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C. L. WORTH, Sec.-Treas., Room 409, Union Station, Toronto

Phones: Day, Main 4860.
Night, North 346.

THE CENTRAL RAILWAY AND ENGINEERING CLUB OF CANADA, MEETING.

Room 315, Union Station, TORONTO, March 19th, 1912.

The president, Mr. Bannon, occupied the chair.

Chairman,—

The first order of business is the reading of minutes of the previous meeting, and as you have all had a copy, it will be in order for someone to move the minutes be adopted as read.

Moved by Mr. Baldwin, seconded by Mr. Barker that the minutes of the previous meeting be adopted as read. Carried.

Chairman,—

The next order of business is the remarks of the President. It is unfortunate that we are unable to hold our meeting in the Prince George to-night. A few days ago Mr. Worth got word that we could not have our usual room, and this brings us face to face with the fact that we must get some permanent quarters. The Executive Committee has taken the matter up, and I hope by next meeting night to have some definite announcement to make in reference to this.

The Executive Committee is also taking up the matter of the advisability of running a Social Evening, which will be a little different from the usual smoker. They have decided to have a banquet. Where this banquet will be held, and the date on which it will be held, I am not prepared to state to-night, but you will be notified of this later. I may say that it has been decided that this banquet will be restricted to members only. It will be an informal banquet, the cost per plate will be about $2.00, and the charge to members will be $1.00, the Club paying the balance. The places under consideration are the Walker House, the St. Charles, or McConkey's.

We want every member of the Club to avail himself of this opportunity. This is an experiment, and is a step above the old Smoker, and I think we shall be able to enjoy ourselves much better than we have done in the past, and I trust that a large portion of the members will make it convenient to attend this banquet. As near as we can tell at the present time the banquet will be held in the early part of April. The next order of business is the announcement of New Members.

NEW MEMBERS.

J. W. Helps, Electrical Engineer, Toronto.
L. G. Winder, Inspector, G. T. Ry., Montreal.
J. G. Platt, Mech. Rep., Hunt Spiller Mfg., Co., Boston.
F. A. McGivern, Civil Engineer, Toronto.
G. H. Sutherland, Steamfitter, Consumers' Gas Co., Toronto.
T. Brown, Machinist, Gurney Foundry Co., Toronto.
W. G. Rumble, Drill Hand, Gurney Foundry Co., Toronto.
W. Kemp, Traveller, Dominion Radiator Co., Toronto.

MEMBERS PRESENT.

W. R. Maynard	A. M. Wickens	W. H. N. Davis
T. Brown	G. H. Davis	J. E. Rawstron
W. Dennett	A. H. Jones	Jas. Wright
W. Crossley	C. F. Nield	T. B. Cole
W. Finlay	R. Summerson	J. F. Campbell
J. H. Morrison	H. G. Fletcher	L. M. Watts
R. H. Fish	J. Barker	A. W. Ritchie
W. Cornish	A. M. Smith	J. McGill
C. Daniel	Jas. Anderson	E. A. Morrison
E. E. Cummings	W. Newman	W. Smith
W. Kemp	T. J. Ward	W. Hebden
R. S. Coxon	J. W. Walker	J. Douglas
J. Adam	H. Goodes	H. G. Woodley
A. Woodley	T. McKenzie	J. Kelley
G. Baldwin	G. S. Browne	J. Herriot
W. O. McLean	A. W. Carmichael	W. R. Gardner
J. A. Disney	F. A. Jacobs	C. T. Jackson
C. G. Herring	C. D. Scott	J. Bannon
G. Black	F. Scott	J. T. Robertson
L. S. Hyde	C. L. Worth	

Chairman,—

I will now pass on to the order of business of "Reading of papers and discussion thereof." The paper to-night is entitled "Notes on Foundry Practice," and has been prepared by Mr. E. B. Gilmore, but unfortunately Mr. Gilmore is out of town, and Mr. Robertson has kindly consented to read this paper. Mr. Robertson, I understand, is an authority on this subject, and thoroughly understands what this paper is about, I have therefore much pleasure in introducing Mr. Robertson.

Mr. Robertson,—

I am very pleased to be here to-night, but I am afraid that my presence is unfortunate. In the first place I know that Mr. Gilmore would like to have been here himself to handle his paper, which he no doubt would have been able to do much better than I can, and secondly, in spite of what your Chairman has said, I am not thoroughly familiar with many of the points brought out in this paper. I am afraid there are a good many here to-night who are much more familiar with this subject than I am; however, I will read Mr. Gilmore's paper as he sent it to me.

"NOTES ON FOUNDRY PRACTICE."

A PRACTICAL TREATISE ON THE PRINCIPLES OF IRON FOUNDING.

By E. B. Gilmore, Foundry Expert, Toronto.

