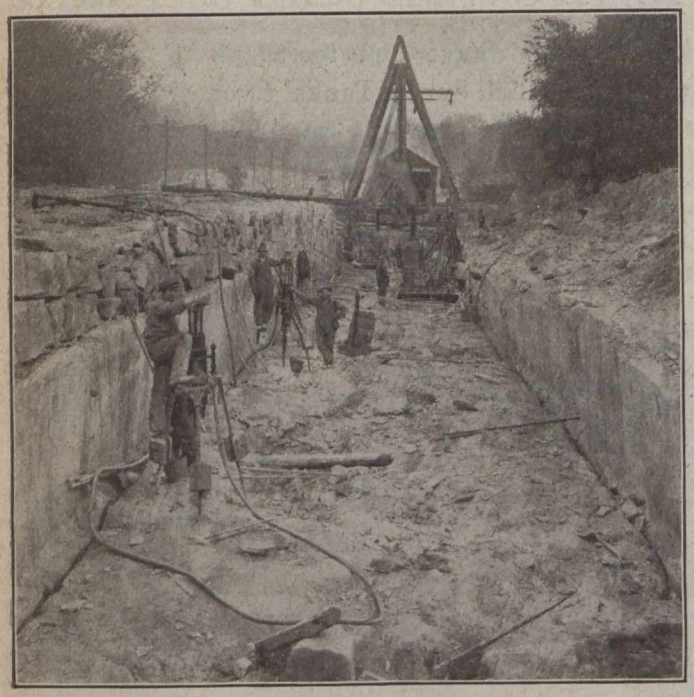
a combined maximum carrying capacity of about 162,000 h.p.

The first conduit, installed in 1903, was steel plate encased in concrete while No. 2 conduit, installed in 1910, was constructed of reinforced concrete 18 inches thick laid on a continuous concrete saddle. This second conduit, when inspected in April, 1918, after being in service eight years, showed no signs of cavitation or deterioration, although a velocity



ROCK EXCAVATION IN PIPE TRENCH NEAR INTERNATIONAL RAILWAY CROSSING—INGERSOLL-RAND ROCK DRILLS AT WORK

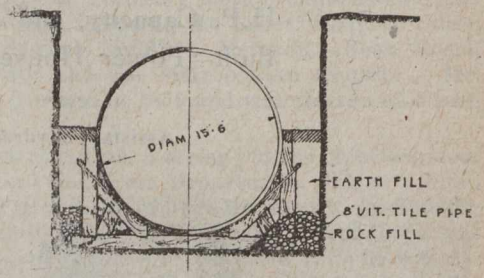
of 25 to 28 feet per second had been maintained during operation. A remarkable feature in connection with this pipe is the fact that there is no vegetable growth whatever appearing on the walls. This is undoubtedly due to the high velocity of the water.

The third pipe line now being installed is 13.5 feet interior diameter. The staves are B.C. fir, 4 inches thick by 6 inches wide. The pipe is banded with ⅞ inch steel bands made in two sections with two shoes. The spacing of the bands varies, according to the pressure head, from 8¾ inches at the forebay end to 2½ inches at the power house end. The following is a digest of the specifications covering the material furnished for this conduit:—

