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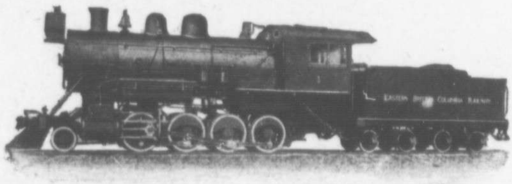

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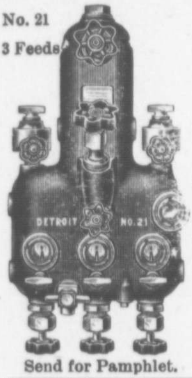

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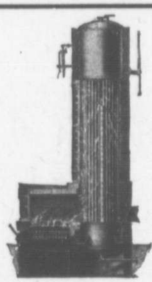

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OFFICIAL PROCEEDINGS

Vol. 4. No. 2. TORONTO, CAN., February 15, 1910. $1.00 per year 15c. per copy

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C. L. WORTH, Sec.-Treas., Room 409, Union Station, Toronto.
Phones: Day, Main 4860
Night, North 346

PROCEEDINGS OF THE CENTRAL RAILWAY AND ENGINEERING CLUB OF CANADA MEETING.

Prince George Hotel, TORONTO, February 15, 1910.

The President, Mr. Duguid, occupied the chair.

Chairman,—

As it is nearly half-past eight, no doubt nearly all are here who will be present to-night. The meeting will now come to order.

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

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

Chairman,—

Next order of business is the remarks of the President.

I have no special remarks to make to-night.

One thing I would like to remind you all of is the Social Evening to be held a week next Friday night, the 25th inst., in the St. Charles, at the corner of Yonge and Melinda streets. All who were there at the last Social Evening will no doubt be able to find the place again, and the Reception Committee are sparing no efforts to make this a huge success.

There is another item I would like to draw your attention to, and that is, the Secretary has received a letter from the Assistant Secretary of the Canadian Institute, which is as follows:

TORONTO, *February 10, 1910.*

MR. C. L. WORTH,

Sec.-Treas. C. Railway Club.

Dear Sir:—

I am desired to draw your attention to Mr. R. Patterson's address before the Canadian Institute — see card — at the Physics Building, on Saturday evening, February 26th.

Any members of the Club who may be interested are invited to be present at the meeting and take part in the ensuing discussion.

Yours truly,

M. J. LOGAN,

Asst. Sec.

The address will be on "The Technical Education for a Modern Mechanic."

Mr. Worth has replied to this letter stating that the matter would be brought before the Club to-night, and I hope as many members as possible will be present.

Regarding the getting of new members for the Club, all members who have not got membership application blanks should get a few and carry them around in their pocket and try and induce their friends to become members. Members should also try and get more advertisements for our book if possible. It makes it that much cheaper to publish the book, and there is lots of room for advertisements. Members come in contact with manufacturers and others who advertise and they should try and induce them to place an advertisement in the book. The Secretary will give advertising contracts to any members who applies for them.

I might also mention to members who have not paid their fees for 1910 that they are now due, also there are a number of members whose fees are outstanding for 1908 and 1909.

I have no further remarks to make, and the next order of business is the announcement of new members.

NEW MEMBERS.

Mr. J. L. Hutcheson, Superintendent, Booth Copper Co., Limited, Toronto.

Mr. P. Philmore, Fitter, Canada Foundry Co., Limited, Toronto.

Mr. G. M. Henderson, Superintendent, Holden & Schofield Machine & Tool Co., Toronto.

Mr. J. G. Jones, Chief Engineer, Manufacturer's Life Building, Toronto.

Mr. W. R. Gardner, Engineer, C. & W. Walker Co., England.

Mr. R. C. Hamilton, Clerk, Canadian Freight Association, Toronto.

Mr. W. Large, Machinist, Grand Trunk Railway, Toronto.

Mr. W. J. Keating, Brass Manufacturer, Toronto.

Mr. J. Greville, Machinist, Grand Trunk Railway, Toronto.

Mr. F. Matthews, Carpenter, Grand Trunk Railway, Toronto.

Mr. C. C. Chappelle, Machinist, Grand Trunk Railway, Toronto.

MEMBERS PRESENT.