"I would rather lose $100 than that casting should go to the scrap pile."

This and similar remarks in the foundry has been the inspiration of the writer with his wide and varied experience to endeavor to help those who have been so unfortunate to be placed in that position to cause them to make the above remark. But all foundrymen are aware that the moulder is not born who will make every casting good, at the same time every casting that is bad is caused by an adequate cause, it is simply violating the laws that govern moulding. Good luck or bad luck in the foundry is nothing, it is simply doing right or doing wrong.

It is not the intention of the writer that any one reading this paper will at the finish be a full-fledged moulder and make no bad castings, but it is my object to give to the reader something which the regular apprentice in the foundry cannot always get unless he goes to some trades school or some other source which in a great many cases entails a large amount of study on the part of the student, and, if this is eliminated in the least degree, I will be amply rewarded for the time spent in its preparation.

As the art of moulding is one of the most scientific branches of industry, and there are so many circumstances and conditions which are very often beyond the moulder's control, for instance, the sand in some districts is of very poor quality and requires special manipulation unknown to the strange moulder in that district, and the same applies to the iron, also there is the firm or the superintendent who will not keep up the equipment or who do not or cannot get up a good design of rigging for the production of some particular work, and make any old thing do. In this case it takes a thorough skilled mechanic to do the work.

It will not be out of place here to discuss the foundry business in general, and how to make it successful.

In the first place, we have a lack of good mechanics. Why? Because in all the foundries there is a general aim to specialize not only in the men, but also in the work, and the foundry that specializes is usually successful. There are no companies starting a foundry for the sole purpose of training moulders, but for the main purpose of making money, and if they make money they are considered successful as a business venture, any foundry that specializes in any particular line can usually reduce the cost of production to such an extent that no other foundry can compete with them, and for any other foundry to attempt it it means a very heavy loss at the beginning, until they get their men trained into that line of work, for in any special work you do not wish what is generally termed skilled mechanics, but those men become in a very short period of time skilled beyond the regular mechanic, and they not having any regular line of occupation, are desirous to make the best of what is before them. They make better wages than the ordinary laborer, and, in many cases, larger than the regular mechanic, and produce more work. They become adepts in this one line, and are beyond competition, whereas the regular workman who is trained to think about his work cannot remain on one class of work for an indefinite period, his brain would become dull for want of action, and he would leave the job even though it was a loss to him financially.

Another point which gives very serious consideration to the company embarking into the foundry business is the selecting of a competent manager, as most of the large concerns have been formed by capitalists who were business men and had no practical knowledge of the foundry business, and are to be guided by some other influence beyond their control, which, in a great many cases, are very expensive. You can go into any large foundry and you will see monuments of different superintendents which have cost lots of money and have been discarded, simply because of change of management. In a great many instances the new management did not know how to operate them and could not realize their benefits, consequently they were consigned to the store room or scrap pile. I have one instance in mind at present wherein their was a machine in the foundry which was paying its investment over one hundred per cent. The machine, through constant usage, required some repairs, but as the superintendent contemplated a change, he left the repairs to his successor who instead of making the necessary repairs, decided that the machine was no good and ordered it to the scrap pile. Now, if the management had been alive to their interests and been practical this would never have occurred. It is the same way with moulding machines. Some foundrymen are cranks on the moulding machine question, and they will cause a company to spend lots of money on machines and not always get the results promised, and cause disappointments, and when a change of management takes place they may get a man who is diametrically opposed to moulding machines, and will leave them to rust and decay. Any company selecting a manager should aim to get a man of good capabilities. He should be a man of intelligence, having a good knowledge of business routine and principles. Having this knowledge, he will be more liable to be conservative in the spending of his company's money. And, again, he must be a thorough practical mechanic, broad-minded as to methods in producing work, understand human nature, because there is as much in understanding your men as the work, as there is no trade which demands so much skill and experience, and when so many enter into it and are so wholly deficient in its practical operation, and to-day there is no field in any mechanical line which offers so many inducements for a young man than in the foundry, mainly on account of this specializing, as very few skilled mechanics are being trained. Some of the large companies have employed the technical student from the trades school as manager of their foundries. He has been a decided failure, as it takes more than brains and intelligence to manage a foundry. He must have experience, which is only got by hard knocks, which is essential for a good foundry manager, as a foundry is no charitable institution.

