

# International Historic Mechanical Engineering Landmark



**American Society of Mechanical Engineers**



Lester pelton, whose invention paved the way for low-cost hydro-electric power.

**Pelton Waterwheel Collection  
North Star Power House Museum  
Grass Valley, California  
October 12, 1991**



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# PELTON WATER WHEEL

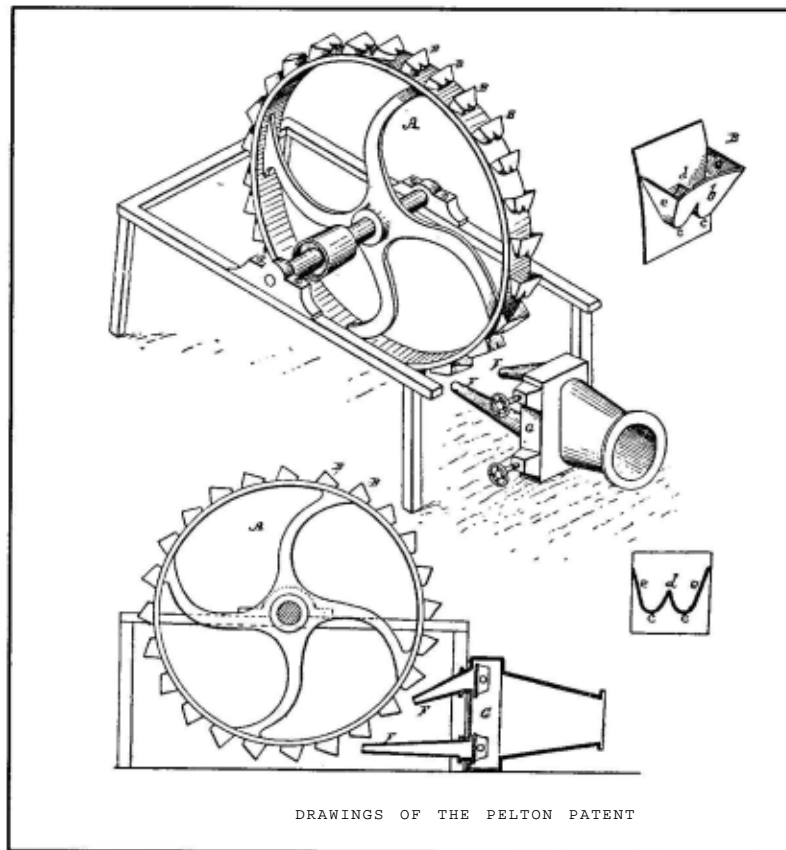
## MUSEUM

The North Star Mine Powerhouse in itself is an historic landmark built in 1895. Since that time, the building was completely enclosed to protect the thirty foot wheel and other mining artifacts, which includes the Pelton Wheel Collection.

## PELTON WHEEL COLLECTION

The collection exhibited in the North Star Powerhouse Museum is an assembly of historic items built by Lester A. Pelton and/or the Pelton Water Wheel Company.

Among the collection is a twenty four inch diameter water wheel, the first known cast iron wheel with split buckets made by Pelton. Another item of interest, is the 70-inch diameter wheel made of wood with metal buckets (Patented October 1880).



Other items in the collection are:

- 1.2 bronze buckets (from 18-foot diameter wheel.)
2. Eleven-inch wheel on a plate, in a wood frame
3. Eleven-inch Pelton No. 2 in a cast iron case with a built-in nozzle
4. Thirteen-inch wood wheel with cast iron buckets in a box frame
5. Eighteen-inch steel with cast iron buckets
6. Pelton bucket (Patented Oct. 1880)
7. Pelton Tachometer, 0- 1700 rpm (patented 1883)
8. Many more artifacts

# PELTON WATER WHEEL

## History

After discovery of gold in California, the mining industry flourished. Related industries also grew, such as: stampmills, crushers, logging operations, saw mills; there were blacksmith shops, machine shops and foundries. Water was the main source of power.

Water wheels of various types were used, some more efficient than others. Crude jets were used to increase the power and speed of the wheel. Later, new nozzles were made of brass utilizing a higher head of water. Changes in bucket designs brought the efficiency of the wheel to approximately 40 percent. The equipment in the mines were increasing in size and demanded more power, and soon found the wheel was inadequate as a power source.

During this period, Lester A. Pelton of Camptonville, Yuba County, California, a carpenter and a millwright familiar with water wheels and the overshot and undershot methods of driving them, began looking for another way to increase their speed and power.

In early 1878 he obtained the necessary equipment to test the

various types of buckets. He spent the following two years testing thirty to forty different bucket designs. Close examination showed water splashing back against the next bucket impeding it. Many experiments were made to overcome this problem.

