PAGES

MISSING

The Canadian Engineer

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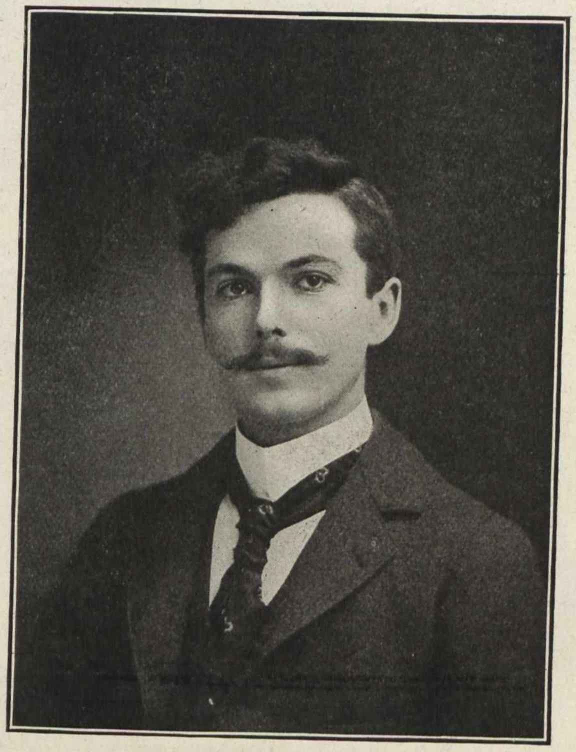
"We judge ourselves by what we feel capable of doing; but the world judges us by what we have already done."

—*Longfellow.*



ALEXANDER R. GOLDIE.

A few years ago it was heralded to all parts of the world that this was the era of the "young man" in business; and the pages of popular magazines were filled with panegyrics of Schwab, President of the U.S. Steel Corporation; Hyde, President of the Equitable Life Insurance Co., and other youthful administrators of great industrial concerns. Alas, "time that treadeth down all things but truth" has been trying as by fire this system of energy and knowledge, minus wisdom; and the end is not yet.

Alexander R. Goldie, the subject of our sketch this month, was born in Galt, Ontario, in 1873—the same year that Sir John Macdonald and Sir Hugh Allan mixed up the negotiations for laying down the Canadian Pacific Railway. He is, therefore, a comparatively young man; but then, few mechanical engineers in the Dominion have had a better academic, technical and practical training for the responsible position he now fills as works manager of the Goldie & McCulloch Co.'s plant. He matriculated from Galt Collegiate Institute 1889; graduated from the Toronto School of Practical Science 1893; and from 1893 to 1895 worked in a number of different sections in the Galt works, including Drafting-room, Cost Department, etc., in order to get a practical knowledge of shop work. Then for one year he served as assistant works manager under his father, John Goldie—a man of plain living and high thinking, but a sterling mechanic of the same school which produced men like Arkwright, Watt, Rennie, Nasmyth and George Stephenson. When his father died, in 1896, he straightway assumed the duties of Works Manager, and from that time until now has had charge of the mechanical engineering part of the business, with conspicuous success.

In a letter to the biographer recently, he says:

> The careful way in which the business had been built up by Mr. McCulloch and my father has made it easier for the younger members of the company to carry it on.

This modest word is characteristic of the man.

If Mr. Goldie had done nothing else of note than lay out, design and equip the new boiler works at Galt—described and illustrated in our last issue—he would be entitled to a place of honor in our gallery of Canadian engineers who have "done things."

CANADIAN ELECTRICAL DEVELOPMENT AT NIAGARA FALLS.

BY ORRIN E. DUNLAP.

The Power House is Shown on the Right at the Water's Edge; Distributing Station on Bluff above; Horseshoe Falls to the Left.

Power House and Distributing Station of Ontario Power Company at Niagara Falls (Canadian Side).

In accordance with its agreement with the commissioners of Queen Victoria Park, the Ontario Power Company on Saturday, July 1st, demonstrated that it had power ready for commercial service by starting the first unit in its power station at Niagara Falls. Thus it is evident that another power company will shortly be prepared to furnish a generous supply of electric power on the Canadian side at Niagara as well as for transmission to the New York side of the river.

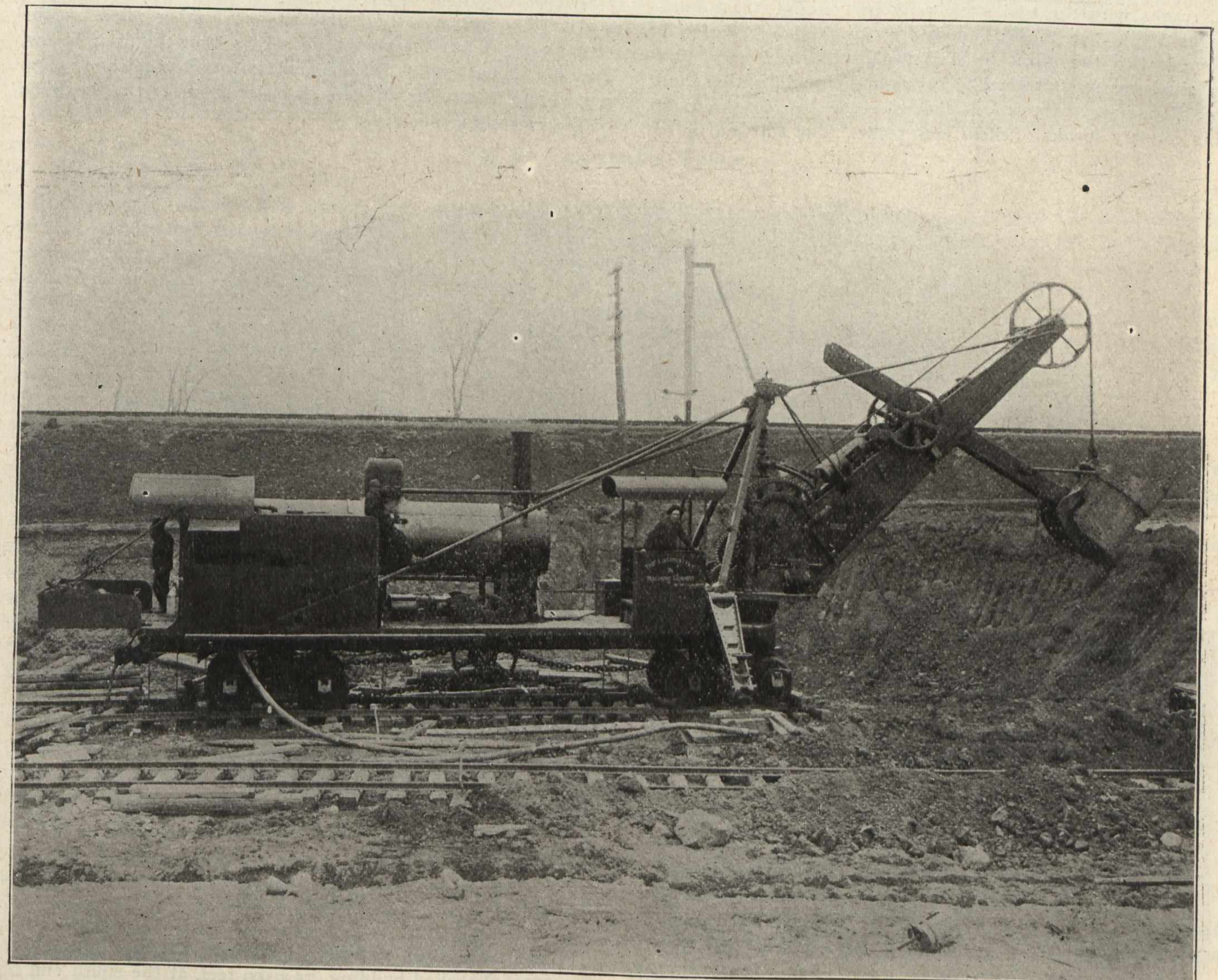
The power station of the Ontario Power Company is located at the water's edge on the Canadian side, almost in front of the New York end of the Horseshoe Falls. The first section of the building is now being completed, and it is expected that the installation will supply 60,000 horsepower. The turbines that are being installed by this company were designed and built by J. M. Voith, Heidenheim-on-the-Brenz, Wurtemberg, Germany, and are of the inward-flow, double, Francis type, the two runners of which are 78 inches in diameter, each capable of developing about 5,700 horsepower. The water is controlled at the turbine by swivel gates, and these act as guides. In height the turbines are about 13 feet, while the bed-plate measures 21 by 29 feet. Under a head of 175 feet they will make 187½ revolutions per minute. The head of 175 feet is made up of 155 feet above the shaft and 20 feet below it.

It has been found that the work of the Ontario Power Company on the Canadian side at Niagara is about as interesting as any of the power projects over there. It was this company that built great wing-dams out in the upper river to uncover a large area for the river bed, and when the rocks were high and dry it proceeded to build two forebays on the uncovered section. These forebays were recently completed and the water let into them for the first time. From the lower end of the inner forebay a steel flume 18 feet in diameter extends to a point on the high bank over the power station. This flume empties into an open relief or spillway near old Table Rock, and from this point the penstocks carry the water supply to the turbines located in the power house in the gorge below. Eight penstocks will connect with each 18-foot flume and drop through shafts and tunnels excavated through the cliff to the power station. It is expected that each big flume will deliver 3,900 cubic feet of water per second, the water flowing through the pipe at about 15 feet per second. Only one steel flume has been built so far, but this is expected to supply enough water for the development of 60,000 horsepower.

Power from this station is to be delivered at the international boundary line to the Niagara, Lockport and Ontario Power Company, which company is now engaged in erecting a transmission line eastward from Niagara Falls, the announced intention being to pass through Lockport, Medina, Albion and other places on the way to Rochester, N. Y. The point where the transmission line will cross the Niagara gorge has been selected, and a force of men is at work there getting ready to string cables across the river. The point is a short distance below the Devil's Hole, where steel towers are to be erected to support the cables in their passage down the Canadian cliff and up the New York cliff. On the Canadian side the heavy timber growth has been cut away for several hundred feet, making a bad scar on the beautiful section of the river bank, the finest of the gorge. Foundations are now being built for the towers on both sides of the river. Connections between the banks have already been made. This was accomplished by James Wadsworth, of Queenston, Ont., rowing across the rough stream and carrying the line with him, letting it unreel as he progressed. The trip was successful, and now the line hangs high above the water and will serve as the means to pull wires and cables across. A large transformer house is being erected on the top of the high bank on the New York side, the cost to be about $50,000.

In the accompanying illustration the relation of the station of the Ontario Power Company and the Horseshoe Falls of Niagara are for the first time accurately portrayed, while high on the bluff, up from the power station, the new distributing station of the Ontario Power Company is shown. This distributing station is 550 feet back from the power house and about 255 feet above it. It is expected that this distant control of the current will remove some of the dangers common to such work and operation. The cables and wires for control will leave the power house through the penstock tunnel, and from the top of the bank will run to the distributing station through clay conduits. The low-pressure bay upon the main floor of the distributing station contains the 12,000-volt automatic oil circuit-breakers, while in the chamber beneath are the sectional duplicate bus bars and their immediate connections. The transformers stand in pits in the transformer room.—(Western Electrician.)

3½ YARD "ATLANTIC" TYPE STEAM SHOVEL.



The above is a photographic illustration of a 3½ yard "Atlantic" Type Steam Shovel, recently built by the Locomotive and Machine Company, of Montreal, Ltd. This shovel—the weight of which is about 80 tons approximately, was designed by A. W. Robinson, of Montreal, formerly of the Bucyrus Company. The engraving shows one of the shovels in trial operation by the Canadian Pacific Railway Company at Montreal Junction, and on the strength of its successful performance, the company, through W. R. Baker, has ordered three more. It has been subjected to most exhaustive tests, and on comparing its performance with that of a Bucyrus shovel, on the same work, it was found to have excavated fifty per cent. more material in the same working time, and to have consumed only three-fourths of the fuel. Mr. Robinson is also the designer of the Bucyrus machine, which is so well and favorably known, about a thousand of them being in service; but in this latest production he has made a most remarkable advance in speed, power and efficiency. Some idea of the power of this machine may be gained from the fact that it can dig a cutting 60 feet wide and 25 feet deep at one time, loading the material on a train of cars alongside. It loads standard cars, 34 feet long, in 1¾ minutes each, scooping up five tons at a time with its immense steel dipper. Although so large and powerful, it is handled with greater ease and rapidity than the old style, and seems almost human in its motions. It is a matter of satisfaction that these machines are now built in Canada, as heretofore they have all been imported from the United States. Not only that, but this Canadian design is being largely used in the United States, where it is being introduced by the American Locomotive Co., and bids fair to supersede the old style by reason of its superior speed and efficiency.

One of these shovels has also been sold to the Canada Copper Company, for digging heavy ore.

CANADA FOUNDRY COMPANY'S DAVENPORT WORKS, TORONTO.

The fine perspective view shown below represents "Canada's model engineering plant," built by the Canada Foundry Company, at Davenport, just outside the city limits of Toronto.

This company was organized in 1900, purchased the ancient St. Lawrence Pipe Foundry, Toronto, and continued the manufacture of cast iron pipes, hydrants, and waterworks supplies generally. Owing, however, to the energy and enterprise which the new executive threw into it, the volume of business increased so rapidly that the Berkeley Street plant was soon found to be altogether inadequate to meet the demands, hence a sixty acre site was secured in an ideal location at Davenport: near the junction of the Grand Trunk and Canadian Pacific Railroads; upon which has been erected large machine shop, foundry, forge, screw and nut factory, bridge shop, and boiler shop; all connected by 1½ miles of yard tracks with the two great railway systems. So admirably laid out are these immense shops and so perfectly equipped with the latest modern tools and machinery, that even rivals are constrained to express their admiration, and every Canadian interested in the progress and development of his country speaks of them with pride. The starting up of this plant in 1903 was a red letter day in the industrial history of the Dominion.

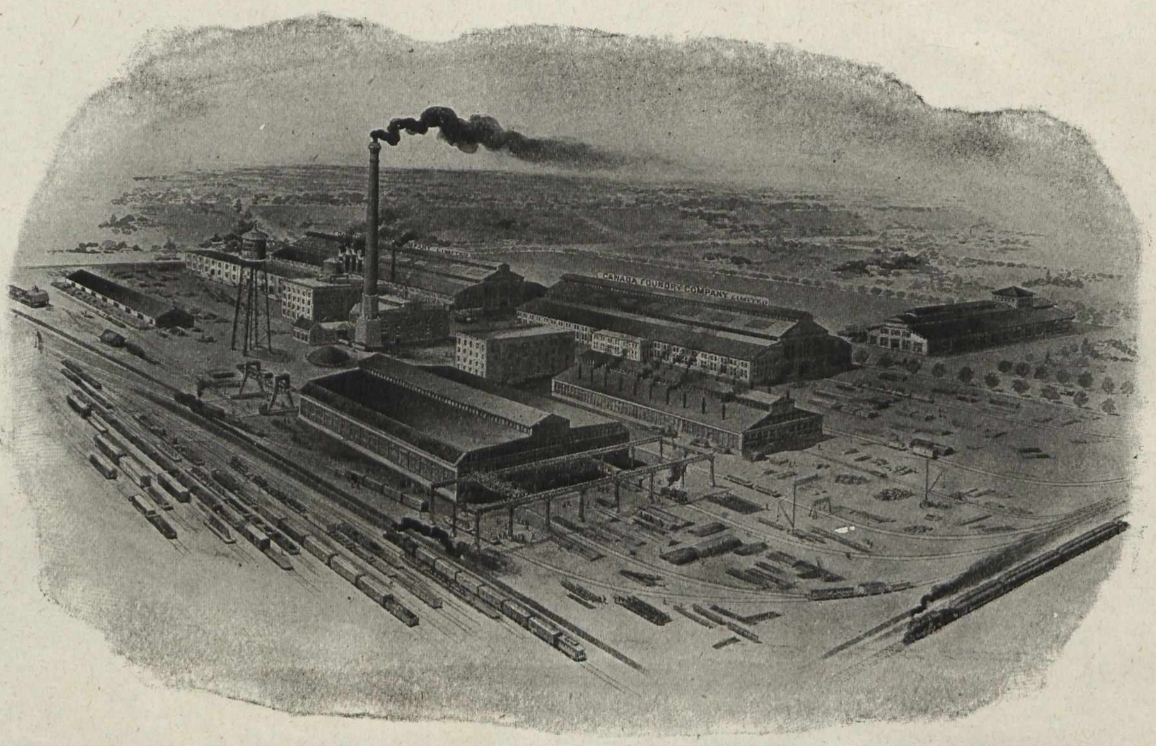


Fig. 1.—Birds Eye View Looking Northwaras.

When we visited the works a few days ago (July 17) every department was in full swing; in fact every shop seemed like a bee-hive. So crowded were the floors with work that it was next to impossible to get photographic views in detail, hence we had to be contented with pictures taken when all was still.

In Fig. 2 is shown a group of the respective heads of departments, with Mr. J. W. Harkom, the genial and able General Superintendent in the centre. The magnitude of the work going on in these extensive works, may be inferred from the size of the superintendent's staff.

The accounting, drafting and production departments are temporarily located in the north-east corner of the machine shop; but will soon be domiciled in the fine, concrete walled offices now in course of erection at the south-east corner of the works.

In logical order we now come to the pattern shop. The activities of this department may always be taken as a good index of the condition of the sales department, and we were fortunate in getting a snap shot (Fig 4), when every bench was occupied, and work at high pressure. In this shop, 220 feet long by 50 feet wide, over 50 men were at work, on benches fitted with Emmert Patent Vises; or, on the latest modern labor-saving machines: Band saws, jointers, circular planers, thicknessers, trimmers, tool sharpeners, etc.; nearly all electrically driven. On each pillar down center of building (6) is fixed a glue pot heated by electricity, and controlled by the foreman in his office. Protection against fire is adequate, for there is a complete sprinkler system and water bucket on every post. The adjustable sage green window blinds can be transferred from one side of shop to the other to suit the course of the sun. Wash basin and well kept lavatories are provided for the men. Impressed we were with the orderly, business-like way in which this section is run. We learned that two years ago only eight skilled pattern-makers were employed, whereas now there are forty. The 80,000 feet of yellow pine lumber piled on the storage ground at the north end shows that the floor below, now used as a sand, coke and general foundry storage room, will soon have to be utilized in order to meet the demands of the increasing business.

Pattern Vault.

The storage of patterns is provided for in a four story fire-proof detached building, 75 x 100 feet, at the south end of pattern shop. Here we found 20,000 patterns, arranged on the respective floors, as follows:—A, heavy: all kinds; B, cranes, dynamo fields, etc; C, hydrants, valves; D, pumps, air compressors. The patterns are hoisted to the floors by hydraulic elevator. The walls are steel and brick, and the building is lighted on three sides, through wire glass windows in iron casings. Every alternate window has a half-swing open sash, held by a chain attached to a fusible plug, which melts at 170°-F. and thus closes automatically in case of fire, which is then taken care of by an efficient sprinkler system. The place is heated in winter by exhaust steam about 50°-F. Four pattern-makers are constantly employed on the top floor D, repairing and altering patterns, and the vault foreman, who is also inspector of castings, is assisted by four helpers. As in the case of pattern shop, so here, we found an excellent card system, which we purpose illustrating at some future date.

Parallel with the pattern shop and vault, on the east side,

Fig. 2.—Departmental Chiefs.

is the foundry, 300 feet long by 120 feet wide, consisting of 60 foot middle bay, two 30 foot wings, and gallery over the eastern wing. In this well lighted building, we found 342 men working on the moulding of castings large and small: huge 20 ton turbine intake castings for Niagara Falls were being made in loam; massive C. G. E. Dynamo fields and spiders, for Winnipeg, were being swept up in dry sand pits; bed plates and cylinders for air compressors, pumps, etc., were being moulded in cope and drag, on the middle and eastern floors; while overhead; on the gallery, hydrants, valves, and other small green sand duplicate castings were being hand-moulded in snap-flask and on follow-board by the hundred. The only labor saving devices we perceived in operation were pneumatic hand rammers, Fig. 6, pneumatic riddles for sifting sand, and a Sellers' centrifugal facing sand mixer, all saving common manual labor. Appliances as substitutes for skilled labor, such as gear moulding machines, pulley moulding machines, and devices for duplicate work, i.e., bends, branches, tees, valves, hydrants, etc., which one finds universally in the United States and the later foundries of England, we failed to find anywhere. In the centre bay are 2=20 ton "Morgan" electric travelling cranes, made by Canada Foundry Company, while on the main columns are fixed 6=5 ton electric jib cranes, capable of being moved from one post to another. Over the moulding floor in eastern wing are 2=15 ton electric travelling cranes.

The 5 core ovens grouped together, located outside the main building near the southwest end, are commodious, and the terra cotta hollow-bricked roof excellent; but the underground heating furnaces, fired inside the shop, the sliding doors, and truck axles on fixed centers, are manifestly behind the times. Three "Colliau" cupolas 66", 56" and 36" linings respectively, supply the metal for the moulds, and have a capacity of 40 tons daily. The blast is supplied to the cupolas from rotary pressure blowers, through pipes with numerous friction producing bends; while the means adopted for delivering coke fuel to the charging floor is anything but an economical arrangement. A like criticism holds good with regard to the storing and handling of pig iron and scrap.

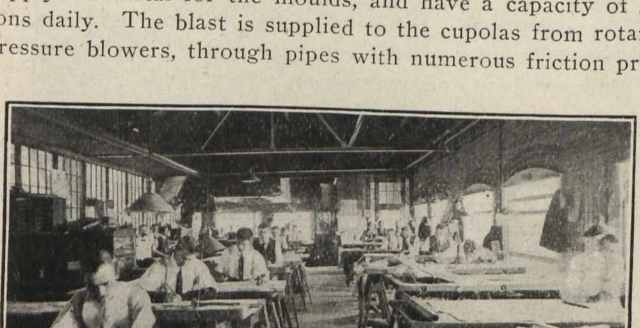


Fig. 3.—Drawing Office.

In the crowded casting cleaning section, at south-east end, are grinders, rumblers, and other modern appliances; but no pickling vats for effectively removing, by dissolving, the core sands in pump and engine cylinder ports, etc. At the opposite corner is a heating furnace and dipping tank, for coating hydrants and other waterworks castings with an antiseptic, rust preventing mixture of pitch, etc. On the gallery over these sections, we found a detachment of carpenters busy making and repairing flasks, and a feature of this part is the equipment of labor-saving wood-working machinery. About 170 feet of the western wing floor is reserved for the making of cores. Overhead, on runways, is a 3 ton air lift travelling crane. Here it was, as an aid to the 27 busy core-makers, that we found the centrifugal sand mixer, made by Wm. Sellers, of Philadelphia.

Fig. 4.—Pattern Shop.

One feature of this foundry is the manner in which the comfort of the moulders has been considered; for behind the core room is a chamber, 60 x 30 feet, in charge of an attendant, in which is a double row of wash basins with 20 spigots, and around the walls we counted 96 lockers for the men's clothes; while over the cleanly lavatories is another room provided with 6 shower baths.

On the whole the foundry is an interesting department; and while we have pointed out one or two important details which we deem unmechanical and uneconomical, we have nothing but praise for the general layout and design. The minor defects indicated will doubtless be remedied when the necessary extensions are made.

Fig. 5.—Foundry.

The brass foundry, 60 x 30 feet, shown in Fig. 7, is located inside the iron foundry, next the cupolas. Seven brass moulders operate 6 pot furnaces, 5=300 pounds, and 1=120 pounds, with underground natural draft fire places. Castings weighing up to 21 cwt. are made even in this small shop; and from the high pressure work going on in the production of brass and bronze parts for standard pumps, air compressors, etc., it is evident that a larger modern shop will be needed in the near future.

The machine shop (Fig. 8) is 300 x 120 feet, and in detached line with the foundry, so that rough castings can be run on trucks direct from one department into the other. The view is taken from gallery at south end, looking towards the foundry. To the right of the middle bay, and immediately in front of the foremen's office, is a partly finished locomotive, about to be lifted by one of the 2=50 ton "Morgan" electric travelling cranes. The large tools and machines are mostly located at the north end, hence are not brought prominently into view. Upon entering the doorway at foundry end, we perceived on the right hand a colossal 22 ft. "Bertram" boring mill finishing a 20 ton turbine intake segment for Niagara Falls. And on the left hand side of track a 30 ft. x 84 in. x 84 in. "Bertram" planer, 52 ft. bed, on which a pair of huge locomotive frames were being planed, with ¾ in. cut, ⅛ in. feed. Next to the first named tool is an 8 ft. "Niles" boring mill, followed by a "Bertram" 5 ft. mill. In front of the latter is a large "Niles" multiple drill, with special adjustable table. But the tool which attracted our special attention was a 40 ft. "Bertram' triple-headed slotter (Fig. 9).

A 23 ft. locomotive frame was being squared and straightened with a 1 in. cut, 3-32 feed. Each head is driven by separate 7½ horse-power C. G. E. motor; indeed all the heavy tools throughout the shop are driven by independent motors. Behind the large slotter is a 30′—0″ "Niles" lathe, with 60 in. swing. After passing several minor boring mills, and drill presses by Bickford, N.H., Niles-Bement; London Machine Tool Company, etc., we came to a horizontal boring mill, by Barrett Boring Mill Company, Meadville, U.S.A., on which the flanges and interior of a large pipe were being faced and bored simultaneously. Adjoining this machine is a Niles-Bement facer, with 62 cutting tools on a 52-in. head, cutting 9 feet in 1½ hours. The shop floor on eastern side of track opposite the last mentioned tools is used for erecting purposes, and at the time of our visit the immense turbine intake base segments were being assembled, and an imposing sight they made. Behind this erecting floor, under the drawing office, are 6 planers—some large, 4 shapers, and 1 large "Bertram" horizontal milling machine. Under the western gallery we counted 18 lathes, 8 drill presses, and numerous special tools, such as bevel gear cutter, by Gould & Eberhardt, Newark, N.J., grinders, etc.

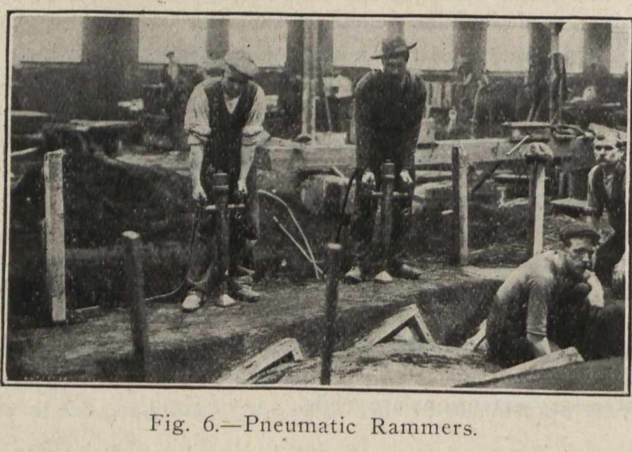


Fig. 6.—Pneumatic Rammers.

