by contract, and in 48 by day labor. Interesting facts are shown by grouping the results according to the location of the cities as in the accompanying table, from which it appears that in the east usually one-third of the cities do extension work by contract, while in the Central and Western States from one-half to two-thirds of them employ the contract system.

Methods of Making Waterworks Extensions in Seventy-two Cities Grouped According to Location.

Location.	No. of cities which make extensions by contract.	day labor.	Percentage by contract.
New England	3	26	10
New York, Pennsylvania, New Jersey, Delaware, Maryland and District of Columbia	5	10	33
Virginia, Georgia and Florida	1	2	33
Ohio, Indiana, Illinois, Michigan and Wisconsin	5	4	56
Kentucky and Tennessee	2	..	100
Missouri and Texas	2	1	67
Minnesota, Iowa, Kansas, Nebraska and Colorado	3	3	50
Washington, Oregon, Utah and California	3	2	60
Total	24	48	33

NOTES ON THE SMELTING OF TITANIFEROUS IRON ORES IN THE ELECTRIC FURNACE AT WELLAND, ONT.

By B. F. Haanel, B.Sc.

Early in October, 1908, the Electro-Metals Company, Limited, of Welland, Ont., invited the Mines Branch of the Department of Mines to send a representative to Welland to witness the smelting of titaniferous iron ore in their electric furnace. I was, accordingly, instructed to proceed to Welland and report upon this experimental run.

The furnace used during these experiments was similar in construction and design to that employed at Sault Ste. Marie during the experiments carried on by the Dominion Government in 1906, hence a description is unnecessary.

The ore—which was sent by the Union Pacific Railway from their property in Wyoming—contained as high as 2 per cent. titanic acid (TiO_2), and the object of the experimental run was to show that an ore high in titanium could be successfully reduced in the electric furnace.

The principal figures relating to the run are as follows:—

Length of run (deducting stoppages)	22 h. 45 m.
Mean volts on furnace—	
High tension side	10,800
Low tension side	35.6
Mean amperes on high tension side	25.0
Power factor	0.91
Power used $\frac{10,800 \times 25 \times 0.91}{746}$	329 h.p.
Pig iron obtained	3,317 lbs.
Output of pig iron per 1,000 electrical horse-power days	Short tons. 5.040
Electrical horse-power years per ton of pig iron =	0.543

The analyses of the iron ore, charcoal, lime, slag, and pig iron produced have not yet been made by the chemists of the Mines Branch; but some analyses made in the laboratory of the Electro-Metals Co., Limited, of Welland, show that with a charge containing 35 pounds of lime only a trace of iron was found in the slag, and that the iron content of the slag increases with the increase of lime.

In the runs containing 50 pounds of lime the amount of slag produced was very large. In future runs on this ore, however, the amount of lime per charge will be reduced to 25 pounds, which, it is calculated, will greatly reduce the amount of slag.

The lime was only reduced to 35 pounds in runs preceding or after my visit. The charges used during the run witnessed by me were as follows:—

	Pounds.
Ten charges—	
Iron ore	200
Charcoal	60
Limestone	50
Three charges—	
Iron ore	200
Charcoal	65
Limestone	50
Twenty-two charges—	
Iron ore	200
Charcoal	70
Limestone	50

Making a total of 35 charges.

Some analyses of the pig iron obtained showed only a trace of titanium.

The output in pig iron per 1,000 horse-power days for this run must not be considered as the best result that can be obtained, as the furnace during the first seven hours of the run operated very badly. To arrive at definite and reliable results as to output the furnace should run continuously for at least three days.

On the completion of the analyses of the ore, lime, pig iron, etc., a full report will be prepared.

COMPRESSED AIR PRODUCTION AND USE.*

By A. C. Whittome.

The early builders of air compressors must have realized how inefficient their plants were, and therefore they adopted the terms "Mecanical" and "Volumetric" efficiency in order to conceal the fact. Unfortunately the terms have been handed down so that, at the present time, we still hear of such impossible mechanical efficiencies as 92 per cent. to 95 per cent., and volumetric efficiencies to even 99½ per cent. Of course such efficiencies never were and never will be attained in the compression of air; they have only been assumed through neglecting those losses which are absolutely inseparable from what it is, practically, semi-adiabatic compression. They would even be impossible if air could be compressed isothermally.

Of course, latter-day manufacturers are not desirous of hoodwinking their customers, few of whom really believe that the so-called "efficiencies" can actually be attained, but it is difficult to get out of a groove, and whilst everyone is desirous of having a proper basis of comparison established, no one cares to take the first step to establish it. One can sympathize with an agent or manufacturer who does not wish to say that his plant is 30 per cent. to 40 per cent. below the efficiency claimed by a competitor on the old system of comparison. On the other hand, intelligent purchasers of compressors ignore altogether the so-called "efficiencies," and use their own judgment in comparing different types of plant. Still the anomaly exists that, with the consent of all interested parties, machinery is on paper credited with efficiencies which it cannot possibly attain. This paper is written in the hope that a better system of comparison will be adopted for arriving at the efficiency of compressors, so that one type can be properly compared with another type.

When we talk of the "mechanical efficiency" of an electric generator we know just what is meant, viz., the proportion that the power delivered at switch-board is to that shown in the cylinders; why should not a similar result be conveyed

*Paper read before the Transvaal Institute of Mechanical Engineers.