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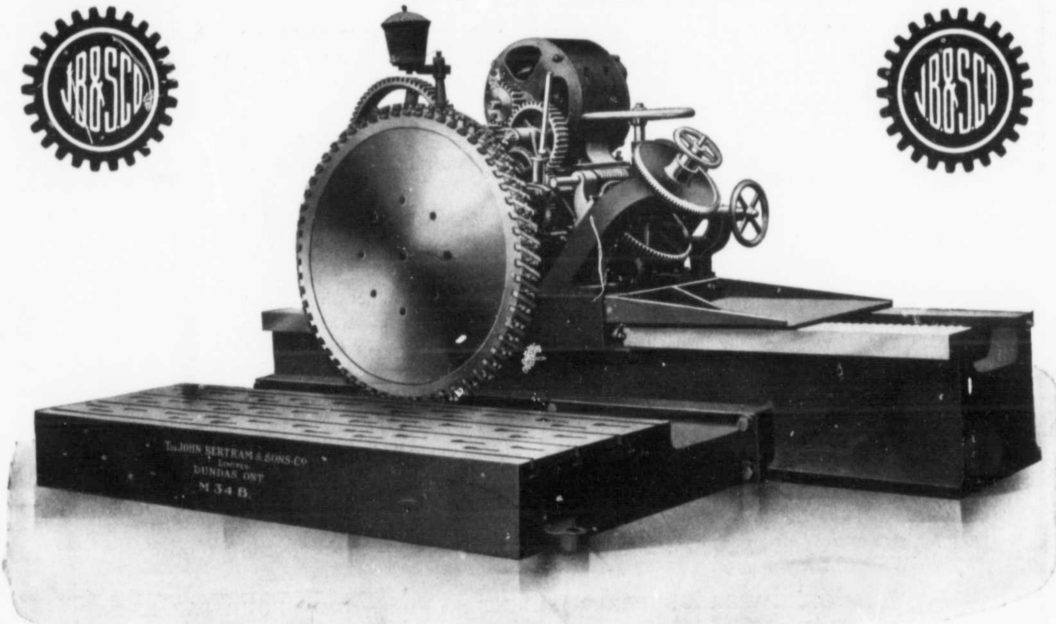

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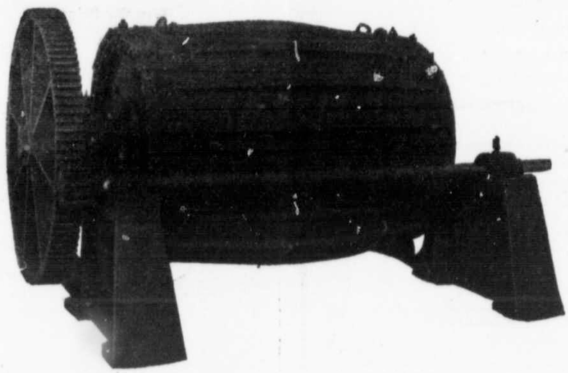

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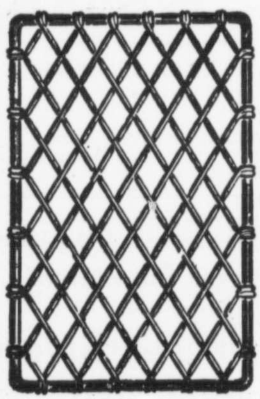

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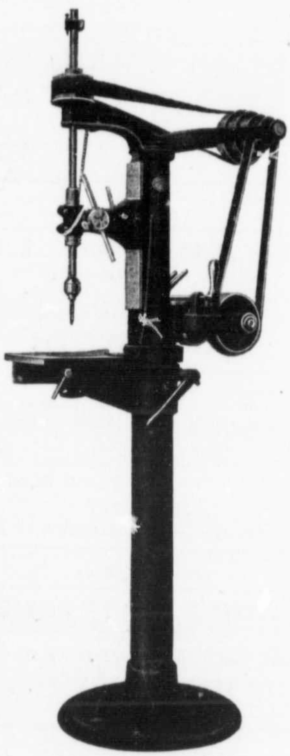

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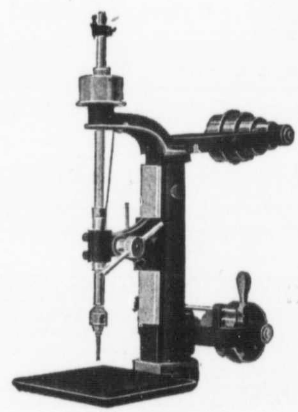

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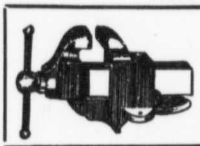

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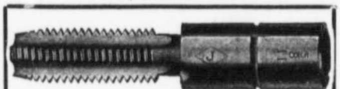

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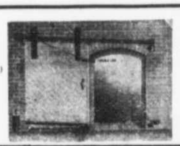

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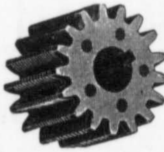

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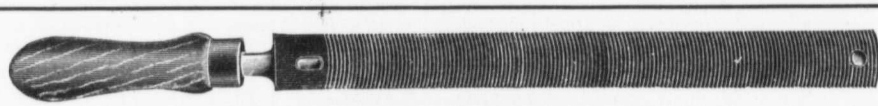

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Industrial Education Situation in Canada

An Account of What Has Been Done for Technical and Industrial Education in Canada as a Result of the Movement Started Four Years Ago by the C.M.A.; and an Explanation of the Situation as it Now Exists. A Commission of Three to be Appointed to Investigate; Funds now Being Raised.

One of the most important problems before the manufacturing interests of Canada at the present time is that of trade and technical education. For the past four years, the matter has been given considerable attention by the Canadian Manufacturers' Association, and during those four years very considerable work has been done towards organizing a movement which will result in the accomplishing of something.

It looks now as if these efforts had finally culminated into something definite. At first it was aimed to accomplish something through the Dominion Government, as it was felt to be a national question; but constitutional difficulties arose, and now the Provincial Governments are being approached individually by the Committee appointed at the last convention of the Canadian Manufacturers' Association held in Montreal in September of this year.

Prospects are bright for the raising of the necessary funds to thoroughly study the needs of the various provinces, and to investigate thoroughly systems of trade and technical education existing in other countries, in order that some system may be devised which will fill the requirement of different sections of the Dominion.

A History of the Movement.

The object of the present article is to discuss the various steps leading up to the present situation, and to explain that situation thoroughly as it now stands. This, no doubt, will prove of very great interest to many manufacturers throughout the country.

The movement was started formally in 1904 at the annual convention of the Canadian Manufacturers' Association in Montreal, when the following resolution was passed:

"Whereas the importance of technical education to the manufacturing industries warrants and requires the establishing of modern, thoroughly equipped technical schools throughout Canada; and

"Whereas the instituting of a general system, with one standard curriculum, requires that all the schools should be under one central management; and

"Whereas it is the function of the Federal Government alone to properly organize such a system of schools throughout the Dominion;

"Therefore, be it resolved that the association should, through a special committee, investigate the subject of technical education, as it is dealt with in other countries, with a view to recommending early action on the part of the Dominion Government in inaugurating a national movement for a standard system of technical education in Canada."

As is clearly shown in this resolution the aims of the Association in the first place was to gain the interest and support of the Dominion Government in the movement.

Standing Commitee Appointed.

A standing committee was appointed at the same convention, composed as follows: S. M. Wickett, chairman; Alfred Burton, Thomas Findley, Gerhard Heintzman, Harold Van der Linde, J. P. Murray, Geo. A. Howell, W. F. MacKay, W. T. Whitehead, L. H. Packard, and Wm. Pakenham.

This committee presented a report the following year at the convention in Quebec. This report dealt chiefly with the importance of the part played by technical education in the industrial development of Germany, England and the United States. This report concluded with this recommendation:

"That the Dominion Government be requested to appoint a Commission to report on the best method for establishing a comprehensive national system of technical education to provide Canadian industry and commerce with trained assistants from amongst the Canadian people, and thereby aid in developing Canadian industry, and do away with the present condition of affairs, which compels employers to go abroad for men to occupy the more responsible and more remunerative positions in Canadian enterprises."

The Memorial of 1906.

This recommendation having been approved of, a memorial was drawn up and presented to the Government on May 11, 1906, pressing for the appointment of a Commission of enquiry. Various arguments with which the members of the Association are already familiar were advanced in support of the petition, in addition to which an effort was made to anticipate the objections which it was known would be raised on constitutional grounds. In this connection it was shown:

(1) That the B.N.A. Act need be no barrier to action, for while it left education to the provinces, it entrusted the regulation of trade and commerce to the Dominion, and technical training was in a substantial measure a part of the national industrial policy.

(2) That the examples of other countries having federal governments, such as Germany and the United States, amply justified the Dominion in giving aid to industrial education;

(3) That by establishing experimental farms and biological research stations, by conducting an engineering course at Kingston, by contributing to the support of the Railway Department of McGill University, and in other ways, the Dominion Government had already evinced a direct interest in our educational problems, thus making its own precedent.

This memorial was endorsed by each of the branches of the Canadian Manufacturers' Association; by the Canadian Trades and Labor Congress; by the leading universities; by twenty-eight Boards of Trade in Canada; and by the Press. This goes to show the hearty support the work of the Association was receiving.

Endeavor to Interest Dominion Government.

Meanwhile an active canvas of members of the Cabinet and of private members was carried on at Ottawa; and from the opinions expressed the Technical Education Committee of the Canadian Manufacturers' Association believed that good headway was being made. But in the fall of 1907 the question assumed a different aspect from the result of an interview a deputation from the Toronto Reform Association had with the Premier on the question. The difficulty revealed itself in a decided reluctance on his part to depart from his traditional policy of safeguarding provincial rights. This led the committee of the C.M.A. to seek the individual support of the Provinces. As a result British Columbia, Alberta, Saskatchewan, Manitoba, Ontario, New Brunswick, Nova

Scotia and Prince Edward Island, all endorsed the proposal in writing; while the committee had the assurance from a member of the Quebec Cabinet that that Province would offer no opposition, provided the rights of the provinces in the matter of instruction under the British North America Act were not impaired.

The possession of these letters made the Committee reasonably sure that no further trouble would be experienced; but in spite of these when the question came up in Parliament, the debate on the resolution was adjourned before anything came of it, and the Premier subsequently informed a deputation representing the Technical Education Committee that serious constitutional difficulties stood in the way.

Report of Committee at Montreal, 1908.

At the Convention of the Canadian Manufacturers' Association in Montreal in September of this year, this standing Technical Education Committee made a report showing the progress that had been made and recommended that the Canadian Manufacturers' Association should itself appoint a Commission of Enquiry on Industrial Education, the necessary funds to be raised by the Association by application to the Provinces and by an Association grant.

The latter part of the report of the committee dealing with the appointment of a Commission is as follows:—

"Meanwhile, the need for a thoroughly practical and broad-based system of industrial education is increasing day by day. We are failing to realize as fully as we should the importance of conserving bye-products consequent upon the converting of our raw materials into merchantable products, because we make little or no effort to utilize waste. While our greatest commercial competitors are aided, by institutes of research, to derive handsome profits from the manufacture of by-products, we, through lack of those aids, are compelled to see prospective profits thrown on the scrap heap. In spite of walls of tariff protection, foreign-made goods of a kind that should be and are being made in Canada keep coming into this country and displacing those of home production, to the detriment of the Canadian artisan and the Canadian manufacturer. That this is possible is due, to a considerable extent, to the greater efficiency of the labor which the foreign manufacturer is able to command. By it his cost of production is reduced to a point away below anything that the most careful and skilful factory manager can hope to attain under present conditions in Canada.

"What makes it all the more unfortunate is that, while we, as a country, are not abreast of the times in respect of this great problem, our competitors abroad are forging further and further ahead, not simply under the stimulus of private initiative, but with the active encouragement of administrative officers. 'Progress,' says President Roosevelt, 'must consist in the development of physical labor so that it shall represent more and more the work of the trained mind in the trained body. To provide such training, to encourage in every way the production of new men whom it alone can produce is to show that we have a true conception of the dignity and importance of labor. The printer, the electrical worker, the house-painter, the foundryman should be trained just as carefully as the stenographer or drug clerk. They should get over the idea that to earn $12 a week and call it salary is better than to earn $25 a week and call it wages. The young man who has the courage and ability to refuse to enter the crowded field of the so-called professions, and to take to constructive industry is almost sure of an ample reward in earnings, in health, in opportunity to marry early and to establish a home, with reasonable freedom from worry. We need the training, the manual dexterity and the industrial intelligence which can be best given in a good agricultural, or building, or textile, or mechanical school.

"When our greatest industrial competitors, as represented by their executive head, begin to look at things in this light, we Canadians can ill afford to waste further time in idleness, and it is with a view to setting the machinery in motion that your Committee beg to offer the following suggestion:

"The constitution given the Canadian Manufacturers' Association by Act of Parliament states that 'the Association may, by by-law or resolution, provide for the appointment of committees of enquiry to enquire into any matter affecting the manufacturing, import or export interest of Canada, and such committees may examine upon oath (which oath any member of said committee is hereby empowered to administer) any party who appears before them, and the evidence so taken may be used to assist the Association in arriving at a decision with reference to the matter under consideration.' Acting upon this provision, it is suggested that the Association should itself appoint a Commission of Enquiry on Industrial Education, and appeal to the various provincial governments for assistance in carrying the undertaking through. Your Committee's idea is that there should be a working commission of three, with one corresponding member for each province; the three to be appointed by the Association, the others by the provinces contributing. It would be the duty of the working commission to visit a number of the principal industrial schools and technical colleges of the United States, France, Germany and Great Britain, to study the causes that have contributed to their success, to learn the principles governing their location, to ascertain how they are maintained, to gain an insight into their methods of instruction, to enquire into their economic effect upon surrounding industries, etc., etc. Afterwards they would be required to hold sittings in various points throughout Canada, with a view to familiarizing themselves with the requirements of local industries, and seeing how best those requirements could be met by the adaptation of foreign methods. They would also be expected to give full consideration to the constitutional aspect of the problem, and to formulate a system of industrial education for the country at large, wherein the parts to be played, respectively, by private interests, municipalities, provinces and the Federal Government would be accurately defined.

"The cost, it is believed, would not exceed $25,000, covering a working period of not more than two years, including honorarium to the commissioners, salary of secretary and stenographer, office supplies, travelling expenses at home and abroad, and the publication of the report.

"Of this, it is believed the Association could well afford to assume $5,000, leaving $20,000 to be raised among the provinces.

"This proposal furnishes a basis for immediate action, and will, it is hoped, be favorably considered by the meeting."

Action of the Association.

The Association in convention decided to act upon this recommendation of the Committee on Technical Education, and the following committee was appointed to obtain the funds necessary for the work of the Commission: J. F. MacKay, business manager of The Globe, chairman; Alfred Burton, Thos. Findley, Harold Van der Linde, J. P. Murray, J. S. McKinnon, W. P. Cohoe, Reg. Scarfe, J. O. Callagham, F. J. Howell, W. J. Whitehead, S. H. Burlond, D. H. MacKay, and Frank A. Rolph.

SITUATION AS IT IS NOW.

Interviewed by THE CANADIAN MANUFACTURER, J. F. MacKay, chairman of the Committee, told of what had already been done by the Committee. The Committee have the grant of $5,000 from the Association. Less than two weeks ago a deputation from the Committee waited upon the Educational Department of the Province of Ontario, and asked for a grant of $8,000 to assist in the work. The Minister of Education received the deputation cordially, and expressed himself as being in sympathy with the movement.