Having roughly glanced at the northern half of the shop, devoted to general machine work, we pass by the tool store room situated behind the conveniently placed foremen's office to the southern half, which is reserved for general floor and bench work. Along the wall under eastern gallery are benches fitted with "Parker" vises. Here is done the assembling, fitting and testing of cranes, pumps, air compressors, hydrants, etc. In the middle bay the assembling of locomotives and heavier structures is done. In the foreground of Fig. 8, to the left hand, may be seen the 150 ton "Bertram" press for forcing wheels on axles, and nearby is a 300 ton "Bertram" press for heavier but similar work. Other special tools, viz., wheel borers, pneumatic frame riveters, grinders, etc., are distributed about the floor under the south-west corner under gallery; while down this wing

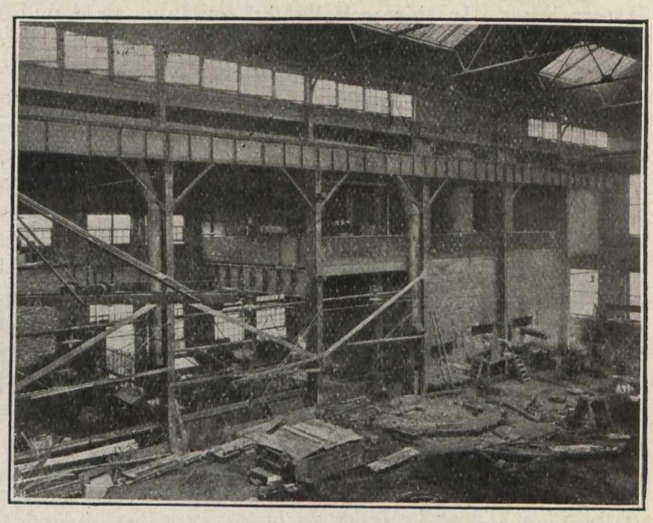


Fig. 7.—Brass Foundry.

towards the middle of shop we counted 8 planers, 2 grinders, 2 slotters, 1 boring mill, and 2 drill presses. Such is a brief description of the fine equipment, and of the cosmopolitan work being done on the ground floor. Ascending one of the convenient staircases we reached the western gallery and counted 46 lathes, drill presses, etc., distributed thereon, all in active operation, finishing the parts for pumps, air compressors, etc. On the opposite side, at south-east corner, is the blue printing department; next to this is the brass finishing section with 27 busy machines, and beyond this part is the tool room with 23 fine machines, lathes, grinders, millers, shapers, drills, etc., the latest and most approved types. The remainder of the eastern gallery is occupied by the production department and engineering offices.

Taking it all in all the like of this machine shop as regards design and equipment can not be seen this side of Niagara Falls. But large though it is comparatively, it is already overcrowded, and the space reserved for extension southwards will soon have to be occupied to meet the demands of the good time coming.

The forge and blacksmiths' shop (Figure 10), is a well lighted, commodious and generously equipped department. The abundance of glass makes it very hot in summer. A few handfuls of liquid air thrown inside on the day of our visit would have been very refreshing for the 55 men working therein. On the eastern side is ranged a series of 11 forges and two pair in the middle of the building, each

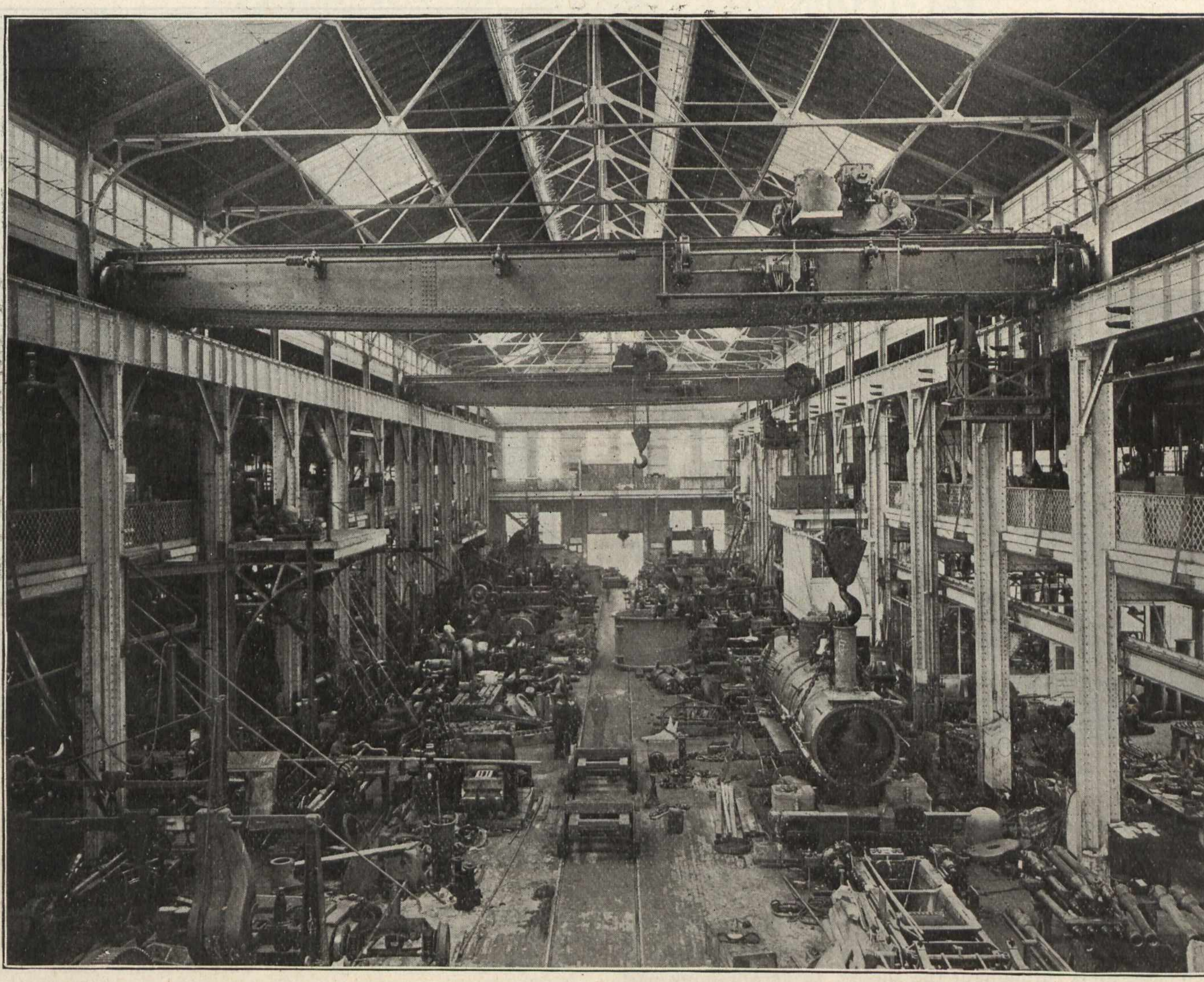


Fig. 8.—Machine Shop.

set adjoining the 15 cwt. and 7 cwt. steam hammers. While situated alternately down the western side are a series of heating furnaces, each in juxtaposition to a (1) bulldozer for forming 10" x 1" truck bolsters; (2) forming machine for street car end sills; (3) ½ to 1½ inch bolt heading machine (Acme Machinery Company, Cleveland, Ohio); (4) ½ inch. to 1⅛ inch rivet forming machine (American Machinery Company, Willoughby, Ohio); (5) ½ inch to 1 inch nut-making machine (National Machinery Company, Tiffin, Ohio); (6) triple "rider" hammer for forming insulator pins (made by Canada Foundry Company—Harkom's patent); (7) 1 to 1¾ inch nut-making machine (Ajax Machine Company, Cleveland, Ohio). This blacksmiths' shop is a well conceived and admirably planned department.

At the south end of blacksmiths' shop is a four story building 100 x 60 feet, on the ground floor of which is the general stores office, together with racks and bins for nut and bolt iron, tool steel, brass, lead, etc. The second floor is reserved for the storage of smaller parts of hydrants, pumps, compressors, Locos; while on the third floor are machines for threading, grinding and finishing nuts, screws, and cap screws; and shelves, bins, and other receptacles for storing same.

On the top floor is the general screw and nut factory (Fig. 11) and tool room for this department, where 50 hands are employed in the making of nuts, screws, studs, tap bolts, etc.

In close proximity to the screw and nut factory is the power house, equipped with a 350 horse-power 16 x 23 x 20, Robb-Armstrong tandem compound steam engine, and D. C., 300 horse-power, C. G. E. generator; also an 8 x 13 x 20 x 15 vertical, triple expansion steam engine (Madison, N. Y.)

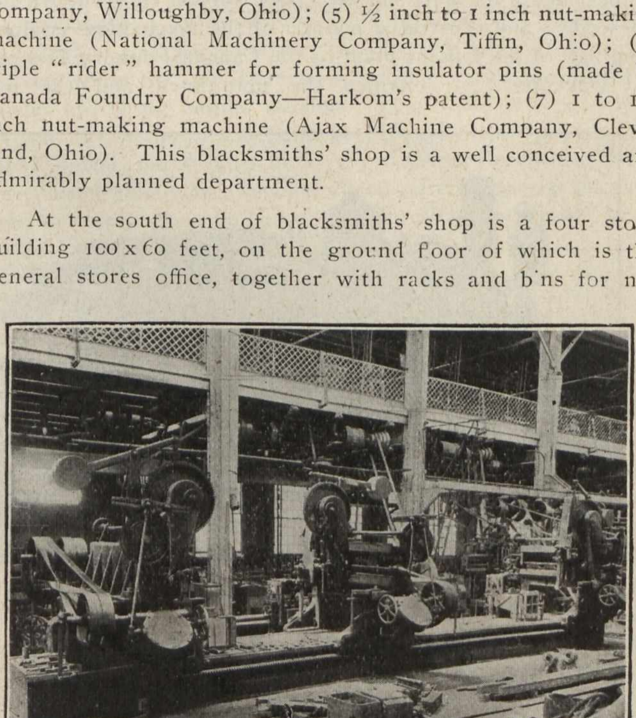


Fig. 9.—Triple-Headed Slotter.

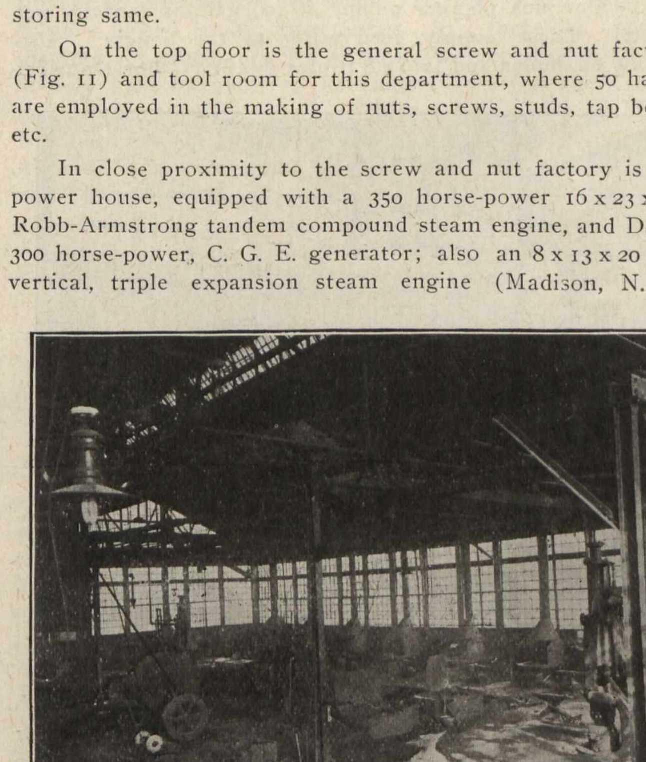


Fig. 10.—Blacksmiths' Shop.

connected to an alternate pair of 100 horse-power C. G. E. generators (Fig. 12); and in addition a 12 x 12 McEwen horizontal steam engine, 100 horse-power, connected to a pair of C. G. E. generators, 100 horse-power, respectively. The switch board equipment is located on a gallery at the end of engine house, as shown in Fig 12. On runways overhead is a 10 ton hand power travelling crane for handling engine parts in case of repairs. A travelled engineer is not entranced with this equipment for furnishing light and power to the fine shops we have been describing. Probably the administration would reply that this power plant is only

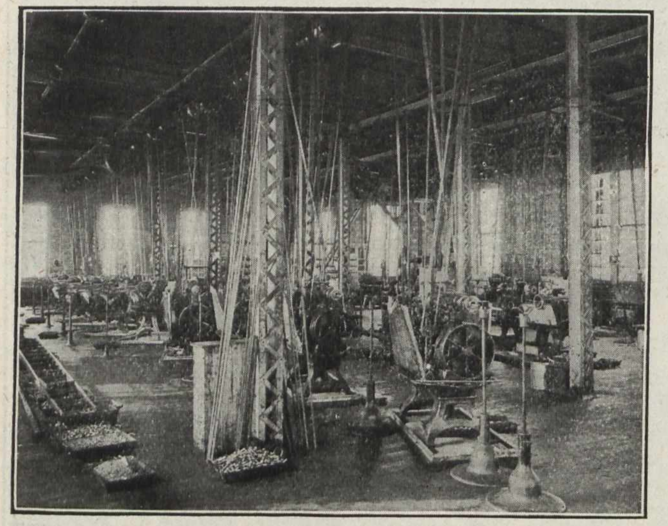


Fig. 11.—Screw and Nut Factory.

temporary, since they purpose utilizing electric power from Niagara Falls. At every turn one is impressed with the foresight shown in the wise provision made for change and extension to meet the demands of the future. In a separate room is a 16 x 24 x 24 cross-compound air compressor (Fig. 13) which delivers 1,500 ft. of compressed air to the hoists and pneumatic tools throughout the shops. In an adjoining part of the power building are 5=150 horse-power return tubular boilers, 72 in. x 18 ft., supplying 140 pounds steam pressure to the engine plant. These boilers are fired by means of "Jones" and "Parsons" mechanical stokers.

Hydraulic System.

West of the boiler shed is the pump house, in which are 3=8 x 5 x 12 inch plunger pumps of 100 gallons capacity per minute. These supply feed water to the boilers. Also 3=6 x 5 x 7 duplex and 1=6 x 8 triplex motor (15 horse-power)

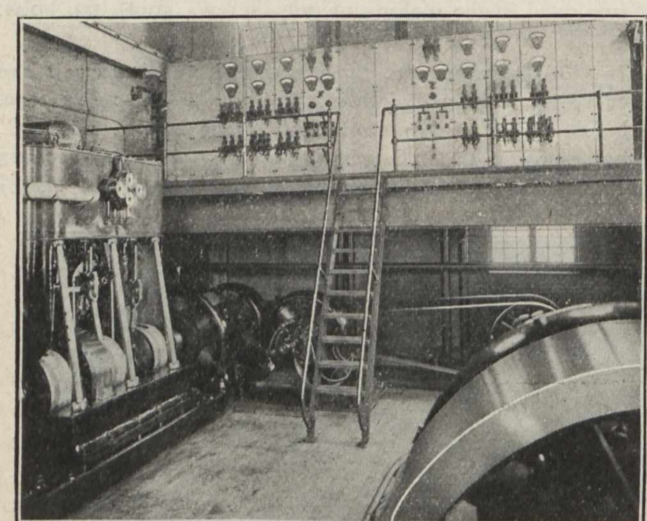


Fig. 12.—Engine House.

driven pump for power plant, elevators, etc., together with 1=14 x 8 x 12 single acting steam pump (250 gallons per minute) for pumping water to 50,000 gallon water tank on roof of pattern vault, which gives a pressure of 40 pounds per square inch, for domestic services, lavatories, etc. The largest, however, is an 18 x 10 x 12 duplex underwriter pump—

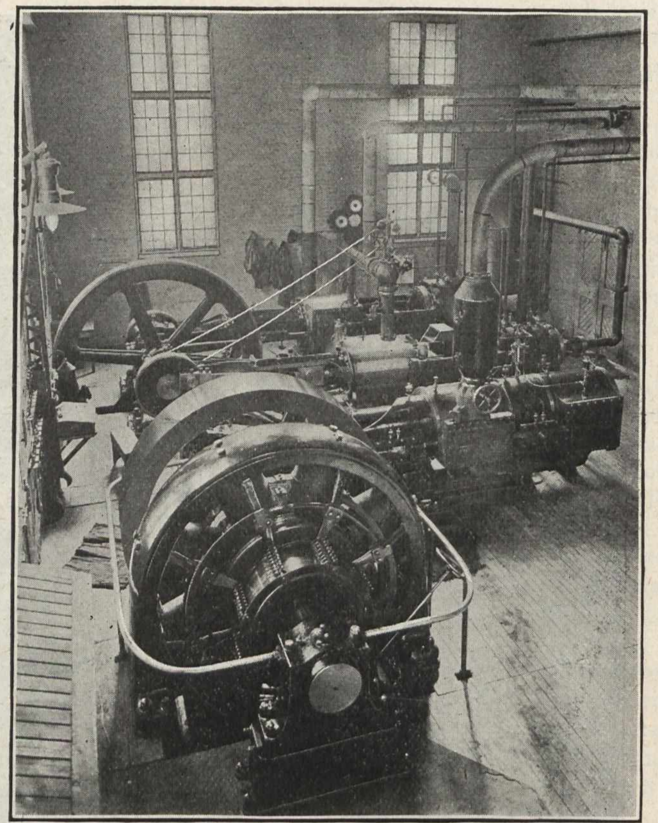


Fig. 13.—Air Compressors.

1,000 gallons per minute capacity. This pump is used for forcing water up to the adjoining 100,000 gallons water tower, which is 150 feet high, and gives a head pressure of 65 pounds per square inch in the fire sprinkler system and hydrants throughout the plant. The water for the tanks is drawn from a large nearby cistern, 14 feet 6 inches deep and a capacity of 250,000 gallons. This cistern is filled directly from the street main, and the average consumption of water is some 75,000 gallons daily. The pumps were all made by the Canada Foundry Company; the water tower by the Chicago Bridge and Iron Works.

Lack of space forbids other than a mere reference to the chemical and testing laboratories, foundry supplies stores, pig iron piles, lumber racks, finished stock yards, and large enclosed shed for the housing of air compressors, rock crushers, rock drills, steam pumps, gasoline engines, boiler tubes, hydrants, gate valves, check valves, etc.; but we have described and illustrated enough of the mechanical engineering half of the famous plant of the Canada Foundry Company at Davenport, to convince the uninitiated and the most

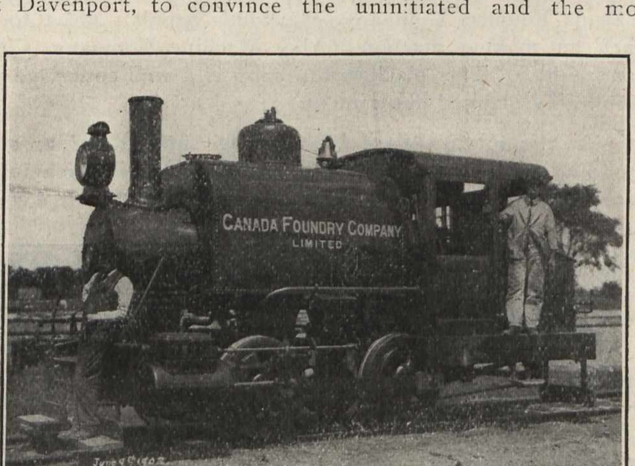


Fig. 14.—Locomotive.

sceptical that right here on the outskirts of Toronto, Canada has an engineering plant of which her sons may justly be proud.

We purpose in our next issue describing and illustrating the equally fine and extensive Civil Enginering half of the plant, viz., the structural, bridge and boiler shops.

EFFICIENCY OF MODERN LOCOMOTIVES.

Mr. Alvin B. Johnson, of the Baldwin Locomotive Works, Phila., U. S.A., recently made the following statement:—

"A locomotive is not subject to an annual reduction of efficiency. So long as its boiler is in condition to carry the pressure for which it was designed, and so long as the locomotive is maintained in a proper state of repair, it is capable of doing its maximum work. With the great improvements which have been made in boiler construction there should be no necessity for reducing the working pressure until the locomotive is, from other causes, about ready for withdrawal from service. There is not, therefore, an annual reduction of 10 per cent., nor of any other percentage, by reason of the depreciation of the efficiency of existing locomotives. The percentage of reduction of power caused by the retirement of old locomotives is much less than the ratio which the number of such locomotives bears to the whole number in service, because most of the locomotives now being withdrawn from service are light in weight and obsolete in type. Experience has shown that at intervals of about 20 years there come revolutionary changes in railway equipment. Thus we have seen the transition of carloads from 20,000 to 40,000, from 40,000 to 60,000 and from 60,000 to 100,000 pounds capacity each, accompanied by corresponding changes in the weight of rail and in the capacity of locomotives. So certain is the further development of railway science that it is unsafe for any railroad manager to count upon the efficiency of the best known appliances for a period of more than 20 years in the future. Modern locomotives should maintain their maximum efficiency for at least 20 years, and should then be available for a good many years' service on branch lines. The depreciation is, therefore, less than 5 per cent., and instead of 4,600 locomotives being required annually to make good the depreciation in existing equipment, approximately 2,300 will be sufficient.

The locomotives now doing the greater portion of the work of the country have been constructed during the past ten years. They are of enormously greater capacity than those which they have replaced. Twenty years ago the heaviest standard freight locomotive had a weight on driving wheels of from 100,000 to 110,000 pounds. At present the average weight on driving wheels of heavy freight locomotives is about 180,000 pounds an increase of fully 75 per cent.

One of the most conspicuous facts in railroad work during the past few years has been the vast sums spent in reducing grades, straightening curves and otherwise so improving the conditions of traffic as to reduce the power required for its movement. Such reduction of grades and curves is equivalent to a large increase in the effective capacity of locomotives, while the introduction of gravity yards also largely reduces switching engine mileage. It is difficult to convert this into the terms of a definite percentage of increased locomotive power, but it must be a very considerable factor both in increased efficiency and in reduced cost of operation, and tends to lessen the number of locomotives required for a given freight tonnage.

The average number of miles of track locomotive for the whole country is approximately five, but this includes all of the old established lines where traffic is concentrated and trains are numerous. Rarely do new roads provide themselves so liberally with power; one locomotive for each ten miles of track is nearer to the usual allowance. Therefore 600 locomotives per annum should be sufficient to provide for new construction of 6,000 miles.

It is difficult to determine what number of locomotives is required annually to provide for increase of traffic, exclusive of renewals of existing equipment and equipment for new mileage. During the seven years from 1897, when the total number of locomotives in the country was 36,080, to 1904, when the total number of locomotives in the country was 44,529, the increase was 8,449, or an average of 1,207 per annum. This annual increase, of course, covered also new mileage and increased tonnage. It would be a liberal allowance to assume that 1,000 locomotives per annum are required for increasing tonnage.

Summarizing the foregoing, the total requirements of American railroads appear to be:—

Number required for renewal of existing equipment..	2,300
Number required for equipping new mileage..........	600
Assumed requirements for increasing annual tonnage..	1,000
	3,900

During 1903 the American Locomotive Company built in its eight shops 2,216 locomotives, and the Baldwin Locomotive Works built in their shops in Philadelphia 2,022. Although having contracts sufficient to operate to their maximum capacity throughout that year, a number of causes contributed to prevent both concerns from realizing their maximum production. Both were engaged largely in rebuilding their shops, and both were greatly hampered during a considerable portion of the year by difficulties in obtaining supplies of materials. The Rogers Locomotive Works were operating as a third competitor, but their production was not made public. Since then the American Locomotive Company has acquired the Rogers Locomotive Works, and now advertises its capacity of 3,000 locomotives per annum. The Baldwin Locomotive Works are endeavoring to maintain a production of 50 locomotives per week. During March, 1905, they actually turned out 216 locomotives. It is, therefore, apparent that the combined capacity of these two concerns is approximately 5,500 locomotives per annum, or sufficient to renew the entire locomotive stock of the country each eight years. Not only is their capacity sufficient for all the needs of our American railroads, but as appears from the foregoing, there exists a surplus capacity of something like 1,600 locomotives per annum out of which to provide for increasing future demands, for exports to foreign countries and for sales to those buyers whose purchases do not figure in the statistics."
—Railway and Locomotive Engineering.

AMOUNT OF AIR REQUIRED FOR VENTILATION.

Under the general conditions of outdoor air, namely, 70 degrees temperature, and 70 per cent. of complete saturation, an average adult man, when sitting at rest in an audience, makes 16 respirations per minute of 30 cubic inches each, or 480 cubic inches per minute. With 70 degrees temperature and 70 per cent. humidity, the air thus inhaled will consist of about 1-5 oxygen and 4-5 nitrogen, together with about ·1 7-10 per cent. of aqueous vapor, and 4-100 of a per cent. of carbonic acid. By the process of respiration the air will, when exhaled, be found to have lost about 1-5 of its oxygen by the formation of carbonic acid, which will have increased about one hundred fold, thus forming about 4 per cent., while the water vapor will form about 5 per cent. of the volume. In addition, the exhaled air will have warmed from 70 degrees to 90 degrees, and, notwithstanding the increased proportion of carbonic acid,—which is about one and one-half times heavier than air,—will, owing to the increase of temperature and the levity of the water vapor, be about three per cent. lighter than when inhaled. Thus it will be seen that this vitiated air will not fall to the ground as has often been presumed, but will naturally rise above the level of the breathing line, and the carbonic acid will immediately diffuse itself into the surrounding air. In addition to the carbonic acid exhaled in the process of respiration, a small amount is given off by the skin. Furthermore, 1½ to 2½ lbs. of water are evaporated daily from the surface of the skin of a person in still life. If the air supply at 70 degrees is assumed to have a humidity of 70 per cent., and to be saturated when it leaves the body at a higher temperature, then at least 4 cubic feet of air per minute will be required to carry away this vapor.

Taking into consideration these various factors, it becomes evident that at least 4½ cubic feet of fresh air will be required per minute for respiration, and for the absorption of moisture and dilution of carbonic acid gas from the skin. This, however, is only on the assumption that any given quantity of air, having fulfilled its office, is immediately removed without contamination of the surrounding atmosphere; but this condition is impossible, for the spent air from the lungs, containing about 400 parts of carbonic acid gas in 10,000, is immediately diffused in the atmosphere. The carbonic acid does not fall to the floor as a separate gas, but is intimately mixed with the air, and equally distributed throughout the apartment.

It must then be evident that ventilation is, in effect, but the process of dilution and that when the vitiation to be maintained in the apartments is decided, the necessary constant supply of fresh air to maintain this standard may be very easily determined. For the purpose of calculation, 0.6 cubic feet per hour is accepted as the average production of carbonic acid by an adult at rest, and the proportion of this gas in the external air is as 4 parts in 10,000. If, therefore, the degree of vitiation of the occupied room be maintained say at 0.6 parts in 10,000, there will be permissible an increment of only 2 parts in 10,000 above that of the normal atmosphere, or 2 divided by 10,000 equals .0002 of a cubic foot of carbonic acid in each cubic foot of air. The 0.6 cubic foot of carbonic acid produced per hour by a single individual will, therefore, require for its dilution to this degree 0.6 divided by .0002, equals 3,000 cubic feet of air per hour. Upon this basis the following table has been calculated.

