Pelton wheel turbine working principle pdf

The principle of using Pelton Turbine Water turbines is turbo machins that use water energy. The Pelton turbine is a type of pulse turbine; such turbines convert water pressure energy into kinetic energy entirely in the distributor. During the conversion, the jet of water accelerates in the nozzle and is directed to the blades of Pelton's wheel tangent. The water jet is redirected about 180 degrees in the blades. The pulse of the water jet is transmitted to Pelton's wheel. Learning Goals and Experiments Design and Function of the Pelton TurbineInfinition of Torque, Power and EfficiencyGraphic representation of characteristic curves for torque, power and efficiency Specification Feature pelton turbineTransparent front panel to observe the operating area of the turbine loading using the range of brakeAdjustable needle nozzle to install various nozzles of cross sections , the gauge shows the pressure on the turbine inletFlow determining the speed of the base module Water reserve using the base module or through the laboratory supply old Peyton wheel from The Wind Germany. The Pelton Wheel is a pulse-type water turbine invented by American inventor Lester Allan Pelton in the 1870s. There were many earlier variations of pulse turbines, but they were less effective than Pelton's design. The water leaving these wheels tends to still have high speed, taking away most of the dynamic energy brought to the wheels. The geometry of Pelton's paddle was designed in such a way that when the rim was running at half the speed of the jet of water, the water left the wheel at very low speed; thus, its design extracted almost all the pulsed energy of the water, which allowed to make a very efficient turbine. Drawing history from the original patent of Lester Allan Pelton in October 1880, Lester Allan Pelton was born in Vermillion, Ohio, in 1829. In 1850, he traveled by land to take part in the California Gold Rush. Pelton worked selling fish he caught in the Sacramento River. In 1860 he moved to Hamptonville, a mountain center. At this time, many mining companies were powered by steam engines, which consumed huge amounts of wood as fuel. Some water wheels were used in large rivers, but they were ineffective in small streams that were found near the mines. Pelton was working on a water wheel design that would work with a relatively small stream found in these streams. By the mid-1870s, Pelton had developed a wooden prototype of his new wheel. In 1876, he turned to casting miners in Nevada, California, to build the first commercial models in iron. First Pelton was installed at the Mayflower mine in Nevada in 1878. The benefits of Pelton's invention were quickly recognized, and his product soon became enjoyed. He patented his invention on October 26, 1880. By the mid-1880s, the foundry foundry of the miners could not meet demand, and in 1888 Pelton sold the rights to his name and patents for his invention to the Pelton Water Wheel Company in San Francisco. The company set up a factory at 121/123 Main Street in San Francisco. Pelton Water Wheel Company manufactured a large number of Pelton wheels in San Francisco that were shipped around the world. In 1892, the company added a branch on the East Coast at 143 Liberty Street in New York City. By 1900, more than 11,000 turbines were in use. In 1914, the company moved production to a new, larger premises on Alabama Street, 612 in San Francisco. In 1956, the company was acquired by Baldwin-Lima-Hamilton, which ceased production of Pelton Wheels. In New York, A and G Price in the Thames, New York, produced Pelton water wheels for the local market. One of them is on an open display in the Thames Goldmine Experience. The design of the nozzle is a straight power, high-speed water flow against a series of spoon-shaped buckets, also known as pulsed blades that are mounted around the outer rim of the drive wheel (also called a runner). When a jet of water enters the blades, the direction of water speed changes to follow the contours of the blades. The pulsed energy of the water jet exerts torque on the bucket-wheel system, rotating the wheel; The jet of water makes a U-turn and goes out on the outside of the bucket, slows down to low speed. In this case, the pulse of the water jet is transferred to the wheel and, therefore, to the turbine. Thus, the pulse energy really works on the turbine. Maximum power and efficiency are achieved when the speed of the jet water is twice the speed of rotating buckets. A very small percentage of the original kinetic energy of the water jet will remain in the water, resulting in the bucket being emptied at the same speed as it is filled, thus allowing the high-pressure input to continue continuously and without loss of energy. Usually two buckets are installed side by side on the wheel, with a stream of water divided into two equal flow; this balances the side load strength on the wheel and helps to ensure a smooth and efficient transmission of momentum from the jet of water to the turbine wheel. Since water is almost unstoppable, almost all available energy is extracted at the first stage of the hydraulic turbine. Therefore, Pelton wheels have only one stage of turbine, unlike gas turbines that operate with compressed liquid. Application of the Pelton wheel assembly at the Valchenzei hydroelectric power station, Germany. Pelton wheels are the preferred turbine for hydropower, where The water source has a relatively high hydraulic head at low flow speeds. Pelton wheels are made in all sizes. At hydroelectric power plants there are multi-ton Wheels Pelton, mounted on vertical bearings of oil fields. The largest power units - the Biidron hydroelectric power plant at the Grand Dixens Dam in Switzerland - have more than 400 megawatts. The smallest Pelton wheels have a diameter of only a few inches across and can be used to push energy out of mountain streams, having