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The Canadian Engineer

ESTABLISHED 1893.

WITH WHICH IS INCORPORATED

THE CANADIAN MACHINE SHOP.

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CIVIL, MECHANICAL, STRUCTURAL, ELECTRICAL, LOCOMOTIVE, STATIONARY, MARINE, MINING, METALLURGICAL, AND SANITARY ENGINEER, THE SURVEYOR, THE MANUFACTURER, THE CONTRACTOR AND THE MERCHANT IN THE METAL TRADES.

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UP TO THE ENGINEERS.

There is a unique opportunity for engineers to find a road on which first-class civic management and business prosperity may travel in Toronto for all time. The opportunity is part of the eternal transportation problem, the solution of which calls for real municipal statesmanship; but which is often approached by pettifogging electioneerers. The whole problem has not been submitted in concrete form to public judgment. Parts of it have, with the result that, perhaps without reasoning out details, tendencies and probabilities, the public has condemned a piecemeal dealing with a proposition that can only be successfully handled by men of large outlook, strong grasp, and rare courage in administration.

Though the situation primarily is local, it is of much interest to engineers everywhere. Three railways use the Toronto Union Depot. The Canadian Northern is new, and handles very much less traffic than the Grand Trunk or the Canadian Pacific. But its business will rapidly increase. For all practical purposes it is as important a factor as the two senior lines. The roads coming from the East converge near the water-front, close to where the Don empties itself into Lake Ontario, and proceed in close contiguity to the shore, to the Union Station. The Grand Trunk continues to the city's western boundary in sight of the water. Over it the Canadian Pacific has running rights.

Immediately on each side the Union Station, pedestrian and vehicular traffic crosses the metals by overhead bridges. Including Yonge Street, none of the principal eastern thoroughfares have any other approach to the water than over the tracks, to the great impediment of business and constant danger to life. The in-coming and out-going trains cannot travel rapidly. The multiplicity of tracks helps to prevent the proper development of shipping. Altogether the situation is creditable to none of the parties affected by it.

Seventeen years ago, Mr. Wellington, an eminent New York engineer, reported to the Board of Trade, at a cost of about $1,000, in favor of the construction of a four-track viaduct, which would carry all the passenger and through freight trains above the danger line, while leaving the switching of cars to and from the factories which abound along the shore, to be done, on the present level by horses, almost entirely between midnight and 6 o'clock in the morning. There was much agitation for overhead lines. It came to nothing, because the railroads were too poor and too powerful to be induced to spend money on something without which they could manage to get along.

It was predicted then that such a scheme would be necessary some time in the future, and would then be much more costly—a prophesy which it was quite safe to make; and which may now be regarded as fulfilled. Mr. Wellington's scheme involved the building of a new Union Depot at a cost of $500,000, the purchase of land for a new passenger car storage yard for $120,000. The elevated structure including a draw bridge at the Don River was to cost $1,536,000. The total expenditure was estimated at $2,654,300. He suggested that the city should raise the money for the work, rent the whole to the railways, for an amount equivalent to about three per cent. on the outlay, and so keep control in civic hands, so that additional railroads might obtain entrance to the city on advantageous terms.

The city, it was argued, could borrow the money at a little more than half the rate of interest the railroads would have to pay—a disparity greater than it would be now, because the railroads instead of only being poor and powerful, are powerful and opulent, too: and can obtain money much cheaper than they could in the penultimate decade of last century.

The desirability of improving the railroad arrangements along Toronto water-front is patent to a child. On elevated tracks trains would save many minutes coming in and out of the city; which as far as operating expenses are concerned, would shorten the distance between Toronto and Montreal by several miles. The amount of time saved by business men during the year would be enormous. Time is money to the traveller. On the score of improved railroading and general business efficiency, the investment would yield excellent returns. It would be practically impossible, of course, to raise the factories along the lake to the level of an elevated track, and so absolutely eliminate all risks to non-railroad traffic. But there should not be any more difficulty in handling the traffic from warehouses and docks along Toronto water front at night than there is at New York in moving the enormous cargoes of vessels into and out of the dock sheds, when ordinary business is suspended.

The situation is virtually the same as it was seventeen years ago, only more so. In chances for engineering distinction, it is infinitely better than it was then. There is little chance for adequate Dominion assistance for harbor improvement, so long as the sewerage of Toronto is emptied into the Bay. The citizens have turned down last year's council's proposition for dealing with the problem. The by-law authorizing the construction of the bridge on Yonge Street, across the tracks which are a danger to all traffic, and especially the multitudinous traffic to the Island during the summer, was also defeated; so that the City Council is without any specific electoral mandate, and is looking for a policy.

Two new factors have come into the situation. The plans for the new Union Station have been submitted to the civic authorities, and have not been warmly received. The disclosures of plans for the entrance of the Canadian Northern from the east through Balmy Beach and Kew Beach, precipitated Grand Trunk and Canadian Pacific schemes for new entrances to the city, in order to obviate the heavy grades which greatly militate against expeditious handling of east-bound traffic from the city. The Minister of Railways has hung up the matter of access from the east for two months until the engineers representing the main interests concerned can find modus vivendi which will not destroy the only sylvan retreats by the lake shore which are left to the citizens of Toronto. Mr. C. B. Smith has been appointed by the city to assist and advise the City Engineer. The Board of Trade has also appointed an engineer; and, as an illuminant of the difficulty, the City Council has offered five hundred reprints of the Wellington report to be suitably distributed. The Wellington report is valuable as containing a wise engineering scheme, and as a moral for municipal governers who are either afraid, or have not the capacity to deal with a big question in a big strong way. It is a weakness in civic government that is subject to complete overthrow once a year, that, instead of propounding comprehensive, economical plans indicating real leadership, they have to go back half a generation for inspiration, after having tinkered at the business, to the disgust of their constituents. If ordinary business capacity had been employed, during the stages leading up to the present position, the Council of Engineers which has practically been established, would have been asked to report upon some definite or alternative plans which commended themselves to the public men charged with dealing with the question.

When a business man thinks of structural alterations to meet new business conditions he tells his architect and builder what he wants to do; and it is for them to say whether his ideas are practical. Though the re-organization of transportation facilities inside of Toronto is an engineering problem, the complications arising from the proximity of waterfront and railroads thrusts upon the city the duty of finding some scheme which will serve the city as a whole, while not prejudicing either of the interests of the concern.

Railway transportation must be improved, harbor facilities must be extended. To do either or both of these is to benefit the business connected with both, and though the engineers may be trusted to propound wise and practicable measures to meet existing and future conditions, it would have been better if there were more direct and coherent inspiration from the powers that be. As the city stands to gain by a revision of its transportation services, public opinion must be the governing factor in determining how it shall be done. Seeing that the City Council can be ejected, holus, bolus, from office once a year, and new men might spoil the execution of large projects, the city must decide broadly on a policy and delegate the carrying of it into effect to men of proved capacity and tried integrity.

What is required is some body compounding the function of a Board of Directors and a public commission. "The Canadian Engineer" has reason to believe that if the city would undertake to bear a part of the cost of what would be a great public improvement. and facilitation of business, the railways could be persuaded to fall in with the idea of forming a Terminal Company. The bonds required for such an undertaking would be very heavy. They should be guaranteed by the city, (possibly by the Province), in conjunction with the Railroad Companies; in which case representatives of the Province, of the City, of the Board of Trade, should be on the Board of Management. The function of this Company would be to control and manage not only the Union Station, but all tracks entering or within the city limits. The existing railways would use all these tracks in common; and railways hereafter desiring entrance into the city could be placed upon an equal footing with them. The Terminal Company would handle all cars once they came within its sphere, and collect and distribute all freight within the city. Four tracks, one each for east and west bound freight, and one each for east and west bound passenger traffic, would serve to handle Toronto business practically for all time.

Now, if the principle of some such scheme as this, could have been endorsed by the city, the railways, and the mercantile organizations, the council of Engineers would have a task thoroughly in keeping with the character of their profession. If a great community will only make up its mind as to what it needs; engineers can give it. In the present case the engineers are looked to for leadership. So it is up to them. Good luck to them.

SOCIETY OF CIVIL ENGINEERS.

The report of the Canadian Society of Civil Engineers, for 1906, shows that society to be in robust health. Possibly never before in its history has the growth in membership and in financial surplus been so pleasing, and never before has the society entered upon a new year with a brighter promise for the future.

Among the items deserving of comment, is that regarding membership. This has now reached a total of 1,521, as compared with 1,387 a year ago. This means an increase of 144 members, or slightly in excess of ten per cent. A feature which must be viewed with no little pleasure, is the manner in which the student membership is being increased. The number is now 579, or thirty-five per cent. of the whole. As compared with a year ago, the increase has been 67 members, or thirteen per cent. The general feeling in the Society is favorable to the admission of student membership, though some are opposed to it. Those who favor it, however, will see in the large increase a promise of a strong support to the Society in days to come. The falling off of student membership in the city of Montreal becomes understandable, when the large increase in the associate membership is pointed out, the graduates from the former having fortunately swelled the ranks of the latter. In addition to the total membership mentioned, there is a list of 134 candidates awaiting admission into the Society. With these added, the total would reach the large number of 1,655.

While the report on membership is all that could be hoped for, that on the financial condition of the Society is equally gratifying. Receipts have increased and expenditures decreased; what more could be asked for in these days of rapidly advancing costs? The receipts were $8,780 for the year, or $673 more than for 1905. Expenditures were $7,963, or $2,094 less than for 1905. The Society was thus nearly over $800 ahead on the year's transactions. It now finds itself in possession of over $2,100 in cash and in the bank, and if it were not the practice of the Society to pay out very considerable sums in books and magazines about this time of year, we should feel disposed to urge them to draw that large balance out of the bank and invest it in something that would make money for them.

A number of papers were read at the meetings of the Society, during the year, and many interesting and instructive discussions took place. A variety of topics, all concerning the engineering realm, were dealt with. The papers were of much value, but it would almost appear that none have been regarded as markedly superior, as the decision, whereon hangs the coveted Gzowski Medal, had not been given previous to the Annual Meeting.

The Society is to be congratulated upon the excellent progress it made during the year recently closed, and it should be a cause of no little satisfaction to the retiring president, Mr. H. D. Lumsden, and to the officers who have been associated with him, to feel that the affairs of the Society were never in better shape than when they handed them over to the incoming board for 1907.

THE COST-PLUS-A-FIXED-SUM CONTRACT.

Every person who has to do with the making of contracts for construction work, and indeed any kind of work, knows the difficulties that are to be met with:—the time in which the work should be completed; the charge for extras over and above the original contract, and last but not least, inferior workmanship.

In a paper read before the American Public Works Association, at Atlanta, Ga., Mr. Frank B. Gilbreth, general contractor, of New York, presents lucidly the difference between the "lump sum" contract; the "percentage" contract, and the "cost-plus-a-"fixed-sum" contract.

The cost-plus-a-fixed-sum contract is the only one in which the interests of the owner and contractor are identical, but in order to make this so the cost must be actual and complete, and the fixed-sum must be the only profit which the contractor receives. The cost of construction to the owner then is the actual cost of labor and material, and the profit to the contractor.

Mr. Gilbreth considers the advantages and disadvantages of the three forms of contracts, taking as a basis, the lowest cost to the owner, speedy construction, and future business between owner and contractor, based on past experience.

Under the "lump sum" contract the contractor agrees to furnish all material and labor, in accordance with the specifications for a certain fixed sum. This seems satisfactory enough to the inexperienced, but those who know are well aware that this form of contract offers too many chances for the contractor to put in a charge for numerous "extras," which he charges to the owner at his own price, since there can be no competition. He may also do the work hurriedly, or very slowly, doing which ever will keep the cost down, and in this way increases his profits. Then again he adds a large enough percentage to what he has figured as being the actual cost of the work to cover unfortunate circumstances that may happen, and which, if they do not happen, swell his profits. Why should not the owner have this saving? Every cent that the contractor can save, it matters not from what source, goes into his own pocket, whereas if anything extra has to be done the owner must pay for it.

The "percentage" contract offers a very good basis upon which to work, with the exception of its one great drawback. With this form of contract the owner's and contractor's interests are almost identical. The owner can regulate the speed at which the work is done, and decide as to the amount and kind of labor to be employed. In fact he has control over everything, and, as Mr. Gilbreth says, "the chances of con-"tinued pleasant relations would be good, if it were "not for the fact that the owner is apt to suspect that "the contractor may be increasing the cost of work for "the sake of getting more profit, since this is directly "in proportion to the cost."

To overcome this the cost-plus-a-fixed-sum contract has been devised. This form has all the advantages of the "percentage" system, and does not tempt the contractor to make the cost higher than is absolutely necessary, since the amount that he will receive is set from the first. The cost-plus-a-fixed-sum contract gives the owner direct supervision over practically the whole of the work, and the purchasing of the material, and if the contractor is desirous of making for himself a good reputation he will see to it that the work is well and expeditiously done.

In speaking of this system, an English contemporary says:—"If contractors in Canada can get business "under these circumstances they are fortunate, but in "England people are more sceptical." Judging from this it would appear that they have not a thorough understanding of the subject, which may be summed up as follows:—The contractor is assured a certain figure, and, if he is to continue in business, he will see to it that the work is done properly, and at the lowest cost. The owner has full control over what is going on, and is entirely freed from that word of all words in contracting "extras," and also has the advantage of being in a position to purchase all his material on a cash basis, which in most cases would result in a very considerable saving.

THE CASE OF IRON AND STEEL.

The farmers asked the Government to cease bonusing iron and steel on the ground that the industries have received from eight to ten million dollars in the last ten years and are, therefore, old enough to walk alone. They may suppose that the iron and steel industries of Canada are in a more commanding position than any other. There is no other branch of manufactures in which so many changes occur, as are forced by those who have command of great plants, great capital and great resources in scientific knowledge, as in the iron and steel industries. It takes longer than eight or ten years to achieve the end for which bounties on iron and steel were first granted. The farmer applauds the wisdom of encouraging British trade relations with Canada rather than American. He cannot dissent from the proposition that it is even better to encourage the development of our own resources by our own people on our own soil, than it is to multiply transactions with our brethren across the sea. For the more occupations we can establish that will bring them to us, will be better for them; as well as for us.

The exploitation of the iron and steel deposits of Canada is only in its infancy. It is right and proper that the Government should persistently encourage their development. This year the Canadian Northern Railway will be extended to the Hutton mines, north of Sudbury, ore from which can then be transported to Toronto, where blast furnaces will be established under Canadian control. Iron ore will also be brought from mines west of Port Arthur to smelting works at that city, also under Canadian control.

These are two examples of what is being accomplished by Canadians. But our pushful neighbors are not slow to act along the same lines, with a view virtually to annexing even more of commercial Canada than they already possess. For example, the Bessemer Ore Company has been formed by Americans to explore territory close to the north shore of Lake Superior. They have, within the last three months discovered a deposit of high grade hematite ore, containing 200,000,000 tons only 25 miles east of Port Arthur. Over sixty test pits have been put down, most of them on the east and west ends of the deposit, which has been traced for a distance of five miles. The ore is within two or three feet of the surface, and the test pits have so far shown it to be continuous to a depth of 35 feet. Steam shovels could be used for mining after the preliminary shaking up of the ore with explosives.

The Canadian Bessemer Ore Company is naturally intended to minister to the iron and steel prosperity of the United States. If the logic of past events were different from what it is you might be amused at the United States habit of expecting that many of the best commercial opportunities of Canada will naturally fall into Yankee hands. Here is "The Iron Age," a sober, well-informed journal of the highest repute the world over, discussing "The Canadian Bonus and Iron Ore Development," and showing how the great manipulators of ore, having aparently outlived their surprise that the Almighty should have placed priceless treasures of metal north of the Minnesota boundary, have naturally assumed that they are the appointed exploiters of these assets.

While it is admitted that prospecting has not been neglected, that the establishment of two large steel companies has conduced to the development of our ore supplies, it is asserted that the exploration north of Lake Superior in the hope of finding the continuation of the remarkable formation which has given Minnesota its pre-eminence among the ore-producing states, has been carried on by American rather than Canadian interests. If the farmer would like to know something more about our neighbors' attitude to iron and steel in Canada, he might discover it in this paragraph:—"The fact that strong and long-established "steel companies in the United States have a far "greater stake in getting control of any important "ore finds that may be made in Canada than have "Canadian steel manufacturers themselves, is likely "to be a prominent factor in iron mining development "across the border, and one that will count for more "than any preferential bonus on pig-iron into which "Canadian ores enter. The Moose Mountain "properties, north of Sudbury, Ont., acquired last year "by well-known capitalists experienced in iron and "steel manufacture in the United States, are already "being put in shape to ship to this side in 1907, and it "is quite well assured that these ores will practically "all find their destination in this country. Significant "also is the fact that American interests, rather than "Canadian interests, have brought to light Bessemer "ores of greater extent and value than was at first "credited in the Thunder Bay district east of Port "Arthur. It would be natural to expect that what- "ever is desirable in this or in other districts contigu- "ous to Lake Superior, would ultimately be acquired "to reinforce the position of important steel companies "on this side. On a smaller scale the situation is com- "parable with that which made the Steel Corporation "the one interest with which Mr. Hill was willing to "treat when he brought his big ore tonnage to market. "Among the American steel companies, with tens of "millions of investment and with ore supplies still suf- "ficient for the farther future, measured by the stand- "ard set by the Steel Corporation's reserves, it is a "question if there will not always be one whose "willingness and ability to acquire a Canadian ore "property of proved value will be sufficient to distance "Canadian competition."

Clearly, then, if the trend of trade in the United States is any criterion, Canada will have no independence in iron and steel unless she takes her own strong measures to develop her own resources in her own way. Under prevailing conditions about half the pig-iron used in Canadian manufacture is imported. The ores of Minnesota are brought near to the coal of Pennsylvania; and their product could be brought northward to Canada and destroy the Canadian steel industry if the bonus were incontinently withdrawn. The development of the industry must be continued by public assistance. An end cannot be put to it until the supply of cheap ore makes the importation of pig-iron from the United States unnecessary and unprofitable.

EDITORIAL NOTES.

For some time past a number of the larger United States firms have been establishing branches in Canada, in order that they might avoid paying the Canadian tariff. The Press of that country is now raising the complaint that their manufacturers are being compelled to locate in Canada, through the Canadian tariff. Why should the Americans raise a complaint of this kind. Canada to-day is following the example of the United States. Our tariff is like unto the one which has already built up the United States at the expense of Great Britain, and with injury to her manufacturers. The United States manufacturer must not feel hurt when the dice turns up against him.

* * * *

The Ontario municipalities, with the exception of Brantford, voted overwhelmingly for the model by-law authorizing provisional contracts for the supply of electrical power under the auspices of the Hydro-Electric Commission, at the head of which is the Hon. Adam Beck. It is only to be hoped that public administrators will justify, by their efficiency in handling the most ticklish problem that has ever been set a congerie of municipal council, the wisdom of the electors. Since the by-law was carried there has been practically no outstanding development of the situation. There is nothing to do but to wait the natural development of estimates, and orders for power. There is comfort in reflecting that Mr. Beck has announced that the estimates of the Commission, already given out, were based upon the assumption that only one-half of the municipalities might endorse its policy.

* * * *

With the advent of the new year the Harbor Commission of Montreal underwent a radical change in organization. For at least seventy years that somewhat numerous board of business men represented varied interests in looking after the harbor of Montreal. There were delegates upon it representing the Dominion Government, the shipping interests, the municipality of Montreal, the Board of Trade, Corn Exchange, and Chambre de Commerce. This arrangement has now ceased. The ten or a dozen men are succeeded by a board of three, and these three appointed by the Government. It may well be hoped that the new arrangement will result in more satisfactory administration than the board had shown in recent years. Political views in the past appeared to have too much sway; the result gave rise to discussion and wrangling, which often delayed the necessary work of the port. Excessive Government influence, too, was frequently alleged; and the chairman was thought to defer too much to the views of gentlemen at Ottawa who were not always disposed to regard the Montreal point of view, and did not appear to be alive to the national importance of the harbor.

WEEKLY EDITION OF THE CANADIAN ENGINEER.

Beginning Next Week.

The proprietors of "The Canadian Engineer" will, beginning with Friday, February 8th, 1907, issue a weekly edition, supplementary to the monthly issue of the paper which they are glad to know has rendered excellent service to the engineering interests of Canada for the last thirteen years.

The weekly will deal mainly with construction news, awards of contracts, and questions in connection therewith, in fact all matters which for any reason it does not seem advisable to hold over for the larger monthly edition. It will not affect the size or scope of the monthly, which will remain as the best permanent contemporary history of Canadian development, as exhibited in engineering works.

The issue of forty additional numbers per annum, is in itself a considerable task, involving much labor and expense. The size of the weekly edition will be governed by circumstances. At first it will probably not exceed sixteen pages. It will be mailed on Saturday, so as to be in the hands of readers, throughout central Canada, on Monday morning. The position of "The Canadian Engineer" is such that it can afford to add a weekly number to the service given existing subscribers at one dollar per year, for the rest of their current year.

Present subscribers who have not as yet renewed their subscription to the monthly edition for the current year, may, by remitting forthwith one dollar and fifty cents, extend their subscription for twelve months after the expiration of their present subscription. New subscribers may begin with a first subscription of one dollar and fifty cents for a year. All renewals thereafter, will be at $2 per annum.

FOR THE ADVERTISER.

"The Canadian Engineer" is read by more contractors, engineers, and material men than any other trade journal in Canada. It covers thoroughly the subjects of civil, mechanical, mining and electrical engineering. With the supplementary weekly edition it will reach still more of these classes.

Are you as an advertiser receiving your share of orders for materials, machinery, tools, equipment, contractors' supplies, etc? If not, you should get in touch with all users of such through the medium of "The "Canadian Engineer," their favorite trade journal.

The trade journal—the one a man pays for and therefore wants and reads, is read only for business reasons. It gives him information which puts butter on his bread; and treats of the business which is closest to his heart, head, hand, and pocket-book. You may advertise in a good many ways but you cannot afford to neglect the trade paper. There is less waste in reaching possible buyers through the trade paper than by any other means of advertising.

If you wish to sell more machinery, tools, equipment, etc., or if you want to ask for bids on public work of any kind you cannot afford to pass by the weekly "Canadian Engineer" in making your appropriation.

THE ELECTRIC FURNACE: ITS EVOLUTION, THEORY AND PRACTICE

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

Article VI.—Continued.

OTHER USES OF THE ELECTRIC FURNACE.

Another method for the treatment of mixed sulphide ores such as those of zinc and lead is the chlorine smelting process of Swinburne and Ashcroft. Although largely a chemical process, the final stage is carried out in an electric furnace, and a short account may, therefore, be given here.

The ore, consisting of sulphides of lead, zinc, iron, and manganese, with some silver, is decomposed by the action of dry chlorine at a temperature of 600° C. or 700° C. in a special vessel called a transformer, forming a fused mixture of chlorides of the metals, while the sulphur comes off in the free state, and can be condensed and saved. The earthy matter, or gangue, from the ore remains suspended in the fused chlorides. Enough heat is produced by the reaction to keep the transformer at the right temperature, which can be regulated by passing the chlorine more or less rapidly. When the transformer is full of chlorides they are tapped out, leaving enough behind to serve as a molten bath into which the ore can be charged, and through which the chlorine can be passed. The molten chlorides are then treated with molten lead, which serves to remove the silver, then with zinc to remove the lead, and the residual chlorides are dissolved in water, separated from the gangue by filtration, the iron and manganese precipitated chemically by the addition of chlorine and zinc oxide, leaving a solution of zinc chloride only. This solution is evaporated, and then fused and electrolysed in a furnace shown in outline in Fig. 19, p. 216, 1906). The products are molten zinc, which is tapped off at intervals, and chlorine, which is compressed and used again for the treatment of fresh quantities of ore. The process is one of great interest, and is applicable to very many complex ores which are difficult to treat by other methods. It is self-contained, and does not require any expensive reagents, as the chlorine for the transformer is produced in the electrolysis of the zinc chloride, but the operations are somewhat complicated, and would need very careful attention. At present the only commercial installation is at a plant of the Castner-Kellner Co., which has a supply of chlorine from other processes, and uses it for the treatment of complex ores as described above, but omits the final electrolysis, obtaining the zinc in the form of chloride. Accounts of this process can be found in the "Electrochemical Industry," Vol. 1., p. 412; Vol. II., p. 404; Vol. III., p. 63, and elsewhere.

Electrolysis.—The use of a "direct" current for dividing a chemical compound into two component parts has already been mentioned, see "Electrolytic Furnaces," p. 216, 1906, but a few more words may be added here. When a direct or continuous current flows through a fused salt or a solution of a salt in water, the salt or the water is broken up by the current into two parts, one of these being hydrogen, or a metal which is liberated at the cathode or electrode through which the current leaves the liquid, while the remainder of the salt or of the water is liberated at the anode or electrode by which the current enters the liquid. Thus:—

$NaCl$ (electrolyzed) = Na (at cathode) + Cl (at anode). That is to say, when fused common salt is electrolyzed, sodium is set free at the cathode and chlorine at the anode.

$CuSO_4$ (electrolyzed in aqueous solution) = Cu (at cathode) + SO_4 (at anode), or when a solution of copper sulphate in water is electrolyzed copper is set free at the cathode while SO_4 is liberated at the anode. The final result of the operation will depend, however, upon the nature of the anode. If this is of platinum or carbon, and is not attacked by the SO_4, the latter will react with the water of the solution and form sulphuric acid and oxygen, thus:—

$$SO_4 + H_2O = H_2SO_4 + O,$$

and the end products of the electrolysis will be copper at the cathode and oxygen at the anode. If, however, the anode were made of copper or some other metal that would be acted on by the SO_4, this reaction would take place:—

$$Cu + SO_4 = CuSO_4.$$

The copper sulphate solution would thus be regenerated, no oxygen would be liberated, and the only result of the operation would be a transfer of copper from the anode to the cathode.

The latter case is exemplified in the electrolytic refining of copper, the anode consisting of impure copper, which constantly dissolves under the action of the current, while pure copper is deposited on the cathode. When it is desired to extract a metal from the fused salt or solution in which it is contained, the anode should, if possible, be insoluble in the solution employed, or if this is impossible it should be inexpensive, as it will be dissolved in proportion as the other metal is recovered.

In the equation given above for the electrolysis of fused common salt, chlorine and sodium are the end products. For the production of sodium an aqueous solution would have been impossible, as the water would react with the sodium, forming caustic soda and hydrogen.

In the electrolysis of a fused mixture of two salts or of a solution of a salt in water, the current will break up the compound which is the least stable; thus in a solution of copper sulphate in water, the current separates the copper sulphate into its components, and not the water; but in a solution of aluminium sulphate it would be the water and not the aluminium salt that would be decomposed. It is necessary, therefore, to employ a solvent that is more stable than the salt it is desired to decompose, or, failing this, to use the pure salt in a state of fusion. This is the reason why the extraction of aluminium from its ore is carried out in a fused mixture of fluorides instead of in an aqueous solution.

In the electrolysis of solutions a definite amount of electricity in passing through the solution will always produce a definite amount of decomposition. This amount is always the same for the same solution, and in different solutions chemically equivalent amounts of decomposition are effected. A current of one ampere flowing through acidulated water for one second will liberate 0.0104 milligrams of hydrogen, and in any other solution the weight of the metal liberated will be 0.0104 milligrams, multiplied by the atomic weight of the metal and divided by the valency of the metal in the particular solution. Thus, the amount of the monovalent metal sodium that would be set free per second would be 0.0104 mg. + 23, the atomic weight of sodium, or 0.239 mg.; while the weight of copper deposited would be 0.0104 mg. × 63.2, the atomic weight of copper, or 0.657 mg. in cuprous salts, such as Cu_2Cl_2, in which copper is monovalent, while in the more usual cupric salts, such as $CuSO_4$, in which the metal is divalent, only half that amount would be deposited by the current. The amount of metal actually obtained as the result of electrolysis is frequently less than the calculated weight on account of secondary reactions, such as the metal redissolving in the electrolyte, hydrogen being liberated instead of the metal, leakage of the current, etc.; and the ratio of the metal actually deposited to the theoretical quantity is known as the current efficiency, as it shows what proportion of the current is effective in liberating the metal.

The electrical energy necessary to produce a definite weight of a metal by electrolysis of a chemical compound of the metal depends not only on the number of ampere hours needed to liberate the weight of metal, but also on the voltage of the operation, that is on the electrical pressure needed to drive the electric current through the electrolyte so as to produce the decomposition. Each solution has a definite electrical pressure which must be exceeded before electrolysis will take place, and the working voltage must be decidedly above the minimum in order to drive a rapid current of electricity through the solution. Heat is also produced by the passage of the current, being proportional to the square of the current and to the resistance of the electroyltic cell, while, as has been noted, the amount of metal deposited is proportional to the current alone. For a given amount of chemical work done the heat generated will be less as the current is less, and, therefore, the efficiency of the operation will be greater. In electrolysis at furnace temperatures, however, it is often convenient to heat the electrolyte electrically instead of by the external application of fuel heat, and in such cases the production of heat by the current cannot be regarded as waste.

The nature of the anode has a great effect upon the voltage needed for electrolysis. Thus, electrolysing a solution of copper sulphate with an anode that does not dissolve, copper and oxygen would be liberated, the electric current would have to do the work of separating these elements, and a pressure of more than one volt would be needed; but if the anode were made of copper, this would dissolve as fast as the copper deposited on the cathode, no chemical work would be done, and the smallest voltage would suffice to produce electrolysis. It is possible to calculate the amount of energy needed to separate a definite weight of a compound into its elements, and the relation of this to the electrical energy actually required to produce this decomposition is the energy efficiency of the process.