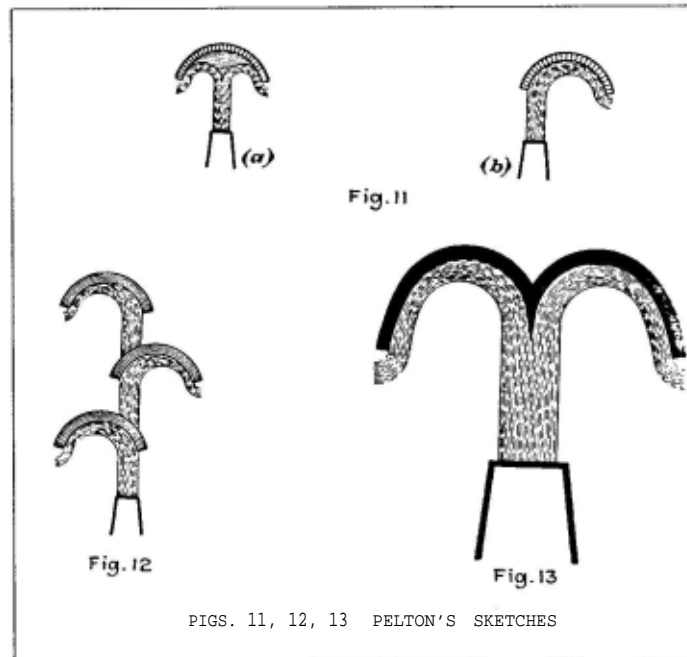
Different stories have been told how Pelton solved the impeding problem. One as told by his friend, Jim Hutchinson, while Pelton was visiting a neighbor and shooting the breeze. His neighbor used a garden hose to drive a stray cow away. He noticed the steam of water coming from the hose hit the

experiments had failed. Another version, as experiments were being made, a wheel being tested became off-centered on the shaft causing the water to impinge on one-half of the bucket and deflect to one side. This resulted in increased speed of the wheel. This also caused an end thrust to one bearing. To eliminate the new problem, Pelton then alternated the buckets as shown by his sketch Figure 12 the next step was obvious, the buckets were joined and centered to split the steam as shown by his sketch 13. The tests of the joined buckets were so

surprising that Pelton took steps to obtain his patent. With the help of James H. Hutchinson, an employee of Allen Foundry, the wheel was perfected and became a huge success.

Business began to boom at the Allen Foundry, later known as the Miner's Foundry and Supply Company, which became overburdened with orders, that were coming from everywhere. Transportation was also becoming a problem.

Pelton went to San Francisco and worked an arrangement with Brayton, one of the owners of Rankine, Brayton and Company machine shop, and organized the Pelton Water Wheel Company.



FIGS. 11, 12, 13 PELTON'S SKETCHES

cow directly on the sharp bone of its nose. The water divided as it struck, half to one side and half to the other side and none deflected back. He then realized why his

# PELTON WATER WHEEL

## WORLDS LARGEST TANGENTIAL WATER WHEEL

The North Star Mining Company had acquired additional mining properties and realized the need for more power to work the additional area. After some investigation and studies, the decision was made to develop a compressed air plant.

On May 4, 1895, a contract was signed with Fulton Engineering and Shipbuilding Works of San Francisco. This provided for the manufacturer of a water wheel with the choice of either the Knight, a competitor, who also designed water wheels, or the Pelton water wheel. The Pelton people had concerns about a wheel larger than fifteen feet in diameter.

Further studies by A.D. Foote, a civil engineer, hired to design and construct the plant, E.S. Cobb, E. A. Rix and the Pelton Company determined that a wheel with a maximum diameter of 18 feet 6 inches could be safely operated. The Pelton Company guaranteed an efficiency of 85 percent at full load, an average of 75 percent from half to full load of theoretical power of water, to govern the speed of the wheel

at a maximum of 120 revolutions per minute, and not raise the air pressure above 105 psi.

Foot calculated that a wheel of a 30-foot diameter was also practical but was unable to convince the Pelton people, so the 18-foot 6-inch wheel was built (Figure 1). The pit where the wheel operated still exists in the museum.

Edward S. Cobb, mechanical engineer of San Francisco, designed the wheel which was delivered to be the largest tangential wheel ever made. There were 64 buckets attached to the rim.

However, this wheel was short lived. More air was needed as more machinery was added. The Board of Directors authorized an enlargement of the plant.

Experience at the plant confirmed Foote's earlier thinking and the new 30-foot diameter wheel was constructed. It became the largest in the world.

