

Northern Pacific Rotary Snow Plow #2



Source: Heather Tinus

Designated as a Historic Mechanical Engineering Landmark

Lake Superior Railway Museum

506 W Michigan St.

Duluth, MN 55812

April 16, 2015



Source: Heather Tinus

HISTORIC MECHANICAL ENGINEERING LANDMARK

NORTHERN PACIFIC ROTARY SNOW PLOW NO. 2 1887

THIS ROTARY SNOW PLOW, CONSTRUCTED BY THE COOKE LOCOMOTIVE & MACHINE WORKS IN PATERSON, NEW JERSEY, IS THE OLDEST SURVIVING RAILROAD ROTARY SNOW PLOW. PATENTED BY CANADIAN ORANGE JULL IN 1884, THIS WAS THE FIRST MACHINE TO RELIABLY CLEAR DEEP, PACKED SNOW FROM TRACKS. POWERED BY A LOCOMOTIVE-TYPE STEAM ENGINE, IT USED A BI-DIRECTIONAL ROTATING WHEEL WITH BLADES THAT CUT INTO THE SNOW AND PASSED IT TO AN IMPELLER, WHICH THREW IT TO EITHER SIDE OF THE TRACK. THE PLOW WAS PUSHED BY SEVERAL LOCOMOTIVES.

ROTARY PLOWS, USED PRIMARILY IN WESTERN NORTH AMERICA AND EUROPE, PROVED MUCH MORE EFFECTIVE AGAINST HEAVY SNOWFALLS THAN WEDGE PLOWS AND MANUAL LABOR. THIS PLOW ORIGINALLY SERVED IN THE CASCADES, BUT WAS LATER ASSIGNED TO DUTIES IN MINNESOTA. IT REMAINED IN SERVICE FOR 81 YEARS. LATER PLOWS OF THIS TYPE WERE LARGER, AND MOST STILL IN SERVICE USE ELECTRIC MOTORS POWERED BY THE GENERATOR OF ONE OF THE PUSHING LOCOMOTIVES.

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS 2015



Source: Heather Tinus

Landmark Description

The Northern Pacific Rotary Snow Plow #2 is the oldest rotary snow plow still in existence. Rotary snow plows offered a safer means of snow removal for railroad companies than traditional methods. Snow sheds were the first protection railroads had from the snow. They were structures built to protect the rails from snow and ice. Although the snow sheds were pliable and could be restored or repaired, hundreds of feet of sheds could be destroyed by snow slides and fires.

The second line of defense were snow plows, also known as buckers. Buckers were installed with a large wedge and moved at high speeds in order to have their momentum carry them through large snow drifts. Although buckers were effective, they were also very dangerous. Since the tracks were buried deep in snow, the train engineer could not see obstacles or debris in the way. If a speeding bucker hit one of these obstacles or a densely packed drift, it was possible for the bucker to derail.

Rotary snow plows were much safer because they moved at slow, consistent speeds to remove the snow. A large cutting wheel would cut the snow from the track ahead and pass it to a revolving throwing wheel (fan) behind it. The fan would throw the snow off to the side of the tracks. Depending on which way the shaft was rotating, the knives on the cutting wheel could reverse to throw snow to either side of the tracks to avoid hitting structures. Even though the rotaries were slow, they were extremely effective because of their uninterrupted motion. In one hour, a rotary could do the same amount of work as a plow could do in one day.



Source: Tinseth Appraisal Service

Restoring and Preserving the Snow Plow

The Lake Superior Railroad Museum purchased the Northern Pacific Rotary Snow Plow #2 from the Steam Preservation Society in Cadillac, Michigan for \$3,750 on February 14, 1975. The museum spent about another \$10,000 for preparation, loading, and transportation of the rotary. During this time, there were many generous donations to the museum. Some of the major contributions came from: Soo Line, which provided free transportation of the rotary from Chicago to Superior; Burlington Northern, for unloading the rotary; and the Minnesota Historical Society, which gave a generous \$5,000 grant to the museum. Currently, the rotary is on display to the public at the Lake Superior Railroad Museum in Duluth, Minnesota.

History

Inspired by a spinning snow shovel patented by J. W. Elliot in Canada (CA 399), inventor Orange Jull expanded this concept and created a full-scale operating machine with the help of the Leslie brothers (John S. and Edward Leslie). Jull received a patent for the "Snow Plough" on January 22, 1884 (CA 18506) and it was assigned to the Leslie brothers who paid royalties.

The parts for the first rotary snow plow were built by the Leslie brothers in their machine shop in Orangeville, Ontario. The snow plow was assembled on a flatcar in Parkdale, Ontario, during the winter of 1884. After the snow plow went through many design stages, the final design incorporated a cutting wheel and a throwing wheel (fan) attached to a single shaft.