It is essential that every foundry manager should be conversant with all the elements which enter into the constituents of pig iron. Foundrymen now realize that pig iron is not a simple substance, but an alloy of elements which are very dissimilar and have physical characteristics which give strength, elasticity, conductivity, malleability, tenacity, density, etc., in proportion to the amount of the elements present. Greater knowledge is being sought every day concerning the chemical questions involved in foundry practice. It is not essential that a foundryman should be a practical chemist, but it is very essential that he should be conversant with the action of all the elements which enter into the constituents of iron, and with this knowledge he will be more able to produce a better and a cheaper casting and comply with rigid specifications and overcome the numerous emergencies that beset the melter of pig iron. You are apt to think that the quantities of those elements are so small that they will not affect your castings. Take, for instance, what a little carbon it requires to change iron into steel, and it is only when you get a correct knowledge of the percentages of the elements in iron that you will be able to bring your experiments to a successful termination.

The question then arises, What is pig iron? Bloxam says that a "Metal is an element capable of forming a base by combining with oxygen," and these compounds of elements with oxygen are called oxides. Iron in a pure state is of practically no value, as it is too soft. It is of a high magnetic power, but it does not hold it long. When it is in combination with carbon and the other elements its value is so increased that it becomes the most valuable metal known. Pig iron contains from 92 to 94 per cent. iron, carbon 3 to 4.50 per cent., silicon .04 to 8 per cent., phosphorus from a trace to 1.50 per cent., sulphur from a trace to 1 per cent., manganese from .25 to 1.50 per cent. These are commercial figures. Later, when we take up the various elements singly we will enter into their relative values and their effects on iron.

NUMBERING OF PIG IRON.

Pig iron is usually numbered from No. 1 to Nos. 7 and 8. The great amount of different grades and their variations in different sections where they are made has made this numbering very confusing. As a natural consequence foundrymen have had to resort to more stable methods, viz., buying by analysis which system is pretty well established. Although iron is still sold by numbers, the analysis designating the number.

No. 1 foundry iron is the darkest of the numbers, and contains the largest amount of graphitic carbon. It has very large crystals and a rough appearance when broken. Its tensile strength and elastic limit is very low. This iron is usually used in stove plate and very light castings.

No. 2 is used more generally in the foundry than any other grade. The grain is closer than No. 1. It is harder and stronger, being lower in graphitic carbon and silicon. One great advantage in using No. 2 is that you can use a large amount of scrap in your mixture.

No 3 is a stronger iron than No. 2, but is a very poor scrap carrier, the percentage of graphitic carbon and silicon is much less and the combined carbon greater. It is not good practice to use No. 3 alone, although you may get your desired analysis for your mixture, as there are other elements which will be incorporated in your mixture which will be beneficial, although unknown to you from an analysis. If you are compelled to use one grade try and get from different districts, as some of the ores have an admixture of vanadium, tatnium and other elements not analyzed for. The other numbers go into grey, forge and mottled, which is exclusively used for puddling purposes.

These elements are usually called impurities. I do not see why they should be called such, because as I have already said that iron in the pure state is useless and requires these elements in order to make it of a commercial value, so why should they be called impurities? I would call any mixture of iron an alloy, because there is no such a thing as bad iron, but only misplaced iron, as definite combination of these elements is the only alloy to be used when you correctly understand their proper application.

The principal and most effective element that we have to contend with is carbon. The different proportions of carbon held in chemical composition in iron determines the quality of the material, whether it is cast iron, malleable iron or steel. Cast iron contains more than steel, and steel more than malleable iron; it exists in pig iron in two distinct forms, the combined and the graphitic. It depends upon the proportions of these to determine the character of the metal. There is no particular dividing line wherein we may say definitely that this is cast iron, malleable or steel. By way of illustration, you cannot tell when lamb ceases to be lamb and become mutton, and it is similar in irons. The addition of the various elements in iron do not, as a rule, affect the iron directly, but their influence on the carbon is what makes the changes. Carbon enters into combination with iron as low as .05 and up to 4.5 per cent., .05 is a very low carbon steel, and 4.5 carbon is a high carbon iron. Now, these percentages of carbon can be changed during the process of melting and treatment through the form and construction of the cupola or whatever kind of furnace that you may wish to melt your material in. For instance, if you take a cupola having a fore-hearth, which means that you have practically no bed in your cupola beyond the melting zone, and use a high carbon iron, your product will become a low carbon iron. Again, if you use a cupola with a high bed and charge a low carbon iron, your result will be a high carbon iron for the reason that when iron is melted in a cupola at the melting zone the oxygen comes in contact with the carbon in the fuel and the carbon in the iron is consumed and passes off as carbon monoxide, and carbon dioxide gases, in the first instance, when passing through the melting zone the iron does not come into contact with any more carbon. It passes the fore-hearth, whereas in the second instance it passes through the melting zone, the iron reaches the bed of the cupola and comes into contact with a large amount of coke, absorbs the carbon from the fuel and becomes saturated. And, again, carbon conditions may be changed with the blast conditions as a heavy blast and light charges of coke will reduce the carbon contents and the reverse heavy charges of coke with light blast will increase the relative quantity of carbon in the product. Now, seeing that carbon is the controlling element in iron it behooves the foundryman to correctly understand the workings of his cupola in order to get out of the cupola what he puts in, or, in other words, put in what he knows and get out what he desires.