Prof. Sexton, in Nova Scotia, has been doing much for the cause of technical education in that Province, and it is expected that the Nova Scotia Legislature will make a grant of $2,000 to the Committee of the C.M.A. If both these grants materialize, as it is hoped they will, the Committee will have $15,000 with which to start work. It is expected that some of the other provinces will follow the lead, notably New Brunswick and British Columbia.

This is the situation now. As soon as the necessary funds are raised the Commission will be appointed, and the investigation will be started forthwith. Prof. Sexton has been mentioned as a probable member of the Commission of three, and the work he has already done for the cause of technical education will fit him for this most important work.

[In a succeeding issue we will publish an article dealing with what is being done at the present time for trade and technical education in the United States. During the past year the Metal Trades Association have started an important movement supplementing what they had already done. In other circles interesting systems of technical education have been adopted and tried out, proving successful. We will give an account of these systems.—EDITOR.]

Simple Cost System For Small Shops

BY CHAS. ROELS.

A great number of small shops, especially jobbing shops, use no cost system. It is then, very often, a part of the foreman's task to keep the record of the time and the materials needed to carry out the work. This may be easy to do when many of the same kind of pieces are required, but, when thirty men are working on several jobs, repair jobs for instance, the foreman's task may prove to be too heavy. It is obvious that under such conditions the exact cost and profit of a job are seldom known. The writer has had many occasions to note the big differences between the apparent and the real costs, and these differences indicated the necessity of a cost system even in the smallest shop. The one here illustrated was devised for, and has been for several years in use in, a jobbing shop employing about fifty men.

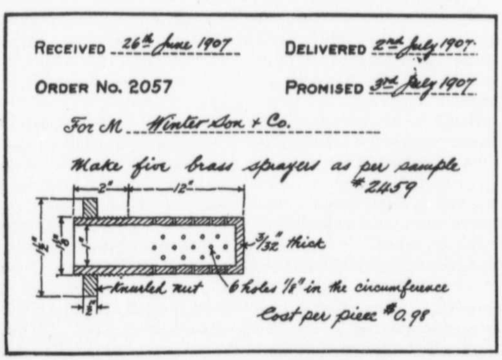

Fig. 1—Order for Foreman, Giving Details of the Work to be Done

An order, Fig. 1, is sent from the office to the foreman for every job. Full details of the work to be done are given, indicating numbers of drawings, sketches or samples, if there are any, in short, everything that will furnish a ready reference in the future. The foreman notes in a special book the date order is received and the name and address of the customer. When the work is ready, he notes on the same line in his book the date of delivery. Every day the new orders are recorded, and the finished cancelled. Once in a month the whole is rewritten. Patterns, castings or special materials are ordered by the office according to the foreman's directions.

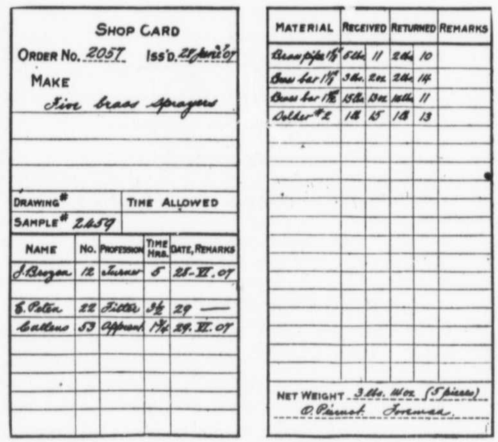

Fig. 2—Workman's Shop Order on Which Data are Recorded as Shown.

A shop order, Fig. 2, is given by the foreman to the workman for every piece or series of pieces to be made in the shop. All material wanted is applied for in the store-room. The storekeeper notes on the back side of the shop-card the kind and quantities of the materials used. When the work is finished the workman writes down, as shown in Fig. 2, his name, shop number, and the time devoted to the work.

The shop card, Fig. 2, was issued for the office order, Fig. 1, and a glance at both will show nearly everything in regard to the system. As will be seen, the work was first handled by the turner and then by the fitter. Finally a boy polished the finished sprayers, and delivered the work and the card to the foreman, who saw thus at a glance everything concerning the cost of the job. The net weight of material is marked upon the card which is then sent with the office order to the office, where special expenses and general charges are added. Finally, the cost and the date of delivery are marked upon the orders and they are filed.

Some orders require more than one shop card; for instance, to bore a 22-inch cylinder true, put new spring rings in the piston, true up the piston rod, and put new bronze bushing on the stuffing box. Four shop cards are then made, one for every part of the job, so that the cost of every detail is known. Nothing in the shop is done without an order, and not an hour is spent at a job without a shop card.—Machinery.

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A MATTER FOR CONSIDERATION.

In these days we pride ourselves on our scientific knowledge. It is a scientific age. Yet we sit in public buildings and have our eyesight destroyed by most unscientific lighting. Churches are notable for this. We sink into a cushioned seat and blink at an immense chandelier of light.

To be sure, this is being slowly rectified—but far too slowly for the credit of the scientific age. When it is shown that good lighting—good for the people's eyesight—can be secured cheaper than poor lighting, some person sits up and takes notice. But not always can good, scientific lighting be obtained cheaper, or as cheap, as the poor variety. Then the value of eyesight drops, and the value of the "almighty dollar" advances.

This is a subject worthy of the thoughtful consideration of all responsible for the lighting of public buildings.

A MAN WITH A GREAT WORK.

In another part of this issue is an article by Thomas D. West, asking for data concerning the underlying causes of accidents in foundries and other departments of manufacturing plants.

Mr. West is a foundryman He has seen many accidents happen in the foundry. He has taken up a life work of doing something to eliminate accidents in the foundry. Being a foundryman, he naturally starts with the foundry.

At the convention of the American Foundrymen's Association in Toronto, through the efforts of Mr. West, a committee was appointed to investigate the causes for accidents in the foundry. Mr. L. L. Anthes, Toronto Foundry Co., president of the A.F.A., is Canadian representative to this committee.

The first step in the prevention of accidents is to gather data showing the underlying causes. Such data forms a basis upon which to work.

It is this first step, the gathering of data, that the committee are now engaged in. Forms have been sent out to manufacturers in Canada and the United States for this purpose. These forms can be secured from L. L. Anthes, Toronto Foundry Co., if any of our readers have not already received one.

The work of this committee is a great one. It deserves the hearty co-operation of all manufacturers. It is only by securing the deep interest of the manufacturer in this work, that good, reliable data can be secured. Unreliable or misleading data would be worse than none.

WHAT IS AND WHAT IS TO COME.

We have received many complimentary letters and remarks about our new plan of four specialized editions each month, and each edition has come in for its share of goodwill. We ourselves are proud of our efforts, but by no means satisfied.

The changes have naturally been costly. Nothing good is produced for nothing. We have devoted very considerable effort to it. But we will not stop here. We hope to spend more—a great deal more. Our efforts will increase.

At present the organization of the new scheme is like a machine on its first run. It hasn't found a bearing. It takes an abnormal amount of power, and an abnormal amount of lubricating. But, like the machine, the organization will soon find a bearing. Things will soon run smoothly. Then we will have means and effort available for steady improvement.

The present issue contains some timely articles. Here are some of them:

The Industrial Education Movement is reaching a climax. We publish in this issue an article giving a synopsis of what has been done and an idea of the present situation.

The making of steel in the electric furnace is something with a future ahead of it. We publish an article illustrating how soft steel has been made in electric furnace in a commercial way by a Canadian Company. We illustrate a sample of the steel.

In the past few years, steel castings, malleable castings and forgings for manufactured parts, have been waging warfare against one another. This issue contains an article dealing in a comprehensive way with up-to-date practice in the respective use of these for various purposes.

Hints as to the handling of men are always welcome to an employer. Well written articles on such a subject always command attention. The article in this issue, "The Science of the Pay Envelope," is of absorbing interest. There are several other timely articles of no less interest and value.

As to what we are doing for future issues! Let us just give one instance. Cylindrical grinding and disc grinding are becoming greater and greater factors in manufacturing. The grinder is no longer merely a machine for putting a fine finish on a piece of work. It has assumed its place among the tools that do work—that remove metal. Experiments have been conducted in several Canadian shops with grinding machines. We have in course of preparation for the Machinery Edition an article dealing with these experiments, supplemented with data and information gathered from various other sources. We have great hope of this being an article of great value to many of our readers.

Making Soft Steel in the Electric Furnace

Results of the First Commercial Experiments with the Lash Process, made by the Canadian Lash Steel Process Co., Ltd. Experiments Conducted by Independent Metallurgical and Electrical Engineers. Sample of Soft Steel Made in Furnace Shown in Photograph.

BY HORACE W. LASH*

In the February 7th, 1908, issue of THE CANADIAN MANUFACTURER was published a description of the Lash Process for making steel, which outlined in a general way what The Canadian Lash Steel Process Co., Limited, was undertaking in the way of the development of this process in the electric furnace, and promised our readers a report of the results after the plant was in operation.

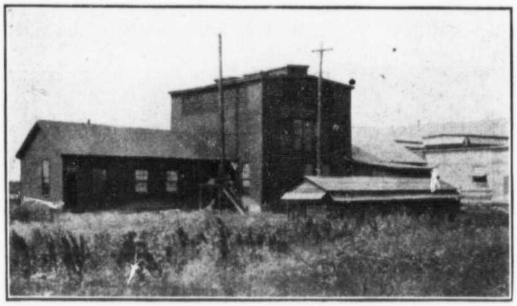


Fig. 1—Plant of Canadian Lash Steel Process Co.

The company, having built their plant, and completed their test runs, a description of the same, and the results of these runs are given below. A brief description of the process is as follows:—

The lash process consists of making a mixture of concentrated magnetic ores, or iron ore sands, granulated pig iron and carbon, and charging the same into either an electric or open hearth furnace and producing steel. It is not a direct process in the strict sense of the word, but is an ore and pig process, the ore, however being greatly in excess of the amount of pig iron used, and practically eliminating the scrap, using only such scrap as is made in the regular operation of a steel works.

The amount of pig iron required to make a ton of steel is less than one-half of what is required in regular open hearth practice when the mixture is used in an electric furnace, on account of its non-oxidizing atmosphere; this feature, coupled with the fact that the rest of the mixture is iron ore, which is, of course, the cheapest source of metallic iron, will produce a ton of steel ingots at a price much lower than they are produced in regular practice, either in the United States or Canada, figuring the electric power required at its regular market price as sold in large quantities.

Figure No. 1 gives a view of the plant, which is located in Niagara Falls, N.Y., corner 28th Street, and Buffalo Ave.

Figure No. 2 gives a view of the furnace just before starting the plant, which furnace is of the Heroult type of 1,000 h.p. capacity, and is capable of making 4 to 5 tons of steel in one heat.

Figure No. 3 shows the same furnace in operation, and was taken during the making of the 20th heat.

Figure No. 4 shows the hydraulic tilting mechanism of the furnace, and the back of the furnace in a tilted position while pouring.

Figure No. 5 shows the transformers which were made by the General Electric Co., and are of 750 k.w. capacity.

Figure No. 6 shows the casting crane with the slag ladle hanging thereon, and a view into the pit, where the casting was done; all ingots cast at this plant were bottom poured in groups, and were 6x6 inches square, weighing on an average of 500 pounds each.

Figure No. 7 shows the mixing plant in which the material was mixed that was charged into the furnace, the ore, granulated pig iron or cast iron borings, and carbon in the form of coke, charcoal or anthracite coal being put into this plant and thoroughly mixed with a small proportion of slacked lime, the slacked lime being used to keep the material in bond.

Figure No. 8 shows the billet yard, and a pile of billets representing the first 10 heats.

Figure No. 9, photograph taken by THE CANADIAN MANUFACTURER of a specimen of the Lash steel, forged from an ingot to one inch square, bent cold. This steel is 0.24 carbon, showing a tensile strength of 73,000 pounds. Attention is called to the flow of the metal at the bend, and that it is without a fracture.

OPERATION OF FURNACE.

The operation of this plant was as follows:—

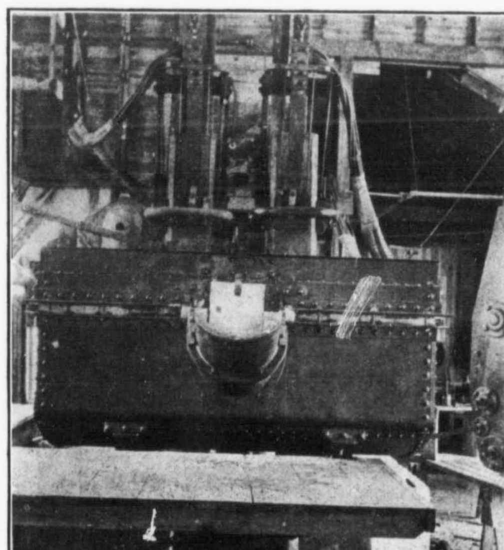


Fig. 2—Heroult Electric Furnace.

67 per cent. of magnetic iron ore, 23 per cent. of cast iron borings or granulated pig iron, and 10 per cent of coke dust, was put into the mixing pan in batches of about 500 pounds and allowed to thoroughly mix for 10 or 15

* President of the Canadian Lash Steel Process Co., and Vice-President of Garrett-Cromwell Engineering Co., Cleveland, O.

minutes, when about 4 per cent of the slacked lime was added. After this material was thoroughly mixed and a sufficient quantity had been accumulated, a sufficient amount of the same to make 4 tons of steel was charged into the electric furnace; about 100 pounds of steel scrap was scattered over the top of the same, and a small

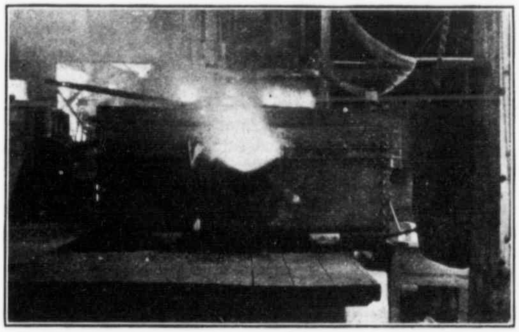


Fig. 3—Electric Furnace in Operation.

bar was put into the furnace to form an arc for the electrodes; the electrodes were then lowered into position, the current turned on, and the furnace closed up tight, and the entire batch of material was melted. After the same was thoroughly melted, the slag was poured off into the slag ladle, and a refining slag put into the furnace for the final refining of the metal; on completion of this operation, the metal was poured into the casting ladle, thoroughly draining the furnace, and the same cast into ingots, when the next charge was added and the operation repeated as described above.

A full report describing the entire operation at this plant of all the heats made would be very lengthy, during the making of the first 10 or 12 heats no attention was paid to getting definite results, but the first runs were for the purpose of familiarizing the men with the process, and

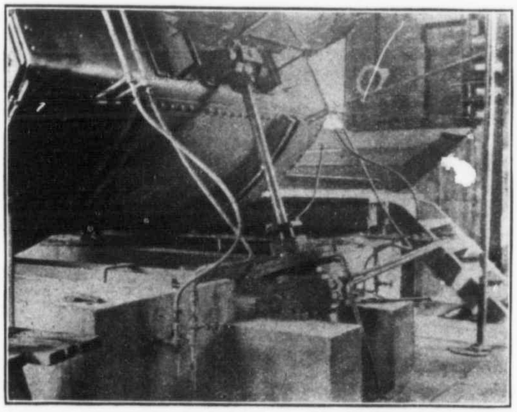


Fig. 4—Furnace Hydraulic Tilting Mechanism.

the furnace operation, and also to ascertain the best method of charging, refining, etc.

Method of Charging for Best Results.

Some of these heats were made with the material in the form of bricks, the same being preheated in the stack of the furnace before charging, and while this method did not give the best results in every respect, it is believed that the future operation of a large plant would be along these lines, or along the lines of preheating the mixture without briquetting, because from a theoretical standpoint, this method is ideal, making use, as it does, of the waste heat of the furnace for a partial reduction of the material.