W. A. Hare.
J. Bannon.
J. Herriot.
C. H. Bull.
G. P. Beswick.
G. F. Milne.
G. Shand.
J. C. O'Brien.
G. S. Brown.
C. Martin.
G. Baldwin.
W. J. Dempster.
J. S. Grassick.
R. Stockhill.
A. P. Link.
G. Jones.
L. Salter.
S. Best.
R. Worboys.
A. Dewsbury.
F. J. Clement.
J. Wright.
W. E. David.
J. R. Armer.
W. Malott.
E. Logan.
A. T. Bliss.
J. Barker.
B. Clarke.
R. Pearson.
A. Stewart.
A. E. Till.
C. G. Herring.
E. B. Gilmour.
E. B. Allen.
G. Black.
A. M. Wickens.
J. F. Campbell.
A. J. Lewkowiez.
G. H. Dyer.
J. Adam.
J. Murison.
H. Cross.
R. H. Brown.
J. McWater.
C. Daniel.
G. A. Young.
G. C. Keith.
J. W. Hetherington.
L. S. Hyde.
C. D. Scott.
E. Stanley.
F. W. Barron.
J. Greville.
W. Dony.
R. Titlaw.
J. T. Fellows.
W. Philpotts.
G. Cook.
O. Burt.
F. Mathews.
W. E. Archer.
J. M. Clements.
C. Chappelle.
K. D. Clarke.
D. Campbell.
E. Blackstone.
H. O. R. Horwood.
W. Gardner.
W. Marchington.
F. Hardisty.
H. O. Eddrup.
J. Duguid.
C. L. Worth.

Chairman,—

Next order of business is the reading of papers and discussion thereon.

The paper to-night is by Mr. E. B. Gilmour, Superintendent of the Moulding Department of the Canada Foundry Co. Mr. Gilmour is present, and I have much pleasure in calling on Mr. Gilmour.

THE PRINCIPLES OF MELTING IRON IN THE CUPOLA.

BY MR. E. B. GILMOUR, SUPERINTENDENT, MOULDING DEPARTMENT, CANADA FOUNDRY CO., LIMITED, TORONTO.

I fully intended to have a model of a cupola here to-night. I wrote to Buffalo to a friend of mine who has one, but unfortunately he did not care to send it to me on account of the possibility of its being damaged in transit, but possibly I shall be able to make myself clear by use of the blackboard.

The subject which I have chosen for to-night would have been worded differently had I been addressing a body of foundrymen, and in order to make it more intelligent to all I have worded it, The Principles of Melting Iron in the Cupola, whereas it would have been simply cupola practice. 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 made in sizes ranging from 18″ to an unlimited size in diameter, to suit the requirements of the foundryman, and in nearly every foundry there are two or more cupolas, a small one for every day use, and a large one for specially large heats. The shape and style of cupolas have become more or less standardized with very little difference as regards results, unless when some one in authority is putting in a new plant, and wants one of his own design, and at the same time, if he was put upon his own resources he could not melt iron even in his own cupola. I might spend a whole evening giving sketches of various cupolas that have been tried at different times, some with very good results, others that did not come up to the standard and were abandoned. 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 the 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, every one is trying to get the best results as regards quality and quantity in 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 of cupola with the single tuyere on each side, blowing direct into the furnace which gave good results. Now they are built in multiple rows of tuyeres, which is a great improvement.

In good cupola practice there is a loss of heat units to the extent of about 25%, and in order to have perfect combustion, you must supply a sufficient amount of oxygen to the amount of carbon in your cupola, as when a substance containing carbon burns in an insufficient supply of air, oxidation of the carbon is not complete and the product, instead of being carbon-dioxide, is carbon-monoxide, consequently there will be a great loss of fuel, in not using all the heat units capable of being produced, according to the amount of fuel supplied, but if you add at different stages in your cupola more oxygen, it will combine with the carbon-monoxide and produce carbon-dioxide, and in this stage you have as near perfect combustion as it is practical to get, from a cupola. Too much blast is attended with an increased consumption of fuel per ton of iron melted, which also chills the furnace and causes it to scaffold, on the other hand, too little blast is attended with a loss of heat. It is not my object, in coming before you this evening, to advertise any particular kind of cupola or condemn any one that is on the market for sale, but to try and outline some of the principles involved in melting iron in the cupola. After a very careful study, extending over a number of years, both from a chemical and practical standpoint, I designed a cupola of the following design, as shown in Fig. 1. I never had the opportunity to erect a cupola as desired, but some years later I was employed with the E. P. Ellis Co., Milwaukee, Wis., who had a cupola of practically the same design which was giving most remarkable records; this was a Whiting cupola of nine tons capacity per hour. Previous to the changes having been put upon it which afterwards gave fifteen tons per hour and giving very hot iron for the finest of machinery castings, with a consumption of fuel of ten to one, this ratio could be easily increased, but in order to get good hot and clean iron, you must use fuel, and this is a very exceptional result. We often see in trades journals records of far more phenomenal results than this, but I am sorry to say that they are only upon paper, or if they are in the foundry, you have a proportional large scrap heap caused by dull iron. One great secret in foundry practice is to get the iron hot, which means clean iron. The fact of trying to save a little coke in the cupola is all a fallacy because the price of coke is not of so much consideration, when in ordinary practice you get eight pounds of iron melted for one pound of coke. The principal thing is to get quick melting so that you can get more hours moulding. As a rule when iron begins to flow the moulder gets ready to pour, so consequently the longer your heats, the less production.