Wood Stave Pipe Specifications

"Staves shall be made of live timber known as Oregon or Douglas Fir, sound, straight-grained, entirely free of all deadwood, rotten knots, dry rot, cracks, shakes, or any other defects or imperfections that might impair its strength or durability. Pitch seams not extending more than one-quarter of the way through the thickness of the stave will be allowed. Small, tight, sound knots, not over three-quarters of one inch in diameter and not occurring oftener than one in four feet of stave will be allowed. Sap on the inside of the stave and not extending more than three-quarters of an inch in thickness will be allowed. All timber used must be thoroughly seasoned by either air or kiln drying before being milled into staves. The staves shall be of uniform thickness and each stave shall be of uniform width throughout its entire length. The staves may vary in length from twelve feet to thirty-two feet, but not more than ten per cent. shall be twelve feet, and not more than twenty per cent. shall be fourteen feet and less in length. The ends of the staves shall be cut square with the side and shall be fitted with the saw kerf for the insertion of a metal tongue of wrought iron or steel plate of No. 12 B.W.G. The size of the kerf shall be of such dimension as to make the tongue fit tight in all directions and cut across the ends of the stave in exactly the same position. The saw kerf in the end of the stave shall be one-sixteenth of an inch less in depth than one-half of the width of the metal tongue to be inserted in the staves. The staves shall be dressed on both sides to true circles of the inside and outside diameter of the pipe and the edges shall be dressed to conform to the radial lines of the pipe.

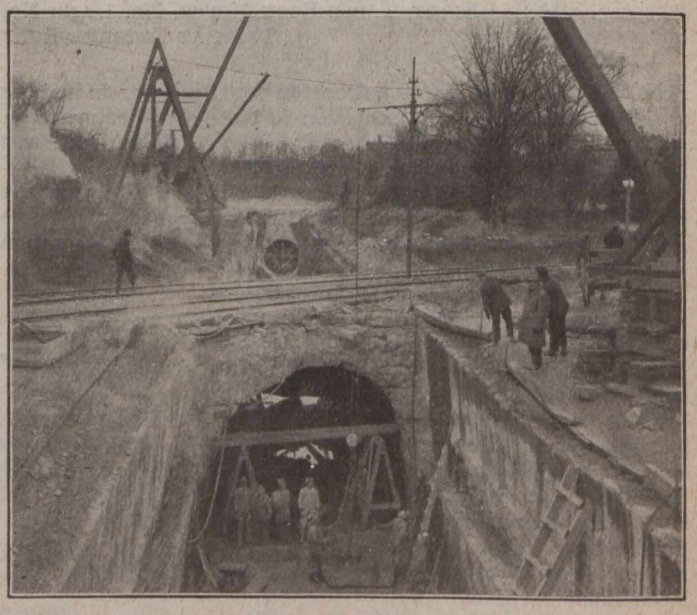
"The steel or wrought iron metal tongues shall be one and one-half inches in width, measured with the length of the pipe, and in length shall be one-eighth of an inch longer than the width of the saw kerf across the end of the stave so that when the tongue is in place it will project one-sixteenth of an inch into the adjoining staves.



TYPICAL SECTION OF PIPE TRENCH IN ROCK

"Steel in the bands shall be made by the open hearth process; phosphorus shall not exceed .06. The ultimate strength shall be from 55,000 to 65,000 lbs. per inch. The yield point shall be not less than one-half of the ultimate strength, and shall be determined by the drop of the beam of the testing machine. Elongation is to be a minimum per cent. in eight inches of 1,400,000 divided by the ultimate tensile strength. For each increase of one-eighth inch in diameter above three-quarter inch, a deduction of 1 shall be made from the specified percentage of elongation.

"The rods or bands shall be capable of bending 180 degrees around a diameter equal to the diameter of the specimen tested without fracture on either side. Bands must be free from any injurious seams, flaws or cracks and have a workmanlike finish. The bands shall be provided with a button head on one end and the other end to be provided with six inches of cold rolled thread of United States Standard Gauge. Each threaded end shall be provided with a hexagonal nut



TRENCH FOR WOOD STAVE PIPE THROUGH ROCK SECTION, SHOWING TUNNEL BENEATH INTERNATIONAL RAILWAY CO.'S TRACKS—BOTH SIDES OF CUT ARE CHANNELLED HERE

one-sixteenth of an inch thicker than the diameter of the band. Each threaded end shall also be provided with one plate washer of the proper diameter and standard thickness. The nut shall fit the thread of the band and in such a manner as to turn easily and shall give the full bearing on all of the threads of the nut. The threads shall be of such strength