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Classification steam turbines

The aim of a steam turbine is to produce the maximum amount of electrical energy in the minimum amount of space. Today, steam turbines produce more electrical energy than any other system. They comprise approximately 78 percent of all generation capability in our country. Their largest manufacturer is General Electric. GE put its first turbine into operation in November 1901; it had 500 kW of capacity. Now, steam turbines encompass well over 500 million kW of capacity. In a power plant, the steam turbine is attached to a generator to produce electrical power. The turbine acts as the more mechanical side of the system by providing the rotary motion for the generator, while the generator acts as the electrical side by employing the laws of electricity and magnetism to produce electrical power.

A steam turbine consists of a rotor resting on bearings and enclosed in a cylindrical casing. The rotor is turned by steam impinging against attached vanes or blades on which it exerts a force in the tangential direction. Thus a steam turbine could be viewed as a complex series of windmill-like arrangements, all assembled on the same shaft. Because of its ability to develop tremendous power within a comparatively small space, the steam turbine has superseded all other prime movers, except hydraulic turbines, for generating large amounts of electricity and for providing propulsive power for large, high-speed ships. Today, units capable of generating more than 1.3 million kilowatts of power can be mounted on a single shaft.

In the steam_turbine, steam is discharged at high velocity through nozzles and then flows through a series of stationary and moving blades, causing a rotor to move at high speeds. Steam turbines are more compact and usually permit higher temperatures and greater expansion ratios than reciprocating steam engines. Steam is first heated in a boiler, where it reaches a temperature of approximately 1,000 °F. It enters the turbine at a speed greater than 1,000 mph. The first valve that the steam encounters as it goes from the boiler to the turbine is the Main Stop Valve (MSV), which is either fully open or fully closed. The MSV does not control the steam flow other than to completely stop it. The steam hits the first row of blades at elevated pressure. Its pressure is so high, in fact, that it can produce a torque with just a small surface area. The steam's impact causes the rotor to begin turning. As the turbine stages progress, however, the steam loses density, thus requiring increasingly large surface areas. For this reason, the size of the blades increases with each stage. Its partitions direct the steam at the rotating blades. The steam must strike the blades at a specific angle that will maximize the useful work of the steam's high pressure. This is where nozzles come into play. A thrust bearing is mounted at one end of the main shaft to maintain its axial position and keep the moving parts from colliding with stationary parts. The journal bearing supports the main shaft and restricts it from springing out of its casing at high speeds. The exhaust hood guides steam from the last stage of the turbine, and it is designed to minimize pressure loss, which would decrease the thermal efficiency of the turbine. After the steam leaves the exhaust section of the turbine, it enters a condenser, where it is cooled to its liquid state. The process of condensing the steam creates a vacuum, which then brings in more steam from the turbine. The water is returned to the boiler, reheated, and used again. This steam comes from the reheat section, which is forcing steam back through the turbine, and is used to cool the high-pressure section.

Multi-level steam turbines. In modern steam turbines not only one impeller is propelled, but several being in a series. Between them idlers are situated, which don't turn. The gas changes its direction passing an idler, in order to perform optimally work again in the next impeller. Turbines with several impellers are called multi-level. The principle was developed 1883 by Parsons. As you know, with the cooling gas expands. Therefore it is to be paid attention when building steam turbines to a further problem: With the number of passed impellers also the volume increases, which leads to a larger diameter of the impellers. Because of that, multi-level turbines are always conical.

In power stations today, different types of turbines are used in a series, e.g. one high pressure -, two medium- and four low pressure turbines. This coupling leads to an excellent efficiency, which is even better than the efficiency of large diesel engines. This characteristic and the relatively favorable production make the steam turbine competitionless in power stations. Coupled with a generator and fired by an atomic reactor, they produce enormously much electric current.

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