The best results obtained came from the method of charging loose material into the furnace in bulks; these results proved beyond a doubt the commercial possibility of the process for making steel from a mixture in which a large quantity of ore is used, and it leaves the possibility for still better records, when proper arrangements are made for a preliminary treatment of this mixture by the waste heat of the furnace before charging.

What Was Accomplished.

An average of the second half of the run in which the material was charged in bulk as above described,

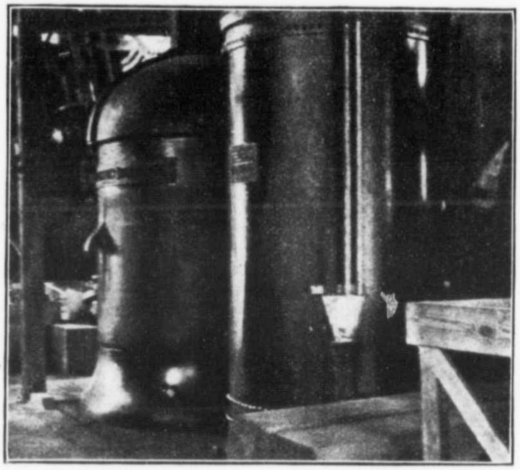


Fig. 5—The Transformer Room.

gave a result that proves conclusively that one gross ton of steel can be easily made for ¼ of an electric h.p. year.

An average of the same heat proved that the electrode consumption would be less than 50 pounds of electrodes per gross ton, and the yield of the metallic contents charged into the furnace, owing to its non-oxidizing atmosphere, is better than that obtained in the regular O. H. practice.

In making steel by this process, and laying aside entirely the fact that it is a commercial proposition, owing to the low cost of producing the same, the results obtained in the quality of steel made were more than satisfactory. It must be borne in mind, that the largest part of the material from which this steel is made, is metallic iron in its native state, in the form of ore, and that when this material is mixed with granulated pig iron, all of the metallic contents come direct from the native iron; the physical quality of the steel thus made is in every respect superior to steel made by the regular process of scrap and pig, even when the chemical analyses are about the same.

Then the high heats in the electric furnace permits of a better condition for refining and pouring. In a number of heats made at this plant, in which the sulphur and phosphorus in the mixture was above .2, the same constituents in the steel were almost eliminated, a result that it would be impossible to bring about in the regular open-hearth practice.

The writer has spent four years perfecting this process in an experimental way before these tests were made, and the results of the tests have proved beyond a doubt that the Lash process is in every respect a commercial proposition. Particularly is this so for Canada, which country is greatly blessed with numerous water powers, and an abundance of magnetic iron ore, which is just what this process requires for its developments.

Tests Made by Independent Experts.

The tests at this plant were under the supervision of Messrs. FitzGerald & Bennie, Niagara Falls, N.Y., and Mr. Robert Turnbull, St. Catharines, Ontario. Messrs. FitzGerald and Bennie, and Mr. Turnbull stand high in their profession of metallurgical and electrical experts, and the greatest care was exercised on their part to obtain accurate results.

The following is quoted from Messrs. FitzGerald & Bennie's report:—

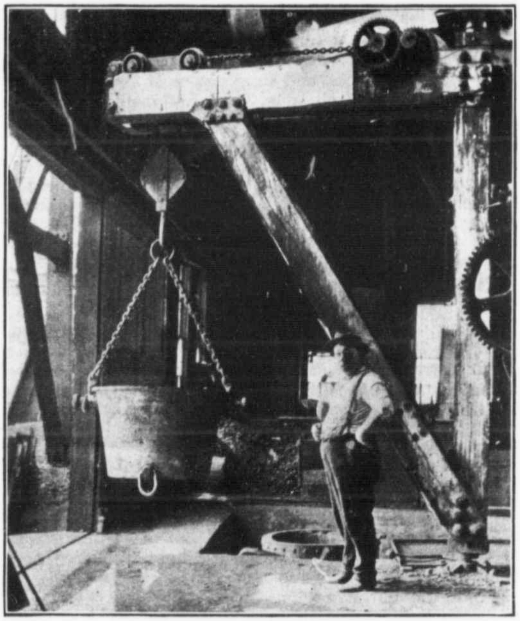


Fig. 6—Casting Crane.

"In a general consideration of the electric furnace experiments there is a reason to be satisfied. So far as the power consumption is concerned the results obtained show that no difficulty in reaching a power consumption of ¼ h.p. year per ton of steel produced need be expected. The only serious problem which we have been faced with in the experiments is that of electrode consumption. However, if the conditions of the experiments are considered, there is reason to believe that this difficulty may be met successfully. There is one other point to be noted in this connection: the Lash process so far has been tried only in the Heroult furnace where carbon electrodes are used, and this difficulty would not have to be faced in the induction furnace of the Rochling-Rodenhauser design."

What the Experiments Show.

Over $30,000 was spent by the Canadian Lash Steel Process Co., Limited, in building this plant, and conducting these tests, and the results have brought forth conclusively the following:—

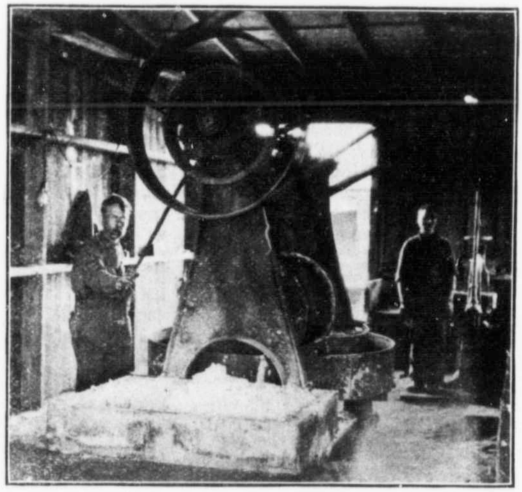


Fig. 7—The Mixing Plant.

First:—That cheaper steel can be made by this process than by the regular O.H. practice; this is owing to the reduction in the amount of pig iron required, and the fact that the rest of the metallic content is in the form of ore, which is iron in its cheapest state.

To any one familiar with the steel trade, this cost can be easily figured when the cost of ore, pig iron, carbon in any form, and water power is known. On $3.00 ore; $18.00 pig iron; and $15.00 power, ingots can be made for less than the cost of the pig iron.

Second:—The quality of the steel is very much better owing to the material in the charge coming direct from its native condition.

Third:—The control of the heats and temperatures is absolute, and the trouble due to impurities in fuel is eliminated.

Fourth:—The carbon content of the bath can be brought under absolute control, as it is only necessary to slightly vary the mixture to bring out any carbon content desired.

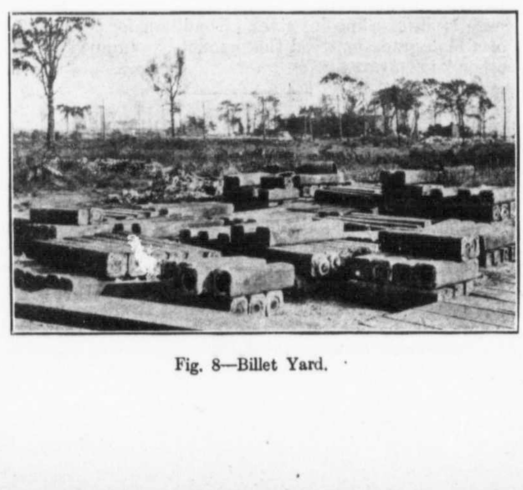


Fig. 8—Billet Yard.

Fifth:—The cost of building a plant of a given capacity is very much less than a plant for regular O. H. practice on account of the elimination of all producers, checker work, underground flues, etc., the electric furnace being nothing more than a large sized ladle lined.

Sixth:—The attendance required should be less, as the material is simply charged into the furnace, the furnace is closed up tight, and the power applied; owing to the character of the material that is charged, and the electrical control of the operation, no attendance is required until the melt is made, it therefore becomes a mechanical proposition throughout, in which the materials are all handled by machinery, and the furnace is self-regulating; it is possible to charge a large size furnace in less than two minutes. These facts, when compared with the pig and scrap proposition, which takes considerable labor to handle, are apparent to those familiar with the steel business.

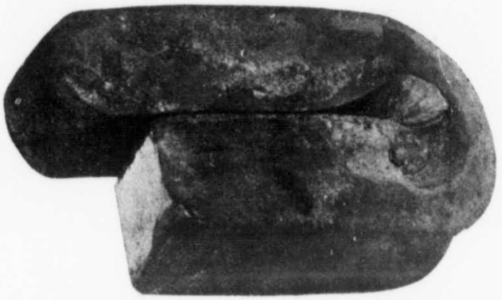


Fig. 9—Photograph of a Piece of the Lash Steel, Forged from an Ingot to One Inch Square, Bent Cold Steel is 0.24 Carbon, Showing a Tensile Strength of 73,000 Pounds. Attention is called to the Flow of metal at the Bend.

Seventh:—The cost of refractories, repairs, etc., will be very much less, and there should be no interruption to continuous operation of a plant, because a complete furnace fully lined, ready to go into operation, can be kept as a spare, and with the proper crane arrangements can be set in the place of the furnace needing repairs, which furnace can be taken to another building for this purpose, therefore, it is apparent that the cost, and the care of checker work, producers, flues, etc., are entirely eliminated, owing to the construction of the electric furnace the roof is very much stronger and better maintained.

Finally:—The control of the heat for the elimination of impurities, and the handling of the steel, and the fact that the amount of impurities charged into the furnace is always known, gives a condition for the making of a high grade material that cannot be obtained by any other known process.

The Band Saw as a Machine Tool

By Philip Bellows.

While passing through a large American machine shop recently I was impressed by the presence of a band saw that seemed to have missed its way from the pattern shop and got entangled among the milling machines, planers, etc. Upon inquiry I was told that the master mechanic, who was comparatively new to the place, had caused the machine to be installed about six months before to handle a certain class of work that had formerly been done in the lathe.

In the shop referred to, a large amount of rolled brass is used for various purposes and previously this was handled in the shears and on the face plate of the lathe, or in the drill press according to which one suited the particular job in hand. A great deal of zinc plate is also used, about $\frac{1}{2}$ inch thick, which is turned into disks. Previously the method of procedure was to bolt a plate on the face plate of the lathe and cut out the disk with a tool. Now however, all rolled brass up to $\frac{1}{8}$ inch thick and zinc plates up to $\frac{1}{2}$ inch thick are marked and brought to the band saw, which saws them like soft pine boards.

The best kind of saw blade for this work is one about $\frac{1}{2}$ inch wide, $\frac{1}{32}$ inch thick and with the teeth set very fine; that is, to make the width of the cut about $\frac{3}{64}$ of an inch. The teeth should be small so that the work upon each individual tooth will be light. Such a tool is in reality a straight milling cutter. Rolled brass up to the thickness mentioned may be cut very fast; when cutting thicker plates a slower feed should be taken, but the saw should not be expected to cut thick plates in any case. Cast brass and bronze should not be used.

Some difficulty was at first experienced through the cuttings passing through the saw slot, coming between the saw and the lower wheel and becoming imbedded in the rubber band cemented to the wheel. As soon as this was discovered, connection was made with the compressed-air line and a fine jet of air blown onto the surface of the wheel where the wheel and band saw meet and this keeps the former clear of all small specks of metal.

Tests made in my presence showed the following results: The wheel of the saw ran at 460 revolutions per minute for the saw blade. A strip of brass 13 inches long was fed to the saw and was split down the middle in three sections, equivalent to a cut of $21\frac{2}{3}$ feet per minute. A cut 2 feet long in a zinc plate $\frac{1}{2}$ inch thick occupied seven seconds by a stop watch, or equal to a cut of 17 feet per minute.

The saws used last on an average a little more than a month apiece, which is very remarkable considering the fact that in that time their cut runs up to a total of from 40,000 to 70,000 feet. One thing that favors the metal-cutting saw is the evenness of texture of the material; no knots and no false spots, as in wood.—American Machinist.

When The Lights Went Out

A few years ago when I was on the road as an electrical salesman, I stopped over night in a small town in Maine. A bunch of us were sitting around the stove in the bar of the little hotel when the electric lights flickered and went out.

From the darkness came a solemn voice that said: "Electric lights out, b'gosh, and yet it ain't blowin' hard either. Something's happened to the dynamo, maybe."

I had been selling electrical supplies to the little lighting companies for several months, but I had never heard this particular idea expressed before. I laughed long and loud, and was all the more amused when no one joined me.

After they had lighted a big kerosense lamp, I proceeded to explain to the crowd that incandenscent lamps can't be blown out by the wind. When I had finished, the old rube who had commented on the lights said:

"Look here, young man, if you knew a little somethin' about local conditions and about your own business, you'd know that the wires in this township are hung up slack on the poles in some places and that they get to slatting in a good stiff breeze. When they do, there's a short circuit that puts the line out of business."—System.

The Science of the Pay Envelope

Bigger Wages and Better Work the Product of the New Plan. System of Piece-Work, Where the Rate is Not Cut Unless Some New Labor Saving Device is Installed. Reprint from Saturday Evening Post, Copyright by Curtis Publishing Co.

BY JAMES H. COLLINS.

One Saturday noon several years ago, the superintendent of a large machinery works in Lancashire came into his chief's office with a long face and a short announcement.

He said that the fatal hour was at hand. The decisive blow had fallen.

For many months this establishment had been watching the progress of a competitor over in Yorkshire. Superintendent and proprietor knew there was but one way in which any competitor could touch them vitally. And now this rival had found that way.

"They'll really go, eh?" asked the proprietor.

"Twenty, sir," was the dejected reply. "We shall be short-handed Monday week, and handicapped for six months at least."

The chief wasn't so cast down.

This machinery works has, for three generations, manufactured certain apparatus used in spinning some of the inelastic fibres. On its office walls hang patents granted to the founder eighty years ago. These have long expired, yet it is an education in good English merely to read them. All over the world its machines are standard and indispensable. The consignment received two years ago by an American trust, for instance, was studied by some of our best machine builders. They took a specimen to their shops, dismantled it, and tried to build something as good at about the same price. But they couldn't approximate either quality or cost, even with the help of our tariff, and when that trust wanted more apparatus it had to send to England again.

The merit of this British establishment's machinery is due partly to knowledge gained through three generations, with good design. The rest lies in its efficient corps of workmen. The new competitor over in Yorkshire had no more been able to touch it in quality than the American builders, nor to sell at prices sufficiently lower to compensate for the different quality. But, during a period of heavy demand for such apparatus, the newcomer got trade that the older concern could not take care of, the latter skimming the cream off the most profitable demand.

WHEN SCIENCE KNOCKED OUT DOLLARS.

Now, however, the Yorkshire house had come for some of the Lancashire manufacturer's mechanics, and was getting them away. Agents had been sent to offer higher wages. Some of the best men, tempted, had given notice. This was a blow under the belt.

The superintendent wanted to know what must be done.

His employer said, "Nothing whatever—let 'em go."

And absolutely nothing was done. Higher wages might have been offered. The men might have been reminded of the long relation that had existed between them and their old employer. Instead, they were permitted to pack tools and leave as though with the heartiest good will. The first twenty had so congenial a leave-taking, in fact, that others followed in a week or two.

But within a month all those workmen were back at their old benches, at the old wages, and mighty glad to be there. The competitor had paid higher wages as promised. Yet he could not hold them, nor get them to give the same amount of work.

For one thing, his working conditions were not so attractive—his shops were not so clean or light. And he didn't know how to pay wages scientifically. He thought wages were simply a matter of handing out so much money every week.

The older concern, on the contrary, has a wage-system developed through years of experience, with many adjustments of disputes. It is a system under which men have a free hand for speeding, yet without unjust "pacemaking," and with few chances for inferior work to slip through.