The production of chlorine and caustic soda by the electrolysis of fused salt, and the production of sodium and other alkali and alkaline earth metals by electrolysis of the

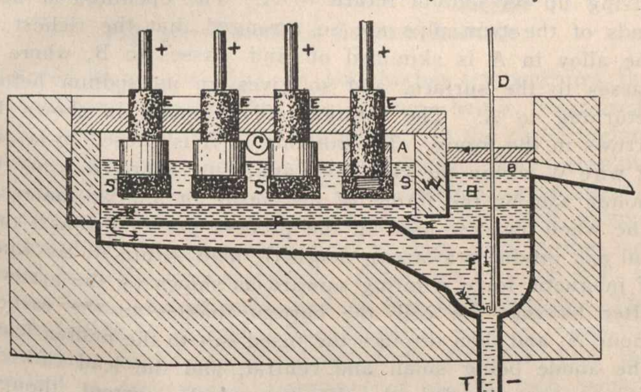


Fig. 34.—Acker's Caustic Soda Furnace.

fused salts of these metals is an important department of electric furnace operations. A few examples will be given.

The Acker Process for Caustic Soda and Chlorine.—In this process fused common salt, or sodium chloride, is electrolysed, using carbon anodes, by which the current enters the liquid, and molten lead for the cathode by which the current leaves. The salt is broken up into chlorine, which is liberated at the anode, and is led away and used for making bleaching powder, and sodium, which is liberated at the cathode, and alloys with the lead. The lead containing the sodium is then treated with steam, which combines with the sodium to form caustic soda.

The following reactions take place:—

$2NaCl$ (electrolysed) = Cl_2 (liberated at the anode) + Na_2 (alloying with the lead cathode).

Na_2 (alloyed with the lead) + $2H_2O$ (the jet of steam) = $2NaOH + H_2$.

The ingenious arrangement by which this is accomplished is illustrated in Fig. 34. The heavy lines indicate an iron tank containing molten lead. The tank is divided by a horizontal partition P into two portions, through which the lead circulates as shown by the arrows. The upper portion of the tank is again divided by the wall W into two compartments, A and B. The larger compartment A contains melted salt S, into which descend four carbon electrodes E, which are connected to the positive cable from a direct current dynamo, while the iron tank containing the molten lead is connected at T to the negative cable. The electric current passes from the carbon electrodes through the molten salt to the fused lead on which the salt rests. In passing through the salt chlorine is liberated at the carbon electrode and escapes, passing away through the pipe C. D is a steam pipe furnishing an upward jet of steam in the pipe F connecting the upper and lower compartments. One effect of the jet is to produce a circulation of the lead through the three compartments of the furnace. The sodium produced by the electrolysis of the salt alloys with the lead in compartment A, and is carried around with it to the jet of steam, which combines with the sodium, forming caustic soda and hydrogen, which rise to the surface of the lead in compartment B and escape by the spout; H is the fused caustic resting on the lead. The compartment A is lined, above the level of the lead, with magnesite bricks. The salt to be used in the process is warmed on the top of the furnace and then introduced through charging holes in the roof. Each anode consists of a block of graphitized carbon 14 inches long, 7½ inches wide, and 3 inches thick, which is supported by two five-inch carbon rods, E, passing through the top of the furnace. The carbon blocks are lowered until within ¾ inch of the molten lead, and the supporting carbon rods are protected from the salt by fire-clay sleeves. The current used is 8,200 amperes, the voltage of each furnace or pot being only 6 or 7. Forty to 45 pots are used at once, being connected in series, so that the same current passes through them all, and the total voltage necessary is 275; about 3,000 H.P. being supplied at the generating station, which is 1,500 feet away. The current density at the anodes is about 2,750 amperes per square foot, and this is sufficient to keep the salt at a temperature of 850° C., which is a bright red heat, and 75° C. above the melting point of the salt, while it is far above the melting point of lead. The output of each furnace is 25 pounds of caustic per hour, which is 93 per cent. of the amount which should theoretically be produced by the current, but the voltage is considerably higher than is required by theory, as nearly half of the energy of the current is needed to keep the furnace at the high temperature of fused salt. The caustic soda in B is fused and practically anhydrous, so that it is ready for market without any boiling down, such as is required when aqueous solutions are used for electrolysis. The Acker process is described by Prof. Richards, Electrochem. In., Vol. I., 1902, p. 54.

The Castner Sodium Process.—This is the standard method of making that metal, and no less than 3,500 tons per annum are now made in this manner. It consists in electrolysing fused anhydrous caustic soda, using nickel for the anode, and carbon, or some metal, such as iron, for the cathode. The products of the operation are sodium and hydrogen at the cathode, and oxygen at the anode, all in equal atomic proportions.

The following reactions probably take place:—

$2NaOH$ (electrolysed) = Na_2 (at cathode) + $2HO$ (at anode).

$2HO$ (at anode) = $H_2O + O$.

H_2O (electrolysed) = H_2 (at cathode) + O (at anode).

Or, put into one equation:—

$2NaOH$ (electrolysed) = $[Na_2 + H_2]$ (at cathode) + O_2 (at anode).

As the sodium is lighter than the fused caustic, it floats to the top, and great difficulty is experienced in preventing it from burning in the air or in the oxygen liberated at the anode, which also rises to the surface. In the Castner apparatus (see Fig. 35) this is accomplished by the metal cylinder E, from the lower edge of which a cylinder of nickel gauze is continued down between the nickel anode C and the cathode D. The sodium rises within this cylinder and collects at F, from which it may be ladled, or may overflow through a spout, while the oxygen rises outside the gauze cylinder, and is, therefore, unable to attack the sodium. The hydrogen rises with the sodium inside the cylinder and escapes through holes in the cover. The use of the gauze cylinder allows the anode and cathode to be brought very close to each other, being only one inch apart, without danger of the sodium meeting the oxygen, and in this way the resistance of the apparatus is kept low, and a high electrical efficiency can be obtained.

The apparatus consists of a cast iron pot A, set in brickwork B, and heated if necessary by a ring of gas burners H to a temperature very little above the melting point of the caustic soda. The cathode D is supported in position and insulated from the iron pot by means of the tube G, which, being closed at the bottom by a ring of insulating material, such as porcelain, is filled with the fused caustic soda, which is then allowed to solidify. The tube is kept a little cooler than the rest of the apparatus, and the caustic in G, therefore, remains solid, and supports and insulates the cathode. It is very important that the fused caustic should not be heated far above its melting point, because the sodium would then rapidly redissolve. The caustic melts at about 300° C., and should be kept not more than 10° above this; 90 per cent. of the theoretical quantity of sodium being then obtained. If heated 20° above its melting point no sodium would be produced, as it would dissolve as rapidly as it formed. A pot 18 inches in diameter and two feet deep will hold 250 pounds of melted caustic, and takes a current of 1,200 amperes at five volts. The current density is 2,000 amperes per square foot at the cathode and 1,500 at the anode. At the Niagara Electrochemical Company's plant in 1902* there were 120 such pots, employing, in all, 1,000 H.P., and producing about 50 pounds each per day, or 6,000 pounds for the whole plant. The consumption of power was about four H.P. hours per pound of sodium.

Of the total annual production of sodium, about 1,500 tons are used for cyanide making, 1,500 tons for making sodium peroxide, and 500 tons are sold in the metallic state.

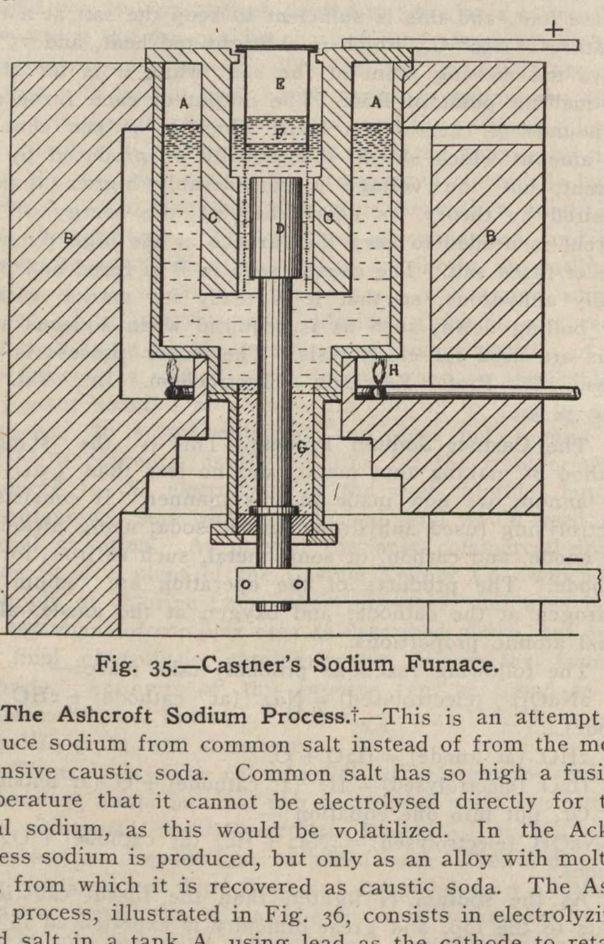


Fig. 35.—Castner's Sodium Furnace.

The Ashcroft Sodium Process.†—This is an attempt to produce sodium from common salt instead of from the more expensive caustic soda. Common salt has so high a fusing temperature that it cannot be electrolysed directly for the metal sodium, as this would be volatilized. In the Acker process sodium is produced, but only as an alloy with molten lead, from which it is recovered as caustic soda. The Ashcroft process, illustrated in Fig. 36, consists in electrolyzing fused salt in a tank A, using lead as the cathode to retain the resulting sodium, and then carrying the sodium lead alloy to a second tank B, where it becomes the anode, in a bath of fused caustic soda kept just above its melting point. In this tank metallic sodium is liberated at the cathode C, and floating upward is caught within the hood D, and overflows through the pipe E.

The reactions that take place can be made clear by the following equations:—

In A—$2NaCl$ (electrolysed) = Cl_2 (liberated at the anode) + Na_2 (dissolving in the lead cathode)......... (1)

In B—$2NaOH$ (electrolysed) = $2HO$ (at anode) + Na_2 (liberated at the cathode)....................... (2)

Na_2 (in lead alloy) + $2HO$ = $2NaOH$........... (3)

* Richards, Electrochem. Ind., Vol. I., 1902, p. 15.

† Ashcroft, Trans. Am. Electrochem. Soc., Vol. IX., 1906, p. 123; Electrochem. and Met. Ind., Vol. IV., 1906, p. 218.

In A, with an insoluble anode, the salt, which forms the electrolyte, is broken up into chlorine and sodium. In B, the caustic soda electrolyte is reformed by equation (3) as fast as it is destroyed by equation (2).

The products of the first tank are chlorine, which is piped away and utilized, and sodium as an alloy with lead, while common salt is consumed. The second tank yields sodium only, which it takes from the lead alloy. The fused caustic, which serves as electrolyte, is not destroyed, but merely serves as a carrier for the sodium. The electric current will also liberate twice as much sodium as in the Castner process, because only sodium is set free at the cathode, while in the older process equal equivalents of sodium and hydrogen were set free.

As the tank A must be hot enough to fuse salt, that is nearly 800° C., while the tank B is little more than 300° C., the lead sodium alloy must be cooled during its passage from A to B, and the lead returning from B to A must be reheated. This is accomplished by a twin pipe P of considerable length connecting the two vessels, so that the alloy flowing from A to B gives us its heat to the lead flowing from B to A. The pipe is folded on itself for compactness, only a part being shown in the drawing. The method of producing a continuous circulation of the lead is also very ingenious, and consists in producing, electromagnetically, a rotation of the lead alloy in A, and in providing a suitable baffle F, and openings G and H in the end of the twin pipe which enters A, so that the rotating alloy is forced to pass from A to B, circulate in B, and after giving up its sodium return to A. The openings at both ends of the twin pipe are so arranged that the richest of the alloy in A is skimmed off and passes to B, where it passes to the surface, and so gives up its sodium before returning to A. The rotation of the metal is shown by arrows in the figure. The rotation in A is caused by a coil of wire W within the cast iron tank, but separated from the molten salt by the lining of magnesite or similar material. The whole current used in the process passes through this coil and produces a strong magnetic field within A, the lines of magnetic force pointing upward as shown by the arrows. After leaving the coil the current passes to the carbon anode N, and then through the fused salt to the molten lead. The anode being small and central, and the lead cathode being more extended, the direction of the current, though mainly vertical, will be partly horizontal, and so will cut the lines of magnetic force. The result will be a horizontal rotation of the molten contents of A, and, as has been explained, this leads to the desired circulation of lead from A to B and back again. The tanks A and B are made of cast iron, and heated externally by fuel as well as internally by the passage of the current. A is provided with two openings, J and K, one of which has a hopper for charging in the salt, while the other serves to remove the chlorine. In B, the cathode C is globular in form, allowing the sodium which deposits around it to pass easily upwards into the hood D. The cathode is insulated from the bottom by a layer of solidified caustic as in the Castner apparatus, and is hollow, thus allowing of cooling by air or other substances if the temperature were too high. The hood D is connected to the iron cover of B, and thus with the sodium-lead anode, so that there is no tendency for sodium to form on any part of the tank except the cathode C. The method for producing a circulation of the lead does not sound very efficient, but it is stated to work well in a furnace using some 2,000 or 3,000 amperes, and the whole operation is reported to be working satisfactorily. The voltage needed will be about 7 volts in A, that is, the same as in the Acker process, and about 2 volts in B, or, in all, 9 volts. The process should show marked economies in comparison with the Castner method.

The alkali metal **potassium** strongly resembles sodium, and is obtained by electrolysis of its fused salts in practically the same manner. **Magnesium,** largely used for flashlights, and the alkaline earth metals, **barium, calcium** and **strontium,** which until recently were quite rare in the metallic form, although lime, the oxide of calcium, is so common, are all obtained by the electrolysis of the fused chlorides of these metals.

The products of the Acheson resistance furnaces have already been referred to. The more important are: **Carborundum** (see Fig. 8, p. 173 and p. 287); **siloxicon**, p. 287; and **Graphite**, p. 173.

Carborundum.*—The industry is in the hands of the Carborundum Company, of Niagara Falls, and the output for 1905 was 2,800 short tons, valued at 10 cents a pound. The charge consists of sand and coke, with small amounts of sawdust and salt, the reaction being: $SiO_2 + 3C = SiC + 2CO$.

When heated to moderate temperatures the product is a greenish amorphous powder, but at higher temperatures the carbide crystalizes, forming carborundum, which is employed as an abrasive. At still higher temperatures the carborundum decomposes, the silicon being volatilized, leaving the carbon behind as graphite. In the carborundum furnace all these products are produced. The graphite immediately around the core (which itself is graphitized), the carborundum forming a cylinder, 14 inches thick, around the graphite, and the amorphous carbide still further removed from the source of heat. A furnace of 1,000 H.P. is 23 feet long, 10 feet wide, and 10 feet high outside. The length inside is 16 feet. The resisting core is composed of granular coke, and is 20 inches in diameter, and the terminal at each end is composed of 25 four-inch square graphitized carbon rods, 34 inches long. The amount of power required has been variously stated, but may be about four kilowatt hours per pound of carborundum.

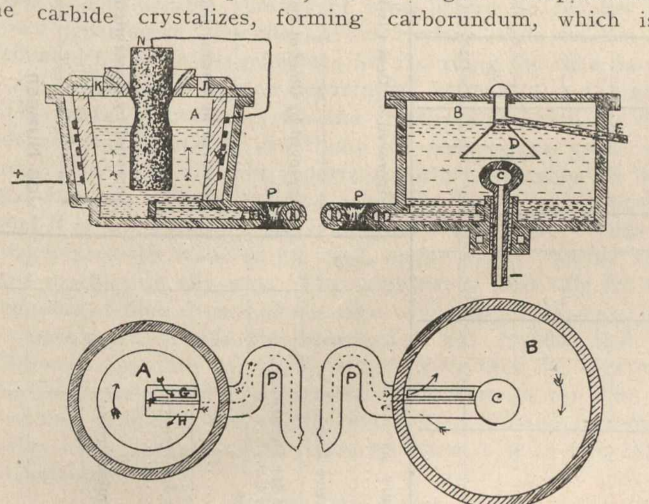


Fig. 36.—Ashcroft's Sodium Furnace.

The discovery of carborundum† by E. G. Acheson in 1891 is described by himself in an interesting lecture on "Discovery and Invention." Mr. Acheson was attempting to harden clay by impregnating it with carbon in an improvised electric furnace. After the experiment he noticed a few bright specks at the end of the carbon electrode. These specks were found to be hard enough to cut not only glass, but even the diamond itself, and were the origin of the important carborundum industry.

Graphite.—The International Acheson Graphite Company now employ 3,000 H.P. in this manufacture, and in 1905 the output was 2,300 short tons. This was more than the production of natural crystalline graphite in the United States, and sold at nearly twice the price on account of its superior qualities. It is used largely for paints, electrodes and lubricants.

Among other uses of the electric furnace may be mentioned the production of glass. This is obtained by melting together carefully selected varieties of silica, lime, soda, potash, etc., usually in gas-fired furnaces. Several electric furnaces have been devised for this purpose on account of the greater convenience of this mode of heating. The heat is produced either by a series of electric arcs, or by passing the current through the glass itself; glass being a conductor when molten. Care must be taken, however, to prevent impurities in the electrodes entering the glass, or pure graphitized electrodes might be employed.

Phosphorus.—This is largely made in the electric furnace. It is obtained by heating a phosphate with carbon and sand. The phosphorus is reduced and volatilized while the remainder of the charge melts to a slag. As the charge must be heated in the absence of air, the electric furnace is particularly suitable for its treatment. Both arc and resistance methods of heating are employed.

Carbon Bisulphide.—This is another electric furnace product, and is made by heating carbon and sulphur. The electric current passes through a mass of broken carbon, which becomes strongly heated. The sulphur, melted by the waste heat of the furnace, flows down into the hot portion of the furnace, where it reacts with the carbon, and is volatilized at CS_2, being condensed outside the furnace.

* The Carborundum Furnace. F. A. J. Fitzgerald Electrochem. and Met. Ind., Feb., 1906, Vol. IV., p. 53.

† The writer regrets that an incorrect account of this discovery was given in Article I.

SYSTEM IN INDUSTRIAL ESTABLISHMENTS

By A. J. Lavoie.

ARTICLE XI.

The Foundry.—Continued.

Cost Records.

On final completion of any particular job, drawings patterns, special tools, etc., are exchanged by the mechanic for his checks at various places where the above-mentioned articles have been selected, and the job card, form No. 45 and No. 113 is returned by the workman to the foreman's office for approval. Then this form, together with form No. 54 and No. 113, is forwarded without delay to the Cost Office and filed in numerical order under job number according to drawing number.

This completes the necessary data to make a lucid detail cost of all castings produced.

Then the data relating to each individual piece must be grouped together, the number of hours, material, labor, and machine work, and if any operation has been performed under the bonus system the time saved and amount of money paid must be taken from form No. 54-113, and form No. 40-21. It must then be entered on a collateral sheet, see form No. 118, which form is made out in triplicate, and approved by the necessary persons, as indicated on form. The original of form No. 118 is sent to the engineering office for filing purposes, the duplicate to the managing director in department No. 1, where the cost of making castings will be carefully noted, and from whence it will be forwarded to the general auditor. The triplicate is kept by the cost office, and acts as a record in case the other two copies should be lost in transmission between the departments interested.

Employee Time Card.

Before dealing with another department let us consider the employee time card, form No. 119-120, from which the pay-roll is made up; the methods of using same, and the results obtained.

The employee's time card is one of the most important forms used in an industrial establishment. To be effective and free from complications it must be simple, compact, complete in itself, and must be filled in and signed by the employee himself, and must contain enough information to show clearly the various jobs performed by the employee in his day's work.

Employee's Honesty.

It may be urged: Do you trust the honesty of each individual employee. The Lavoie System does and does not. It does by giving each individual the right to fill in his own time card, and by having him sign the same; in this way promoting a corps of self-respecting artisans; and it does not because of a double checking system for every entry on said time card, as will be noted in the following paragraph.

The employee's time card is prepared from the individual employee pay-roll record sheets. If any employee resigns or is laid off temporarily or discharged, the pay-roll clerk will remove from the record file the employee's record sheet, thus eliminating any possibility of making out unnecessary time cards, and preventing mistakes.

A. J. LAVOIE'S SYSTEM NO. 11B — This form to be made in triplicate. — PRODUCTION DEPARTMENT NO. 4

PREPARED BY ● FOUNDRY COST REPORT ● DATE COMPLETED

A. J. LAVOIE'S SYSTEM, LONGUEUIL, P.Q. CANADA

Number of Sheets Required to Complete Report.......... *Sheet No*..........

Drawing No.	List No.	Pattern No.	Material Cost $	Material Cost c.	Labor and Machine Cost $	Labor and Machine Cost c.	Total Cost $	Total Cost c.	Time Taken in Hours	Bonus: Time Saved	Bonus: Money Paid $	Bonus: Money Paid c.
TOTALS												

	$	c.
Time taken in Hours as per above figures........		
Total Cost as per above List....		
Per cent. Allowance for Departments Nos. 2, 3, 4........		
Cost of Making........		
Per cent. Allowance for Department No. 1.....		
Total Cost for Manufacturing..		

Approved by Cost Clerk.	Approved by Chief of Department, No. 4.	Approved by Estimating Engineer.	Approved by Superintendent.	JOB NUMBER.

Printed Blue on 20 lbs. Pink Bond Paper. Padded on top only.

This Time Card is a true statement of my time as utilized on the following jobs:

Job No.	Drawing No.	List No.	Pattern No.	Production List No.	Time in Hours and Minutes: Started	Finished	Amount	Bonus
					TOTAL TIME			

A. J. Lavoie's System No. 120. Production Department No. 4. Employe's Time Card.

Back of Form No. 119.

Employe's Check No.		Working on Machine No.		IN.
Date.		Signed by Employe.		
In Dept. (give Name and Number).				
Day / Night } Work	Number of Hours	Rate per Hour	Amount. $ c.	Out for Lunch.
Regular Time				
Overtime				In from Lunch.
Bonus				
Piece Work				
				OUT.
TOTALS . .				
Number of Times Late.	Advance on Salary.			
Date of Pay Day.	Total Amount of Money to be Paid.			Total Time.

NOTE—EMPLOYE, IF YOU LOSE THIS TIME-CARD YOU LOSE YOUR PAY.
A. J. LAVOIE'S SYSTEM NO. 119

Printed Royal Blue on 100 lbs. Pink Color Cardboard (medium quality). Size of form, 3 in. x 5 in.

Preparation of Time Cards.

The time cards are prepared by an apprentice of the Preduction Department No. 4 (pay-roll section) who stamps on each card the employee's check number, and the date the card is to be used. In the afternoon of the same day the cards are placed in a special rack provided for the purpose, which rack is located at the main entrance to the works, the entrance being kept closed until the whistle or any other adopted signal is given. Then it is opened and a man standing by the card racks sees that each employee takes his own time card. The employee is then admitted to the premises.

Lost Time.

The Lavoie System provides means for finding out the amount of time lost between entrance to works and department or machine. On entering the establishment the employee lifts his time card under the surveyance of the man at the entrance, but he must be in time to get into the establishment, as otherwise the door will be closed and he will be considered late. After he is admitted to the premises he may lose a considerable amount of time before he reaches his own department. By the Lavoie System this time is accounted for since the machines for recording the time on the cards are located in each department, instead of at the gate. This makes it necessary for the employee to reach his own department before he can stamp the time on his card. He must also be in his own department when stamping his time for leaving. These printing machines work automatically, and it is impossible for an employee to make any change in the impression made on his card, or for him to tamper with the machine in any way. The employee is paid only for the amount of time shown by his time card, unless the employee is able to show that the time card is not correct and the foreman approves his claim, which must then be approved by the pay-roll clerk. Moreover, the ribbons of the time recording machines are of different colors, making it impossible for an employee to stamp his time card in any other department.

Bogus Time Cards.

Let us suppose that an employee takes two time cards at the entrance, and stamps them at the proper time stamp, then when the owner of the second card comes along he cannot get into the works unless he gets his own time card. This is the first notice that is given that one man took two cards, and whether he took them intentionally or not has to be found out, which will be done by watching the employees when they drop their cards at the exit wicket after their day's work is completed. If some arrangements have been made between the two employees, the late one will secure a second card to get in, and will then exchange same for the original card that was brought in by his fellow employee. This may be all right for the day, but it will not compare favorably when checked with the pay-roll, and with the report of lates made out by the man at the entrance to the establishment, and it would be detected when checking the job cards. All the entries on form No. 120 should be identical with the various job cards mentioned on time card during the day all the job cards being approved by the foreman and by the inspector, if the jobs are finished. It will be found very easy to check the same every day, as the time card, and job cards are put together, and at the end of the day's work all the cards relating to each employee are left at the wicket of the exit from the works, care being taken to see that the time card is placed on the top of the job cards.

From this it will be seen that it is impossible for any employee to turn in two time cards when leaving the works, since it would be necessary for him to have job cards for both time cards approved by foreman and inspector.

It is manifest, that under the "Lavoie" Time-card System, honesty is the best policy, even where the moral tone is low.

STARTING OF CARNEGIE STEEL GAS ENGINE.

Somewhat over a month ago there was started at the Edgar Thompson Works of the Carnegie Steel Co., Pittsburgh, the first large gas power installation in America, using blast furnace gas and double-acting, four-cycle gas engine of a large capacity. This event is of rather unusual importance, as it marks the commencement of a new regime in methods of power generation of the United States Steel Corporation which has already taken so prominent a stand in favor of the internal combustion type of prime mover. The starting of the Carnegie engine also is of further interest, for the reason that it furnished an effective demonstration of the capabilities of the Westinghouse design for the work in hand. This design, however, was by no means an untried one, as a number of gas engine units of a similar design, but smaller capacity (500 H.P.), have been in operation elsewhere with success; but the Carnegie engine represents the first of the series of 12 large units (3,000 H.P.) which are now being built by the Westinghouse Machine Co.

The Carnegie blowing unit was started for the first time on December 7th, and after a tyring-out period of only two days was then put into regular commercial service. Since then the unit has carried commercial load during the regular daily run without developing external or internal defects either in structure or operation. A rigid inspection of working parts after a few days' run failed to uncover the least evidences of wear or excessive stresses, and during a month's daily operation no prematures or backfires have occurred.

In design the gas engine follows the same general lines as those of smaller Westinghouse units, previously described in the technical press. It is of twin tandem double-acting style, with centre-hung flywheel, and with two air tubs arranged in "vis-a-vis" fashion opposing the two engine frames. The gas cylinders are 38 in. in diameter by 54 in. stroke, and air cylinders 60 in. in diameter; normal speed, 60 to 75 r.p.m. Engines of the same size are being constructed for electric work, in which case the air tubs are removed and a generator mounted upon the shaft next to the flywheel. The generator will have a rated capacity of 1,500 K.W., running at 75 r.p.m. Such a unit is now under construction for the Edgar Thompson plant. The generator will be solid coupled, and will deliver direct current at 250 volts.

Although this gas engine unit furnishes an uninterrupted supply of air for blowing purposes, the duty imposed upon it is by no means uniform. Owing to changes in the compactness of the furnace burden the air pressure must vary in proportion. The usual range is 12 to 20 lbs. per sq. in. except when the furnaces are tapped when the pressure reduces to 5 lbs. On the other hand, when the furnaces are closely packed the pressure may increase to 20 lbs. These variations in pressure delivery are accompanied by corresponding variations in the quantity of air delivered, all of which is taken care of by the valve gear, while the speed of the engine is entirely under the control of a sensitive centrifugal regulator, designed upon the relay principle, but controlling the gas inlets, individually and directly, at the point of gas supply. A speed-changing mechanism provides means for manual control of the speed of the blowing unit when desired.

Compressed air is employed as usual for starting, and it is a point worthy of note that this large unit has been started and placed under full load in 53 seconds from the time of turning on the air, while one minute is ordinarily sufficient. As the starting is automatic, only gas and air valves require attention of the operator at the time of starting, no other parts of the engine needing manipulation.

Much experience has developed during the past two or three years in the operation of large gas engines on natural gas. It is, however, a point worthy of note that the use of "dirty" gas, either producer or blast furnace, is a very different problem, so difficult as to establish a very narrow margin between success and failure, where the necessary experience in its use has not previously been acquired. But in adopting the large gas engine as a standard form of prime mover in steel plants, the Carnegie Steel Co. has not been blindly dependent upon skill of gas engine designers. For a long period a 500 H.P. Westinghouse gas engine of design similar to the large unit was maintained in daily operation at the steel plant for purposes of experimentation. Experience derived from the operation of this smaller unit gave unusual promise, which seems to have already been fulfilled in the operation of the large unit. During a thirty-day test of 24 hours per day, including Sundays, this experimental unit sustained regular commercial load with but two stops (equivalent to a run of 99⅓ per cent. of the elapsed time). One of these stops was due to failure of gas supply. At the end of this run the engine was found to be in excellent condition, no unusual wear had developed at any point, and all moving parts were working freely. This excellent record is not a little due to the effectiveness of the lubrication and cooling systems which have been devised for this double-acting design of engine.

From every standpoint the results that have been achieved with the use of blast furnace gas at the Edgar Thompson Works constitute nothing less than a vindication not only of the design, but also of the action of the steel companies in adopting gas engines for general motive power throughout every department of their works.

A NEW RECORDING PYROMETER.