Cubic Feet of Air Containing 4 Parts of Carbonic Acid in 10,000 Supplied per Person.

Per hour	6000	4000	3000	2400	2000	1800	1714	1500	1200	1000	525	375	231
Per min.	100	66.6	50	40	33.3	30	28.6	25	20	16.6	9.1	6.2	3.8

Degree of Vitiation of the Air in the Room.
(Parts of Carbonic Acid in 10,000).

5	5.5	6	6.5	7	7.33	7.5	8	9	10	15	20	30

The figures indicate absolute relations under the stated conditions, and are generally applicable to the ventilation of schools, churches, halls of audience and the like, where the occupants are reasonably healthy and remain at rest. But the absolute air volume to be supplied cannot be specified with certainty in advance, without a thorough knowledge of all the conditions and modifying circumstances, in fact, the climate, the construction of the building, the size of the rooms, the number of occupants, their healthfulness and their activity, together with the time during which the rooms are occupied, all have their direct influences. Under all these conditions, it is readily seen that no standard allowance can be made to suit all circumstances, and results will be satisfactory only in so far as the designer understandingly, with the knowledge of the various requirements as they have here been given, makes such allowance.

—Extract from Treatise on Ventilation and Heating by B. F. Sturtevant Co., Boston, Mass.

THE THERMIT PROCESS IN AMERICAN PRACTICE.*

BY ERNEST STUTZ.

Just a year ago the first Thermit was manufactured in this country, and the applications developed in Europe by Dr. Hans Goldschmidt, at the works of Th. Goldschmidt, Essen-Ruhr (founded 1847), were transplanted to American soil and have since blossomed forth under the fostering care of American ingenuity.

The principle of the Thermit Process can now be said to be known to the technical world, and it will be sufficient

Break of Welded Bar, 2½ x 2¾, After Pressure of 50 Tons.

to state that through the ignition of finely divided aluminium and metallic oxide, a reaction is started which produces heat of about 5,400° F., and at the same time reduces the iron oxide to a metallic iron almost free from carbon, in a highly superheated liquid state. Thermit Steel has practically twice the temperature of open hearth steel, and a correspondingly greater fluidity. By suitable additions of carbon, in the form of steel punchings, chilled iron shot or Ferro-Silicon, its hardness, and by addition of Manganese, its toughness can be increased to any suitable degree.

The following analyses will confirm this.

The first is one of pure Thermit Steel; the other of the steel in the riser of a welded steel locomotive frame, drawn out under the hammer into a bar some three feet long, and turned down and broken.

Analysis of Thermit Steel.—Illinois Steel Co., The Rookery, Chicago, Ill.

Carbon.	Manganese.	Silicon.	Sulphur.	Phosphorus.	Aluminium.
0.05	0.10	0.204	0.04	0.05	0.18

Tensile Strength, lbs. per sq. in	Elongation, per cent. in 8 inches.	Contraction of Fracture.
59,320	25.33%	59.6%

Pennsylvania Railroad, Altoona.

Thermit Steel, with Addition of 2% Carbonless Manganese 5% Iron Punchings, (Calculated on Amount of Thermit).

Carbon.	Manganese.	Silicon.	Sulphur.	Phosphorus.	Aluminium.
0.102	2.330	1.227	0.034	0.070	....

Tensile Strength, lbs. per sq. in.	Elongation, per cent. in 8 inches.	Appearance of Fracture.
91,600	21.5	Silky.

The simplicity of outfit and manipulation and the speed with which the reaction does its work are its chief recommendations for industrial purposes.

In a crucible some 20 inches high and therefore easily transportable, in half a minute can be produced 30 lbs. of

*A paper read at the annual meeting of the American Society for testing materials, Atlantic City, July 1st, 1905.

liquid steel, so hot that it will melt a steel bar of 4″ square section and fuse with it to one homogeneous mass.

The essential characteristic of Thermit is that it welds by fusion, and by reason of this fact, calls for the foundryman's experience more than the blacksmith's. Its success depends on the proper material, shape and condition of the mold.

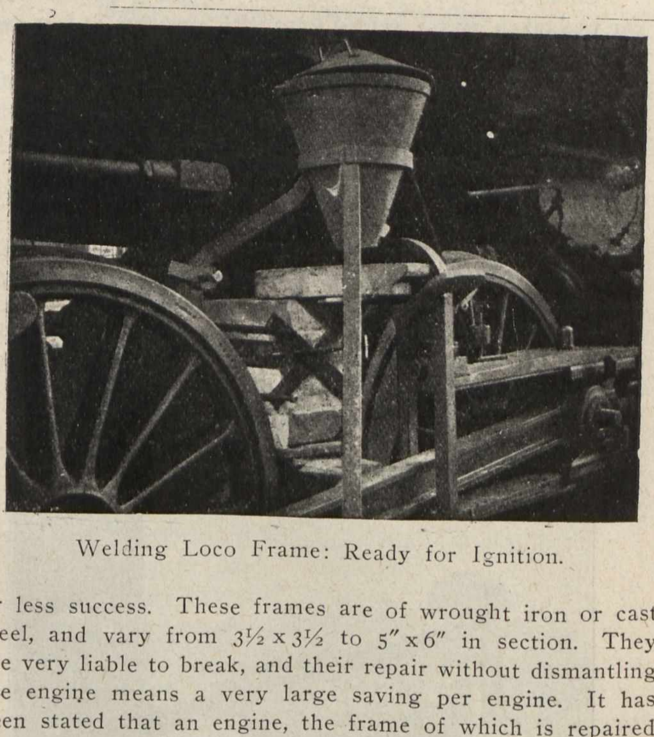
The mold into which the contents of the crucible are run must be of refractory material. The general instructions must, of course, be broad and cannot go beyond stating that a mixture of equal parts of sharp sand and ordinary brickmakers' clay has given satisfaction. The formula has been varied sometimes, according to local conditions, in some cases flour, in the proportion of 6 to 100, being used as binder for the sand. Some shops have already evolved their own particular formulas, which they treat as secret. The mold always must be dry—burnt dry. In some cases, for instance, at the Elkhart Shops of the Lake Shore & Michigan Southern, the difficulty has been overcome by using fire-brick cut down to size. This certainly overcomes the question of drying molds.

The shape of the mold must next be considered. It must be so constructed that the steel flowing down through the gate will not strike direct on to the casting or forging, but will flow underneath the lowest part and rise around and through it. What is required is good circulation for the Thermit Steel. It must flow around all the welding surfaces, and as it gets chilled in contact with these, it must be driven up into a riser and be followed by a sufficient supply of fully heated Thermit Steel to effect the actual weld, which takes the shape of a collar or reinforcement, cast on or over the fracture.

The mold must therefore allow (1) for a gate, (2) for a collar, shoe or other reinforcement on the surface of the welded piece and overlapping the edges of the break or joint, (3) a riser, (4) a skim gate, to prevent the slag from getting mixed with the steel.

The formula for calculating the amount of Thermit must also allow not only for the cubic space of this reinforcement, but further, for again as much Thermit, to supply the contents of gate and riser.

These are the general instructions for welding, for instance, LOCOMOTIVE FRAMES—a problem which some thirty railroads in this country have investigated with more

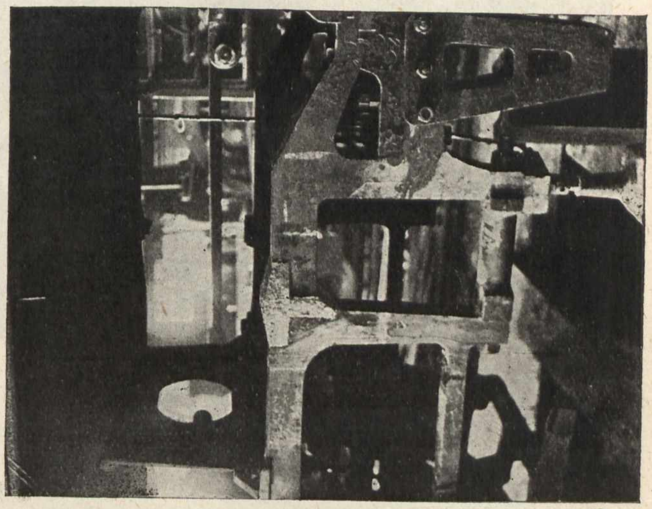


Welding Loco Frame: Ready for Ignition.

or less success. These frames are of wrought iron or cast steel, and vary from 3½ x 3½ to 5″ x 6″ in section. They are very liable to break, and their repair without dismantling the engine means a very large saving per engine. It has been stated that an engine, the frame of which is repaired in the forge, remains a fortnight out of commission, and the actual weld costs $250 to $300. The work by Thermit can be done comfortably in three or four days, at a cost of about $50.

In reply to a circular letter of inquiry, about twenty railroads have supplied data, which, however, cannot be considered complete, as some of the most regular and extensive users of Thermit did not care to supply the information asked for.

The first successful weld it has been possible to get a record of was made by Mr. Sanderson, Superintendent Motive Power, Seaboard Air Line, on October 19th, 1904. This engine has continued in service ever since. It is one of eight engines welded on that road which has given satisfaction, which speaks highly for the care used at the Portsmouth shops in handling a new and therefore difficult problem.



Loco Frame: Welded in the Jaw.

Another series of successful welds is reported by the Boston & Albany Line, where Mr. Fries welded five engines quite successfully—one being in continuous service since the end of November. One, welded in the jaw, broke again, but four inches away from the weld.

Of late the Lake Shore & Michigan Southern has shown great interest, its perseverance has been crowned by success in some very good welds at their Elkhart Shops, about which Mr. Webb read a very interesting paper at the last annual meeting of the American Foundrymen's Association, giving a full account of each step in the operation. On a preliminary tests, a welded bar 2½ x 2¾ stood a pressure of 50 tons on supports 20 inches apart, before breaking, and that, after two sides of the reinforcing collar had been machined off.

In all there are records of thirty engines with welded frames that have been in service for three months or longer. Failures are recorded only in isolated instances and are assignable to three different reasons:

First, wrong construction of mold.

Secondly, insufficient Thermit; in other words, insufficient circulation—therefore, insufficient fusion.

For those familiar with the process, a weld that breaks on account of lack of cohesion at the welding surface is attributable under all circumstances to lack of experience or care, except in one particular case.

It is possible for Thermit welded frames to break in spite of proper execution of the work. The original break is due, in the first place, to a structural defect. With the break in such a position as to necessitate the entire removal of the reinforcing collar, it is too much to expect the mere bridging of the broken ends by Thermit Steel to overcome this innate weakness.

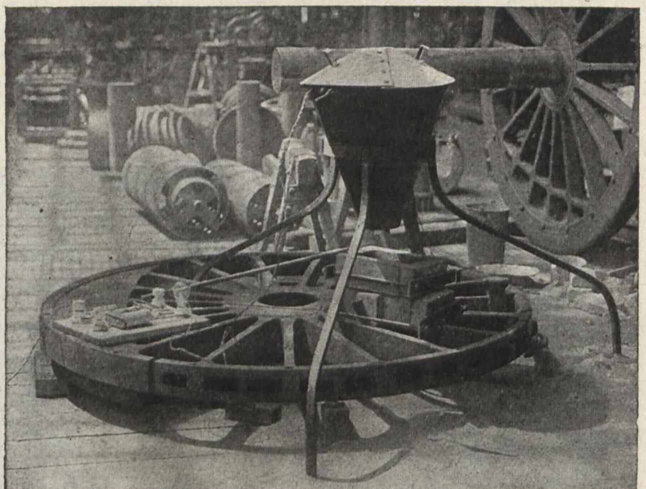
An important factor in success in welding locomotive frames is to allow for equal shrinkage of parallel parts; also, wherever possible, to spread the ends apart in order to let them come back when the iron begins to set.

Another operation of interest to railroad men is the welding of spokes of drivers.

In making tests of the metal of such welds, the Chicago, Milwaukee & St. Paul R. R. found a tensile strength of 93,900 lbs. per square inch. The analysis agreed with that of the Pennsylvania R. R., with the exception of Manganese, which in this case was only 0.74.

Next come repairs in Marine Engineering, which are mostly successes obtained by Mr. Des Anges, Superintendent, Floating Equipment of the Long Island R. R.

A 12" crank shaft (13⅝" at point of fracture) of the ferry-boat "Manhattan Beach" was welded with 400 lbs. of Thermit. The break was in the "wheel centre," necessitating

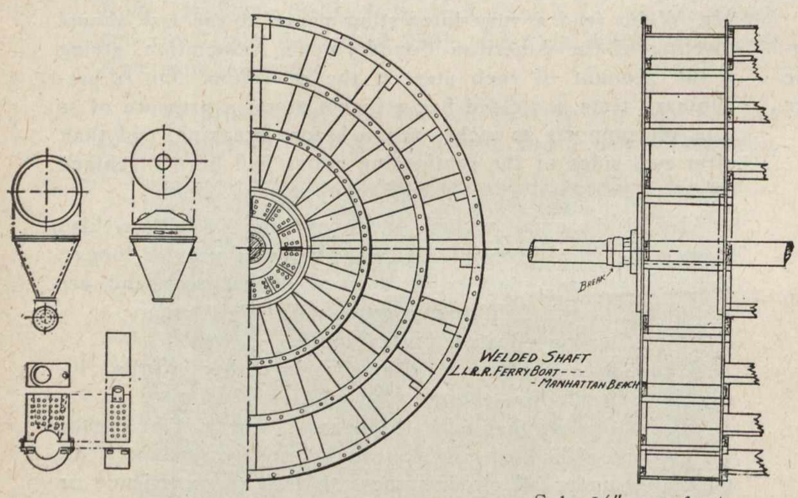


Welding Spoke of Locomotive Driving Wheel.

the shifting of the centre to a new position and shortening the paddle boxes. The shaft was pre-heated by a charcoal fire and hand-blower, to black heat. To protect the woodwork of the ferry-boat, an asbestos curtain was hung around the crucible, which served its purpose admirably. The ferry-boat has been in uninterrupted service for nearly three months, and continues so now.

A rudder-stock, 5" in diameter, was welded with 50 lbs. of Thermit and 10 lbs. of punchings. The collar in this case had to be entirely removed, but the welded rudder-stock has now been in service for eight months.

On the Great Lakes, through the enterprise of Capt. Johnson, at that time with the Dunham Towing & Wreck-



Scle ⅛" = 1 foot.

Weld of Crank Shaft "Manhattan Beach."

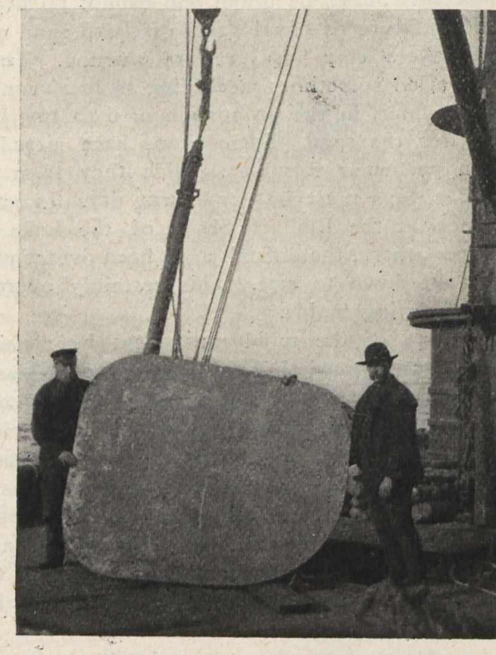
ing Co., the rudder-shoe of the tug boat "Schenck" was welded, 125 lbs. of Thermit being used. The weld was sound—in replacing the propeller, a chain broke and the propeller dropped on the weld shoe without injuring it.

Some important repairs of gray iron castings are also reported. At the Renovo shops of the Pennsylvania R. R. a hydraulic wheel press was repaired, the part welded having to stand a pressure of 60 tons per square inch. The original "strong back" holding the wheel against which the axle was pressed was not strong enough for the purpose until repaired by Thermit.

Cylinder covers are also repaired by Thermit, and have been made as good as new.

Work with gray iron castings requires more experience, in regard to pre-heating and cooling down gradually—more Thermit is necessary to effect the weld on account of a hard, glassy scale on such castings, which resists fusion, and an addition of Ferro-Silicon (about 2%) is advisable to prevent hard spots at the lines of junction between Thermit Steel and cast iron.

The most important application of the Thermit Process is for making a continuous rail. The process having been brought to a high state of perfection in Europe before coming here, there was little room for



Weld of 5-in. Rudder-Stock.

changes in practice. About 30 different cities are investigating the process in actual operation and about 5,000 joints have been put in up to date. All these roads recognize in the Thermit Process the best and simpiest means of joining rails for electric traction, as long as care is taken to do small and simple things right. Competitors in the field of rail-welding may send out fanciful blue-prints about broken joints, to create unfavorable impressions, but such manœuvres prove nothing beyond the fact that they admit the success of the Thermit Process in this field.

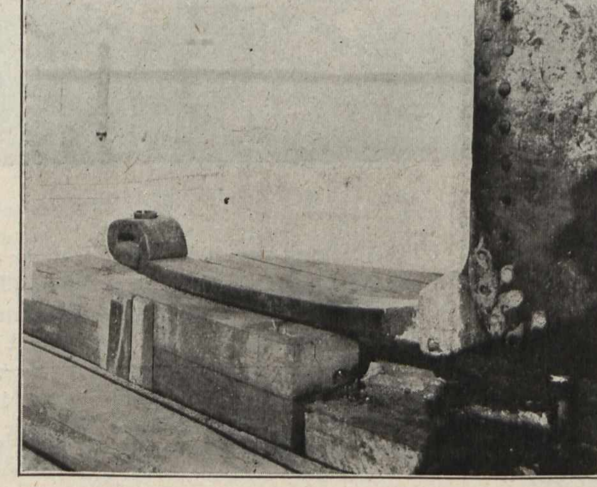
Some tests may be of interest. A heavy double trolley car was taken over a welded joint with supports 13 feet away, without breaking it.

To decide whether the head of the rail got softer, Micrometer Caliper measurements were taken of depressions made under equal blows of a steam hammer, by a blunt tool hardened at the head, ¼" in diameter.

½" away from the joint the depression was 0.1432".

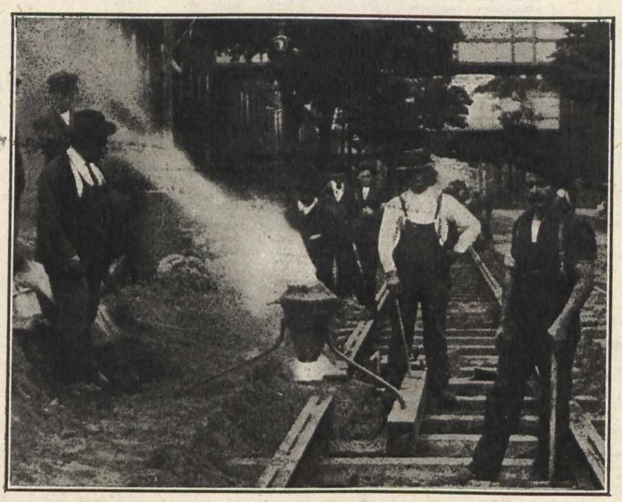
3' away from the joint the depression was 0.1596".

The electric conductivity of the Thermit joint is recognized to be higher than that of the rail, due to increase of area, and is permanent.



Welded Rudder Shoe Tugboat "Schenck."

That steel foundries should have been the first to recognize the possibilities of liquid steel that can be produced anywhere in half a minute, goes without saying. There are already several of the largest with whom Thermit is as much a necessity as foundry sand. Some prefer



Welding Trolley Rail at Holyoke, Mass.

—for no apparent reason—not to disclose the fact that they repair faults in castings by Thermit, but all can openly admit that they use it to reduce the size of their risers, an application which, through its simplicity, recommends itself to all foundries—gray iron as well as steel. Thermit thrown loosely or in a paper parcel on steel, will ignite and keep the contents of the riser fluid even after the metal has become plastic in the casting. Liquid cast iron will only ignite Thermit in the presence of the ignition powder.

The application of Thermit to reduce the piping in ingots, although very simple in itself, necessitates some liquid steel being held in readiness to fill up the piping after the solidification has been interrupted by a Thermit reaction. This should not be impossible to arrange.

Riehle Bros. Testing Machine Co.

Tests on Malleable Iron Bars Cast at Pennsylvania Malleable Co.'s Works, McKees Rocks, Pa.

Before Titanium Thermit Reaction.

	Dimensions.	Ultimate Strength, Pounds.	Deflection.
No. 1—1	1.000 x .999	4,100	1.00″
1—2	.995 x .999	4,500	.98″
1—3	Lost in anneal.		
2—7	1.060 x .998	4,540	1.28″
2—8	1.012 x 1.006	4,610	1.40″
2—9	1.006 x 1.005	4,500	1.40″
	Average before treatment.	4,450	1.212″

After Titanium Thermit Reaction.

	Dimensions.	Ultimate Strength, Pounds.	Deflection.
No. 1A— 4	1.011 x 1.010	5,920	1.30″
1A— 5	.999 x 1.000	4,260	1.27″
1A— 6	.989 x .995	4,850	1.55″
2A—10	.995 x .996	4,620	1.47″
2—A11	.998 x .996	4,410	1.37″
2A—12	1.011 x 1.000	4,810	1.44″
	Average after treatment.	4,811	1.60″

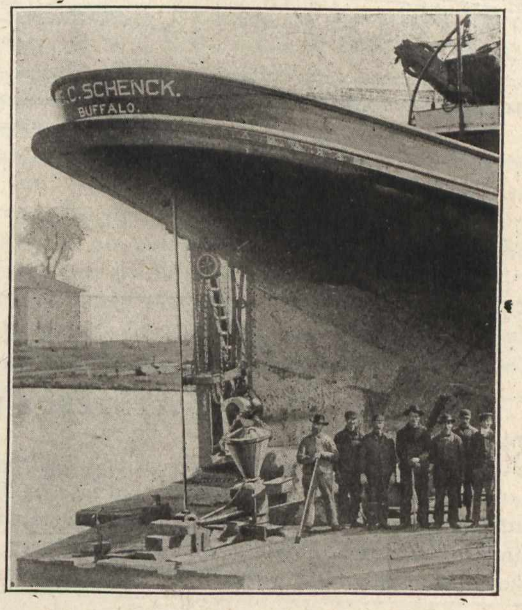
Another branch of Alumino-Thermics which will be of interest, is the improvement of gray iron castings, by the introduction of Titanium Thermit in the ladles, by immersing it in a cartridge below the surface of the metal. Some experiments, thanks to our fellow-member's, Dr. Moldenke, kind intercession, were made at the Pennsylvania Malleable Works, with the foregoing results, the bars having been poured out of the same ladles, one before, the other after, the Titanium Thermit reaction.

Experiments with lower grades of iron showed the same favorable results.

At the Featherstone Foundry, Chicago, Titan Thermit treated test bars showed a tensile strength of 3,550 lbs., against average untreated, 3,250 lbs.

The metal, after treating, is much denser, but can be easily machined.

Incidentally it may be mentioned that by the introduction of a 1½ lb. cartridge of ordinary black Thermit into an 800 lb. ladle, 40 lbs. of steel borings can be melted without difficulty.



Welding Rudder Stock of Tugboat "Schenck" on Marine Railway, Sault Ste. Marie.

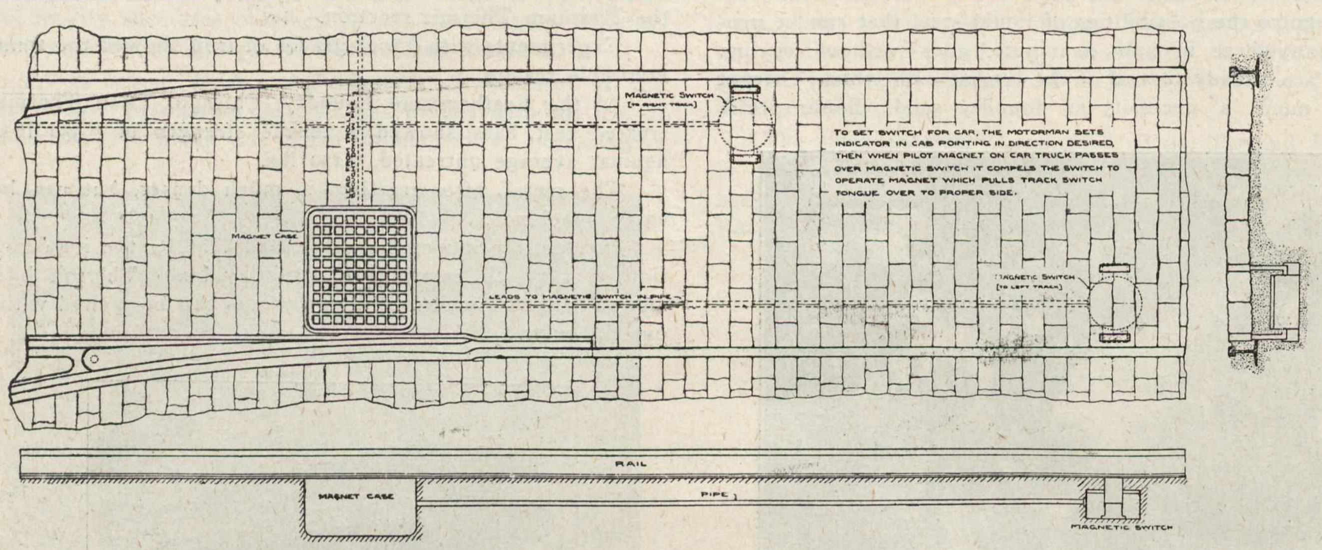
This necessarily very short account of what is doing in Thermit cannot, of course, cover the entire field of the applications, but will perhaps tend to convince those who had rather be guided by results obtained elsewhere than spend time and money from what they think experiments, and encourage others who are doubtful from lack of experience, by showing them what has been accomplished in actual practice.

Made in Germany.

For the Benefit of Canadian Manufacturers.

A circular letter has recently been issued in Prussia to manufacturers and their agents warning them against giving information of the condition of the markets and of manufacturing interests in their reports to the press, etc. The following is an extract from the letter:—"The reports in our technical and trade papers are most assiduously studied abroad, and by representatives of our foreign competitors residing in Germany. . . . The articles published in our journals and trade papers should not state the sellling prices of our manufactured goods, how their cost compares with that of similar goods produced in competing countries, of what ingredients the articles are composed, what the tariff rates are, etc. Such detailed reports, which often expose even the secrets of manufacturing, form an excellent weapon in the hands of our competitors, and serve to injure German business interests. All public reports should refrain from giving details. No complaints about bad business should be published, as this is hurtful to our export trade. . . ." The circular concludes with the suggestion that German factories should be kept closed to foreigners.—(Hardwareman).

—The Coast Line Telephone Co. has been formed with a capital stock of $1,000,000. This company will unite with other independent companies in the New England, middle and Southern States in opposition to the Bell Companies.



