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VOL. 57. No. 12. TORONTO, OCTOBER 30, 1908. New Series—VOL. 1. No. 8.

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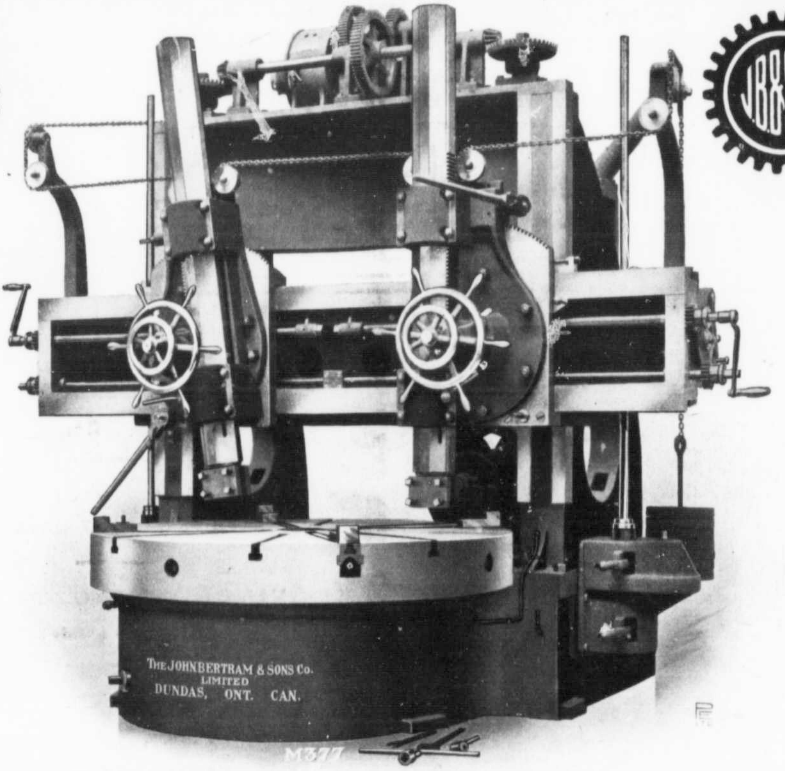

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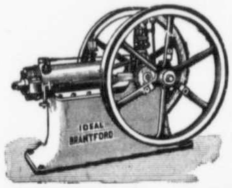

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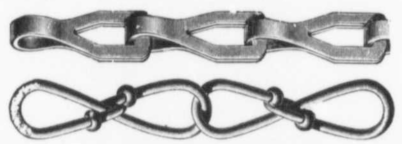

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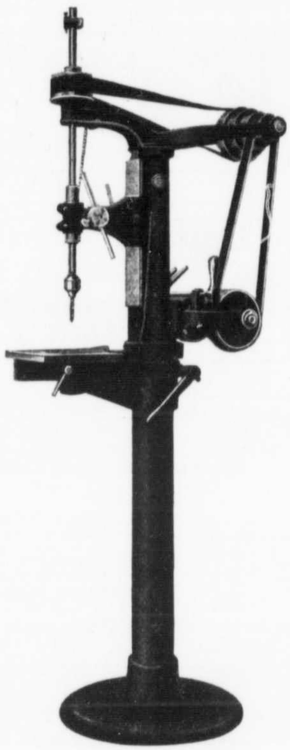

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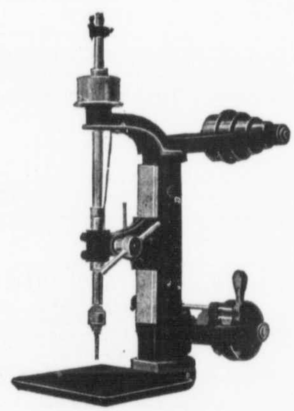

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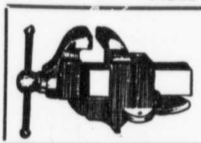

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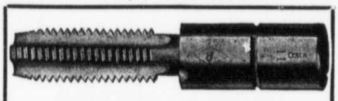

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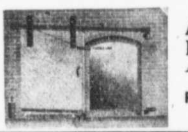

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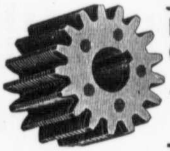