In this era of rapid technical progress in all industrial and manufacturing establishments where high temperatures are employed, there is an increasing demand for instruments to automatically and accurately record every change that occurs. Records obtained from such apparatus make it possible to control the temperatures, so that the product is perfectly uniform and most economically produced. The accompanying illustrations show a recording pyrometer of the thermo-electric type, which is capable of application to al-

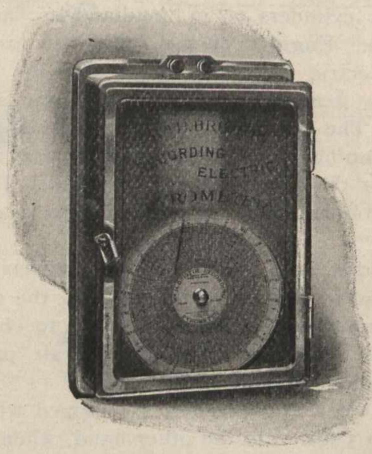


Fig. 1.—Wm. H. Bristol Recording Pyrometer.

most every commercial and industrial requirement. It has been devised by William H. Bristol, 45 Vesey Street, New York.

The complete instrument consists of three distinct parts, namely: The recorder, which is located at the point most convenient for observation of the records and for changing

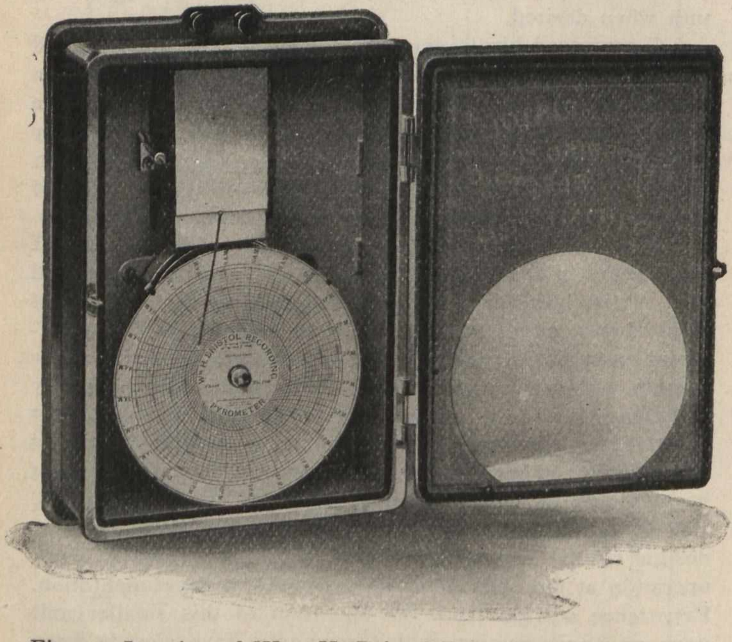


Fig. 2.—Interior of Wm. H. Bristol Recording Pyrometer.

of the charts; the thermo-electric couple, the fire-end of which is to be inserted into the space where the temperature is to be measured; the leads consisting of duplex flexible cable for making the electric connection between the recorder and the fire-ends. An exterior view of the instrument is shown in Fig. 1.

The thermo-electric couple, which is located where the temperature is to be measured produces a current of electricity, which is communicated to the recorder through the connecting leads. This current actuates a galvanometer movement, which is contained in a dust proof metal case, shown in the upper portion of Fig. 2. The galvanometer movement is made according to a special design by the Weston Electrical Instrument Company with pivot and jewel bearings for the moving coil. It is "dead beat" in its action.

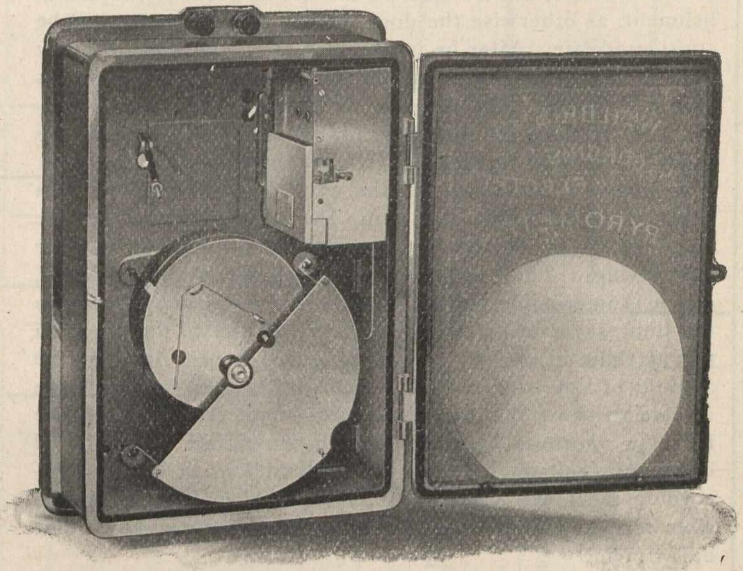


Fig. 3.—Operating Mechanism of Wm. H. Bristol Recording Pyrometer.

The recorder arm moves free and clear just in front of a chart, which is revolved by a clock movement once in every 24 hours, or at any other desired rate. These charts are prepared with a semi-transparent smoked surface, which is so sensitive that a record may be be made upon it with a hair. When applied to the instrument, as shown in Fig. 2, the chart is supported only over a portion of its surface by a semi-circular plate, shown in the lower portion of Fig. 3. The clock movement for revolving the chart is contained in the round case behind the semi-circular chart support, and is provided with an auxiliary attachment for periodically vibrating the unsupported portion of the chart, thus bringing the smoked surface into contact with the pointed end of the recorder arm at intervals of a few seconds. By this means, the record of its position is obtained and friction is eliminated.

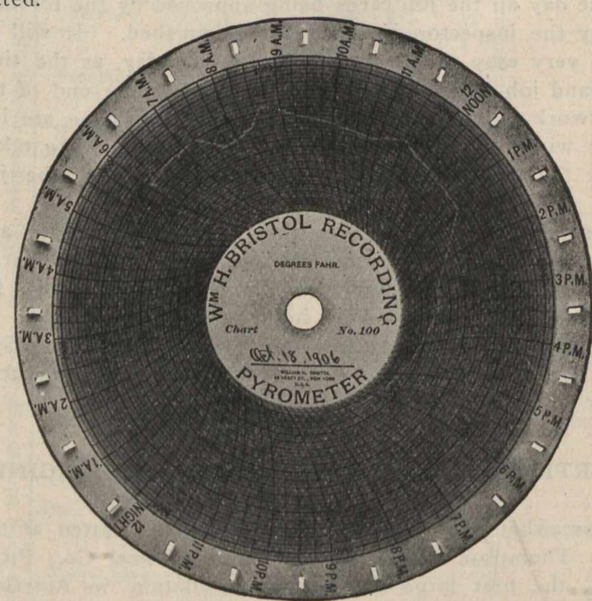


Fig. 4.—Chart of Wm. H. Bristol Recording Pyrometer.

The series of marks made by this periodic contact of the recorder arm, which removes the carbon from the chart, forms a continuous curve, unless the changes in temperatures are extremely rapid. After the record of the day is completed the chart may be removed from the instrument and "fixed" by immersion in a fixitive solution, which consists of gasoline or alcohol, to which has been added a small amount of concentrated fixitive. After fixing, the charts may be handled and filed without any danger of destroying the record.

Fig. 4 is a reduced photographic reproduction of a smoked chart, with a record of the temperature in the lead bath, which is used for calibrating these pyrometers. It is interesting to note the constancy of the temperature during the period of nearly half an hour, while at night the metal was cooling and passing from the molten to the solid state. The simplicity of construction insures durability and permanent accuracy and makes the operation of the instrument an easy matter. The protecting case containing the galvanometer is hinged to the back of the recorder, and in Fig. 3 is shown turned to one side. This arrangement prevents injury to the recorder arm, while the charts are being changed or the clock wound.

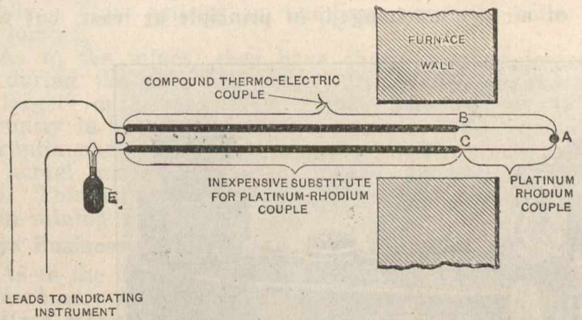
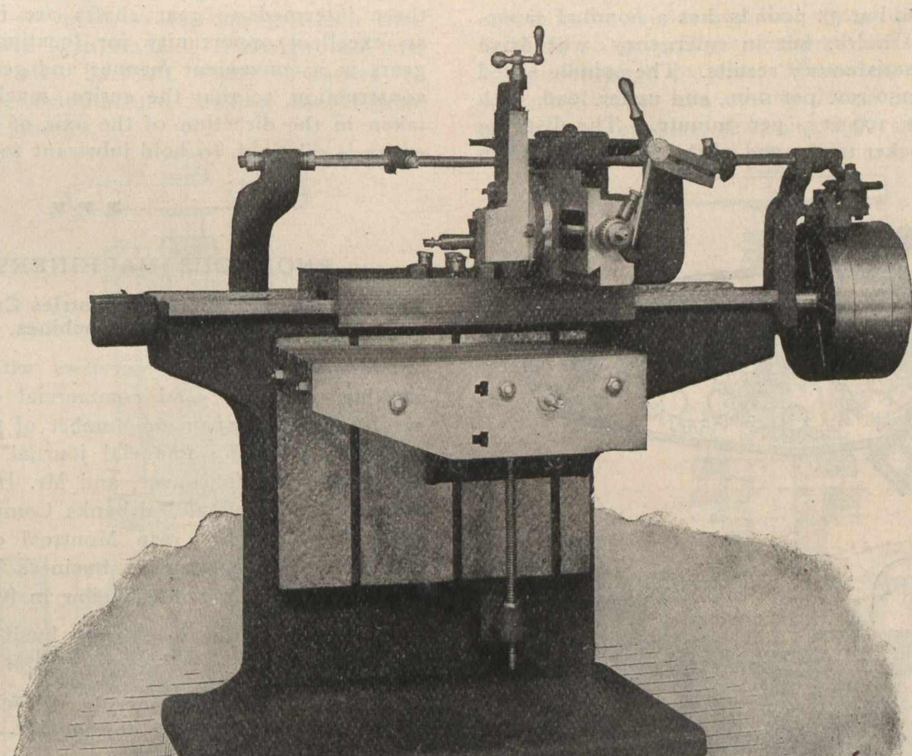


Fig. 5.—Compound Couple for High Temperatures.

It should be mentioned that the coating of lamp black on the charts is not sufficient to obscure the graduations, and the edges and centre are unsmoked. The charts can, therefore, be conveniently handled and packed for shipment. The couples employed for ranges not exceeding 2,000 degrees Fahr. are made of special alloys, which are inexpensive, and may be of almost any desired form or length to suit the special requirements. For ranges above 2,000 degrees Fahr., the standard Le Chatelier platinum-rhodium elements are used. Compound couples, as illustrated in Fig. 5, may be used to reduce the high cost of the platinum-rhodium element. The inexpensive alloys employed for the extension of the couple are such that the two secondary thermo-electric effects at the junctions with the platinum and platinum-rhodium elements neutralize each other if the temperature at these junctions does not exceed 1,200 degrees Fahr. The indications on the instrument will be the same as if the whole couple had been made of the more expensive metals. Where there are varying temperatures at the cold end of the couple, a mercury compensator is used, which automatically changes the resistance of the circuit, so that no correction is necessary for the working range of the instrument.

AN OPEN-SIDE SHAPER.

The illustration shows an open-side shaper representative of a line of similar tools of which the one here described and illustrated is the smallest.



An Open-Side Shaper.

The machine is driven by a screw 2⅛ inches in diameter working in a bronze nut and without any gearing between the pulleys and the screw.

The saddle is provided with a taper gib to take up wear. The cross feed is by power or hand and is adjustable. The down feed is by hand.

The reversing mechanism consists of cams on the saddle which come in contact with adjustable dogs on the rod. These cams turn the rod which reverses the machine and actuates the cross feed. The table raises and lowers by means of a crank handle. Ball thrusts are provided for the driving and table-elevating screws. The supplementary table may be removed and work bolted to the side of the table or the table may be entirely removed and work may be secured direct to the column. This machine will shape a surface 30 x 15 inches. Maximum distance from the head to the table 15½ inches. Down feed of tool slide 6½ inches. Weight of the machine and countershaft 3,450 pounds. This open-side shaper is built by the Cincinnati Shaper Company, Cincinnati, Ohio.

❧ ❧ ❧

—It has been announced in the daily press that Mr. F. B. Girdlestone, of Bristol, England, would be appointed engineer to the Montreal Harbor. "The Canadian Engineer" has it on good authority that there is no truth in this whatever, Mr. Girdlestone not being even an engineer.

THE LITTLE GIANT CORNER DRILL.

A new Little Giant pneumatic drill for corner work is being placed on the market by the Chicago Pneumatic Tool Company, Chicago and New York. From past experience in air tool practice the company claims to be justified in stating that this new drill surpasses any other drill yet devised for drilling in close quarters, and in corners particularly, the machine having been designed especially for work of the latter class. The parts for the No. 4 Little Giant drill interchange with the new drill, thus insuring quick repairs.

This new tool weighs but 35 pounds, has a nominal capacity for drilling 1½-in. holes, but in emergency will drive 2-in. twist drills with satisfactory results. The spindle speed when running light is 150 rev. per min., and under load, with 80 pounds air pressure, 100 rev. per minute. The distance from the end of the socket to the end of the feed screw when run down is 5⅞ in., the length of feed 2 in., and the distance from the centre of the spindle to the outside of the housing 1 5-16 in.

According to the claim of the builder, in addition to being the most powerful drill ever built, weight considered, it possesses advantages over other designs of corner drills, owing to the spindle being driven by gears instead of by ratchet and pawl, which insures steady and constant spindle movement.

The accompanying engravings give a clear idea of the construction of the drill and its neat and compact design. The exterior appearance of the drill is shown in Fig. 1, and Fig. 2 gives a sectional plan and sectional elevation which bring out all of the important differences between this drill and the Little Giant drills previously manufactured by this company, so that further description is hardly necessary.

The air motor movement and the handle controlling the inlet of air are unchanged, in principle at least, but where the drill spindle would normally occupy a position in line with, or not more than once removed from, the motor shaft three intermediate gear shafts are interposed. This gives an excellent opportunity for locating the speed reducing gears in a convenient manner and generally compacting the construction, so that the entire machine is of short length taken in the direction of the axis of the spindle. The case entire is oil tight, to hold lubricant for the motor and gears.

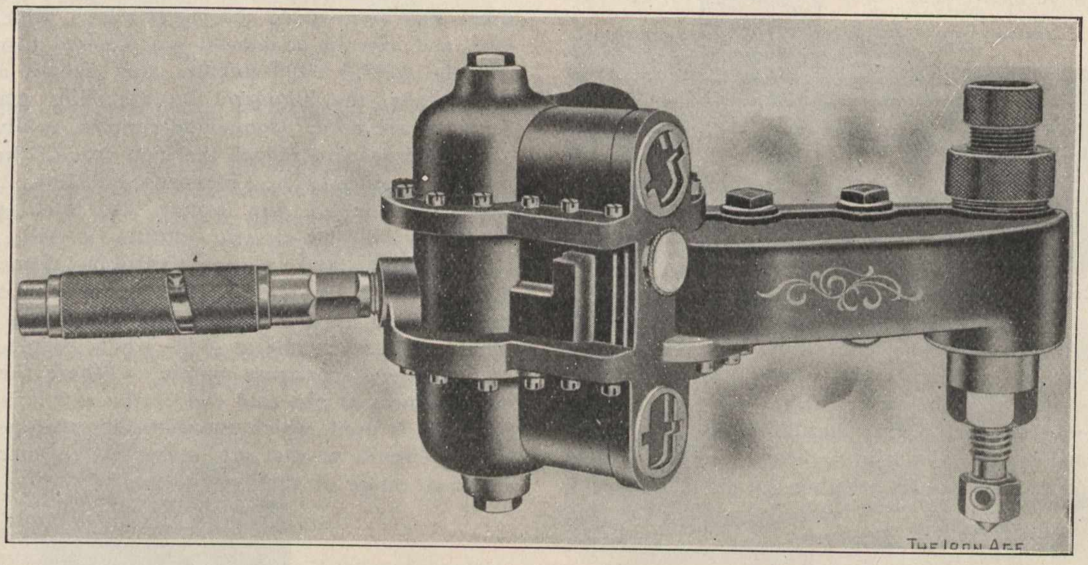


Fig. 1.—The Little Giant Pneumatic Drill for Corner Work, Made by the Chicago Pneumatic Tool Company.

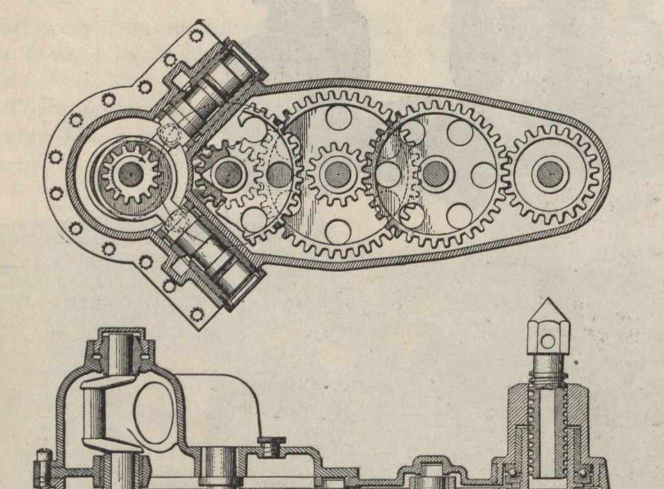


Fig. 2.—Sectional Views of the Little Giant Corner Drill.

ENORMOUS MACHINERY BUSINESS.

The Lumber and Mining Industries Create a Strong Demand for Machines.

Some interesting interviews with prominent Eastern banking, financial, and commercial leaders appear in the special Canada expansion number of the "Monetary Times" —Canada's leading financial journal. This particular number deals with Vancouver, and Mr. H. G. Fuller, the president of the Canadian Fairbanks Company, was seen by the "Monetary Times'" own Montreal editorial representative concerning the machinery business in British Columbia. The interview is reprinted below in full:—

"How has the machinery business been in British Columbia?" I asked Mr. H. J. Fuller, president of the Canadian Fairbanks Company.

"Splendid," was the reply. "During the past year we found business increase enormously. I was almost going to say that it had doubled."

"Has the growth been very great from year to year?" I asked.

"No, it has not. It increased very rapidly some years back, owing to the mining boom. When the boom collapsed, business to some extent ceased. There was a period of half a dozen years when business was almost stationary. This has lately changed, and we have experienced an active demand for all kinds of machinery."

"From what manner of industry do you find the demand principally arise?"

"So far as machinery men are concerned, there are practically only three businesses in the Province—lumbering, mining and canning of fish. There has been much more activity in lumbering and mining in British Columbia during the past year or so. The salmon canneries have also been doing very well."

Improvement in Lumber and Mining Industries.

"To what do you attribute the improvement in lumbering and mining?"

"I understand there is some understanding amongst the lumbermen by which all are able to obtain higher prices, or do business at lower cost, and in some manner to show better results. Then the market has been greatly extended. The quantity of lumber recently sold in British Columbia is enormously larger than ever before. British Columbia lumber has been used at San Francisco, on the Panama Canal construction work, and for other purposes. There is also much building within the Province, and in the West generally. This activity in building naturally calls for much lumber.

"As to the mines, they have shown marked improvement during the past few years. Previously, mining was done largely on paper. When things flattened out, it left the country in a bad way. But a number of the companies have continuously worked, with the result that there is now more actual mining going on in the country than ever before. This naturally gives rise to a large amount of business in mining machinery.

Always Business Competition.

"As to the canning industry, 1906 was a light year, but new machinery is always needed."

"Have many new lumber mills been added recently?"

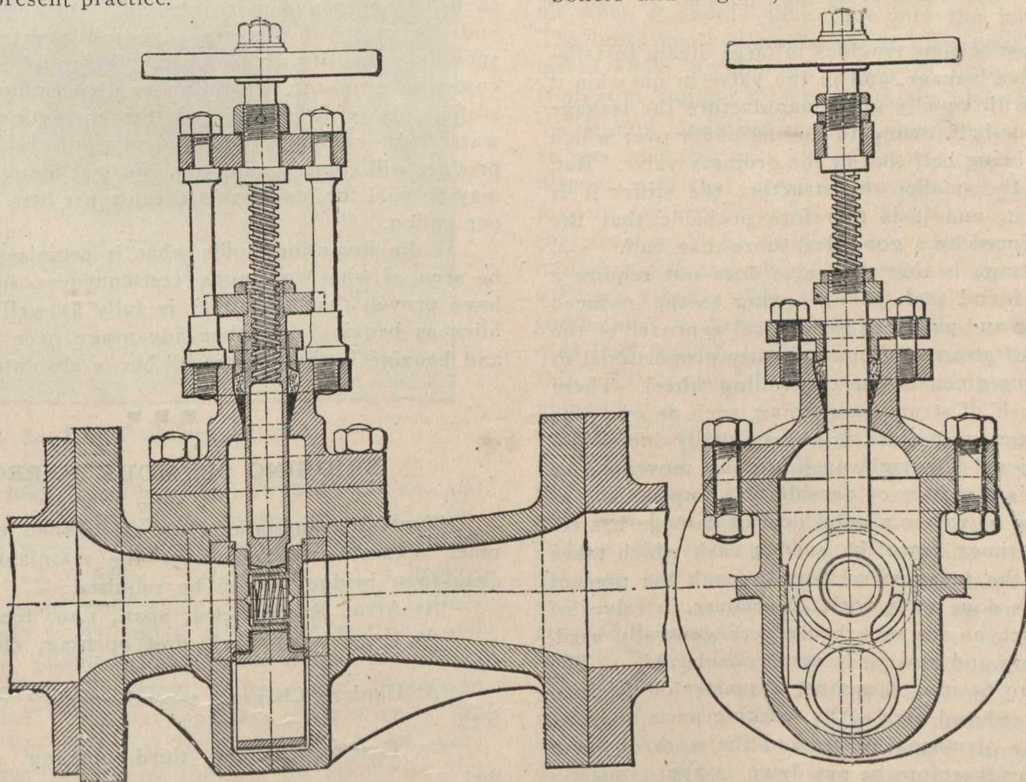
"I cannot give exact figures, but I should say that the Crow's Nest Pass country has experienced the greatest activity. Six years ago there were only about six mills along the C.P.R. line there; there are now, I think, thirty-six."

"Do you experience much competition in obtaining the business?"

"There is always opposition. Some of it is Canadian, but yet more is American. We are able to hold our own, and expect to do so in future. We have our branch house at Vancouver, and are thus always on the spot."

THE HOPKINSON-FERRANTI STEAM-VALVE.

It may well have been thought that the manufacture of stop-valves had reached finality in design, since they have been manufactured for so many years, during which time many improvements have been made. A design has now been brought out by Mr. Ferranti, which promises to revolutionize stop-valve manufacture, making considerable modification in present practice.



The Hopkinson-Ferranti Steam-Valve.

The valve works upon the principle of converting the pressure of the fluid to be controlled into velocity, passing it through a comparatively small orifice, in which the working parts of the valve are placed at a high velocity, and then reconverting the velocity into pressure again by means of a suitably-formed nozzle.

The valve is being manufactured by the well-known firm of Messrs. J. Hopkinson & Co., Limited, of Huddersfield, England. From the engraving its construction will be readily understood. The new idea is so simple, and the advantages of the valve are so obvious, that it seems strange that it has not been invented long ago. It must be remembered, however, that accurate knowledge on velocity and pressure conversions of elastic fluids is of quite recent date; and it has only been by a combination of circumstances that the present development has been brought about.

Some years ago the Venturi water-meter suggested to engineers the possibility of using a valve of less than the full bore of the pipe carrying the water to be controlled, and resulted in a plain straight-through valve being connected between two simple conical pieces of pipe. This device was serviceable where efficiency was a matter of small importance, and where the drop of pressure occasioned was of little consequence in the system where it was applied. No doubt this idea has met with no general application on account of its shortcomings, as it has the same disadvantage as using a valve which is too small for its work.

When Messrs. Hopkinson, some time ago, were considering the question of manufacturing valves under Mr. Ferranti's patents, they made careful experiments to determine the value of the valve, and after they had successfully applied it to one of the engines in their power-house, they removed it, and put in its place an ordinary straight-through valve of the same bore as the throat of the nozzle-valve, connecting it with increasing and decreasing cones to the steam-pipes. It was then found that the engine would only give about two-thirds of its normal load, thus showing, in a form which can easily be appreciated, that this sort of device, which, as explained above, had had some application in water work, was quite unsuitable for use in pipes which were carrying steam at normal velocities. The whole tendency, however, of modern engineering in steam-pipe systems, and generally in the control of fluids, has been to do away with everything causing a drop of pressure or reduction of head; and it is for this reason that the globe or screw-down valve is being so generally abandoned in favor of valves of the straight-through pattern. Moreover, in steam installations so many valves are usually found in series between the boilers and engines, that any appreciable drop of pressure through each of the valves would add up to a serious figure before the engine was reached.

As the result of very careful design and a large number of experiments, Mr. Ferranti has produced a valve with very much smaller working parts through which the drop of pressure, under normal circumstances, is negligible, and which is capable of carrying the heaviest overloads. This valve can therefore advantageously take the place of any ordinary full-bore straight-through valve.

The steam entry to the valve is formed of a conical nozzle. It has been found advisable in practice to make the throat of this nozzle half the diameter of the pipe in which the valve is placed, and it therefore has one-quarter the area. In this throat the operative parts of the valve are placed. These are made according to Messrs. Hopkinson's well-known construction, the discs and seats being of the "Platnam" metal, which has been found very durable under the most severe conditions. As, however, it is of the utmost importance that the path should be perfectly smooth, so as to avoid as much as possible loss from eddying, the moving part of the valve is of special construction. This will be seen from the illustration, which shows that the moving parts are so constructed that when the valve is closed the ordinary discs are in position against the faces; and when the valve is opened a smooth tubular passage is brought accurately into line between the cones forming the path through the valve.

The steam, on leaving the throat, passes through a diverging nozzle and converts its velocity into pressure; and it is the smoothness of the throat and correctness of the whole path which are of such great importance in giving the valve a high efficiency. The nozzles, both leading to and from the throat, have been designed on the basis of equal conversion of energy per unit length of the path, so as to obtain the minimum loss by eddying. Every precaution is taken in the design and manufacture of the valve to ensure the tube which forms the path through the throat being in accurate alignment with the nozzles when the valve is full open. To give an idea of the importance of the smoothness of path in the throat, it may be stated that when this special construction is replaced by the parts ordinarily found in a straight-through valve, the drop of pressure at once becomes serious.

The advantages to be obtained by the use of this valve are very important. The new valve, for the same capacity as that of an ordinary straight-through valve, is very much smaller in size, and is of about half its weight. This matter, though not so important on land, is one of very great importance on board ship, where everything possible is done to reduce weight.

One of the most serious troubles in large steam installations is that of valve leakage, and in the valve in question it will be seen that with equally good manufacture the leakage must be at most one-half, owing to the periphery over which leakage can occur being half that in the ordinary valve. But, as is well-known, the smaller the structure the stiffer it is possible to make it, and it is therefore probable that the leakage will be reduced by a good deal more than half.

Another advantage is that the valve does not require a bye-pass; as it is found that, partly owing to the reduced area of the opening and partly to the conical approach to the opening, the flow of steam is almost directly proportional to the number of turns given to the controlling wheel. There is, therefore, no rush of steam on opening, such as one gets with ordinary valves, and there is a continually increasing and nearly proportional flow right up to the last movement of the handle. This is a matter of considerable importance, as by careless opening of valves a good deal of damage has resulted at different times, from the sudden rush which takes place. Owing to the progressive flow through the present valve, this danger is done away with. Moreover, in valves of fair dimensions, such as are now being very generally used, the work of opening and closing is very considerable. The present valve has to be moved against a quarter of the load on account of the reduced area of its working parts, and for only half the stroke of normal valve; and the work of opening and closing may therefore be put down as approximately one-eighth of that at present required.

The lagging of steam-pipes for the purpose of saving heat losses is now generally done with very great care; and in steam installations where the engineers are concerned with the good appearance of their pipe-work, it is always a very serious difficulty to so lag the valves as not to lose heat, and yet, at the same time, to prevent their spoiling the general appearance of the plant. The new valve lends itself very specially to being well lagged; in fact, the diameter of the lagging required for the pipes is about that which is required for entirely enclosing the hot part of the valves; and thus a neat and workmanlike job can now be made of the covering of a pipe system.

Many engineers will, no doubt, have come across the difficulty and annoyance arising from the fact of their having to provide different flanges upon their steam-pipes where these are jointed to stop-valves, owing to the welded-on flanges suitable for pipe-lines being too small in diameter, and having bolts at too small a radius for connecting to the cast-iron or cast-steel valve-boilers. This difficulty is entirely got over in the new valve, Fig. 3 showing with one end connected to a standard pipe-line welded flange.

It will be seen from the figure that the cones of which the valve is formed enable the bolts to be put close enough in to the centre to allow of standard pipe-line welded-on flanges being used. The other end of the valve is shown connected to a cast-iron flange, which is effected by simply drilling the valve flange to suit. The importance with the new valve of being able to keep standard pipe-line flanges throughout the pipe system is very great, and will be much appreciated by engineers.