AUTOMATIC TRACK SWITCH ARRANGEMENT
PATENTED

ELECTRIC SWITCH.

PATENTED IN UNITED STATES AND CANADA.

This Electric Switch, the joint invention of Messrs. B. Hughes and H. Young, Montreal, is fully covered by United States and Canadian patents. The design and development is in the hands of Albert E. Smaill, Mechanical Engineer, Montreal, who is also associated with above in placing same on market.

It is essentially similar to a compass with electric contacts mounted on same center pieces as needle. The needle and contacts are magnetically held in the neutral position and the swinging to either side being controlled by two pole pieces at right angles to normal position.

The switch can be applied to any use requiring the control of electric currents without actual contact between operator and switch being required, such as a block system on railroads, or the operation of track switches on electric railways.

The switch as at present developed is arranged for the operation of track switches on electric railways, the operation being under the complete control of the motorman, and does not require the car to be slowed down or the motorman even to see the switch. It does not require any alteration to the road bed such as insulated rails, etc., and is entirely proof against all damage due to hard usage, climate, frost or wet, and is in every way thoroughly reliable.

In this application the electric switch is buried beneath the road-bed at a convenient distance away from the track switch, the outside or controlling pole pieces being carried up to the surface of the road. The leads from the switch are taken to two solenoid magnets which are in an oil filled case beside track switch.

On the car there is a pilot magnet attached to the truck in such a position that its poles will pass over the pole pieces of the electric switch buried beneath the road bed at the same time clearing them by at least four inches.

The operation is as follows:—On approaching the track switch the motorman sets the handle of a pilot switch in his cab, in the direction he wishes to go. This controls the polarity of the pilot magnet on truck which in turn magnetically affects the pole pieces in road-bed and thus causes the electric switch arm to swing over in the desired direction and close the circuit of the solenoid at track switch which in turn pulls switch tongue in proper direction.

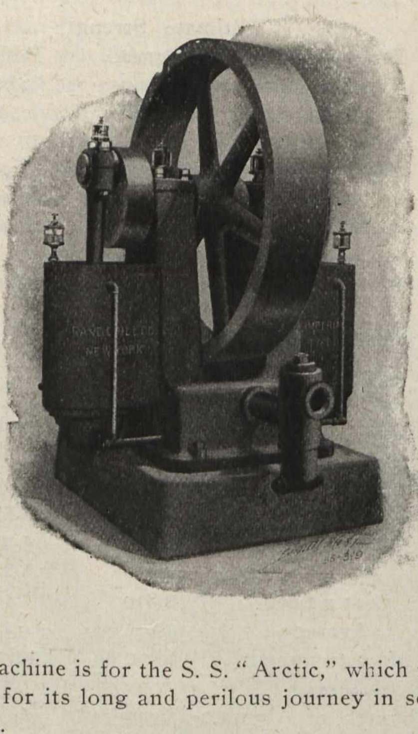
The attachment of the switch tongue is of such design that it requires very little alteration to the switch bed and leaves the tongue entirely free so that it can also be moved if desired with the ordinary switch iron.

There is also an alternative arrangement by which the switch will be brought into action by means of a locomotive or similar iron or steel mechanism passing over it. The arrangement will work equally well in all weathers.

❧ ❧ ❧

Air Compressor for North Pole.

The Department of Marine and Fisheries through their consulting Engineers, the Standard Construction Co., of Montreal, have paid the Canadian Rand Drill Co. a distinct compliment in selecting one of their Imperial Type XI - IAir Compressors for the forthcoming expedition to "Greenland's icy mountains."



This machine is for the S. S. "Arctic," which is fitting out at Halifax, for its long and perilous journey in search of the North Pole.

The compressor is to be operated by a windmill, since it is impossible to obtain fuel for steam, and the air will be discharged into several receivers at a high pressure; the air, in turn being used in place of steam to generate electricity.

ESSENTIAL ELEMENTS IN THE DESIGN OF DAMS.

JOHN S. FIELDING, C.E., TORONTO.

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ARTICLE VIII.

Table A gives the values of area, weight, adhesion S.S.F. stability mom. and O.S.F. for Fig 24[a] (similar to Fig. 24 shown on page 208), for dams having a height of ten feet, with bases varying from two feet to ten feet.

The area varies from 10 to 50 square feet.

The weight varies from 1,400 to 7,000 pounds.

The adhesion varies from 910 to 4,500 pounds.

The S.S.F. varies from .2912 to 1.4552.

The stab. mom. varies from 1,866 to 46,666 ft. lbs.

The O.S.F. varies from 1.78 to 3.628.

The pressure on the face remains constant at 3,125 lbs.

Table B we omit at present because it deals with Fig. 25, which takes account of the vert. pressure of the water.

Table C gives values of Fig. 26[a] (similar to Fig. 26 on page 207), and the variation in the values may be seen by reference thereto.

Table D gives variation of values in section Fig. 28 which, with dc or ae equal to 1 ft., or 2 ft., approaches very nearly to a scientific profile section, but changes as dc or ae is increased, until the section corresponds to Fig. 26. In this table the width of base ab equals bc in all instances, the variation being in the width of top dc and height of back face ae.

By reference to the table C it will be seen that the value of the O.S.F. increases rapidly from this point, until at section with base .9 of height, the O.S.F. is twice the S.S.F., and the need of close calculation for the overturning resultant decreases correspondingly until with a base, .8, .9, or 1.0 the height, no one would care anything about the resultant line of pressure.

With a satisfactory factor against sliding, any dam will be secure against overturning, and the use of extreme mathematical refinement in determining the section of a dam would appear to be a direct result of using too low a factor of safety against sliding.

In table C the underlined values only of S.S.F. can be considered satisfactory.

In table A none of the values of S.S.F. are satisfactory, and not until the base ab is equal to about 1.6 bc will the value of S.S.F. 2.329 be satisfactory.

In table D all excepting the first two figures have a satisfactory value of S.S.F., being 2.2 and over.

It will be noted that in all figures of table D, the base is equal to the height. The varying values of different proportions of width of base to height for each of these three figures from 28[a] to 28[k] may be given at some future date, but would take up too much space for present article.

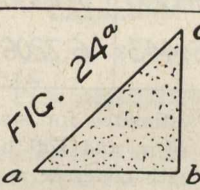


TABLE A.

bc = 10 FT. WEIGHT OF CONCRETE = 140 lbs. COEF. FRICTION = ·65

PRESSURE = bc^2 x 31·25 = 3125 lbs. OVERTURNING MOM. = 10416 FOOT LBS.

VALUE OF ab	2 FT.	3 FT.	4 FT.	5 FT.	6 FT.	7 FT.	8 FT.	9 FT.	10 FT.
AREA, SQ. FEET	10	15	20	25	30	35	40	45	50
WEIGHT IN LBS.	1400	2100	2800	3500	4200	4900	5600	6300	7000
ADHESION IN LBS.	910	1365	1820	2275	2730	3185	3640	4095	4500
S.S.F.	.2912	.4368	.5824	.728	.8736	1.0192	1.16486	1.3104	1.4552
STAB. MOM.	1866	4200	7466	11666	16800	22800	29866	37800	46666
O.S.F.	.178	.4032	.658	1.120	1.6128	2.188	2.866	3.628	4.482

J.S.F.

In any solid profile the overturning stability increases rapidly as the sliding safety-factor is increased.

The overturning stability and the stability against sliding are nearly uniform in a rectilinear section with a base of .4 of the height. As will be seen by reference to Table C, however, the safety factors O.S.F. and S.S.F. are very small.

The O.S.F., given is with fulcrum at the toe of dam, and as a heavy pressure cannot be delivered to a knife-edge in this manner, a fixed amount should be taken from all values of O.S.F. given, and if this were done, the section with base .5 of the height, would more nearly fulfil the conditions for equality of O.S.F. and S.S.F. for a rectilinear section.

Now, such a section would require to be carefully built, since it would have a very limited amount of excess strength, and it would become very desirable to secure close mathematical calculations for the stresses in such a wall, and to locate as nearly as may be done the point of delivery upon the sub-base of the overturning resultant.

Erratum on Page 209.

Adhesion = 65/100 = vertical pressure = 137,500 should be,

Adhesion = 65/100 (vertical pressure) = 137,500.

Efficiency of a Dam.

The efficiency of a dam depends mainly upon the site. In the Sodom Dam one pound of mass holds back 126 pounds of water. In the Periar Dam one pound holds back 1,260 pounds of water.

Once the site is chosen the Engineer has mainly to deal with pounds pressure on the face of the dam, since one mile of water against a dam will give precisely the same pressure as one foot.

Efficiency of a Unit of Mass.

Assume a dam to have a S.S.F. of 2, and a coefficient of friction of .65, then the efficiency of a unit of the mass will be represented by $\frac{200}{65} = 3.076$ to 1, i.e., 3.076 lbs. of mass being necessary to hold back one pound of pressure.

Now, any two designs of solid walls or profiles presenting a vertical face to the water, and having the same values of S.S.F. and coefficient, will show a similar ratio of 3.076 to 1 for efficiency of mass, so that any known rule for estimating the pressures in a mass of masonry does not in any way increase the efficiency of a unit of the mass.

If the S.S.F. be $1\frac{1}{2}$, then the ratio of efficiency will be

$$\frac{150}{65} = 2.307 \text{ lbs. of mass to hold back 1 lb. of pressure.}$$

The efficiency is improved, but at the expense of safety.

The true expression of these would be 3.076 lbs. of mass to 2 lbs. of pressure, and 2.307 lbs. of mass to $1\frac{1}{2}$ lbs. of pressure = 1.538 lbs. of mass to 1 lb. of pressure for each case.

10 feet in height	with pressure of			3125	lbs. on face		would cost	$13.45	per lin. ft.
20	"	"	"	12500	"	"	"	53.83	"
30	"	"	"	28125	"	"	"	121.11	"
40	"	"	"	50000	"	"	"	215.32	"
50	"	"	"	78125	"	"	"	336.44	"
60	"	"	"	112500	"	"	"	484.47	"
70	"	"	"	153125	"	"	"	659,42	"
80	"	"	"	200000	"	"	"	861.28	"
90	"	"	"	253125	"	"	"	1090.06	"
100	"	"	"	312500	"	"	"	1345.75	"

or cost = $13.4575 h^2 when h = height from sub-base to crest.

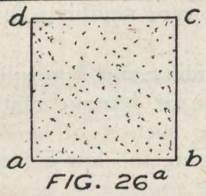


FIG. 26a

TABLE C.

$bc = 10^{FT.}$ Weight of Concrete = 140 lbs. Coef. Friction = ·65

Pressure = $bc^2 \times 31{\cdot}25$ = 3125 lbs. Overturning Mom. = 10416 foot lbs.

Value of ab	2 FT.	3 FT.	4 FT.	5 FT.	6 FT.	7 FT.	8 FT.	9 FT.	10 FT.
Area, sq. feet	20	30	40	50	60	70	80	90	100
Weight in lbs.	2800	4200	5600	7000	8400	9800	11200	12600	14000
Adhesion in lbs.	1820	2730	3640	4550	5460	6370	7280	8190	9100
S.S.F.	.5824	.8736	1.1648	1.456	1.7472	2.0384	2.32972	2.6208	2.912
Stab. Mom.	2800	6300	11200	17500	25200	34300	44800	56700	70000
O.S.F.	.286	.605	1.0752	1.6801	2.419	3.293	4.301	5.443	6.7206

J.S.F.

This is simply the expression of 1.00 ÷ by the coefficient of friction $= \frac{1.00}{.65} = 1.538$.

Now what should be sought for is the securing of an actual increase in efficiency of mass.

Using a heavy material weighing say 170 lbs. per cubic foot will give a good efficiency ratio per unit of a cubic foot or cubic yard of material.

Using a cheap class of material of great weight and strength will give a good efficiency ratio per dollar of expense, but if we can load homogeneous material with cheaper material, such as concrete with sand, gravel or broken stone or water, we will be increasing the efficiency ratio of each cubic foot of concrete to each pound of pressure, or of each dollar of cost to pounds pressure sustained.

Concrete is the material of to-day.

One cubic foot will weigh 140 lbs.

One cubic foot will cost 19.4 cents, at $5.30 per cubic yard.

One pound will cost .14 cents, at $5.30 per cubic yard, with .65 coefficient, and S.S.F. of 2 = ratio of 3.076, each pound of pressure will require an expense for concrete of .43064 cents.

These sums are probably ordinary estimates for structures with coefficient of .65 and S.S.F. of 2. and will hold good for structures with S.S.F. of 1.75 with concrete at $6, or S.S.F. of 1.5 with concrete at $7.

If the S.S.F. could be increased by any percentage, and the cost be increased by a lower percentage, then the "ratio of efficiency of the unit of mass," or unit of cost, will be increased, and this is the goal that should be sought by all designers of Dams.

On page 104 is given a section of earth loaded dam, Fig. 21, which shows S.S.F. of 2.55, weight of concrete of 1,447,600 lbs., weight of filling of 368,000 lbs., pressure of water on vertical face of 520,000 lbs.

2.783 lbs. of concrete to 1 lb. of pressure is the ratio of this section for the concrete, with S.S.F. of 1.8094 for concrete alone, but the true S.S.F. is 2.55, which gives a ratio of 1.0193 lbs. of concrete per lb. of pressure sustained.

Referring to page 6, where it was shown that all solid profiles show a uniform efficiency of 1 to 1.538 lbs. of mass, it will be seen that the above 1 to 1.0193 is a very decided gain.

The practical result of such treatment of the question is that the loaded section is shown to have a very great advantage over any possible profile of solid dam.

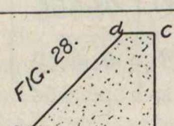


TABLE D.

$ab = bc = 10^{FT.}$ Weight of Concrete = 140 lbs. Coef. Friction = ·65

Pressure = $bc^2 \times 31{\cdot}25$ = 3125 lbs. Overturning Mom. = 10416 foot lbs.

	28A	28B	28C	28D	28E	28F	28G	28H	28J	28K
Value of dc or ae	1 FT.	2 FT.	3 FT.	4 FT.	5 FT.	6 FT.	7 FT.	8 FT.	9 FT.	10 FT.
Area, sq. feet	59.5	68.0	75.5	82.0	87.5	92.0	95.5	98.0	99.5	100.0
Weight in lbs.	8330	9520	10570	11480	12250	12880	13370	13720	13930	14000
Adhesion in lbs.	5414.5	6188	6870.5	7462	7962.5	8372	8690.5	8918	9054.5	9100
S.S.F.	1.732	1.98	2.20	2.387	2.548	2.679	2.78	2.853	2.897	2.912
Stab. Mom.	52990	58104	62008	64960	67095	68507	69370	69814	69977	70000
O.S.F.	5.087	5.578	5.761	6.236	6.441	6.577	6.655	6.702	6.718	6.7206

J.S.F.

GEAR DESIGN AND MANUFACTURE.

BY THE EDITOR.

I.

In the domain of applied mechanics, the toothed wheel—or third mechanical power as it is called—has played an important part. The delicate wheels in the mechanism of a lady's watch on the one hand, and the colossal gear of the

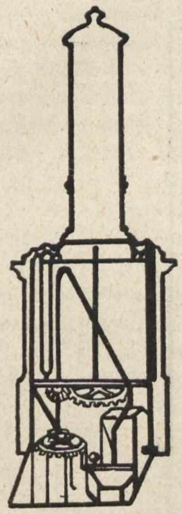


Fig. 1—Section.

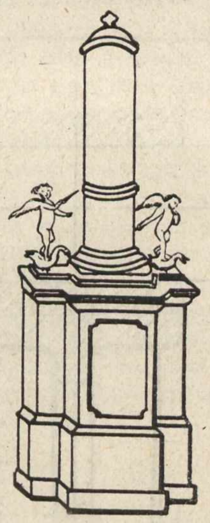


Fig. 2—Elevation.

First Application of Toothed Wheels, 120 Years B. C.

Ferris wheel at the Chicago World's Fair on the other, may be cited as extreme examples of its application. Every mine, factory and mill in the world, bears witness to its universal utility. This unique device for the transmission of power was invented by an Egyptian named Ctesibius, a member of the famous school of Alexandria—who flourished about 120 years B. C. It was first applied to operate a Clepsydra or "water dial" (Figs 1 and 2), which consisted of a cylinder resting on a pedestal. Two figures were placed on the latter, one of which dropped water from its eyes, whilst the other pointed with a wand to the hour marked upon a vertical line drawn upon the cylinder. This cylinder turned on its axis once a year, and its rotation was imparted by means of two pinions, each with 10 teeth, and two gears with 60 and 61 teeth respectively, receiving their primary impulse from a revolving bucket wheel. Many ingenious contrivances have been operated by gears since the days when Egypt was in her glory; but few have excelled in interest the appliance which first called forth the inventive genius of Ctesibius, the renowned schoolman of Alexandria.

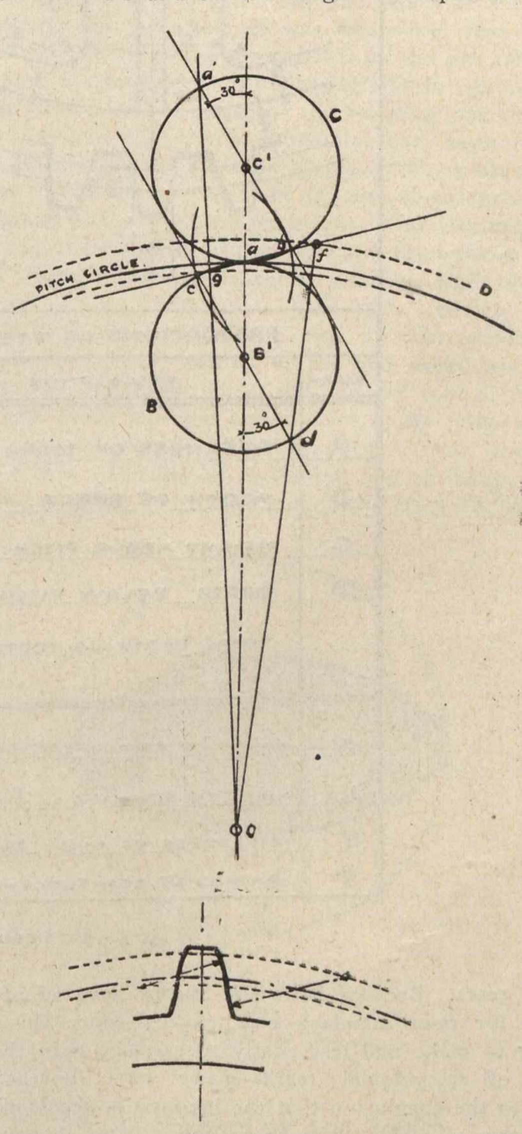
It is probable that these primitive toothed wheels were cast in bronze, for the founding of metals, especially brass, was a well known art in those days on the banks of the Nile. As far as one can gather, the teeth of these ancient toothed wheels consisted simply of square cogs on the face of circular disks, having no regard to ease of movement, lessening of friction, or saving of propelling power. It was not until nearly 1800 years later, that any marked advance in this direction was made. In the year 1674, however, a Danish mathematician named Roemer, conceived the idea of forming the contour of the teeth on the lines of epicycloidal curves developed by means of generating circles. And about the same time, De Laihre, published a treatise in which he demonstrated that "if the tooth of either a wheel or pinion be formed by a portion of an exterior epicycloid, described by a generating circle of any dimension whatsoever, the tooth of its follower will be properly formed by a portion of an interior epicycloid described by the same generating circle. The object being to obtain a uniform pressure and velocity throughout the machine, so that the wheels, whatever might be their position, would act uniformly and equally, and that the surfaces of the teeth touching at a point should roll over each other and avoid all friction."

From that time the epicycloidal form of tooth for spur wheels has been adopted as the almost universal system.

I have not deemed it necessary to describe graphically the epicycloid and involute, assuming that all are familiar with these geometrical forms; while, however, this may be true, it yet remains a fact that very few in either the average drafting room or pattern shop can develop quickly by means of generating circles the epicycloidal teeth of any given wheel and pinion. Most rely on odontographs like those of Willis, Robinson and Grant; or, charts like those of Walker. Consequently, if these "short cuts" are not to hand, the proportioning and contouring of the teeth is a very laborious and uncertain procedure; all because the method of development is not an intellectual possession applicable in all cases. But is there a simple, reliable, universal system of developing the epicycloidal teeth of gears? I verily believe that we have such a method in the geometrical formula of Reuleaux, which I have proved by extensive experience to give excellent results, as regards depth of contact and harmonious working.

The modus operandi is as follows: Assuming the total depth of tooth to be .7 of the pitch, then the formula for determining the diameter of the generating circles = pitch x 2, or, 1 inch diameter for teeth ½ inch pitch. This rule holds good no matter what may be the diameter of the wheel.

Method.—(Fig. 3) assuming pitch diameter = 8 inches, and pitch of teeth ½ inch, then pitch circle = 4 inch radius, and rolling circles C and B = 1 inch diameter. Draw two parallel lines a′C′b and c B′d through the respective centers

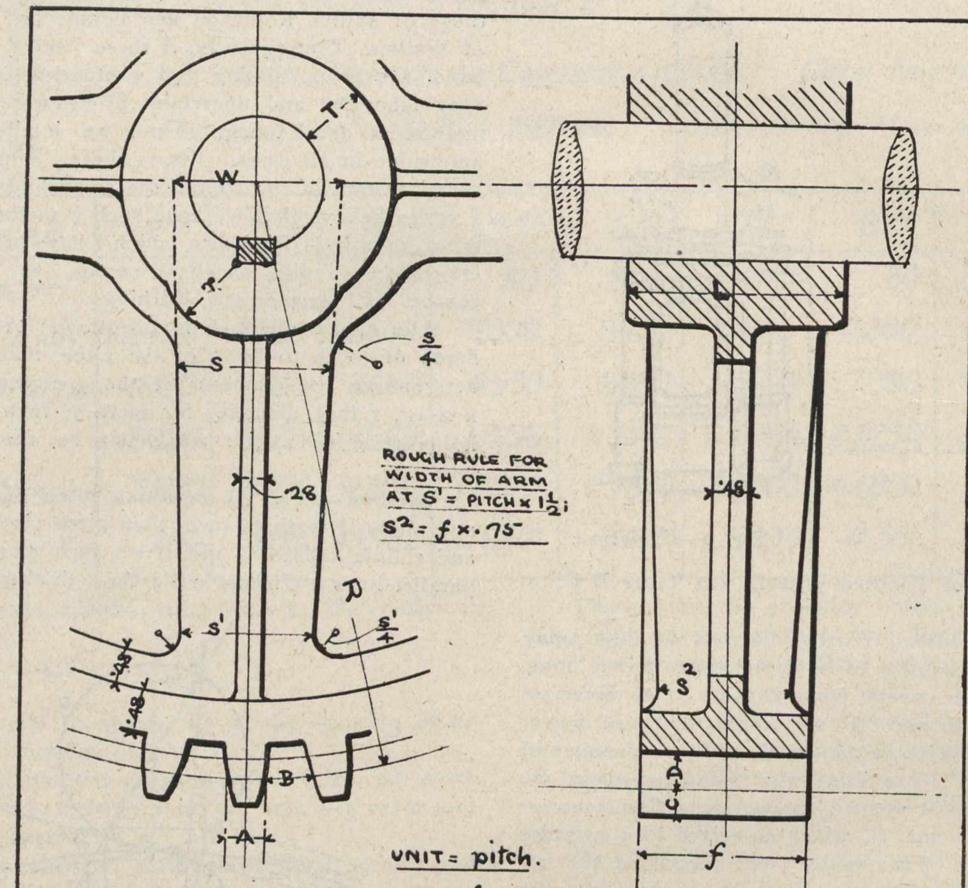


Figs. 3 and 4.

of the rolling circles, each making angles of 30 degrees with the vertical center line. Draw line c a b f through points where c b intersects the generating circles. Connect a′ and d with o, and the points where these two lines intersect line c a b f at g and f respectively, will determine the radial lines D, E, from which the radii of the upper and lower flanks f c and g b are struck.

With this demonstration of Reuleaux's simple and practically accurate geometrical method for "laying off" the epicycloidal teeth of gears, we proceed to say a word or two about involute teeth.

It cannot be denied that there is considerable difference of opinion among Engineers as to the comparative mechanical advantages of the involute and epicyloid for contouring the teeth of gears. Because Brown & Sharpe have adopted the involute for their standard gear cutters—since this shape is easier to make and less costly to produce than the dual profiles of epicycloidal teeth—many have unreasonably jumped to the conclusion that the involute is necessarily the better form of tooth. The exact experiments, however, of Hawkins, Reuleaux, Cromwell and others have demonstrated the very contrary, and have credited the epicycloidal tooth with the following advantages: (1) That the minimum number of cycloidal teeth which may be geared satisfactorily in a pair of like diameter, is 7, while the smallest number of workable involute teeth under similar conditions is 11. (2) That in cycloidal teeth less power is lost in overcoming friction than in involute teeth. (3) That cycloidal teeth, when considerably worn, retain their original shape much better than involute teeth under similar conditions. Indeed, the only advantage possessed by involute toothed gears is that the shafts upon which they are hung may be slightly varied without disturbing their harmonious working, whereas, any alteration in the centers of cycloidal toothed gears is detrimental to their accurate rotation and full efficiency. It is probably this latter fact which has induced many an Engineer in charge of rolling millls to look with favor upon the involute form of tooth; for the operating mechanism of a train of rolls or a bloom shear is constantly subjected to such terrific shocks and abnormal strains, that it is next to impossible to keep the journals free from excessive wear, and the shafts from getting out of line. Had not steel gears come upon the scene, we should doubtless have heard more about the relative merits of the involute and the cycloid. The discussion was silenced by the advent of costly steel castings, excessively proportioned.



PROPORTIONS OF TEETH.		EPICYCLOIDAL TEETH			SHORT TEETH
MARK	DESCRIPTION	SPUR	BEVEL	HELICAL	SPUR
A	THICKNESS OF TOOTH.	.48	.47	.46	.48
B	WIDTH OF SPACE.	.52	.53	.54	.52
C	HEIGHT ABOVE PITCH LINE.	.31			.193
D	DEPTH BELOW PITCH LINE.	.39			.243
	TOTAL DEPTH OF TOOTH	.70			.436

W	WIDTH OF ARM AT CENTRE OF GEAR = $\sqrt{\frac{f \times R}{n}}$ — f FACE OF TEETH. R RADIUS OF GEAR AT PITCH LINE. n NUMBER OF ARMS.
L	LENGTH OF HUB = $f + \frac{1}{20}R$.
T	THICKNESS OF HUB = pitch x .89 - to pitch, with small pitches.
r	RADIUS OF REINFORCEMENT = ($T + \frac{1}{8}$" FOR SMALL PITCHES. $T + \frac{1}{4}$" FOR LARGE PITCHES.

Fig. 5.—Proportions of Machine Molded Gears.