For the benefit of those who are not familiar with the cupola I will begin at the foundation and explain how iron is melted. The cupola is practically a cylinder made of boiler

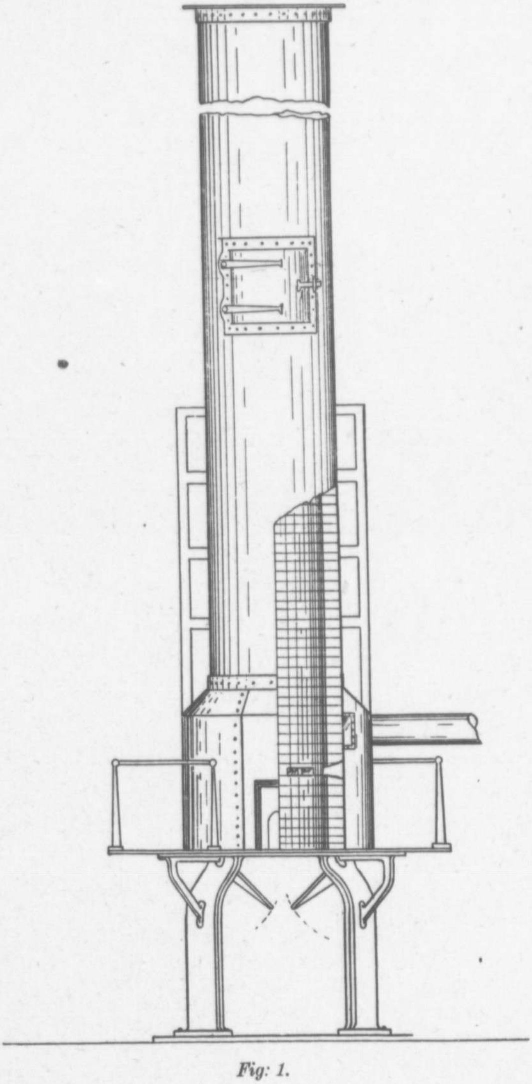

Fig: 1.

plate with holes at regular intervals divided around the shell averaging about two feet from the bottom. This shell is set up on four legs attached to a cast iron frame with two half circled doors with hinges. These doors are held up with a rod or pin from the ground. The inside of this shell is lined with fire brick all the way up to the top in order to preserve the shell. These holes around the shell are called tuyeres, which are connected to each other by a continuous belt around the outside, and it is this tuyere arrangement that gives effective or non-effective melting, as the case may be. On top of the bottom doors there is about four inches of sand gradually

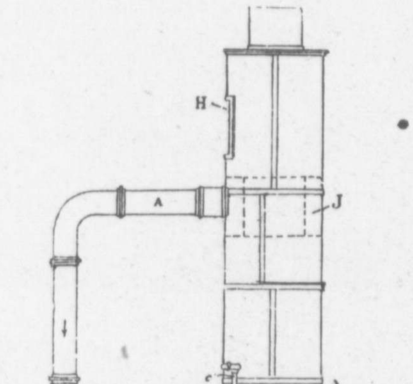

Fig 2.—A. Baillot Cupola.

tapered towards the tap hole, A fire of wood is started on top of th s sand and filled up with coke, up to twenty-four inches above the top of the tuyeres. Between this point and the tuyeres is called the melting zone; this is where all the melting is done. On top of this coke bed an amount of iron is put on, to about 3½ pounds to one of coke in the bed, thereaf er another layer of coke and iron alternately, of one to ten, and this is continued until all is charged that is required for that day. On top of each charge of iron is placed about 30 to 40 pounds of lime stone, this makes the slag from the iron and coke very fluid, so that in large heats it is run off, so as to keep the cupola clean.

About two years ago, when the foundrymen were in convention in this city, there was a new cupola put upon the market with phenomenal records of melting called the Baillot cupola (Fig. 2). It embodied the same principle as I was working in my cupola, but with this difference, that he drew all the gases from the cupola as they escaped over the top of the highest charge with another row of tuyeres at this level. As a consequence he draws the carbon-dioxide gas which is, roughly speaking, the ash of the gases, generated in consumption. Now this is a gas that you want to get rid of. His system is to get the oxygen from the charging door, also the carbon-monoxide from the cupola, which would be hot, and get rid of the clogging of the tuyeres. This system has not proved so good as the designer anticipated, as I watched the records and demonstrations for three days, and noticed a very heavy burning out of the upper tuyeres, and the iron was not hot enough for the usual run of light castings. I believed that the saving of fuel was at the expense of the iron.

