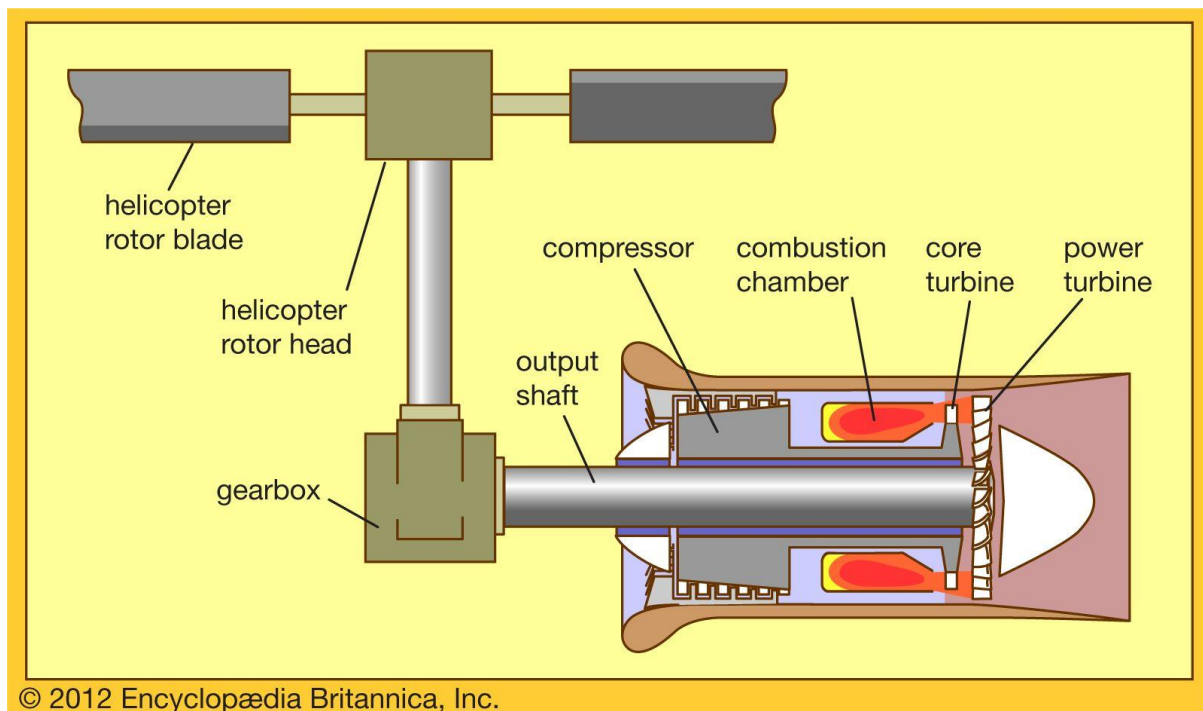




Subject Code & Name: **23AST101 Fundamentals of Aerospace Engineering**

Topic: Turbo shaft

A turboshaft engine is a type of gas turbine engine that is optimized to produce shaft power rather than thrust. While similar in many respects to a turboprop engine, a turboshaft engine is primarily used to drive a rotor system rather than a propeller. This makes it the preferred choice for helicopters, marine applications, and industrial power generation.



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Components of a Turboshaft Engine

1. Air Intake:
 - Function: Directs air into the engine.
 - Component: Ducts and inlets designed to maximize airflow efficiency.
2. Compressor:
 - Function: Compresses incoming air to a higher pressure.
 - Component: Multiple stages of rotating blades (axial or centrifugal compressors).
3. Combustion Chamber:
 - Function: Mixes compressed air with fuel and ignites the mixture to produce high-temperature, high-pressure gas.

- Component: Fuel injectors, ignition system, and combustion liner.
4. Turbine:
 - Function: Extracts energy from the high-pressure gas produced in the combustion chamber.
 - Component:
 - Gas Generator Turbine: Drives the compressor.
 - Free Power Turbine: Drives the output shaft.
 5. Reduction Gearbox:
 - Function: Reduces the high rotational speed of the turbine to a speed suitable for driving the rotor system or other machinery.
 - Component: Gears designed to achieve the necessary reduction ratio.
 6. Exhaust:
 - Function: Expels the remaining gases after energy extraction by the turbine.
 - Component: Exhaust duct and nozzle.

Operation of a Turboshaft Engine

1. Air Intake:
 - Air enters the engine through the intake and is directed towards the compressor.
2. Compression:
 - The compressor stages progressively compress the air, increasing its pressure and temperature.
3. Combustion:
 - Compressed air is mixed with fuel in the combustion chamber and ignited. The resulting high-pressure, high-temperature gases expand rapidly.
4. Energy Extraction:
 - The expanding gases pass through the gas generator turbine, which extracts energy to drive the compressor. The remaining energy is used to drive the free power turbine.
5. Power Transmission:
 - The free power turbine drives the output shaft, which can be connected to a helicopter rotor system, a marine propeller shaft, or industrial machinery.
6. Exhaust:

- The remaining gases are expelled through the exhaust, typically providing little to no additional thrust.

Advantages of Turboshaft Engines

1. High Power-to-Weight Ratio:
 - Provides significant power output relative to its weight, making it ideal for applications where weight is critical, such as helicopters.
2. Compact Design:
 - Turboshaft engines are typically smaller and more compact than equivalent piston engines, allowing for more flexible design and installation options.
3. Smooth Power Delivery:
 - The continuous rotation of the turbine provides smooth and consistent power output, which is essential for applications like helicopter rotor systems.
4. Fuel Efficiency:
 - Generally more fuel-efficient than piston engines, especially at higher power settings.
5. Reliability:
 - Turboshaft engines have fewer moving parts compared to piston engines, resulting in higher reliability and lower maintenance requirements.

Applications of Turboshaft Engines

- Helicopters: Most helicopters, including military (e.g., AH-64 Apache) and civilian (e.g., Bell 206) models, use turboshaft engines due to their high power-to-weight ratio and reliability.
- Marine: Used in naval vessels and commercial ships where compact, reliable power is needed for propulsion and auxiliary systems.
- Industrial Power Generation: Employed in power plants and industrial settings where continuous, high-power output is required.
- Auxiliary Power Units (APUs): Used in aircraft to provide power for electrical systems, air conditioning, and engine starting.

Summary

Turboshaft engines are versatile and efficient power plants optimized for producing shaft power. They are crucial in applications where reliability, compact design, and a high power-to-weight ratio are essential, such as in helicopters and various industrial

uses. Their design allows them to convert the energy from combustion efficiently into mechanical power, driving rotor systems and other machinery with high effectiveness.