Until very recently, the aim of every designer of toothed wheels was to get two or more teeth in gear at a time. To accomplish this, it was necessary that the teeth should be long, and seven-tenths of the pitch became the standard length. In calculating the horse-power of a gear, the tooth was always recognized as a cantilever, liable to be broken off at its root by a lever strain. The new departure consisted in so proportioning the tooth, that the old lever strain was transformed into a shear strain; instead of breaking off, it had to be pushed off. This desired economy was attained by reducing the length of the standard tooth from .7 to say .5 of the pitch, and shaping the flanks in such a manner that although there was only one tooth in gear at a time, yet wherever gears with this short tooth were practically applied, they rolled so noiselessly and with such manifest power of resistance, that the spectator could only stand and wonder why long teeth should ever be used for the transmission of high powers. It was my good fortune to be the first person in the United States to publicly advocate the adoption of the "one tooth in gear system" for high powers; articles which appeared under my signature in the American Manufacturer and Iron Age of October 18th, 1894, also the Pattern Maker's Journal and The Foundry, for November of the same year, all setting forth the general advantages of the system, and detailing instances of its practical application.

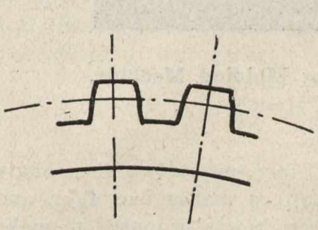


Fig. 6.—Short Tooth.

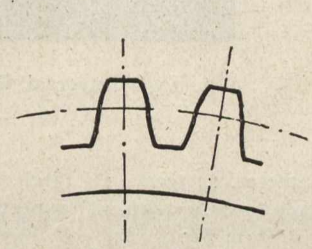


Fig. 7.—Long Tooth.

Fig. 6 represents a reduced outline of short teeth 6-inch pitch, as cast on two gears 8 feet—2 inches diameter x 18 inches face, each weighing 9¼ tons each, made for the tin plate rolling mills at the La Belle Iron Works, Wheeling, W. Va.

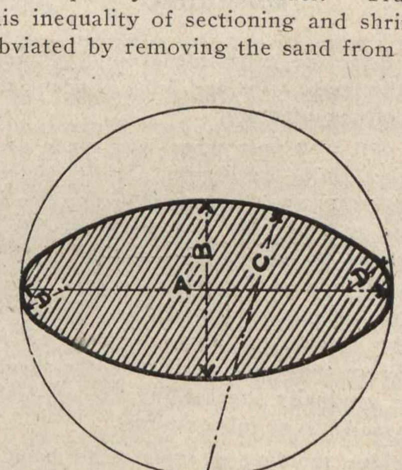
Fig. 7 shows standard epicycloidal teeth of like pitch, for the purpose of comparison. In the spring of 1895, the 13-inch "Belgium" mill of the National Rolling Mills, McKeesport, Pa., was disabled owing to the breaking of a large steel gear 8 feet 4 inches diameter—with its complimentary pinion having triple staggered teeth. As many as six teeth in a row were torn out at the roots. Gears with Double Helical teeth had failed previously. I was requested by the Engineer to investigate the case, and without hesitation, undertook to design a cast-iron gear and a pinion with straight, spur teeth, having only one tooth in gear at a time. The offer was accepted. The gear was 8 feet 4 inches diameter, 7-inch pitch, 22-inch face, weighing 12½ tons, and the pinion 4¼ tons. This pair ran uninterruptedly for some five years, until the plant was torn out for more modern equipment, demonstrating that with properly designed short teeth, instead of long teeth, gears made of cast iron may succeed, where even steel proved a miserable failure.

Indeed, one could occupy the whole of the space at my disposal, in the citation of trustworthy facts showing the unwisdom of using teeth .7 of the pitch on large spur driving wheels and pinions transmitting great powers and running at high velocities: for the evidence is over-whelming as to their unfitness to resist wear and tear. On the other hand, one could advance case upon case, instance upon instance, proving the remarkable adaptability of short teeth .5 of the pitch—or less, working under like conditions—to successfully resist the wear and tear of actual work. My object, however, is not to do a piece of special pleading in defense of a "fad," but to still further popularize an idea, the practical adoption of which, I believe, would be on the lines of progress and economy, and I may be permitted to remark in concluding this part of the discussion that when the one-tooth-in-gear system comes into general use for high powers—as it assuredly will—then high-priced, irregular gears of the Double Helical and Staggered tooth type —which are almost impossible to mold with the necessary degree of accuracy; which are exceedingly difficult to set on their shafts; and which are, after all, of questionable advantage—will be relegated to the limbo of curiosities; for spur wheels with short teeth embody all the advantages claimed for these irregular gears as regards strength, and at the same time are manifestly superior as regards mechanical adaptability and practical application.

Having dealt with the question of teeth, we now pass on to the allied subject of the spokes, or arms. The most artistic form of arm is undoubtedly the oval, but its use is limited to comparatively narrow faced gears, for its minor axis is parallel to the face of the teeth, thus leaving a portion of the rim on either side of the arm unsupported, consequently it is usual to introduce—sectional arms into gears with wide faces; since by this form, the entire face is supported without excess of metal, while the strain upon the teeth is equally distributed throughout the entire plane of the gear.

Arms.

In the general designing of a gear wheel there is a factor of supreme importance which one has ever to keep in mind, and that is the necessity of attaining uniformity of section, with a view of realizing uniformity of shrinkage. I well remember—among other instances of the deplorable consequences of neglecting this law of uniform sectioning—one remarkable case: A gear wheel had been cast one evening, and the next morning was brought out of the foundry to the cleaning ground. About noon a noise was heard like the report of a cannon. Upon examining the wheel, it was discovered that one of the slender cross arms had separated from the rim and there was a space of nearly ⅝ inch; indicating that the rim had been in terrific tension. The cause of the bursting was this; the gear—for which this was a substitute—had been broken through the rim, owing to some severe shock or blow; consequently it was ordered to make the rim about three times the thickness of the tooth on pitch line. This was done, and it made the sectional area of the rim about three times that of the arm where it connects to the rim; hence, when the gear was cast, the metal in the arm cooled much more quickly than that in the rim, so that finally, the comparatively delicate section of the arm could not resist the enormous shrinkage pull of the hub and root of the arm on the one hand, and the heavy mass in the rim on the other, and consequently burst asunder. True, the fatal effects of this inequality of sectioning and shrinkage might have been obviated by removing the sand from the hub and



A = Width of Arm.

$$B = \frac{A}{2},\quad C = \frac{3}{4}A,\quad D = \frac{A}{8}$$

Fig. 8.—Diagram of Arm Section.

the rim of the newly poured casting, thus accelerating the cooling of these massive parts, and balancing the cooling rate of the lesser arm sections. But there is no need for resorting to these tricks of the foundry, if the law of equal sectioning is observed. In subsequent practice, the object lesson cited was a constant reminder of the necessity of making the arms and rim of a gear as nearly of equal sectional area as the circumstances of the case would permit. It is a sound practical rule in gear design to make the thickness of the rim equal to the thickness of the teeth on the pitch line—for gears without shrouds.

The diagram shown, Fig. 8, indicates the best modern practice of proportioning arm sections. The taper should be = ½ inch per foot, or, ¼ inch per foot per side for large gears; and ¾ inch per foot; or, ⅜ inch per foot per side for small gears.

Hub.

Again, some Engineers have strange notions about keys and keyseating. A small shaft may occasionally be seen with an abnormally large key, hence the metal between outside of the gear hub and the corner of the keyseat in same is very meagre. Many a gear wheel has been torn from its shaft, the tear having been caused by an oblique rent starting at the corner of the keyseat, in accordance with the law that the strongest part is its weakest point. It is an excellent device to re-inforce all hubs over their keyways (Fig. 9), by taking the corner as a center, and striking a radius equal to thickness of hub + ⅛ inch for small, and thickness of hub + ¼ inch for large bores. By so doing the thickness of metal in the hub may be reduced to a minimum, thus still further contributing to an equalization of section, and consequently a sounder and stronger casting.

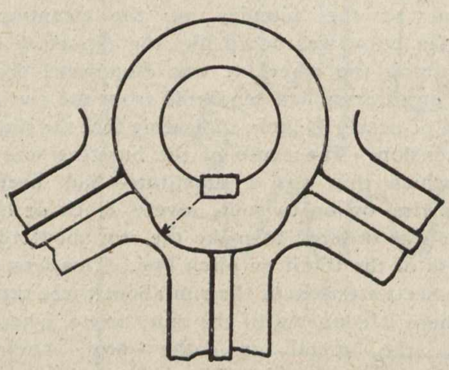


Fig. 9.

II.

Manufacture.

We now leave the debatable ground of opinion in the designing of the teeth, arms and hubs of gears, for the practical domain of manufacture

The first cast iron gear wheel was made about 1782, at the Coalbrooke Dale Ironworks, Staffordshire, England. Until about 25 years ago, the common practice in the foundry world was to make the castings from full patterns, or in some instances, by means of a section of the rim, while in others the teeth were formed in cores. About the year 1870, however, Jackson, of Manchester, England, began to make gears by machinery, doing away with full patterns altogether. From that time until now the machine molded gear has been gradually superseding the old-fashioned hand molded gear, made from full patterns.

That machine molding is superior to hand molding in the manufacture of gear wheels needs in these days of enlightenment no elaborate proof. Pattern molded gears are necessarily defective, for the diameter at the opposite ends of the teeth must be unequal owing to the draft given to the pattern, while the rapping needed to draw the pattern oft-times causes the wheel to be out of round. Besides, who ever saw a full pattern drawn without patching? It is claimed that the defect due to draft is practically overcome by careful meshing the gears with "cope" and "drag" together. A manifest fallacy, for if the teeth are tapered, their driving contact can only be at the extreme ends, and not across the entire flanks, which accounts for the common experience of the breaking of gear teeth at the corners. But even where the first castings from complete wooden patterns are fairly accurate, the rapping and soaking with water essential to the withdrawal of the pattern from the sand causes it to warp, so that when the pattern is taken out of the store for subsequent castings, it is found to be so radically out of shape that another expensive pattern has to be made. Then again, look at the area needed to store these complete patterns, especially the large size! Further, take the matter of pattern expense. A full pattern, say 40 inches

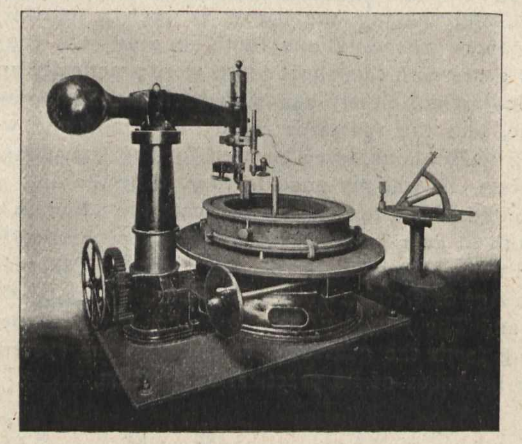


Fig. 10.—Universal Gear Molding Machine.
(Groves' Patent.)

diameter, 84 teeth, 1½ pitch, 4½ face, properly and strongly made, would take an expert pattern maker five days, and cost from $20 to $25. If, however, it was proposed to make a gear of the same dimensions on a machine like the one illustrated (Fig. 10), the only pattern needed would be a block having the form of a single tooth space for making the

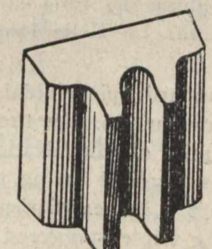
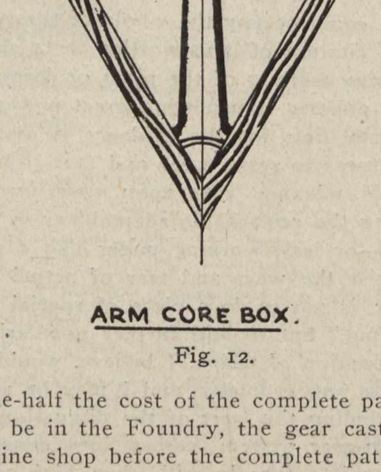


Fig. 11.—Tooth Block.

tooth molds (Fig. 11) a sweep for forming the tooth backing, a box for making the green sand arm cores (Fig. 12), and another plain box for making the dry sand center core. These preparations would be made in about two days, at



ARM CORE BOX.

Fig. 12.

less than one-half the cost of the complete pattern, and the work would be in the Foundry, the gear cast, cleaned, and in the machine shop before the complete pattern was even into the foundry. Besides, with ordinary care, 100 castings could be made off these preparations without any appreciable diminution in the matter of accuracy and finish. Fig. 13 shows a photographic print of a pair of large short toothed gears, 74-inch .50 pitch, diameter, 78 teeth, 3-inch pitch, 8-inch face, double shrouded, weighing about 1¼ tons each —made on the machine illustrated (Fig. 10). The feature about these wheels is that neither hammer nor chisel was used in the cleaning of the teeth, for upon hoisting the castings from the sand the burnt facings simply peeled out of the tooth spaces, leaving a bright smooth skin, having the appearance of cut gears; indeed, gears made with this degree of perfection are immeasurably superior even to cut gears, since, although the latter give smooth running, they do so at the expense of the life of the wheels, by the cutting away of the hard skin of rich combined carbon from the flanks of the teeth, leaving the opener grained metal for a wearing surface. In fact, so superlative are the advantages of molding toothed wheels by machinery—namely, in the

(1) Absence of costly patterns.

(2) Abandonment of draft, and

(3) Greater accuracy of pitch—

that the passing of the antiquated hand molded pattern gear is only a matter of time, for increased economy and mechanical efficiency are factors which the progressive Engineer can not afford to disregard.

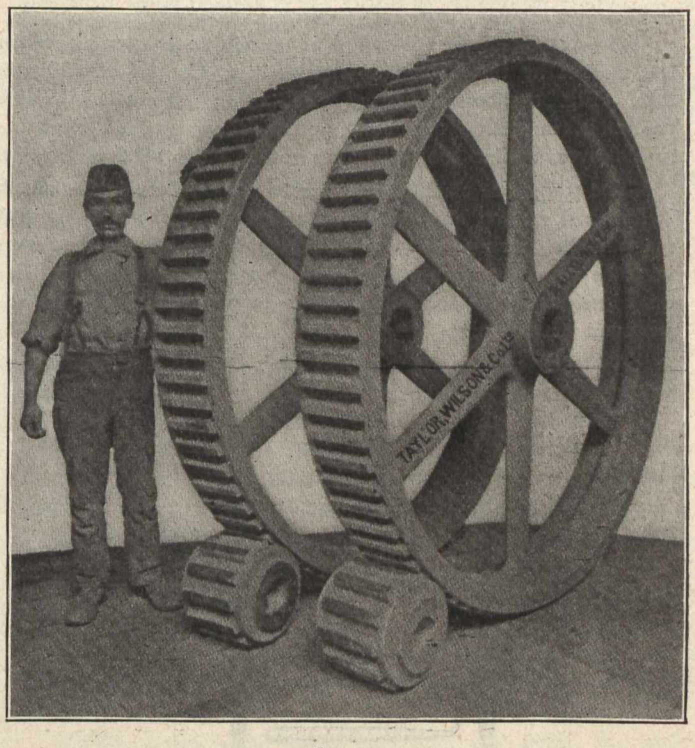


Fig. 13.

GAS PRODUCER POWER PLANTS.

BY SAMUEL S. WYER.

Before the American Institute of Mining Engineers, Samuel S. Wyer of Columbus, Ohio, recently read a paper on gas producer power plants. He attributes the fact that such plants have received but little attention in this country to five conditions: Ignorance and prejudice, newness of the work, inflexibility of gas engines, the fact that fuel economy is not imperative, the fact that we are not determined to be rid of the smoke nuisance.

Mr. Wyer stated that the manufacture of producer gas is an old process and the gas has reached a high stage of development so that such installations should no longer be regarded as experiments. It is necessary, however, that the power plant shall have its engine adapted to the gas which it is to use. Westinghouse, Church, Kerr & Co. states that an engine which will develop 100 horsepower with natural gas will give only 80 horsepower with producer gas, thus losing 20 per cent. in capacity; for a 200-horsepower engine this loss will be 15 per cent. and for sizes more than 300-horsepower the loss will be 10 per cent.

A point which is often overlooked in considering the producer gas plant question is the fact that such a plant is, by its very nature, a solution for the smoke problem. No smoke can escape into the atmosphere and no chimney is required.

For operating a gas producer plant the labor required is about the same as for a steam plant of the same size. There is an advantage for the producer plant in the fact that when no power is being produced little attention is required, and there is practically no fuel consumption. No greater skill is required in handling gas engines than steam engines, but sometimes a man trained to the handling of steam apparatus takes a little while to become accustomed to gas apparatus.

Data of cost of installation are given as follows, by two engineering concerns: "The cost of gas power plants, including gas generating plants and gas engines, up to 500 horsepower, is about 25 per cent. higher than the cost of a steam plant of the same size. Large plants from 1,000 horsepower upward cost about the same as a first-class steam plant of similar size."

A producer gas plant must be able to make gas sufficiently clean for use in an engine from a low-priced fuel, bituminous slack being usually the most available. Sometimes, however, anthracite culm or wood may be cheaper. In any case the percentage of sulphur must be low, if the gas is to be used in an engine.

For removing tar and volatile hydrocarbons from gas made from bituminous coal, the only reliable way so far used has been to bring the gas in contact with an incandescent bed of charcoal. Centrifugal apparatus has been tried, but without success. Fine dust can, however, be removed by centrifugal fans.

Quickness of bringing into service after a period of idleness is one advantage of the producer plant, as it can be worked at full capacity within 15 minutes of the time of starting. The producer may be stopped instantly by shutting off the supply of air and steam.

Eighty per cent. is in most cases the thermal efficiency of gas producers, although it is sometimes higher. Twelve pounds of coal per square foot of grate area per hour is the best rate determined by experience for gasification, but some makers advise as high as 20 lbs. The lower rate is, however, more likely to give a uniform gas. Difficulty has been found, when using bituminous coal, with the forming of clinkers and the production of coke. Using a steam blast automatic feeding, which reduces caking to a minimum, adds to the efficiency of the apparatus and lessens the difficulties.

Producer gas varies in calorific value from 125 to 150 British thermal units per cubic foot. With gas of this value, a brake horsepower is often produced from 1 to 1¼ pounds of coal per horsepower-hour. In localities where water is scarce, the producer gas system often is a helpful solution to the power problem. With a gas holder, it is also possible to make and store up heat energy for use in times of excessive load. Floor space required for gas holders, producers and auxiliary apparatus is about the same as that required for engines and boilers of the same power. As there is no condensation of the gas in piping, it may be carried several thousand feet if desired, since the cooler the gas the better it is for use in the engine.—The Engineer.

NEW MACHINISTS' TOOLS.

The accompanying cuts show some new tools now placed on the market by the Brown & Sharpe Mfg. Co., of Providence, R.I. Fig. 1 shows improved steel beam trammels. These trammels, in design and construction, show marked improvements over similar tools that heretofore have been obtainable.

The trams are clamped by knurled nuts to the beam, which is flattened on top and the thrust taken by washers to prevent marring the bearing surfaces. A spring friction holds the trams in place when the nuts are loosened for setting. One tram has an adjusting screw and slide, which is convenient for fine adjustment of the points.

A swivel handle at the top of each tram is a noticeable advantage, as it enables the trammels to be much more conveni-

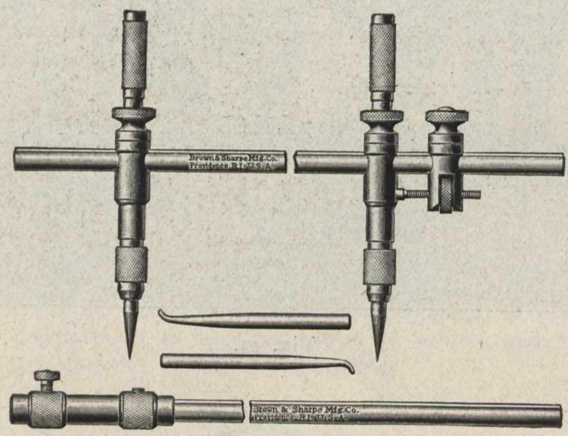


Fig. 1.

ently and accurately used than is possible with fixed handles. The adjustable points are held by spring chucks and can be removed easily and replaced by pencil or other special points.

A pair of calipering points is furnished with these trammels. With the beam regularly supplied, the trammels will describe a circle 26-in. in diameter, but an extension beam that will allow the trammels to describe a circle 54-in. in diameter is furnished when desired.

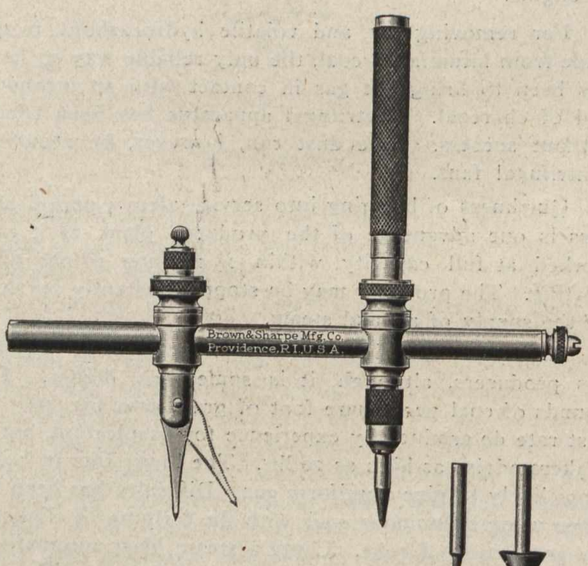


Fig. 2.

The Universal Dividers, shown in Fig. 2, have many points of excellence in design and construction. The scriber point holder has both a fine and a quick adjustment; the fine adjustment is obtained by a screw, enclosed in the beam, which engages the nut on the scriber point holder. By pulling up the small knurled knob, shown at the top of the post, the screw is released and the post can be quickly adjusted; this knob springs into place as soon as released.

The scriber point is adjustable either side of the centre, as shown by the dotted lines, and can be set for scribing small circles or for working close to a shoulder. The adjustable centre point is held by a spring chuck and can be removed easily and replaced by pencil or other special points. The posts are clamped by knurled nuts and held in place by spring friction when the nuts are unclamped for setting the points.

A V point is furnished for use in describing a circle about a hole already drilled. A caliper point is also included. The beam is 4-in. long and the points can be set to describe a circle 8-in. in diameter.

THE FRANKLIN AUTOMATIC CONTINUOUS FEED ELECTRIC BLUE PRINTING MACHINE.

The machine illustrated in Fig. 1 is made in Canada and will make either continuous or single prints of any length

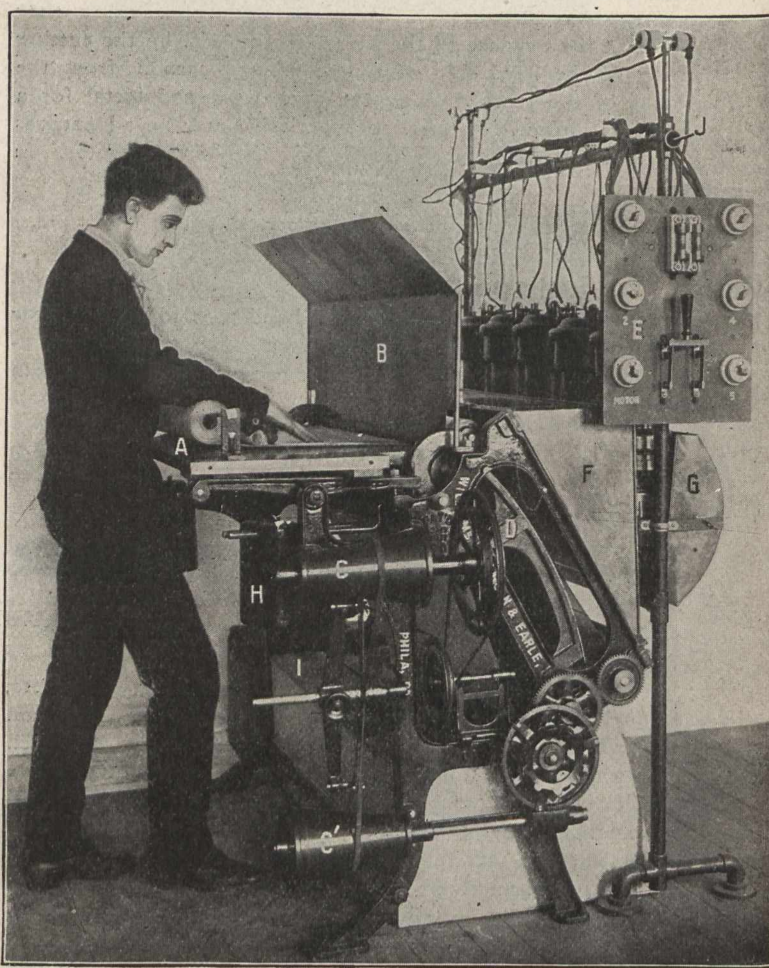


Fig. 1.

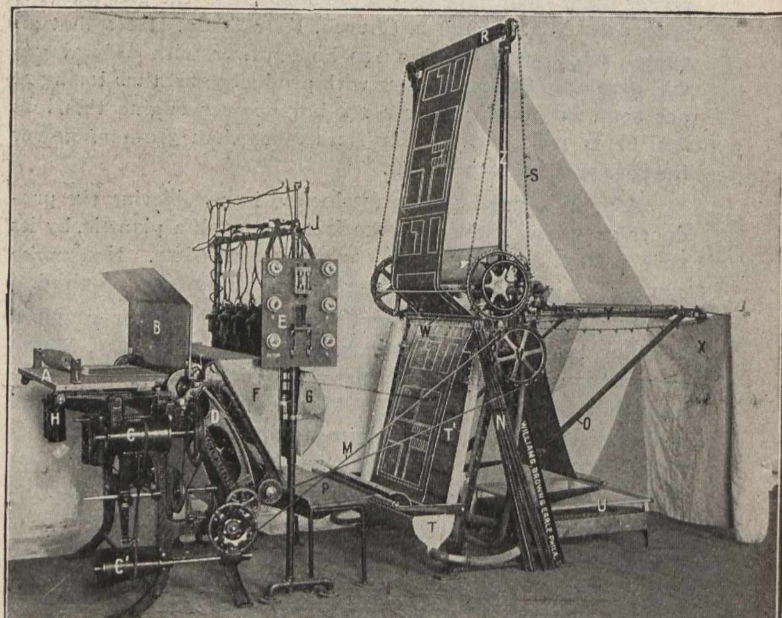


Fig. 2.

from tracings by electric light. Itt is operated by electric motor.

In Fig. 2, the Blue Printing Machine, is shown in combination with the Franklin Blue Print Washing and Drying

Machine. The operation of the machine is exceedingly simple. A roll of blue print paper is placed at A, and with the tracing passes over the printer, and is printed by a light from five electric lamps. The tracing automatically drops off and the paper continues under board P into the washing trough and under the roller T. It then passes upwards towards W. A constant spray of water is thrown over the surface of the paper at W and runs over the entire surface to T. The paper then passes over the rollers above W over the top roller R, the back roller X, the lower roller at U, and is wound up on a roller provided for that purpose. A gas or steam heater at U supplies sufficient heat to dry the paper perfectly. The prints are then ready for immediate use. Separate prints may also be washed and dried as easily as on the separate print machine.