When iron is in the molten condition the carbon is in the combined form, so that whatever condition you want the carbon in your casting it can be controlled by the temperature of pouring, the method and manner in which it is cooled; also the thickness and construction of the casting required. In order to hold the carbon in the combined state you must have rapid cooling, which means strong and hard castings. Slow cooling changes the carbon from the combined state to the graphitic state, which means soft, but weak castings. This regulating of the carbon from one state to another is greatly influenced by the presence of the other elements, such as silicon, sulphur, phosphorus, manganese.

SILICON (FLINT).

By a judicious use of this element the founder can change the combined carbon to the graphitic, and vice versa. This element is better administered in the blast furnace than in ferro-silicon irons. When carbon has become graphitic the further addition of silicon hardens iron. This, however, is produced entirely through its influence on the carbon and not by the direct influence of the silicon. Silicon is not a softener of iron, nor is it a lessener of shrinkage, but through its influence with carbon and only during a certain stage does it produce those effects.

The loss of silicon in re-melting is in proportion to the amount present. In a 3 per cent. mixture there will be a loss of about .25 per cent. In a 2½ mixture the loss will be about .20 per cent., and in about this proportion down the line.

Cast iron which contains enough silicon to take out the brittleness and to allow it to make a solid casting is the strongest composition ordinarily found in cast irons. If strength be more important than softness we will leave the greatest amount possible of the carbon in the combined state that will not cause the iron to be too brittle.

SULPHUR.

Sulphur has the effect of holding the carbon in the combined condition and of making the casting hard. It is not so injurious an element as generally looked upon. When it is present up to .08 or .09 it has the effect of strengthening cast iron. Beyond that point it is very dangerous, having the effect of causing blow holes in castings.

Sulphur is readily removed from iron in re-melting. It is found that the temperature of the cupola has a wonderful effect in determining the percentage of sulphur in iron. At high temperature the sulphur will be taken up with the slag, as there is little affinity between iron and sulphur under this condition, and that iron becomes comparatively free. You will also remove sulphur by an addition of manganese, which will form a manganese-sulphide. If you have to stop the blast or reduce the pressure while melting, you will reduce the temperature of your cupola; consequently, the sulphur will attach itself to the iron. Sulphur in iron increases the combined carbon and lowers the graphitic and affects the crystallization, but will not affect the silicon, so that in buying iron you sometimes get iron high in silicon, high in sulphur, high in combined carbon, and low in total carbon. This iron might show a very good fracture in the pig, but if cast into a chill mould develop a heavy chill in spite of the presence of the silicon, indicating that iron is not suited for very light castings or castings to be machined. Also if you put iron in the cupola comparatively free from sulphur, and do not melt it hot, it will absorb all the sulphur from the fuel and your castings will be high in sulphur. High sulphur castings are usually filled with blow holes and hard to machine, and in coming in contact with the damp sand, will get chilled and develop excessive shrinkage. Thus if you know that your iron is all right before melting and have trouble with your castings, what you want to do is increase the temperature of your cupola; also get an analysis of your coke, and if it shows one per cent. or over, discard it as being unfit for melting iron.

PHOSPHORUS.

The principal effect of this element is that it makes the iron fluid, and is extremely valuable in light castings. It has the effect of weakening the casting, but only when it is over one per cent. and under this point it is very beneficial, as it is a lessener of shrinkage. I have cast heavy castings with a one per cent. phosphorus and had good results. High phosphorus irons should be poured at low temperatures on account of the difference in specific gravity of it and the metal. It is not to be expected that a given quantity of this element will always behave the same, for other elements may be present in such a way as to change the entire results. Phosphorus causes cold short (brittle when cold). The cupola does not burn it out. It will absorb some in melting from the fuel, although very slight.

MANGANESE.

This element has of late taken a more important place in the range of foundry mixtures. It will almost wholly remove sulphur by forming a manganese sulphide which will pass off with the slag. I have known of an instance when a mixture was all that could be desired, so as to get good soft castings for machining, with the exception of being low in manganese, and those castings were so hard that it spoiled the best tools trying to cut it without effect.

The same mixture was taken with an addition of manganese and the results were surprising. This element has the effect of closing the grain and making the iron susceptible to chill. Manganese is better administered in the form of ferro-manganese in the ladle than in the cupola. Its loss in the cupola is in proportion to the amount of sulphur present when your iron is high in sulphur your loss will be very great, and when your sulphur is low your loss of manganese will be low.

THE PRINCIPLES OF MELTING IRON IN THE CUPOLA.