Each department is in charge of a foreman. Men are paid piece-work rates. No piece-rate is ever cut unless some new labor-saving device is installed. Then a new rate is set and adhered to. To insure quick work and good, each foreman is paid a premium on every machine leaving his department. But he forfeits this premium should any defect develop in a machine after sale. A piece of that apparatus might break down years after, in India or Massachusetts. The defect would be traced back to the foreman responsible for letting it pass his inspection, and he would not only have to refund his premium but would have the disgrace of bad work as well, which in this plant is a real stigma.

When the competing concern stole these men and started them on a system discarded by the older plant years before it was bound to lose, and did. It simply paid money for work, and got less work.

Adjustment of forces in such a plant is so delicate that six weeks of bad times, with laying off of men, usually means loss of the year's dividend. But this wage-system, together with clean, light workshops and other minor considerations, brought those mechanics back so quickly that the dividend wasn't affected.

The American pay envelope is a great institution.

Our factories alone pay out $2,600,000,000 yearly in wages. Our railroads add $840,000,000 more—forty cents wages on each dollar they receive, it is figured. Pittsburg's pay-roll, in good times, is a million dollars a day, counting Sundays.

Mere size, however, isn't the only consideration.

How it is made up and handed out—these count, too.

So employers are all interested in wage-systems, and the latter are endlessly varied, while many of the labor troubles are fought out not so much over amount of wages as the system by which they are paid. Just the tiniest little screw loose in a factory's wage-system plays hob, and such tiny screws will insist upon getting loose in a plant where everything is ostensibly running blithely.

In one of the departments of a great American watch factory, for example, a new boy was put to work one morning.

He was about the best boy that ever went to work in that plant. He had twice as much upper story to his cranium as any of the round-faced Polish lads working there, and only half as much muscle and animal activity.

His job was polishing wheels, or mainsprings, or some other of the 3,700 operations needed in turning out a watch, and it was piece work. Where the Polish boy did eight dollars' worth of work a week with their muscles, this new chap went to work with that tall head of his, and by the end of the first week had schemed out a system by which he earned sixteen dollars. The idea of anybody making that much money in this department, however, shocked the superintendent. Without investigating, he cut the rate, so that the Polish boys made but six dollars. The new boy was interested in the work by this time, and set his head going once more, and schemed another scheme that brought him up to sixteen dollars again, and shocked the superintendent a second time, and brought another cut that landed the Polish boys on a common level of four dollars. And still the new boy wasn't discouraged. He thought harder than ever, with the outcome that, in two months, the piece-rate in that department was cut four times.

WHAT THE NEW BOY BROUGHT ABOUT.

Then the new boy concluded that, while the work was very pleasant and the wages good, still he believed he didn't want to be a great watchmaker. He would rather be a great editor. So he quit and got a job as a galley-boy in a printing-office.

By that time all the Polish boys were down to wages so low that it was not certain but that, when Saturday night came, they owed the company something for the privilege of working in its fine plant. For none of them could hope to keep up with this phenomenon of a boy who had come in and unsettled wages, and then gone away again. So there was trouble, and many quit, and others took their places and quit, too, and, finally, that department bred a strike that was the scandal of a factory that had always had happy relations with its people, and for two years, long after the original cause of all this trouble had gone away and been forgotten, there were complaints and beartburnings and friction in that department.

Obviously here was a superintendent who didn't know his own factory. Otherwise, no cut would ever have been made on that class of piece-work; but, instead, the remarkable talent of the new boy would have been discovered, and overtures made to him to stroll round the place and see if he couldn't suggest improvements in the way the product was being turned out.

Hundreds and hundreds of strikes have grown from precisely this cause—either a "pacemaker" being entertained unawares, and followed no further than the pay-roll, or else a "pace-maker" introduced intentionally where employees are working on piece-rates for the purpose of speeding production. The next inevitable step, in most cases, has been a reduction of the rate. And the next is usually a strike.

It is on this side (the blind side of many employers) that far-sighted men to-day are building up wage-systems based on science as sound as that brought to bear in any other technical manufacturing problem. These systems are first laid down right, then administered partly by demonstration that nothing in this new fangled scheme is going to hurt him, and partly by more money in his pay envelope. He gets the latter in the shape of a bonus on the output of his department. But if he has a man under him whose work doesn't come up to a good average, part of the foreman's bonus is deducted. He isn't permitted to discharge that man for such a cause, however. If a system of this sort can't take average labor as he finds it, little could be expected from it in a country so harassed for labor as this. So the foreman spends time at the bench of the man who doesn't seem to catch the idea, and coaches him, and brings him up to standard. He does this because it means money in his own pay envelope.

The type of superintendent who can install such a system and keep it running is a fine specimen of mankind.

Again and again have profound theorists, lacking this personal element, worked out such systems on paper. They were perfect systems—so perfect that, like the Universe as explained in a well-known theory, they needed only an initial push to set them going forever. But nobody came along and pushed. So they never went.

Listen to the opinion of a superintendent who can apply that push.

The way to deal with organized labor, he holds, is to take labor's organization as you find it, as something already systematized for you, and carry it further with a better organization of your own.

He says he would rather put new ideas before the average labor union than the average board of directors. Likewise, that labor trouble isn't always a disease. Sometimes it's just a symptom of disease in the brain of the business.

Another superintendent of this sort has interesting "stunts."

At his factory, for instance, there has always been a certain chair in his office in which nobody but a workman is permitted to sit. All through the shops, among a thousand men, it is known that any workman has the right to walk into his office with a grievance, and sit in that chair and talk it over with the superintendent.

The Impulse of the Personal Element.

This is the superintendent who became president of his company. To-day much of his time is passed at the executive office in New York. But every afternoon, sharp at four, Eastern time, his office is connected with the factory out West by long-distance telephone. Business first. Foremen report one by one, and at each end of the line is an extra earpiece for a stenographer to take down what is said. After that, he talks to men. Perhaps some chap dropped a casting on his foot recently. This is his first day outdoors. So they get him round to the 'phone that afternoon and the Old Man asks him, "How's the foot healing, Bill?" and tells him he mustn't do it again.

Wage-systems based on the new principle have been applied very widely in the machine-shops, each installation adapted to fit conditions, and each with its own special features. A very reasonable objection to them was that of the small employer, who said: "Oh, yes, that's all very well for a big company, with plenty of capital and thousands of men, but how can a little fellow like me adopt it?" Nevertheless, some of the best results have been obtained in small establishments by the use of systems of time-cards that distribute all the work of record-making about the different departments. The clerical work of a large wage-system of this new type is rather complex, as expert estimators and systematizers are now employed to perform the "theory" operations for a whole factory.

Under any piece-work system, of course, there is always the chance that too high a price will have been set on some special job, thus enabling a few workmen to earn abnormal wages. This causes discontent among their fellow-workers, and also dissatisfaction among themselves when their earnings go back to normal again. Cutting prices in such circumstances is always dangerous. Therefore the system is usually graded in a way that pays the workman a high bonus for small savings of time, and a proportionate decrease as saving runs into larger ratios. Thus the system furnishes automatic checks and safeguards.

From this bonus plan the principle is being carried up into systems where a single workman or a group of workmen meet the employer or superintendent, agree upon a price for carrying out certain work, and do it on contract. A Pacific Coast shipyard has tested this plan. A number of experimental contracts were given out in this way, and it was found that the men not only had good judgment in estimating what a job was worth in wages, but also in eighteen cases the time in which they finished contracts, compared with hour-wages, left them a good margin of profit. At the same time the employer got his labor at a reasonable, known cost, and there was naturally no restriction of output.

Somebody has pointed out that most labor battles are fought, not between employers and employees, but between the employer's wage-earners and salary-earners

Most of the improvements now being made in wage-systems and other labor conditions, on the contrary, are due to the fact that the employer is dealing directly with his men.

Lately a new middleman has come into the labor situation—the engineer.

The Engineer Tackles the Problem.

Sometimes, he is a civil engineer, and again a mechanical or electrical man. Perhaps, his diploma is yet more recent, and he has one of the new specialties, like illuminating or refrigerating.

But, wherever he goes in an executive position, the engineer can be counted upon to tackle the labor problem. He sees that this department in shop or factory still runs on an old-fashioned rule-of-thumb plan, whereas everything else has been systematized. He refuses to believe that the problem is unsolvable, and goes at it as something to be studied and brought into scientific order.

The engineer, for instance, has been largely instrumental in killing that evil of the contracting business, the pay-check. Hundreds of labor battles have been fought to abolish this unjust instrument for sweating employees. As the contracting business has passed from the control of small men and into the hands of large firms, with engineer-superintendents, the verdict of the latter has almost invariably been an indorsement of this protest of the workers. To-day the pay-check on contracting work is a thing of the past in the cities, though it is said to be growing where small jobs are done with unskilled, unorganized laborers.

The evils of the pay-check are many. During the recent money stringency, when many factories paid by check temporarily, their men objected, because, as merchants had to take them on account, it gave the latter knowledge of what operatives were earning. The man who draws ten to twenty dollars a week likes to keep his income confidential, just as much as the millionaire.

With rough labor on an excavating job the pay-check evil is of a less sentimental nature, being usually plain usury. Frequently the contractor, who pays thus is in league with the saloon-keeper who cashes the checks, or will cash them himself at a high rate of interest. He maintains a boarding-shack where men are charged for meals that they eat at home, and a "slop-chest" sort of store where he sells them clothing at high prices. His pay-roll is made up so that checks are handed out but twice a month, and he always holds a reserve of four or five days as a leverage by which to control employees. If a man is discharged he gets a check that is really a promissory note, cashable next pay-day. This may be ten days off. But the saloon-keeper will turn it into money at interest rates figured for each day the check has to run, amounting to twenty or thirty per cent.

But the engineer, bringing sense and arithmetic into the contracting industry, has driven this type of employer to the small job away up in the mountains.

This subject of wage-systems to-day represents a new movement in industry as widespread as it is quiet, and as effective as it is rational. For many labor disputes, reduced to the bare premises, were nothing more than efforts of workers to fix a just wage-system from their own point of view. If the labor problem is complex the wage problem is more so. It is one of the most hopeful signs of the times that employers are setting about its adjustment.

Electrolytic Production of Copper Tubes

Manufacture of Copper Sheets, Tubes and Wire Direct from Impure Copper by Electrolysis. Various Early Methods. A Practical Method Devised by the Writer. Relative Cost of Different Processes. Abstract of Paper Given Before The Institute of Mechanical Engineers at Bristol, Eng., July, 1908.

By Sherard O. Cowper-Coles.

This article is limited to the description of the production of copper sheets, tubes and wire by electrolysis from impure copper.

The methods described are all based on the work of Davy and the law of electrolysis established by Faraday in 1833, namely, that when a current of electricity is passed through a solution containing metallic salts and two or more electrodes, one of which is soluble in the solution, a known quantity of metal is transferred from one electrode to the other for a given quantity of electric current; that is to say, if the soluble electrode (the anode) is connected to the positive pole, and assuming the metal and the electrolyte employed to be pure, a weight of metal will be deposited upon the cathode connected to the negative pole, corresponding to the amount dissolved from the anode. If the anode is of impure metal many difficulties are introduced, and if the current is increased to a sufficient density to enable the metal to be deposited at such a rate as will give commercial results, other serious difficulites arise. Electro-metallurgists have been working for thirty years or more devising methods to overcome the difficulties experienced in applying Faraday's law to the commercial production of copper tubes, sheet, and wire from comparatively impure copper having the physical properties of wrought copper, when deposited at a sufficiently rapid rate.

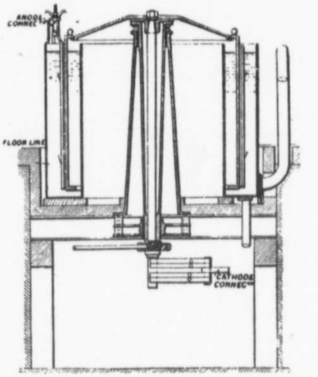


Fig. 1—Vat Used for Centrifugal Process.

The refining of copper by electrolysis has now assumed vast proportions, and the annual output of electrolytic copper in the year 1907 has been estimated at 400,000 tons, equal to 56 per cent. of the world's production, and the capital sunk in the industry at about £15,000,000. The whole of the copper thus produced is in the form of rough slabs or cathode plates which have to be smelted and worked to the desired forms.

Electro-metallurgists have been striving for many years to devise a process which does away with the smelting of copper after it has been electrolytically refined, and to electro-deposit copper after the refining operation in such a form that it can be placed direct on the market as finished sheets, tubes and wire.

Wilde's Process.

It was observed shortly after Elkington practically applied Faraday's law to the refining of copper in the year 1865, that the electric current density, or the rate at which the copper is deposited, could be considerably increased by circulating the electrolyte or moving the electrodes. It was soon found that circulating the electrolyte alone was unsatisfactory, and that the best results could be obtained with a vertical mandrel revolved in the electrolyte. Wilde was one of the first to use a cylindrical cathode, his object being to deposit copper on iron rollers suitable for textile printing purposes, for which he took out a patent in the year 1875. The anodes consisted of copper cylindrical tubes, and the iron cylinder to be coated with copper (the cathode) was placed in the centre of the cylindrical vat and caused to rotate on its axis. Such an arrangement, in conjunction with a circulating propeller placed in the electrolyte, ensured an even distribution of copper over the whole of the surface uniformly along the length of the roller by means of the motion imparted to the solution, and the equal density thus maintained. The current density was low, considerably under 20 amperes per square foot.

Elmore's Process.

The next development of importance was the Elmore process, which consists of using horizontal mandrels on which copper sheets or tubes are deposited, while agate burnishers travel continuously over the copper, so as to consolidate it, and at the same time prevent the growth of copper trees or nodules. Even with the use of a burnisher the current density could not be increased beyond 30 amperes per square foot, and the mechanical difficulties introduced by the burnisher are considerable. Large works were erected to operate this process near Leeds, England, and on the Continent, and are principally engaged in the production of large tubes and cylinders for special purposes.

Dumoulin's Process.

Dumoulin introduced, at a later date, a process for burnishing copper during deposition with sheepskin as a substitute for agate, and claimed that the process had also the advantage of insulating any projections that might be formed on the deposited metal, the sheepskin impregnator coating all projecting parts with a thin film of animal fat, thus preventing further deposition until the surrounding depressions are raised to

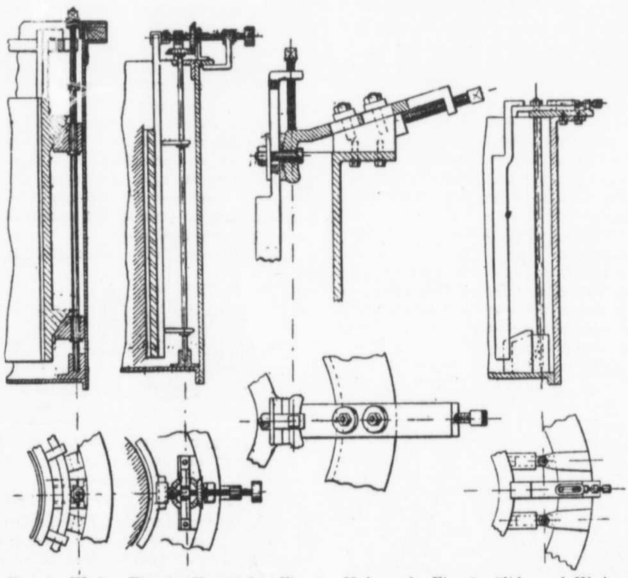


Fig. 2—Wedge Fig. 3—Eccentric and Screw Fig. 4—Universal Fig. 5—Slide and Wedge

Anode Adjustments.

the common level. It was also claimed for this process that a current density of from 30 to 40 amperes per square foot of cathode surface could be employed at a voltage of about 1.6 per vat. This process was tried on a large scale in England but was soon abandoned.

