lifted, cut to the proper length by the oxo-acetylene method, and then sunk and connected up. All such connections were made under water by divers. A slip joint fitted with graphite packing with a lead ring gasket was used in each connection. The type is illustrated in Fig. 6.

A special expansion joint with a free movement of 3 ft. is fixed on each section in the river. This will allow for any expansion or contraction, and will also be of great assistance at the pier connection. A section and detail drawing of this joint is shown in Fig. 7.

The new line is made so as to present an arch effect against the current in the river, thus relieving, as far as possible, the strain caused by anchor ice, etc.

Considering the length of time these pipes were in the river, their condition was marked, in that there was practically no corrosion. The buoyancy of the pipes in the river was overcome by means of wooden cribs, loaded with stone. Their general construction is illustrated in Fig. 9.

The work is being done by the Montreal firm of Loomis, McBean and Williams, at the contract price of $40,000, but with the extra work which has since been ordered this amount will be augmented by several thousand dollars.

The design and ideas of construction are those of Mr. Arch. Currie, city engineer of Ottawa, who recommended last July that the above procedure be undertaken, while Mr. A. N. Beer, assistant waterworks engineer, and Mr. Peter Carnochan are supervising the work of construction.

POWER DEVELOPMENT AT LONG LAKE, ALASKA.

Long Lake, which lies about two miles from the beach at an elevation of 727 ft., has an area of 3.1 square miles. It is situated near Speel River, between Ketchikan and Skagway, 35 miles southeast of Juneau, Alaska. A description of a project on foot to construct a 10,000-kw. plant appears in a recent issue of Western Engineering. Mr. E. P. Kennedy, assistant superintendent, Alaska Treadwell, G. M. Co., is the writer.

Water measurements for eight months and an estimate for the remaining four give a yearly run-off of 21,757 million cubic feet, and as the drainage area is taken at 32.4 square miles, the above run-off amounts to 24 ft., or an equalized yearly flow of 689 cu. ft. per second. The initial plant will use 300 sec.-ft., which is equivalent to a run-off of 10.4 ft. over an area of 32.4 square miles.

The power plant is to be situated near Second Lake, 2,000 ft. from and 535 ft. below Long Lake, and about 1½ miles from the beach. This plant will consist of two units, each of 5,000-kw. capacity and each to be direct connected to a water turbine utilizing 300 second-feet.

To be assured of a continuous flow of 300 sec.-ft., the lake will be drawn on by tapping with a tunnel or by a syphon to a depth of 12 ft., and the two spillways from the lake closed, thus raising the lake level 25 ft., giving an available storage of 37 ft. The cost of this power installation would be:

Power house with two 5,000-kw. units complete	$250,000
Pipe lines, two 60-inch with head-gates	93,594
Closing spillways from lake	10,000
Tapping lake	5,000
Contingencies and incidentals	3,000
Plant for construction	13,882
Total	$375,476

Or a capital cost of $37.54 per kilowatt or $27.95 per horse-power.

The cost of operating the above plant would be, per year:—

General expense	$ 6,000
Operating labor	6,000
Supplies, etc.	4,000
Total	$16,000
Operating cost per year per kilowatt	$1.60
Interest and depreciation, 8% on capital cost	3.00
Cost of kilowatt-year	4.60
Cost of horse-power-year	3.43

To be assured of a yearly average of 10,000 kw., the generators should be run at 25% above normal capacity for 6 months of the year while there is a large excess of water, and thus provide for unforeseen shut-downs.

Surveyed lake area is 3.1 square miles, or 86,423,040 sq. ft., requiring 20 ft. in depth at this area to provide for the required storage.

This storage is obtained by raising the lake level 25 ft. and drawing on the lake 12 ft. The increased area obtained by raising the lake will make up for the decreased area by drawing the lake and also provide sufficient storage below the 2 ft. of ice.

Power estimate is based on a pipe-line loss of 1%, water-wheel efficiency of 82%, generator efficiency of 93%; total efficiency of 75% from the water. Three hundred second-feet under 542-ft. head at 75% will generate 10,320 kilowatts.

From flow measurements the following figures are obtained:—

	Measured flow.	Required flow for 300 sec.-ft.	From storage.
January	324,187,200	803,520,000	479,332,800
February	283,046,400	725,760,000	442,713,600
March	374,976,000	803,520,000	424,544,000
April	352,512,000	777,600,000	425,088,000
May	1,154.390,400	803.520.000	....
June	2,947,104,000	777,600,000	....
July	5,340,729,600	803,520,000	....
August	4,860,492,480	803,520,000	....
September	4.473.792,000	777.600,000	....
October	803,520,000	803.520,000	....
November	518,400,000	777,600,000	259,200,000
December	324,187,200	803,520,000	479,331,800
	21,757,337,280	9,460,800,000	2,510,210,200

Detail of Construction Plant.

Horse tram from beach, 11,000 ft., 30-in. gauge, 20-lb. T-rail, 76 tons at $40 per ton	$3,040	
7,335 ties, 6 by 8 by 48 in., equivalent to 117,328 ft. B.M., at $14 per M.	1,642	
Labor and tools	3,000	
		$ 7,682
Gasoline tow-boat		2,000
2 barges at $3,000		6,000
1 donkey engine		1,400
2 horses		600
1 air-hoist		200
1 compressor with water-wheel and pipe for riveting		
Riveting hammers, etc.		2,000
Camp		1,000
Three cottages		2,000
Sawmill $600, cost absorbed in tram ties and cottages.		3,000
Total cost of plant		$25,882