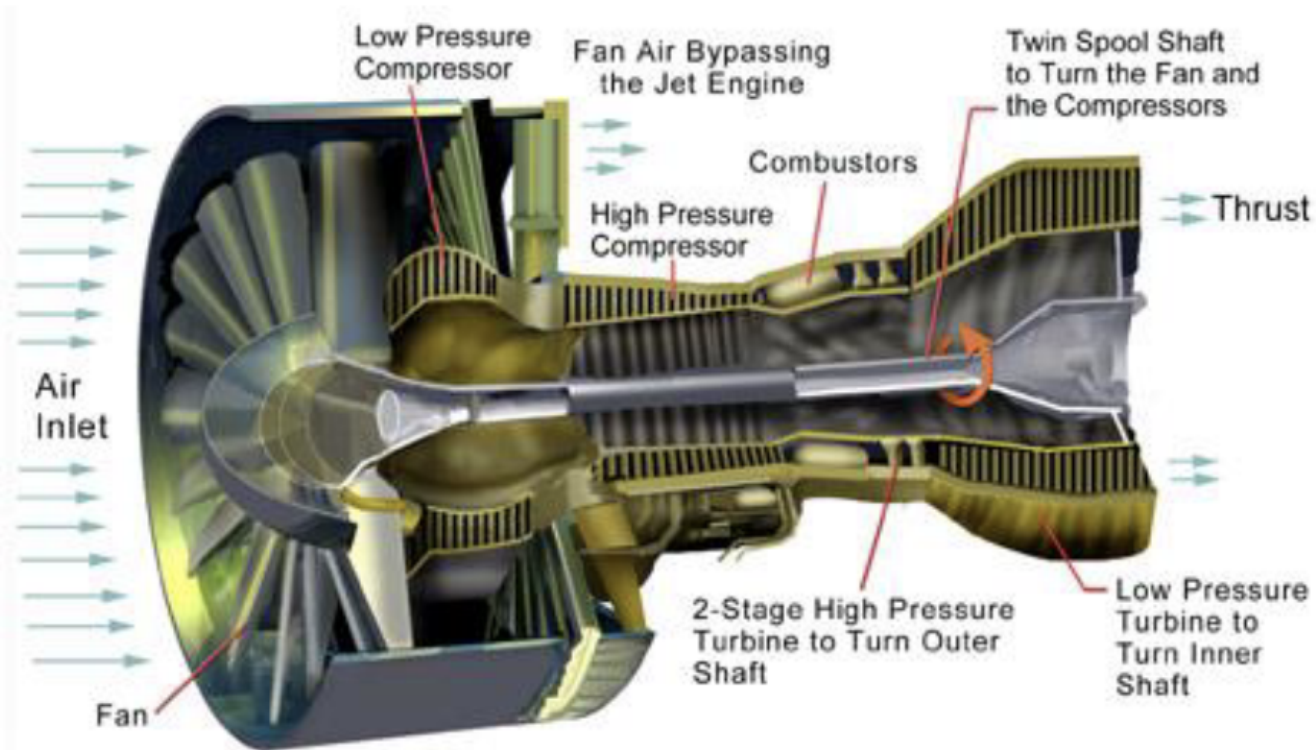


4: Turbines and Compressors

4.1: Turbines



- **Turbines** are devices that drive an electric generator, and can be found in steam, gas, or hydroelectric (by water) power plants.
- As the fluids passes through the turbine, work is done against the blades, which are attached to the shaft.
- The shaft rotates, and the turbine produces work.

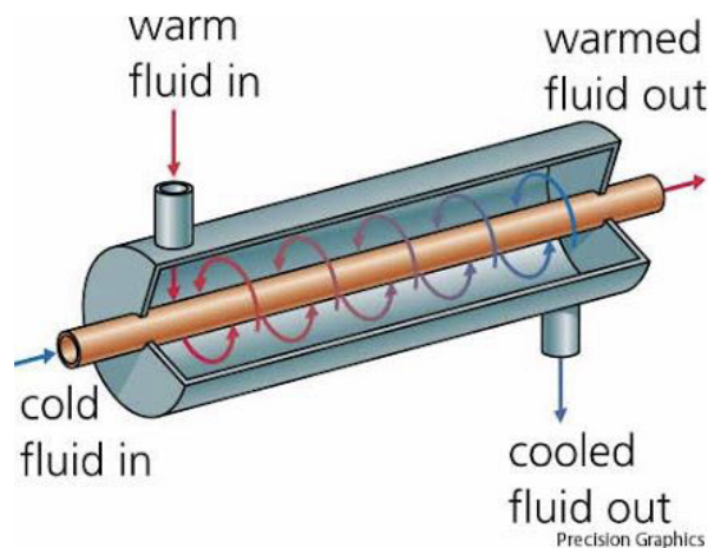
4.2: Compressors

- **Compressors**, as well as pumps and fans, are devices used to increase the pressure of a fluid.
- Work is supplied to these devices from an external source through a rotating shaft.
- Therefore, compressors involve work input.

4.3: Characteristic

- Fans increase the pressure of a gas slightly and is mainly used to mobilize a gas.
- Compressors are capable of compressing the gas to very high pressures.
- Pumps work very much like compressors except that they handle liquids instead of gases.
- Note that **turbines produce power and others require power input.**
- Heat transfer from turbines and compressors is usually negligible ($\dot{Q} = 0$) since they are typically well insulated.
- Potential energy change are negligible ($\Delta PE = 0$).
- Velocities are usually too low to cause any significant change in the kinetic energy. ($\Delta KE = 0$)
 - Noted that for turbines and fans, the velocities encountered can be high, but the change is usually small so that can be disregarded.

5: Heat Exchangers



- Heat exchangers are devices where two moving fluids streams exchange heat without mixing.
- Heat exchangers are widely used in various industries.
- Heat Exchangers typically involve no work interactions ($W_{ext} = 0$) and negligible kinetic and potential energy changes ($\Delta KE = 0$ and $\Delta PE = 0$)
- Heat leakage is usually neglected.
- Only happens in the two streams inside the heat exchanger.