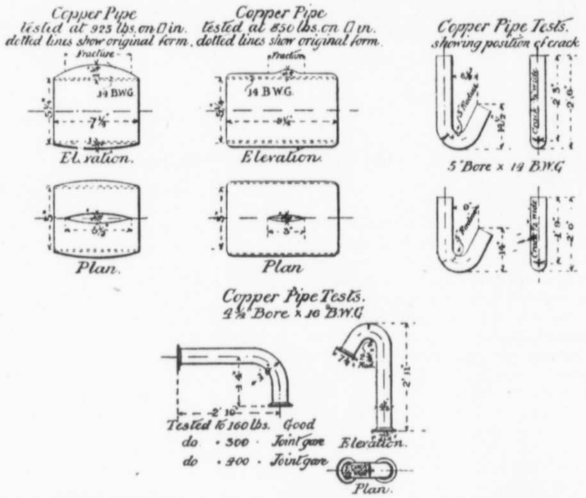


Fig 6—Mechanical Tests on Copper Pipes made by the Centrifugal Process.

Other Processes.

Attempts have been made at various times to further increase the rate of deposit by Swan, Elmore, Thofehrn, Graham, Poore and others, by impinging jets of the electrolyte against the cathode surface. The quality of the copper is liable to vary in density if impinging jets alone are employed; it is, therefore necessary to move the cathode, otherwise the copper is deposited in the form of annular rings of varying density and smoothness.

The author, when carrying out some experiments on the production of copper tubes and sheets by electro-deposition on rotating cathodes, observed that when the speed was greatly increased entirely new results were obtained and that a current density of 200 amperes or more per square foot could be employed, the copper remaining smooth and having a tensile strength equal to the best rolled or drawn copper, and in some cases a tensile strength some 50 per cent higher than that obtained by the ordinary process of casting and rolling, the tensile strength increasing with the rate of rotation of the mandrel. The result of revolving a mandrel at a comparatively high speed is that every molecule, as it is deposited, is burnished or rubbed down so as to produce a tough fibrous copper, the usual order of things being reversed, the present practice being to put the mechanical work into a mass of copper by rolling or drawing instead of treating each molecule separately.

The Centrifugal Process.

This observation led to further experiments, which resulted in evolving the process now known as the centrifugal copper process for the manufacture of sheets, tubes and wire, which will now be described in detail, together with the results obtained.

After a long series of experiments had been made to determine the best composition for the electrolyte and the most economical current density to employ, the critical speed was accurately determined by means of revolving cathodes in the form of cones. By observing the point at which the copper remains smooth, and by measuring the circumference of the cone at that point and multiplying it by the number of rotations per minute, the critical speed is readily determined; 200 amperes per square foot is found to be the most economical current density, although a current density up to 500 amperes per square foot can be employed by increasing the rate of rotation, but the increased cost due to increased voltage renders such a current impracticable for ordinary commercial work.

One of the chief difficulties inherent in any electrolytic or wet process for the production of copper tubes and sheets is having any working parts, such as bearings, in an acid copper sulphate solution, and this was one of the first troubles encountered when working the centrifugal process on a commercial scale. This difficulty was eventually overcome by constructing vats in the form of an annular ring, as shown in Fig. 1. It will be observed by such an arrangement all working parts are outside the vat and do not come into contact with the electrolyte, so that the bearings can be lubricated in the ordinary way; only the actual face of the mandrel on which the copper is to be deposited is immersed in the electrolyte. The cathode consists of a steel or cast iron cylinder closed at one end, to which is attached on the inside a steel rod projecting below the edge of the mandrel to guide it into position; the cylinder can be 5 or 6 feet in diameter or even larger so as to produce a copper sheet of say 20 feet long by 4 or 5 feet broad. Anodes composed of crude copper are placed around the mandrel with intervening spaces and are fed forward by suitable mechanical means, Figs. 2 to 5, as the copper dissolves away so as to keep the voltage constant.

One great advantage of the centrifugal process is that a very low voltage is required even when employing a very high current density; for instance, only 0.8 of a volt is required at the terminals of the vat when working at a current density of 200 amperes per square foot of cathode surface. The effect of revolving the cathode is five-fold; firstly, it keeps the electrolyte agitated, so that there is always a fresh supply of copper ions in proximity to the cathode; secondly, each molecule of copper as it is deposited on the cathode is burnished or rubbed down by means of the skin friction between the revolving cathode and the electrolyte; thirdly, the rotation prevents any foreign matter that may be in suspension in the electrolyte settling on the cathode and becoming entangled by further copper being deposited around or over it; fourthly, it brushes away any air bubbles on the cathode, which are the cause of nodules forming; and fifthly, the rotation of the cathode ensures the thickness of copper being uniform even when a mandrel of say 8 feet in length is employed.

Making Tubes and Sheets with Centrifugal Process.

The method of making tubes by the centrifugal process is as follows:—A mandrel somewhat smaller than the finished internal diameter of the tube is prepared by coating it with an adhesive coating of copper by first depositing copper upon the surface from an alkaline solution and then thickening it up in an acid solution, the surface being highly burnished and treated chemically to ensure the easy removal of the deposited tube. The mandrel thus prepared is then placed in a vat as shown in Fig. 1, according to the diameter of the tube and its length. When the desired thickness has been obtained the mandrel is removed and placed in a horizontal or vertical lathe, and a round-faced roller run over the surface so as slightly to expand the deposited copper, which can then be readily drawn off.

Copper sheets are prepared in a similar manner, the only difference being that the mandrels are of much larger diameter, and a narrow insulating slip is fitted down one side so that the sheet can be easily removed

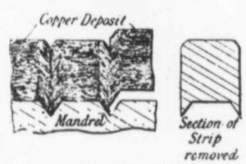


Fig. 7—Diagram Showing Method of Forming Weak Line of Cleavage Due to Crystalline Structure.

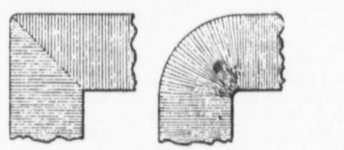


Fig. 8—Diagram Showing the Effect of Sharp and Rounded Corners on the Crystalline Structure of Metal Castings.

by inserting a tool under one of the edges of the deposited copper. It is no more costly by the centrifugal process to make thin sheets than thick ones; copper foil can be made in five minutes direct from crude copper.

Tests of Tubes and Sheets.

Copper tubes produced by this process without any drawing have given a maximum stress of 17 tons, and tubes after drawing have withstood a pressure of 3,000 lbs. per square inch without showing any signs of distress, as shown by the following test made by Mr. David Kirkaldy:—

Diameter outside.	Thickness of Metal (mean)	Length.	Weight per Foot.	Subjected to a Pressure.
Inches.	Inch.	Inches.	Lb.	Lbs. per sq. in.
1.123	0.063	4.94	0.814	3,000

Sheets made without any rolling have given a maximum stress of 28 to 30 tons and more per square inch according to the peripheral speed at which the mandrels were revolved. The following are some tests made by Mr. W. Harry Stranger :—

Saunders have both experimented with such processes but so far they have not been worked commercially.

Elmore's process consists of producing copper tubes by his burnishing process, cutting them into long spirals and then drawing them into wire.

Other experimenters have tried placing an insulated spiral strip on a cylindrical mandrel so as to produce long copper spirals, but such an arrangement only allows of a very low current density being employed, on account of the nodules which form on the edges of the strip, even at very low current densities, rendering the strip unsuitable for drawing down into wire.

Copper wire is made by the centrifugal process in the following manner:—A mandrel similar to that used for making copper sheets is employed, around which a spiral scratch is made, the pitch being determined by the size of wire required.

The effect of the spiral scratch (which need only be very light but must be angular), is to cause the crystalline structure of the copper to form a cleavage plane, as shown in Fig. 7. The copper divides exactly at the apex of the scratch, that is, the copper deposited in the scratch is equally divided and forms a small V-shaped fin on two sides of the copper strip. If the scratch is not angular, but rounded at the base, the copper will not divide, as the crystals are radial, as shown in Fig. 8. After the desired thickness has been obtained, approximating the pitch of the spiral scratch, the mandrel is removed from the depositing cell and placed in a vertical position on a lathe, and the copper strip is unwound at an angle of about 45 degrees to the face of the mandrel. During the process of unwinding, the small fin or burr is removed by passing the wire through a suitable die and then through a wire-drawing machine provided with three or more draw-plates to reduce the strip to the desired diameter. By employing a mandrel of 6 or 7 feet in diameter, lengths of wire 4 or 5 miles long can be made in one operation.

Dimensions	Area.	Reduction of Area at Fracture	Extension on 8 ins.	Elastic Limit (Yield Point)	Maximum Stress	Remarks.
				On Original	Area	
Inches	Sq. in.	Per cent.	Per cent.	Tons* per sq. in.	Tons* per sq. in.	
1.109 x 0.006	0.0066	31.8	21.1	20.4	25.5	Fair break in centre
1.135 x 0.007	0.0079	17.7	20.4	28.4	28.4	Fair break in centre.
1.114 x 0.005	0.0055	—	6.3	22.4	34.6	Specimen broke outside datum points on slightly larger area.
1.124 x 0.008	0.0089	—	14.4	22.6	27.7	Specimen broke outside datum points on slightly larger area.
1.114 x 0.01	0.0111	18.9	12.0	—	27.3	Fair break.
1.121 x 0.011	0.0123	24.4	20.0	18.2	27.3	Do. Do.
Bending test.	Strip bent three times upon itself. No cracks.					

* Tons of 2,000 lbs.

Fig. 6 shows the result of some mechanical tests on copper pipes made by the centrifugal process and subjected to hydraulic pressure, giving results far above those required by the Board of Trade.

The formation of copper trees and nodules was another difficulty that had to be overcome, but which had been reduced to a minimum in the centrifugal process, for the reason that impurities held in suspension in the electrolyte have no opportunity of settling on the cathode, and all gas bubbles are swept from the surface on which the copper is being deposited.

Production of Copper Wire by Centrifugal Process.

The production of copper wire by electrolytic means is a more difficult problem than the production of copper tubes and sheets. Various processes have been suggested and tried from time to time, such as the electro-deposition of copper on thin wire, until it has obtained a considerable thickness, and then drawing the thickened wire down to a comparatively fine wire. Swan and

Advantages of Electrolyte Process Over Smelting.

The advantages of an electrolytic process as compared to a smelting process are many, and the day is not far distant when copper will no doubt be leached direct from the ore and electrolyzed with insoluble anodes, to produce finished copper sheets and tubes in one operation direct from the ore without the intermediate process of smelting and refining.

The centrifugal process is a step in this direction, as it is capable of depositing copper from its solutions by using insoluble anodes in the form of finished tubes or sheets in one operation. The centrifugal process is at least ten times faster than any existing electrolytic process, and a high current density can be employed without deteriorating the quality of the copper. There is no risk of lamination, as no burnishers are employed. The plant is simple and free from mechanical complications, and the amount of copper locked up for a given output is small compared to other processes. The process is of interest to mechanical engineers, as it conclusively proves that to get a high tensile strength in metals combined with ductility, it is not essential to put a large amount of work into the metals as hitherto

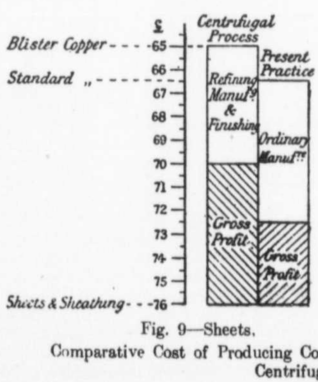


Fig. 9—Sheets.

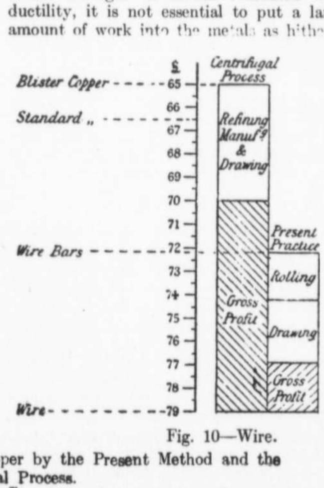


Fig. 10—Wire.

Comparative Cost of Producing Copper by the Present Method and the Centrifugal Process.

has been considered necessary, by the processes of swaging, rolling or drawing, but that a very small amount of energy will suffice when applied in the manner described in this article.

Comparative Cost of Producing Copper Sheets and Wire

In Fig. 9 is given the comparative cost of producing copper sheets by the process of smelting, refining, casting, and rolling, as compared with the centrifugal process.

In Fig. 10 is given the comparative cost of producing wire by the ordinary process of smelting, refining, rolling, and drawing, and the centrifugal process.

The capital expenditure of a plant for the centrifugal process both for the manufacture of sheets, tubes and wire, compares very favorably with an up-to-date rolling mill and wire drawing plant. The cost of such a plant, with buildings, is about £80,000 for an output of 100 tons per week of 5,000 tons per year. The following is an estimate of the cost of a plant for the centrifugal process capable of dealing with 10,000 tons of tubes, sheets, and wire per annum:—

Estimated Cost of Plant for Producing 10,000 Tons of Tubes, Sheets, and Wire per Annum by the Centrifugal Process.

	£ s. d.
Cost of 95 vats anda ccessories...	6[illegible],000 0 0
Machinery for finishing tubes, sheets and wire............	5,000 0 0
Cranes and lifting gear........	1,500 0 0
Building......................	15,000 0 0
Plant for mandrel-making.....	2,000 0 0
Machinery for fitting shop.....	1,500 0 0
Pumps, atomizers, filter tanks .	5,000 0 0
Driving machinery for vats....	5,000 0 0
Conductors and electrolyte.....	5,000 0 0
	£104,000 0 0
Floating capital for copper.....	30,000 0 0
	£134,000 0 0

Estimate of Cost per Ton of Producing Copper Tubes, Sheets, and Wire by the Centrifugal Process Direct from Crude Copper.

	£	s.	d.
Power per ton (2,240 lbs.) 1,015 k.w. hours at 0.275d per kw .	1	2	2
Wages at 8d. per hour, 18½ hrs		12	4
Management.................		5	0
Interest on copper lock-up.....		1	0
Depreciation on plant and building........................		10	0
Heating elecrolyte............		1	0
Finishing and gauging.........		5	0
Cost per ton.........	£ 2	16	6

These figures represent the actual working cost on which there would be a further reduction of the previous metals recovered, and if £1 10s. be deducted from the above cost, which may be taken as an average difference between Chili-bar and electrolytic copper, the cost per ton is reduced to £1 6s. 6d.

Data About Foundry Accidents Wanted

The American Foundrymen's Association at the Toronto Convention in June, 1908, Appointed a Committee to Work Towards the Prevention of Accidents in Foundries. The Writer of this Article is the Chairman of this Committee, and L. L. Anthes, Toronto, President of the A.F.A. is the Canadian Representative to the Committee. The Desire at Present is to Secure Data Regarding the Underlying Causes of Accidents. Canadian Manufacturers are Urgently Requested to Take an Active Interest.

By Thomas D. West.

There is no effort more worthy of recognition and every support, than that of the prevention of accidents. The foundry, whether iron, steel, malleable or brass, is as liable to have mishaps that will maim, kill and destroy property as with other industries. There are very few, if any lines of manufacture, or commercial business that is not interested at the present day in the prevention of accidents.

The writer's efforts in this work while dating back a couple of years, are most noticeable of results, commencing with the paper he read before this Association January 8, 1908, and the founding of the American Anti-Accident Association in Sharpsville, the 22nd of that month.