The patent rights of the above machines are controlled by The Hughes, Owens Co., Limited, stationers, Montreal.

CAMERON PUMPS IN THE BROOKLYN AND MANHATTAN TUNNEL.

The expenditure of millions of dollars in Greater New York in subways and tunnel work is attracting considerable attention, owing to the difficult engineering problems encountered and sub-surface tunneling methods employed by the various contracting firms who are executing the work.

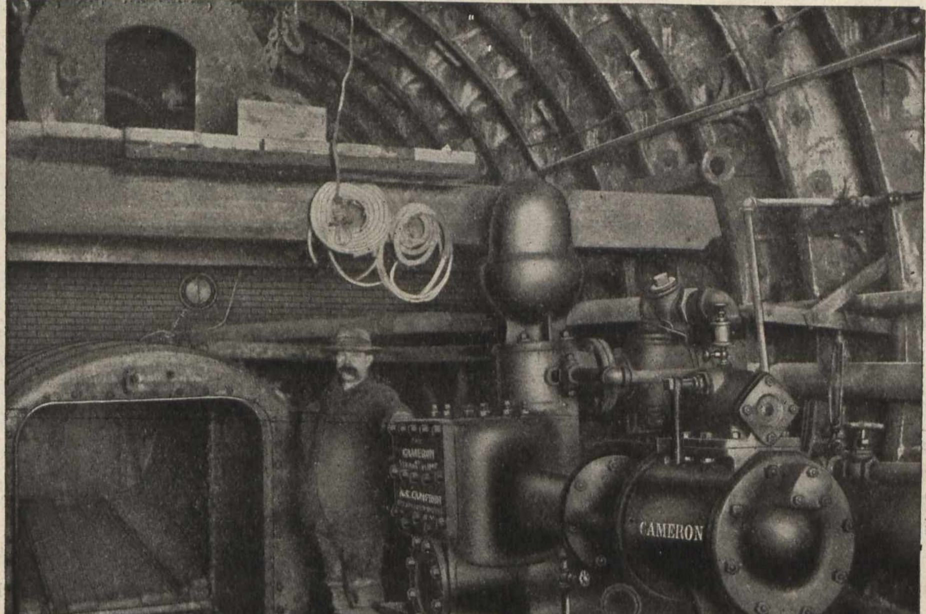
The accompanying illustration shows a photographic view of the Brooklyn and Manhattan Tunnel Pumping Station, situated on the Brooklyn side in the tunnel. This tunnel is now in the course of construction under the East River, the Brooklyn shaft being at Furman and Jaroleman streets, and will connect the Brooklyn Subway with the Interborough Rapid Transit Subway at the southern end of Manhattan Island in Battery Park.

The overhead construction of the tunnel is clearly shown with the sectional cast-iron lining.

plished through the two air locks, which are also shown in the view. The lower air lock, which is 6 ft. 6 in. in diameter, is used for the exit of material, which is removed by cars on a trackway. The upper air lock is an emergency lock for use by the men in escaping in case of the flooding of the tunnel.

The accumulation of water in the excavation is forced out of the air chamber by means of the air pressure through a pipe built within the bulkhead, the water thus falling to a sump outside of the wall, from which it is pumped to the surface, the lift being 60 feet.

Owing to the water being very dirty and gritty, the water cylinder of this pump is supplied with a removable iron bushing. The pump is operated by compressed air, the exhaust of which is delivered into the compressed air chamber of the tunnel, where it is again utilized.



Soon after ground was broken for the tunnel, it was necessary to install a pumping plant to provide for the disposition of the water, and the accompanying illustration shows a Cameron Regular Pattern Piston Station Pump, 14-in. by 10½-in. by 18-in., of the light service type, in position in the tunnel, about 100 feet from the Brooklyn shaft.

By a careful observation of the left-hand side of view, the reader will notice a bulkhead, consisting of a solid brick wall built across the entire tunnel. This wall is built entirely of brick, being three feet thick, and heavily braced witn timbers, and forms the compressed air chamber situated on the further side of the bulkhead, where the air pressure is maintained at 20 pounds per square inch. The tunnel is being driven by the "Pneumatic Shield" method.

The entrance into the workings of the tunnel is accom-

The Cameron pumps are especially adapted for this work, being compact and strongly built, having few working parts, and no outside valve gear or rods to become broken or to get out of alignment. The construction of their operative mechanism is such as to give equal efficiency with compressed air or with steam. They are the product of The A. S. Cameron Steam Pump Works, having their general offices and works at the foot of East 23rd St., New York.

Over a score of Cameron horizontal plunger and piston pumps are in service at the various parts of this tunnel; in fact, over a hundred are solving the unwatering problems in numerous parts of New York's subways and tunnels.

Mr. W. I. Aims is the Engineer in charge of the work for the New York Tunnel Company, and to him we are indebted for the foregoing information and illustration.

EXTRACTS FROM AN ENGINEER'S NOTE BOOK.

Cylinder Bolts.

A bolt must break by a combination of tension and torsion. According to no less an authority than Professor Unwin, .13 of the bolt area is devoted to resist the torsion. It is the usual practice to allow for both by taking as a safe stress a low value, and of course the breaking area is the thread bottom. For steel bolts for cylinders the stress taken is 4 tons per square inch. No faced joints (unless they are very small ones) should have bolts of less than ¾-in. diameter. Otherwise the bolts may be broken simply by screwing them up.

In finding the diameters of bolts for cylinder cover the circumferential pitch is usually a definite multiple of the bolt diameter. If D_1 be the diameter of the bolt circle, and d_1 the diameter of the bolt at the bottom of the thread, then πD_1 is the circumference of the bolt circle, and kd_1 is the pitch (circumferential).

The strength of any one bolt is = bolt area $\times$ stress allowed in pounds.

$$= \frac{\pi d_1^2}{4} \times f_t .$$

The number of bolts is $\frac{\pi D^1}{k d^1}$.

Hence total strength $= \frac{\pi D^1}{k d_1} \times \frac{f_t \pi d_1^2}{4}$

If p be the maximum pressure in pounds per square inch on the piston, then total load $= \frac{\pi D^2}{4} p$.

Therefore, $\frac{\pi d_1}{k d_1} \times \frac{f_t \pi d_2}{4} = \frac{\pi D^2}{4} \times p$.

From which equation we can get

$$d_1 = \frac{7}{22} \times \frac{k p D^2}{f_t D^1}$$

Strength of Cylinders and Pipes.

If a hemispherical vessel be hung by a string and subjected to an internal pressure it moves neither to the right nor to the left. From this it is evident that the total pressure on the curved surface is equal to that of a projected surface of the same diameter. So that in any pipe of diameter d, if p pounds per square inch be the internal pressure, and if it be the thickness in inches, then $p d = 2t \times f_t$ where $= f_t$ tensile stress allowable in pounds.

This is the fundamental formula upon which all calculations for pipes and cylinders are based. If the pipe is riveted, allowance must be made for the efficiency of the riveted joint. Or if the pipe be brazed an allowance must be made. The above remarks do not hold for thick cylinders in which the stress at the inner surface is not the same as at the outside.

A usual casting rule for steam cylinders is $t = .18 \sqrt{d}$ and the cylinder body is usually a quarter of an inch thicker than this, in order to allow for reboring.

To Design a Connecting-Rod.

The length of the connecting-rod is usually a certain factor of the length of the stroke of the engine. Let us assume that the length of the connecting-rod has been fixed upon as being 36 inches. We can obtain the diameter of the rod if we consider it as strut hinged at the ends; we can use Rankine's formula:—

$$\text{Buckling load} = \frac{f_c a}{1 + \frac{4c}{n}\left(\frac{l}{k}\right)^2}.$$

In this formula a = area of cross-section of rod in inches $= \frac{\pi d^2}{4}$ and l = length of rod in inches. For a rod of circular section $k = \frac{d}{4}$.

In order to find the buckling load we must find the total pressure on the piston, which is:

$$P = \frac{p \times \pi D^2}{4}$$

In this case f_c may be taken at 21.4 tons and a factor of safety of 8 allowed.

In the case of an engine, designed by the writer, I find that the total pressure on the piston came to 11,000 lbs. The length of connecting-rod was fixed at 36 inches.

Substituting, therefore, these values in order to find the value of d (the greatest diameter of the rod) in inches, we get,

$$11{,}000 = \frac{21.4 \times 2240 \times \frac{\pi}{4} d^2}{\left(1 + \frac{4}{30{,}000} \times \frac{36 \times 36 \times 16}{d^2}\right) \times 8}$$

or

$$21.4 \times 2240 \times \frac{\pi}{4} d^4 = \frac{36 \times 36 \times 16 \times 4 \times 88}{3} + 88{,}000\, d^2.$$

From which equation we obtain that:

$$d^2 = 2.59.$$
$$d = 1.61.$$

In such a case the diameter of the connecting-rod would be taken as 1¾-in.

Designing a Valve Rod.

In the same engine I find that a **D**-slide valve has been used, and that the dimensions of the rod are 13 inches by 16 inches.

The steam pressure in the chest was 51 lbs. per square inch. The coefficient of friction in such a case is taken as .2. We therefore find that the total pressure to be taken by the rod is (in pounds).

$$= 51 \times 13 \times 16 \times .2 = 2{,}200 \text{ lbs.}$$

For the rod we allow f_t as 10,000 lbs., and to find the diameter of the rod we have

$$\frac{\pi}{4} D^2 \times 10{,}000 = 2{,}200.$$

For this D equals (nearly) ⅝-in. It is probable that in such a case the rod (on account of possible bending) would be made ¾-in.

The Bolts or Studs for the Cover.

It is necessary, in order that the cover joint may be well made, that the bolts should not have a greater distance between them than five times the diameter of the bolt. Again, not less than a ⅝-in. bolt should be used, because an attendant on screwing up a smaller bolt, is very likely to break a stud off.

To take a concrete example, with a cylinder 8½-inches in diameter, the number of bolts under the above rule works out at twelve. The initial steam pressure of 155 lbs. per square inch gives a total pressure on the cylinder cover of 8,500 lbs.

If we allow a stress of 4,000 lbs. per square inch on the bolts (twelve in number) used, we find that these bolts would be strong enough for a total pressure of

$$\frac{\pi}{4} \times (⅝)^2 \times 12 \times 4{,}000 = 14{,}700.$$

Consequently the ⅝-in. bolts are quite strong enough for our purpose.—(Engineering Times.)

The Canadian Engineer.

ISSUED MONTHLY IN THE INTERESTS OF THE

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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Editorial matter, cuts, electros, and drawings should be sent whenever possible, by mail, not by express. The publishers do not undertake to pay duty on cuts from abroad. Changes of advertisements should be in our hands not later than the 10th of the preceding month.

TORONTO, CANADA, AUGUST, 1905.

CONTENTS OF THIS ISSUE.

Important Announcements.

Our July issue has been entirely exhausted.

Owing to very serious business reasons, the proprietors of "The Canadian Engineer," have been constrained to dispense with the services of their late advertising agent, Archibald W. Smith. The new Advertising Representative is Mr. J. J. Salmond, who was at one time on the staff of "The American Machinist," and is himself a practical machinist, having worked at the bench for over eight years. For the last three years he has been the successful advertising representative of "The Monetary Times." Advertisers of machinery can be assured, therefore, that their goods will be displayed advantageously in our columns.

We regret that lack of space has shut out this month, the copyright articles on "Descriptive Metallurgy of Iron and Steel," and "System in Industrial Workshops." This omission has troubled us not a little, knowing the interest they have evoked. They will, however, appear in our September issue, and continue serially throughout the year.

The Industrial Outlook.

Montesquieu,—in his "Spirit of Laws,"—says: "Happy is the nation whose annals are dull." There is nothing spectacular in the foundation laying of a large engine, wide-span bridge, or lofty building; but how necessary it is that the concrete beds and huge stones should be well laid, if the machines, or superstructures built thereon, are to be safe and enduring.

Since Wolfe settled the destinies of Canada on the Plains of Abraham, the sons of Britain have been steadily, silently, but surely laying the foundations of the future greatness of the Dominion: clearing the forests, cultivating the prairies, cutting canals, navigating rivers, sinking coal pits, digging ore mines, and building towns and cities at strategic points; and right nobly has this pioneering been done. To-day, Canada stands second to none in the world, as a lumber exporting, dairy producing, fruit growing, and wheat raising country; and the calm, patient industry which has brought this to pass, has been its own reward; for the native Canadian, in physical development and vital energy, is second to none on earth; and in the matter of savings (per capita) the Canadian people are the wealthiest on the globe. So that if Canada's annals have hitherto been "dull," it is because her sons have been quietly "sawing wood," and making the prairies to blossom as the rose.

Sir Wilfrid Laurier has said that the nineteenth century was the United States' glory, but the twentieth century is to be Canada's. The American farmer evidently believes this, to judge from the way in which he is emigrating into our North-West Territory; and the American manufacturers are manifestly convinced: to see the way in which they are establishing branch works and factories in choice spots on Canadian soil, near our large cities and prospective centres of population.

Having laid the firm foundations of future greatness, by a Wisely-guided provision for the necessaries of life—food, clothing, and shelter—the country is now ready for a mighty forward movement in the development of her boundless mineral resources; particularly in iron and steel. At this point, we can not do better than quote W. K. George, President of the Canadian Manufacturers' Association before the London Chamber of Commerce (England, June 22nd):—

> Most of our provinces are not only larger than many of the greatest European powers, but at least equal to them in natural resources. They possess water-power, the motive power of the future, to an extent almost beyond calculation. Within 50 miles of Ottawa there is water power capable of developing 900,000 horse-power; and the rest of Canada, except the prairie section, was equally well provided. Canadians would fail in their duty if they did not develop their country in every possible phase, fully utilizing her resources. If they did not provide remunerative and attractive employment for her people, the people would go elsewhere for it, as they had done in the past. The last United States census showed that there were in that country 1,250,000 natives of Canada; attracted by satisfactory employment at remunerative wages; which was due to the great industrial development of the Republic. Under fair and equitable conditions, Canada would have the same marvellous development.

The pendulum of prosperity has already begun to swing. Great machine works like those graphically described on pages 234 and 238, are springing up on every hand. Ere many moons have waxed and waned, The Dominion Coal Co., of Nova Scotia, will employ a special line of boats to handle freight from Montreal to Toronto, and in addition will erect large coal elevators in the harbor of Montreal, and Toronto will be used as a distributing point for sending cheap coal to all parts of the Province of Ontario. By next summer, Niagara Falls will supply cheap electrical power to Hamilton, Toronto, and western cities as far as London. And even as we write, news comes to hand, that before Christmas, Winnipeg in the West, (like Ottawa in the East), will run her street cars, and supply local factories with cheap electrical power developed from the Pinnawa Channel of the Winnipeg River. Truly, Canada is God's country; for waterfalls and rapid running rivers, from which to get cheap power, abound almost everywhere. It is estimated that 30,000 extra hands will be needed in the North-West this summer to gather in the bounteous harvest!

Hitherto, our immense resources of iron ore have been almost useless, on account of their *refractory* nature. The ordinary temperature of the blast furnace, 2,500° F., being altogether too low for the effective and economical reduction of such ores. But wonderfully opportune comes the possible electric furnace, with its temperature of 3,000° F. and upwards—at least 1,000° higher than the melting zone temperature of the blast furnace. We have not the least doubt, that within five years from now, the electric furnace for smelting purposes will be a commercial success. When that time arrives, the iron and steel industries of Canada, with cheap ore, coal, and motive power in abundance, will go forward with leaps and bounds. At that stage, Canada as an iron producing country would be in its infancy, for its wealth in mineral ores will hardly have been touched; whereas in twenty-five years the low phosphorus ores of our neighbor, the United States, in Lake Superior district will,—at the present rate of consumption, be practically exhausted.

The Problem of Ability.

E. GRIFFITH-JONES, B.A.

When we consider the causes that have led to the rapid economic and social progress of the last century, what is it that stands out most prominently? It is the fashion among those who champion the cause of Socialism to claim that all wealth is produced by labor. They point to the indubitable fact that without the man who works with his hands no wealth can possibly be produced. The man who sows the seed, and reaps the harvest; the man who carries the hod, and shapes the stone, and lays brick on brick; the man who makes the engine, and stokes the fire, and turns the helm of the vessel—these are they who are the creators of the world's ever increasing wealth. The employer, the inventor, the organizer, the master, according to this theory, are often considered almost superfluous figures in the great social machine. They do not work with their hands, nor bear burdens on their backs, nor earn their living with the sweat of their brow, and therefore they are supposed to have little or nothing to do with the production of wealth.

Without detracting in the least from the honorable and essential place of manual labor as a factor in progress, there is another side to this question. What distinguishes the present era of industrialism is not the increased effort put forth by labor, nor even the number of laborers in the world. There are, for instance, more laborers in the empire of China than in the whole of Europe; yet the civilization of China is stagnant, and the amount of wealth, and especially its rate of increase per head of the population, is not a fraction of what it is in Europe. Or take this fact. A hundred years ago in England ten millions of people made an income of £140,000,000, or fourteen pounds per head; to-day the same number can and do produce £350,000,000, or thirty-five pounds per head. Why is it that the productive power of labor has been increased nearly two and a half times in a hundred years? It is because of the invention of machinery, the discovery of better manufacturing processes, the more efficient co-ordination of the forces of production, greater economy in the expenditure of energy, and that vast process of making Nature do for us what till recently had to be done by human muscle, which was the triumph of the nineteenth century to have achieved. Now this difference has not been created by the laborer at all; it has been produced by the thinker, the discoverer, the mechanical genius, the chemist, in a word, by the men of exceptional ability, who have enabled labor to turn its energies into more fruitful channels. It has indeed come about, in a most paradoxical way, that the century of democracy—as the nineteenth century may undoubtedly be called, is still more truly the century of aristocracy, the aristocracy, that is, not of birth, but of talent. To-day we depend as much as ever in the last resort on skilled and unskilled laborers to do their part in the production of wealth, for clearly we cannot and never will be able to do without them; but we depend still more on the man who has insight into Nature's laws, who has the gift of turning her vast and obedient forces to human use, who can co-ordinate the energy of human muscle and brain with these natural forces, and who can organize social and industrial effort with a view of doing easily and rapidly what formerly could only be done with infinite labor of muscle and brain alone.

Editorial Notes.

Canada Thinking Southward.

The reflective Canadian has Millman's prophetic line ever in view:

Westward the course of Empire takes its way.

But the appeal made in high places recently for the people to think "Imperially," is bearing fruit. Dominion statesmen and capitalists are evidently looking out of themselves and cogitating even *cosmically*. Here is what "The National Review" says about it:—

> Canada is always thinking westward. That we know. But we are apt to forget that she is now also thinking southward—that she hopes eventually to bring the West Indies, British Honduras, and British Guiana within the boundaries of her political economy, and also to extend her commercial *rapprochement* with Mexico to the greater and more stable politics of South America. The arrangement with Messrs. Elder, Dempster, and Company to run a monthly service of steamers between Canada, the Bahamas, Cuba, and Mexico is really the most significant event of the month. The statesman-capitalist of Canada, who is always a financier of the Rhodes type, has long taken deep interest in the southward expansion of Canadian commerce, and more than £20,000,000 of his reserve wealth—i.e., the capital not required for the development of his Canadian schemes—has been invested in Latin America. The truth is that Canada,

because Quebec is a vital part of her polity, is a natural ally of the coming Latin Federation which is the inevitable answer of Mexico, Brazil, Argentina, and Chili to recent extensions of the Monroe Dogma. Here is a most important factor in the strain and stress of world-politics, which cannot here be discussed in its bearings on the future of the Empire.

With her own North-West Territory; the Orient, and South America as objectives, Canada, as a manufacturing country, has great possibilities of realizing Sir Wilfrid Laurier's dream.

New Discovery of Coal in Canada.

The stars in their courses seem to be fighting for Canada just now. Sixteen thousand more desirable emigrants have come into our ports this year than did last, making 146,266 in all—mostly British, and this will help the farmers to comfortably gather in the wondrous harvest of golden grain now waving on the broad prairie lands of Manitoba and the North-West. Almost simultaneous with the promise of a bounteous harvest, comes the glad tidings from the East coast of an important discovery of coal. The Halifax Herald of July 19th, contains the following:—

The biggest coal strike ever made in Canada was made yesterday, when Deputy Inspector of Mines Neville uncovered the northern out-crop of the Mullins seam near Lingan, about nine miles in a straight line from where the Cape Breton Coal, Iron and Railway Company are operating at Broughton. This discovery adds over 100 per cent. to the Dominion Coal Company's proved coal areas on land, and assures numerous other leaseholders of a profitable coal seam in their leases. The Dominion Coal Company hold the leases upon which the strike has been made, and will undoubtedly proceed with their development. The seam is known as the Mullins seam, and has been lost to prospectors for upward of fifty years. It showed 6 feet of clean coal, equal in quality to the coal of the Low Point areas, and its outcrop line will measure from 18 to 20 miles, extending from Lingan to Mira Bay, its greatest distance from the coast line being at Broughton, which is about 6 miles from here. This shows a land area of about 100 square miles, or 619,520,000 tons of coal. President Ross is jubilant over the discovery, as it adds a long lease of existence to the operations of the Dominion Coal Company. The discovery has created a big sensation among mining men. The seam is only about 70 feet from the surface, but this is only on the outcrop. The find also establishes the important fact that the Tracey and the Mullins are two distinct seams, a matter about which there had been some doubt.

Daily Consular and Trade Reports, U.S.A., July 29th, 1905.

IRON AND STEEL IN CANADA.

The American Iron and Steel Association has for some years collected statistics of iron and steel manufacture in Canada as well as in the United States. The figures for the production of pig iron have been published heretofore; those for steel ingots and finished products are now given. We may note that the total output of pig iron was 270,942 tons in 1904, against 265,418 tons in the preceding year.

The total production of steel ingots and castings in Canada in 1904 was 148,784 gross tons, against 181,514 tons in 1903, a decrease of 32,730 tons. Bessemer and open-hearth steel ingots and castings were made in each year. Almost all the open-hearth steel reported in 1903 and 1904 was made by the basic process. The direct steel castings made in 1904 amounted to 6,505 tons. Canada has not made crucible steel prior to the present year.

The following table gives the production of all kinds of steel ingots and castings in Canada from 1894 to 1904, in gross tons; also the production of all kinds of iron and steel rolled into finished forms, from 1895 to 1904:—

	Steel Ingots.	Rolled Products.
1894	25,685	......
1895	17,000	66,402
1896	16,000	75,043
1897	18,400	77,021
1898	21,540	90,303
1899	22,000	110,642
1900	23,577	100,690
1901	26,084	112,007
1902	182,037	161,485
1903	181,514	129,516
1904	148,784	180,038

The production of bessemer and open-hearth steel rails in 1904 amounted to 36,216 gross tons, against 1,243 tons in 1903; structural shapes, 447 tons, against 1,983 tons in 1903; cut nails made by rolling mills and steel works having cut-nail factories connected with their plants, 99,000 kegs of 100 pounds, against 118,686 kegs in 1903; plates and sheets, 3,102 tons, against 2,450 tons in 1903; all other finished rolled products, excluding muck and scrap bars, blooms, billets, sheet bars and other unfinished forms, 135,243 tons, against 118,541 tons in 1903. The total quantity of all kinds of iron and steel rolled into finished forms in Canada in 1904 amounted to 180,038 tons, against 129,516 tons in 1903. Of the finished iron and steel reported for 1904, about 126,850 tons were steel and 53,188 tons were iron.

On December 31, 1904, there were 18 completed rolling mills and steel works in Canada. In addition, 3 plants were being built and 2 plants were projected. Of the completed plants, 2 were equipped for the manufacture of steel castings only, 5 for the manufacture of bessemer or open-hearth steel ingots and rolled products, and 11 for the manufacture of rolled products only. Of the building plants, one was being equipped for the manufacture of steel castings by a special process, one for the manufacture of open-hearth steel ingots only, and one for the manufacture of merchant bar iron, railway spikes, etc. One of the projected plants is to be equipped for the manufacture of skelp and bar iron and the other for the manufacture of wire rods.

Of the 18 completed rolling mills and steel works in Canada on December 31, 1904, three were located in Nova Scotia, 5 in Quebec, 9 in Ontario and 1 in New Brunswick. The building plants are in Nova Scotia, Ontario and Manitoba, and the projected plants are in Ontario.

The association is officially advised that the production of iron ore in Canada in 1904 amounted to 312,286 gross tons, against 235,977 tons in 1903, and that the production of coal in 1904 amounted to 6,705,232 gross tons, against 6,824,999 tons in 1903. The figures for 1904 are subject to revision, but are substantially correct.

THE VALUE OF ENGINEERING.

The value of engineering service in the construction of industrial works is nowadays appreciated to a far greater extent than it was even within the memory of the younger men of the profession; but the public has yet a good deal to learn in this direction. The argument, why it pays to employ a competent engineer, was presented so concisely in a pamphlet recently issued by a well-known engineering firm in Cleveland, Ohio, that it seems to us worth while to reproduce it.

It pays to employ a competent engineer, because of:—

"1. Reduction of first cost, including the avoidance of 'extras.'

"2. Reduction of operating expenses because: (a) The desired results are obtained with maximum economy of labor, fuel and supplies. (b) Repairs are a minimum. (c) Depreciation is a minimum.

"To what extent will it pay?

"On first cost it will probably save from one to three times the cost, possibly more.

"On operation, including repairs and depreciation, the result of the best design and supervision of construction, as compared with haphazard or mediocre engineering, is a saving of 20 per cent to 30 per cent., or more, of the amount paid the engineer. This is the direct saving, but, because of the greater reliability, the direct gain is incalculable.

"Therefore, upon basis No. 1, if the engineer saves in first cost an amount equal to his charges, his employment is justified; a greater saving is profit; and, upon basis No. 2, he will also directly save annually 20 per cent. to 30 per cent., or more, interest on his charges besides the indirect saving stated above.

"The net result is a dividend on the engineer's charges of 100 per cent. or more, at the start; and 30 per cent. or more, annually, during operation.

"What other investment pays at such a rate?"

Although this argument was not presented with especial view to mining and metallurgical plants, it is directly applicable to them with as much force as to the construction of electric railway, lighting and power plants, to the erection of a cotton mill, or the building of a bridge. It is a short-sighted policy which disregards the immediate commercial value of the services of the engineer, and in nothing is it more so than with respect to mining, milling, and smelting plants. The plants that have been built and abandoned after one brief, inglorious campaign, which stand all over the West, as monuments to ignorance, bear silent testimony to the absence of competent engineering; but greater is the number of those which are operating at less than proper efficiency, because of defective design, whose troubles are known only to the wise.—Engineering and Mining Journal.

PERSONAL.

Col. Geoffrey Porter, R.E., Master of the Mint, Calcutta, India, will visit Sudbury to ascertain to what extent Sudbury nickel can be used in coinage.