In general cupola practice there are a number of irregularities in melting which caused Mr. Hart to make an inquiry as to the cause. This is also in the blast furnace; he says:—"He describes some of the irregularities to differences in atmospheric pressure; thus the range of the barometer in Great Britain being about three inches, or rather more than one tenth of the mean pressure, this change of density would produce a difference of one-tenth in the bulk of the air. And, therefore, between a severe frost with the thermometer at 20° and sultry weather at 70°, the difference would be 50°, and as atmospheric air dilates or contracts one four hundred and eighty-fifth part of every degree, this difference in temperature would produce a variation of rather more than one-tenth in the mass or bulk of the air. So that, if during severe frost the barometer stood at thirty-one inches, while during sultry weather it stood at twenty-eight inches, the combined effects of the differences in temperature and the pressure would amount to a total variation of one-fifth in the bulk of the blast, which would be nearly equivalent to a careless furnace man putting into his furnace ninety pounds of coal instead of one hundred. During a whole casting, indeed, the difference from temperature and pressure amounts to something like an irregular charging of the furnace with ninety pounds indiscriminately, instead of one hundred pounds regularly."

These observations of Mr. Hart are certainly worthy of attention. The impression of the effect of moisture in the air is still as firmly held as ever. Taking the average of five years, selected at intervals of the same period, for twenty-two years working, the following quantities of coal were consumed for every ton of crude iron produced:—

	Winter *Cwt.*	*Spring* *Cwt.*	*Summer* *Cwt.*	*Autumn* *Cwt.*
Foundry iron furnace.	49.7	52.2	53.1	55.4
Forge iron furnace....	43.6	44.2	44.6	45.8
Blast furnace iron....	43.2	44.1	50.1	49.5

In the first, or foundry iron furnace, the excess of autumn over winter months is eleven per cent; in forge furnace equal to five per cent., and in blast furnace fifteen per cent.

Mr. Baldwin,—

I might state that through Mr. Worth I had a copy of the paper sent to me before the meeting, and I have picked out one or two questions I would like to ask Mr. Gilmour.

The first is, why does iron deteriorate when being melted in a cupola?

Mr. Gilmour,—

Iron deteriorates because it comes in contact with the fuel. If you could melt iron and keep it from the fuel it would retain all its properties. For instance, if you take good iron and put it in your cupola and melt it, you would not get the same quality of iron out that you put in, because it comes in contact with the fuel.

I have known iron to be put into a cupola with coke that was high in sulphur, and the sulphur spoilt all the iron in the cupola in the first two charges; in the third charge it worked better, because nearly all the sulphur from the coke had been absorbed by the first two charges.

Mr. Baldwin,—

Are there no other methods of melting iron than in a cupola, if so why have they been discarded?

Mr. Gilmour,—

There are other methods of melting iron, one of them is by an air furnace.

Mr. Gilmour at this point gave a description of an air furnace on the blackboard, stating that there was no direct opinion as to the best kind of air furnaces as there were so many varieties, some preferred a direct line of draft, and others preferred the curved.

This method is not popular simply because it is too expensive. The expense of the fuel is something enormous, and the time it takes to melt the iron is very great, I might say

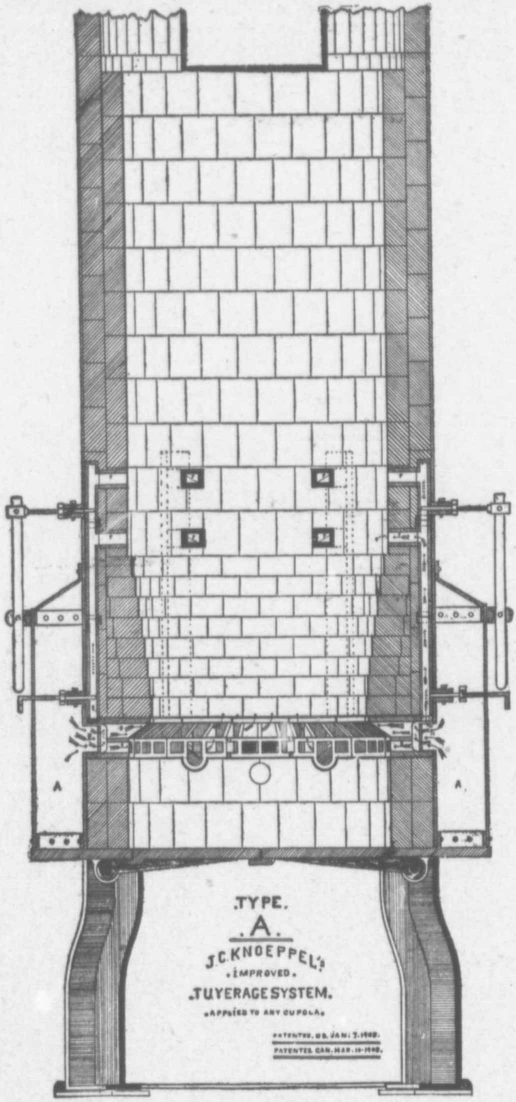

Fig. 3—Section Knoeppel Cupola.

that the time taken is almost double. In order to melt about twenty tons of iron it is necessary to run the furnace nearly eight hours, whereas in a cupola we can melt twenty to thirty tons of iron in two hours.