The grounds for commendable achievements to prevent accidents in our foundries was so strongly urged by the writer at the American Foundrymen's Association's convention at Toronto, last June, as to result in the appointment of a committee consisting of the following gentlemen, to labor for the cause:

L. L. Anthes, president American Foundrymen's Association, Toronto, Canada; Dr. Richard Moldenke, secretary American Foundrymen's Association, Watchung, N.J.; Howard Evans, secretary Philadelphia Foundrymen's Association, Philadelphia, Pa.; F. H. Zimmers, secretary Pittsburgh Foundrymen's Association, Pittsburgh, Pa.; Frederick F. Stockwell, secretary New England Foundrymen's Association, Boston, Mass.; C. E. Hoyt, secretary Associated Foundry Foremen's Association, Chicago, Ill.; James H. Beans, secretary Centre Foundry & Machine Co., Wheeling, W. Va.; W. J. Spencer, M.E., 712 Girard Trust Building, Philadelphia, Pa.; Thomas D. West, chairman, Sharpsville, Pa.

The character of the men composing the above committee is evidence that no effort will be countenanced that are not just to employer and employee alike, with a sole aim to best prevent accidents, all that is practical.

The cause of accidents are chargeable chiefly to: 1. Sheer carelessness. 2. Intoxicants. 3. Smoking. 4. Inattention to surroundings. 5. The improper use or disregard of safety devices. 6. Disregard of rules or orders. 7. Disrespect for consistent authority and discipline. 8. Taking chances. 9. Inferior workmanship, machinery, etc.

The first move being made by the above committee to forward its work lies in making efforts to obtain statistics as to what accidents are caused through each of the above respective factors. We have good data as to how accidents happen, but as to the underlying cause shown in the above nine and other like factors, little or none exists in a way that can be of real service in assisting any individual, firms, societies or legislative bodies to rightly designate a remedy. The knowledge of underlying causes is as essential in the question of best preventing accidents as in the remedying of defective machinery, or other industrial affairs of life.

One unfortunate feature of this whole subject that has to be righted lies in the narrow view many entertain. Instead of studying to learn what is really at the root of our country's deplorable accidents, all with a view of best preventing them, it is a tirade with many on employer's being fierce after profits and too inhuman to install safety devices, or in other words, the employer is wholly to blame, should pay all the costs, and is expected to stop accidents.

This error is leading many employees and others to expect public support in their theory that safety devices and actions of employers are the only essentials needed in the prevention of accidents. This causes many to say, in a figurative way to proprietors, put in your safety devices, but do not attempt to load us with any care, responsibility or worry in order to help you to prevent accidents.

Founders will bear with the writer on stepping outside of their provinces with this paper, as what may be done in this respect is largely due to the fact that there is much that lies with the general public and other trades which effect the inner workings of our foundries, and while we assist the outside or other industries, we can the better bring about the conditions that should prevail in our shops.

Great harm is being done in having the opinions prevail that the want of safety devices is the chief cause of all our accidents. There is much benefit that is yet to be derived by the installation of safety devices, and wherever it is possible of their decreasing our accidents, they should be installed. Before proceeding further we will consider how far safety devices can be expected to be utilized in preventing accidents.

According to statistics of Dr. Joseph Strong, in his "Social Progress," we had of the 76,000,000 population for 1900, the following citizens being engaged in gainful occupations:

Professional services	1,258,739
Trade and transportation	4,766,964
Domestic and personal service	5,580,657
Manufacture and machine pursuits	7,085,992
Agricultural pursuits	10,381,765
Total of all occupations	29,074,107

The above figures show that in 1900 we had 46,305,883 people who must be accounted for, either as wives, home makers, or growing children, in addition to a class that may be termed, criminal, vagrants or loiterers. Having the figures of this paragraph before us the question may be rightly asked, what percentage of our people are there who can be protected from the destruction of life and property in our affairs, of work, recreation, loitering, vagrancy and criminality, by means of safety devices? The writer cannot figure out from existing conditions that much over 20 per cent. of our population can be safeguarded by the best application of safety devices that are to be provided.

When we consider that we are daily maiming and killing about 1,600 and destroying nearly $2,000,000 worth of property, the 80 per cent that cannot be protected by safety devices strongly affirms that whoever desires to help best prevent accidents to any commendable degree will have to look to other factors.

Safety devices will not prevent an automobile's killing one and injuring four every day in the year as is the present rate, nor will they decrease the 5,000 killed and injured by the celebration of our "Fourth" with dangerous deadly weapons, and fireworks.

Again as an illustration in the case of fires and other forms of wastes in destroying property it can be asked. How much of our $2,000,000 daily losses can be prevented by safety devices?

The campaign which the writer is waging, and the solicitations he is making for the support of citizens is not one merely to lessen the loss of a few lives and hundred dollars' worth of property every day as can only be done by safety devices, but one that seeks to strike at the roots of all the evils and the deplorable losses resulting from accidents.

We should be, as a people, brought to a position where common sense and prudent actions can make civilization a success, instead of having the crimes in terrifying wastage of life and property which our unbridled national laxity have created.

The evils causing us far the greatest number of accidents as found in the third paragraph of this paper are best known by those who have come up from being a (or were associated with apprentices through the sphere of) journeymen to become managers of business plants in which their own hard-earned savings are at stake. This is said with all due respect to those writers that are now constantly coming before the public through our popular magazines and papers, who attribute accidents largely to improper protection by safety devices and laying all the blame at the door of proprietors, something they would not do had they any extended experience as overseers or managers of hazardous labor, or sought to take measures best to prevent accidents.

When safety devices are put in it is often a continual combat for overseers to get employees to use them, and this is a point there should be a special law, whereby operatives could be arrested by co-workers or employers and be heavily fined or imprisoned for not following instructions in using safety devices. Likewise where accidents are happening through the indifference of an operative to take a few extra steps or exertions, to obtain the chain or tool that was made especially for handling the job.

The writer is not seeking to censure anyone; the only desire is to have the issue rightly tracked and state facts that should have weight with our public press and legislative bodies in passing judgment on causes and best remedies to reduce our accidents to a minimum as far as practical.

It is not the purport of this paper to treat any of the needed training and discipline of youths and adults as a means to lessen the evil influences of the factors seen in the third paragraph, as the writer has previously presented very clear treatises on the responsibilities of the home, teachers, employer, operatives, etc., in regard to their respective parts in aiding the best prevention of accidents.

The chief object of this paper is to awaken an interest among all our founders in a plan to secure statistics to show the underlying cause of accidents in their plants, and such will no doubt arouse other industries, etc., to do likewise.

It is not to the employe's interests any more than that of the employer's, that we should remain inactive as in Europe, until ill-advised law makers will pass unwise liability provisions, the character of the same being shown in English employers being held responsible for his operatives from the time they leave their home until their return. In this connection it is to be remarked that this latter provision involves every person that hires another, no matter in what sphere of industrial or domestic employment. This as an example can include any citizen from one that might engage a servant or farm hand to one that would desire the services of a plumber, paper hanger in household work, up and through all classes of manual and clerical employment, even though employed but a few hours during any day.

We have now too many in our country that would be glad to meet with slight disabling injuries if they thought fines on employers or people worth a little property, would support them in idleness or on a drunk without increasing their number. To have such laws as are now enforced in some parts of Europe placed upon us would be very unjust to all our respectable and responsible classes of citizens that is worth anything, especially in view of the fact that this country excells others in carelessness and disasters.

The writer has always taken the position that the larger part of all our country's accidents were due to sheer carelessness or foolhardiness, and has placed much literature in the hands of public press editors, congressmen and others, to sustain this, and there is evidence of its having done much good.

It is said "The necessity for increased production involved greater haste and perhaps less tendency to watchfulness at machinery, so that there is the greater need for inculcating at an early age that scrupulous carefulness which we have heretofore been content to allow the experience of time to bring." This is all in accord with the writer's advocacy of its being very important for us in this country to commence the teaching of greater care and faithfulness along with a more rigid discipline of our young in our homes and schools.

The "Engineering" also states "In foundry work, the increase is most marked. Ten years ago, the number of non-fatal accidents did not reach 2,000, whereas in the past four years, they have gone up from 3,800 to 6,798." This shows that this new employers' liability is not causing any reductions in accident, but working the other way. The iron, steel, malleable and brass foundries have all hazardous vocations and are all eager to reduce the number of their accidents all that is possible. It is believed that few things can assist them to do this at the start better than an education along the line of our learning the true underlying cause of present accidents.

In order to obtain such data, a blank form of report has been gotten up by the committee authorized by the American Foundrymen's Association on the prevention of accidents. This blank will be circulated in the very near future among all the foundries of the United States and Canada. Among other things on which information is requested in the blank is the classification of accidents by causes cited in the third paragraph of this paper, as well as those which were unavoidable by the unfortunate sufferers. Further, the expenses caused by these accidents, both direct and subsequent through repairs necessary or damaged by fire.

It is hoped that full statistics will be supplied, all of which will be kept confidential, and only the summaries, used for the purpose of making a general report, which if complete enough, is designed to play an important part in the legislation on accidents and other factors constantly coming up.

Both the writer as well as any member of the committee will be glad to furnish any further information that may be desired in this connection.

The whole question of the urgent need of and practicability of doing must, to prevent our great loss of life and property through accidents, is one that has been winked at by all classes entirely too long. Is not this indifference, if continued, one that will bring grave injustices and suffering to operatives as well as employers?

For humanity's sake, if for no other, this subject should be afforded every attention, and the appeals of this paper for data on the underlying cause of accidents, can, if liberally complied with, give results in helping to decrease them as by no other cause—statistics now in existence and should be commended by all that are involved in work or recreation, whether employe or employer.

POWER PLANT OPPORTUNITIES.

Ontario.

TORONTO.—It is expected that tenders for part of the distributing plant for Niagara power will be called by the City Council, Toronto, in a few weeks time.

HAMILTON.—The contracts for the city waterworks, pumps and motors have been awarded as follows: The John McDougall Co., Montreal, the pumps at $7,220; The Canadian Westinghouse Co., Hamilton, the motors at $12,928.

NEW TOOLS AND SHOP EQUIPMENT

Only Descriptions of New and Interesting Machines, Tools or Appliances Can Be Published. No Mere Write-Up Can be Used.

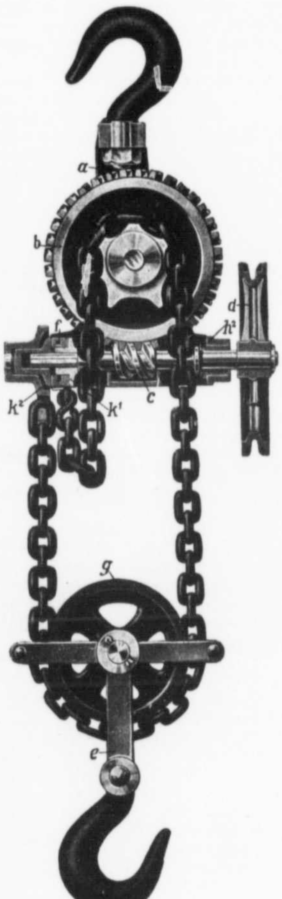


Fig. 1.

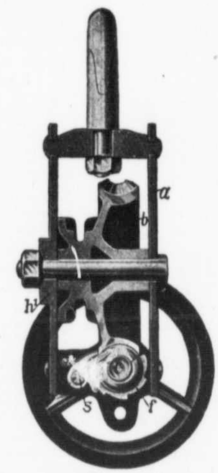


Fig. 2.

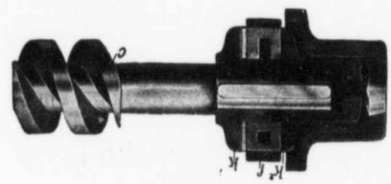


Fig. 3.

Atlas Worm Gear Chain Blocks

The accompanying illustrations show the construction of the Atlas worm gear chain blocks, which are equipped with an automatic brake. The features of this block as brought out in the following description should be of great interest to all users of chain blocks. The action of the brake is of chief interest. This is shown in Fig. 3.

In the brake action (Fig. 3), the worm spindle is fitted with the ratchet wheel "f," which is driven by a friction washer, between collar "k 1" and ratchet wheel "f." When the load is being lifted, the worm is pressed toward the hand chain wheel and the brake revolves loosely on the end of the shaft, but when the lifting ceases, the friction brake is thrown into action automatically. In lowering, the worm is pressed toward the bearing and under the reverse action of the worm-wheel the pressure between "k 1" and "k 2" increases. This arrangement secures a friction lowering gear, but the friction does not retard the raising of the load and hence the block works with the greatest ease.

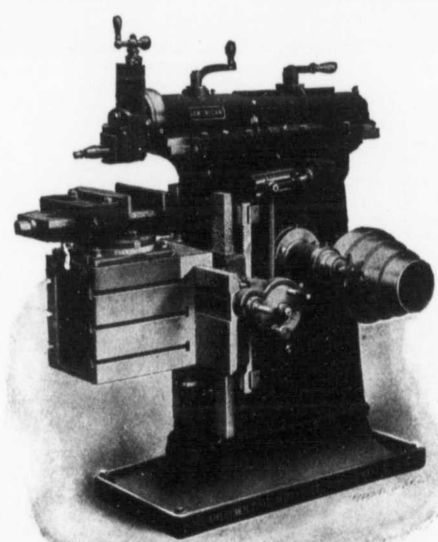
The principal parts of Atlas chain blocks are constructed of steel and wrought iron, insuring a degree of safety absolutely necessary in hoisting appliances.

All blocks are tested before leaving the factory to at least 50 per cent. above their normal capacity. Moderate overloading, therefore, which frequently occurs when the block is in inexperienced hands, will not cause break downs.

These blocks are made by Schuchardt & Schutte, New York, and sold in Canada from the firm's offices at 91 Youville Sq., Montreal.

New Single-Geared Crank Shaper

Accompanying is an illustration of the new single-geared crank shaper just placed on the market by the American Tool Works Co., Cincinnati, O. This machine was designed for heavy manufacturing purposes and the use of high speed steels. The column, the base, the ram, the head and other parts are of heavy and strong design. The cross feed



New Single-Geared Crank Shaper.

is a patented design, and is variable and automatic with a range of .008 in. to .200 ins., obtainable while the machine is in operation. It is supplied with graduations and pointer either side of zero, reading from 1 to 25 notches, each notch representing .008 in. feed.

For lubricating the ram slides are provided with felt wipers at both the front and centre of the column. An oil pocket is cast integral with the pocket in the rear.

The cross rail is of box form, and is longer than is usual, giving the table an extra length of horizontal travel.

Another feature of the machine is the telescopic elevating screw, with ball bearing thrust.

This machine is sold in Canada by the A. R. Williams Machinery Co., Toronto.

Making an Ordinary Lathe into a Collet Lathe

By A. Read.

It quite frequently happens in the average toolroom or machine shop that there is a scarcity of collet lathes to meet the requirements. This is perhaps more often the case in the toolroom. In the building of jigs, fixtures, dies, gages, etc., the collet lathe is certainly an indispensable tool, and in the shop where there happens to be only one, it is a case of wait, most of the time. Now any ordinary hollow spindle lathe can be quickly and cheaply converted into a first-class collet lathe by making a fixture similar to the one shown in Fig. 1.

A represents the lathe spindle which in our case carried a center about 1¼ inches diameter at the small end. To this center we fitted the hardened and ground taper sleeve E. This sleeve was ground to fit collets we used on other lathes. As this rig admits of much larger size collets than the ordinary draw-in collet lathe, we made up

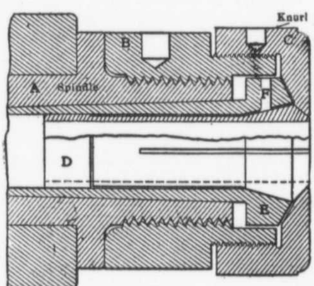


FIG. 1

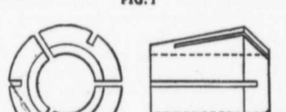


Fig. 2

The Collet and Closer.