The name and style of this furnace is derived from a cupola or dome leading to the chimney, which is now frequently omitted.

Cupolas are usually made in sizes ranging from 18 in. to an unlimited size in diameter, to suit the requirements of the foundries that they are installed in, and in nearly every foundry there are two or more cupolas, a medium sized one for every-day use, and a large one for special large heats. Some large foundries have a small one for experimental purposes. The shape and style of cupolas have become pretty well standardized with very little difference as regards results.

All founders possess more or less knowledge of cupola practice, and mixing of irons. When I say founders I do not mean moulders, as plenty of moulders do not know anything about a cupola.

The cupola furnace for melting iron has a great advantage over all kinds of furnaces, as it melts iron cheaply and quickly, from a small quantity to an unlimited amount, with very little fuel. The cupola does not improve the quality of the iron melted, but in this age of keen competition, everyone is trying to get the best results as regards quantity and quality of their product. The improvements that have been worked on the cupola have been very little, comparatively, with the other improvements that have been added to the foundry. I remember the old style cupola with the single tuyer on each side, blowing direct into the furnace which gave good results. Now they are built in multiple rows of tuyers, which is a great improvement.

POSSIBILITIES OF THE ELECTRIC STEEL REFINING FURNACE.

When the Tropenas converter was introduced and success assured, it was introduced and success assured, it was believed that the steel casting industry had about reached the top notch. Although unable to compete with the open hearth furnace on large castings, for the smaller lines of work the converter could produce steel superior to that of the open hearth. Each system was, therefore, practically in a field of its own. Now, however, with a better understanding, cheapening and controlling of electricity, attention has been drawn to consider the electrical furnace as a still more efficient medium for the production and refining of steel.

About 15 years ago, in a plant where the writer was employed, an attempt was made to melt grey iron in the cupola by electrical means, instead of coke. Sunday was the day selected to try the experiment on account of the fact that the whole power of the plant was required for the purpose. It is not necessary to go into details, further than to say that iron was melted, but so sluggish was it that pouring from the ladle, much less the pouring into a mould, was impossible. Since that time a number of electric furnaces have been designed, and in their operation have given excellent results by producing high grade steel at phenomenal low cost. At an additional cost of $1 per ton, they can transform the most common Bessemer iron into best quality iron suitable for car wheels or automobile and small marine engine cylinders. In fact, you can produce just what you desire and know what it is before taking it from the furnace. It is the most practical method for reducing sulphur, and, at the same time, for obtaining a strong close-grained yet soft iron suitable for machining.

THE GRONWALL ELECTRIC FURNACE.

One of the most efficient types of electric furnace up to the present time is the "Gronwall," invented by Messrs. Gronwall, Lindblade & Stalhane, three Swedish engineers of Ludvika. This furnace has some very distinct features, not embodied in others. The two-phase current arc type has been adopted, a procedure exactly opposite to the induction system. Electric furnaces differ from all others in that they receive their heat from mechanical sources, those of the open hearth and converter being heated from a chemical combination. In the mechanical method, you can control the elements of your mixture with certainty, whereas, in the chemical, everything depends upon the nature of the fuel used. Again, comparing the electric furnace with the crucible, there is a bath wherein you can make additions of refining slag so as to make steel to suit any specification desired.

A general view of the Gronwall furnace is shown in Fig. 1. It will be noted that there are two carbon electrodes hung perpendicular, being a means of additional strength, compared with some types which have the electrodes hung at an angle inside the furnace, where with the intense heat they become soft and liable to break and drop into the bath of metal. Such

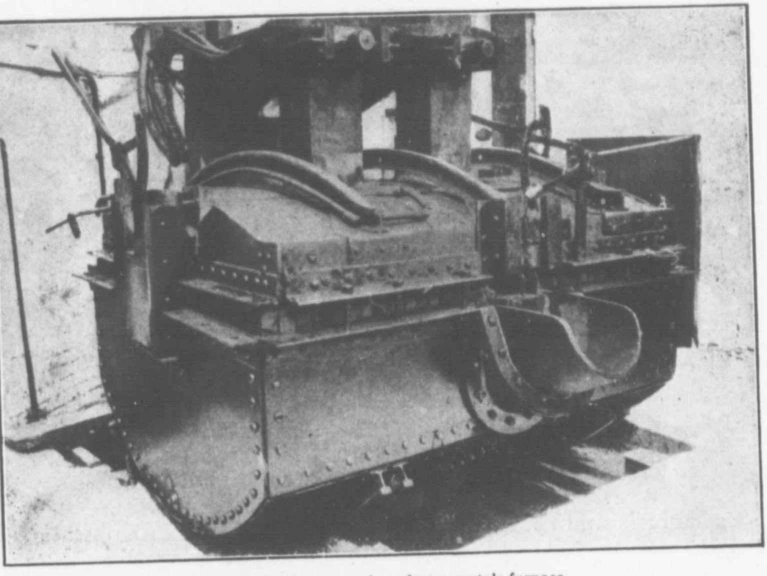


Fig. 1—2½ tons capacity, electro-metals furnace.