As I said before, the amount of coal used is enormous.

Mr. Lewkowiez,—

Are there no furnaces in which producer gas is used?

Mr. Gilmour,—

I do not know whether there is one or not, I have never seen one in use.

Some years ago there was a man came to this country with the system of a gas producer furnace, using producer gas from the blast furnace to run a gas engine.

Another system was tried in which oil was used for producing the heat, the iron was melted in a cupola, and run from the cupola into a ladle, and from the ladle it was poured into a converter, and gas produced from oil was turned into the converter to burn out the carbons and the silicon.

The greatest trouble in the steel foundry is that the sulphur and phosphorous is very injurious to steel. You get what is called wild heat.

I designed an air furnace myself once, and when I went to visit a friend of mine, who was a chemist, I spoke to him about the same principle, and he said that he had just designed a furnace of the same kind. I went and looked it over, but found that he could never get his iron hot enough, consequently they had to fall back on the cupola.

Mr. Clarke,—

I would like to ask Mr. Gilmour if there are any Knoeppel furnaces in use?

Mr. Gilmour,—

The Knoeppel furnace is the one I had reference to. There are some others in use, but I cannot tell you where they are.

Cuts of this furnace will be shown in the journal under Figs. 3, 4, 5 and 6.

Mr. Clarke,—

Mr. Knoeppel told me that he did not take much stock in the tuyeres running up above the charging doors. What his patent was, was on the continuous tuyeres, which gave an equal distribution of the blast. I wanted to see one work-

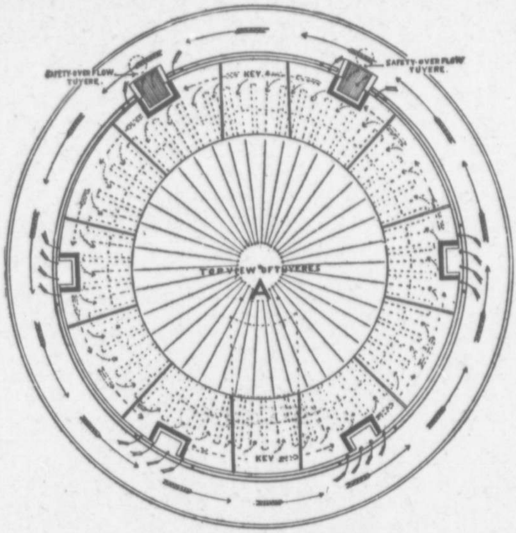

Fig. 4—Top view of Tuyeres A.

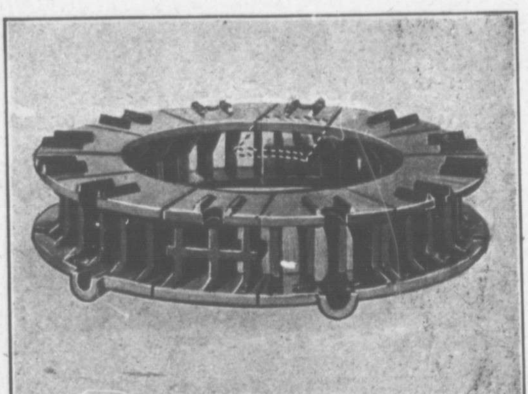

Fig. 5—Knoeppel Tuyeres.

ing, but he had only a little one that he had been experimenting with.

Mr. Gilmour,—

He wanted me to put one into the Canada Foundry, but I did not care to bring the matter up at that time with the company, as there were other things needed in the plant which were of more importance.

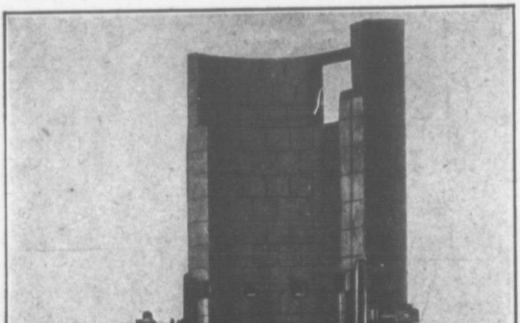

Fig. 6—Section Knoeppel Cupola.

Mr. Clarke,—

There is another thing, he would not guarantee that you could save fuel.

Mr. Gilmour,—

I know that you can save fuel.

