DEPARTMENT OF AEROSPACE ENGINEERING

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UNIT III - FUNDAMENTALS OF GAS TURBINE ENGINES

Introduction to Gas Turbine Working Principles and Cycle

Gas Turbine

A gas turbine, also called a combustion turbine, is an internal combustion engine. It has an upstream rotating compressor coupled to a downstream turbine and a combustion chamber.

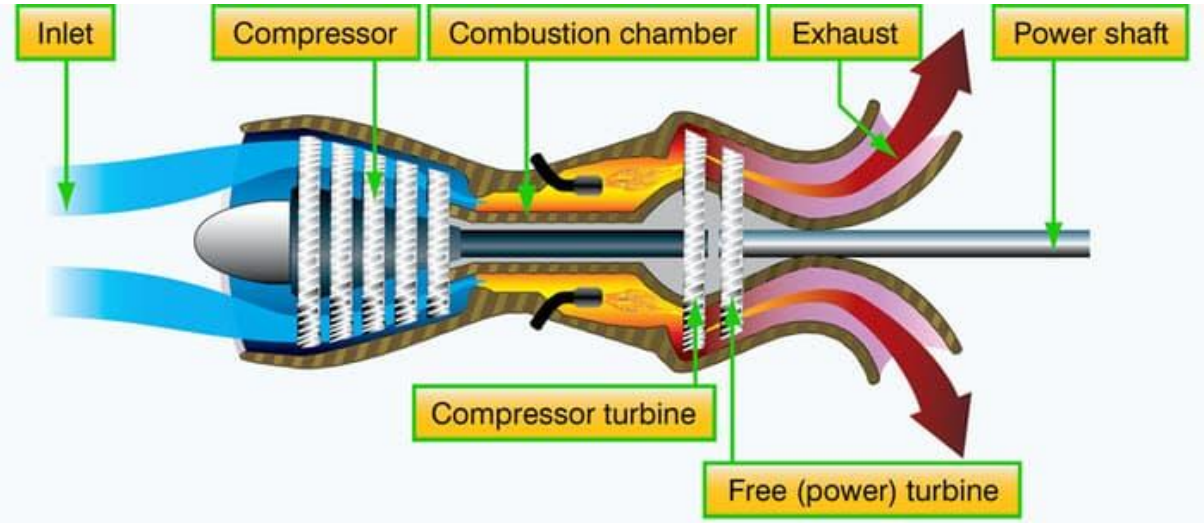
1. The **compressor**, which draws air into the engine, pressurizes it and feeds it to the combustion chamber at speeds of hundreds of miles per hour.
2. The **combustion chamber**, is typically made up of a ring of fuel injectors that inject a steady stream of fuel into combustion chambers where it mixes with the air. The mixture is burned at temperatures of more than 2000 degrees F. The combustion produces a high-temperature, high-pressure gas stream that enters and expands through the turbine section.
3. The **turbine** is an intricate array of alternate stationary and rotating aerofoil-section blades. As hot combustion gas expands through the turbine, it spins the rotating blades. The rotating blades perform a dual function: they drive the compressor to draw more pressurized air into the combustion section, and they spin a generator to produce electricity.

Operating Principles:

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.



Thermodynamic Processes of Gas Turbine Engine:

Gases passing through an ideal gas turbine undergo three thermodynamic processes. They are,

1. Isentropic compression
2. Isobaric (constant pressure) combustion
3. Isentropic expansion

Together, these make up the **Brayton cycle**.

In a practical gas turbine, gases are first accelerated in either a centrifugal or axial compressor. These gases are then slowed using a diverging nozzle known as a diffuser; these processes increase the pressure and temperature of the flow. In an ideal system, this is isentropic. Gases then pass from the diffuser to a combustion chamber, or similar device, where heat is added. In an ideal system, this occurs at constant pressure (isobaric heat addition).

As there is no change in pressure the specific volume of the gases increases. Finally, this larger volume of gases is expanded and accelerated by nozzle guide vanes before energy is extracted

by a turbine. In an ideal system, these gases are expanded isentropically and leave the turbine at their original pressure.