"PETROLIT" INVENTION.

An invention made by the Swedish marine engineer, Mr. Hugo Medberg, and which it is said, will be a hard competitor against kerosene oil for both lighting and power purposes, appears to be an assured success according to the Swedish paper "Dagens Nyheter." The inventor himself has already disposed of the patent a couple of months ago at a comparatively insignificant price, while the present owners of the patent, who also are Swedes, ask thirty million francs for it, and they already have offers from many holds. Even Rockefeller is said to have entered into negotiations to acquire the novelty, which he fears will be a dangerous competitor.

The invention consists in the producing of a stuff which is given the name "Petrolit," and with quite remarkable properties. The light, which this new article gives, is said to be stronger and more pleasant than that of kerosene and the energy for power purposes greater than a corresponding quantity of kerosene. "Petrolit" is produced from common wood-tar, which under the influences of certain stuffs, this is the secret of the invention, is mixed with water. In countries with plenty of wood-tar, the new product will come very cheap, and it is figured that "Petrolit" may be sold for less than 1½ cents per litre or about 6 cents per gallon.

If the invention holds what it promises, it will readily be seen of what enormous consequences it will be. Trials have proven that "Petrolit" is fully as well fit for automobiles as benzine. Another advantage over both kerosene and benzine is that "Petrolit" burns absolutely odorless.

BRIDGING SEYMOUR NARROWS.

"Careful examination has established the fact that to reach Vancouver Island from the mainland the following clear-span bridges would be required:—

"At Arran Rapids, clear span, 1,100 feet.

"At Cardero Channel, first opening, clear span, 1,350 feet.

"At Cardero Channel, second opening, clear span, 1,140 feet.

"At Cardero Channel, third opening, clear span, 640 feet.

"At Middle Channel, clear span, 1,100 feet.

"At Seymour Narrows, first opening, clear span, 1,200 feet.

"At Seymour Narrows, second opening, clear span, 1,350 feet.

"The length of the section across the group of islands, known as Valdes Islands, lying between the mainland and Vancouver Island, is about thirty miles. The channels to be bridged are of great depth, with the tide flowing from four to nine knots an hour."

The construction would cost about $25,000,000.

DEVELOPMENT OF THE ROE PUDDLING PROCESS

By James P. Roe, Pottstown, Pa.

II.

The first heat lasted 20 minutes up to the drop of the bath. Immediately after the drop the iron failed to show at the lower end of the furnace, and on looking in at the back, the mass was seen to be stuck at the middle. After several rapid oscillations at the maximum angle of 50°, the bottom itself became loose, and, when the door was opened, the discharge looked like a volcano having a attack of nausea.

Before the next bottom was tried, one of the caulked joints of the double trough sprung a leak and I decided that it was unadvisable to continue experiments on this structure, with its large plane surface remaining, at times horizontal for appreciable periods, tending to form steam pockets. A new trough was, therefore, built of small pipes, besides being at an angle of 45°. The working bottom and sides were composed of 75% of burnt Grecian Magnesite, and 75% of roll scale. When this was hot, 700 pounds of puddle tap was melted on it. The first heat, 1,600 pounds in weight,

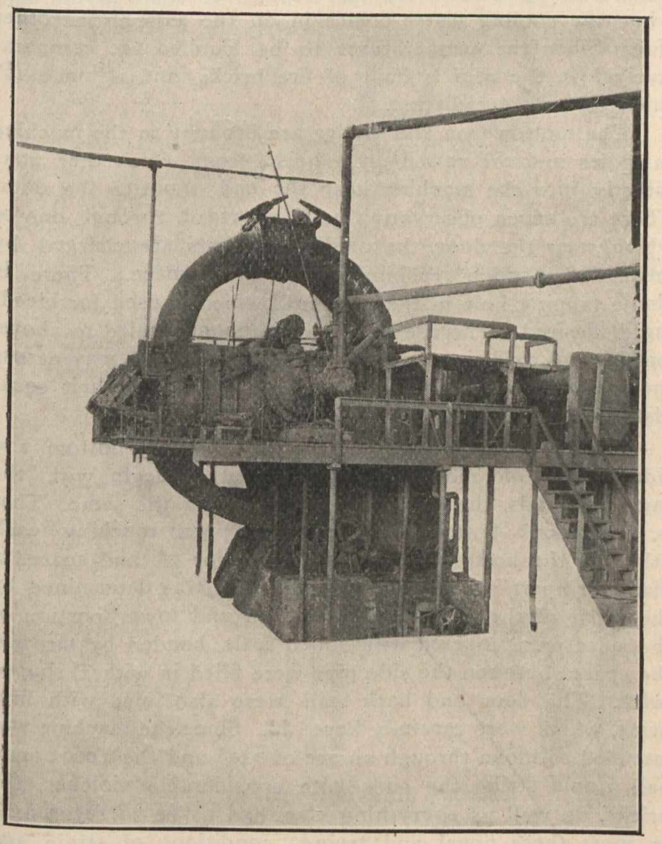


Fig. 3.—Roe Puddling Process.

was a slow one, taking one hour and twenty minutes, and several balls were formed instead of the one looked for. When these balls were rolled into puddled bars the iron showed up very well. After a delay caused by a broken waterpipe, three heats were made, weighing 1,000 pounds each. The time was 32, 33, and 42 minutes respectively, and the iron was well puddled, but contained pieces of magnesite from the sides and bottom, which caused blisters in the iron when rolled. This was repeating the history of the rotary puddlers. The next heat required one hour and nine minutes, as it stuck fast several times at the middle of the trough, a portion of the previous heat having aproned at this point on account of being held too long in the horizontal position during the early stages. In order to free the iron from this apron it was necessary to work with an angle of 50° from the horizontal and, when it let go, the mass struck the ends with such violence as to jar the machine badly and to loosen up the whole of the working sides and part of the bottom. This compelled another step.

The original thought was that the bottom and sides should be self-maintaining, that is, should be able to maintain a relatively uniform thickness by balancing the influences of the heat and scorification by means of the cooling influence of the water, much as in the case of the blast furnace bosh, and thus to do away with all fettling. The original covering was only intended to preserve the trough until this balance was obtained. Reasoning along this line, in view of the difficulty we had in keeping the magnesia sides in place, it was only carrying the experiment a little further to do away with the original lining, and to rely entirely on the chilling of cinder upon the pipes. The next move, therefore, was to cover the bottom as before, but to leave the side pipes bare, merely to coating them with boiled linseed oil to close up the interstices and to prevent the passage of air or gas. This was tried, but was a failure, since we could not obtain a sufficiently high temperature in the presence of so large an exposed water-cooled surface.

Sloping sides to the trough had now lost their attraction, and I turned to the vertical form. The lower pipes touched each other, while the upper ones had spaces between them equal to their diameter. T shaped fire-brick were inserted in these spaces, producing a flat inner surface, the idea being that they would be cut away on the inside by the wash of the centre and would be replaced by its congealing. The length of the hearth was at the same time reduced from 28′-0″ to 20′-0″, as it had become evident that it was longer than was essential to the process, and was too long for the heating capacity as then existing. The bottom and lower portion of the sides were lined with rolled scale and 9% of tar, which was rammed into place.

Several very successful heats were then made, producing good iron. The work went along fairly well, except when visitors were present; that time being usually selected for the happening of the various untoward events, due to the crudeness of all the arrangements, such as a ball punching out at the end of the trough, the slipping of the engine valve on its stem, the running of a heat of cinder into the pit when it should have gone into the furnace, and so on. The heats made averaged about 1,200 pounds in weight and lasted about 30 minutes. Many of these heats were made from iron coming directly from the blast furnace.

It now appeared that the experiments had gone as far as was advisable with the extremely crude appliances at my disposal and that greater refinement of means were necessary to further progress. It had been proved conclusively that iron could be puddled by causing a mixed bath of molten metal and slag to flow backwards and forwards in a heated trough, when the bath was arrested with sufficient suddenness at the end of each oscillation, and that the puddled iron could be massed into a compact ball by continuing this operation and could then be shot out ready for further manipulation.

Up to this time I had given but little thought as to how to dispose of the puddle ball after it was made, believing that the experiments themselves would, in a great measure, point out how this should be done. This proved to be true, and, as the work proceeded, I became convinced that, in order to carry out the idea of using large units, the mass must be maintained in its integrity up to the point that is reached in modern steel practice, that is, up to the slab or billet. The puddling machine, therefore, must have the capacity to produce a ball which would approximate the weight of a steel ingot. The ball must be squeezed in one mass, rolled on a blooming mill and cut to length in slabs or billets. When this was accomplished the low costs of the modern steel plant should be attainable. The path marked out, therefore, was the use of molten metal from the blast furnace and mixer, puddling in a machine to be further developed in detail, squeezing in a machine to be designed, and rolling in a blooming mill into slabs or billets, or, in a plate mill, directly into plates. By this means, there would be avoided at least the greater cost of handling loose piles of muck bar. It will be noted, also that the course of procedure above noted is precisely that of steel-making, mechanical puddling and squeezing being substituted for converting and casting into ingots. 'It will also be noted that the squeezed slab is in a more advanced stage than the ingot, being much more solid and homogeneous.

The existence of a blooming mill in an abandoned Bessemer plant decided the location of the new furnace. It will be noticed from the perspective view, Fig. 3, and from the longitudinal and cross sections, Figs. 4 and 5, that this furnace differs considerably from the first one both in general appearance and in detail. The side plates of the furnace, or trough, also have the function of girders and are extended downwards and have racks on their peripheries, which gear into pinions on a counter-shaft. The stacks, four in number, are so placed as to produce as even a distribution of the flame and temperature in the furnace as possible. They converge above the axis of the trunnions, where they meet, for the double purpose of clearing the platform around the furnace and of keeping the gases in balance at any angle. This construction also prevents the ingress of air through the lower pair of stacks, which would decrease the temperature and oxidize the iron. The door, forming the whole of one end, is operated by means of an hydraulic cylinder, placed horizontally under the furnace, which drives a revolving cross-head. This cross-head is kept parallel by means of pinions gearing into tracks in the side plates and

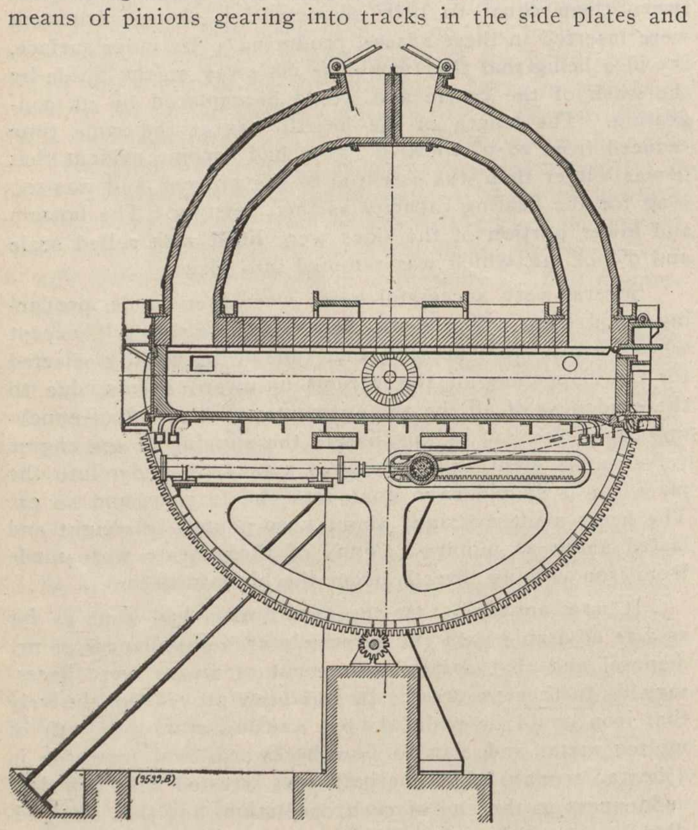


Fig. 4.—Roe Puddling Process.

is connected to the door through two connecting rods. The door is firmly locked by means of wedges, which pass through the side plates and connecting rods and are actuated by two small hydraulic cylinders placed back to back.

The door is constructed in a series of sections 9" wide, in order to avoid distortion by heat, and the lining bricks are held in these sections by dovetails. The sections are fastened to girders at the top and bottom of the door and the bottom girder has a trunnion at each end to receive the connecting rods. The edges of the door are sharply convex in form, while the sill, lintel and jambs are also convex, but have a larger radius. The result of this construction is that, when the two convex surfaces are forced together by means of the wedges which lock the door, the adhering cinder from the previous heat is ground off and the door is tightly closed. The sill and lintel are water-cooled in order to chill the molten cinder, when it strikes them, and thus to seal the joint and prevent the egress of iron. This problem of rapidly sealing the joint of a large door to retain molten iron and also to resist the shocks of the later operations was a novel one, but was successfully met by the arrangements described.

The trunnions carry the whole weight of the machine and are supported on roller bearings. The machine itself is so balanced that it has a slight tendency to always return to a horizontal position. As a consequence, although the machine is heavy, but little power is required to operate it. The heating agents are admitted through the trunnions as before. We adopted oil as the fuel for the new machine, instead of coal, principally because it was cheaply installed and lent itself well to experimental purposes. The use of coal, while perfectly practicable, causes delay through the necessity for cleaning fires. The use of gas is also perfectly practicable, but it required a more costly construction and introduced new problems which might well be left for later solution.

The oil is heated by steam and pumped to the machine, the last three feet of the pipe being steam jacketed. It then passes through a burner in which it is atomized by air under 6 pounds pressure. As it enters the trunnion it meets the first portion of the air for combustion, which is supplied under a pressure of 6 ounces, and a little further on the rest of this blast is so admitted as to give a gyratory motion to the flame. The two flames whirling in opposite directions, impinge on each other at the centre of the furnace and a very perfect mixing and combustion results, producing a uniform and effective heat. The main for the combustion blast is brought in on the axis of the machine on one side, while the cooling water comes in on the axis at the other side. Since the temperatures to be handled are comparatively low, the roof is built of fire brick, and is made 16" thick to reduce radiation.

The molton iron and cinder are brought to the machine in ladles and are raised on a hoist, from which they pour directly into the machine near the end opposite the door. There are seven observation holes provided, through one of which, near the door, the oxidizing agents are charged by means of a spoon reaching across the furnace. There is also a tapping hole in the rear end, which is used for bleeding, if desired. The use of the long spoon, alluded to above, enables the oxidising agents to be added all the way across the furnace at the same instant and thus insures their equal distribution.

From the encouraging results of the last bottom and sides in the old machine, I determined to begin with the same materials, the construction also being the same. That is, the trough bottom was made of pipes touching each other on the bottom and up the sides for 7", and spaced a diameter apart above that height, which was determined by the wash of the cinder. The bottom and lower portion of the sides were covered with rolled scale, bonded by tar, and the spaces between the side pipe were filled in with T shaped brick. The door and back wall were also lined with fire-brick, which were carefully keyed in. Since the machine was intended to move through an arc of 140° and the 4,000 pound ball would strike the ends with considerable violence, the bricks, as well as everything else, had to be so secured as to meet these novel and trying conditions of strain and shock, in addition to the ordinary strains due to heat.

Co-incident with the building of the new machine a squeezer had to be designed and built. The conditions to be met by it were that the puddled mass, or ball, should be received with the least possible loss of time after its consolidation in the puddler; the product should approximate the form of a steel ingot, adapted to rolling in the blooming or plate mill; and the cinder should be removed in a uniformly sufficient manner from the whole of the mass, from the centre to the surface.

The first condition, above named, made it necessary that the squeezer should be mobile so that it could be brought to each puddling machine in a plant as it was needed. The second condition indicated that the pressure should be applied in the two horizontal directions and in the vertical direction, either successively or simultaneously, as desired. The third condition indicated the application of the pressure for an appreciable time in one direction, this being the most effective means of influencing the interior of a semi-mobile mass, as had been fully proved by experience in hydraulic forging. It was also argued that if sufficient pressure be applied to a mechanical compound and be maintained for a sufficient time, the more mobile of the constituents will exude from the mass, provided there is opportunity for its escape until an irreducable residue is reached which will be held by cohesion. It was, therefore, determined that hydraulic power should be used, applied by cylinders acting in the three directions, that slots should be provided in the surfaces coming in contact with the mass, in order to allow free egress for the cinder. It is quite evident that the pressure, applied in the way described, would be much more effective than that of a rotary squeezer, since the direction of pressure is continually changing in the latter, as the ball moves forward, and the channels for the egress of the cinder, just established, are sealed up again with the cylinder and segments.

Through the opportune breaking of a segment in a rotary squeezer, I was enabled to get some little data as to the power which would be required for efficient work. The ball, which caused the break was a cold one, and, therefore, abnormal. The pressure required to break the segment, figured out to 500 pounds per square inch on the central vertical section of the ball, the normal pressure, therefore, must have been less, since many balls have passed through without causing fracture. The diameter of the balls was slightly over 6", and, consequently, the greatest distance the cylinder had to travel was 3", since the least dimension of the bloom made by the new squeezer was to be 12", double

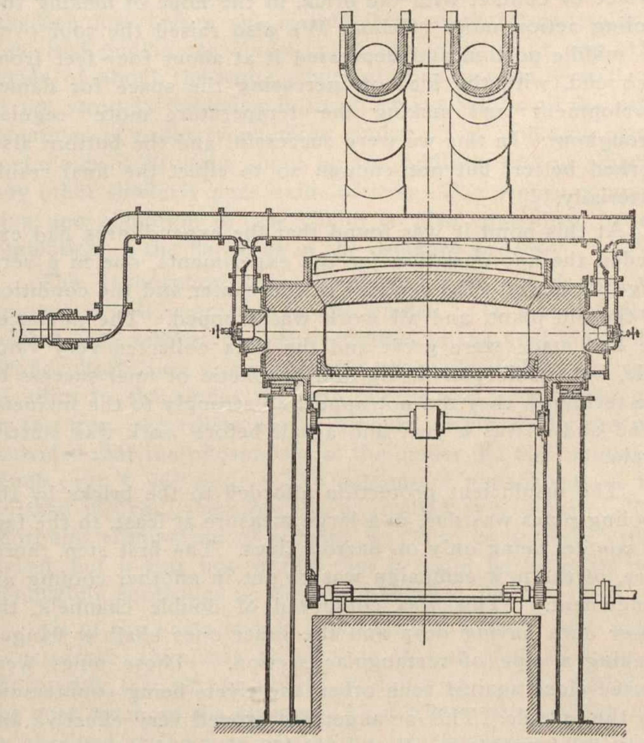


Fig. 5.—Roe Puddling Process.

that of the rotary squeezer ball, the shortest course of travel for the cylinder would be 6". I arbitrarily took the squares of the respective distances as the basis for comparison and determined on 2,000 pounds to the square inch as the power required. A perspective rear view of the squeezer is shown in Fig. 6. The weight of the squeezer is 1.50 tons, which is, I believe, the greatest weight ever carried on four wheels, and yet it is easily moved by two men with bars. I might mention that every person I consulted in regard to this squeezer before it was built and operated, except one, disagreed with me as to its probable efficiency in removing cinder.

As already explained, one of the important features in my puddling process was the abandonment of all fettling and the charging of all cinder and oxidising agents. An auxiliary furnace for melting the cinder was, therefore, a necessary addition to the plant. This was built much in the form of an ordinary puddling furnace and oil was employed as fuel. The building of this furnace with a stationary hearth proved, as will appear, to be a serious drawback, and the use of a tilting furnace for this purpose was strongly indicated. The balance of the plant, except the fuel pump and high-pressure blower, consisted of parts of the old Bessemer plant. These we were able to use, but they had suffered sadly from the neglect of nine years disuse. The buildings were large and straggling and even those parts on which we put new roofs gave only the same protection as an umbrella against the wind and cold. To have put them in proper shape would have been to spend a lot of money on that which was apparently a non-essential. This, however, proved to be a serious error, as the first run was made during the winter season, which was an extremely cold one. This added greatly to our troubles.

The cupolas belonging to the old plant were used for melting the pig iron, as it was correctly thought the work would be too irregular at first to allow the use of iron direct from the furnace. These cupolas had 10'-0" shells, but were lined out to 4'-0" in the clear, and thus other undue complications were introduced.

The earliest troubles to develop were with the dampers, and they began on heating up the furnace. The original dampers were of cast iron, which cracked and melted down. They were replaced by flat coils of pipe, connected to the water supply by means of rubber hose. These hose burned off during the first heat and a large amount of water found its way into the furnace through the roof, resulting in a slow heat of 2 hours and 10 minutes duration.

New coils were made and metallic hose were substituted for the rubber ones. During the second heat the dampers lost their water and closed the stacks by settling down on them, and the heat was discharged before it was finished. Asbestos dampers, held together by light wrought iron frames, were then substituted and have proved entirely satisfactory.

The next five heats developed various minor defects in the arrangements, but were carried through with encouraging success, although attended by annoying troubles due to the old plant. The end bricks had by this time been washed out and had not been replaced by cinder as was hoped would happen. The cinder on the bottom had also been badly washed away and many of the pipes were exposed to the flame. The heating capacity was not sufficient to keep up the temperature under these conditions, and it was also evident that there was not sufficient room for flame development in front of the trunnions. On cooling down, many of the pipes were found to be badly distorted, due to steam pockets.

These pipes were replaced, the whole bottom was lowered 6" to give more room for flame development, and better water connections were added to facilitate the prevention of steam pockets. The ends were lined with tap cinder, cast in the dovetails, instead of brick. Stops were also added to prevent the machine oscillating too far in either direction.

The working bottom was made by covering the pipe with broken pieces of tap cinder, and a special pile was placed in the middle, which was intended to melt and flow over the rest of the bottom. The cinder was then fused into a mass, about 2½" thick, but the piles did not entirely melt, as the cinder was very refractory. A heat of the same cinder, melted in the auxiliary furnace, was then poured in which smoothed up the bottom, with the exception of the hump in the middle.

The first few heats on this bottom worked well, but each successive heat was higher in carbon than the one before it. This indicated that we were still short of heat and the excessive temperature of the cooling water showed that much of it was being lost by absorption, some of the pipes not being sufficiently covered. It was, therefore, evident that some more durable material must be used for the bottom, at least tentatively, since the cinder bottom, as we were making it, did not seem able to stand the wear and tear. Although still convinced that the bottom could be made self-repairing, it was determined to use magnesite brick as a foundation for the cinder. Following open-hearth practice, the brick was laid up as tightly as possible, but it was found that they had considerable expansion at the comparatively low heat of the puddling furnace, and humped up badly as the furnace heated up. Observations seemed to show that the expansion was about 7-32" to the foot, and the bricks were relaid with this allowance, which proved to be correct. Molten tap cinder was flowed over this bottom, making it perfectly smooth. Since the bricks were laid on the flat, the thickness of the bottom was about 3".

The cold weather was a great handicap, much aggravated by the character of the plant, which caused frequent stops on account of frozen pipes, often, just as greatly desired data were almost within our grasp, when all our efforts were lost, and a fresh start had to be made. At a conservative estimate, the cost of the delays due to using the old plant would have more than sufficed to build a new one, with the exception of the blooming mill.

The magnesia brick bottom proved a distinct advance. Several good heats were made and we began to get reliable data as to the working of the squeezer. No melted tap cinder was added between heats as it was desired to try out to the uttermost the resistance of this bottom to the chemical and physical action of the cinder, and to the abrasion of the puddle ball as it slid over it during massing. The many stops due to the cold weather resulted, however, in the bottom becoming very rough and hilly. It cracked into sections on cooling, which became concave on heating up, thus leaving comparatively wide cracks between them. The cinder and iron ran into these cracks, and kept the bottom up off the pipes. It became necessary, therefore, to replace this bottom long before it was worn out. The magnesia brick had done so well in the bottom that it was determined to use them in the ends and in the side walls up to the cinder line. Fire bricks were put in behind these bricks to prevent excessive radiation, as the magnesia bricks are too good conductors of heat to be efficient in this respect. The bottom was put in as before.

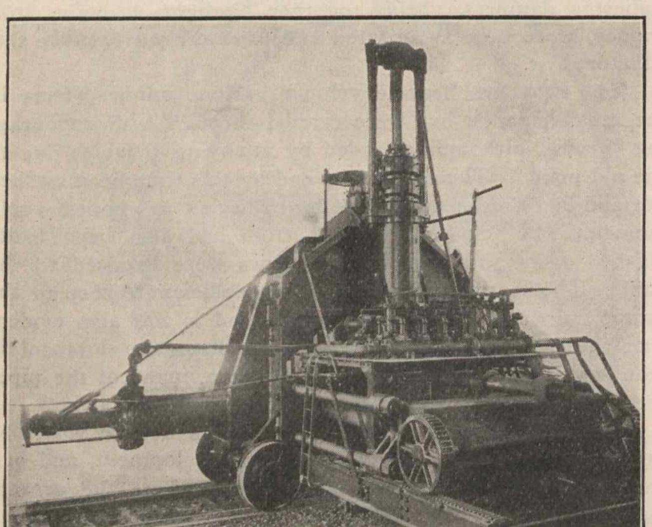


Fig. 6.—Roe Puddling Process.

As long as the tap cinder covering remained on the bottom the results were good, but as soon as it wore off in the middle portion the cinder in the joints between the bricks was washed out and was replaced by cast-iron, which became partly refined, to which parts of the later heats stuck fast. Finally, this bottom had to be taken out on this account. The temperature in the furnace was higher and more regular.

It being desirable to try other refractories, a bottom of chrome brick was put in, and covered with cinder as before. It was very smooth, and looked beautiful, but it could not stand the work and all washed up in the first heat. Later on other brick were tested in the door, such as graphite, carbon, bauxite, and amorphous carborundum brick, but none of them stood more than ten heats.

During these developments in the furnace the squeezer had been doing its work satisfactorily, but it seemed desirable to increase the opportunities for the egress of cinder from the compression box. This was done by doubling a number of slots and increasing their size from 3-32 to 3-16 of an inch.

The next bottom put in was a magnesia brick on edge instead of on the flat. As long as the tap cinder remained on the bottom, the results were satisfactory. As soon as it was gone, however, trouble began again. It was not, however, for the same reason as before, that trouble having been largely overcome. The tap cinder was evidently serving as does the fettling in the puddling furnace, to form a reservoir upon which the cinder of the heat drew to automatically correct its composition. When it was gone the cinder we were using proved to be too high in silica to properly dephosphorize the metal. This was due to the auxiliary cinder furnace, which now began to show the effect of wear in addition to its other deficiencies, not being able to melt the cinders which were low enough in silica. We then adopted the expedient of bleeding off the cinder, immediately after the desiliconising period, and adding fresh cinder for the dephosphorizing. This proved effective but occasionally the cinder still remained too high in silica for the most efficient dephosphorization.

As the bricks of the bottom became thin in the middle portion, it was found that the cooling pipes did not give them the protection that was hoped for and, finally, these pipes again became exposed. At this time the bricks retained their original thickness for about one-third of the distance from each end, and it was determined to fill up the central third with tap cinder. This worked well until some of the iron got down on to the pipes and chilled around the holding straps. On this nucleus a heat finally froze fast and had to be taken out when cold.

It was only necessary to renew the middle third in putting in the next bottom, which was done with magnesia bricks as before, except that a mixture of boiled linseed oil and resin was put over the pipes in order to increase the surface of contact with the brick, in the hope of making the cooling action more efficient. We also raised the roof over the middle portion and depressed it at about four feet from each end, with the idea of increasing the space for flame-development and making the temperature more regular throughout. In this we were successful and the bottom also worked better, but not enough so to effect the final result materially.

At this point it was found that the expenditures had exceeded the appropriation for the experiments, due in a very large measure to the severity of the winter and the condition of the old plant, and all work was stopped. The advances we had made were great and the data collected very valuable, but, while convincing and prophetic of final success to the technical, they did not appeal so strongly to the financial mind and it was a year and a half before work was started again.

The insufficient protection afforded to the bricks by the cooling pipes was due, in a large measure at least, to the fact of contact being only on narrow lines. The first step, therefore, of the new campaign was to put in another cooling arrangement. This was composed of double channels, the outer ones having deep and the inner ones shallow flanges, making a pipe of rectangular section. These pipes were butted close against each other, the rivets being countersunk on the outside. This arrangement proved very effective and practically overcame all the troubles from this source. In putting in this bottom it was lowered as far as the construction permitted and the roof was raised in the middle. This again improved the combustion which was now very satisfactory. A radical change was also made in the shape of the bottom, which had a vital effect on our final success, but, unfortunately, the exigencies of the various Patent Offices prevent me from giving any description of it at this time. Additional escape vents were added to the squeezer, by changing the construction of the bottom supports.

The first bottom was made up of magnesia brick for one-third of the furnace length from each end and the middle section was made of tap cinder. This worked very well, the middle portion wearing down to a certain thickness where it remained practically constant, cutting down a little during the heat and building up again from the cinder left behind or added before the next heat. The bottom was used in that form until the certainty of this fact was thoroughly developed.

The tap cinder was then taken out from the middle third and it was filled in with magnesia bricks, as in the remaining two-thirds. The linseed oil and resin was first spread over the channels and the bricks bedded in it. This mixture retained its original condition throughout the run. The change in the bottom was made with the idea of seeing whether any useful thickness of cinder could be maintained on top of the brick and also whether the bricks could be used without any protection, beyond that afforded by the cinder incidentally present. The latter fact was not fully developed but the former was shown to be entirely practicable. It was proved that a small charge of melted tap cinder, or iron ore, added about once in every ten heats would maintain the bottom indefinitely. This procedure was henceforth adopted and practically ended our troubles with the refractory bottom.