streams of several gallons per minute. Some of these systems use household plumbing to deliver water. These small blocks are recommended to be used with 30 meters (100 feet) or more head, in order to generate significant levels of power. Depending on the flow of water and design, Pelton wheels work best with heads from 15-1800 meters (50-5,910 feet), although there are no theoretical limitations. The design rules are the Sectional view of the Pelton turbine installation. The specific η with the eta s option does not depend on the size of the particular turbine. Compared to other turbine designs, the relatively low specific speed of the Pelton wheel implies that geometry is inherently low-transmission design. Thus, it is most suitable for feeding a hydroelectric power plant with a low flow-to-pressure ratio (meaning relatively low flow and/or relatively high pressure). Specific speed is the main criterion for matching a particular hydroelectricity to the optimal type of turbine. It also allows you to scale the new turbine design from the existing design of the known performance. η with n P/q (g H) 5/4 display (eta s'n'sqrt) / sqrt ((gH) (size parameter), where: n 'displaystyle n' (rpm) P (displaystyle P) - Power (W) H (displaystyle H) - Water head (m) - y Displaystyle that the Pelton oriented turbine is most suitable for applications with a relatively high hydraulic H head, because of the 5/4 exhibitor is more than unity, and given the characteristically low specific speed of Pelton. Turbine physics and derivative energy and the initial speed of the jet In an ideal (no friction) case, all hydraulic potential energy (Ep and mgh) is converted into kinetic energy (Ek q mv2/2) (see Bernoulli principle √). that all speed vectors are parallel to each other. Determining the speed of a wheeled runner as: (u), then, when the jet approaches the runner, the initial speed of the jet in relation to the runner: (Vi and u). The initial speed of the jet Vi Final jet speed suggesting that the jet speed is higher than the speed of the runner if the water will become a backup in the runner, then because of the preservation of mass, mass, the mass entering the runner should be equal to the mass when leaving the runner. It is assumed that the liquid is unstoppable (the exact assumption for most liquids). It is also assumed that the transverse area of the jet is constant. The speed of the jet remains the same in relation to the runner. Since the jet recedes from the runner, the jet speed in relation to the runner: In the standard reference frame (relative to the Earth) the final speed is then: Vf Optimal speed of the wheel We know that the ideal speed of the runner will result in all kinetic energy in the jet being transferred to the wheel. In this case, the jet's final speed should be zero. If we allow Vi 2u 0, the optimal speed of the runner will be u and Vi /2, or half of the initial speed of the jet. Torque By the second and third laws of Newton, the F force superimposed by the jet on the runner is equal, but the opposite of the speed of the fluid pulse change, so F q (Vf - Vi)/t If D is the diameter of the wheel, the torque on the runner is T and F (D/2) Torque is the maximum when the runner is stopped (i.e. when you are 0, T and D). When the speed of the runner is equal to the initial speed of the jet, the torque is zero (i.e. when you are Vi, then T - 0). At the torque area versus the speed of the runner, the torque curve is straight between these two points: (0, p'DVi) and (Vi, 0). The efficiency of the nozzle is the ratio of the jet's energy to the force of the water at the base of the Power Power P and Fu nozzle, where the angular speed of the wheel is located. Replacing F, we have P 2 (Vi and u)u. To find the speed of a runner with maximum power, take a derivative P relative to you and set it to zero, dP/du 2 Vi and 2u). Maximum power occurs when you and Vi/2. Pmax and Kwi2/2. Replacing the initial power of the Vi jet and √2gh, this simplifies up to Pmax and ug. This amount is exactly equal to the kinetic power of the jet, so in this ideal case, the efficiency is 100%, since all the energy in the jet is converted into a shaft output. The efficiency of the Wheel power, divided by the initial power of the jet, is the efficiency of the turbine, η 4u(Vi u)/Vi2. This is zero for you No 0, and for you - Vi. As the equations show, when the real Pelton wheel works close to maximum efficiency, the liquid drains from the wheel at a very low residual speed. Theoretically, energy efficiency depends only on the efficiency of the nozzle and the wheel, and does not change depending on the hydraulic head. The term efficiency may refer to: Hydraulic, Mechanical, Volume, Wheel, or Overall Efficiency. The components of the Bucket system are detailed on a small turbine. The channel that brings high-pressure water to the pulse of the wheel is called penstock. Penstock had the name of the valve, but the term was extended to include all hydraulics feeding fluid. Penstock is now used as a generic term for water passage and control that is under pressure, whether it supplies the pulse turbine or not. The South Eastern Times (1661). In southern Australia. November 24, 1922. page 6. Received on March 10, 2017 - through the National Library of Australia. MOUNTAIN INTELLIGENCE. Launceston Examiner. XLV (210). Tasmania, Australia. August 22, 1885. page 3. Received on March 10, 2017 - through the National Library of Australia. Leskohje, Roger. (2011). Lester Pelton and Pelton Water Wheel. Nevada County Historical Society. ISBN 978-0-915641-15-4. B Leicester Allan Pelton. American Society of Mechanical Engineers. U.S. Patent 233692, L. A. Pelton, Wheel of Water, issued Oct. b Conclusions of the review of historical resources of the area showplace (PDF). San Francisco Department of Planning. 2012 - Wagner, Hermann-Josef; Mathur, Jyotirmay (2011). 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