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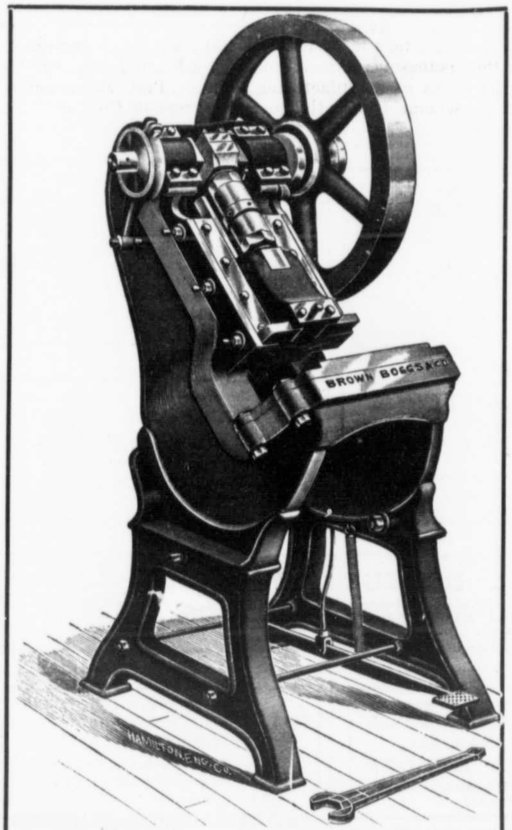
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OF THE
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SHOULD MANUFACTURERS BUILD NOW?

This is a question in which every manufacturer who has building operations in view is asking himself. Here are views expressed by some of our readers, who are in a position to know the facts:

"At present cost of building is lower than it has been for the last three years; most lines of material are lower, labor is lower and, owing to men's anxiety to keep their jobs, the same men are doing 20 to 25 per cent. more work than they have been doing. Contractors are also figuring on a much closer margin of profit, in fact not, in most cases, getting any profit at all. The outlook at present is, that owing to the good crops throughout Canada in 1908 and the large amount of railway building going on, trade will be good this winter, and next year is likely to be one of the best business years for Canada, so that cost of building will likely go up again in the spring."

"The present is a good time to build factories or warehouses as both labor and material are cheaper now than they have been for years. Manufacturers who contemplate erecting factories or warehouses should let their contracts out early this fall to take advantage of the prevailing low prices. The same cannot be said of residential property, particularly that of the 'flat' or 'apartment' class, which has been overdone to such an extent that there are now thousands of them vacant and offered at greatly reduced rentals."

"The present is a good time for manufacturers and others to carry out building operations for three reasons:

"(1). Materials are somewhat easier though not as low in Canada as in the United States; (2). While wages are down only to a slight extent, laborers are much more easily obtained and controlled than in the past few years, and therefore will produce more in a day than formerly; (3). We are on the eve of a boom which will equal if not exceed the one we have just had and when it comes those who have their buildings completed will find they have saved a large percentage in cost and will be ready to take advantage of the occasion offered."

CO-OPERATIVE ENGINEERING EDUCATION.

In Cincinnati two years ago Professor Herman Schneider, Dean of the College of Engineering of the University of Cincinnati, started a movement to organize a system of co-operative engineering education by which students would receive a thorough technical training and at the same time a thorough practical training, to provide for the increasing demand for well educated engineers in the shops of manufacturing plants. Prof. Schneider put his scheme before the manufacturers in Cincinnati. It appealed to them as a business proposition. These manufacturers had found that the ordinary engineering courses did not give young men that practical training which is necessary to equip them for immediate usefulness in responsible shop positions that can pay high enough salaries to attract men of their years, education, and mode of living. This plan as proposed by Professor Schneider would train engineers for the shop, and the manufacturers realized that it would pay them to co-operate in such a scheme.

These co-operative engineering courses have been in operation in Cincinnati for two years, and all concerned express themselves as being well satisfied with the results. These courses are arranged so that students work alternate weeks in the college and in the shops in the city. Two sections alternate with each other. The course is six years in length. There is a course in mechanical engineering, in electrical engineering and in chemical engineering. Students get a thorough training in all departments in the shops as well as in the various technical subjects in the University.

In another part of this issue it is suggested in an article that a similar system of co-operative education be inaugurated in Toronto and Montreal, the manufacturers co-operating with the Universities in these two cities as in Cincinnati. This is worthy of the careful consideration of the University authorities and the Canadian Manufacturers' Association.

In a future issue we will publish an article describing in detail these co-operative engineering courses as conducted in Cincinnati, giving opinions of those interested as to the success of the scheme, and as to its future.

WHAT THIS NUMBER CONTAINS.

In this issue the question of the advisability of inaugurating in Toronto and Montreal a system of co-operative engineering training, whereby the student will receive a thorough practical training in manufacturing shops and a thorough technical training in the University, is considered. This is a big problem and the article should interest every large manufacturer, as he is vitally concerned.

* * *

The descriptive article of the new plant of E. & T. Fairbanks & Co., Limited, and the article "Construction of One Storey Shops" are the style of articles our readers may look for in this edition. Each month the aim will be to publish something valuable and reliable on factory construction. This edition next month will contain something on saw-tooth roof construction.

* * *

In this issue we publish an article on methods of dealing with the depreciation of machinery. A system is outlined which will be invaluable to any manufacturer who has not already a comprehensive system to handle this question. The source of the article is proof of its value.

