

ELECTRO
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METHOD
OF
IRON AND
STEEL
PRODUCTION

JOHN B. COOPER
PERSHAW

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ELECTRO-THERMAL METHODS OF
IRON AND STEEL PRODUCTION

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ELECTRO-THERMAL METHODS OF IRON AND STEEL PRODUCTION

BY

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WITH AN INTRODUCTION BY

DR. J. A. FLEMING, F.R.S.

ILLUSTRATED BY

50 Tables and 92 Diagrams and Photographs



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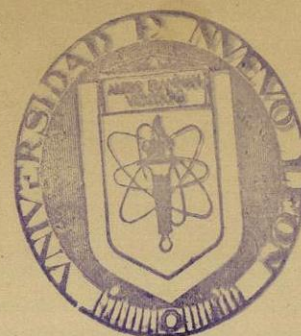
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PREFAZ ~~BI~~OTECA

THE *Electric Furnace* is now firmly established as a useful adjunct of the blast-furnace, Bessemer converter, and open-hearth furnace in all the important iron and steel producing countries of the world. The Author's purpose in preparing this handbook has been to amplify and bring up to date the information relating to electric methods of smelting and refining iron and steel that was presented in an earlier handbook published in 1907.¹

In Chapters I. and II. of the present work a general sketch of the scientific principles of electric heating is given, together with the broad lines of electric furnace design, in so far as these relate to furnaces for the smelting or refining of iron or steel. The theoretical side of the subject has not been dealt with more fully, because the handbook is intended for the men actually engaged in the steel industry rather than for the designers and constructors of large furnaces. It has seemed to the Author that full details of actual installations, and of methods of operation of the various types of furnace described, with summaries of working costs and tests of the raw materials and finished steel, would be more valuable to the practical steel-maker than a more extended treatment of the theoretical and mathematical side of the subject, especially as many of the data required for electric furnace calculations require verification or are altogether non-existent. The greater portion of the handbook is therefore devoted to the practical application of electric heating in the Iron and Steel industry, the improvements that have been made in the leading types of furnace, either in design or in methods of work,

¹ "The Electric Furnace in Iron and Steel Production," by John B. C. Kershaw: The Electrician Printing and Publishing Co., London.

during the period 1907—1912 being dealt with at considerable length in Chapters III. to VIII.

Chapters IX. and X. contain descriptions and other details of a large number of the less well-known furnaces, many of novel design, which are at present passing through the experimental stages of their industrial development, while Chapter XI. contains a summary of all the figures given in the previous Chapters of the handbook relating to Power consumption and working costs.

The Author is not connected by business relations with any of the patentees or companies exploiting the furnaces described; this fact should give added value to the handbook, and to the judgments expressed upon the various furnaces and processes dealt with.

The APPENDIX contains a large amount of useful information which it was not possible to incorporate in the body of the handbook. This includes (1) a list (based on official information) of all the electric furnaces for Iron and Steel Production in operation or under construction in 1912; (2) The titles and dates of all the more important British Patents relating to the subject and granted during the period 1901—1912; (3) Reprints in full of the text of British Patents which are of special interest, and (4) Abstracts of and notes from recent valuable papers on Electric refining.

That a practical work of this character, bringing together within one cover much scattered information was called for, is proved by the following quotation from the *Journal of the Iron and Steel Institute* for 1910.

“Every steel manufacturer found a difficulty in comparing the statements of the various makers of electric furnaces, and in deciding which one he should adopt; and the expense was obviously too great for anyone personally to consider the investigation of the respective merits of those furnaces.” (J. H. Heap, in Discussion on Campbell’s paper upon “Electric Steel Refining.”)

In the preparation of the handbook, which the Author believes will meet the above need, facts and data have been used from many and varied sources. The more important and valuable papers and articles that have been contributed on the subject to Scientific Societies, or have appeared in the Technical Press during the last five years, have been largely drawn upon; and the information they contain has been supplemented by that obtained by the Author directly from the Patentees and Users of the various furnaces described. Very full references to all the original literature are given in the course of the handbook, so that readers may consult this when it is necessary to obtain further information.

The Author’s thanks are due to the following Firms and individuals who have assisted him in the preparation of the handbook, either by the provision of facts and other data, or by the loan of drawings and photographs:—

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Finally, the Author must express his very great thanks to Professor Donnan, F.R.S., who kindly looked over the MS. of Chapters I. and II., to Mr. John E. Raworth, C. P. A., of London, who has given much time to the preparation of the list of British Patents which appears in the APPENDIX, and especially to Dr. J. A. Fleming, F.R.S., London, for kindly consenting to write an Introduction to the Handbook.

JOHN B. C. KERSHAW.

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WATERLOO, LIVERPOOL.

June, 1913.

INTRODUCTION

It hardly seems necessary for the Writer to introduce a work on "Electro-Thermal Methods of Iron and Steel Production" by an Author already so well known as Mr. Kershaw. Nevertheless it is an advantage to have the opportunity of recommending to those specially interested in the Iron and Steel Industries this careful endeavour to furnish precise technical information on so important a subject. The applications of the heat-producing powers of the electric current have of late years become increasingly valuable, both in domestic and manufacturing work, and are no longer to be regarded as merely experimental or tentative. The Writer endeavoured to set these out briefly in some Cantor Lectures on the "Applications of Electric Heating," given at the Royal Society of Arts in March, 1911.