The water wheel was built by Cobb and Hessemeyer of San Francisco. The construction of the wheel was similar to the 18-foot 6-inch wheel built by the Pelton Company. It is constructed of

steel except of cast iron, and the Risdon patented buckets, which were made of bronze. Later, the buckets were replaced with cast iron. (Pelton buckets are presently on the wheel). The normal speed of the wheel is 65 rpm, with pressure of 350 psi and a single jet of 1  $\frac{3}{4}$  inches in diameter which can produce 1000 horsepower. This wheel is in its original position, less the compressor and related equipment.

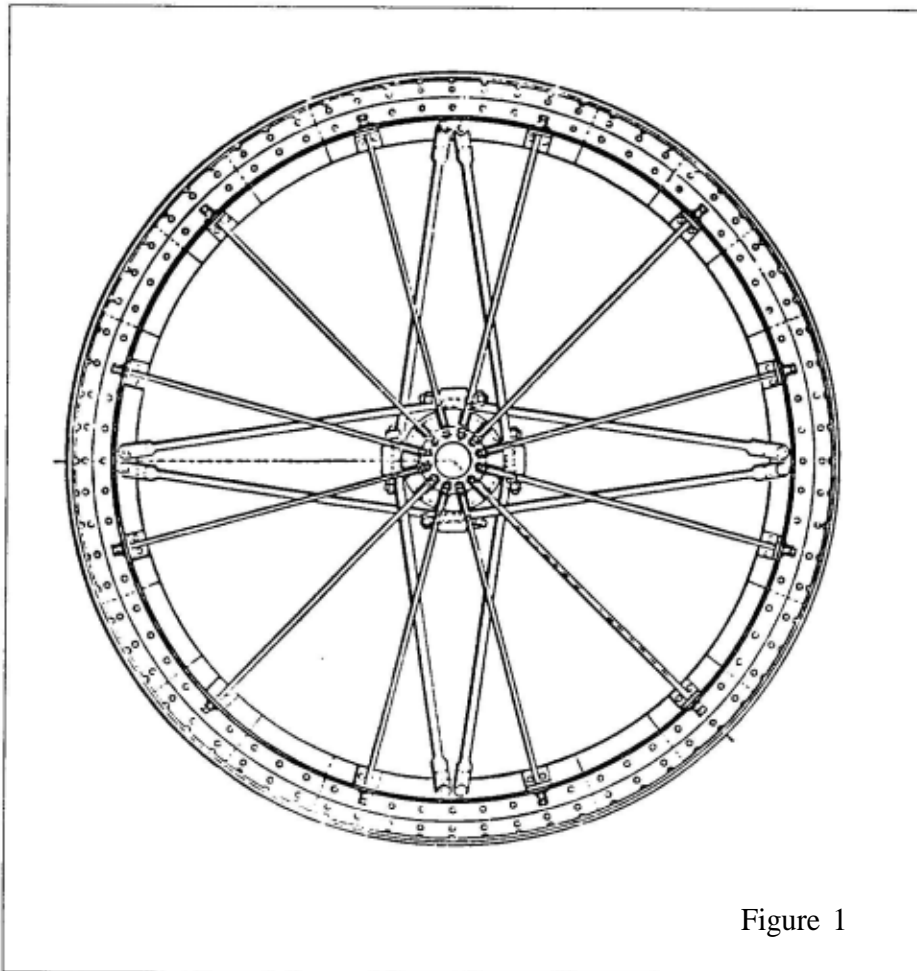


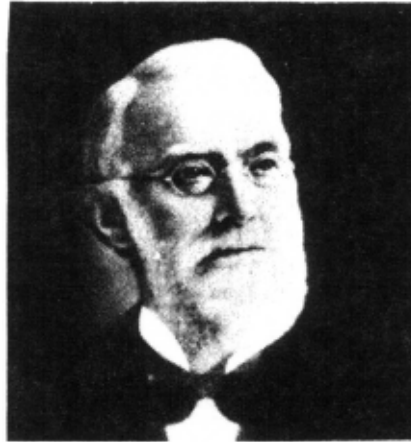
Figure 1

## PELTON WATER WHEEL

**LESTER A. PELTON**  
**(1829-1908)**

Pelton was born in Vermilion, Ohio, in 1829. At age 20 he set out by foot to cross the plains and strike it rich. The first fourteen years he spent mining and wasn't very successful. He moved to Camptonville and turned to carpentry, built homes, a school house, mine structures, and water wheels, eventually becoming a millwright.

His interest was in the water wheel and from early 1878 to 1880 he tested 40 types of wheels with different buckets leading to the discovery of the "splitter" type bucket. A contest was held with four other makers of water wheels.



