

Maine Forest and Logging Museum

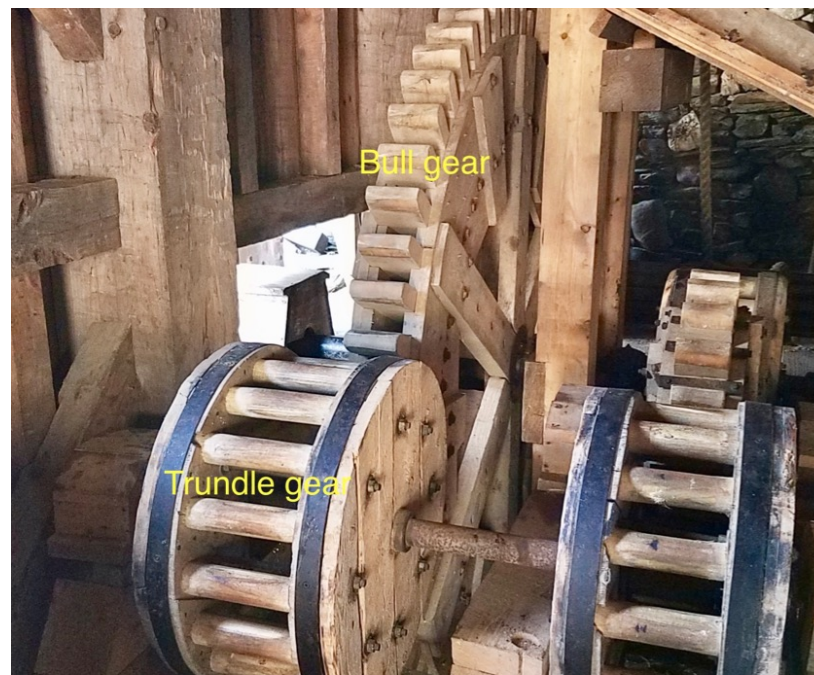
Re-creation of Oliver Leonard's Mill on Blackman Stream

By Herb Crosby



Waterpower was a major source of energy in the 1800s, with nearly 2,000 water-powers in Maine. Towns were often built near waterfalls to harness this energy. There were 7 water-powered mills on Blackman Stream in 1868 according to the State Hydrographic Survey. The current reconstructed mill was built in the 1980s.

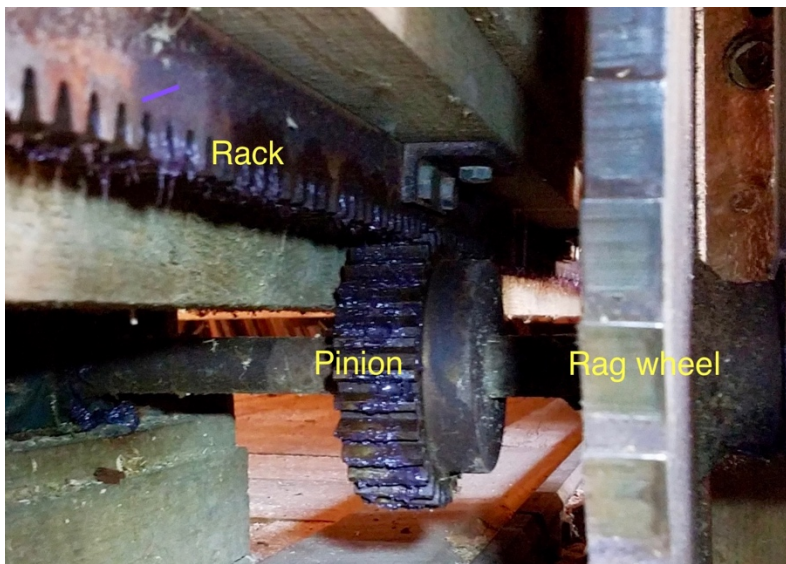
Water is impounded by a stone dam at a natural falls two hundred feet upstream from the sawmill. A portion of the stream flows through a canal to a mill pond beside the mill. Logs are stored in the mill pond to condition them and reduce insect damage. Water flows from the mill pond through a wooden sluice to the top of a 9-foot diameter overshot water wheel. The water flowrate is controlled by a wooden gate operated by the sawyer. Water fills the waterwheel buckets and the weight turns the wheel as the water drops. This energy is called potential energy. This potential energy is turned into work plus some friction losses. The power produced depends on the elevation drop or head, water flow rate, and waterwheel efficiency. This waterwheel typically turns at 10 revolutions per minute producing about 3 horsepower at moderate flow, equivalent to the work of 30 laborers. The waterwheel torque is about 1,600 pound feet.