a contingency would raise the carbon content and practically make the steel into cast iron, unless the carbon was withdrawn before it dissolved; otherwise, additions of ore and scale, to reduce the carbon present, would have to be made, as in the open hearth furnace, necessitating subsequent deoxidation of the steel before being poured. The vertical electrodes seldom break. The average analysis of the Amphorus Carbon Electrodes is as follows: Carbon 96 per cent., ash 2.80 per cent., sulphur .80 per cent. These electrodes are provided with screwed joints, so that they can be fed into the furnace continuously, the consumption being about 100 pounds per charge of a 5-ton furnace.

Their size is 14 inches square by 6 feet long, and 1.57 specific gravity. Each electrode is independent of the other, so that if anything goes wrong with one, the other can run the furnace. If arranged in sets, any single unit interference means complete shut down. The current passes from the electrodes to the slag or the metal in the bath, forming an arc, then through to the basic lining on to a carbon block at the bottom of the furnace.

The main shell of the furnace is built of boiler plate and magnesite brick lining, with a hearth of dolomite rammed therein as in Figs. 2 and 3. The roof is made of channel iron in the form of a frame, to hold the silica brick. It is separate from the other lining, so that when repairs are required to the roof, it affects nothing else. Working doors are provided at each end, also at the tapping spout, of a size to suit the requirements of charging. This can be either hot or cold, and if a very large piece is wanted to be disposed of, the top can be lifted off altogether and quickly replaced. At the back of the furnace there is a rachet arrangement for the regulation of the electrodes. This may be done by hand or automatically as desired. The loss of electric energy is reduced to a minimum by the method of gripping the electrodes quite low down. The furnace is tilted by hand or by power, electric or hydraulic. The electrical equipment has been properly taken care of, and there is little difficulty in reducing a high tension to 50 or 70 volts.

ELECTRIC IRON SMELTING FURNACES.

The same engineers have also designed and patented an electric iron smelting furnace of the cupola type, using charcoal as a reducing agent. This to all appearance is going to hold its own in the manufacture of pig iron, and I believe will be a commercial success especially in Canada where there is such abundance of ore, but so high in phosphorus that it can-

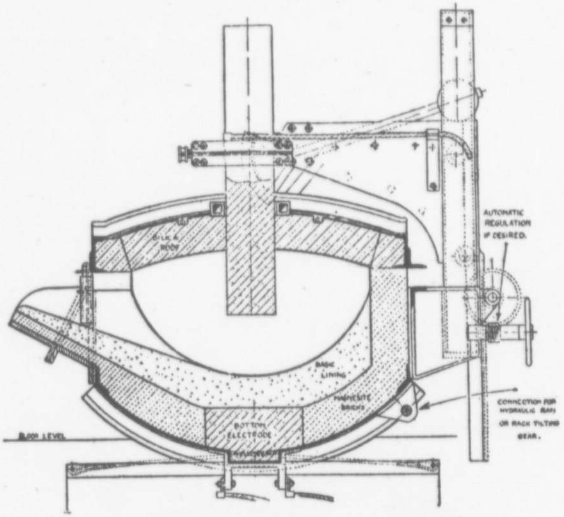


Fig. 2—2½ tons capacity, electro-metals steel refining furnace—cross section.

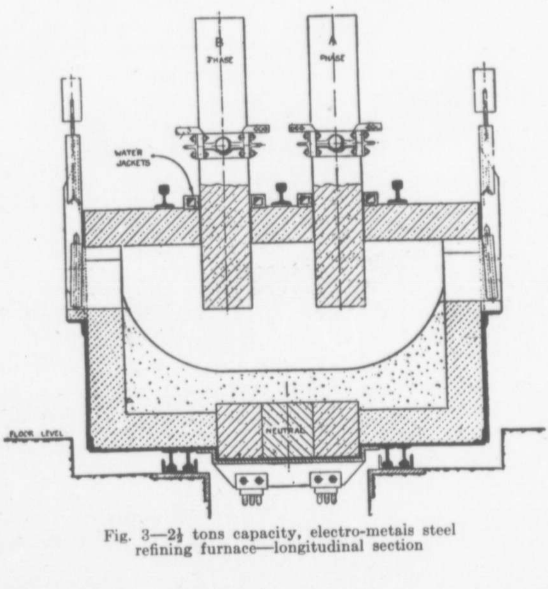


Fig. 3—2½ tons capacity, electro-metals steel refining furnace—longitudinal section

not be used in the manufacturing of steel. There are other designers in Canada working along similar lines, but as their efforts are still in the experimental stage they cannot at this time be discussed. I have appended the latest report of the Trollhattan furnace operation.

