

REACTION TURBINE

Reaction turbines are a type of turbine that develops torque by reacting to the gas or fluid's pressure or mass. The operation of reaction turbines is described by Newton's third law of motion (action and reaction are equal and opposite).

In a reaction turbine, the water enters the wheel under pressure and flows over the vanes. As the water, flowing over the vanes, is under pressure, therefore wheel of the turbine runs full and may be submerged below the tailrace or may discharge into the atmosphere.

Parts of Reaction Turbine

1. Spiral casing
2. Guide mechanism
3. Turbine runner
4. Draft tube

1. Spiral Casing

The water, from a pipeline, is distributed around the guides ring in a casing. **This casing is designed** in such a way that its cross-sectional area goes on reducing uniformly around the circumference.

The cross-sectional area is maximum at the entrance and the minimum at the tip as shown in Fig. As a result of this, the casing will be of the spiral casing or scroll casing.

2. Guide Mechanism

The guide vanes are fixed between two rings in the form of a wheel. This wheel is fixed in the spiral casing. **The guide vanes are properly designed in order to:**

1. To allow the water to enter the runner without shock.
2. Allow the water to flow over them, without forming eddies.
3. Allow the required quantity of [water to enter the turbine](#). (this is done by adjusting the opening of the vanes).

All the guide vanes can rotate about their respective pivots, which are connected to the regulating ring by some mechanical means. The regulating ring is connected to the regulating shaft by means of two regulating rods.

The guide vanes may be closed or opened by rotating the regulating shaft, Thus allowing the required quantity of water to flow according to the need. The

regulating shaft is operated by means of a governor, whose function is to govern the turbine (i.e., to keep the speed constant at varying loads). The guide vanes are generally made of cast steel.

3. Turbine Runner

The runner of a reaction turbine consists of runner blades fixed either to a shaft or rings, depending upon the type of turbine. The blades are properly designed, in order to allow the water to enter and leave the runner without shock.

The runner is keyed to a shaft, which may be vertical or horizontal. If the shaft is vertical, it is called a vertical turbine. Similarly, if the shaft is horizontal, **it is called a horizontal turbine.**

The surface of the runner is made very smooth. The runner may be cast in one piece it may be made of separate steel plates and welded together. For low heads, the runner may be cast iron. But for high heads, the runner is made of steel or alloys. when the water is chemically impure, the runner is made of special alloy.

4. Draft Tube

The water, after passing through the runner, flows down through a tube called draft tube. it is, generally, drowned approximately 1 m below the tailrace level. **A draft tube has the following functions:**

Types of Reaction Turbine

The reaction turbines may be classified into the following three types, depending upon the direction of flow of water through the wheel.

Types of Reaction Turbine are:

1. Radial flow turbines.
2. Axial flow turbines.
3. Mixed flow turbines.

1. Radial Flow Turbines

In such turbines, the flow of water is radial (i.e., along with the radius of the wheel). The radial flow turbines may be further sub-division into the following two classes:

Inward Flow Turbines

1. In such turbines, the water enters the wheel at the outer periphery and then flows inwards(i.e. towards the centre of the wheel).
2. Here the runner is surrounded by a guide mechanism.
3. In this turbine, the outer diameter of the runner is the inlet and the inner diameter is the outlet.

Outward Flow Turbines

1. In such turbines, the water enters at the centre of the wheel and then flows outwards (i.e., towards the outer periphery of the wheel).
2. Here guide mechanism is surrounded by the runner.
3. In this turbine, the inner diameter of the runner is the inlet and outer diameter is an outlet.

2. Axial Flow Turbines

In such turbines, the water flows parallel to the axial of the wheel. Such turbines are also called parallel flow turbines.

Types of Reaction Turbine in Axial Flow Turbine:

1. Kaplan turbine
2. Propeller turbines

Mixed Flow Turbine: Francis Turbine

The Francis turbine is a **type of water turbine** that was developed by **James B. Francis**. It is an **inward flow reaction turbine** that combines radial and **axial flow concepts**.

They operate in a head range of ten meters to several hundred meters and are primarily used for electrical power production and their **output varies from a few kilowatts to 1000 megawatt**. In this turbine the working fluid changes pressure as it moves through the turbine, giving up its energy. **This types of turbines are located in between the high-pressure water source and the low-pressure water exit.**