THE ELECTRIC FURNACE: ITS EVOLUTION, THEORY AND PRACTICE

By Alfred Stansfield, D. Sc., A.R.S.M., Professor of Metallurgy in McGill University, Montreal.

These letters speak for themselves. They are similar to others received:—

UNIVERSITY OF WISCONSIN, COLLEGE OF MECHANICS AND ENGINEERING.

Madison, Wis., Dec. 7, 1906.

Dr. Alfred Stansfield, Professor of Metallurgy, McGill University, Montreal, Can.

Dear Sir,—I have been deeply interested in a serial running in "The Canadian Engineer" dealing with the electric furnace, and under your authorship. This appears to me by far the best treatment of the electric furnace from the applied standpoint that has been attempted, and it is helpful to me in connection with my instructional work.

I was much disappointed to learn that "The Canadian Engineer" cannot furnish me the back numbers containing your contributions, and thought that by some chance you might have this available for distribution in another form. If so, I should like to secure it.

I am in hopes that you will publish this in book form so that I may use it as a text. Is there any prospect of this being done?

Yours very truly,

C. F. BURGESS.

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Worthington, Ont.,

Dec. 13, 1906.

"The Canadian Engineer," Toronto, Ont.

Gentlemen,—Kindly forward me the September number of "The Canadian Engineer." I also wish to enquire whether the series of articles on "The Electric Furnace," by Alfred Stansfield, may be obtained in book form, and if so, where, and for how much. Thanking you for this information,

I remain, yours truly,

A. C. SCHAEFER.

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[The proprietors of "The Canadian Engineer" have pleasure in announcing that the articles by Dr. Stansfield, which have been running in "The Canadian Engineer" for the past eight months, and which will be concluded in Engineer," on fine paper, and will be tastefully bound. will be printed from new type, larger than that used in "The Engineer," one fine paper, and will be tastefully bound. So as to meet the needs of university students the price has been fixed at the low figure of $2. Orders can be given at the head office of "The Engineer," 62 Church Street, Toronto, and at the subsidiary offices, 32 B, Board of Trade Building, Montreal; "Free Press" Building, Winnipeg, and Northern Bank Building, Hastings Street, Vancouver.]

VI.

Other Uses of the Electric Furnace.

The production of iron and steel in the electric furnace is still in its infancy; and will be limited until the high price of electrical energy is reduced. But there are many other uses to which this source of heat has long been profitably applied, as has been indicated in the first two articles of this series. In some of these processes, electrical heat is alone able to produce the required result, while in others the value of the product and the greater economy of the electrical method has enabled it to supplant the older processes, even though the latter employed cheap fuel as the source of heat. Some of these uses of the electric furnace will now be considered.

The Ferro-Alloys.—The alloys of iron with certain metals, such as manganese, chromium, tungsten and titanium, or with the metalloid silicon, are often known as the ferros, and are usually equivalent to cast iron; that is, iron with a large percentage of carbon, in which part of the iron has been replaced by one of the above metals or metalloids. In some cases, however, carbon is present only in small amounts or not at all, and, on the other hand, more than one of the alloying metals may be present in the same ferro. The ferros are used in the production of steel as convenient means for introducing into the steel the manganese or other metal contained in the ferro; it is usually less costly to obtain these metals as ferro alloys than in the pure state, and the presence of the iron is not objectionable in additions made to steel; although the carbon, which is also usually present, is sometimes undesirable.

The metal manganese resembles iron in many particulars, but it is more difficult to reduce from its ores, and when this is effected in the blast furnace, with iron ore to furnish enough iron to collect and alloy with the manganese, some 2½ or 3 tons of coke are required to produce one ton of the 80 per cent. ferro-manganese, and about 20 per cent. of the manganese is lost in the slag owing to the imperfect reduction of the ore. Such an operation is very wasteful, both in fuel and in the valuable manganese ore, and the electric furnace is so much more economical in both these particulars that it can be used in competition with the blast furnace method. Silicon-eisen, that is low-grade ferro-silicon containing some 10 per cent. or 15 per cent. of silicon, can be made in the blast furnace by using siliceous charges and a great excess of fuel, the silicon being derived from the silica in the charge. In the electric furnace, however, using quartz as the source of silicon, with coke to reduce the quartz to the metallic state, and some iron ore or scrap iron to alloy with the silicon, an alloy containing as much as 80 per cent. of silicon may be obtained; and the electric furnace ferro-silicon has largely displaced the blast furnace product, as the cost of the former, per unit of silicon, is so much less. Some other ferro-alloys are also made more cheaply in the electric furnace.

The ferro-alloys may be produced in electric crucible furnaces, such as the Siemens vertical arc furnace, Fig. 2, p. 170, or the Heroult ore-smelting furnace, Fig. 22, p. 437, in which a carbon electrode dips into a carbon-lined receptacle, which forms the other electrode. In such a furnace the alloy will usually absorb a considerable amount of carbon from the lining, and if a carbonless alloy is required, a furnace like the Héroult steel furnace, Fig. 25, p. 326, should be used, in which two carbon electrodes are employed, which need not touch the molten metal, and the lining of the furnace is not made of carbon.

The electro-metallurgy of silicon is described by Albert Keller,* who states that at Livet, with 4,000 H.P., he was able to turn out 20 tons of 30 per cent. ferro-silicon per day, and that one ton of the alloy requires 3,500 kilowatt hours for its production from quartz, scrap iron and coke, the furnaces being each of 650 H.P.

The production and probable uses of ferro-titanium are discussed by Auguste J. Rossi,† who reduces titaniferous iron ores in the electric furnace, either with carbon or with the assistance of molten aluminium, which serves to reduce the metal from its ore. He has obtained alloys with from 10 per cent. to 75 per cent. of titanium, which, when aluminium was used as the reducing reagent, only contained a few tenths of one per cent. of carbon. Rossi states that titanium is not really such a bugbear to the iron metallurgist as is usually supposed, but that on the contrary ferro-titanium, added to either pig iron or steel, markedly improves the mechanical properties of the metal. In the case of steel he suggests that the well-known property of titanium

*Keller, Journ. Iron and Steel Inst., 1903, Vol. I., p. 166.

†Rossi, Mineral Industry, Vol. IX., 1901, and Trans. Am. Inst. Min. Engs., Vol. XXXIII., 1903, p. 191.