The squeezer, with the minor modifications mentioned, had proved itself to be a thoroughly efficient tool, which removed the cinder uniformly from the mass of iron, leaving no pockets or excesses, and delivered the bloom in good shape and of uniform structure. The questions as to refractories, combustion and mechanical arrangements having now been well worked out, we were at liberty to devote ourselves entirely to practice, which had only been incidentally studied as the other problems were being solved.

The most important feature is, of course, the production and maintenance of the proper cinder, both chemically and physically. The conditions being the same in this respect as in the ordinary puddling process, the same kind of cinder is required. It is produced and regulated practically in the way except that, since there is no fettling to act as an automatic regulator, the proper composition must be effected and maintained by direct additions. The cinder which was charged just before the melted iron consisted generally of remelted puddle tap cinder, although iron ore or any other oxide of about the same composition acts equally well. It is not strongly oxidizing in its effect but fulfills all the other functions of ordinary puddling cinder. The oxidation of the metalloids is brought about by the addition of roll scale or any other similarly pure oxide of iron. The proper composition and condition of the cinder is also controlled by the regulation of the flame, as in the ordinary process.

The dephosphorization is chiefly determined by the amount of silica present in the cinder. It was definitely settled that with 25 per cent. of silica in the final cinder the dephosphorization was practically nil, while with 12 per cent. of silica in the cinder the phosphorus was reduced to 0.06 in the iron, regardless of the amount originally in the pig, provided that the phosphorus in the cinder did not amount to much over 5 per cent. The amount of phosphorus in the finished pig can, therefore, be controlled very closely. The thorough elimination of sulphur was also completely established, but it was not settled that it could be as easily and completely controlled as the phosphorus.

All of the heats in this campaign were made with metal direct from the blast furnace, as it was deemed best to thoroughly test the feasibility of doing so. This added to the cost, since, in the absence of a mixer, a metal could only be obtained at the time of tapping, which occurred six times in the twenty-four hours. We took what came from the furnace, regardless of what it was making, and the machine handled with equal facility metal ranging from forge to foundry pig. The operation of the process went along very smoothly during this run and the iron made was all good, except a few heats in which experiments were made with the cinder which did not work out well. Finally, the cinder furnace gave out completely and a new one had to be built or work must cease. It was then determined to stop the experiments since all had been done that could be accomplished without continuous running under commercial conditions, which was impracticable with the plant as it existed.

Since the basic idea in developing my process was to produce large masses of puddled and squeezed iron, which could be rolled direct into finished products without piling, its feasibility could not have been proved by any experiments on small machines. It necessarily required the use of a puddling machine and squeezer which would deliver blooms of sufficient weight to be comparable with the steel ingot, that is, of from three to four thousand pounds. This entailed very heavy costs for building and operating, with the additional disadvantage of heavy carrying costs during stoppages or while the data obtained were being digested. These costs were increased during the final run by the fact that only three heats could be made in twelve hours, with an occasional fourth if the blast furnace happened to be running fast. The results justified the expenditure.

Although no absolute data as to commercial costs could be obtained in such a plant and under the conditions of our work, enough were obtained to afford a fair basis for a close estimate as to what they would be in a well-designed plant, with continuous running. It can safely be affirmed that they would not exceed those of a well-equipped steel works.

Besides demonstrating in a general way the entire technical and commercial practicability of this process, the experiments have also settled certain other matters of detail in addition to those already described. It was proved that a clean and effective bottom could only be maintained by having somewhat more than half of it uncovered and exposed to the flame at all times, thus keeping it hot and making the temperature of the bath more uniform as well as that of the iron after it had come to nature. It was necessary also, both in the early and late stages of the operation, that the metal should start on its down trip as rapidly and suddenly as possible. Both of these necessary steps were rendered more feasible and certain by the changes in the shape of the bottom, already alluded to.

Another feature demonstrated was the practicability of keeping the iron spread loosely and evenly over the bottom, after the drop, and when it had come to nature, and of retarding or hastening the finishing at will. This was done by the proper manipulation of the oscillations and made it certain that all of the iron would be uniformly finished, and that there would be no raw iron present when the massing into a ball by impact against the ends was begun.

A gain in weight of about four per cent. for the squeezed bloom over the pig-iron charged was fully proved. This came in part from iron reduced from the oxide of the cinder and in part from the discharge of the ball into the squeezer as soon as it was made, by which the opportunity for surface oxidation while lying in the furnace was entirely eliminated.

The only repairs for fettling was the bath of refractory cinder spread over the bottom about once in ten heats, which took only five minutes to apply. As a mechanism, the machine stood up to its work very well. There were no mechanical repairs required after the few changes in detail, to improve its efficiency, were completed. Although the machine had to stand the shock of the impact of three or four thousand pounds against its ends, it did so without suffering and not even a brick was started from its place.

The average time of making a heat was 59 minutes and it was evident that regular working and proper appliances would reduce this time materially. It was also shown that the machine would be made with a capacity of two and a half tons per heat. This would give over thirty tons of blooms per turn of 12 hours. Each machine would require the service of a puddler and two helpers, one of whom would manipulate the oscillations.

The iron is more thoroughly worked than in the ordinary puddling process and the metalloids can be more completely eliminated. This permits either the starting with inferior pig-irons or the production of better material from the same grades, thus widely extending the range of material entering into the blast furnace or produced from it. The maxima of the various elements operated upon at different times were 3.5 per cent. of silicon, 3 per cent. of phosphorus, 0.35 of sulphur, and 2.5 per cent. of manganese. With all of them good material was obtained. The heats with high silicon were not appreciably longer than the normal, nor were those with higher sulphur shorter.

It was also demonstrated that the iron so made could stand a higher percentage of carbon than could that produced in small units, which required to be subsequently welded together. The dimensions of the bloom, as it came from the squeezer, being 12 x 24 x 54 inches, there was ample opportunity for the necessary work in reducing it to the finished size. The bloom being solid and homogeneous from end to end, there was no danger of segregation or of physical imperfection like piping. It was possible, therefore, to get iron of considerably greater tensile strength longitudinally than is practicable in the ordinary process. The transverse strength, however, still remained materially lower than the longitudinal. The following are given as typical results in the three grades;—

C	P	S	Ultimate Strength	Elongation	Reduction of Area	Rolled Section
			lbs.	%	%	inches.
0.06	0.06	0.009	45,890	30.0	44.4	7-16 x 21¾
0.08	0.19	0.009	52,420	30.2	53.6	1⅛ round.
0.24	0.13	0.007	68,280	19.7	30.9	½ x 13.

The market for the product of this process would be a wide one. Even with the wonderful increase in the production of steel during the last forty years production of wrought iron has not materially decreased, although relatively much less, and the oft-prophesied disappearance of the puddle furnace seems as distant as at the time of the invention of the Bessemer process. Besides the uses which have determined this survival of puddling in the face of the vast flood of soft steel, excellent in quality for many purposes, there is a large range in which wrought iron would be employed, if it could be obtained at, or near, the price of steel. This is peculiarly true of those uses in which sudden or continuous shocks are to be withstood, or in which the material is to be exposed to the action of corrosion, especially in light sections such as wire or roofing sheets. The investigations of the United States Agricultural Department,* although not yet sufficiently completed for a definite pronouncement, seem unquestionably to point to a life for iron fencing wire about three times as long as for that which is made from steel. Undoubtedly also the opinion is spreading among engineers and intelligent consumers that wrought iron, when of good quality, is better than soft steel for many of the uses in which the latter is now almost exclusively employed on account of its cheapness and the abundant supply.

There is, however, one cause which is slowly undermining the ordinary puddling process, and which may eventually even bring about its final downfall. This is the strong disinclination of the intelligent workman of to-day to undergo the excessive labor demanded by puddling. A man with intelligence enough to make a good puddler can usually make as much money in other ways and with less bodily strain, and more and more of them are refusing to take up the trade. This is not a fanciful assertion, and I have heard of plants which had to be abandoned because a new generation of puddlers could not be educated to take the place of those who were passing away.

To obviate the necessity for this severe labor and to supply wrought iron of better quality than the average now made in the ordinary puddling furnace, at a price which would be at least as low as that of soft steel, was my aim in the development of this process. That this goal has been reached, or, at least, is within easy reach through commercial operation, is my earnest belief; fortified, I am happy to say, by the opinions of many men, well qualified to judge, who have observed the actual working of the process. To give the reasons for the faith that is in me, has been the object of this paper. If it has shown to any one that the problems have been met and solved through close study, hard work, some persistence and a reasonable knowledge of the art and not by hasty guesses or wild assumptions, my object has been accomplished.

*Farmers' Bulletin, No. 239.

SOULANGES CANAL POWER DEVELOPMENT COMPANY.

(From Our Montreal Correspondent.)

Extensive engineering operations are now in progress on the Soulanges Canal, having as their object the construction of a new water-power development for the Montreal Light, Heat and Power Company. The water will be taken from the Soulanges Canal by a new canal, 3,000 feet in length, now in course of construction by the Power Company, which will bring the water to the banks of the St. Lawrence River, where the power house will be situated. The power development is for an ultimate capacity of 20,000 H.P., and it is expected that 15,000 H.P. will be ready for delivery next fall, it being the intention to install three-quarters of the apparatus during the present year. The power will be transmitted to Montreal at 50,000 volts for distribution over the Montreal Light, Heat and Power Co.'s existing system. The electrical machinery will be the most efficient manufactured.

The hydraulic machinery is being supplied by the Allis-Chalmers-Bullock Co., of Montreal, the steel work by the Dominion Bridge Co., and the electrical apparatus by the Canadian Westinghouse Co., of Hamilton, Ont., the Canadian White Co. being the contractors for the dam and canal work.

The power house, flumes, head works, and, in fact, the entire work at the power house is being constructed of reinforced and plain concrete.

The original owner of the right to take water from the Soulanges Canal was M. P. Davis, he having obtained a concession from the Dominion Government to take the surplus water from the canal for a period of sixty years. This concession afterwards became the occasion of the formation of the Provincial Light, Heat and Power Co., which company eventually transferred the lease to the present owners.

The plan Mr. Davis had in view was to construct a canal to lead the water from the Soulanges Canal to the Ottawa River, some miles distant. The present owners of the lease, however, by the advice of Mr W. McLea Walbank, first vice-president and chief engineer of the Montreal Light, Heat and Power Co., decided to abandon the Davis plan as being too expensive, and to run the water towards the St. Lawrence instead.

The undertaking is an extensive one, embracing the construction of a canal with a length of about 3,000 feet, a width at bottom of 160 feet and a height of 27 feet, the whole to be lined to a considerable depth with reinforced concrete. The most striking and important feature, however, is the massive dam to be constructed at the end of the canal, close to the St. Lawrence River. This dam will be a solid mass of reinforced concrete, 155 feet wide and, at places, approaching 80 feet in depth, and pierced by a number of tunnels, which form the flumes for the water-wheels. The public roadway passes over the top of the flumes, the power house also forming a portion of the massive construction. The head of water will be about fifty feet, and 5,350 H.P. will be provided by each of the three units.

It is expected that the transmission lines will cross the rivers and canal by a long span construction, averaging from 800 to 900 feet. The distance from the power house to the terminal station at the city limits is about 27 miles. Here the power will be stepped down to approximately 11,000 volts, and conveyed to the main station in the centre of the city.

The electrical system is being built from the designs of Mr. R. S. Kelsch, C.E., the consulting engineer for the Power Co.

Construction work was started last May, and about 250 men were kept employed all season. The total cost of the undertaking is estimated at $1,500,000.

Owing to the security offered by the enormous dam to be constructed across the river end of the power canal the Government decided to waive its demand for the four steel gates which were called for at the Soulanges Canal end. These steel gates were demanded as a precaution against possible mishap to the power canal, and, although they were to have been generally left open, means were to have been provided for electrically closing them in about four minutes. The great strength of the canal and dam, with its massive concrete construction, was in the end regarded as a sufficient precaution, and the gates will, therefore, not have to be built.

—Tenders for the land titles offices, to be erected at Regina, Sask., will be received by F. J. Robinson, Deputy Minister of Public Works, Regina, up to February 11th, instead of February 4th, as heretofore announced. Particulars are given in the advertisement, which appears on another page.

ASPHALT BLOCK PAVEMENTS.

By George S. Hanes B.A.Sc.*

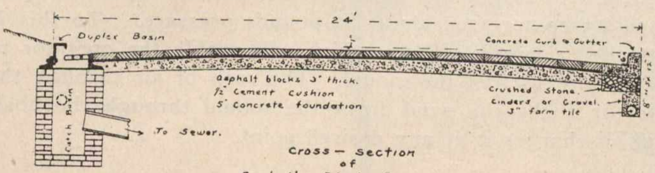
To construct a high-class pavement which will give entire satisfaction is the aim of engineers in every town and city throughout the Dominion. Many experiments have been tried in road-making with macadam, cedar blocks, bitulithic, sheet asphalt, vitrified brick, and numerous other forms of roadway. Of these, perhaps, each particular form is held by some engineers to be the best and most durable.

Another pavement has recently been added to the list in the form of asphalt blocks, composed of a mixture of asphalt, coarse red sand (skimpings from the Michigan copper mines) and other ingredients, which are heated, mixed and pressed into blocks under an enormous pressure, the blocks usually being about 3-in. x 5-in. x 12-in.

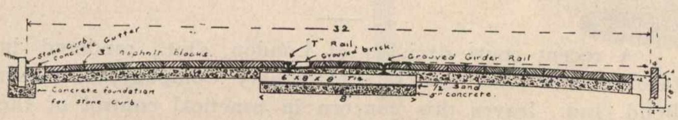
In this article the writer will refer to pavements as constructed in Windsor.

The first form of asphalt block pavement constructed in Windsor has been a failure. The blocks, made in Toledo, Ohio, were laid on a foundation of crushed stone, with a sand cushion. Of course, settlements occurred, a condition which is sure to happen to pavements having this kind of foundation; although some cities still retain a foundation of this kind for vitrified brick, etc.

The next form of foundation used consisted of a 6 in. layer of concrete, about 1½ in. of sand cushion, and 4 in. asphalt blocks, with sanded joints. This form also has



Cross-section of Asphalt Block Pavement. Scale,– 4' = 1 inch.



Cross-section of Asphalt Block Pavement; also shewing Street Railway Construction. Scale,– 5' = 1 inch.

been discarded, because it was found that water penetrated at the joints and completely saturated the sand cushion, which made the foundation subject to the action of frost.

The pavements shown in the accompanying sketch are of a form which has been developed gradually, and which now promises such good results with asphalt block pavements. Pavements of two widths are shown in the illustration, 24 ft. and 32 ft., respectively, having catch basin in place.

The construction is as follows:—The subgrade is thoroughly rolled with a large steam roller, and then a concrete curb and gutter, or a stone curb set in concrete and a concrete gutter is constructed. The fine grading is then completed, and on this is placed a 5 in. concrete foundation, 1:3:6, which is thoroughly tamped and graded. When this foundation has been allowed to set, a ½ in. cement cushion, 1:3, is spread uniformly over it, and made perfectly smooth and true by a template or other device, and left sufficiently wet so that it will set, if allowed to, perfectly. Within at least fifteen minutes from the time of spreading the cushion the asphalt blocks are laid and tamped, so as to present a uniform appearance. Before the day's work is finished the blocks already laid are sprinkled with a fine spray of water in order to again moisten the cement cushion. The blocks are then grouted with a thin cement grouting, composed of one part of cement to one part of sand. Next day the pavement is again grouted with a thicker grout, one part cement and one part sand, and thus continued until the joints between the blocks and spaces between the rails and gutters have been completely filled. In five or six days the street is ready for traffic.

The street railway construction consists of a 5 in. bed of concrete as a foundation for the ties, and a ½ in. sand cushion to allow for irregularities in the ties. These are placed 2 ft. centre to centre, and then the spaces between the ties are filled with concrete, and a cement cushion used under the blocks between the rails. Two forms of rail are used on different streets, as shown in sketch. A "T" rail, with a specially made vitrified brick on some streets, and on others a grooved girder rail.

This form of pavement seems to be one of the most up-to-date now constructed. The pavements built in Windsor in 1904 are ideal driveways, and, though subjected to a great amount of driving, they show no signs of wear. These pavements are on resident streets, but are largely used so as to avoid other streets which are less desirable.

Some of the chief characteristics of the pavement which is making such rapid headway are as follows:—The blocks, being slightly plastic, the joints are ironed together and made smooth by the traffic, so that the surface presents as smooth an appearance as sheet asphalt pavement. It is healthful, since it is waterproof, the water readily running off along the concrete gutters; it is easily swept and kept clean, only requiring an occasional flushing. It is not noisy, there being no joints as in the case of vitrified brick. It is not very slippery, and, therefore, presents a good footing for horses. When opened for the purpose of fixing gas or water mains, etc., the materials are easily replaced, and when the blocks have been grouted the place of opening cannot be detected. With a sheet asphalt pavement or bitulithic pavement this cannot be accomplished so readily.

The cost of the pavement last year was $2.27 per square yard. The city pays for the catch basins, street intersections, and 35 per cent. of the cost of frontage. This pavement, then, when 24 ft. wide, as shown on sketch, costs $2.40 per foot frontage to the property holders. The cost is the same for the 32 ft. street, as the street railway companies pay for eight feet. About 18,000 square yards of asphalt block pavement was constructed during the year 1906. The blocks were made in Walkerville, Ont.

This pavement will undoubtedly have a great future, having given entire satisfaction when well constructed.

* City Engineer, Windsor, Ont.

DISPATCHING TRAINS BY TELEPHONE.

To equip a railway, steam or electric, with a telephone system for the dispatching of trains, has been, and is yet considered by many an expensive method, although for this special work it has been deemed very efficient. One of the reasons for the great expense has been that phone stations had to be erected at every point where connections could be made, and the telephone installation kept under lock and key.

Fig. 1.—Jack Box.

The rapid and frequent trains that are called for on all railways nowadays, whether steam or electric, has made it desirable, and indeed necessary that a change be made in prevailing methods of issuing orders to the different train crews. Where stations are close together the telegraph system is not advantageous, and the block system is far too costly.

These conditions have given the telephone manufacturer an opportunity, and the foregoing conditions have called for the dispatching telephone. With the use of the telephone errors are almost impossible, since the order is acknowledged as soon as it is received. It offers no chance for guesswork, and wrong transcriptions are entirely eliminated.

The Stromberg-Carlson Telephone Manufacturing Company's method of applying telephones to railway trains is as follows:—

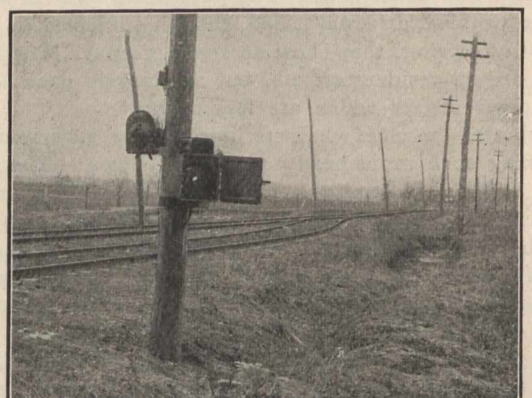


Fig. 2.—Interurban Railway Phone Service.

Each train or each car, if an electric railway, is equipped with a semi-portable telephone. This telephone can be used direct from the car by making connection with the telephone line wires in one of two ways:

First, by bringing into use the cord and plug with which each instrument is provided inserting the plug in the jack box, which is usually mounted on a pole at the switch or along the track. These are located at intervals along the line wherever they are needed.

Second, by using the Stromberg-Carlson jointed extension pole, which is provided with a jack, mounted in the

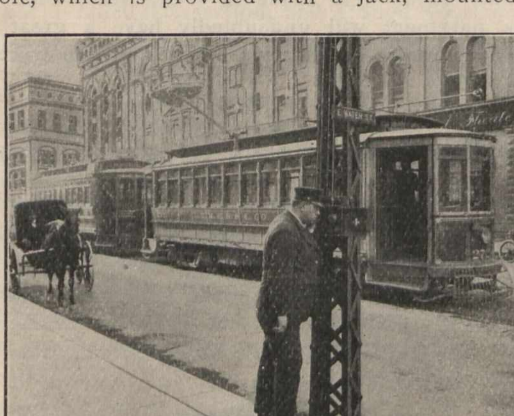


Fig. 3.—City Railway Service.

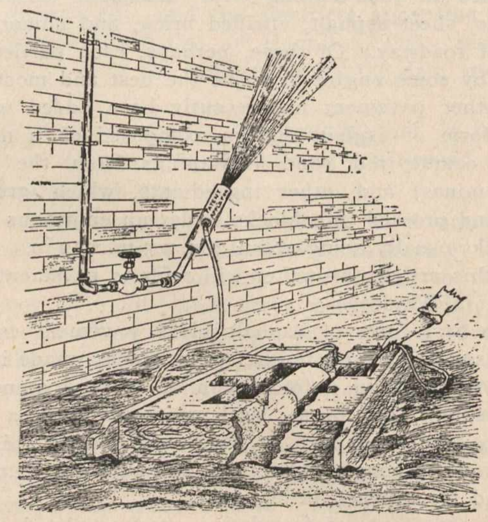
lower end, in which the plug, attached to the telephone, is inserted as in the plug box above described. The opposite end is provided with two hooks for catching the line wires. The pole is jointed, thoroughly wired, well and substantially built, and when put together is electrically connected. Thus in the open country and where there is no plug box at hand, instant communication can be had by this means with the dispatcher, superintendent, or with any station on the line.

City lines are also feeling the need of such a system, and the service is rapidly extending.

CLEANING MOULDS BY PNEUMATIC SUCTION.

A device that is proving itself to be a boon to foundrymen, is an appliance for removing dust and dirt from moulds by the use of compressed air. Every moulder knows how difficult it is to clear sand or dirt from deep boxes or narrow spaces, especially in dry sand or skin-dried moulds, and will readily welcome anything that will enable him to do this quickly, and with ease. The difficulty met with is shown nowhere to better advantage than in the case of large moulds, in which a number of cores have been set.

The appliance for accomplishing this is being manufactured by the J. W. Paxson Company, of Philadelphia, Pa.



Cleaning Moulds by Pneumatic Suction.

As shown in the illustration it consists of an apparatus operated by compressed air at 80 pounds pressure. To this is attached a length of hose which will enable the operator to reach any part of the mould. The rush of air through the ejector sucks the sand from the mould through the hose, and discharges it at any desired point.

CONCRETE MACHINERY PATENT UPHELD.

A recent court decision at London, Ont., rendered in favor of the Ideal Concrete Machinery Company, of South Bend, Ind., leaves this concern in practical control of the manufacture and sale of face-down, horizontal core concrete block machinery.

The patent, the validity of which is now so firmly established, was acquired from the original inventors, Messrs. Borst and Croscop, and thoroughly covers the process of manufacture of face-down concrete building blocks.

Early last spring Mr. Henry Pocock, of London, Ont., opened negotiations for the purchase of rights of manufacture of the Ideal machine under the Canadian patent. After a visit to the company's factory and an examination of the machine and the method of its manufacture, negotiations were suddenly broken off. Mr. Pocock returned to Canada, and after constructing a similar machine sought to patent it. In August last he began offering this machine for sale. The company learned of this, and immediately sought an injunction of court, restraining Mr. Pocock from making, selling or dealing in the machine, alleging that it was a wholesale appropriation of their invention, with some changes and complicating additions. The decision just rendered is the result.

After a trial lasting nearly three days, in which expert evidence was introduced from Toronto, Detroit, Fort Wayne, Audobon, Ind., and London, Ont., the court gave a clear and exhaustive summing up of the contentions of the parties, in which it was declared that the plaintiff's patent was a good and valid one, thoroughly protecting the invention sought to be covered by it. It was held that the machine sold by Pocock was an infringement on the rights of the plaintiff, and the defendant was enjoined from ever again, at any time, making, selling or in any way dealing with the machine in question. Plaintiff was given costs of action and all orders for the infringing machine taken since the interim injunction was granted in September.

The Ideal Company is opening a large plant at London, Ont., for the manufacture of Ideal machines for the Canadian trade.

THE S. AND S. VARIABLE SPEED COUNTERSHAFT

For thirty years or more the variable speed countershaft has been looked forward to. The problem has been occupying the minds of eminent engineers in nearly every part of the civilized world.

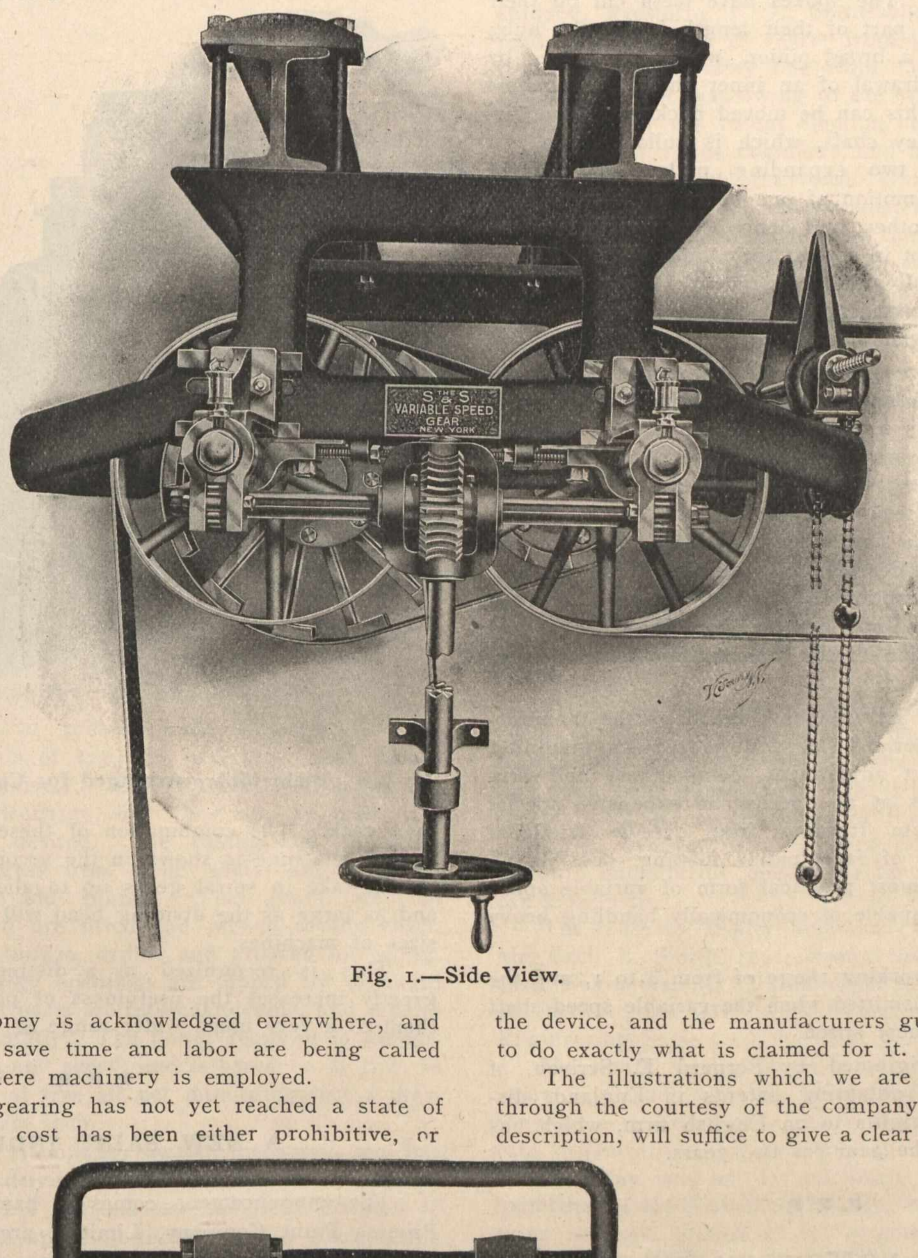


Fig. 1.—Side View.

That time is money is acknowledged everywhere, and appliances that will save time and labor are being called for in every field where machinery is employed.

Variable speed gearing has not yet reached a state of practical utility; the cost has been either prohibitive, or

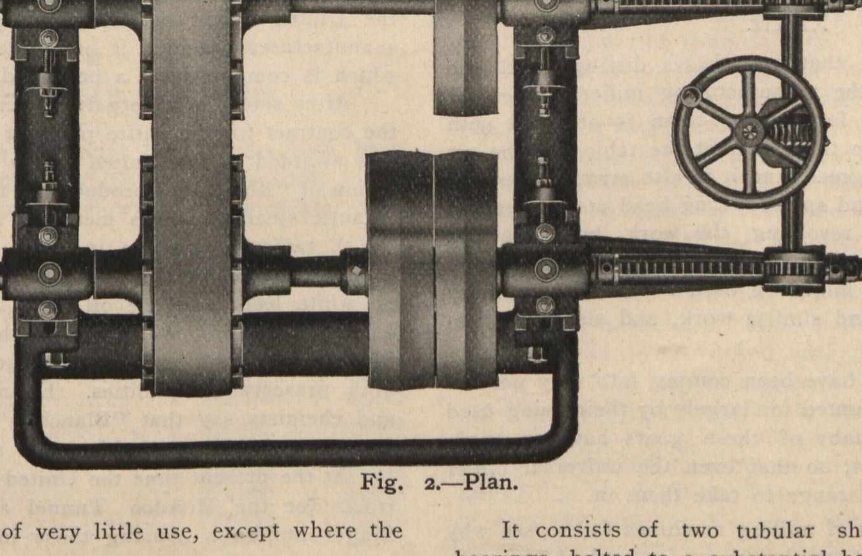


Fig. 2.—Plan.

the apparatus has been of very little use, except where the load is of the lightest.