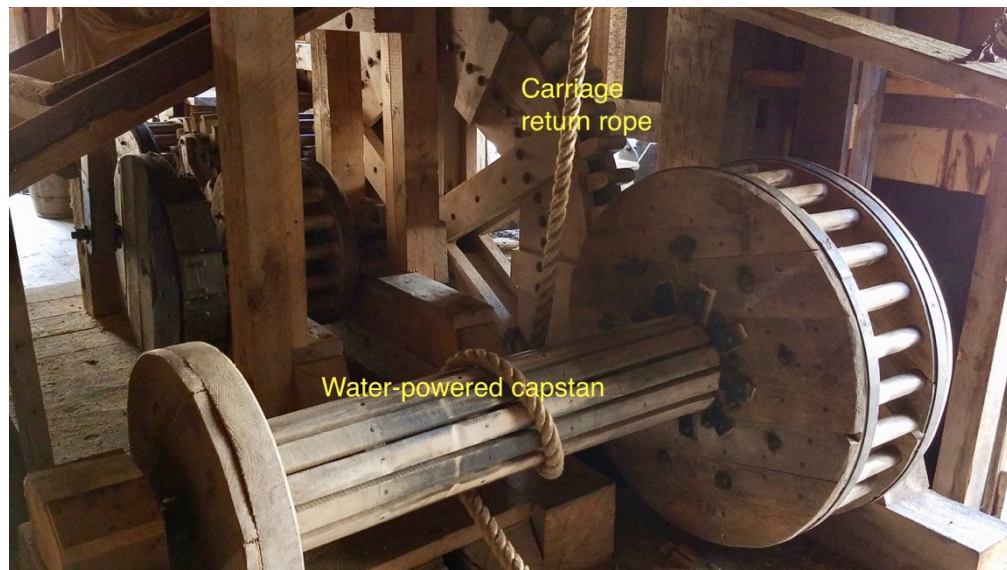
The waterwheel turns a shaft which has a large wooden gear at the other end inside the mill. This large gear is called a bull gear and has 58 wooden gear teeth. The bull gear drives a wooden trundle gear with 16 teeth, increasing the speed to 36 rpm. Gear speeds are inversely proportional to number of gear teeth. A series of wooden gears drives a 2-foot-long crank. A connecting rod attached to the crank pushes the sash saw up and down with a 4-foot stroke 36 times a minute. A steel saw blade is mounted in a wooden frame called a sash that moves up and down in wood guides. The blade is mounted at a slight angle so it only cuts on the down stroke. The crank assembly has a steel weight to offset the weight of the heavy saw sash acting downwards.



Logs are pulled up a ramp called a brow into the mill using a block and tackle. The block and tackle has 2 moving sheaves with 4 rope passes, increasing the pulling force by 4 times minus friction losses. The sawyer pulls 120 feet of rope to move the log 30 feet. Work into the rope equals work out of the block plus friction losses. The log is then rolled onto a log carriage and secured with steel dogs at each end. The carriage moves on steel wheels along a track towards the saw, driven by a rack and pinion under the carriage. This pinion gear is connected to toothed rag wheel outside the carriage.



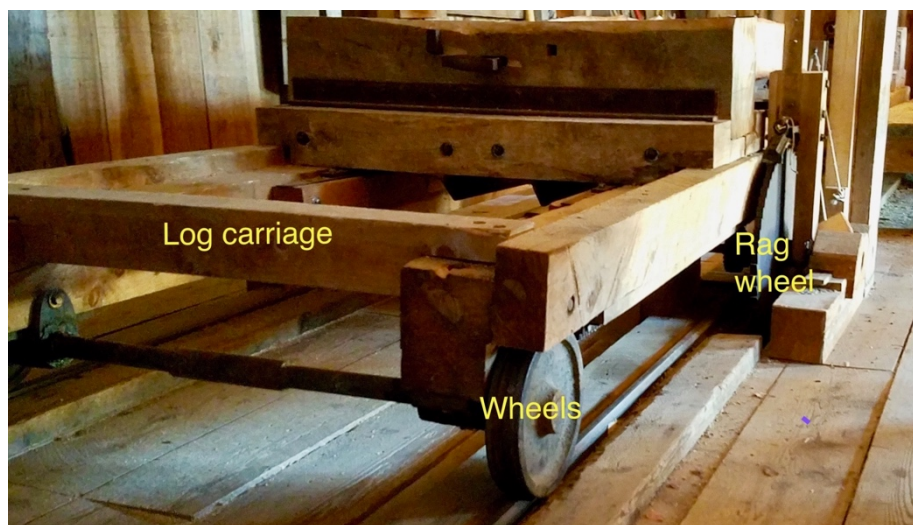
A pusher ratchet turns the rag wheel 6 degrees each time the saw moves up, advancing the log $\frac{1}{4}$ inch towards the saw blade. A keeper ratchet then locks the rag wheel and carriage while the blade moves down sawing. The pusher ratchet is driven by a wooden linkage connected to the saw frame. You can see the linkage rocking back and forth and hear the steel ratchets clicking during sawing.



The carriage advances about $\frac{1}{4}$ inch each saw stroke, taking 15 minutes to saw a 12-foot-long board. The carriage automatically stops at the end of the cut when a lever disables the ratchets. The sawyer then pulls up on a large rope beside the carriage, lightly wound around a rotating wooden capstan downstairs and then coming back upstairs to the saw carriage. The rope tightens on the friction capstan, using waterpower to quickly pull the log carriage back to the starting point. Releasing the rope lets it again slip, stopping carriage movement. The sawyer then repositions the log for the next cut. You can see the water-powered friction capstan and rope downstairs. A brake engages the bull wheel to lock the saw when not in use.

Water-powered sash saws typically cut about 1,000 board feet of lumber a day, several times the production of manual pit saws. There is a 2-man pit saw outside the mill. Sash saws were later replaced by rotary saws and band saws that were quicker, cutting continuously.

Waterpower is still a major source of renewable energy. Hydroelectric turbines today produce about one-third of Maine's net electric generation.



<https://youtu.be/8DRKc10ZHKY>