The whole field of Electrometallurgy is one in which a great harvest of extremely useful achievement is still waiting to be reaped in the future, as it has been in the past. There seems to be no part of the manufacturing domain in which the electric current is not proving itself to be an implement of immense power. The Iron and Steel industries of this country hold such a predominant position that any innovation which seems likely to disturb existing methods of manufacture ought to be carefully investigated. The Electric furnace in its various forms, is no longer a mere laboratory instrument. It has taken a place as an operative agent, side by side with older appliances for the conduct of metallurgical operations.

The questions which the Iron and Steel manufacturer desires to have answered are, first, whether the electric furnace methods can produce Iron and Steel having any improved qualities, apart from cost, and, secondly, if any advantage in respect of quality can

be demonstrated whether the process can compete from the point of view of costs, with the furnace methods based on combustion.

Mr. Kershaw's book has for its object to give some exact information on these points, and to show how far the electro-thermal processes have demonstrated their advantage at present.

When a new application of electricity comes to the front there is always a tendency to underrate or over-rate its value. When the telephone was first invented official electricians laughed at it as a toy, but before long its proved practical value induced them to put into operation legal machinery to control its use, and enabled a Government Department to take Royalties for twenty years (reckoned in hundreds of thousands of pounds) for license to employ it.

At the inception of electric-lighting the public were led to believe in an immediate triumph over gas-lighting, but twenty years had to elapse before the older illuminant began to be seriously affected by the younger.

The real difficulties which arise in these new departures are never those that are anticipated, but are always something quite unexpected.

In the light of such experiences, therefore, no cautious person would assume that a new thermal process will undercut the older furnace method, in a brief space of time.

On the other hand, the advice to "*wait and see*," if followed too far, is one which is not seldom accompanied by the unpleasant experience of transferring business profits to other pockets than those of the "*waiter*."

The matter which lies at the foot of all technical applications of electricity is the cost per unit of producing electric energy. It is commonly assumed that countries rich in water-power have a position of supremacy as regards the production of a cheap supply of electric energy. It has, however, been demonstrated that the production of electric energy by the combustion of coal has not by any means reached its lowest limit of cost in Great Britain, and that if scientific methods and developments are brought to

bear upon the problem, we have no reason to fear that a country rich in coal strata, like Great Britain, will be at immeasurable disadvantage when compared with countries rich in water-power.

The first aspect of the subject is, however, the intrinsic advantage of electric furnace methods over combustion methods. If distinct superiority in the quality of the material produced can be demonstrated, then the question of cost of production will be more readily attacked.

Mr. Kershaw's book may therefore be strongly recommended to those iron and steel manufacturers who are first concerned to know what has already been done, and what are the proved points of value in the electrical methods of production. The various forms of electric furnace in use are fully described, and the question of costs of working are discussed, from the point of view of experimental results.

The electrical processes seem to have particular advantages in the production of special or alloy steel, which are of increasing importance.

Whilst the classical blast-furnace method for pig-iron production is not likely to be affected for a long time to come (at least in this country), there are nevertheless subsidiary operations in steel production in which the electrical methods are likely to prove their superiority soon; and a Book which deals in an impartial and critical spirit with the facts of experience is therefore of particular value to the Iron and Steel metallurgist who is desirous of precise information in order to determine his position as regards the newer methods. Lord Bacon tells us in one of his Essays, that truth emerges more readily from error than from confusion; and hence the first step in attaining the truth is to set out the facts, and view them steadily and as a whole.

This Book will enable the reader to do it as far as concerns the electrical production of Iron and Steel.

J. A. FLEMING.

UNIVERSITY COLLEGE,
LONDON.
March, 1913.

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COMPARATIVE POWER CONSUMPTIONS AND RUNNING COSTS, ETC.

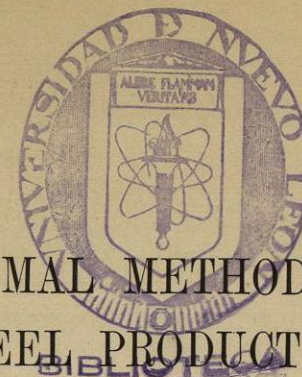
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BIBLIOTECA



ELECTRO-THERMAL METHODS OF IRON AND STEEL PRODUCTION.

CHAPTER I

INTRODUCTION

In a small handbook entitled "The Electric Furnace in Iron and Steel Production" published in London in the year 1907,¹ the writer, after describing all the well-known types of electric furnace, summarised the position at that date, in the following words:—

"The use of the electric furnace for iron ore reduction is, therefore, in the writer's opinion, not likely to undergo any industrial development at present, excepting under very special conditions.

"In countries like Norway and Switzerland, with abundance of water-power that can be developed at very low cost, it is possible that a native iron-smelting industry might be established, if iron ore and lime are found in the locality of the water-power. But here, again, special conditions will be required to render the industry a financial success, and it is unlikely that the iron will be able to compete in price in the open market, with the product of the ordinary blast-furnace.

"Taking the cost of the electrical horse-power year at £2 and the average power consumption in Table 1 we have the following costs:—

1. Steel from molten scrap, 2s. 6d. (400 kw. hours).
2. Steel from cold scrap and pig, 5s. 0d. (800 kw. hours).
3. Pig-iron from ore, coke and lime, charged cold, 15s. 6d. (2,500 kw. hours).
4. Pig-iron from ore, coke and lime-charged hot, 12s. 5d. (2,000 kw. hours)."

¹ The Electrician Printing and Publishing Co., Ltd.