John Galt, C.E., has recently moved into new and more commodious offices in the rejuvenated Osler & Hammond Building, at the corner of Jordan and Melinda streets.

Colin F. McIsaac, M.P.P. for Antigonish, Nova Scotia, has been appointed a member of the Trans-Continental Commission, and may be made chairman of this important commission.

H. P. Douglas, formerly vice-president and general manager of the Canadian Otis Elevator Company, Limited, is now treasurer of the Canadian White Company, engineers and contractors, Montreal.

Collingwood Schreiber assumes the duties of chief consulting engineer for the Government on August 1st. Mr. Butler becomes Deputy Minister of Railways and Canals. Mr. Schreiber has his office in the Railway Department.

Charles Fergie, general manager of the International Company, of Westville, N.S., has accepted the position of superintendent of mines of the Dominion Coal Company, succeeding Austin King. He will probably enter on his new duties next month.

Chief Engineer Kinnear, of the M.C.R., has resigned his position, and will devote his time to supervision of the construction of the double tunnel under the Detroit River. Mr. Kinnear is succeeded as chief engineer by his former assistant, George H. Webb. Mr. Kinnear still retains his position of assistant manager of the M.C.R.

Mr. D. J. Russell Duncan, late of the Canada Foundry Co., Limited, Toronto, has been appointed city engineer of Port Arthur. During his sojourn in Toronto Mr. Duncan lectured and read important papers on engineering themes before learned and technical societies of the Queen City. His genial manner and interesting personality won for him many friends in business circles, who heartily congratulate him upon his important appointment.

Professor S. M. Dixon, of Dalhousie College faculty, has been appointed to the new chair in civil engineering of the University of Birmingham, of which Mr. Chamberlain is chancellor. It is the most important position of its kind in the United Kingdom. The buildings of Birmingham University, costing half a million pounds, cover thirty acres, and the institution is essentially modern. Within its own grounds it has a working coal mine, a school of brewing and a school of commerce. Great attention is paid to engineering, and Professor Dixon will be tht head of the department. He is a brilliant graduate of the University of Dublin. He was appointed professor of civil engineering in the University of New Brunswick in 1892, and in 1901 professor of physics at Dalhousie, and last year was made head of the new department of civil engineering.

J. A. Kammerer, formerly of the Royal Electric Co., and now one of the directors of the Hamilton Cataract Power, Light and Traction Company, is another Canadian who has decided to look abroad over "fresh fields and pastures new." Mr. Kammerer, with his wife, has left this month for a trip to the new Empire of Japan. He is going on a tour of pleasure and observation, but doubtless he will keep his eye open for the possibilities of electrical development in the East. Mr. Kammerer is the pioneer of long distance transmission of power by electricity in Canada, having advocated its practicability at a time when the idea was ridiculed by many of the most eminent electricians of this country and Europe. He was one of the promoters of the Cataract Power Company, whose project for transmitting power 35 miles from DeCew Falls to Hamilton in 1895 marked the beginning of this phase of electrical development in Canada. Mr. Kammerer's objective is Tokio, and he expects to be absent in the East for about six months. His friends wish him a pleasant, successful trip and safe return.

INDUSTRIAL NOTES.

The Robb Engineering Company are building a 150-h.p. boiler for the Good Shepherd Asylum, Quebec.

The Big Master Mining Co., Gold Rock, have installed a duplex pump, built by the Smart-Turner Machine Co., Limited, Hamilton.

Grant's Spring Brewery, Hamilton, have installed a new steel mash tub built by the Smart-Turner Machine Co., Limited, Hamilton.

The Brantford Board of Water Commissioners have awarded the contract for three large boilers to the John Inglis Co., Toronto.

The Montreal Steel Works Company has purchased land on St. Etienne Street. The company will extend their works on this property.

The Woodruff-Robins Co., a roller-bearing plant, has purchased land on King street, Toronto, where they will erect a factory costing $50,000.

The Smart-Turner Machine Co., Limited, Hamilton, have installed one of their steam and oil separators in the Hamilton Sewerage Disposal Co.

The Dominion Bridge Co. have decided to install a plant in Winnipeg to manufacture for their western business, and a site is being looked for.

The Cockshutt Plow Co. are building a fine warehouse at Regina. It will be of brick, three stories high, and its dimensions 60 by 100 feet.

The Electric Light Company of Golden, B.C., have placed an order with the Robb Engineering Company for an 80-horse-power engine and boiler.

The Northern Aluminum Co., are doubling the capacity of their works, and will erect buildings costing upwards of $200,000 at Shawinigan Falls, Quebec.

The Robb Engineering Company has received an order for two 100-h.p. Robb-Mumford boilers from the Western Canadian Collieries, Blairmore, Alberta.

The Robb Engineering Company has received an order from the Allis-Chalmers-Bullock, Limited, for a 75-h.p. engine for the C.P.R. shops at Moose Jaw.

The Dominion Government has awarded the contract for building the breakwater at Port Stanley to Messrs. Haney & Miller, Ottawa, the price being $100,000.

The Canadian Shovel Co., Hamilton, have recently purchased from the Smart-Turner Machine Co., Limited, three sand belt machines for their new factory.

I. D. Bradshaw & Co., Toronto, have installed an automatic feed pump and receiver, built by the Smart-Turner Machine Co., Limited, Hamilton, Ontario.

The asphalt plant belonging to the City of Winnipeg was badly damaged by fire, at a loss of $10,000. It was destroyed by the same cause last February.

The Nova Scotia Iron & Steel Co. have recently put in two of Barr's automatic spike machines, manufactured by the Smart-Turner Machine Co., Limited, Hamilton, Ontario.

The Canadian General Electric Company have completed the purchase of another large site in Peterboro', Ontario, and will this summer make large additions to their buildings.

Messrs. Seaman & Kent, Meaford, have installed an automatic feed pump and receiver and steam and oil separator built by the Smart-Turner Machine Co., Limited, Hamilton.

The town of Dauphin, Manitoba, has ordered from the Robb Engineering Company, Limited, two 100-h.p. boilers and a 100-h.p. engine for the electric lighting plant which the town is installing.

Brantford has adopted a by-law requiring all manufacturers to use smoke consumers or raise their smoke stacks sufficiently to ensure the smoke being carried off, on penalty of fine or imprisonment.

The Climax Road Machinery Co., of Marathon, N.Y., are looking for a location for a Canadian factory. The representative, John Robertson, was in Peterboro, Ontario, recently in that connection.

The first Portland cement to be manufactured east of Montreal was turned out by the Sydney Cement Company recently. The plant, which has just been completed, has a capacity of 500 barrels per day.

Messrs. M. P. and J. T. Davis, Quebec, have secured the contract for the reconstruction of the quay wall of the Louise Basin, which caved in a couple of months ago. The work will cost in the neighborhood of $300,000 or $400,000.

The Canadian Drawn Steel Company have placed their order with the Smart-Turner Machine Co., Limited, Hamilton, for one of their automatic feed pumps and receivers, and also a double press straightner for straightening shafting.

The Canadian Fairbanks Company have been awarded the contract for transmission material, consisting of Fairbanks universal giant hangers, shafting, etc., to be used in the Canadian Government Canal Repair Shop at Cornwall, Ontario.

Messrs. Wm. Strong & Co., of Montreal, have installed a Garrigue double effect evaporator, with pumps and condensers for reclaiming the products in their soap factory, the apparatus being built by the Smart-Turner Machine Co., Limited, Hamilton, Ontario.

The Goldie-McCulloch Co., of Galt, Ontario, is now filling an order for a pair of cross-compound 1,200-h.p. engines for the Winnipeg Street Railway Company, and two pair of cross-compound vertical engines, 850-h.p. each, for the Dominion Iron & Steel Co., Sydney.

Ottawa and the Consumers' Gas Company have reached an agreement by which the city pays the latter the sum of $200,000 for its plant, etc.; the company, however, to hand over to the city $3,000 worth of the $10,000 stock on hand, thus making the price equivalent to $207,000.

The by-law to grant the Dominion Roller Screen Co. a free building for five years, free water power and light, was passed at Iroquois, Ontario. The company will at once remove their factory from Toronto to Iroquois. Twenty-five hands will be employed on the start. The company has a capital of $150,000.

The Robb Engineering Co., Amherst, has received an order from the Dominion Coal Company for two 100-horse power Robb-Mumford boilers; from the Standard Manufacturing Company, Sackville, for a 125-horse power Robb-Mumford boiler, and from R. S. Carter, Maccan, for a 65-horse power engine.

The Cape Breton Coal, Iron & Railway Company, which represent millions of English capital, have submitted a proposition to the effect that if Sydney will assist in various ways, a shipbuilding plant and other works, involving an expenditure of twenty millions of dollars, will be established within the limits of the city.

The Canadian Shipbuilding Company have launched the Government steel dipper dredge, which has been under construction at their shipyard for some months. The dredge is of the boom type and carries a two-yard dipper. It will be used on the lower St. Lawrence River, and is therefore fitted with both salt and fresh water machinery.

The Imperial Steel & Wire Co., Limited, will double the capacity of their works at Collingwood at once, making the output fifty gross tons of wire per day. The plant has been running steadily night and day since February last, when it was first put into commission. Additional boilers, engines and machinery will be ordered immediately.

J. Haney, Montreal, contractor, has signed a contract with Toronto for the construction of a water tunnel under the bay. This tunnel, which may take two years to complete, will convey Toronto's water supply from Lake Ontario, and will do away with the pipes across the bay, which have caused so much trouble in the past.

At the annual meeting of the Chicago Pneumatic Tool Co., held recently, the announcement was made that the company has purchased the Canadian Pneumatic Tool Company, of Montreal. It has secured that company's entire stock, and will take possession within the next thirty days. The price said to be paid for the plant is over $600,000.

At Goderich, the elevator belonging to the Goderich Elevator & Transit Co. was totally destroyed by fire, and the loss, including contents, will be over $400,000, partly covered by insurance. The structure was one of the most modern elevators on Lake Huron for receiving and shipping, and had a grain capacity of half a million bushels.

The Canadian Tool & Shovel Company, which is building a factory in the annex of Hamilton, Ontario, elected the following officers at a recent meeting: Charles H. Holton, president; Edward McCarty, vice-president; W. A. Holton, secretary-treasurer, and Fred Skelton and Charles McCarty, directors. All the stock of the company has been subscribed.

The Dominion Bridge Company has decided to install a plant in Winnipeg to manufacture for their western business, and a suitable site has been secured. The new plant will employ about 150 men. It will be equipped with shears for cutting the heavy steel, and punches and riveters for setting the material up. The building will be about 300 feet by 100 feet in size, and in addition there will be a storage yard equipped to carry a stock of the standard sizes and weights of structural steel.

The Keewatin Flour Mills Co., Limited, has contracted with the Macdonald Engineering Co., of Chicago, to erect at Keewatin a large fireproof milling and elevator plant, the cost to be in the vicinity of $750,000. Both buildings will be entirely of steel concrete construction. The mill will have an output of 5,000 barrels per day, and the elevator will have a storage capacity of half a million bushels. Work will be commenced at once, as the contract calls for the completion of the plant early next year.

The Canadian White Company, Limited, is incorporated in Canada to carry on a general contracting and engineering business, on similar lines to J. G. White & Company, Incorporated, of New York; J. G. White & Company, Limited, London, England, and the Waring-White Building Company, Limited, London, England. The Letters Patent of the Canadian company were granted the latter part of May, and the organization of the company is now being completed. This company will carry on a general contracting and engineering business, and will undertake any civil, mechanical, electrical, hydraulic and building work. It will be fully equipped to handle large construction contracts for steam or electric railways, and will be prepared to design, build, equip and operate electric lighting plants and power installations, gas works, water supply, sewage systems, piers, docks, harbor works, office buildings, apartment houses, hotels, etc.

RAILWAY NOTES.

An agreement has been reached at Kingston between the City Council and the Street Railway promoters and the line is again in operation.

At a recent meeting the Guelph City Council granted the application of the G. T. R. to build a station on Jubilee Park, the present depot accommodation being insufficient. The conditions of the award have not yet been announced.

At St. Thomas a by-law to confirm the agreement between the city and the South-western Traction Company, to allow the latter to use the local street car system, was carried. Work on the electric line from London to Port Stanley will now be proceeded with.

The contract for double-tracking the main line of the C. P. R. between Fort William and Winnipeg has been awarded to Messrs. Foley Brothers, Montreal. The distance is 426 miles, and the work is to be finished within three years. Work will be started at once east and west of Rat Portage.

Construction on the western section of the Grand Trunk Pacific is to proceed immediately. The route is definitely located westward to the intersection with the Regina & Prince Albert branch of the C. P. R., and provisionally to Edmonton. The first contracts will cover a section 400 miles in length.

At Kingston, Ont., the newly organized street railway company elected the following officers: President, H. W. Richardson; Vice-President, R. V. Rogers, K.C.; Secretary-treasurer, W. F. Nickle; directors the above named and Geo. Richardson, H. C. Nickle, G. Macdonald, Kingston; and W. D. Ross, general manager of the Metropolitan Bank, Toronto.

The construction of the Detroit Tunnel Line from Windsor, Ontario, to West Detroit Yard, Michigan, including the electrification thereof, is placed in charge of an Advisory Board of Engineers consisting of Mr. William J. Wilgus, Vice-President of the N. Y. C. & H. R. R. R., Mr. Howard Carson, Consulting Engineer, and Mr. W. S. Kinnear, Chief Engineer of the Tunnel Company. The Chief Engineer will be in direct charge of construction, reporting to Mr. H. B. Ledyard, Chairman of the Board of Directors, on executive and financial matters, and to the Board of Advisory Engineers as to plans, specifications and methods of doing the work.

MINING MATTERS.

A company has been formed to develop the gypsum rock mines near Perth, Ont. There is already a large market for this mineral.

It is estimated that the lead refined for the last fiscal year in British Columbia amounted to 17,000 tons, of which 11,000 was exported.

Professor Knight and C. W. Dickson, Ph.D., of Queen's, have returned from a six weeks' prospecting tour of New Ontario. Dr. Knight reports the district as enormously rich in silver, the vein covering a circle of four or five miles in diameter.

The steamer Elbert H. Gary, of the Pittsburg Steamship Company, the largest boat in commission on fresh water, passed through the Canadian Soo Canal, carrying the largest load of iron ore ever taken down the Great Lakes, The Gary, which is 569 feet in length, had on board 11,424 tons of ore.

A promising discovery of copper has been made recently cently in Wenge Township, ten miles from the Soo, on the line of the Algoma Central Railway. A syndicate of residents have a vein of 500 feet uncovered, which shows throughout its whole length ore rich in copper and silver. The company will immediately sink a shaft to a depth of 150 feet and then drift.

Engineers engaged on the surveys for the Grank Trunk Pacific Railway have made a rich discovery of oil just east of Lake Abitibi, in the farther Temiskaming district. A huge well pouring forth quantities of oil, estimated at 700 barrels a day, has been located, and it is evident that the flow has been going on for years. The constant flow has resulted in the formation of a lake of oil.

The Nova Scotia Coal and Steel Company have decided upon the removal of their steel plant at New Glasgow to Sydney Mines, in order to centralize their works and secure material reduction in cost of production. The work of removal will begin within the next few months. The plant comprises one blast furnace and four open hearth furnaces, all erected at the cost of about half a million dollars.

In a lecture given by Dr. J. C. McLennan recently it was shown that copper, manganese, and aluminium, which at ordinary temperatures are non-magnetic, will when mixed with certain proportions, produce an alloy almost as magnetic as cast-iron. The discovery was made in Germany, almost a year ago by Dr. Hensler, and may work a complete revolution in the manufacture of electrical machinery.

An unusual mineral has been found in Lillooet, British Columbia. A quantity of heavy sand, having a grayish color and metallic lustre, was found, and Dr. Heffman, of the Federal Geological Survey Department, to whom a sample was forwarded, reports that it is made up of iron-nickel alloy, 47 parts; platinum, 43 and other minerals, 10. The "other minerals" comprised iridosmine, native gold, magnetic oxide of iron, titanic iron quartz and garnets. The iron-nickel alloy is strongly magnetic, and on analysis gave over 75 per cent. of nickel.

The Dominion Government have appropriated $15,000 for the purpose of making experiments with the electrical process of smelting ores and manufacturing steel. Experiments will take place at Sault Ste. Marie, and the Consolidated Lake Superior Power Company will furnish a building and dynamo capable of supplying 400 electric horse-power for four months free of charge. All kinds of ores will be experimented with, and important results are expected to be obtained. The system used will be the Heroult process, which takes its name from the inventor. Mr. Heroult himself will conduct the experiments.

W. H. Hunt, of Seattle, Wash., is at Vancouver working on a proposition to develop mining property on Texada Island, north of Vancouver, on which he and his associates have secured options. The present company has secured a bond on the property for a number of years. This summer a train line will be put in to Ellis Bay, about four miles from the former landing, which was exposed in times of storm. The company plans to employ about 500 men on the work during the summer, and will increase the working force to 1,000 during the winter. The ore will be shipped to the Irondale smelter, in Washington. The product of Texada is regarded as among the finest ore in the world.

LIGHT, HEAT, POWER, ETC.

Mr. Taylor, of the firm of Stewart, Witton and Taylor, Brantford, is drawing up plans for the remodelling of the plant of the Brantford Gas Company.

Kingston will retain the services of John M. Campbell, electrical expert, as general manager of the municipally-owned gas and electric lighting plants.

Cecil B. Smith, M.E., has been selected to make the preliminary investigations of the various sources of power available for Winnipeg's use, and will report on the work as soon as possible.

It is reported that the Electrical Development Company has entered into a contract to supply the Toronto Railway Company and the Toronto Electric Company with power from Niagara Falls at $35 per horse-power.

The newly-installed municipal lighting plant at Paris, Ontario, is running behind financially, and there is now a proposition that the town co-operate with a private company in piping natural gas from the wells at Attercliffe, near Dunnville, for use in Paris.

It is announced that the Dominion Natural Gas Company will be ready within three months to supply the City of Brantford with natural gas for lighting and heating purposes for 45 cents, with a reduction for power demands. It is claimed that the supply in the vicinity of Dunnville is practically inexhaustible.

The Ontario and Minnesota Power Bill was once more before the Senate Railway Committee on July 13th and was amended after a vote. Amendments have been made in the Ontario and Minnesota Power Bill which provide that the company shall develop power on both sides of the river equally. The company are to provide, on the Canadian side of the international boundary line, such power as the Governor-in-Council may order after two weeks' previous notice.

The Ontario Power Company has carried out its agreement and has started the machinery of its first installation of 60,000 volts of electric fluid, every part of the hydraulic and electrical machinery working as successfully and smoothly as clock work. The work of this great power plant, which has a franchise to develop over 200,000 electric horse power, turned the first sod March 19, 1902, and commenced its regular work of construction on May 1, 1903.

The Government has appointed the Electrical Power Commission, the members of which are the Hon. Mr. Beck, member for London; P. W. Ellis, Toronto, and George Pattinson, member for South Waterloo. They are authorized to collect all information possible in regard to water powers in the province suitable for the development of electrical energy, estimates as to the cost of such development, the cost of such energy to manufacturers in comparison to the cost of the same power, and all other details that will enable the Government to adopt a definite policy.

MUNICIPAL WORKS, ETC.

A by-law to raise $35,000 for a municipal electric light plant carried at Napanee, Ontario.

A by-law to raise $50,000 for water works system will be submitted to the ratepayers of Thorold, August 14th.

At Guelph a by-law was passed granting $55,000 towards the extension and improvement of the gas plant, which belongs to the city.

Medicine Hat, N.W.T., has issued debentures aggregating $54,600 for water works and natural gas extensions and the erection of a new municipal building.

A by-law was passed at Wingham, Ontario, to raise $12,000 for the purpose of improving the water works system to make it more adequate for fire protection.

The Council of Belleville will submit a by-law to the Lieutenant-Governor in Council asking authority to borrow $15,000, with which to extend the gas system. The works, which are under municipal control, show a profit of $4,000 for five months of this year.

MARINE NEWS.

The contract for the Port Stanley breakwater has been awarded to Harvey & Miller. The amount is about $100,000.

All previous records will be broken when, in May, 1906, new Canadian Pacific steamships are added to this company's Atlantic fleet, which will have a guaranteed speed of 20 knots per hour.

The Government stream dredge "Sir Wilfrid," which was lost three years ago between Newcastle and Port Hope, has been located. An effort will be made to discover the cause of her mishap.

The Sydney City Council have granted a free site to the twelve-million-dollar shipbuilding enterprise promoted by English capitalists, headed by Messrs. Mayhew and Gladstone. A portion of Victoria Park will be secured for that purpose.

Captain Doty, of Goderich, has purchased the hull of the steamer City of Collingwood, burned at Collingwood last month, paying fifteen thousand dollars for the wreck. He will rebuild the vessel at the Collingwood Dock. The passenger steamer Lincoln, formerly on the Windsor and Pelee Island route, which was burned at Sandwich two months ago, is now being rebuilt at Goderich by Captain Doty, who purchased that wreck also.

The new Canadian-Mexican Steamship Line began operations on July 20, when the first steamer subsidized by the Canadian and Mexican Governments sailed from Montreal to Mexican ports, touching at Havana. By the terms of contract with the Mexican Government vessels may carry cargoes and passengers from Canada to Cuba, cargoes and passengers both ways between Mexico and Canada, but on north bound trips no freight may be taken from Cuba to Canada.

NEW INCORPORATIONS.

Dominion.—The Canadian Fairbanks Company have increased their capital from $500,000 to $600,000.

The Western Canada Cement and Coal Company, Ottawa, $1,250,000; A. F. MacLaren, W. A. Fleming, C. A. Irvin, J. Lavelle and S. F. Bell, Ottawa.

The Mexican Electric Light Company, Montreal, $6,000,000; A. R. Doble, E. M. Edgar, L. L. Edgar, C. F. Hibbert, L. S. Colwell, Montreal. To carry on the business of an electric light, heat and power company, also that of electrical contractors.

Drummond Mines, Montreal, $100,000; G. E. Drummond, T. J. Drummond, W. H. Drummond, W. J. White, J. Gouldthorpe, Montreal.

Western Construction Company, Toronto; $4,000,000; A. P. Murry, J. G. Pyke, F. H. Hewitt, P. M. Robertson, and G. Smith, Montreal. To carry on business as general contractors for constructing railways, canals, telephone and telegraph lines, etc.

Kaministiquia Power Company, Fort William, $2,000,000; H. S. Holt, C. R. Hosmer, F. W. Thompson, H. W. Norton, Montreal, and F. H. Phippen, Winnipeg, Man. To carry on the business of an electric light and power company.

The Western Countries Electric Company, Brantford, $500,000; S. F. McKinnon, J. N. Shenstone, C. Greville-Harstone, Toronto; J. Knox, C. S. Scott, Hamilton, and others. To carry on business as a general power company.

Corrugated Concrete Pile Company, Montreal, $50,000; V. E. Mitchell, D. Armour, A. Chase-Casgrain, C. M. Cotton, S. Le Huray, K. J. Beardwood, and L. L. Legault, Montreal.

Eastern Coal Company, Toronto, $500,000; J. S. Lovell, E. W. McNeil, R. Gowans, S. G. Crowell, W. H. Blake, Toronto. To carry on the business of a mining, milling and development company.

Wallingford Company, Ottawa, $45,000; F. Cornu, L'Ange Gardien; F. S. Shirley, Hon. N. A. Belcourt, and M. I. Hickson, Ottawa. To carry on business of a mining and development company.

The Steel Concrete Company, Montreal; $200,000; E. A. Wallberg, W. F. Boggis, J. L. Harrington, Montreal; H. Fisher, J. Murphy, Ottawa. To carry on business as engineers, contractors, etc.

The Ontario Transmission Company, Niagara Falls, $1,000,000; J. S. Lovell, W. Bain, E. W. McNeill, S. G. Crowell, W. F. Ralph, Toronto. To carry on business of a power company for the production of steam, electric, pneumatic, hydraulic or other power.

Ontario.—The Canada Sand-Lime Pressed Brick Company, Toronto Junction, $60,000; R. Kennedy, J. D. Flavelle, J. Mortimer, J. Carew, and T. Stewart, Lindsay. To manufacture brick from sand, clay, lime, etc.

Fairbanks-Morse Canadian Manufacturing Company, Toronto, $250,000; G. W. Sparks, Chicago; C. J. Brittain, J. L. Ross, A. W. Holmestead, and J. Milne, Toronto. To manufacture and deal in tin, manganese, lead, stone, coal, lumber, etc.

The Ajax Production Company, incorporated under the laws of the State of Delaware, U.S., has been granted a charter by Ontario Government to carry on business as an oil company at Petrolia, Ont., but in doing so not to use more than $40,000 capital. G. A. McGillivray, Petrolia, attorney.

The James Warnock Company, Galt, $200,000; K. B. Warnock, C. D. Massey, A. G. Warnock, Toronto; J. B. Warnock, F. T. Strong, Galt. To manufacture tools, implements and parts of carriages as springs, gears, etc.

The Dunnville Mutual Natural Gas Company, Dunnville, $15,000; W. M. Gray, S. Haney, G. Reid, O. E. Willson, G. A. Latimore, W. H. Penny, W. E. Werner, F. Scaife, W. E. Traver, and C. D. Trimble, Dunnville.

The Canadian Pacific Railway Company is strengthening the iron bridges across the branches of the Don River to meet the strain of the heavy locomotives which have come into use since the bridges were built 23 years ago. The contract price for repairing the two bridges is $95,000.

Petrolia Torpedoes Company, Petrolia, $50,000; D. Barr, Dutton; and W. M. Lowery, M. M. Lowery, S. M. Lowery, E. Stokes, Petrolia; and J. H. Kittermaster, Sarnia. To pursue mining operations for oil, water, gas, etc., and to deal in nitro-glycerine, dynamite, etc.

The Sharples Separator Company, incorporated in Pennsylvania, has been granted a charter in Ontario, to use not more than $40,000 capital. Attorney, C. A. Masten, Toronto.

Union Steamship Company, Hamilton, $100,000; R. C. Mackay, A. B. Mackay, W. G. Walton, W. Southam, W. Magee, Hamilton. To carry on the business of a navigation and transportation company.

The Brintnell Adjustable Roller Bearing Company, Toronto, $100,000; A. Nelson, E. H. Adams, W. H. Scott, A. S. Dewar, A. H. Longhead, C. D. Scott, and J. E. Cook. To manufacture roller and other bearings and machinery.

The Glenora Power Company Picton, $100,000; W. Boulter, D. L. Bongard, W. J. Carter, Picton; S. E. Foster, Wiarton; and W. H. Crow, Welland.

Canadian Oil Company has increased its capital from $1,000,000 to $1,500,000.

The York Brick and Cement Ware Company, Lambton Mills, $40,000; W. Beith, M. E. Beith, Toronto; R. Weddell, and R. G. Weddell, Trenton; and R. Beith, Bowmanville. To manufacture brick, brickware, cementware, etc.

