

to whether velocity head was to be allowed for. In this connection it is pointed out that the suction pipe up to the condenser is 42-inch, and the discharge outlet from the pump 24-inch, and a tapering enlarger and valves are used to connect the 24-inch pump outlet to the 36-inch delivery pipe provided by the city. The difference in pressure between the two ends of this enlarger was slightly over 7/10 pound per square inch, being greater at the 36-inch end, and amounted to about 7/10 of one per cent. of the total head. The nature of the specifications prevented allowance being made for difference in velocity head between suction and discharge pipes, and it was also agreed that the discharge connection should be placed on the outlet from the pump where its diameter was 24-inch, and the results are reported on this basis.

The discharge pressures were taken with a sensitive Bourdon gauge, and the suction pressures by mercury manometer; there was always a slight pressure in the suction pipe at its centre line. Both readings were taken every five minutes, the discharge gauge being carefully calibrated.

The specifications required that the water pumped should be measured by Venturi meter, and both of the pumps discharged through a 36-inch meter with 21-inch throat. The quantity was calculated from readings of a mercury manometer, using the coefficient supplied by the Builders Iron Foundry, the makers of the meter, who state that a manometer reading of 5.07 inches of mercury corresponds to a discharge of 25.30 millions of Imperial gallons daily.

Readings were taken on the manometer at five-minute intervals, and in order to check the recorder for the meter, readings were also taken on it, and the results included for reference.

The contractors for the units were the Turbine Equipment Company, Toronto, who were represented by their manager, Mr. Austin, and also by Messrs. Salt and Petersen of the De Laval Turbine Company, Trenton, who designed the machinery and built much of it. The writer represented the city of Toronto and personally conducted both the trials.

Remarks on the Trials.

The results obtained on the units are a matter of great satisfaction, partly because they have so far exceeded the guarantees of duty, and partly because the results are exceptionally high for this class of pumping unit, and have probably not ever been exceeded by any similar unit running under similar conditions of steam and of equal water pressures.

General Dimensions of the Units.

(Both are exactly alike.)

<i>Turbine.</i>	
Normal speed	revs. per min. 3,430
Diameter of steam pipe	in. 4.5
Diameter of exhaust pipe	in. 36
<i>Double Helical Reduction Gear.</i>	
Number of teeth in pinion	33
Number of teeth in gear	197
Ratio of teeth	5.97
Pump speed corresp'd'g to turbine speed above	575
<i>Pump.</i>	
Number of stages	2
Suction and discharge openings	in. 24
Suction inlet to condenser	in. 42
Size of city's discharge main	in. 36
Enlarger from pump discharge to main	in. 24 x 36
Rated speed	revs. per min. 575

<i>Air Pump—Wheeler Rotrex.</i>	
Size	in. 20 x 40
Size of direct coupled driving engine	in. 7 x 7
Rated speed	revs. per min. 200

<i>Feed Pump—Goulds Triplex Single Acting.</i>	
Size of plungers	in. 3 1/2 x 6
Speeds in the two units	revs. per min. 47 & 66

Results of Duty Trials.

	Westerly unit.	Easterly unit.
Average barometer reading	in. 30.06	29.43
.....	pounds per sq. in. 14.77	14.45

<i>Pressures and Temperatures.</i>		
Average boiler pressure—pounds per sq. in.	149.4	148.4
Steam pressure at the turbine—pounds per sq. in.	144.7	144.6
Pressure in the calorimeter—pounds per sq. in.	1.36	1.38
Temperature in the calorimeter—deg. F.	294.8	300.2
Moisture in steam at turbine—per cent.	0.66	0.35
Vacuum in exhaust chamber—in. .	29.33	28.69
Temperature of steam in exhaust pipe—deg. F.	60.3	61.9

<i>Water Pressures.</i>		
Suction pressure as read—pounds per sq. in.	0.89	1.19
Delivery pressure near suction pipe level—pounds per sq. in.	107.34	107.97
Difference of gauge levels reduced to—pounds per sq. in.	0.79	0.40
Net pressure produced by pump—pounds per sq. in.	107.24	107.18
Net pressure specified—pounds per sq. in.	107.0	107.0

<i>Quantity of Water Pumped.</i>		
Size of Venturi meter tube—in. ...	21 x 36	21 x 36
Average manometer reading—in. mercury	4.895	4.99
Corresponding discharge—millions of Imp. gals. per 24 hours....	24.86	25.10
Specified discharge—millions of Imp. gals. per 24 hours.....	24.00	24.00
Dial on recorder gave—millions of Imp. gals. per 24 hours	24.80	24.99

<i>Speeds.</i>		
Average pump speed—r.p.m.	582.6	574.8
Corresp'ding turbine speed—r.p.m.	3,478	3,431
Average air pump speed—r.p.m. ..	151	147
Feed pump speed, double strokes each plunger	66	47

<i>Water Horse Power.</i>		
Net pressure produced* by pump—pounds per sq. in.	107.24	107.18
Discharge—million Imp. gals. per 24 hours	24.86	25.10
Work done per hour—foot-pounds:		
Westerly unit ..	2,562,679,427	
Easterly unit ..	2,585,972,052	
Corresponding water horse-power.	1,294.3	1,306.0

<i>Steam Used per Hour.</i>		
Steam condensed during test, including drips—pounds	169,803.5	168,010.0
Steam used per hour—pounds	16,980.3	16,801.0
Steam used per water horse-power hour—pounds	13.14	12.88