* * *

For the clay worker, the owner or superintendent of brick yards, there are two articles of value in this issue. "Electric Motor Drive in the Clay Plant" includes many suggestions which will no doubt prove of great value to some clay worker.

New Plant of E. & T. Fairbanks & Co., Ltd.

Description of the Construction and Equipment of this Company's Plant at Sherbrooke, Que., For the Manufacture of Scales, Valves, Power Hammers and Other Specialties. Plant Just Completed in September.

There has just been completed at Sherbrooke, Que., an excellently laid out factory for the E. & T. Fairbanks & Co., Limited, for the manufacture of scales and balances of all kinds; and also valves, power hammers and other specialties. As well a contract has already been entered into by the company to supply castings to another manufacturer. The company is an off-shoot of the parent company located in St. Johnsbury, Vermont, where the Fairbanks scales are manufactured. The Canadian company was organized in 1907 with the

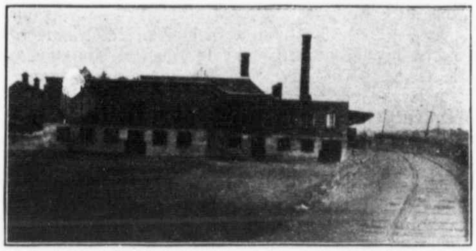


Fig. 2—East End of Factory of E. & T. Fairbanks & Co., Limited.

head office at Sherbrooke, where they propose to manufacture all scales required for the Dominion of Canada.

The buildings extend from the east to the west a length of 303 feet by a width varying from 63 feet to 115 feet.

A good idea of the layout of the plant and the style of the structure can be obtained from the ground plan and elevation shown in Fig. 1.

Arrangement of Foundry.

The iron and brass foundry is located in the west end, and has an annex for storing sand and clay on the ground floor of the cupola house. There is an elevated charging floor, with a coke storage compartment on the same level. The coke is elevated by means of a bucket conveyor from beside the railway siding, where it is shovelled from the cars and put into the building through a chute and opening in the roof. The moulding sand is carried up in the same elevator, and is spouted to a bin on the ground floor below the coke storage bins.

The iron for the cupolas is elevated to the charging floor by means of an Otis-Fensom elevator, in front of which is located a 3-ton scale which weighs all charges before they go on to the elevator.

The core room adjoins the cupola house. It is equipped with Millett core ovens for baking the sand cores.

At present the foundry floor consists of a space 75 feet wide by 60 feet long, one-third of which is reserved for brass work, and two-thirds for cast iron. The iron will be melted in a 60 inch Whiting cupola, and provision has been made for the addition of a future cupola of 72 inches diameter alongside the present one. A 10-ton Niles travelling crane conveys the metal from the cupola to the flasks, and runs up and down the building in the centre of the three bays. The brass melting section is fitted with a Swartz melter. As well it is equipped with the usual crucible melting pots set in a pit on a level with the floor, so that either or both methods of melting may be used.

The Machine Shop.

Adjoining the foundry is a two-storey building, 60 feet wide by 110 feet long, which is used as a machine shop and cleaning room, the cleaning room taking up three bays, or 30 feet, next the foundry. This building has two stories with an open well 70 feet long, over which a 7½ ton Niles travelling crane operates, the upper floor being in the form of a gallery on which are located light machine tools. An Otis-Fensom elevator has been installed between the ground and first floor of this building.

The machine shop is equipped with a full line of modern machine tools for not only manufacturing purposes, but also for making their own special tools, and for doing all necessary repair work.

A space 21 feet by 30 feet in the gallery floor of the machine shop is set apart as a tool room, which will be conducted on the principle whereby each workman is held accountable for the tool temporarily in his possession.

Other Departments.

Next the machine shop is located a building 30 feet by 60 feet, which is known as the paint shop. And next the paint shop comes the sealing and packing department which is 40 feet wide by 80 feet long. In this department the various parts of the scales are assembled and tested, and then packed for shipment.

The shipping room or depot is situated next the packing room, as shown in the plan, Fig. 1, and is equipped with a shipping platform right on the railway siding, thus making very convenient shipping facilities. This platform is 10 feet wide, runs the entire length of the building, and is covered with a canopy. Alongside this platform is situated a 100-ton standard track scale,—so that all raw materials entering the works, and finished

Fig. 3—West End of Factory, E. & T. Fairbanks & Co., Limited.

material leaving same, can be weighed in the cars before leaving the company's yard.

The depot is designed with a 14-foot basement in which is located the boiler plant for heating the buildings and drying lumber, the floor over this basement being constructed of steel and reinforced concrete.