During design changes, the Leslie brothers filed many patents for individual components, but did not include Jull in any of them. At this point, the Leslie brothers and Jull parted ways and no longer collaborated. With the redesign of Jull's snow plow, the Leslie brothers sent their drawings to the Cooke Locomotive & Machine Works in Paterson, New Jersey where the plow was put into production beginning in the spring of 1886.

There were many variations of the rotary snow plow created throughout the years, but its origins are attributed to the work of Jull and the Leslie brothers.

The Northern Pacific Rotary Snow Plow #2 was built in December of 1887 by the Cooke Locomotive & Machine Works. This snow plow was originally used to clear deep snow drifts in the Cascade Mountains until it was replaced by newer models. The Rotary Snow Plow #2 was sent eastward to perform less rigorous duties in Minnesota and was in service for a total of 81 years before it was retired.



Source: Heather Tinus

Technical Background

Initial Design

Orange Jull's first idea was to have a cutting wheel revolving at high speeds to cut away the snow. Once the snow was cut away, it would pass through the cutting wheel and into a fan. The fan then threw snow out an aperture in the top of the fan housing. The Leslie brothers built Jull's invention and tested it in the winter of 1884. Although the design was able to throw the snow 200 feet, it was impractical because the snow could only be thrown in a fixed direction; depending on the surroundings of the track, it would be ideal for the operator to have control over which direction the snow would be thrown.

Revisions

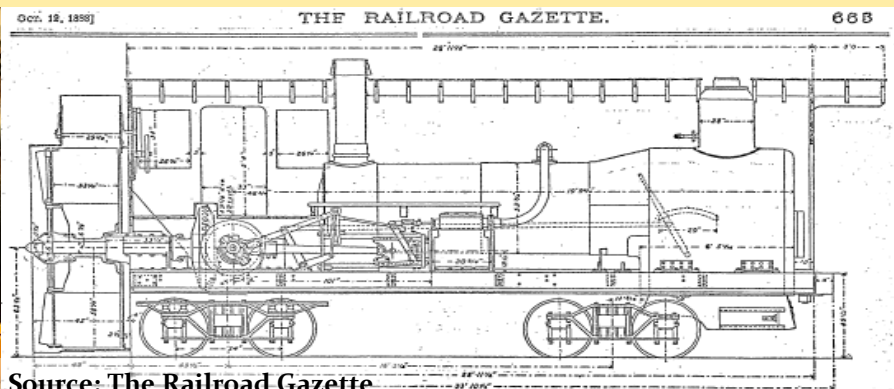
To improve the design, the Leslie brothers redesigned the fan wheel so that it could revolve in both directions, allowing snow to be thrown to either side of the track. Additionally, a movable hood on the fan's casing was designed to direct the snow. To divert the accumulated ice and snow that piled up in the front of the rotary, an ice cutter was attached to the front truck. To prevent derailing of the locomotives behind the rotary, a flanger was added under the car supporting the plow to clear the last few inches of snow from the rails. During testing on the Fremont, Elkhorn, and Missouri Valleys, it was discovered that when snow passed between the opposite revolving cutting wheel and fan wheel, the boiler powering the system was not able to overcome the friction that was generated. Once again, the Leslie brothers needed to redesign.

Final Design

For the final design, the fan wheel and the cutting wheel were on the same shaft. Now that there was just one unit, both friction and power consumption were reduced. The shaft was powered by a steam engine inside the car, but the rotary unit could not move on its own power. The unit was pushed by three or four locomotives, moving at a speed of 4-6 mph.



Source: Heather Tinus



Source: The Railroad Gazette

THE HISTORY AND HERITAGE PROGRAM OF ASME

Since the invention of the wheel, mechanical innovation has critically influenced the development of civilization and industry as well as public welfare, safety and comfort. Through its History and Heritage program, the American Society of Mechanical Engineers (ASME) encourages public understanding of mechanical engineering, fosters the preservation of this heritage and helps engineers become more involved in all aspects of history. In 1971 ASME formed a History and Heritage Committee composed of mechanical engineers and historians of technology. This Committee is charged with examining, recording and acknowledging mechanical engineering achievements of particular significance. For further information, please visit <http://www.asme.org>.

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Source: Heather Tinus

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References

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Patent Summary: CA 18506. (n.d.). Retrieved January 29, 2015, from <http://brevets-patents.ic.gc.ca>

Individuals & companies that donated money or services for the purchase and restoration of the Northern Pacific Rotary Snow Plow #2 in 1974-75

Allen Anway
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