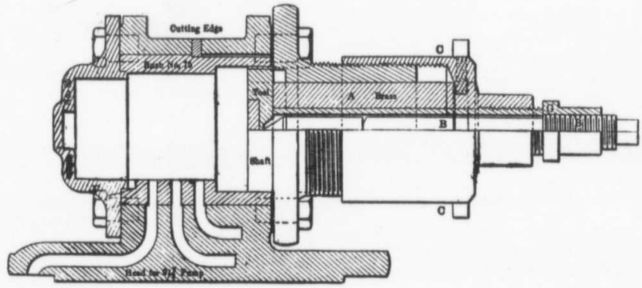
some extra sizes. The machinery stub sleeve B was next fitted to the spindle, and by means of a spanner wrench screwed up tight to the shoulder. This sleeve has a fine thread on front end to which a cap C was fitted having a taper to match the front end of the collet. The working of this rig must be apparent at sight. Both tapers of the collet being used and as the cap C is made with a fine thread (20 per in.) a very powerful grip is obtained. A spanner wrench is fitted to the cap C also. We have used this chuck quite extensively in our shop, and most of our men prefer it to the ordinary draw-in collet. It is nearly as rapid in manipulation, is very stiff and rigid, and for holding power it has the collet lathe beat a mile.

Where the use of long bars is not required, an ordinary small centre lathe with no hollow spindle can be used by extending the sleeve B and fitting it to a short collet as shown in Fig. 2. The sleeves B and C should be made of machinery steel, case-hardened; a pin F forms a key to prevent the collet D from turning.—American Machinist.

Repairing Air Pumps.

By C. E. McLaughlin.

In making repairs to air pumps the most important repair is in the top head; in fact the top head is the whole works. The parts



Reamer for Main Bushing Cylinder Head Cap 9½-inch Air Pump.

most subject to wear are main bush No. 75, packing rings Nos. 78 and 80, and left main-valve cylinder-head.

On all pumps that come to the shops for repairs the main bush is more or less worn, and on account of the valve seat in center of bush, it is impossible to ream or file this bush out true. The only way it can be machined is to bolt the top head to angle plate, or remove bush from head and chuck it in lathe. Either is an expensive practice. The common shop practice is to scrape and file until shoulder is removed. This makes a poor job at the best, and it takes from one to three hours. With the use of this reamer the job can be done in from 10 to 20 minutes in a mechanical manner. By changing tool in end of shaft the reamer can be bolted to left main-valve cylinder-head No. 85 and cylinder portion of this trued out.

Main shaft A is the size of cylinder portion of main bush No. 75. In the end of this shaft are inserted tools F, then apply part G, which acts as tool-post screw, as it holds tool in place. Parts B are then applied. Shaft is then placed in part D, bonnet C screws down over D, set-screws in C are set in to engage shaft A. Reamer is now ready for service. Bolt reamer on head with screw bolts which holds cylinder-head No. 84. As reamer is applied shaft and tools just enter bush and hold reamer central while being made fast. The shaft is then fed in by turning bonnet C until the tools reach center of cylinder which is worn largest. Tools are then set out by screwing down on part B until it is felt that tools are touching all around. Now clamp tools by screw G, which also acts as drive for reamer. By using ratchet wrench on G and turning bonnet C, reamer is fed in as far as it will go, then feed back to outside of bush and the job is done.

This tool is no experiment, as I have been using it for about two years, and it gives perfect satisfaction.—American Machinist.

TO MAKE A VENETIAN BLIND.

While building a house, Senator Platt, of Connecticut, had occasion to employ a carpenter. One of the applicants was a plain Connecticut Yankee, without any frills.

"You thoroughly understand carpentry?" asked the senator.

"Yes, sir."

"You can make doors, windows, and blinds?"

"Oh, yes, sir!"

"How would you make a Venetian blind?"

The man scratched his head and thought deeply for a few seconds. "I should think, sir," he said finally, "about the best way would be to punch him in the eye."

ALUMINUM CASTINGS.

Very favorable results have been received in service from castings manufactured from the alloy of Aluminum and Magnesium.

The Aluminum-Magnesium alloy castings (containing eight or ten per cent pure Magnesium) are about fifteen (15) per cent. lighter than the alloy of Aluminum and Copper, and the Aluminum-Magnesium alloy is also about thirty-three (33) per cent. stronger.

Recent experiments made in the machining of castings made of Aluminum and Magnesium showed that the castings machined 75 per cent. faster than those which are made of the alloy of Aluminum and Copper.

Personal Mention

Mr. G. B. Blanchard, recently elected vice-president of the Dominion Power & Transmission Co., Hamilton, has resigned.

CAPTAINS OF INDUSTRY

Opportunities for Business. News of Building or Enlargement of Factories, Mills, Power Plants, Etc.—News of Railway and Bridge Construction—News of Municipal Undertakings—Mining News.

BUILDING NEWS.

Ontario.

TORONTO.—A $50,000 wing will be added to the Free Hospital for Consumptives at Toronto.

BRANTFORD.—N. Kew has the contract for the erection of a new mineral water factory for Austin Burke here.

TORONTO.—The Sunbeam Incandescent Lamp Co.'s new building here will be enlarged.

WOODSTOCK.—The factory of the Richards Pure Soap Co., Limited has been damaged by fire.

BERLIN.—The Berlin Orphanage building will be improved and enlarged.

HAMILTON.—The Domestic Specialty Co.'s warehouse and contents have been destroyed by fire, damage amounting to $3,000.

TORONTO.—The City Council has passed two by-laws, one to issue $365,975 for public school buildings and the purchase of sites and $148,000 for high school buildings.

TORONTO.—Fire broke out in the storerooms of the H. W. Johns-Manville Co., Limited, and did considerable damage to the stock and building.

Quebec.

LENNOXVILLE.—The Frost & Wood Co. are erecting a new warehouse here.

MONTREAL.—Shapiro Bros., 359 Notre Dame West, Montreal, will erect a three-story warehouse at the corner of McGill and Notre Dame St. The architect is Mr. Alphonse Piche, Victoria Building, Montreal, and C. E. Deakin, 11 St. Sacrament St., is the general contractor.

MONTREAL.—The Catholic Board of School Commissioners have decided to purchase property at the corner of Beni and Dorchester Street for the erection of a school to be known as the Madame Marchand Academy.

MONTREAL.—Mr. H. Wener will erect a new factory on Papineau Ave., Montreal, at a cost of about $3,200. C. Dufort, 555 St. Antoine St. is the architect, and M. Labis & Co., 782 Laval Ave., are the contractors.

ST. HYACINTHE.—Contract for the new Catholic school has been awarded to G. B. Duhamel. Mr. Chas. Bernier is the architect.

MONTREAL.—One of the warehouses of the Montreal Cotton & Wool Waste Co., Limited, Duke St., on Oct. 19, was damaged by fire to the extent of $50,000.

Saskatchewan.

ELSTOW.—The Canadian Elevator Co., and the Winnipeg Elevator Co. will build elevators here.

BELLE PLAIN.—Plans are being prepared by R. J. Bunyard, Moose Jaw, for a large new school here.

GRASSEY LAKE.—The Medicine Hat Milling Co., will put up a new elevator here.

ESTEVAN.—The Farmer's Elevator & Trading Co. will pull down their old warehouse here and have a new elevator built by Stormwald & Co., contractors, Mohall, N.D.

MELFORT.—A. McMichael will build a 25,000 bushel elevator at Beatty Siding near here.

RADISSON.—A Greek Presbyterian Church will be erected here.

BROWNLEE.—Funds are being raised for the erection of a church here.

British Columbia.

FERNIE.—Plans have been prepared for the new public school building here by Robert Kerr.

VANCOUVER.—A new theatre building may be erected here.

NELSON.—The Porto Rico Lumber Co. will erect a new saw mill here this fall.

Alberta.

COLERIDGE.—A new two-story hotel will be erected here by Paul Lecieux.

New Brunswick.

BATHURST.—The Bathurst Lumber Co. is building a new plant.

Nova Scotia.

TRENTON.—Humphrey's Glass Works and general store have been destroyed by fire.

Manitoba.

MACDONALD.—The Winnipeg Elevator Co., Limited, elevator has been destroyed by fire.

COMPANIES INCORPORATED.

Ontario.

YARMOUTH CENTRE.—The Yarmouth Rural Telephone Co., Limited, have been incorporated with a capital of 10,000 to carry on the business of a Telephone company. The provisional directors include David Caughell, Glover Summers and L. R. Cloes, Yarmouth.

HAMILTON.—The Gurney-Tilden & Co., Limited, have been incorporated with a capital of $800,000, to carry on the business of selling and dealing in all kinds of stoves, furnaces, radiators and grates. The provisional directors include J. H. Tilden, E. D. Cahill and E. E. Marks, all of Hamilton.

TORONTO.—The British Yukon Gold Mines, Limited, have been incorporated with a capital of $1,250,000, to carry on the business of a mining, milling, reduction and development company. The provisional directors include J. C. Mitchell, James Hoperon and William Kelly, all of Toronto.

Quebec.

QUEBEC.—The St. Lawrence Stevedoring Co., Limited, have been incorporated with a capital of $100,000, to take over the stevedoring, loading and unloading plants for vessels, of the Canadian Import Co. The provisional directors include M. T. Webster, W. Q. Stobo and H. Aird, Quebec.

CANSAPSCAL.—The Matapedia Lumber Co., Limited, have been incorporated with a capital of $140,000 to buy sell and trade in timber of all kinds. The provisional directors include O. N. Piche, J. N. Piche and J. L. Piche, Cansapscal.

MONTREAL.—The P. Vincent Lumber Co., Limited, have been incorporated with a capital of $99,000, to carry on the business of lumberers, timber merchants and manufacturers of timber and lumber. The provisional directors include J. P. Vincent, E. M. Tremblay and F. Tremblay, all of Montreal.

MONTREAL.—The Westmount Plumbing & Heating Co. have been incorporated with a capital of $90,000, to carry on a general plumbing, heating and steam fitting business. The provisional directors include W. A. Rousseau, M. A. Cardinal and J. J. Meagher, all of Montreal.

POWER PLANT OPPORTUNITIES.

Saskatchewan,

WOLSELEY.—The ratepayers will vote on a by-law to issue $23,000 debentures, issued as a loan to the Central Light & Power Co.

WATERWORKS, SEWERS AND SIDEWALKS.

Nova Scotia.

HALIFAX.—The City Council has carried a by-law to borrow $25,000 for sewers.

Manitoba.

WINNIPEG.—The City Council will issue debentures to raise money for various local improvements.

TRADE NOTES.

Ontario.

FRONTENAC.—The Frontenac Cereal Co. have taken over Moore's elevator there, having a capacity of 500,000 bushels.

HAMILTON.—Among the firms who have recently placed orders for pumps with the Smart-Turner Machine Co., Hamilton, are: Marsh & Henthorn, Belleville, Ont., the Hamilton Bridge Works, Hamilton, Ont., the Burlington Canning Co., Burlington, Ont.; the Intercolonial Railway, Moncton, N.B.; the Coniagas Mines, Limited, Cobalt; Butler Bros. Hoff Co., Windsor, Ont., and Fowler's Canadian Co., Limited, Hamilton.

TORONTO.—It is stated that the present site of Knox College may be sold to an English Co. for a large departmental store.

KINGSTON.—An order for 25 locomotives has been placed by the Grand Trunk Pacific Railway with the Canadian Locomotive Works.

Quebec.

MONTREAL.—Tenders are being invited for heating and ventilating of the new McGill Medical Building. Messrs. Brown & Vallance, Canada Life Building, are the architects.

MONTREAL.—The Dominion Car & Foundry Co., Montreal, are now running under a full staff. Some large orders have been received from the Canadian Pacific Railway as a result of the heavy traffic movement.

SHERBROOKE.—The E. & T. Fairbanks Co.'s new plant here is now ready for operations.

Manitoba.

WINNIPEG.—Sir Thomas Shaughnessy, president of the Canadian Pacific Railway, said that the Company had spent $10,000,000 double tracking the line between Winnipeg and Thunder Bay last year. The company are preparing to operate trains over the mountains by electricity generated by water power for 700 miles.

MILL AND FACTORY EQUIPMENT.

Quebec.

MONTREAL.—E. G. M. Cape, Montreal, has been awarded the contract for two additional buildings for the Canadian Spool Cotton Co., at Riverside Park, Maisonneuve. Contracts for an intake and well for the same concern have been awarded to the Rexford-Bishop Construction Co., 3 Beaver Hall Square, Montreal. Messrs. Brown & Vallance are the architects.

POWER PLANT OPPORTUNITIES.

Quebec.

MONTREAL.—Mr. Cowie, engineer of the Harbor Commission, is preparing plans for an electric plant to be erected at a central point on the harbor front for the production and distribution of power for every purpose along the harbor.

Ontario.

PORT ARTHUR.—The power contract between the Kam Co. and Port Arthur, has been signed, and the erection of a sub-station at Port Arthur will be commenced immediately.

MONTREAL.—The plant of the Moore Carpet Co., which has been in liquidation for some time has been sold by the liquidator, Mr. John J. Griffith, to T. M. Craig.

BUSY TIMES IN CAMPBELLFORD.

Campbellford, Ont., is a busy town now.

The Trent Valley Woollen Mills have received large orders from leading wholesale houses of Canada, and the future is promising.

The Northumberland Paper Mills are very busy, and large additions are being made to the mill.

The McBurney Lumber Co. have their sawmill running at full capacity.

The Dickson Bridge Co. have many orders ahead.

The shoe factory, flour mill, foundry, sash and door factories are all busy.

In addition to all this the Dominion Government have spent about $300,000 on the Trent Canal in this vicinity, and the work is only commenced. The town is putting in a new power plant, which, when finished, will cost over $100,000, and a large number of men have been employed on the work all summer.

CONTRACT LET FOR GRAND TRUNK RAILWAY CAR SHOPS.

The contract for the construction of new carshops, etc., for the Winnipeg terminals of the National Transcontinental Railway was awarded to Thomas Kelly & Sons, Winnipeg, on Oct. 19. The tenders call for the expenditure of about $500,000, and the work will be started at once.

Malleable vs. Steel Castings vs. Forgings

The Development of the Respective Fields of Cast and Wrought Iron and Cast Steel. With Illustrations of Articles in the Making of which the Three Materials Can be Used to Best Advantage.

By James H. Baker.

Really only one metal is involved in the present consideration; that is iron as a base. By alloying with other elements, by causing chemical changes in these and by varying physical treatment, we get adaptability to the formation of different shapes in castings, forgings and rolled and drawn material. We also get the advantage of certain physical characteristics, such as tensile strength, resistance to crushing, etc. No metallurgical reader need be told that with the iron, as we find it in the condition of ore, we have phosphorus, sulphur, silicon, copper, etc., and that in the blast furnace part of the carbon and sulphur in the fuel is taken up by the iron. All of these elements are generally kept as low as possible, though pure iron is of little use. It is necessary to control the proportions of such of the above as may be desired, and others are often added, such as manganese, nickel, chromium, vanadium, etc. Detailed reference to alloyed steels is left out of present consideration except to say that their use will likely still further advance the use of castings, especially steel castings. The changes from the use of one material to that of another are often brought about by advances in the different arts. The useful phase of the matter is to find what decides the choice of materials. The difference between wrought iron and steel is not considered in this paper, nor is it any part of the purpose to describe the differences between casting, rolling, forging, cold drawing, roll forging, pressing, drop forging, etc.

Carbon Variations.

