Some Steady Flow Engineering Devices

Nozzles and Diffusers

Nozzles and diffusers are commonly utilizedin jet engines, rockets, spacecraft etc. A nozzle is a device that increase the velocity of a fluid at the expense of pressure. A diffuser is a device that increase the pressure of a fluid by slowing it down.

The relative importance of terms appearing in the energy equation for nozzles and diffusers is as follows;

Q : The rate of heat transfer between the fluid flowing through a nozzle or a diffuser and the surroundings is usually very small, even when these device are not insulated. So, we assume heat transfer term is equal to zero these type of devices.

W : The work term is zero sfor these devices because these device not involved an shafts or electric resistance etc.

Δ ke : These types of machines involves high velocity differences and for this reason we must take account kinetic energy changes.

Δ pe: In nozzles and diffusers workinng fluid has experienced little or no elevation change and we omit potential energy change.

Turbines and Compressors

In power plants, the device that drives the electric generator is the turbine. The devices which is increase the pressure of a fluid is called a compressor.

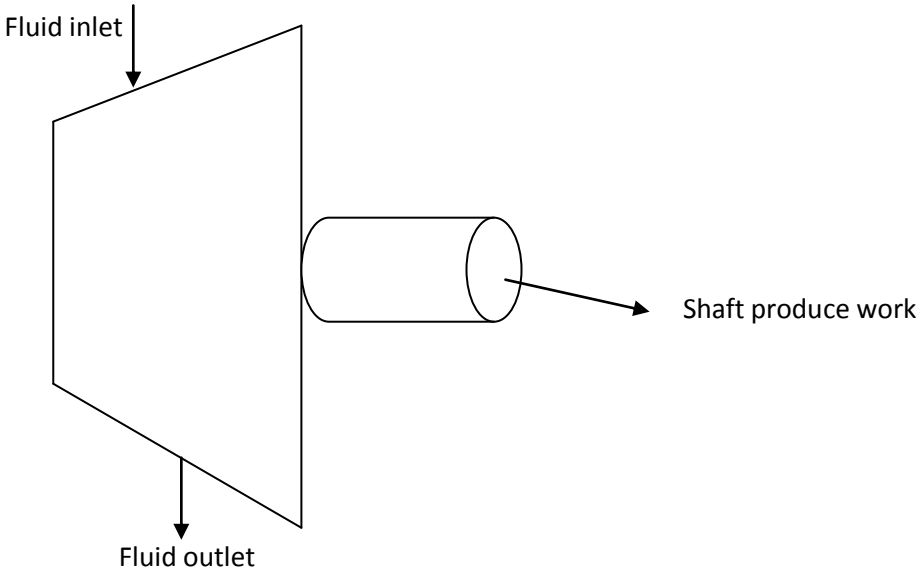

Fig. 1 Schematic representation of Turbine

For these devices the relative magnitudes of the various terms appearing in the energy equation are as follows;

Q : The rate of heat transfer of these devices relatively small to the shaft work. So generally we assume heat transfer of turbines and compressors is equal to zero.

W : These devices main purpose is produce work or required work to increase fluid pressure. So, we cannot ignore work term these type of machines.

Δ ke : Generally velociti changes of these devices are so small and ignored.

Δ pe: The elevation diffrences of working fluid is so small and ignored.

Throttling Valves

Throttling valves are flow restricting devices such as valves, capillary tubes etc. that cause a significant pressure drop in the fluid. Throttling valves produce pressure drop without any work involves.

For these devices various terms appearing in the energy equation are as follows;

Q : Throttling valves are small devices and flow through them assumed adiabatic. As a result heat transfer of throttling valves are equal to zero.

W : Throttling valves are not contain any shaft or electrical resistance etc. and work transfer is equal to zero

Δ ke : Change of kinetic energy in throttling valves are so small and ignored.

Δ pe : Change of elevation in throttling valves so small and ignored.

Pipe and Duct Flow

Flow through a pipe or a duct usually satisfies the steady flow conditions and thus can be analyzed as a steady flow process.

For these devices various terms appearing in the energy equation are as follows;

Q : Heat transfer is depend on the condition of pipes. If pipes are not insulated in this case we must take account heat transfer term but if pipe in well insulated at this time we cannot talk about any heat transfer.

W : If the control volume includes fan, electrical wire etc. work interactions involves in control volume but if control volume noot contain any devices at this time work transfer is equal to zero.

Δ ke : The velocity changes in pipes are so small and kinetic energy changes ignored.

Δ pe : Potential energy change is depend on the installation conditions of pipes. If elevation changes so high in control volume of pipe we must take account potential energy change of system otherwise we ignored it.