TROLLHATTAN FURNACE OPERATION.

As might have been expected, the first six months' working suggested various alterations in the construction of the furnace. It was, therefore, shut down at the beginning of June last, for the carrying out of these alterations. The plant was again started during the first week of September, and has been at uninterrupted work ever since. During the week from September 3 to September 9, the following results were obtained:

	Tons.
Pig iron produced	131.4
Quantity of slag	22.1
Charcoal used per ton of iron	0.336
Pig iron produced per kw. year	5.05
Pig iron produced per h.p. year	3.79
Current consumption per ton of iron	1,736 h.p. hours
Power consumption per ton of iron	2,351 h.p. hours
Average load	1,357 kw.
Average CO2 contents in the gas (by volume)	30 per cent.

The current and fuel consumption depend, of course, to a large extent on the quality of the ore. The results for a protracted period during which the same kind of ore was used are, therefore, of interest.

WORKING RESULTS.

	Sept. 3 to Sept. 30.
Pig iron produced, tons	537.9
Quantity of slag, tons	88.9
Iron in the ore, per cent	67.65
Iron in the ore and lime, per cent.	65.02
Quantity of slag per ton of iron, kg	165
Charcoal used per ton of iron, kg	339.9
Average load, kw.	1,407
Average power, h.p.	1,913.5
*Current used per ton of iron, kw. hours	1,749
†Iron produced per kw. year, tons	5.01
Iron produced per h.p. year, tons	3.68
Average CO2 contents in gas, per cent.	29.27

Average analysis of iron:

C. per cent.	3.64
Si, per cent.	0.36
Mn, per cent.	0.40
S, per cent.	0.009
P, per cent.	0.018

*According to instruments at the furnace.

†Estimated on the basis of 8,760 kw. hours per kw. year.

Comparing these figures with the earlier results, it will be seen that a great improvement has been obtained over the first six months' working results. Per ton of iron there were then used from 2,150 to 3,800 kw. hours, and for the entire time an average of 2,391 kw. hours. The ores then used varied somewhat in quality, but it will be seen that a reduction of 20 to 25 per cent. has been effected in the current consumption. Correspondingly, the output of pig iron per kw. year has been raised from an average of 3.66 tons to over 5 tons. The charcoal consumption has been reduced from 418 kg. to 340 to 345 kg. per ton of iron, and the electrode consumption has also been reduced. The electrodes now used are supplied by the well-known Planiawerke, and are provided with screw joints so that there are no waste stumps.

The practical importance of the process is best proved by the fact that there are now built or building furnaces for an aggregate of 27,000 h.p., while, in addition, furnaces for about 36,000 h.p. are projected.

Chairman,—

You have all listened to the excellent paper which has been read by Mr. Robertson, and I do not doubt but that he will be able to answer any questions you may have to put to him.

Mr. Morrison,—

There is one point I would like to ask Mr. Robertson about, and that is in reference to the covers. He mentioned in the paper that an extra cover was usually kept on hand, and I should like to know the kind of firebrick used in these covers?

Mr. Robertson,—

A cover of silica brick is used.

Mr. Morrison,—

In reference to electrical furnaces. What effect has the electricity on the bricks in comparsion to the coke used in ordinary furnaces?

Mr. Robertson,—

The temperature in the electrical furnaces is in certain parts very much higher, and consequently the brick is more apt to flux than in the ordinary furnace where there is a more even heat. Arrangements have been made to introduce water cooling plates to obviate this defect of high temperature. The reduction furnace that I mentioned worked for six months without having to shut down to have the bricks renewed. This of course does not compare very well with the modern blast furnace, but when these electric furnaces were first introduced they would hardly run for six days without burning out the brick. A magnesite brick is used in the furnace hearth, but fire brick is used in lining the shaft similar to that used in the blast furnace.

Mr. Wickens,—

I am sure the paper has been very interesting to all present. I think Mr. Gilmore has gone into the chemical properties of iron a little deeper than most of us are able to follow.

There is no question that a proper mixture must be put into the furnace if we are to get good iron. We have all had more or less trouble with sulphur in iron. A man who works with cast iron, wrought iron or more especially steel, and perhaps it applies to steel more particularly, knows that too much sulphur in steel when it is used for boiler plates will cause the plates to crack. We had a great deal of trouble some years ago with sulphur in steel that we got for boiler plates also with sulphur in cast iron for cylinders. We either had hard spots or blow holes. It was difficult to get cast iron that was even in hardness all the way through and still hard enough to wear well and not too hard to tool. I think the greatest cause of our trouble was due to sulphur. In boiler plates we always tried to get plates that were poor in sulphur. A few years ago when the American mills were using gas in the furnaces we had no trouble to buy boiler plates with .02% of sulphur, but to-day we have to accept them with .04%. The presence of too much sulphur in the plates causes them to crack, especially at the edges. It appears to me that now that we have got electrical furnaces we should not be bothered with sulphur except that originally in the iron ore and I think it will be possible to eliminate the greater portion of that sulphur.