His wheel surpassed the second best by 19 percent. Work of this crossed the country and order for his wheel came from everywhere. The Allen Foundry, in Nevada City, California, could not keep up

with the orders being received. Pelton went to San Francisco and met with Mr. Brayton of Rankine, Brayton and Co. and formed the Pelton Water Wheel Company.

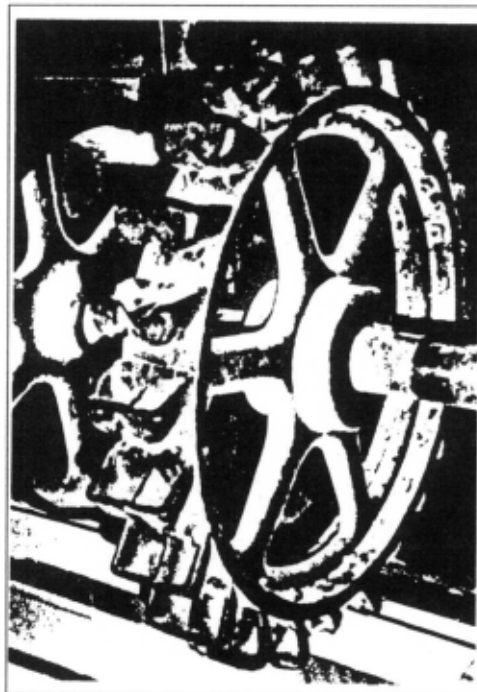
Later, The Pelton Water Wheel Company operated under several names and eventually became part of the Baldwin-Lima-Hamilton Corp. of San Francisco and Philadelphia, PA.

Pelton retired in Oakland, California, where he died March 14, 1908. His ashes were in an urn at a monument to him in Maple Grove Cemetery, Vermilion, Ohio.

## THE LITTLE PELTON DEMONSTRATOR

Displayed next to the 30-foot wheel is a little 24-inch diameter wheel, the first iron wheel made and installed by Lester A. Pelton in the George G. Allen Foundry and Machine Shop, Nevada City, later to become the Miners Foundry.

It ran the machine shop, pattern shop, pipe shop and other machines. It operated under 84 pounds pressure, using water from the city mains. It was used as a demonstrator to show customers needing power drives what



this Pelton Wheel could do while using water pressure.

Installed in 1980, with an overhead line shaft belted to the machines, it was used for several years until individual electric motors were installed on separate machines.

This wheel was donated by the Miners Foundry and Manufacturing Co. to the Nevada County Historical Society in November 1952.

# INTERNATIONAL MECHANICAL ENGINEERING HERITAGE COLLECTION

## PELTON WATER WHEEL COLLECTION

### North Star Power House Museum

The Pelton wheel uses the momentum of a water jet impinging on buckets attached to the periphery of a wheel to produce power. It is a development of the primitive, so called "hurdy gurdy" wheel used in the California gold fields in the nineteenth century. Various inventors contributed to this type of water turbine, including Lester A. Pelton (1831 - 1908), who in 1880 patented the characteristic split bucket form. Subsequent important contributions to the Pelton-wheel technology were made by W.A. Doble. This collection illustrates the origins and the development of the Pelton Water Wheel.



AMERICAN SOCIETY OF MECHANICAL ENGINEERS – 1991



## **THE HISTORY AND HERITAGE PROGRAM**

The ASME History and Heritage Recognition Program began in 1971 as part of the Society's effort to note, document and acknowledge mechanical engineering achievements of particular significance.

The National History and Heritage Committee includes mechanical engineers, historians of technology and the immediate past curator of mechanical and civil engineering of the Smithsonian Institution.

An ASME Landmark represents a step in the evolution of mechanical engineering and reflects its influence on society here and abroad. This landmark is one of many throughout the world that are a part of our engineering technical heritage.

The Pelton Water Wheel Collection is the third Collection to be recognized by ASME. In addition, 34 international, 12 regional and 100 national landmarks and sites have been recognized.

### **ACKNOWLEDGEMENTS:**

"The Pelton Water Wheel" by W. F. Durand, Stanford University, California. Paper published in Mechanical Engineering, Vol. 61, No. 6 and 7, June and July 1939, California State Library, Sacramento, CA

"The Pelton Water Wheel" by Elza J. Kilroy, Vol. 15, No. 2, April 1961, Nevada County Historical Society, CA

"The North Star Power Plant" by William E. Carmen, Vol. 17 No. 4 Nevada County Historical Society, CA

P.G. and E. Progress, Articles, P.G.&E. Co., San Francisco, CA

C. Glen Crawford, P.E., Winlock, WA, furnished some articles from his files. Carmichael Public Library, Articles on file, Carmichael, CA