Gas turbine definition

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Our editors will review what you"ve submitted and determine whether to revise the article.

A gas turbine is a rotary machine in which the chemical energy of the fuel is converted into mechanical energy or kinetic energy in terms of shaft power. In other words, it is a mechanical power or thrust-delivering machine. It uses a gaseous working fluid for this purpose. The generated mechanical power can be used by industrial devices. There is a continuous flow of the working fluid in a gas turbine. Power generation gas turbines are the ones that produce shaft power. To propel an aircraft, gas turbines are used that convert fuel energy into kinetic energy for the generation of thrust. Fig. 1 below shows a typical representation of a Gas turbine.

Let"s understand the basic operating principle of a gas turbine with the following example:

Imagine there is a rocket in which fuel is going to burn thereby creating high-pressure exhaust gas. According to energy conservation law, in high-pressure exhaust gas, the chemical energy of the fuel is converted into mechanical energy. The thrust of the exhaust gas tries to move the rocket forward when the rocket is fired. Now the question is if one fixes the rocket body with a mechanical structure in order to prevent its movement. What will happen?

In such a case, the high-pressure exhaust gas releases but in a backward direction. Now another case is that what if we add a set of turbine blades to this back-fired exhaust gas?

The released mechanical energy which is in the linear backward direction will transform into rotational movement of the turbine shaft which is a big success. This means the chemical energy of the fuel gas is transformed into rotational mechanical energy of the turbine shaft as shown in Fig. 3.

In simple words, in a gas turbine, hot gases move through a multistage gas turbine. It has both stationary and moving blades just like a steam turbine. The stationary blades adjust their velocity and guide the moving gases to the rotor blades. The turbine"s shaft is coupled to a generator.

In a gas turbine power plant, there is a generator known as an electrical machine and this generator needs a prime mover which is a gas turbine in order to generate electricity as shown in Fig. 4.

It transforms the fuel"s chemical energy into mechanical energy or in other words converting natural gas into mechanical energy. The generated mechanical energy is then transferred to the generator"s shaft through a gearbox. Now the turbine can create electrical energy as shown in Fig. 5.

This prime form of electrical energy usually has a low or medium level of voltage. In order to manage power loss in transmission lines, step-up transformers are used to increase this voltage and the increased voltage is provided to the electrical energy which in turn is transmitted through the transmission lines and delivered to the grid as shown in the below Fig. 6.

With the combustion chamber between the air compressor and turbine, both the air compressor and turbine are mounted on either end on a common shaft. Gas turbines require a starting motor as they are not self-starting. The use of an air compressor is to suck the air and compress it thereby increasing its pressure. Axial design type compressors (multi-stage) are preferred for the most advanced and large gas turbines.