I think the paper has gone into this matter almost too deep except for a man who is in the business of manufacturing iron, although the points brought out will certainly be of use to all of us. I hope that some of the members who are used to melting metals and using cupolas will have something to say that will further interest us.

Mr. Taylor,—

I would like to have heard some of the foundrymen enter into this discussion. I know that we receive a great number of bad castings, but I do not want to say very much about them for fear of treading on the toes of some of our local foundrymen. However, I know it is a common occurrence to receive six or a dozen cylinders in order to get one good casting.

I was very much surprised to hear there were so many grades of iron. I do not think the foundrymen here realize that fact, as it seems to me there is only one grade here, which consists of all the old scrap iron and grate bars they can find and I think if a little more attention was paid to distinguishing between burnt grate bars and cylinders they would produce better castings for machining.

I am sure we would all like to hear what the local foundrymen have to say on this matter.

Mr. Robertson,—

In the first place I came here to take the part of Mr. Gilmore and I am certainly not going to take the part of the local foundrymen of Toronto, as I feel quite sure that they are better able to speak for themselves. However, I wish to say this in reference to the remarks of the last speaker and the remarks of Mr. Wickens, that specifications for castings will get more stringent as time goes on. In Europe where competition is much keener than either in Canada or the United States the foundries have been absolutely compelled to adopt the latest methods in order to compete with each other. On this continent it is largely a question of supply and demand and up to the present time the demand has been much in excess of the supply, consequently so long as this exists there is not much hope for improvement in methods of manufacture.

Mr. Wright,—

I see one or two foundrymen here who should be able to give us some information on the points brought out in this paper. The paper Mr. Gilmore has written is very thorough and if some of our molders would get up and discuss it we might be able to understand it a little better.

Mr. Baldwin,—

The Secretary was good enough to send me three advance copies of the paper and I thought after looking it over that some of our foundrymen might be interested in discussing the matter, so I handed a couple of copies to two of our foundrymen expecting that they would come down and take up the discussion and tell us of some of their troubles, but apparently they do not care to say much about it. We do not specialize in our work, and take anything and everything that comes along, which of course makes it hard to get good castings, all round, but I must say that we are getting a better class of castings now with very few scrap castings, but whether this is from better workmanship or better pig iron, I am not in a position to say.

Mr. Taylor,—

I was very much surprised at Mr. Robertson making so many excuses and apologies previous to reading Mr. Gilmore's paper. I see that he understands this subject thoroughly and I have no doubt that if at some future time he can be prevailed upon to write a paper it will be of great interest.

I have great pleasure in moving a hearty vote of thanks to Mr. Robertson for reading this paper to-night, and trust that we shall have the pleasure of hearing a paper prepared by himself.

Mr. Wright,—

I second that. Carried.

Chairman,—

Mr. Robertson, I have great pleasure in tendering to you the very hearty vote of thanks of this meeting, for the very able manner in which you have handled another man's paper.

I understand that Mr. Robertson is in the electrical line, therefore I think he has done remarkable well to handle the paper in the manner he has.

I understand Mr. Robertson has already promised to give us a paper, and no doubt you will all have the pleasure of listening to Mr. Robertson again.

Mr. Robertson,—

Mr. Chairman and gentlemen, I must thank you most sincerely for the hearty vote of thanks, and I feel very grateful for the kind reception which you have given me to-night.

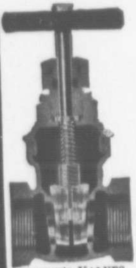
I might say when Mr. Gilmore asked me to read his paper, in a weak moment I said yes; however, I have since questioned the advisability of my doing so, but since coming down here to-night, I must say that I have thoroughly enjoyed myself. While I do not wish to criticize Mr. Gilmore's paper, yet I certainly agree with one or two of the speakers that for the average audience this paper contains too many chemical terms.

I should like very much to come down here next fall and give you a talk on the matter of electrical furnaces. I have spent considerable time in Sweden working with these electric furnaces, and I think I will be able to give you some facts which will be of interest to you regarding electrical iron and steel manufacture.

Chairman,—

The next meeting will be on April 16th, when a paper will be read on "Power Cost," by J. W. Helps, Power Engineer, Toronto.

Moved by Mr. Fletcher, and seconded by Mr. Carmichael, that the meeting be adjourned.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