The S. & S. Engineering Company, a branch of which company is located in Hamilton, Ont., have been able to overcome this difficulty, and are manufacturing a variable speed countershaft, which they are of opinion will be almost indispensable in the modern manufacturing plant. The price is so low that the smallest manufacturer can secure the device, and the manufacturers guarantee the apparatus to do exactly what is claimed for it.

The illustrations which we are enabled to reproduce through the courtesy of the company, together with a brief description, will suffice to give a clear idea of the mechanism.

It consists of two tubular shafts, supported in long bearings, bolted to a substantial base. Each of the shafts carries one expansion and one ordinary pulley, one of these shafts being driven from the main shaft, and the other intended for driving the machine or tool. The variation of speed is obtained by simultaneously altering the diameters of the two expansion pulleys. As the diameter of one expansion pulley increases, that of the other decreases.

The expansion of the pulleys is brought about in the following manner: It will be seen that the hub of the expanding pulley is large, and that the spokes pass through machined slots in it. The spokes have teeth cut on their edges for the greater part of their length inside the hub; these teeth gear with a broad pinion, which is revolved by the insertion or withdrawal of an inner shaft, with helical keyways cut in it. This can be moved backwards and forwards inside the pulley shaft, which is hollow. The two inner shafts for the two expanding pulleys are geared together, so that the motion of one bears the correct ratio to the motion of the other, and hence the diameters of the pulleys are always kept in correct ratio. All the spokes are moved in or out equally, and consequently pulleys of true polygonal form but changing diameter are made by any movement of these inner shafts.

A very short drive is employed between the two expansion pulleys. The reason of this is that the sag and elasticity of the belt is not depended upon for the grip, as the expansion pulleys are designed to contribute this elasticity themselves; hence, all the advantages of a long drive on short centres are secured, each size allowing a certain amount of give to the rim sections, proportionate to the amount of H.P. it is desired to transmit. This feature, together with the advantage of having air gaps between these said rim sections, provides for any irregularities, and ensures a steady tension of the transmission belt at every portion of the range.

Some of the chief advantages claimed by the manufacturers may be enumerated as follows: Substantiability, high efficiency, perfect adjustment, compactness and convenience, noiselessness at all speeds, no expensive special belts required, absolute freedom from outside frictional losses, the only class of face pulley making possible an effective short drive, most practical form of variable speed gear on the market capable of economically handling heavy loads.

All sizes have a working range of from 4 to 1, and the maximum H.P. is transmitted when the variable speed shaft is running at its highest speed.

The idea was originated by Bernard E. Scriven, of Hamilton, who, after obtaining patents in England, disposed of the British rights to an English firm, which has been manufacturing the gear for two years.

MACHINE SHOP NOTES FROM THE STATES.

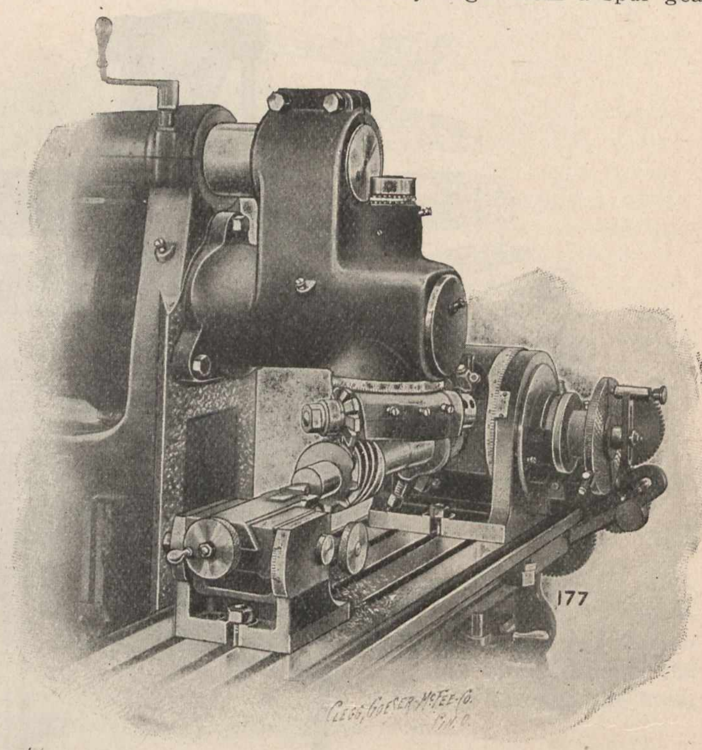
By Chas. S. Gingrich, M.E.

XXXII.

The special feature that has always distinguished the tool-room miller from the manufacturing miller is the fact that a universal miller for the tool-room is provided with a swiveling base for the table so that the table may be set at an angle up to 50 degrees, and it is also arranged so that the universal dividing and spiral-cutting head may be geared to the lead screw for revolving the work, both features having up to the present time been absolutely necessary in order that the machine might be used for making ordinary spiral milling cutters and similar work, and also for spiral and helical gear work.

Lately spiral gears have been coming into very general use, which may be accounted for largely by their being used on gas engines, and many of these gears have an angle greater than 50 degrees, so that even the universal miller does not have sufficient range to take them in.

A great many users of milling machines fail to see why a plain miller could not be rigged up for such work; and, indeed, there is no reason why this should not be done. The Cincinnati Milling Machine Co. have approached this problem from a broad point of view, and have altered the design of the tables on their plain millers. All plain machines they now send out are arranged so that a spiral head can be geared to the lead screw, the same as on universal millers. To provide for setting the cutter at the proper angle with the work, they supply a separate spiral milling attachment, which has a horizontal swiveling cutter spindle, which may be set to any angle from a spur gear



Plain Miller Arranged for Cutting Spirals.

to a rack. The combination of these two attachments on a plain machine is shown in the accompanying illustration. It will take in spiral gears up to about 70 degrees angle, and as large as the dividing head will swing on the several sizes of machines.

This is recognized as a distinct advancement, and greatly increases the usefulness of plain millers, adapting them to a very much wider range of work than heretofore.

A NEW PAINT INDUSTRY.

The announcement comes to hand that the Blanchite Process Paint Company, Limited, are about to commence operations in this country, having acquired the right to manufacture "Blanchite" products and paints in the Dominion.

"Blanchite" products have met with great success in the United States and England, and on this account the manufacturers deemed it advisable to enter the Dominion, which is comparatively a new field.

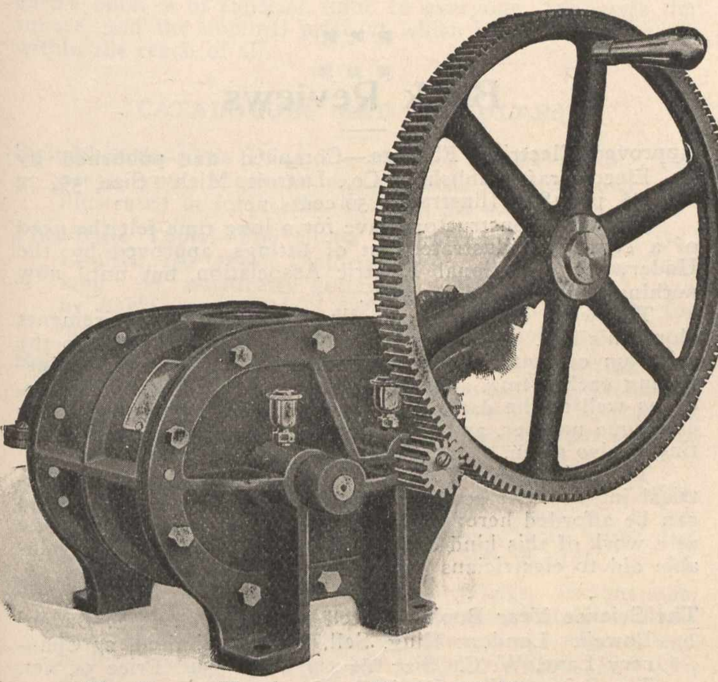
After a test of ninety-five other paints and preservatives the contract for the entire painting of the New York subway was awarded to the United States Company, and the application of "Blanchite" products on many of the largest trans-Atlantic steamships has met with marked success.

A radical departure in paint manufacturing has been brought about by this company. Their products contain no white lead, and the oil used is subjected to a special oxidizing process, which, when they are applied to wood, iron, steel, stone and concrete surfaces, gives them very high preservative qualities. Eminent consulting engineers and chemists say that "Blanchite" is very much better as a preservative than anything else now on the market.

At the present time the United States Company has contracts for the McAdoo Tunnel and the forty-two storey Singer building. Among those interested in the Canadian company are some of the best-known business men in Ottawa and Toronto. The works and office are at 785 King Street West, Toronto.

THE CONNERSVILLE BLACKSMITH BLOWER.

A line of small pressure blowers is the latest undertaking of the Connersville Blower Company, Connersville, Ind., and for this purpose they have built and equipped an entirely new shop. A hand power machine is shown in the illustration, but a machine that may be driven by power is also manufactured.



The No. 35 Hand-power Blacksmith Blower.

The three sizes at present built, Nos. 35, 40 and 50, have displacements of 173, 288 and 576 cubic inches per revolution, respectively. The standard machines are arranged for top discharge, but they can be made for bottom discharge if desired. The casing and revolving parts are of soft gray iron. The shafts are of steel, pressed into place and pinned. The gears are cut from solid stock, and are fitted and pinned to the shaft. The bearings are of bronze, drilled and grooved for oiling. The inlet and discharge openings are tapped for standard pipe connections. All parts are interchangeable, and repairs can be furnished promptly. The power required is proportional to the pressure and speed, and is based on ½ H.P. to discharge 100 cu. ft. of free air per minute against a pressure of 1 lb. per square inch.

The hand blower is built for bottom discharge, and has a large gear with a driving handle, and a pinion in place of a belt pulley. This construction has been adopted to meet a demand which appeared to exist for a blacksmith's blower that can be run by either hand or power, and ordinarily on the opposite end of the blower shaft a pulley is placed, so that belt drive can be used when desired. The arrangement is such that the hand-wheel can be thrown out of gear when it is desired to use power.

TORONTO RAILWAY EARNINGS.

The Toronto Railway's earnings for the year 1906 have passed the three million mark, which is a new record.

The earnings per month, showing the increase over the year 1905, follow:—

	Earnings.	Inc.
January	$236,129	$29,159
February	210,531	25,154
March	233,616	26,800
April	231,634	29,716
May	248,532	22,764
June	254,878	22,127
July	265,891	26,421
August	285,836	35,004
September	308,113	25,541
October	264,860	34,565
November	247,314	26,510
*December	244,750	22,140
	$3,031,687	$337,515

*Estimated.

ANNUAL DINNER: TORONTO ENGINEERS' CLUB.

The annual dinner given by the members of the Toronto Engineers' Club was held on January 3rd, at the club rooms, 96 King Street west, when about sixty of the engineers and their guests were present. The function was a most enjoyable one.

After the works of the caterer had been thoroughly enjoyed, President F. L. Somerville, acting as chairman, read several letters of regret from those who were unable to be present; notably one from Mayor Coatsworth, in which he stated that owing to the extra amount of business on hand after the recent election he was unable to accept the invitation of the engineers, and be with them.

In responding to the toast "Our Country," which was proposed by Mr. F. L. Somerville, Dr. Galbraith, of the School of Practical Science, said that he thought there was no one better fitted to respond to this toast than himself, since his family was Canadian for a number of generations back. It was the first time that Dr. Galbraith had been called upon to reply to this toast. He urged that the kind of emigration that should be encouraged in Canada was that of people who spoke the English and French languages, as those were in common with the present inhabitants of the country. Although, he said, railroad engineers require a great number of emigrants for construction work, those coming in at present are not the class of people to make up the population with.

Mr. T. H. White, chief engineer of the Canadian Northern Railway, said he had seen nearly every part of Canada, and the more he saw the prouder he was of it. In all his experience he had never seen anything he was ashamed of.

Mr. C. E. Goad made a brief reply to the toast to the "City of Toronto." He said he had been in Toronto for thirty-eight years, and in that time had seen the population grow from 40,000 up to what it is at present. He made special reference to the plans of the Guild of Civic Art, which, he believed, if they were carried out, would make Toronto undoubtedly one of the finest cities on the American Continent.

The toast to "Sister Societies" was responded to by Mr. Cecil B. Smith, representing the Canadian Society of Civil Engineers, Mr. Dillon-Mills, representing the Canadian Institute, and Mr. K. A. Mackenzie, President of the Engineering Society of the S. P. S.

Mr. Smith was of opinion that the prospects for engineers in Canada were the very brightest. He urged that they were not numerous enough to be able to stand separate organizations for the different branches, and hoped that the day was not far off when they would all become members of the Canadian Society, which would have sections for each branch of the engineering profession. Mr. Smith believed that the engineers of Canada have a great future before them, and only by their own efforts will they obtain the rewards which they really deserve.

Mr. Dillon-Mills referred incidentally to the President of the Canadian Institute, as the man who has charge of the "hail, rain and snow factory," saying that possibly the reason he was not present was that he might be afraid, owing to the kind of night he had ordered for the occasion, which was a very inclement one. He gave some interesting information in regard to the institute, referring especially to the yearly publication of its proceedings, which enabled them to secure in exchange publications from learned societies the world over. He suggested that the club, and engineers generally make more use of the library and publications, and also said that the Institute would be pleased to receive papers on scientific subjects from anyone, which papers would be published with the annual proceedings, and in this way receive a wide circulation.

Mr. Mackenzie referred to the organization which he represented as being the greatest Engineering Society in Canada, numerically, although viewed from a standpoint of knowledge, it was not. There are over six hundred members in the society. He spoke very forcibly regarding the over-taxing of the teaching staff of the school, which has to deliver from four to six times the number of lectures required from any of the other faculties of the University.

He asked for the support of the engineers in getting this matter remedied, intimating that an effort was to be made to get larger buildings, and to have the teaching staff increased.

The toast to the press was duly honored, and although a toast to the ladies was not on the programme, Mr. J. G. Sing thought that it was quite in order, and so proposed the same, Mr. C. M. Canniff replying.

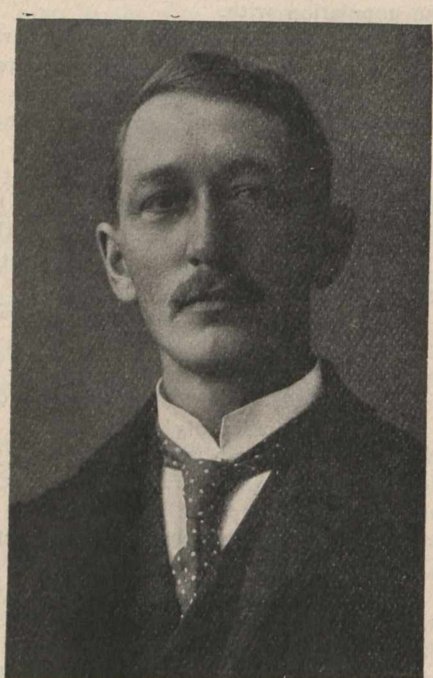
Judging from the success of this annual dinner, it is evident that railroads, power plants, bridges, etc. are not the only things which these men can "Engineer" with success.

* * * *

ANNUAL MEETING

On Thursday, January 10th the Engineers' Club, of Toronto, held their eighth annual meeting, about 60 members being present. Reports received from the various committees showed that the year's work had been most successful. The work of the paper committee was specially commented on, as the papers during the past year were exceptionally good.

Several important recommendations were made for the guidance of the incoming executive, one of these being that more commodious rooms be secured. Considerable discussion took place on the question of publishing a year book, giving the names, addresses, and other particulars regarding each member of the club. It was finally decided to leave this matter in the hands of the new executive, who were instructed to get particulars as to cost, etc., and report.



C. B. Smith, the New President.

President F. L. Somerville particularly urged the members to be careful in their selection of officers for the ensuing year, and judging from the result of the election it is evident that the present year will be amongst the most successful since the organization of the club.

The following is a list of the officers for 1907: President, C. B. Smith; First Vice-President, J. G. Sing; Second Vice-President, A. B. Barry; Secretary, Willis Chipman; Treasurer, John S. Fielding; Chairman of Rooms Committee, C. M. Caniff; Chairman of Library Committee, A. F. Macallum; Chairman of Papers Committee, R. G. Black; Auditors, W. E. Douglas and W. H. Patton.

Following the election of officers President Somerville made a short valedictory address in which he expressed his pleasure at being permitted to preside during the past year. He congratulated the club on its success, and also the engineering profession generally, which he said had an unusually busy year. Mr. Somerville referred to the growth of the shipbuilding industry, and he believed there was a great future before shipbuilders on the Great Lakes. He expressed his regret that the Ontario Government had seen fit to engage an American engineer for the Hydro-electric Commission, and stated that he was of opinion that a competent man could have been found in Canada for the position. Concluding, he thanked the club for the favor shown him while president. He also thanked the executive for the support he had received, and wished the new officers and executive every success.

Book Reviews

Approved Electrical Fittings.—Compiled and published by Electrocraft Publishing Co., Detroit, Mich. Size, 5¼ x 7¾, pp. 187. Illustrated, 50 cents net.

Electrical constructors have for a long time felt the need of a complete, illustrated list of fittings, approved by the Underwriter's National Electric Association, but until now nothing has been forthcoming.

The work before us complies with all the requirements along this line. It affords a ready and accurate guide to the selection of materials approved by the underwriters, illustrating each fitting, and giving the name of the manufacturer, as well as the date when each piece was approved. The catalogue number, and other information regarding each fitting is also given.

To go into the detail of what this compilation of electrical information contains would occupy more space than can be afforded here: suffice it to say that it is as complete as a work of this kind can be, and should prove a very valuable aid to electricians engaged in construction work.

* * * *

The Science Year Book.—Edited by Major B. F. S. Baden-Powell. London: King, Sell, Olding, Limited, 27 Chancery Lane, W. C. Size 6¼ x 9½, pp. 539. Price 5s. net.

The Science Year Book should not only be on the desk of every man of science; but should be found on the desk of every busy man, for as well as containing a complete record of progress in science in nearly every direction, and biographies of prominent scientists of the year just closed, it is composed chiefly of one of the best diaries that has come to our table.

In the very front of the volume will be found a page for each month in the year, with a calender printed thereon, the rest of the page being so arranged that engagements for morning, afternoon, or evening of each day may be entered, and a space is also left for the entry of letters that have to be attended to, or work done. These memos may be referred to by simply opening the cover of the book, as the pages are perforated, and when one month has been completed they may be torn out without difficulty. In this way the current month's engagements are always handy for reference.

The rest of the diary consists of a page for each day in the year, giving the astronomical conditions that will prevail, with special spaces for the entry of temperature, etc. It also includes pages for the keeping of private accounts.

For those who do not require the diary portion a special abridged edition has been gotten out, containing the scientific information included in the other part of the book. This summary occupies 150 pages, and covers astronomy, statistics of the world for 1906, physical and chemical notes, specific gravities and weights, metrology, weights and measures of every description, values of foreign moneys, a review of the year's science in all its branches, zoology and palæontology, natural history, botany, a glossary of recently introduced scientific terms and names, directory of scientific and technical periodicals, and a list of scientific and learned societies. Truly the review of the year, which is contained in these 150 pages is worthy of the highest commendation.

* * * *

The Steel Square Pocket Book.—By D. L. Stoddard. Second edition. New York: Industrial Publication Co., 16 Thomas Street. Size, 3½ x 5¼, pp. 159. Price, 50 cents net.

This little book, and it may well be called little since it can be carried in an ordinary coat pocket quite conveniently, deals comprehensively with the carpenter's steel square. The author is a practical carpenter, and has written his book in plain language, so that everyone who has occasion to use the square will be able to understand it thoroughly. The illustrations are also very graphic, and require almost no explanation whatever.

The size enables the workman to have it handy at all times, hence he can refer to it whenever necessary; for use in roof framing, stair work, hoppers, towers, bicycle tracks, arches, and in numerous other places where the square comes into use. Directions are included for describing hexagons, octagons, and other polygons, circles, ovals, ellipses, brace measurement, dividing a cone. etc. Also directions plainly written for solving many difficult problems with the steel square.

The originality and up-to-dateness of the work is marked, and a commendable point is that there are no reference letters on the cuts: the sketches showing just how the square should be laid on the work, so that the finding of reference letters, which is encountered in many technical books, is avoided.

This small volume contains nearly all the available data regarding the use of the steel square, and as a complete index, arranged in alphabetical order, is included, it is possible to secure the required information very quickly. Mr. Stoddard's book is of especial value to everyone who uses the square, and the nominal price at which it is sold, places it within the reach of all.

CATALOGUES AND CIRCULARS.

Switchboards.—The Dean Electric Co., Elyria, Ohio. Express type telephone switchboards are described and illustrated in folder No. 6. Size, 3½ x 6, pp. 20.

Pneumatic Tools.—The Globe Pneumatic Engineering Co., Limited, 150 Queen Victoria Street, London, E. C., England. An artistically gotten up catalogue, setting forth by half-tone, and lucid description pneumatic tools for nearly every class of work. Size, 8¼ x 10¼, pp. 44.

Rock Drills.—The Canadian Rand Drill Co., Montreal. A booklet published by this company shows the advantages to be derived from the use of their drill. Illustrations are given, showing the drill in use in various parts of the Dominion. Size, 5½ x 3¼, pp. 12.

Wires and Cables.—Canadian General Electric Company, Limited, Toronto. Supply catalogue, section No. 7, has just been issued. It deals exclusively with wires and cables for use in electrical work. Size, 8 x 10½, pp. 45.

Engines and Boilers.—Atlas Engine Works, Indianapolis, Ind. General bulletin No. 134 consists mainly of illustrations and specifications of the various engines and boilers manufactured by this company. Size, 7¾ x 10½, pp. 24.

Power Apparatus.—Western Electric Company, Chicago, Ill. The Hawthorne works of this company, situated in Chicago, are lucidly described, and beautifully illustrated in their booklet, entitled, "Hawthorne Works." Size, 10¾ x 7¾, pp. 24.

Milling Machines.—The Garvin Machine Co., Spring and Varick Streets., New York, N. Y. Circulars Nos. 53 and 54 describe and illustrate the Garvin vertical spindle milling machine, and motor driven milling machines. Size, 6¼ x 9, pp. 12.

Asbestos Shingles and Sheathing.—Wendell & MacDuffie, 26 Cortlandt Street, New York, N. Y. "Everlasting" is the title of a booklet just received from the above mentioned company. It sets forth reinforced asbestos corrugated sheathing, century shingles, building lumber, etc. The asbestos shingles are made to look like natural slate and ordinary tiles, and are claimed to be far more durable. Size, 4 x 8¾, pp. 22.

Gas Producers.—Wellman Seaver Morgan Co., Cleveland, Ohio. In Circular No. G P. 1 the best art of the catalogue designer has been brought into play, in setting forth the Hughes Continuous Gas Producer. This producer was fully described in the January issue of The Canadian Engineer. Size, 6 x 9, pp. 32.

Buyers' Reference.—The "steam" edition of the Buyers' Reference is to hand this month. This book is of special value to everyone who is interested in the use of steam in any way. Size, 8½ x 9½, pp. 70.

Geographic Dictionary of Alaska.—Being a complete list of places in Alaska, together with a brief description of same. By Marcus Baker. Published by the United States Geological Survey, Washington, D. C., 5¾" x 9", pp. 690.

* * * *

CALENDARS.

Calendars that will be found at once, both ornamental and useful, in the business office, have been received from the Becker-Brainard Milling Machine Company, machine tools, Hyde Park, Mass.; the Canadian Fairbanks Company, Montreal; F. H. Hopkinson and Company, railway contractors, Montreal; and the Hamilton Facing Mill Company, Limited, foundry outfitters, Hamilton, Ont.

Crane Company, Chicago, now have their new steel foundry in full running order. In this department steel valves and fittings will be a specialty, and the facilities are such that promptness in the filling of orders for these goods is assured. This addition to the company's varied activities is simply another proof of their efforts to keep abreast of the times.

ENGINEERING SOCIETIES.

Canadian Society of Civil Engineers.—President, H. D. Lumsden, Ottawa; treasurer, H. Irwin; secretary, C. H. McLeod, room 877, Dorchester Street, Montreal.

Canadian Mining Institute.—President, George R. Smith, Thetford Mines, Quebec; secretary, H. Mortimer-Lamb, Montreal, Que.; treasurer, J. Stevenson Brown, Montreal.

Engineers' Society: School of Practical Science.—President, T. R. Loudon, recording secretary, F. A. McGiverin; treasurer, B. W. Marrs; corresponding secretary, C. S. Shirriff.

Engineers' Club of Toronto.—President, C. B. Smith; treasurer, John S. Fielding; Secretary, Willis Chipman. Rooms: 96 King Street West, Toronto.

Canadian Railway Club.—President, S. King, Montreal; secretary, James Powell, Montreal; treasurer, S. S. Underwood, Montreal.

National Association of Marine Engineers of Canada.—Grand president, F. S. Henning, Toronto; grand secretary-treasurer, Neil J. Morrison, St. John, N. B.

Canadian Association of Stationary Engineers.—President, J. Ironsides, Hamilton; vice-president, E. Grandbois, Chatham; secretary, W. L. Outhwaite, Toronto; treasurer, A. M. Dixon, Toronto.

Toronto Branch American Institute of Electrical Engineers.—Chairman, R. G. Black; vice-chairman, K. L. Aitken.

Foundry Foremen's Association.—J. F. Gaffney, The Allis-Chalmers-Bullock, Limited, secretary and treasurer, Montreal; A. Chase, Sawyer & Massey Co., secretary and treasurer, Hamilton.

Association of Ontario Land Surveyors.—President, J. W. Tyrell, Hamilton; chairman of council, G. B. Kirkpatrick, Toronto; secretary-treasurer, Killaly Gamble, Toronto.

Canadian Electrical Association.—President, R. G. Black, Toronto; First Vice-President, R. S. Kelsch, Montreal; Second Vice-President, W. N. Ryerson, Niagara Falls, Ont.; Secretary-Treasurer, T. S. Young, Toronto.

Society of Chemical Industry.—Chairman, F. J. Smale; Secretary, Alf. Burton, 44 York Street, Toronto.

TARMAC FOR ROAD-MAKING

The county surveyor of Nottinghamshire has patented a material for road-making named "Tarmac" and which is controlled by a company called the Tarmac Limited, and, says P. B. MacNamara, Commercial Agent for Manchester, I examined the length of six miles made therefrom, on one of the main roads out of Nottingham, some portions of which were laid over four years, and as yet need no repairs. In motoring over it it seemed like an asphalt pavement, smooth, noiseless, and comparatively free from dust. I examined a mile of it on foot, and could not see any evidence of wear, although it is a very heavy traffic road, motor lorries and traction engines frequently passing over it. I saw "Tarmac" in course of laying and traffic was not interfered with. The first layer of 2¼-inch gauge, 2 inches deep is rolled and allowed to stand, before the top layer of 1½-inch gauge, 1½ inches deep is applied. The material is made from furnace slag and treated according to the patented plan. Two plants located near large iron works are now turning it out, and another is projected. I read the report of a Belgium engineer sent over specially to investigate it, and he commends it very highly. The cost of "Tarmac" at the works is 8s. 6d. per ton, and it is estimated that including freight charges for 100 miles from the works, the cost per square super. yard of road laid would be 3s. The road I examined cost 2s. 3d. per square yard, the distance from the works being 30 miles. Six men were employed and they can spread 50 tons per day. A steam roller can thoroughly consolidate 60 tons per day at a cost of 5d. per ton. I understand that the Tarmac Limited have had inquiries from Canada, with reference to establishing a plant to manufacture their material, but they are still open to negotiate. I may be permitted to say, that if it can be introduced into Canada for the making of main roads, an immense advantage to the public and those responsible for the construction and maintenance of the roads would result, and that it would prove an undoubted economy.

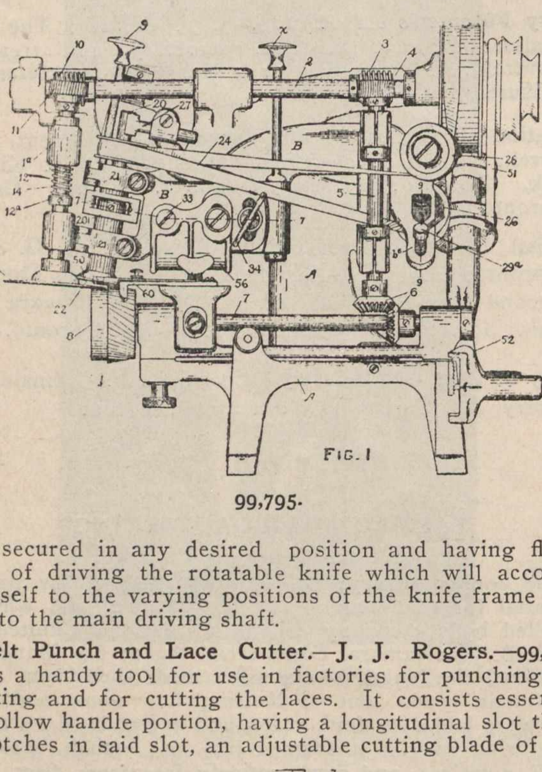
INTERNATIONAL PATENT RECORD

Dominion Houses of Parliament.

CANADIAN PATENTS.

