Most efficient water turbine design

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HOW DO WE GET ENERGY FROM WATER? Hydropower, or hydroelectric ...

The most common type of hydroelectric power plant is an impoundment facility. ...

Water turbines were developed in the 19th century and were widely used for industrial power prior to electrical grids. Now, they are mostly used for electric power generation.Water turbines are mostly found in dams to generate electric power from water potential energy.

Water wheels have been used for hundreds of years for industrial power. Their main shortcoming is size, which limits the flow rate and head that can be harnessed. The migration from water wheels to modern turbines took about one hundred years. Development occurred during the Industrial Revolution, using scientific principles and methods. They also made extensive use of new materials and manufacturing methods developed at the time.

The word turbine was introduced by the French engineer Claude Burdin in the early 19th century and is derived from the Greek word "tyrvi" for "whirling" or a "vortex". The main difference between early water turbines and water wheels is a swirl component of the water which passes energy to a spinning rotor. This additional component of motion allowed the turbine to be smaller than a water wheel of the same power. They could process more water by spinning faster and could harness much greater heads. (Later, impulse turbines were developed which didn"t use swirl.)

The earliest known water turbines date to the Roman Empire. Two helix-turbine mill sites of almost identical design were found at Chemtou and Testour, modern-day Tunisia, dating to the late 3rd or early 4th century AD. The horizontal water wheel with angled blades was installed at the bottom of a water-filled, circular shaft. The water from the mill race entered the pit tangentially, creating a swirling water column which made the fully submerged wheel act like a true turbine.[1]

Fausto Veranzio in his book Machinae Novae (1595) described a vertical axis mill with a rotor similar to that of a Francis turbine.[2]

Johann Segner developed a reactive water turbine (Segner wheel) in the mid-18th century in Kingdom of Hungary. It had a horizontal axis and was a precursor to modern water turbines. It is a very simple machine that is still produced today for use in small hydro sites. Segner worked with Euler on some of the early mathematical theories of turbine design. In the 18th century, a Dr. Robert Barker invented a similar reaction hydraulic turbine that became popular as a lecture-hall demonstration.[3] The only known surviving example of this type of engine used in power production, dating from 1851, is found at Hacienda Buena Vista in Ponce, Puerto Rico.[4]

In 1820, Jean-Victor Poncelet developed an inward-flow turbine.

In 1826, Beno?t Fourneyron developed an outward-flow turbine. This was an efficient machine (~80%) that sent water through a runner with blades curved in one dimension. The stationary outlet also had curved guides.

In 1844, Uriah A. Boyden developed an outward flow turbine that improved on the performance of the Fourneyron turbine. Its runner shape was similar to that of a Francis turbine.

In 1849, James B. Francis improved the inward flow reaction turbine to over 90% efficiency. He also conducted sophisticated tests and developed engineering methods for water turbine design. The Francis turbine, named for him, is the first modern water turbine. It is still the most widely used water turbine in the world today. The Francis turbine is also called a radial flow turbine, since water flows from the outer circumference towards the centre of runner.

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