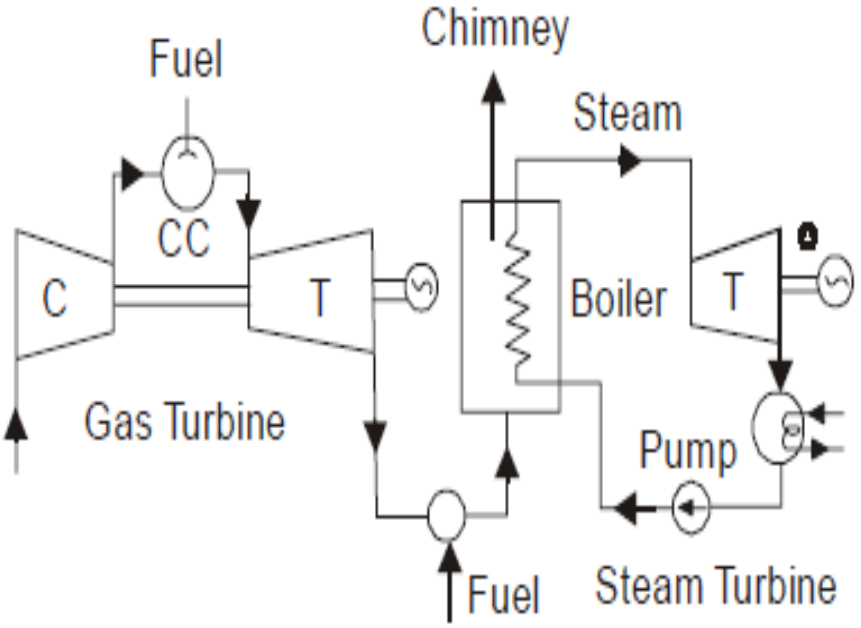


Fig. Combined Cycle (Co-generation)

Site selection of gas turbine power plant

While selecting the site for a gas turbine power plant, following points should be given due consideration:

1. The plant should be located near the load centre to avoid transmission costs and losses.
2. The site should be away from business centre due to noisy operations.
3. Cheap and good quality fuel should be easily available.
4. Availability of labour.
5. Availability of means of transportation