Mr. Clarke,—

He claims that it will save fuel, but he will not guarantee it.

Mr. Gilmour,—

I would guarantee it.

I have seen a 72-inch cupola that has melted 125 tons in one day, at the rate of fifteen tons an hour for the whole day.

Mr. Clarke,—

What would be the ratio of coke consumed?

Mr. Gilmour,—

The ratio of coke is ten to one. They did not try to save the coke, all they tried to do was to get the iron out as quickly as possible.

Mr. Armer,—

Mr. Gilmour spoke about the means of regulating the air supply to the cupola. I would like to ask him about that, if there is any particular way of regulating the air supply?

Mr. Gilmour,—

In regulating the air supply, you usually have the ordinary blast pressure. It all depends on the diameter of the cupola. If you want an air supply higher than blast pressure, you use a water guage set on the side of the cupola. In a 72-inch cupola you would use possibly eleven to twelve ounces of water pressure, and for smaller cupolas you use from six to seven.

Mr. Armer,—

Some of the cupolas have a receiver; what is this used for?

Mr. Gilmour,—

Some of the cupolas have a receiver in front of the cupola, and as the iron melts it runs into it. There is a small hole at the top of this receiver so that you can see the iron melt, and when you have got enough in the receiver, you can tell by looking through this hole.

I do not like these receivers because it is impossible to keep the iron hot enough for anything but very heavy work.

Mr. Armer,—

It is not all right for light patterns, then?

Mr. Gilmour.—

No, it is not all right for light patterns. If you are making heavy castings, as for instance twenty or twenty-five car wheels, you have to melt enough iron at one time to make the twenty or twenty-five car wheels at once, possibly, if there is room, you have two floors of castings, and in that case you can see how much iron would need to be melted at one time, and if one or two of the wheels are not up to the standard, the whole lot are destroyed. If the one or two wheels tested are all right, all that have been cast are accepted. One advantage of the receiver is that you are able to make a test of the iron before making a big cast, and if the iron is not right you are able to mix it so as to bring your analysis right.

Mr. Hare,—

This has been a most interesting paper.

In reference to air furnaces, most of these are used for making malleable iron.

In one air furnace I know of for melting iron, they melt thirty-two tons every twenty-four hours. They have two heats in the twenty-four hours and average thirty-two tons to the whole day, on a coal consumption of 660 pounds per ton of iron, while a cupola will melt iron with a coke consumption of about 200 pounds per ton, an air furnace would not do anything like this performance.

Experiments have been made of melting the iron in a cupola, and running it into an air furnace, but I understand this has been a complete failure, probably due to the sulphur which would get into the iron and which the air furnace would not remove. Possibly Mr. Gilmour can tell us something more about this.

Mr. Gilmour,—

Sulphur in iron is caused from the iron coming in direct contact with the coke, and if the sulphur gets into the iron it is very hard to get it out.

Mr. Hare,—

Can you not get the sulphur out with any method of purifying?

Mr. Gilmour,—

You cannot get the sulphur out of iron by putting it into purifiers, because the damage is already done to it.

Mr. Hare,—

The solution is a very difficult one. The pouring of the iron from a cupola into an air furnace does not do away with the sulphur, because the iron takes up the sulphur in the cupola, and that is why you would get sulphur in air furnace iron. Still, if this could be done, a considerable saving in fuel would result.

Mr. Gilmour,—

If I understand you right, what you mean is, the iron is first melted in a cupola, and then run into an air furnace. As I said before, the iron absorbs the sulphur from the fuel in the cupola, and it is a very hard thing to get the sulphur out again.

At the Carron Ironworks, Scotland, they make a speciality of air furnace iron. They make those large kettles for chemical plants, and they get about double the ordinary price for these castings. They have about ten or twelve air furnaces in operation, and when they are going to cast one of these kettles they melt just enough iron in one furnace to cast one kettle, and each furnace melts just enough iron to take care of one casting.

Mr. Lewkowiez,—

Has there been no method devised to free iron from sulphur after it has been melted, are there no means by which this can be done?

Mr. Gilmour,—

I do not know of any method for getting the sulphur out of the iron after it is once in, I think every foundry man is asking the same question to-day.

There is the same trouble with phosphorous.

One of the chief troubles with Canadian ores is, that they are very high in phosphorous, and I think this has had a great deal to do with the holding back of the steel industry in Canada, you cannot make good steel with high phosphorous ore. They have been trying electrical methods for melting iron to get rid of the phosphorous, and they can only get rid of the phosphorous when they can obtain the electrical power very cheap.