Specially compiled by Messrs. Fetherstonhaugh, Dennison and Blackmore Patent Attorneys Star Bldg., 18 King St. W., Toronto; Montreal and Ottawa.

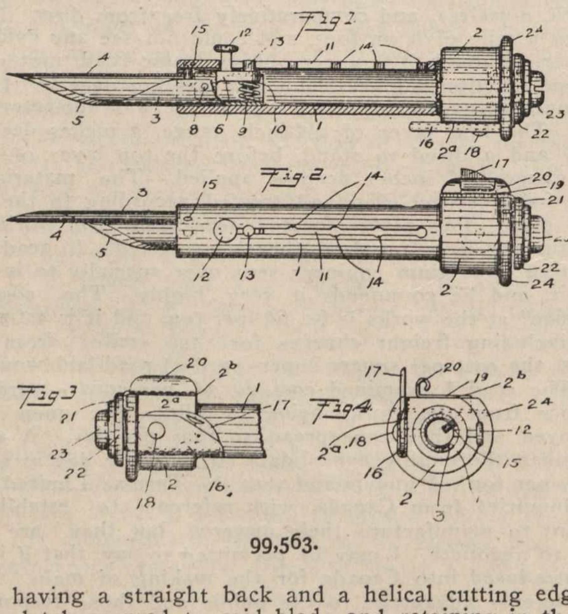
Skiving Machine.—The United Shoe Machinery Co. of Canada.—99,795.—An improved skiving machine for use in the manufacture of boots and shoes. It consists in arranging an adjustable knife frame on the machine frame adapted



99,795.

to be secured in any desired position and having flexible means of driving the rotatable knife which will accommodate itself to the varying positions of the knife frame in relation to the main driving shaft.

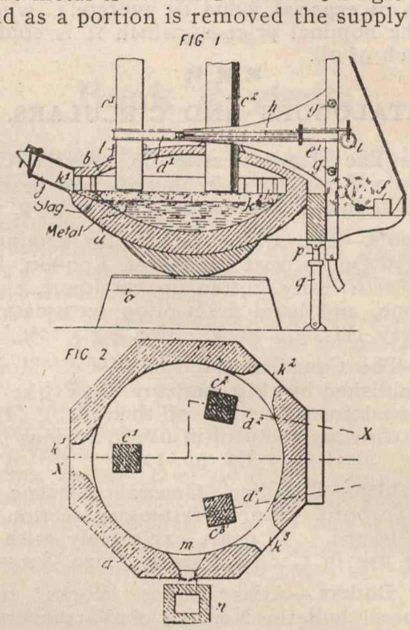
Belt Punch and Lace Cutter.—J. J. Rogers.—99,563.—This is a handy tool for use in factories for punching holes in belting and for cutting the laces. It consists essentially of a hollow handle portion, having a longitudinal slot therein and notches in said slot, an adjustable cutting blade of spiral



99,563.

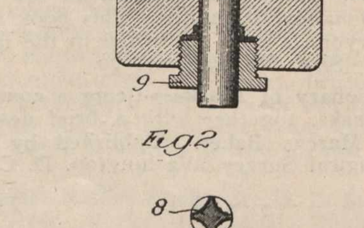
form, having a straight back and a helical cutting edge, a spring latch secured to said blade and retaining in the adjusted positions, and a lace cutting blade secured in the head portion of the handle.

Steel-Mixing Process.—La. Societe Electro-Metallurgique.—99,756.—This invention relates to a process of mixing steel. It consists in introducing the products of a number of converters into a single receptacle in a molten state and retaining the said products in a molten state by an electric current. The metal is removed from the single receptacle in portions, and as a portion is removed the supply is replenished successively thereby, securing a uniformity in the product from a number of converters. The process of mixing is carried on in a non-oxodizing atmosphere, whereby desulphuration and conservation of the oxodizable additions are favored.



99,756.

Valve.—John Bertram & Sons.—99,625.—A valve which in closing allows a free vent during the action of closing, shutting off the fluid in passage suddenly and without apparent decrease of flow during the closing motion. The valve is made with an inlet and an exhaust passage and a wall is interposed between said passages. A cylindrical opening is arranged through the wall having a cylindrical valve seat at the top. The valve spindle extends through the opening and has a cylindrical valve to fit the said valve seat. The shank of the spindle is provided with a longitudinal recess for the liquid to flow freely while the spindle is moving down to close the valve and a supplementary valve or washer is arranged above said valve to further close the valve opening.

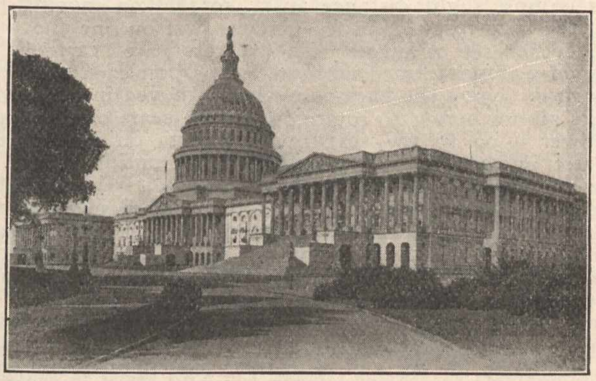


99,625.

* * * *

It is reported from Quebec that the G. T. R. Company will erect a large hotel in that city.

Two carloads of silver ore containing, it is said, an aggregate value of $200,000, is now standing on the siding at the Copper Cliff smelter. This is from the O'Brien mine, which under its agreement must pay the Government a royalty of 25 per cent. of the output. The Ontario Lands, Forests and Mines Department has no confirmation of the reported immense values realized from these ores, but they understand that they are very rich.



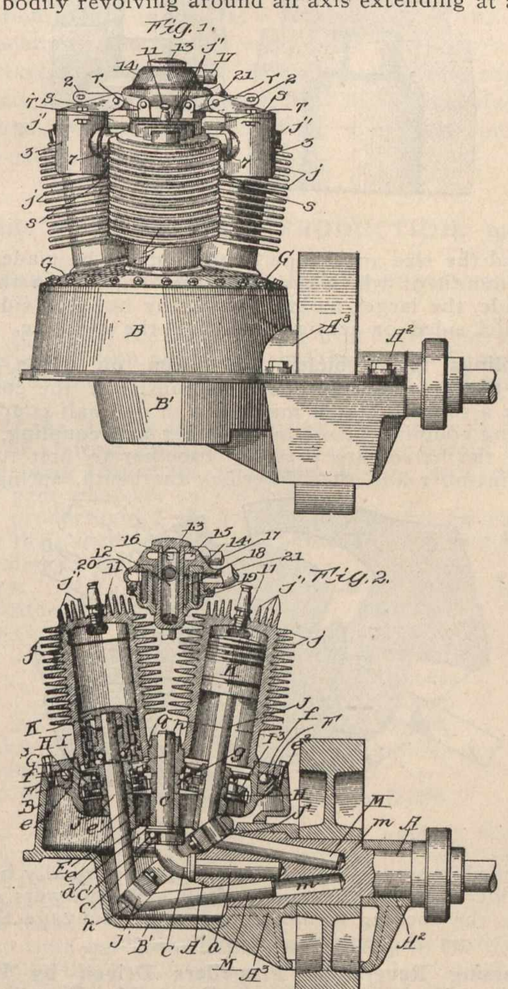
Capitol, Washington, U. S. A.

UNITED STATES PATENTS.

Specially selected and abridged by Messrs. Siggers and Siggers, Patent Attorneys, 918 F. Street, N. W., Washington, D.C., U.S.A.

Rotary Gas-Engine.—John O. Krohn, Barberton, O.—839,300, 1906.—The object of this invention is to provide a gas-engine in which the cylinders revolve around an axis arranged at an angle to the axis of the drive-shaft actuated thereby and are kept comparatively cool by the circulation of air caused by their rapid rotation.

It consists of a driven shaft, a series of cylinders arranged and bodily revolving around an axis extending at an angle

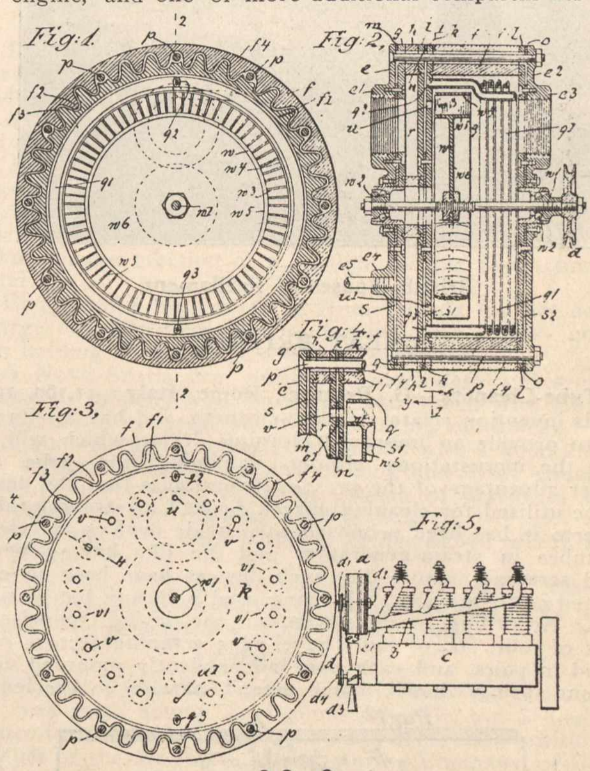


839,300.

to that of said shaft, a ring or annulus placed between and inclined at an angle midway that of said axes, pistons reciprocating in said cylinders the outer ends of which are suitably connected to said annulus, and plungers operatively connected with said annulus reciprocate longitudinally in said shaft.

Combination Turbine and Muffler.—George E. Fulton, Jersey City, N. J.—838,018, 1906.—This invention relates to pressure-fluid engines, and particularly to an improvement in mufflers, which form a part thereof and which are applied to the exhaust-pipe of such pressure-fluid engines; and the object of the invention is to utilise a certain percentage of heat units contained in the exhaust-gases for motive purposes, a further object being to provide in combination herewith an efficient muffler for the exhaust-gases of a pressure-fluid engine to which this invention is applied.

It comprises a combination turbine-motor and muffler having a casing provided with a series of compartments, one compartment of which serves in conjunction with a coil of tubes as a steam-generating boiler supplied with water and heated by the entering exhaust fluid of an attached pressure-fluid engine, and one or more additional compartments for

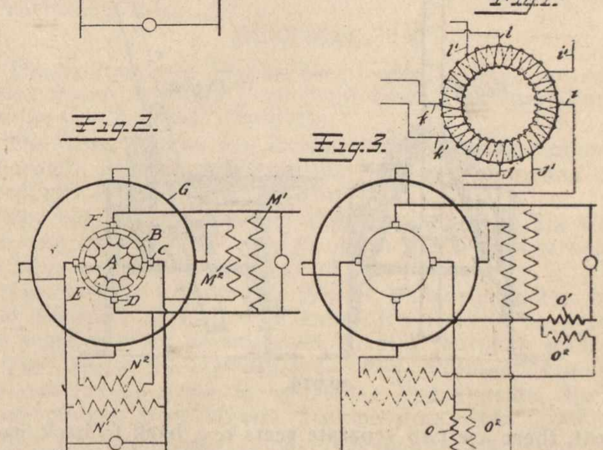


838,018.

the reception of said entering exhaust fluid for the purpose of reducing its pressure and also to impart some of its heat to the walls of its adjoining compartments, a turbine-motor having a shaft and power-transmitting device and mounted within the apparatus and receiving the direct impact of the exhaust fluid and the direct impact of the steam generated within the apparatus.

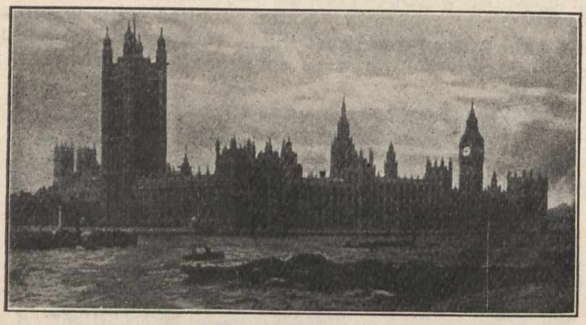
Dynamo-Electric Machine.—William Stanley, Great Barrington, Mass.—838,144, 1906.—This invention relates to dynamo-electric machines, and has for its object to provide a self-exciting dynamo-electric machine in which the field-producing windings are energized by alternating currents supplied from the machine itself.

It consists of the combination of rotor and stator windings connected together, with transformers for inducing alternating magnetising-currents within such windings



838,144.

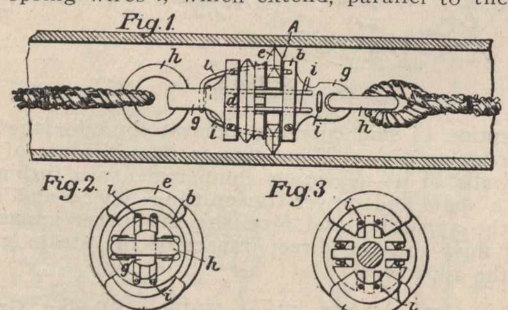
whereby a rotating magnetic field is produced, which with rotation induces opposing electromotive forces of the same phase and similar frequency upon said connected windings.



British Houses of Parliament.

GREAT BRITAIN.

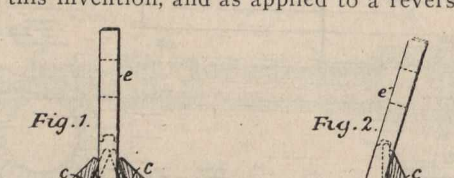
Tube-Cleaners.—G. Restucci, Rome, Italy.—11,160, 1906.—This invention relates to tube-cleaners, and has for its object to provide an improved cleaning device which will remove the incrustations without damaging the tube. A further advantage of the present invention is that the device can be utilised for cleaning curved as well as straight tubes. Hitherto it has been proposed to provide devices for cleaning tubes in steam-generators and the like having bevel-edged scraping sectors, but such devices have been so constructed as to prevent their being used with any but straight tubes. According to this invention, the device comprises a series of four, six, or more bevel-edge scraping sectors *e* arranged in pairs, and each pair independently mounted upon resilient spring wires *i*, which extend, parallel to the length



11,160.

of the device, to the end members *b, d*, of which they are fastened. The sectors are supported and guided entirely by the spring wires above referred to, and each independent sector yields when it meets some resistance greater than that formed by the incrustations in the tube. The device has both its ends provided with discs *b, d*, which have extensions in the direction of its longitudinal axis, and eyelets *g* and rings *h* to receive the ends of the ropes or wires by which the cleaner is pulled in either direction through the tubes whose inner wall it is desired to clean. The sectors are diametrically opposed to each other, and being mounted in the resilient manner described, will yield when they encounter a bend in the tube, or any obstacle which should not be removed.

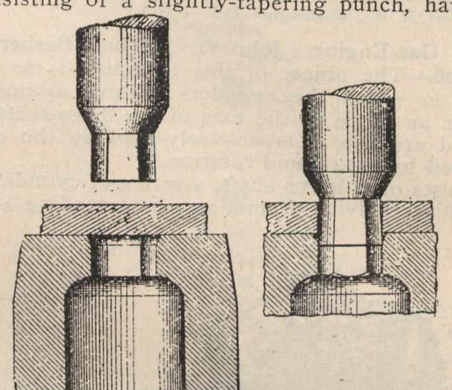
Tram-Car Seats.—T. T. Mercer, Blackburn.—20,019, 1905.—This invention has for its object so to construct outdoor seats that in wet weather a dry seat may be obtained. According to this invention, and as applied to a reversible tram-



20,019.

car seat, there are two separate seats *c, c*, back to back, each free to tilt or rock on pivots in the seat-frame *a*, and to turn up against a back-rest *e* common to both, or to turn down and rest on the seat-frame. The back-rest, instead of being pivoted at its lower end, is pivoted at each side, and at points slightly below the level of the seats. At its lower end it is weighted, and normally assumes a vertical position. There are two pivots *g* for each side, and the pivots take their support in fixed and slotted plates *h* on the seat-frame, the pivots lying a slight distance apart, so that on moving the top of the back-rest to and fro it rocks first on one and then on the other set of pivots. The pivots are carried by V-shaped plates *f* formed with teeth *i*. Upon each seat is a quadrant *d*. Upon the back-rest *e* being moved in one direction, its motion serves to rotate one of the seats on its pivots and lower it on to the seat-frame, whilst on moving the back-rest in the opposite direction its motion serves to rotate and lower the other seat. As one seat is lowered the other remains elevated, the quadrant of the raised seat for the time being coming out of gear with the teeth in the plate. Upon letting go the back-rest, or the user rising, the balance of the back-rest serves to swing it back to the vertical, and thus cause it to raise automatically and return the seat to its former position. To protect the seats from rain when raised, the back-rest is recessed or formed with an opening, and when turned up the seats lie with their top edges within such recess or opening, any water running off the back-rest falling on to the rear faces of the seats.

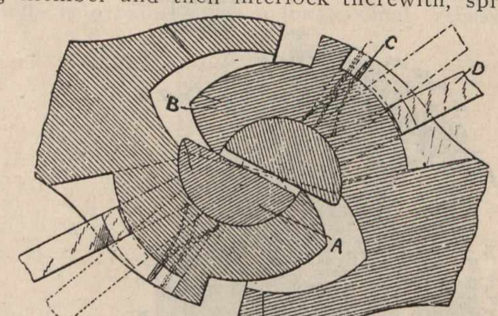
Tools to be Used in the Manufacture of Screw Nuts.—Mucklow.—21,201.—The improvements consist in the manufacture of nut blanks from cold steel by the use of a pair of tools, consisting of a slightly-tapering punch, having at its



21,201.

acting end the size and shape of the nuts to be made, and a die, the mouth of which is somewhat larger than the nuts to be made, the larger mouth passing by bevelled sides into the parallel sided or acting portion of the die hole.

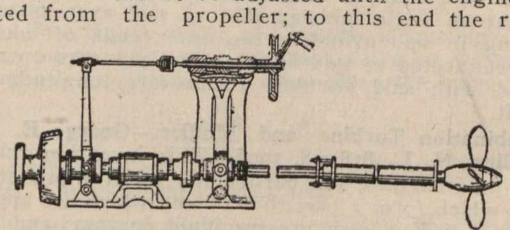
Couplings for Vehicles that Run on Rails.—Wade (Roth).—16,245.—The improvements consist in the combination with a rocking clutch member *a* in one half coupling of an entering coupling face *b* in the other half coupling, adapted when the halves are pressed together to first turn the rocking member and then interlock therewith, spring *c* be-



16,245.

ing provided in a recess in the coupling to normally hold the rocking member in operative position, whilst levers *d*, connected to the rocking members, serve to disengage the said members from the entering coupling faces.

Reversing Reversible Propellers Driven by Internal Combustion Engines.—"Gaines" Reversible Propeller Co. and Rankin.—23,638.—According to the present arrangement a reversible propeller is so connected to the engine that the propeller blades cannot be adjusted until the engine is disconnected from the propeller; to this end the reversing



23,638.

mechanism consists of a worm gearing and a hand wheel provided with a pivoted operating handle on the worm shaft, suitable means being used to connect the operating handle with the clutch.

THE DOMINION WOOD PIPE COMPANY.

The Dominion Wood Pipe Co. now have what they claim to be the best-equipped and the largest factory in Canada for the manufacture of wire-wound and continuous wood stave pipe of a very superior description. The company has secured an extensive site in New Westminster, B.C., adjacent to tide water, and alongside the British Columbia Electric, the C.P.R. and the Great Northern Railways, so that excellent shipping facilities are possessed. Dry kilns of the most modern type are being erected to admit of green lumber being purchased in the open market, and thoroughly dried to suit the company's purpose, thus meeting a want that has been severely felt of late by manufacturers of wood pipe. A special feature of this company's manufacture will be the wrapping of the pipe simultaneously with two independent wires by a patent process instead of the use of one wire only, as has been the method hitherto in use. It is claimed that as the result of the adoption of this patent process the factor of safety in the event of one wire being damaged and not detected is simply reduced from 5.0 to 2.5, and that this method of winding increases the strength of the pipe at each end by 50 per cent. Another valuable feature is the adoption of a special header, which makes a perfect joint, and if the pipe is properly laid leaks are rendered almost impossible. To give the pipe a perfect coating it will be heated to such a degree that the composition, which is kept at a temperature of 350° to 370° Fah., penetrates and reaches every point of the outer surface of the stave and wire. The company, therefore, expects to inaugurate a very great improvement in the manufacture of wire-wound wooden pipe, for which a steadily increasing demand exists.

THE WORLD'S IRON PRODUCTION, 1906.

Canada's Increase the Greatest by 61 per cent.

The reports of the output of pig-iron for the current year by the principal iron producing countries are sufficient to enable a close estimate to be made of the world's production in 1906.

Six of the leading iron-producing countries will show an increase of at least 5,500,000 tons over their output in 1905. The remaining countries, including Russia, will probably show no gain whatever as a whole.

The production of the leading iron-producing countries for 1906, their increase, and the percent of the increase can be estimated as follows (in tons):

Country.	Production.	Increase.	Inc. P.C.
United States	25,500,000	2,908,000	11
Germany	12,400,000	1,420,000	13
England	10,400,000	807,000	8.5
France	3,227,000	150,000	5
Belgium	1,340,000	30,000	2
Canada	628,000	160,000	34
Total	53,635,000	5,475,000	11
Other countries	5,340,000	....	..
Total for world	59,975,000	5,475,000	10

From the above showing it is very evident that with continued prosperity the world's production will pass the 60,000,000 ton mark in 1907 by several million tons; in fact the production the last half of 1906 is considerably above 30,000,000 tons.

At no time has there been such activity in the direction of increasing the production of iron. In the United States furnaces having a capacity of at least 8,000,000 tons per year and in course of construction. Germany expects to increase by about 1,500,000 tons in 1907 from new furnaces, and England as well as several other countries are preparing to make moderate gains in their output of iron in the near future.

The world's production of iron is increasing at a remarkable pace, as the gain for 1905 and 1906 has been 13,500,000 tons. Since 1900 the increase has been 10,008,000 tons, to 59,000,000, a change the more remarkable since there was no material gain in either 1901 or 1904.

The increase in the world's output of iron at periods five years apart, has been as follows:

Year.	Production.	Increase.	Inc. P.C.
1906	59,000,000	18,600,000	46
1900	40,000,000	11,400,000	40
1895	29,000,000	2,000,000	7
1890	27,000,000	8,000,000	42
1885	19,000,000	1,000,000	5
1880	18,000,000	4,300,000	31
1875	13,700,000	1,700,000	14
1870	12,000,000	....	..

INDUSTRIAL NOTES

TRADE ENQUIRIES.

The following enquiries relating to Canadian trade received at the Canadian Government Office, 17 Victoria Street, London, S. W.:—

A Scandinavian firm interested in a new process for treating bog peat for the production of sulphate of ammonia and alcohol is desirous of bringing the method under the notice of interested parties in the Dominion.

A correspondent with experience of the trade is desirous of being placed in communication with parties in Canada interested in the erection of a smelter for the production of spelter.

Enquiry has been received from Canada for the names of large manufacturers of wire fencing and rubber goods. Firm holding Government contracts preferred.

A Nova Scotia firm dealing in machinery and supplies for various industries wishes to get into touch with English manufacturers of metal and wood-working machinery.

A manufacturers' agent at Montreal, with a good knowledge of machinery for railway, mining and other concerns, is seeking the representation in Canada of first-class English firms who are requiring such service.

From the City Trade Branch, 73 Basinghall Street, London, E.C.:—

A London firm is open to appoint Canadian resident agent possessing a connection in the engineering trade to introduce their asbestos and India rubber goods.

TORONTO.

Thomas R. Loudon, B.Sc., son of Prof. W. J. Loudon, who has been acting as demonstrator in the School of Science for the past three months, has accepted a position as manager of the McVicker Manufacturing Company, of Galt.

It has been reported in mining and financial circles here that the $40,000,000 offer for the mineralized portion of the Gillies limits reserved hitherto by the Ontario Government for development as a state property, comes from the Guggenheim firm in New York.

The Canadian Rand Drill Company have moved their office into the Traders Bank Building, rooms 1,104 and 1,105, telephone number Main 6278. They are fully equipped to quote promptly on all their products, or to supply any information required regarding them.

Considerable improvement is to be made this coming spring in the Grand Trunk station at Parkdale. It is understood that new freight sheds will be built, and the facilities generally will be improved. This has been brought about by the increased volume of traffic, due to the rapid growth of the west end of the city.

Dr. William Pakenham, principal of the Technical High School, has been appointed by the Board of Governors of Toronto University as Dean of the new faculty of education, and Professor of the chair in the Science and History of Education. Dr. Pakenham will assume the duties of his new office as soon as his successor in his present position is appointed.

At a meeting of the Toronto Branch of the American Institute of Electrical Engineers, held on January 11th, in the rooms, 96 King St. W., Mr. A. B. Lambe gave an abstract of a paper by Mr. Alex. Dow on direct current distribution, read before the Electrical Congress at St. Louis. Mr. K. L. Aitken read a paper given by Mr. Barnes, before the National Electric Light Association, describing the 250-500 volt system, as used by the Narragansett Power Company, of Providence, R.I.

GENERAL.

The Collingwood Shipbuilding Company have ordered a Duplex Steam Auxiliary Feed Pump from The Smart-Turner Machine Co., Limited, Hamilton.

The Gutta Percha and Rubber Manufacturing Company, of Toronto, Limited, announce that they are in no way connected with any rubber merger or trust.

The contract for the necessary telephone and fire alarm wires and cables for Edmonton, Alta., has been awarded to The Wire and Cable Company of Montreal.

The Baldwin Locomotive Works, Philadelphia, Pa., have found the Allen Compression Lever Rivetters to be a complete success, often having given them a thorough trial.

The Smart-Turner Machine Co., Limited, Hamilton, have received an order for a Duplex End Outside Packed Plunger Pump, from Messrs. Jenkins Bros., New York.

The Canada Steel Goods Company, Hamilton, have placed an order for a Duplex Boiler Feed Pump, with The Smart-Turner Machine Company, Limited, of the same place.

At a meeting of the Canadian Society of Civil Engineers, Electrical Section, on January 7th, Mr. C. H. Darrall read a paper on "The General Adaptation of Electric Motors for Manufacturing Plants."

The United States Steel Corporation has purchased a large tract of land at Sandwich, and will erect early in the summer a big iron plant employing 5,000 men. Large ore docks and coal storage are included in the plans.

The Government has reopened negotiations with the Commonwealth Government of Australia for a mutual tariff preference between the two countries and with New Zealand for an enlargement of the scope of the preferential arrangement now in force.

It is announced that American capitalists have secured large interests in this district, and that in the near future mining operations on a very big scale are to be started, while big smelters for rendering the ore into pig iron are to be erected at Port Arthur.

The Canada Screw Company and the Ontario Tack Company, both of Hamilton, have amalgamated. This should make one of the strongest concerns of the kind in Canada, as the total capital of the new company will be about three-quarters of a million dollars.

It is now definitely understood that the United States Steel Corporation will begin the erection of a large steel plant at Sandwich during the coming summer. The property purchased contains over 1,000 acres. Ore docks and coal storage facilities will be built.

William Jack, of Nanaimo, B. C., and Mr. Eastham, of Tacoma, have organized the Independent North Wellington Colliery Company for the purpose of exploiting over 300 acres of six-foot seam of coal underlying the Jack property at Nanoose Bay, near Nanaimo.

The merger of the Greene Consolidated Copper Company with the Canada Central Coal Company has been approved by the directors of the Greene Company. Sufficient stock in both companies has been pledged for exchange to insure the new company control of both.

There is no trace left of the disastrous fire which recently visited the plant of Messrs. Frost & Wood, Smith's Falls, Ont., and did such extensive damage. The rebuilding has been pushed ahead so rapidly that only a short interruption resulted in the large business done by this firm.

A company has been formed in Quebec City for the manufacture of a new cement that will take the place of stone for building purposes. The company is composed mainly of Quebec gentlemen, who have subscribed a capital of $600,000 to erect suitable works and carry on the manufacturing process.

The publication offices of "The Illuminating Engineer" have been removed from 25 Broad Street, to larger and more centrally located quarters, at 12 West 40th Street, New York. "The Illuminating Engineer" is published monthly, and is devoted exclusively to the science and art of illumination. The price is $1 per year.

Among American stockholders of the C. P. R. it is being stated that one reason why the company's stock has been so active of late is that there is shortly to be a huge increase in its traffic returns, due to the development of the great discoveries of iron ore in the district adjoining Thunder Bay, on the north of Lake Superior.

A company has been formed in Brockville with John C. Yarwood as manager, which will go into the manufacture of cement brick, cement blocks, tile and concrete work of various kinds. Cement building material is being used extensively in Brockville, and is much in favor. The newly formed company has plenty of work ahead of it.

In October, 1905, the Canadian Pacific Railway Company handled 72,000 tons of merchandise across the Fort William docks; in October, 1906, there was 133,000 tons handled. In November, 1905, there was 80,246 tons of merchandise put across the C. P. R. docks; in November, 1906, there was 129,301 tons handled in the same time.

A bill has been prepared by the Minister of Justice, with the object of ensuring to Canadians the use of electrical energy and natural gas, developed near the border line. It says that any company must receive a license from the Federal Government to export to the United States either electricity developed from natural sources, or natural gas.

Two million dollars will be spent within a year on Graham Island, one of the Queen Charlotte group, in a gigantic lumbering enterprise. This will be one of the subsidiary companies to the Graham Steamship Coal and Lumber Company that was incorporated in Los Angeles with a capital of $5,000,000 divided into 500,000 shares of $10 each.