The Banner Oil Company, Petrolia, $100,000; J. C. Winters, J. M. Prophet, J. F. Connor, Mount Morris, N.Y.; C. H. Palmer, H. C. Brewster, Rochester, N.Y.; and D. S. Robb, London.

The Gananoque Bolt Company, incorporated under the laws of the Dominion, have been granted a charter by the Ontario Government also.

The Toronto Sand-Lime Brick Company, Toronto Junction, $40,000; G. H. Large, J. Shultz, T. J. Smyth, W. A. Skeans, and J. S. Proctor, Toronto.

The Beaver Mica and Mining Company, Sundridge, $50,000; J. Pinkerton, J. J. Jackson, C. Pinkerton, Strong Township; J. Herrgott, T. R. Wood, Sundridge; L. J. Herrgott, New Hamburg; J. H. McCurry, North Bay.

Concretes, Limited, Toronto, $40,000; C. Curtis, W. H. Peppin, J. A. Milne, M. A. Curtis, L. Peppin, Toronto. To construct bridges, dams, roadways, etc.

North-West Territories.—Edmonton Oil Company; Saskatchewan Telephone Company; Walsh Scale Company; B. B. Oil and Mines Company.

British Columbia.—The Shoka Company, $15,000. To build railways, bridges, tramways, etc., and to deal in machinery of all kinds.

Nelson Oil & Coal Company. To carry on business as a general mining company.

The Gold Park Mining Company. To develop and work mining, mineral claims, etc.

CATALOGUES.

Machine Tools.—Niles-Bement-Pond Company, 111 Broadway, New York, U.S.A.—"Progress Reporter" No. 8, for July, illustrates large tool equipment in Angus shops of Canadian Pacific Railway, Montreal. 9 x 12—pp. 24.

Steam Pumps.—Canada Foundry Company, Toronto,—Bulletin No. 29. Illustrative of their Standard, Single and Duplex Steam Pumps. 8 x 10½—pp. 12.

Renold Roller Chain.—Link Belt Eng. Co., Philadelphia, Pa., U.S.A.—This well illustrated booklet tersely explains the advantages of this "Sterling chain, which redounds in such great degree to the credit of England's foremost chain maker."

Cement.—Municipal Engineering and Contracting Company, Chicago, Ill., U.S.A.—This pamphlet describes exhaustively the Chicago improved cube Concrete Mixer, and not only illustrates the various applications of this machine, but gives very valuable data for cement users. 6 x 9—pp. 31.

Hollow Concrete Blocks.—The Whitehall Portland Cement Company, Philadelphia, Pa., U.S.A.—A brief, but concisely written statement of facts relative to the increasing popular hollow cement building blocks. 3¼ x 6—pp. 7.

Air Lift Pumps.—The Ingersoll-Sergeant Drill Company, Sovereign Bank Building, Montreal.—Descriptive of their Compressed Air Device for lifting water from wells. 5½ x 3¼—pp. 14.

Oil Engines.—De La Vergne Machine Company, New York, U.S.A., describes and illustrates their Hornsby-Akroyd Oil Engine. 4 x 8½—pp. 6.

Automatic Smokeless Furnace.—Murphy Iron Works, Office 510 Board of Trade Building, Toronto.—Latest "repeat order" data and other information relative to this twenty-three year old device. 11 x 8¼—pp. 3.

Mechanical Oil Pump.—The Lunkenheimer Company, Cincinnati, O., U.S.A., sets forth by pen and engraving, the advantages of their Double and Single-Feed, Mechanical Oil Pumps for Engines. This device will repay investigation by all engine users. 6 x 3½—pp. 23.

Thermit Process.—The Goldschmidt Thermit Company, New York.—An illustrated Essay, read before American Society for Testing Materials, Atlantic City, June. Describes in interesting way their famous welding process. 6 x 9—pp. 13.

Manilla Rope.—C. W. Hunt Company, 45 Broadway, New York (No. 054). —A Treatise on Manilla Rope Transmission and Hoisting, by. C. W. Hunt. This admirably illustrated Pamphlet is probably the best thing ever done on the theory and practice of rope driving. It bristles with data of scientific and technical interest. We advise all our readers to get a copy at once.

Electric Lamp.—The Nernst Lamp Company, Pittsburg, Pa.—This bulletin describes in detail the advantages to be derived from the use of the Nernst Electric Lamp in Railway Stations, etc. 8 x 10—pp. 3.

Integrating Wattmeters.—Westinghouse Electric & Manufacturing Company, Pittsburg, Pa.—A booklet on a new Westinghouse Integrating Wattmeter. There are a number of illustrations showing the parts of this meter. 3 x 6—pp. 24.

Pneumatic Hammers.—The Ingersoll-Sergeant Drill Company, New York.—A well illustrated catalogue, descriptive of "Axial Valve," riveting and chipping hammers. 6 x 9 —pp. 20.

Protection of Bridges.—The American Railway and Maintainance and Way Association, 1562 Monadnock Block, Chicago.—A paper on Protecting and Water-Proofing Solid Floor Bridges. 6 x 9—pp. 42.

Hack Saws.—Diamond Saw & Stamping Works, Buffalo, N.Y.—A booklet describing, with illustrations, Hack Saw Handles and Blades. Prices stated. 6 x 4—pp. 8.

Mining Machinery.—The Wellman-Seaver-Morgan Company, Cleveland, Ohio.—This company makes a specialty of Mining Machinery, and have issued a catalogue describing and illustrating the same. 6 x 9—pp. 40.

Gas Engines.—De La Vergne Machine Company, New York.—The Koerting Gas Engines, as built by the above company, are minutely described, and beautifully illustrated in a catalogue which they have just issued. 11 x 8—pp. 54.

Steam Turbines.—The Warren Electric Manufacturing Company, Sandusky, Ohio.—Bulletin 23. Giving illustrations and description of the Warren Turbine-Alternator. 10 x 8—pp. 12.

Rubber Goods.—The Canadian Rubber Company, of Montreal.—This Company has recently issued three catalogues. "C," dealing comprehensively with interlocking rubber tiling, and other unique rubber floor coverings; "D," devoted to rubber belting and rubber covered rolls; "E," comprising the principal of rubber and special hose, manufactured by this company. These catalogues are well illustrated.

Electrical Apparatus.—The Canadian Westinghouse Company, Limited, Hamilton, Ont.—A profusely illustrated booklet, describing the Westinghouse Company's new factory at Hamilton, as well as electrical apparatus manufactured by them. 5 x 9—pp. 30.

"The Westinghouse Companies in the Railway and Industrial Fields," is the title of a neatly arranged and well illustrated catalogue. 8 x 10—pp. 68.

Screens.—Jeffrey Manufacturing Company, Columbus, O., have issued a catalogue showing screens for various purposes. 9 x 6—pp. 24.

Indicators.—Dobbie McInnes, Limited, 45 Bothwell Street, Glasgow, Scotland.—This company makes a specialty of Engine Indicators, and have issued a catalogue and pamphlets descriptive of same. 9 x 6—pp. 32.

Cement.—Smooth-on Manufacturing Company, 572-574 Communapaw Avenue, Jersey City, N.J.—A booklet giving detailed instructions for using Smooth-on Elastic Cement. 9 x 6—pp. 8.

MACHINE SHOP NOTES FROM THE STATES.

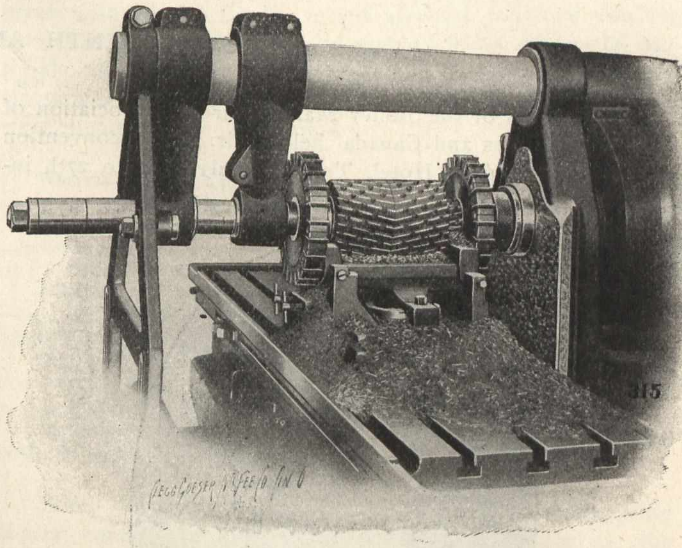
By CHARLES S. GINGRICH, M.E.

XVIII.

One of the first uses to which Milling Machines were put was that of forming irregular gun parts, and although this occurred about a century ago, no one seems to have had sufficient courage to apply the same principle to finishing larger work until in quite recent years.

The illustration herewith is a good example of modern practice. It shows one of the larger sizes of Cincinnati Plane Millers finishing six surfaces of grey iron pieces at a single cut. This work was formerly done on a planer using two heads, and operating on two rows of pieces at a time, working at 50 feet cutting speed on the roughing cut, and the average total time for each piece finished on the planer was 33¾ minutes.

The miller shown in illustration employs a gang of cutters, the outside ones being 10½" diameter, and the large between these two, 6¼" diameter. It takes a roughing cut at 4.3" table travel per minute, and then immediately follows this with a finishing cut at 3⅛" table travel per minute. The roughing cut is ⅛" deep, and the total width of finished surface is 19½", and the average total time for one piece finished on the miller is 13½ minutes, showing a remarkable gain over the planing process, and it also has the advantage of finishing the work with greater uniformity.



Gang-Milling.

This, we think, is an excellent illustration of the possibilities along the lines of cost reduction by the use of millers on general machine shop work.

COMPARATIVE TESTS OF STEAM AND ELECTRIC TRAINS.

According to the "Railway Gazette," a series of tests on the rates of acceleration attainable with steam and with electric trains was carried out by the New York Central Railroad and the General Electrical Company, at the end of April last. A piece of track, 6 miles long, laid with 80-lb. rails, was reserved for the trials. In this length are included gradients of 5 ft. to 19 ft. per mile, and amongst the curves is one of 2 degs. 17 min., whilst the longest tangent measures 7,565 ft. The steam locomotive was a twelve-wheels six-coupled engine, weighing, with its tender, 342,000 lbs., whilst the weight available for adhesion amounted to 141,000 lbs. The electric locomotive was also mounted on twelve wheels, of which eight were drivers. Its total weight was 200,500 lbs., of which 142,000 lbs. rested on the driving axles. The test trains in different cases consisted of eight or of six cars. The weight of the eight-car trains was 513 tons, and of the six-car trains 407 to 427 tons, the former being the weight of the electric trains. In these total weights are included the weights of the locomotives, which accounts for the weight of the six-car train being heavier in the case of the steam locomotive. The paying load was, however, substantially greater with the electric trains. Taking the corresponding runs for both the steam and the electric trains, the following results were obtained:—

	Steam.	Electric.
Length of locomotive over all	67 ft. 7¾ ins.	36 ft. 11¼ ins.
Total weight	342,000 lbs.	200,500 lbs.
Maximum load on one axle	47,000 lbs.	35,500 lbs.
Paying load	256 tons.	307¼ tons.
Average acceleration up to 50 miles per hour, in miles per hour per second	0.246	0.394
Time taken to reach 50 miles per hour	203 seconds.	127 seconds.

In some of the runs with the eight-car train the steam locomotive at the outset accelerated the faster of the two. This was due to insufficient area in the temporary conductor supplying the electric train, the voltage drop in this being from 700 down to 325 volts. Even then, however, the average rate of acceleration up to the maximum speed was substantially greater in the case of the electric train. In some further experiments, in which the electric locomotive ran light the speed reached was 85 miles per hour.—(Model Engineer and Electrician.)

THE AMERICAN BOILER MANUFACTURERS' ASSOCIATION OF THE UNITED STATES AND CANADA.

SEVENTEENTH ANNUAL CONVENTION.

The members of the Boiler Manufacturers' Association of the United States and Canada held their annual convention in the King Edward Hotel, Toronto, July 25th to 27th inclusive.

JAMES LAPPAN, PITTSBURG, PA.
Founder of the Association of Boiler Manufacturers of the United States and Canada.

The convention was formally opened by President Robert Munroe, Jr., of Pittsburg, at 10.30 on the morning of the 25th, in the famous banquet hall of the King Edward, which was profusely decorated with the flags of the British Empire and United States of America, and graced with the charming presence of many of the wives and daughters of the visiting members.

The following is a list of the officers:—

Officers.—R. Munroe, Jr., president, Pittsburg, Pa.; J. D. Farasey, secretary, Cleveland, O.; Jos. Wangler, treasurer, St. Louis, Mo.; M. F. Cole, first vice-president, Newman, Ga.; Peter J. Hamler, second vice-president, Chicago Ill.; John J. Main, third vice-president, Toronto, Can.; John Rourke, fourth vice-president, Savannah, Ga.; J. Don Smith, fifth vice-president, Charleston, S.C.

Associate Members, Officers.—W. O. Duntley, president, Chicago, Ill.; J. T. Corbett, vice-president, Chicago, Ill.; H. B. Hare, treasurer, Cleveland, O.; W. H. S. Bateman, secretary, Philadelphia, Pa.

After John J. Main, 3rd Vice-Pres., and Chairman of Local Committee, through whose efforts the convention was brought to Toronto, was introduced by the President; acting Mayor Shaw heartily greeted and welcomed the members of the convention to the hospitality of the Queen City. The reply to Mr. Main's greeting, and Mr. Shaw's civic welcome, was made by W. H. S. Bateman, (Philadelphia), Secretary of the associate members, who expressed the appreciation of the assembled delegates at the generous way in which they had been received, at this the first meeting of the Association on Canadian soil. In the course of a felicitous address, he said:—

The boiler manufacturers were not represented as they should be, there being more money invested in the boilermaking industry, proportionately, than any other he could mention. There was a time in the history of the world when the boilermaker was not required; but to-day he is absolutely essential to the carrying on of modern civilization. Boilers are the very life and soul of all large industries; they give to us the great steamship, the thundering locomotive, and if the boilermaker had not progressed as he has done, where would our rapid transit be? A thing of imagination and conjecture! Our main objective in bringing the boiler manufacturers together is to bring up the standard of boilers throughout the world, thus making way for the accomplishment of greater things than have been.

President's Inaugural Address.

President Munroe, in his inaugural address, thanked the reception committee for the efforts they had put forth to make this annual convention, one of the most successful since the inception of the organization seventeen years ago. After giving a brief outline of the work done by the Association since 1889, he congratulated the Association on the fact that they had more members and stood higher in the estimation of the public than ever. He said that Mr. Bateman struck the keynote in his assertion, that "boilermaking was the very soul of all great industries." Continuing he said:—

To-day the boilermaker stands at the very helm of civilization, and it is the purpose of this Association to instruct the engineer how to manage boilers, and the boilermaker how to design and build them. If we can do this the Association will have made a grand success, and will be well repaid for all the trouble it has been at since its organization. There was a time when we thought every competitor was an enemy, and ready to pounce down upon us like a hawk, but since the formation of the Association we found they were the best people that ever lived. We understand each other, and work together, progressing as we go, and in this we have even done more for the public than for ourselves.

President Munroe concluded by saying that he considered the greatest honor attached to his position was the being present at the first meeting of the Association on Canadian soil, and enjoying the hospitality of the Canadian boiler manufacturers. Said he:—

The question of membership is one that the boiler men feel they should make strenuous efforts to solve. The sentiment of the speakers on this topic seemed to be that the only way to increase the membership is to make it evident to all boiler manufacturers that they derive benefit by combining for the purpose of exchanging opinions and experiences. Even if the Convention is only a social gathering, it is still very beneficial; it necessitates a meeting with others in the same line of business, and a personal meeting gives one a better idea of character than can be gained in any other way. This knowledge of one another enables men to correspond more intelligently in exchanging ideas and offering opinions.

At the conclusion of the President's address, the ladies and visitors retired, and the regular business of the session began by the appointing of committees, discussion of the next place of meeting, etc. It was decided to hold the next meeting in Pittsburg.

The following is a programme copy of the social events of the Convention:—

Tuesday, July 25th.—10 a.m.—Formal Convention Opening and Reception, Banquet Hall. 2 p.m.—Ladies' Reception, in Yellow Reception Room. 2.45 p.m.—Automobile Ride to Lambton Golf Club. 8 p.m.—Lake Ride on Steamer Chippewa. Music.

Wednesday, July 26th.—Morning Visit to Toronto Stores. 2.30 p.m.—Tally-ho Ride around Toronto. 7.30 p.m.—Trip to Toronto Island, Hanlan's Point.

Thursday, July 27th.—8.30 a.m.—Lake Excursion to Niagara-on-the-Lake. 12.—Noon Lunch, Queen's Royal Hotel. 2 p.m.—Return Trip. Arrive Toronto 4.15 p.m. 7.15 p.m.—Seventeenth Annual Banquet, King Edward Hotel.

Few cities on the Continent offer better facilities for seeing nearby places of scenic beauty and historic interest than Toronto; and the charming "Queen's weather," brilliant sunshine, cooling breezes, which prevailed during the days of the convention, enabled the lady visitors, on automobile, tally-ho, and steamboat, to have a delightful time.

The A.B.M.A. is unlike most societies of a similar character, inasmuch as it does not have prepared papers on technical and business themes read at its sessions, but relies upon the mechanical instinct and wide practical experience of its members to suggest impromptu subjects for profitable discussion. At the Wednesday morning session, Col. Edward D. Meier, of St. Louis, presented the report of the Committee on Uniform Boiler Inspections, reviewing several years' work at Washington. Col. Meier's committee is endeavoring to get a commission appointed by

President Roosevelt to hear all sides and straighten out the tangle of inspection laws. The Slocum disaster has been a weapon in the committee's hands. The Federal laws apply to marine boilers, but the same legislation is reflected in the Acts of States and municipalities with regard to land boilers.

Uniform specifications, and uniform inspection of boilers are two reforms which the Association is striving after. As yet boiler inspection in the United States is not what it should be, and it is hoped that the committee appointed by the Government will be able to bring the inspection up to what is desired.

John J. Main, of Toronto, told the convention that Canadian manufacturers were affected by the United States laws, and that conditions in Canada itself with regard to boiler inspection might be improved.

Among the technical topics dealt with at the afternoon session, was the question of chemical constituents of steel, particularly the percentage of sulphur in boiler steel, and as a number of steel manufacturers were present, considerable discussion took place. The boiler manufacturers claim that the present percentage of sulphur gives too little ductility for the tensile strength of the material. The steel men, on the other hand, claim that the grade of steel now furnished is satisfactory, and that a lower proportion of sulphur would make more difficult the process of manufacture, without giving any practical compensating advantages. The boiler men desire a percentage of .025 sulphur, while the steel makers want the percentage at least .035.

The election of officers for 1905-06, resulted as follows:—R. Munroe, Jr., president, Pittsburg, Pa.; J. D. Farasey, secretary, Cleveland, O.; Joseph Wangler, treasurer, St. Louis, Mo.; M. F. Cole, first vice-president, Newman, Ga.; John J. Main, 2nd vice-president, Toronto; John Rourke, 3rd vice-president, Savannah, Ga.; J. Don Smith, 4th vice-president, Charleston, S.C.; G. H. Kittse, 5th vice-president, Aurora, Ill.

At the Thursday session, a trenchant discussion took place with regard to the recent strained relations existing between the boilermakers, and manufacturers of special materials used by their trade generally. And a series of strongly-worded resolutions, in the nature of an ultimatium, were unanimously adopted:—

Whereas strong and repeated protests have been made at our executive sessions against the growing practice of supply houses and mills furnishing materials and partly finished product to others than boiler manufacturers, thus encouraging them to take away work which legitimately belongs to our members; therefore, be it

Resolved, that we request the supply houses and manufacturers in general to discontinue this practice, as likely to subvert the pleasant relations now existing between us;

That, as they depend on our patronage for the bulk of their business, they should instead of supplying such goods to outsiders refer them to the shops from which they receive this patronage; and

That we would prefer to have this done under a feeling of mutual good-will, and not be compelled to adopt arbitrary measures.

After resolutions eulogizing Toronto, and expressing hearty sentiments of appreciation and gratitude to the Entertainment Committee, and ladies of the Queen City, who had by their royal welcome, generous hospitality, and self-denying efforts, made the visit of the A.B.M.A. such a grand success, had been carried with acclamation, the convention adjourned, to meet in Pittsburg in 1906.

In the evening a grand banquet was held at the King Edward Hotel. The toast-list was as follows:—"The King," President R. Munroe, Jr.; "The President (U.S.A.)" W. Perkins Bull; "A.M.B.A.," James Lappan; "Industrial Toronto," John J. Main; "The Ladies," W. H. S. Bateman; "Canada," Controller John Shaw; "Ideal Power," W. O. Duntley; "Expansion of the Association," J. D. Farasey; "The Old Guard," George N. Riley.

The following is a list of members, associates, and visitors in attendance at the Convention.

Toronto—John J. Main, Joseph Wright, W. J. Guy, A. Taylor, Canadian Heine Safety Boiler Co.; H. W. Coates, editor *The Toronto World;* A. M. Wickens, Canadian Casualty and Boiler Works Co.; Geo. F. Spry, Polson Iron Works; W. P. Bull, W. Inglis, John Inglis Co.; J. L. Lorriman, *Hardware and Metal;* Archibald W. Smith, Jas. T. Webster, *The Canadian Stenographer;* S. Groves (editor), P. W. Ball (assistant editor), J. J. Salmond (advertising representative), *The Canadian Engineer;* J. B. Wilson, Chicago Pneumatic Tool Co.; Frank Bailey, Bailey Bros.; Mark Irish; W. J. Smith, J. B. Smith & Son; J. W. Corcoran, Canadian Printing Ink Co.; John Shaw. Acting Mayor and Controller; J. R. McDonald.

Cleveland—J. D. Farasey, H. E. Teachout Boiler Works; C. T. Smith, Chicago Pneumatic Tool Co.; H. B. Hare, Otis Steel Co.; J. J Champion, Champion Rivet Co.; E. D. Rogers, Cambria Steel Co.; C. H. Starr, Cleveland Pneumatic Tool Co.; Phillips Thompson, *Iron and Trade Review.*

Pittsburg—Jas. Lappan, Lappan Manufacturing Co.; Robt. Munroe, Jr., Geo. Munroe & Sons; T. M. Rees, Jas. Rees & Sons; Col. R. Munroe, Geo. Munroe & Sons Manufacturing Corp.; Geo. A. Riley, National Tube Works; H. S. Hunter, Chicago Pneumatic Tool Co.; D. J. Dougherty, Steamboat Inspection Service.

Chicago—L. W. Henoch, T. J. Corbett, Jos. T. Ryerson & Sons; H. C. Finley, Geo. A. Cameron, Scully Steel and Iron Co.; W. O. Duntley, Chicago Pneumatic Tool Co.; W. A. Roome, A. M. Castle Co.

Buffalo—T. Guilford Smith, Fred O. Brunke, Carnegie Steel Co.; Richard Hammond, Lake Erie Boiler Works; C. M. Farrar, Farrar & Trefts.

Philadelphia—E. H. Fairbanks; W. H. S. Bateman, Lukens Iron and Steel Co.; Henry W. Hartley, Cramp Shipbuilding Co.; R. S. Groves, Worth Bros.; Jas. Thompson, Philadelphia Iron Works.

New York—Thos. Aldcorn, Chicago Pneumatic Tool Co.; Geo. Slate, *The Boilermaker.*

Cincinnati—D. A. Brown, *Official Reporter;* Cliff Tudor, Chas. Tudor, Tudor Boiler and Manufacturing Co.; C. A. Hunt, Worth Bros.

Savannah—Wm. Kehoe, Wm. Kehoe & Sons; John Rourke, Rourke Sons.

St. Louis—Col. E. D. Meier, Heine Safety Boiler Co.; Jos. F. Wangler, Jas. Wangler Boiler Co.

Galt—J. P. Hunter, Jas. Buchanan, Goldie-McCulloch Co.

Boston—W. R. Stavert, Jenkins Bros.; John E. Lynch, Hodge Boiler Works

J. P. Campbell, Akron, O., McNeil Boiler Co.; Chas. Hegewold, New Albany, Chas. Hegewold Co.; A. H. Chapman, Chattanooga, Wash & Weidrer Boiler Co.; Geo. R. Bentley, Harrisburg, Pa., Central Iron and Steel Co.; J. Don Smith, Charleston, S.C., Valk & Murdock Iron Works; J. M. Robinson, East Boston, Atlantic Works; H. D. McKinnon, Bay City, Mich., McKinnon Manufacturing Co.; Henry Brobst, Grand Rapids, Mich.; G. H. Kittse, Aurora, Ill., Aurora Boiler Works; C. F. Wolfe, Brantford, Ont., Waterous Engine Works; V. H. Debendorfer, Mannington, W. Va., West Virginia Boiler and Machine Co.; Wm. McKay, Amherst, N.S., Robb Engine Co., Limited; Wm. A. Brunner, Phillipsburg, N.J., Tippet & Wood; Geo. B. Hartley, Syracuse, N.Y., Solway Process Co.; N. J. Holden, Montreal, N.J., Holden & Co.; H. L. Wrattan, Racine, Wis., S. Freeman & Sons Manufacturing Co.; John Mahar, Tonawanda, N.Y., American Engine and Boiler Works; F. E. Leonard, London, Ont., E. Leonard & Sons.

MEMBERSHIP OF ENGINEERING SOCIETIES.

In his Presidential address before the American Institute of Electrical Engineers, Mr. John W. Lieb, discussed the organization and administration of national engineering societies. He referred at the outset to the formation of engineering societies in Great Britain—the Institution of Mechanical Engineers in 1847, the Iron and Steel Institute in 1869, and the Society of Telegraph Engineers and Electricians in 1871, which became in 1889 the Institution of Electrical Engineers. In America the American Society of Civil Engineers was organized in 1852, the American Institute of Mining Engineers in 1871, the American Society of Mechanical Engineers in 1880, and the American Institute of Electrical Engineers in 1884. The membership of these various societies on January 1st, 1905, was as follows:—American Society of Civil Engineers, 3,203; American Institute of Mining Engineers, 3,680; American Society of Mechanical Engineers, 2,780; American Institute of Electrical Engineers, 3,334. The membership of British and Continental societies was given as follows:—Institute of Civil Engineers (January 1st, 1905), 6,597; Institution of Mechanical Engineers (March 1st, 1905), 3,977; Iron and Steel Institute (January 1st, 1905). 1,909; Institution of Electrical Engineers (August 31st, 1904), 4,303; Verein Deutscher Ingenieure (April 24th, 1903), 17,549; Société des Ingenieurs Civil de France (1901), 3,691.—Iron & Coal Trades Review.

For Steam Engineers

We have had reprinted from the "Canadian Engineer" three articles of practical helpfulness to steam engineers. No. 1 is a paper on "Boiler Feed Water" by A. M. Wickens, No. 2 is on "Purifying Water for Engines" by G. M. Davidson, while No. 3 is on "Boiler Scale and Boiler Feed" by Harry Spurrier. All three men referred to are specialists in their field. You can get a copy of this useful pamphlet for **10c.,** stamps or coin.

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