Cast iron, having 3 to 4 per cent. generally of carbon, is easily master in resisting compression and in resisting corrosion from many causes. When chilled it has a quality all its own. As to castings, at first we had cast iron, and then we got it with steel turnings and scrap of various kinds intermixed in order to make stronger castings. Also we have had castings which were converted into steel after being molded in sand, but this has not advanced much. Next we have malleable castings, which are cast iron with some of the carbon taken out and part of the balance and other elements changed. These are made into many intricate shapes, impossible commercially in wrought material, and yet give a service much nearer to wrought iron as to tensile strength and toughness than simple cast iron.

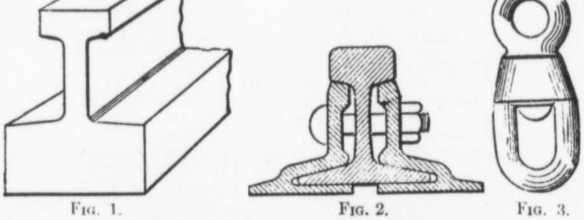
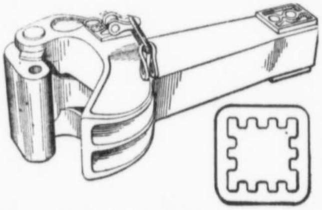


Fig. 1. Fig. 2. Fig. 3.

Contrasts of Cast and Wrought Forms.

Steel castings come in as another link between cast iron and wrought material. Next is wrought iron, with its tensile strength and ductility above malleable castings. Then comes carbon again in combination and we have steel, which in its mild form is some stronger than wrought iron, and with higher carbon very much stronger. Next



Figs. 4 and 5—Coupler Draw Bar and Section of Shank.

come the alloyed steels, either in castings or wrought, which surpass all. But carbon steel—in other words, the regular commercial product—when cold worked, such as cold rolled or drawn shafting, and in one of its highest forms, as high carbon drawn wire, has as much as 10 times the tensile strength of cast iron; hence it is easily seen how widely qualifications for different uses may vary.

Where Cast Iron is Preferred.

Much money and often sore disappointment would be saved if fundamental principles were considered at the start. Cast iron being the basic metal is cheapest per pound,

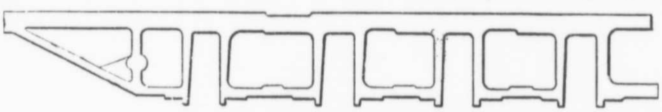


Fig. 6—Cast Steel Locomotive Frame.

but is not therefore the cheapest, even per pound, when it comes to being put into commercial forms. A straight, clean 60-ft. railroad rail cannot be made of cast iron as cheaply as of wrought steel, leaving quality out of the question. On the other hand, for many articles wrought metal would be gladly accepted in place of castings, but price determines that castings shall be used. In this class are door lock parts, engine beds, flywheels, car couplers, brake wheels, sash weights, and parts for cars, for agricultural implements and for household articles without number. On the other hand, there are many articles in which both prices, on account of form, and quality, on account of granular structure, favor plain cast iron. These include ingot molds, smoothing irons, balls for pipe welding, furnace plates, many forms of forging and pressing dies, finishing rolls for rolling mills, etc. It is true that rolls for heavy roughing work are often preferable in steel, but for finishing, cast iron ones are best and would, therefore, be used even at a higher cost. They clean themselves, where wrought rolls would let the hot metal stick to them.

A stove burner shows a wonderful combination of the economical, useful and ornamental in cast iron articles which will never be reached in wrought material. The art of pressing sheet metal is well advanced, but the sharp effect in surfaces and intricate and delicate forms possible in cast iron cannot be realized in wrought material cheaply enough. A stove, whether for gas or coal, is an impossibility in wrought, and even if so made would not stand the heat like cast iron. Cast iron water pipe costs much more per foot than wrought steel, yet it is used almost exclusively for water mains because of its resistance to corrosion by contact with the earth, water, etc. The highly practical difference between the tensile and crushing strength of cast iron is an important factor in maintaining the supremacy in many articles. This principle is well illustrated in the Hodgkinson beam, Fig. 1, where in order to use a minimum amount of metal to support a given load it has about five times more sectional area in the lower flange than in the top. The beam itself has given place to wrought steel, but the principle remains.

Chilled Castings.

Chilled cast iron has its hardness produced by chemical change taking place from sudden cooling, which is a different matter altogether from hardening a piece of steel, for by heating the steel again the hardness may be taken out; but subsequent heating under ordinary conditions will not take the hardness out of chilled cast iron. Another principle often involved in the choice of materials is that of the wear of one on the other. A wrought or fibrous material wearing on a cast iron or granular one is the best condition so far as these metals are concerned. For instance, the wheel box with wagon skein, Fig. 13, is universally of cast iron, on account of wearing qualities as well as cost. Chilling steel castings in the sense mentioned has not so far been done commercially. A little has been done in uniting chilled cast iron to steel castings, but this is limited to plain forms.

Wider Field for More Recent Processes.

The art of casting is so much older than that of rolling, forging and pressing that we may reasonably look for comparatively more development along these last named lines. As to rolling, slitting rolls for cutting hammered plates into nail rods came first. Sheet rolls are about 175 years old, while grooved rolls have been in use only about 125 years, and three-high rolls came in the last generation. It is only 100 years since formed up sheet metal commenced to displace castings in forms which had been in use for thousands of years. When it comes to bars of uniform section, or even those having an alternate limited change of sectional shape and of any considerable length, price alone determines the choice of the wrought, while the quality is also in its favor. In this list are such as railroad rails, wire, concrete reinforcing bars, frames for buildings, bridge members—in fact, an endless number.

The matter of freight for long distance often decides the choice of material, as some articles can be made in wrought so much lighter than castings. This factor is highly important where muleback transportation is involved. In rail joints, forms which can only be made of steel castings will be limited in use because of the uniformly close fit necessary. Many efforts have been made to produce these in castings, but even such forms as Fig. 2 are made cheaper in wrought and there can be no question about their

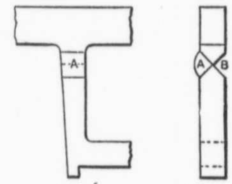


Fig. 7. Fig. 8.
Parts of Forged Locomotive Frame.

being better. In journal boxes for railroad cars efforts in pressed steel are quite recent, but so far there is nothing to report. In journal box wedges drop forged ones have made considerable advance against castings, but the great body of these are still made in castings, mostly malleable, and it will be interesting to watch the outcome.

Malleable Castings and Their Adaptations.

Malleable castings with their large development are limited to a considerable degree by size, or rather by thickness of section, owing to the fact that this material differs physically and chemically from the surface to the center. The best part is on the outside, and the nearer that this better condition can be made to reach clear through, the better the article. A section containing 1 sq. in. would be much better if of ¼x4 in. than of 1x1 in. There are, therefore, many articles which are of excellent quality in lighter sizes of castings, but in heavier are better of wrought; hence another condition divides the uses of the two materials—namely, where size determines the quality. Chain swivels, Fig. 3, are largely, in fact almost wholly, made of malleables in the lighter

Fig. 9—Cast Iron Step. Fig. 10.—Malleable Step.

sizes, say up to ½ in. But when it comes to a swivel, say, for a 2-in. chain, which must pass through a 9-in circular opening and uniformly stand a test of 250,000 lb. pull, malleables are not equal to the requirements, owing to the thick section. Harness snaps are almost wholly made in malleables, of course, with a wrought steel spring, and yet some of the heavier ones are demanded, and a comparatively few are made, in wrought.

In sprocket chains for light work, malleables have maintained their lead. And for medium work they are giving good service where the section can be thinned and the strength increased by making them wider. For heavy work wrought is used because there is little difference in the quality of properly forged material on the outside and that in the center. It was attempted at one time to make the knuckles for car couplers of malleable castings, but they were worthless. At first knuckles were made in

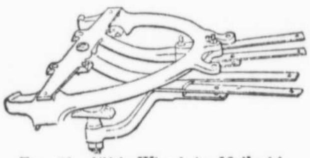


FIG. 11—Fifth Wheel in Malleable.

wrought, but steel castings are now used altogether or nearly so. Coupler draw bars, Fig. 4, were wholly of malleables until a few years ago, when steel castings began to supplant them and have now taken a large share of the coupler trade. This was partly owing, however, to unwise competition in malleables, which resulted in their falling below their regular possible efficiency. Steel castings are here to stay, but malleable draw bars are not a thing of the past. This is owing to the principle named, of getting a large sectional area without any exceedingly thick parts in critical places. Fig 5 is a section through the shank of Fig. 4, showing how sectional area is much increased without thickening too much at any point. These draw bars are too difficult to make in wrought.

INCREASED USE OF STEEL CASTINGS.

Steel castings have been greatly developed in the last decade, and especially in the last five years. They cannot be molded into the finer forms possible with cast iron, and therefore in malleable castings, nor can they be produced of as uniform quality as wrought steel, but they have made marked inroads into the fields of wrought metal and grey iron castings. One of their advantages is

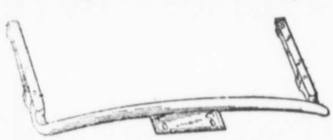


FIG. 12—Formerly Malleable Casting, Now Largely Wrought.

the elimination of separate parts. Bolsters and side frames of various designs in steel castings are coming to the front commercially, and complete standard gauge car bodies are now being made in one piece for furnace charging, etc. Patents have been issued for a truck bolster, side frame and all the journal boxes in one piece. Wrought bolsters and side frames are, as a rule, lighter and cost less, but the reduction in the number of parts by the use of steel castings is working a change. This change may go to greater lengths, or it may find an equilibrium in a combination of wrought and castings.

Many articles formerly of wrought iron or steel are now made, and will continue to be made, in steel castings. Locomotive side frames, Fig. 10, when made of wrought require a weld at nearly every corner, and most of these really mean two welds. Figs. 11 and 12 show a part with one V block, A, placed ready to weld, after it had been heated in one forge and the frame in another. Then the same thing must be gone over again to close the space B, and so on until the frame is completed. This, taken in connection with the expense of forging all these parts before the welding commences, shows how desirable it was to cast this article in one piece. Rudder frames for ships come in the same class and many other parts for ships, while electrical machinery, steam hammer columns, hydraulic press plates and many other machine parts are now made in steel castings. Generally where these displace cast iron it is a question of quality and sometimes of price, because the steel article can be lighter. Where they are used in preference to wrought iron or steel it is a question of price.

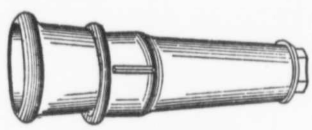


FIG. 13—Cast Skein.

There are many articles in which quality determines the choice of wrought material and price has little or nothing to do with it. These include pipe for very high pressure, as well as unions for such pipe, armor plate, shells, springs, boilers, parts of sewing machines, firearms, automobiles—an endless list, to say nothing of edge tools. Cannon, as a matter of course, were made at first of castings. The Confederate Government put wrought bands on cast iron guns. Then some 25 years ago efforts were made to produce them in steel castings, recourse being had at last to fine wrought steel throughout.

SOME LINES IN WHICH MOVEMENTS ARE CONFLICTING.

While the trend in many cases is clear as to choice of materials, in others it is not. A generation ago such articles as body loops and steps, Fig. 9, were made in wrought. Malleable largely took their place, as shown in Fig. 10. Now many of the same class of articles are again made in wrought. Fifth wheels, like Fig. 11, and numberless other things are hardly approachable by wrought as the shape is difficult, and being light, the quality can be good. Automobile parts generally would not be accepted in malleables. Body hangers, Fig. 12, were largely made in malleables, but now are produced in great numbers in wrought. These are rather large,

FIG. 14—Wrought Steel Skein.

being 2 ft. long, and improved methods n press and roll forging will probably keep the wrought in the lead, both as to price and quality. Wagon skeins, Fig. 13, are mostly made of cast iron. Wrought skeins, Fig. 14, have been used for 30 years, but their cost is against them. Skeins were also tried in malleables, but so far these have not advanced much. Bathtubs, which are much larger and generally plainer in form than articles just named, are being ingeniously made in wrought material, but cast iron

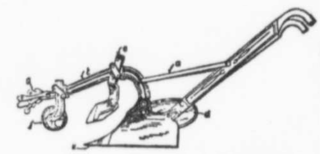


FIG. 15—A Variety in Plow Parts.

holds the lead. There has been an advance in the use of wrought steel pulleys, but it will be a long time, if ever, before cast iron pulleys are entirely displaced in the light and medium sizes, and probably never in flywheel sizes. A question of special interest is whether wheels for freight cars shall be made of wrought material.

COMBINATIONS OF CASTINGS AND WROUGHT MATERIAL.

Without noticing generally built up structures, in which castings and wrought are so commonly combined that we are apt to overlook them, a plow, Fig. 15, will illustrate this class. The braces a, the beam b and the coulter c are wrought. The roller f is cast iron. The clevis g is a malleable casting, for while the intricate form it needs to be tougher than cast iron and comparative cost forbids it to be wrought. The mold board d is of chilled cast iron, as is also the share e. In early days the mold boards were all made of cast iron. Next wrought steel was used—a high carbon surface and a soft steel center or back, so as to be capable of being highly hardened and yet endure use. But the art of chilling cast iron kept advancing and now there are large numbers of mold boards made of this, and owing to their hardness and the fine granular structure they operate more satisfactorily in certain

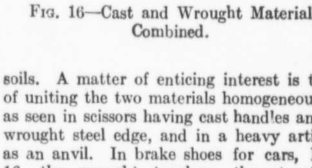


FIG. 16—Cast and Wrought Material Combined.

soils. A matter of enticing interest is that of uniting the two materials homogeneously, as seen in scissors having cast handles and a wrought steel edge, and in a heavy article, as an anvil. In brake shoes for cars, Fig. 16, the wrought toughens the structure and the cast iron gives the wearing quality. While this is a success in these and other cases, it has not been found widely applicable.

Under the enthusiasm of new ideas, possible combinations and variations make an interesting mental picture and tend to cause a pleasant state of feeling in a man who is in love with his work.

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By Bishop George Berkeley (1685-1753)

In some great families, where I choose to pass my time, a stranger would be apt to rank me with the other domestics, but in my own thoughts and natural judgment I am master of the house, and he who goes by that name is my steward, who eases me of the cares of providing for myself the conveniences and pleasures of life.

When I walk the streets, I use the natural maxim that he is the true possessor of a thing who enjoys it, and not he that owns it without the enjoyment of it, to convince myself that I have a property in the gay part of all the gilt chariots that I meet, which I regard as amusement designed to delight my eyes.

Upon the same principle, I have discovered that I am the natural proprietor of all the diamond necklaces, the crosses, stars, brocades and embroidered clothes, which I see at a play or birthright, as giving more natural delight to the spectator than to those that wear them.

In a word, all that I desire is the use of things, let who will have the keeping of them. By which maxim I am grown one of the richest men in Great Britain; with this difference, that I am not a prey to my own cares, or the envy of others.—Scrap Book.

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January—Special sales; stock taking.

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March—Just returned from market; filled up.

April—Rainy weather; bum business; over the limit.

May—Cleaning up; too late.

June—Vacation; too hot.

July—Special sales; going to market.

August—In New York, Atlantic City, Catskill mountains.

September—Just returned from market; filled up.

October—Purchases too heavy; bad weather.

November—Getting ready for the holidays.

December—Too busy; get out.

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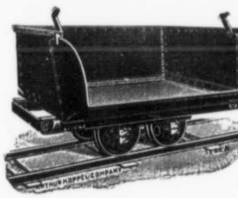

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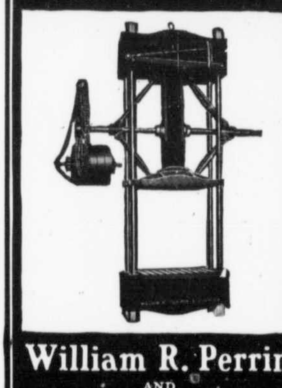

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