It is understood that the Nova Scotia Steel and Coal Company earned over 9 per cent. on the common stock during 1906. This will give a surplus of about $500,000, which can be used for improvements to the plant, while out of this year's earnings dividends at the rate of 6 per cent. per annum will probably be paid on the common stock, payable 1½ per cent. quarterly.

The Panama Canal construction has brought one good contract to a Canadian industry, for the Robb-Mumford Boiler Company, which is the American end of the Robb Engineering Company, of Amherst, has just received an order for 24 three hundred H. P. boilers. This contract was secured in the face of keen competition from works in various parts of the United States.

The DuBois Iron Works, DuBois, Pa., a $1,000,000 corporation have taken over the entire business of the Lazier Engine Manufacturing Co., Buffalo, N.Y. Numerous improvements will be made in the engines manufactured. Mr. Peter Eyermann will have charge of the engineering department. The works will be located at DuBois, Pa., and a branch office retained at Buffalo, N. Y.

The Dominion Iron and Steel Company have taken options on the coal areas of the Atlantic Coal Company and the Routledge Syndicate, located at Lingan Bay, and South Bar, respectively. The areas will be thoroughly prospected and if good coal is found they will be taken over and collieries sunk from which the steel company will secure their own coal, thus making them independent of the Dominion Coal Company.

As a result of the recent troubles between the Steel and Coal Companies, the Dominion Iron and Steel Company is now making a claim against the Dominion Coal Company which, if the courts allow, will oblige Mr. James Ross to present the Steel people with about all the capital of his company. The claim made by the Steel Company exceeds $15,000,000, and covers everything that the company could have lost by the recent friction.

The richest strike in the Tilbury oil fields, Tilbury, Ont., was made on J. A. Tremblay's farm in Romney township recently. Ditches full of oil for miles around the derricks tell the story plainly. Oil gushed in great force from the well before the workmen started operations, and before they could plug the casing at least 1,000 barrels flowed over on the frozen ground and ran in rivulets into the large ditches for which Romney is famous.

Several farming machinery companies have declared their intention to fight prices and methods of the alleged iron and steel combine of the United States. A petition appealing to President Roosevelt and Congress to aid them in their efforts was drafted, calling on the Government to curb the power of the "trust," and to make some new tariff provision which will break up the injurious combine. It has been signed by prominent implement manufacturers throughout the country.

The Héroult process electric smelting plant, which is being erected in California has been credited as the work of the Northern California Electric Company. This is not correct, as we are informed by Mr. R. Turnbull, general agent of the Héroult Electric Smelting Process for Canada, that this company is only supplying the power for the plant. They are in no way connected with the enterprise, the credit being entirely due to Mr. H. H. Noble, of San Francisco, California.

A deal was concluded recently of a good deal of importance in local lumber circles. The Porto Rico Lumber Company has been absorbed by the Beaver Lumber Company of Winnipeg, and the consideration is said to have been in the neighborhood of a quarter million dollars. The purchasing company has been absorbing several mill properties during the last month or so, including the Prairie Lumber Company, the Gibson Lumber Company, and the Regina Lumber and Supply Company.

In an article in the "Financier and Bullionist," of London, England, R. J. Barett, says: "That no more completely or modernly equipped engineering works than those of the Canada Foundry Company, Limited, are to be found on the American continent or in Europe; that these works show that Canadian enterprise and technical skill will enable the Dominion to hold its own in mechanical engineering in competition with either Europe or the United States; that, considering that they have only been in existence four years, these works rank as one of the industrial wonders of the West."

TELEGRAPH AND TELEPHONE

The Board of Railway Commissioners has made a new order with respect to the tariffs of telephone companies. All such companies are required to keep their tariffs on file for public inspection during business hours.

Calgary merchants have been annoyed for some time at the service put up by the Bell Telephone Company, and have, therefore, petitioned the city council to go ahead with the Independent phone installations, promising their support.

Although the citizens of Fort William pay only $2 a month for business telephones and $12 a year for residence, the city during 1906 realized a profit on its municipal telephone plant of $3,300, after providing for a sinking fund and interest, and ten per cent. of the gross receipts for depreciation in value of plant. The profits of the electric light department amounted to about $1,000, the gross receipts being $34,000.

About 7,000 Independent telephone companies are being absorbed by the National Independent Telephone Association, and it is stated that this combine will give the Bell Companies a very bitter fight.

Arrangements for the construction of the first long link for the Alberta Government telephone system have been practically completed. The Public Works Department will be ready when the weather permits to go ahead with the construction of the line from Edmonton to Lloydminster.

MARINE NEWS

The Allan Line carried 77,942 passengers to Canada in 1906, against 70,045 in 1905.

The naval dockyard at Halifax passed into the hands of the Canadian Government on New Year's Day.

The boundary line of Lake Erie has been definitely fixed by the International Deep Waterways Commission, and has been placed on modern chart plans.

It is stated that Lloyds, underwriters, are much interested in the method of refloating stranded vessels, as exemplified by the case of the Bavarian.

It is announced that the Northern Navigation Co., of Sarnia, which owned the steamer "Monarch," recently lost on Isle Royale, will build a duplicate of the steamer "Huronic."

Never in the history of Port Arthur has there been so many vessels wintering in the harbor. It is estimated that there will be over a million dollars represented in vessels there this winter.

The annual report of Harbormaster Postlethwaite shows the total tonnage arriving for the year 1906 was 1,524,827, or 118,968 more than in 1905, when the figures were 1,405,859. The vessels arrived numbered 3,406, or 74 more than in 1905.

The three members of the new Board of Harbor Commissioners for Montreal are G. W. Stephens, C. C. Ballantyne, and L. E. Geoffrion. Mr. Stephens' salary as chairman will be $7,000, and that of his colleagues $5,000 each.

The "Rapids King," a new passenger steamer being built by the Canadian Shipbuilding Company for the Richelieu and Ontario Navigation Company, was launched at the shipyards on January 9th. The new boat is 240 feet long.

H. F. Bullen, of the British Columbia Marine Railway and British Columbia Salvage Company, of Esquimalt, is now in England, where he proposes to purchase further machinery for the improvement of the company's shipyards at Esquimalt.

Early in the coming year the Alaska Steamship Company will build a new wharf on the north side of James Bay. Over a year ago the company acquired this water frontage, and plans had then been prepared for the construction of the wharf. Owing to a depression in the shipping industry the enterprise was held in abeyance; but in view of recent developments it is now considered necessary.

The net earnings of the Niagara Navigation Company for the year ending November 30, 1906, were $123,724. Very little change has been made in the Executive for the coming year, the directorate now being E. B. Osler, M.P., president; Barlow Cumberland, vice-president; J. J. Foy, K.C., Charles Cockshutt, J. Bruce McDonald, W. D. Matthews; B. W. Folger, manager; J. M. Sullivan, secretary.

It is stated that the Canadian Pacific Railway Company's steamship service on the Pacific will be improved next spring. The current report in C.P.R. circles in Montreal is that the company will build two larger and faster vessels for the Atlantic service, and that the "Empress of Ireland" and "Empress of Britain," or vessels similar to them in build and speed, will be brought to the Pacific.

A sternwheel steamer to replace the lost steamer "Pheasant," sunk in the Skeena River this summer, will be built at Victoria. The work will be commenced at once on a new vessel which it is expected to have ready for the coming season's work on the northern river. Alex. Watson, the well-known builder of sternwheeler crafts, will design the vessel and have charge of the construction. The cost is expected to total $30,000. She will be larger than the Hudson's Bay Company's steamer, "Mount Royal."

It is announced that the Federal Government have under consideration a large expenditure of public money to improve the Lower St. Lawrence and safeguard the interests of shipping in the future. This work will be carried on through the intermediary of the Marine and Fisheries Department, presided over by Hon. L. P. Brodeur, and it is said the work to be done will be most thorough to meet the new conditions of navigation, and enable the large steamships of the future to reach Quebec without the least excuse for accident.

The "City of Cleveland" was launched at Detroit on January 5th. She is a side-wheel steamer, 440 ft. long, 96 ft. 6 in. wide, and 22 ft. deep, and will have a carrying capacity of 5,000 passengers.

The Allan Line have two steamers on the stocks for their Canadian trade, both of which are of over 10,000 tons. One of these, the "Corsican," is to replace the "Bavarian." The new vessels should have been ready for service at the beginning of next season, but the recent shipbuilding strike will throw their completion to a later date.

Germany has decided to eclipse the world in a new cruiser, already projected for 1907. One of the first acts of the Government after the elections will be to ask the Reichstag to sanction a great increase in the proposed tonnage of the cruiser, giving it a displacement of twenty thousand tons. The vessel will be equipped with turbine engines, designed to give her greater speed than that of any cruiser yet designed. She will be not only larger and more powerful than any other cruiser afloat, but will be larger and more powerful than any existing battleship, including the "Dreadnought" and "Satsuma."

RAILWAY NOTES

It is said that Vancouver Harbor, which is sometimes referred to as the finest on the Pacific coast, might be lost within that at Prince Rupert, the western terminus of the Grand Trunk Pacific.

An extensive scheme of electric railway-building is contemplated by the Stratford and St. Joseph's Radial Railway Company, which is applying to Parliament for a charter to build passenger and freight lines.

The Temiskaming and Northern Ontario Railway Commission has decided to call for tenders for the forty-mile extension of the road so as to join the Grand Trunk Pacific at a point north of Lake Abitibi.

The Grand Trunk has entered into an agreement with the Canadian Government under which it obtains a lease for 999 years of the canal reserve in Ottawa, as a site for a central passenger station, to cost $250,000.

An electric railway running through Canadian territory, between Detroit and Buffalo, is the ambitious scheme behind the application by the Twentieth Century Transportation Company for the ferry fanchise between Windsor and Detroit.

The Canadian Northern Railway trains will be running between Ottawa and Montreal about next September. The line between Hawkesbury and Rockland is practically completed, save for some trestling, which will be done early in the spring. The road is graded, ballasted, and almost ready for the rails.

The Railway Commission have issued rules governing the use of interlocking and derailing signals, and the speed of trains where one railway crosses another at rail level. It is provided that when clear signals are shown the speed of passenger trains must not be more than 35 miles an hour, and that of freight trains 20 miles an hour.

The Transcontinental Railway Commission acting under authority from the Government, is negotiating for the purchase of a large tract of land east of Winnipeg as a site for shops and yards for the National Transcontinental Railway. The land is about two miles in length by about one in width, and will cost approximately $200,000.

The contract for the locomotive shops at Moncton for the Intercolonial Railway, has been awarded to E. A. Wallberg, Montreal, at a price of about a half million dollars. They will be built entirely of concrete and steel. This is the last group of the shop system to be built there. All the others are being constructed by the same contractor.

Heavy floods have caused considerable damage to the road-bed of the Intercolonial Railway, near Sydney, and seriously threatened it in several places, owing to washing away of dumps and approaches. The ground has slipped away in many places along the Bras d'Or lakes, and it will be necessary to move the tracks further inward in order to ensure safety to trains.

The project for the construction of the Channel Tunnel, which is to connect England and France, has advanced an important step by the formation of the board of directors of the new statutory Channel Tunnel Company. The names of the influential gentlemen appointed are: Lord Burton, representing the South Eastern and Chatham Railway; Viscount Ridley, chairman of the Tariff Reform League; Right Hon. Arnold Morley, formerly Postmaster-General; Vice-Admiral Sir Charles Campbell, recently retired from the Royal Navy; Major-General Sir Alfred Turner, late Inspector-General of Auxiliary Forces; Baron Emile d'Erlanger, chairman. The length of the tunnel will be about twenty-two miles.

The route map of the Grand Trunk Pacific between Winnipeg and Portage la Prairie shows that the line will run through the parish of St. Boniface, St. Charles, Headingly, and straight on to Portage la Prairie. It runs south of the Assiniboine until it reaches High Bluff, within a few miles of Portage, and then it runs north of the river into the town.

It is reported that the Canadian Pacific Railway will have a line into Cobalt within a comparatively short time. The Mattawa branch of the railway is to be extended as rapidly as possible from Temiskaming on the Quebec side of the boundary, 48 or 50 miles north-west to Fort Temiskaming, where a crossing will be made and the line run almost due west to Cobalt.

The railroads of Canada contracted for new equipment last year to the extent of $62,200,000. The new lines under construction total 3,314 miles. The following expenditures are given: Canadian Pacific, $23,000,000; Canadian Northern, $15,000,000; Grand Trunk, $5,000,000; Grand Trunk Pacific, $7,000,000; Great Northern, $10,000,000; Temiskaming and Northern Ontario, $2,000,000.

The Intercolonial Railway will build in its Moncton shops three motor rail cars, for use in the proposed motor service on the Intercolonial next summer. The cars will be modelled after those used on the Great Western Railway of England. They will be sixty-five feet long, divided into three sections, the first section for the steam motor, the second for baggage, and the third for passengers. The motor will be about 200 horse power.

The board of railway commissioners has authorized the Vancouver, Westminster & Yukon Railway Company to cross the Canadian Pacific Railway Company's spur line to the Brunette mills at New Westminster, the applicant company to defray the cost of the construction of a diamond and installing a semaphore. The same company is also permitted to make a junction and cross the C. P. R. at the Fraser River mills at the cost of the applicant company.

MINING

The total output of the Nova Scotia coal mines this year has been 5,213,000 tons, an increase of 53,000 tons over last year.

A big deposit of high-grade iron ore has been discovered near Desbarats, a few miles below the Soo. It is said to be as good as any in the Lake Superior region.

The supply of coke is increasing at Trail, and another copper furnace has been blown in, making three in operation. It is anticipated that soon all of the five copper furnaces will be blown in and then the plant will be reducing 1,700 tons daily.

The Nova Scotia Steel and Coal Co. have a gang of men at work at George's River mining ore in the Ingraham Watson leases, on which they recently obtained an option, and already several shipments have been made to the company's works at Sydney Mines.

There is considerable excitement over the alleged discovery of a very rich vein of gold-bearing rock nine miles north of Madoc. The find was made by E. B. Davis, an old miner, who brought a sample into Belleville recently. It has been tested by experts, and is said to be very rich.

Coal mining operations on a large scale have been begun by the Diamond Vale Coal and Iron Mines, Limited, in Nicola Valley. An order has been received from a large Mexican mining company for shipments of coal and coke in shipload lots. If contracts are made, cargoes will be loaded at Vancouver.

Leases are being secured for a period of twenty years covering the bed of the Lewis River from White Horse to the foot of White Horse Rapids. A company with a capital of $10,000,000 has been formed at St. Louis to dredge in the Klondike as well as the White Horse. The incorporators expect within three years to install three dredges in the Yukon.

This year's lead production in British Columbia amounted to 30,000 tons. The value according to New York prices, less 10 per cent., amounts to $3,000,000. The total production of lead in this country up to the present reaches 226,000 tons, valued at $18,000,000. The prospects for next season look very bright, as a very large increase in the ore tonnage is expected.

A strike of unusual character, but of great importance to the welfare of the district is reported from the vicinity of Chiliwack, B.C. This consists of the discovery of a large quarry of marble of excellent quality about eight miles from the town in the vicinity of Mount Cheam. Mr. Davidson, of Chiliwack, was the prospector who made the find, and the reports he brings as to the extent and quality of the deposits are such as to assure the prompt development of the quarry.

J. S. and W. S. Kuhn, Pittsburgh, are reported to have obtained options on 4,000 acres of copper deposits, including the Wilcox and McGowan mines at Parry Sound, for $760,000. The Messrs. Kuhn are business partners of E. C. Converse. Thomas A. Wood, mining prospector, Parry Sound, has been obtaining leases on an immense area of copper claims for this syndicate. This has been passed on by several New York, Pittsburgh and Detroit mining engineers, and, after an exhaustive examination, the property is now being developed with the intention of making Parry Sound a big copper camp. At the outset $5,000,000 will be expended in developing the property.

The estimated mineral production of British Columbia for 1906 as compared with 1905 is as follows:—

	1906.	1905.
Gold	$ 6,070,000	$ 5,902,402
Silver	2,200,000	1,971,818
Copper	8,690,000	5,876,222
Lead	2,690,000	2,399,022
Coal	4,590,000	4,152,936
Coke	1,050,000	1,358,925
Miscellaneous	1,100,000	800,000
Totals	$26,390,000	$22,461,325

PERSONAL

Mr. Ross McLennan has been appointed private secretary to Mr. F. H. McGuigan, fourth vice-president of the Grand Trunk Railway.

Mr. W. F. Fye left Montreal for Mexico recently, where he will take charge of the engineering work for the Canada Electric Syndicate, Limited.

Mr. William Brown, superintendent of the boiler shop of the Dominion Iron and Steel Company, is dead. Mr. Brown was with the company for four years.

Mr. Frederick Dane, of Toronto, has been appointed to the vacancy on the Temiskaming & Northern Ontario Railway Commission, succeeding Mr. C. B. Smith.

James J. Hill, president of the Great Northern Railroad, will retire from active service in July next. He will be succeeded by his son, Louis J. Hill, first vice-president of the Great Northern.

L. L. Munn, the designer of the Ontario Power Company's plant at Niagara Falls, has made application to use the water-power in the West Fort of Rock Creek in Wasata County, Utah, for the purpose of operating an electrical plant.

Cecil B. Smith, C.E., has been engaged by City Engineer Rust, of Toronto, in the interests of the city to try to find an alternative route for the railways entering the city from the east, with a view to keeping the lines away from the Kew Beach suburbs.

Mr. H. J. Lamborn has been appointed superintendent of power and plant in the works of the Yale & Towne Manufacturing Co., New York, N.Y. Mr. Lamborn was formerly mechanical and electrical engineer, and superintendent of the magnetic separating plants of Witherbee, Sherman & Co., at Minevalle, N.Y.

C. E. Ussher, general passenger agent eastern lines, of the Canadian Pacific Railway Company, has been appointed to a new position—assistant general passenger traffic manager, with headquarters at Winnipeg. William Stitt, formerly agent of the Canadian Australian Steamship Company at Sydney, becomes general passenger agent, eastern lines, with headquarters in Montreal.

C. H. Mitchell, C.E., of Niagara Falls, recently examined and reported upon hydro-electric projects at Prince Albert and Edmonton. The propositions are on the Saskatchewan River, and are about 5,000-H.P. capacity. Mr. Mitchell has established his Toronto office in the Traders Bank Building, rooms 1,004-5. He was formerly engineer of the Ontario Power Company, Niagara Falls, Ont.

H. M. Lane, secretary of the Foundry Supply Association, has resigned the editorship of "The Foundry," published in Cleveland, Ohio, by the Penton Publishing Company. Mr. Lane is about to engage in the business of a foundry consulting engineer, with headquarters in Cleveland. A. O. Backert, formerly editor of "The Iron Trade Review" will succeed Mr. Lane as editor of "The Foundry."

MUNICIPAL WORKS

In order that the water supply of Montreal may be increased, a $2,000,000 loan will be issued.

It is practically decided that Portage la Prairie will take over and own the electric plant and operate it.

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The constantly increasing demand for electric power in Berlin has so taxed the electric plant of the town that large additions are in order, and consequently the Canadian Westinghouse Co. have received a large order for the electrical machinery.

The Light, Heat and Power Department of St. Thomas made a splendid showing in its first year under civic ownership. After the reserving of $5,000 for contingent account, a surplus revenue of between $10,000 and $12,000 will be paid into the city treasury.

LIGHT, HEAT, POWER

Goderich is to have a new arc lamp system, the contract for which was awarded to the Allis-Chalmers-Bullock Company of Montreal. Their tender was $3,547, f. o. b., Goderich, being the lowest of three submitted.

The Stark Telephone, Power & Light Co., have bought the Erindale power concern for $47,500. The deal was put through by the official referee, acting for the liquidator of the York Loan. The property consists of power basin dam, real estate, chattels, franchises and pole lines.

Mr. Du Tremblay, counsel for the new Merchants' Light and Power Company,' which will seek incorporation at the next session of the Legislature, states that this company will have at its disposal several million dollars, and that the promoters from New York and Philadelphia have united with capitalists in the Province of Quebec to furnish the citizens of Montreal with gas and electric light at popular prices. The plans for the erection of the works are now ready.

NEW INCORPORATIONS.

Manitoba.—Cowan Construction Co., Winnipeg, $150,000. W. J. Cowan, D. R. Campbell, P. C. Andrews, C. G. Cowan, F. W. Tisdale, Winnipeg.

Pine Ridge Sand Co., Winnipeg, $50,000. H. Hodgson, Springfield; P. D. Hicks, R. Watson, J. C. Hicks, J. S. Hough, Winnipeg.

The Well Machine and Wind Mill Co., Winnipeg, $20,000. C. S. Tyrrell, J. H. Inkster, H. W. Hutchinson, W. S. Evans, J. A. Machray Winnipeg.

Manitoba Rolling Mill Co., Winnipeg, $100,000. L. A. McElroy, Erie, Pa.; T. M. Kirkwood, Toronto; M. F. Hull, A. D. Sproule, P. J. Proctor, Winnipeg.

Dominion.—The Vancouver Portland Cement Co., Toronto, $1,500,000. J. S. Lovell, W. Bain, R. Gowans, E. W. McNeill, W. F. Ralph, H. Chambers, C. H. Black, Toronto.

St. Lawrence Saw and Steel Works Co., Sorel, Que., $40,000. C. D. Pontbriand, J. Pontbriand, H. M. Pontbriand, F. D. Pontbriand, Sorel, Que.; T. D. Pontbriand, Chicoutimi, Que.

The Canadian Boomer and Boschert Press Co., Montreal, $20,000. A. E. G. Madley, L. de K. Stevens, W. S. Johnson, F. Callahan, J. A. Walker, Montreal.

Dominion Mines and Metals, Sault Ste Marie, Ont., $1,000,000. A. Wilson, London, England; J. H. More, Sault Ste Marie, Mich.; A. J. Saunders, Sault Ste Marie., Ont.; E. J. Daly, M. McKain, Ottawa.

The North Shore Transportation and Wreckage Co., Quebec, $250,000. T. Gagnon, A. Gagnon, Quebec; J. B. A. Martin D. Hatton, Montreal; J. B. D. Legare, J. A. Fafard, O. C. Bernier, Quebec.

Dominion Car and Foundry Co., Montreal, $5,000,000. W. V. Kelley, R. P. Lamont, Chicago, Ill.; W. W. Butler, Saratoga Springs, N. Y.; G. McAvity, St. John, N. B.; A. H. Chave, J. A. Lamont, Montreal.

A. C. Leslie and Co., Montreal, $250,000. W. S. Leslie, A. H. Campbell, E. H. Copland, F. H. Foster, F. B. Leslie, Montreal.

The Lethbridge Collieries Co., Winnipeg, $500,000. I. Cockburn, J. S. Hough, D. E. Adams, D. R. Dingwall, T. A. Burrows, J. Y. Griffin, J. W. Bettes, W. Rogers, C. H. Campbell, Winnipeg.

Dominion Marble Co., Montreal, $50,000. F. A. Johnson, R. T. Hopper, F. H. Markey, W. W. Skinner, R. C. Grant, Montreal.

Western Canada Development Co., Winnipeg, $2,000,000. J. S. Hough, A. C. Ferguson, C. Williams, E. B. Lindsay, W. M. Graham, Winnipeg.

Northern Coal and Coke Co., Winnipeg, $1,000,000. J. S. Hough, A. C. Ferguson, C. Williams, E. B. Lindsay, W. M. Graham, Winnipeg.

Geo. W. Reed & Co., Montreal, $150,000. C. T. Williams, F. H. Barwick, E. C. Barwick, K. D. Church, Montreal; J. K. McNutt, Westmount.

The Prince Rupert Timber and Lumber Co., Ottawa, $450,000. E. H. Moor, W. Anderson, G. H. Rochester, W. Dwyer, R. E. McCracken, A. Fleck, Ottawa; J. H. Sanderson, F. C. Baker, A. H. Woodman, Prince Albert; J. H. Lamont, Regina, Sask.

The Montreal Exploration & Development Company, Montreal, $50,000. B. Burland, L. J. Cartier, Montreal; C. Ralph, Longueuill; J. A. Mitchell, L. A. Derome, Montreal.

Incorporation has been granted by letters patent to the Vancouver Portland Cement Company, with an authorized capital of a million and a half dollars, and head office in Toronto. The charter is taken in the name of a number of solictor's clerks here, and affords no index as to who are really interested in the enterprise.

The Safety Explosives Co., Quebec, $300,000. W. H. Evans, R. W. Withycomb, W. A. Weir, W. J. Wright, A. W. C. Macalister, Montreal.

Ontario.—The Kerr Lake Lawson Mining Co., Cobalt, $1,500,000. W. Lawson, Eganville; W. F. Powell, R. T. Shillington, Ottawa; T. W. McGarry, J. Devine, Renfrew.

Cobalt Lake Mining Co., Toronto, $5,000,000. Sir H. M. Pellatt, N. Macrae, B. Osler, J. F. H. McCarthy, G. C. Loveys, H. Spence, J. M. Ewing, A. C. Ross, M. L. Gordon, Toronto.

The Bucke Silver and Cobalt Mining Co., Ottawa, $300,000. F. A. Heney, Nepean; H. Hopp, E. L. Horwood, T. A. Beament, J. A. MacLaren, Ottawa.

The Youngstown-Cobalt Silver Mining Co., Cobalt, $1,000,000. G. A. Baker, A. P. Dalbey, Youngstown, Ohio; W. A. Sadler, D. H. Glanville, G. W. P. Hood, Toronto Junction.

London-Cobalt Mining Corporation, Toronto, $2,000,000. F. H. Potts, Geo. Stevenson, J. W. McDonald, E. Gillies, E. L. Bradley, Toronto.

Bonanza Roof Extension, Toronto, $100,000. J. G. Shaw, of Montgomery; J. G. Strong. W. R. Williams, G. F. Thompson, Toronto.

The Cobalt Ore Sampling Co., Cobalt, $100,000. W. H. Fletcher, N. R. Macdonald, G. W. Parker, G. A. Woodward, C. H. Moore, G. Ross, Cobalt.

Duluth Cobalt Mining Co., Haileybury, $500,000. J. F. Gillies, J. F. H. McCarthy, J. M. Ewing, W. S. Edwards, Toronto; J. McKay, Sault Ste Marie.

Kennedy Cobalt, Toronto, $1,000,000. W. H. Jackson, J. A. Morden, W. D. Earngey, A. S. Miller, Toronto; D. Kenedy, Toronto Junction.

The Silverfield Cobalt Mining Co., Toronto, $200,000. T. H. Barton, F. D. Byers, A. F. Taylor, L. Duff, E. Dickey, Toronto.

Montreal Cobalt Power Co., Toronto, $1,000,000. J. W. Bain, G. B. Strathy, R. R. Perry, L. C. Todd, J. E. Riley, Toronto.

The Russell Brick and Tile Co., Russell, Ont., $100,000. D. Crackner, C. F. McArthur, Osgoode; D. S. Macdougall, J. D. McPhail, W. F. Kenney, Russell, Ont.

The Erie Ice Co., Windsor, $40,000. J. S. Lovell, W. Bain, R. Gowans, E. W. McNeill, Toronto; J. H. Coburn, Walkerville, Ont.

The Casey Mountain Cobalt Mining and Developing Co., Haileybury, $250,000. R. B. Fergusson, R. G. Williamson, G. A. Pollard, D. A. Reid, Regina, Sask.; D. Williamson, Haileybury.

Wentworth Quarry Co., Hamilton, $60,000. T. H. Crerar, J. McCoy, Hamilton; W. Martin, J. E. Hutty, Binbrook; A. Aiken, Barton.

The Philip Carey Manufacturing Co., of Canada, Hamilton $100,000. G. D. Crabbs, P. B. Crabbs, E. L. Buse, W. J. Mouler, Cincinnati, Ohio; O. A. Cole, Toronto; E. H. Ambrose, Hamilton.

The Sharpe Lake Cobalt Silver Mining Co., Ottawa, $1,000,000. J. E. Murphy, W. Abbott, Cobalt; W. R. Bradbury, W. E. Matthews, R. G. Code, Ottawa.

Independent Cobalt Silver Mines Company, Toronto, $1,000,000. W. M. Williams, Joplin, Mo.; H. H. Mason, Hartford, Conn.; C. E. Mabon, Lewiston, N. Y.; C. E. Loomis, Attica, N. Y.; S. P. Biggs, Toronto.

Silver Horse Shoe Cobalt Mining Co., Toronto, $40,000. J. Brown, M. Sinclair, A. M. Harley, S. Frame, P. Loney, Toronto.

The Cobalt Mutual Mines Co. Haileybury, $100,000. A. G. Slaght, H. L. Slaght, W. H. Phelan, I. McLellan, W. J. Farrell, Haileybury.

Railway Reserve Mines, Ottawa, $1,000,000. T. W. McGarry, G. B. Ferguson, Renfrew, Ont.; W. J. Bell, Sudbury; G. L. Orme, D. E. Johnson, T. A. Beament, Ottawa.

The Peninsular Tug and Towing Co., Wiarton, Ont., $20,000. J. G. G. Simpson, F. Wood, W. Fox, D. J. Byers, C. E. Byers, Wiarton.

The Russel-Chambers Co., Toronto, $500,000. W. B. Russel, Toronto; W. C. Chambers, Harriston; S. Johnston, A. J. Thompson, R. H. Parmenter, Toronto.

The Laurentian Granite Co., Montreal, $200,000. J. Brunet, Notre Dame des Neiges; R. Bickerdike, L. H. Hénault, J. L. Décarie, W. H. Evans, Montreal.