The iron used at the Canada Foundry is very high in phosphorous, and when I started in there, I made an analysis of the iron, as I had not had much experience in high phosphorous iron. In the States we do not get more than .75 per cent. phosphorous in the iron, but in Canada all our iron is over 1 per cent up to as high as 1.4 per cent. I was afraid to tackle it as high as that and I got it down to 1 per cent., and I am able to get good clean castings. Phosphorous weakens iron. The presence of phosphorous in the iron enables you to pour it at a lower temperature, with the result that you are able to take up the shrinkage in the iron. It is this shrinkage that causes the dirty spots in the castings, which machinists say, as a rule, is due to dirty iron. It is no fault of the moulder, more often than not it is the design of the casting.

With high phosphorous iron you have got this advantage that it remains fluid longer and does not set so quickly.

I am satisfied that there are some here to-night who can vouch for it that we do get good, clean, heavy castings at the Canada Foundry through using phosphorous iron.

Mr. Balwin,—

I would like to ask Mr. Gilmour another question.

Some two or three weeks ago I happened to be going through the foundry after the cupola had been charged, and the fire started. After it had been going some little time the fire went out, it would be interesting to know how you started the fire again? (General laughter.)

Mr. Gilmour,—

That is the only incident of the kind I have ever had in my experience.

The blast went on at the usual time and after it had been blowing for over half an hour, I was advised that the furnace had gone out, and asked what was best to be done. I went up and looked in at the tuyeres and could see no vestige of fire at all. The furnace was charged right up to the door, and there was no wood to light it. I do not know how it happened, all I know is that it was out.

The first thing I did was to get a steel bar, and we knocked the breast clean out so that we could get at it, and I got some oil and waste and made a connection with the gas hose and turned on the compressed air, and in less than thirty minutes we had iron running from the cupola.

Mr. Stanley,—

I would like to ask Mr. Gilmour what experience he has had in lowering the tuyeres?

I remember an experience I had in Portland with a very ingenious man from Detroit, who lowered the tuyeres to eighteen inches above the bed, and used Lehigh coke. From the time the cupola was started we had the hottest iron I have ever seen.

In another case the tuyeres were lowered to eight inches above the bed, but the castings were all alike, none of them being over twenty-five pounds.

We were mixing our own scrap and we had to mix up sprues. The sprues were all milled and melted a little faster than the other scrap, nevertheless we got good results.

Perhaps Mr. Gilmour has had some experience in lowering the tuyeres in cupolas.

Mr. Gilmour,—

Tuyeres are only used as low as that in small foundries where small quantities of castings are made.

The tuyeres are always higher in shops where heavy castings are made, and it is necessary to melt a larger quantity of iron.

Mr. Armer,—

Is there no arrangement to prevent the iron running through the tuyeres?

Mr. Gilmour,

There is a slag hole at the back of the cupola, and the moment the iron rises to that slag hole it will run out, consequently, it will not go through the tuyeres.

It is not necessary to let the iron rise as high as the tuyeres, as there is usually a spy hole through which you can watch the progress of your iron melting, and as soon as it rises high enough it is tapped out.

Mr. Herring,—

In reference to the quality of the material used for lining the cupola, does the brick used contain a high percentage of silica?

Another thing I would like to ask is, what is the temperature at melting point, also the temperature of the gas that comes off?

Mr. Gilmour,—

A good grade of fire-brick is used for lining cupolas. High silica bricks cost too much money to be used for ordinary foundry work. They are used, however, in steel furnaces. I might say that silica bricks cost four times as much as good fire-bricks.

As to the temperature of the gas, I do not really know what the temperature is, as I have no means of testing the temperature, but I know that if you stand in front of the cupola you will find the flames very hot.

Mr. Herring,—

What is the temperature at the melting point?

Mr. Gilmour,—

It will run to pretty nearly 3,000 degrees, to be a little nearer, I think about 2,700 degrees.

Mr. Philpotts,—

Speaking about carbon-monoxide gas, what is the percentage of carbon-monoxide gas?

Mr. Gilmour,—

Carbon-monoxide gas is only in proportion to the combination of the oxygen and carbon.

From the air entering the tuyeres you get your oxygen, without it you would not get any combustion.

Mr. Philpotts,—

Can you not give me any figures?

Mr. Gilmour,—

No, I have no figures on this matter, I know that some cupolas produce more carbon-monoxide than others.

Mr. Philpotts,—

Then the production of carbon-monoxide depends on the air supply?

Mr. Gilmour,—

Yes, it all depends on the air supply, as without air you would not get combustion.

Mr. Lewkowiez,—

Is there any advantage to be gained from heating the air that you use for the blast?

Mr. Gilmour,—

I once had that idea and designed a system with a pipe running down the whole length of the smokestack for the purpose of heating the air for the blast, but I found it was no good, because it deteriorated the iron. Hot blast iron is inferior to cold blast iron, everyone knows that.

