College Street to the Canadian Pacific railroad tracks, and north of Gerrard Street in the eastern part of the city. This pumping station, like the main station, exhibits more or less the history of pumping engines, as it contains a Holly vertical triple-expansion pumping engine, having a capacity of 6,000,000 gallons, and a similar pump built by the John Inglis Co., of Toronto. There are also two Blake-Knowles horizontal cross-compound pumps having a capacity of about 4,000,000 gallons. All of these pumps were installed about eight or ten years ago, and two years ago eight electrically driven centrifugal pumps were installed. An extension is being made to this station for housing the two turbine-driven centrifugal pumps, also two centrifugal pumps directly connected to Bellis-Morcom steam engines.

The De Laval turbine-driven centrifugal pumps installed or under contract for the City of Toronto aggregate 90,500,000 gallons per day capacity, and 4,390 water horse-power.

PUMP OPERATION.

For a direct-acting pump in fair condition, operated at a piston speed of 100 ft. per min., "Coal Age" calculates the steam required to operate it by assuming an average steam consumption per indicated horse-power-hour of, say, 150 lb. dry saturated steam, which is a so-called "water-rate" of $150 \div 60 = 2.5$ lb. i.h.p.-min.; and multiplying this water rate by the indicated horse-power of the pump, as shown by the following:

Find the steam required to pump 9,000 gal. of water per hour, from a shaft 450 ft. deep, using a simple direct, double-acting pump running at a speed of 100 ft. per min. and discharging through a 3-in. column pipe.

The effective head, in this case, is

$$h_1 = 450 + \left(\frac{9,000}{60}\right)^2 \frac{450}{800 \times 3^5} = \text{say } 502 \text{ ft.}$$

The indicated horse-power of this pump will then be

$$H = 0.00034 \times 150 \times 502 = 25.6 \text{ h.p.}$$

The weight of steam required to operate this pump, under the assumed conditions, will be

Steam consumption,

$$2.5 \times 25.6 = 64 \text{ lb. per min.}$$

MEASUREMENT OF STREAM FLOW.

In determining, by the weir method, the flow of a stream, or the amount of water available for power purposes, the following handy table, for a weir one foot in length, will be found of interest:—

Depth in In. on Crest	Quantity in Cu. Ft. per Sec. for Each Ft. in Length	In Miners In.	Depth in In. on Crest	Quantity in Cu. Ft. per Sec for Each Ft. in Length	In Miners In.
1	0.08	3.2	7	1.50	60
1½	0.15	6	7½	1.66	66
2	0.23	9	8	1.81	72
2½	0.30	12	8½	2.00	80
3	0.40	16	9	2.18	87
3½	0.50	20	9½	2.35	94
4	0.65	26	10	2.55	102
4½	0.77	31	10½	2.75	110
5	0.90	36	11	2.93	117
5½	1.04	42	11½	3.15	126
6	1.18	47	12	3.35	134
6½	1.34	54			

This table was calculated for depths of water from one to twelve inches by one-half inch increments and for a weir width of one foot.

ELECTRICITY IN GRAIN ELEVATORS AT PORT ARTHUR AND FORT WILLIAM.*

By H. E. Stafford.

ELECTRIC power first came into the limelight in the grain elevator industry in Fort William, in 1902. It was first introduced by the Canadian Pacific Railway, which built a power house operated by steam, for the purpose of electrifying its numerous elevators. This company was the only one using electric power until the advent of the Kaministiquia Power Co., in 1905, which established a power house at the foot of Kakabeka Falls, 18 miles from Fort William, in June, 1905, and the first two units of 7,000 h.p. capacity were put into operation in December, 1906. A third unit of 7,000 h.p. was added in October, 1911, while a fourth unit of 13,000 h.p. was added in August, 1914, making a total of 27,000 h.p.

At this point the power is generated at 4,000 volts, and stepped up to 25 kv. It is transmitted at this voltage to sub-stations at Port Arthur and Fort William, where it is stepped down to 2,200 volts. The loss in transmission is approximately 3,000 volts. The sub-station at Fort William has, at present, three banks of three transformers with a capacity of 5,500 kv.a. for each bank. The station at Port Arthur has six transformers of 750 kv.a. each. The connections from power house to station are star-star, star-delta, with grounded neutral. Port Arthur has in addition, a hydro-electric plant at Current River with a total capacity of 2,500 kv.a., at 2,200 volts, which is used at the heaviest load period to keep down the peak.

Western Terminal Elevator.—This elevator is a recent type, and is the second in Fort William to purchase a power at 22 kv. The station was completed in August, 1914. The old plant which was built a few years ago is of concrete, with steel and tile cupola, while the tanks are tile. The new house, built in 1914, is of reinforced concrete throughout. The building is built on a foundation of piles driven sixty feet below cut-off. The piles are driven in blue clay, and are capable of standing a stress of between 16 and 20 tons per pile. The grain capacity of the elevator is 2,000,000 bushels. The power contracted for is 700 h.p. The plant is equipped with 56 motors of a total capacity of 1,140½ h.p. The motors are used for various purposes, some of which are given below.

There are two car-haul motors (one for each track) of 40 h.p. capacity each, capable of hauling 25 cars each. There are six receiving pits and three receiving legs with 22-inch buckets. Each leg is operated by a 75-h.p. motor. The distributing belt conveyers are operated by a 20-h.p. motor each, and the shipping belt conveyers are operated by a 15-h.p. motor each. The loading legs require from 60-h.p. to 75-h.p. motors each.

There are also seven cleaners and three cleaning legs. The cleaner legs take from 15 h.p. to 25 h.p. each, while the cleaners are operated by a 10-h.p. motor each. This plant is equipped with four flax machines, of 10-h.p. capacity each, and two special flax machines of 7½ h.p. each.

Two fans for collecting dust are operated by a 10-h.p. and 15-h.p. motor respectively, and the building is piped with compressed air supplied by a 4½ by 6-in. compressor for cleaning motors.

*From a paper to be presented at the 32nd Annual Convention of the American Institute of Electrical Engineers, Deer Park, Md., June 29, 1915.