Mr. Clarke,—

I saw a hot air blast installed about fifteen years ago. They had a battery of coke ovens, and instead of allowing the gas to go out of the top of the cupola, they took it through a "U" pipe and passed it under the coke ovens to heat the air. It worked very successfully there.

Mr. Gilmour,—

There is one advantage in using hot blasts, your cupola would not be likely to scaffold. When cold air comes in contact with the iron a great deal of slag forms, and this is done away with by using a hot blast.

Mr. Hare,—

I would like to ask Mr. Gilmour one more question.

In recent years a considerable number of blast furnaces have been run with dry air, that is, with air from which the atmosphere moisture has been removed by the pressure refrigeration process, and with remarkable results in economy of fuel and quality of the iron.

I would like to ask Mr. Gilmour if he has had any experience with dry air in cupola practice. I should imagine that similarly good results would be obtained.

Mr. Gilmour,—

I am satisfied that it would be all right. I think that if we could get the atmosphere dry, we would certainly have better results in the cupola.

A similar question has often been asked in reference to the use of dry or wet coke. I have tried it both ways, and I have never found any difference at all. I know one place where there is no shed at all for keeping the coke in, and I have seen the coke put into the cupola saturated with water, and they got just as good results as when they used dry coke. When wet coke is used gas is formed which has the effect of adding considerably to the heat of the cupola.

One of the advantages of dry air over damp atmosphere is, that in the case of dry air you do not get slag forming over the tuyeres that is caused when the air used is damp.

Mr. Stanley,—

In reference to using dry or damp air in the furnaces, I remember an occasion when there were a lot of grate bars to be melted. It was found that no value could be obtained from melting these grate bars until steam was introduced into the cupola. It was found that we got the best results when three pounds of steam was introduced into the cupola through a half-inch pipe. Perhaps Mr. Gilmour could tell us why this works successfully?

Mr. Gilmour,—

I never saw steam introduced into a cupola, and I am doubtful about the advantage to be gained by allowing damp air to go through the tuyeres.

Mr. Stanley,—

I can testify that I saw a pile of grate bars half as large as this room, melted in a cupola with the introduction of steam into the cupola, and that they made a success of it.

Chairman,—

I am sure you have all listened to Mr. Gilmour's paper with a great deal of interest, and I must say that Mr. Gilmour has answered the questions very clearly that have been put before him, therefore, I think it is in order for someone to propose a vote of thanks to Mr. Gilmour.

Mr. Baldwin,—

As I was responsible for asking Mr. Gilmour to give us this paper, I would like to move that a hearty vote of thanks be tendered to Mr. Gilmour for the able manner in which he has given this paper and the time he has devoted to getting it up, as well as answering the questions so clearly.

Mr. Milne,—

I have very much pleasure in seconding that motion.

Chairman,—

You have all heard the motion, what is your pleasure? Carried.

Mr. Gilmour, I have much pleasure in tendering you a hearty vote of thanks.

Mr. Gilmour,—

I thank you very much for the hearty vote of thanks which you have tendered to me, and if any knowledge has been gained from my paper and the discussion to-night, I feel that I am well repaid for the time and trouble I have taken in preparing this paper. I have to thank Mr. Keith, Editor of "The Canadian Machinery," for the loan of the cuts which will appear in the journal.

Chairman,—

Perhaps Mr. Lewkowiez can tell us something about the arrangements for the Social Evening.

Mr. Lewkowiez,—

I have just returned from an extended tour in the South, and know very little of the arrangements made by the Reception Committee. Perhaps there are some members of the Reception Committee here to-night who know more about how things stand. Mr. Campbell told me what little I know, and I think he knows more than he told me.

Mr. Campbell,—

We are going to have a good time, and we will be there as large as ever on the 25th.

Mr. Lewkowiez,—

I think the Reception Committee will see that everybody has a good time. We want all who are present to-night to come and bring their friends, and get as many new members as possible. The Glee Club will be on hand as usual.

Chairman,

It is expected that all members will bring a prospective member with them. If your friends are not eligible for membership, they will be welcome.

At the next meeting we will have a paper from Mr. Huyette, Manager of the Murphy Ironworks, Buffalo, on "Smoke Abatement." This is a very interesting subject to me, at least; no doubt it will be to a great number of the other members present.

Mr. Bannon,—

I think it would be well to tell the members what this Social Evening will cost them.

Chairman,—

I think most of the members know that at these Social Evenings everything is free. The idea is to give the members an opportunity of becoming acquainted with each other.

Mr. Lewkowiez,—

I am sorry to say that the Chairman of the Reception Committe, Mr. Howard Fletcher, is laid up with an attack of typhoid fever, and that has probably delayed matters somewhat.

Chairman,—

Members of the Reception Committee will kindly wait for a few minutes after the meeting.

Moved by Mr. Armer, seconded by Mr. Clarke, that the meeting be adjourned. Carried.