On the south side of the sealing room is located the owodworking department, which is a building 40 feet wide by 60 feet long, with a 10 foot basement underneath

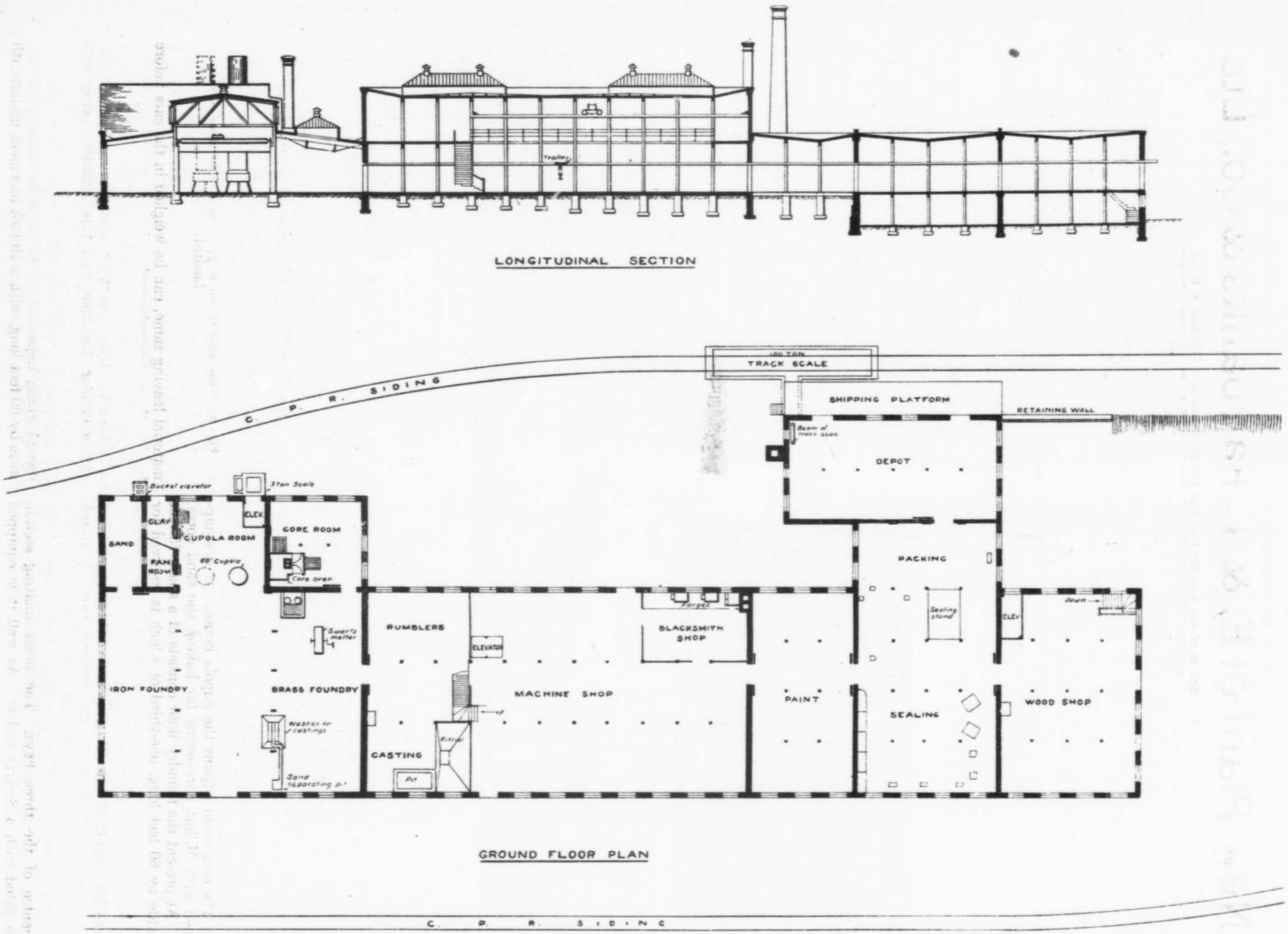


Fig. 1—Ground Plan and Longitudinal Section of Plant of E. & T. Fairbanks & Co., Limited, Sherbrooke, Que.

same. An elevator with a 14x6 foot car, operates between the basement and first floor of the wood shop.

The wood working department also has an equipment of the most improved machinery, including Fairbanks' saw tables.

The blacksmith shop is a department off the machine shop. It is fitted with metal forges, power shears and power hammers.

CONSTRUCTION OF THE BUILDINGS.

The buildings throughout are built with monolithic and reinforced concrete foundations which are carried up to the first floor level, from where the walls are continued in red brick set in lime cement mortar. The floors are made of 2x4 inch spruce on edge, and ⅞ inch hard wood flooring on top, with heavy timber beams and columns—the slow-burning or mill construction. Each department is divided from the other by means of brick walls, with tinned standard automatic fire doors. The

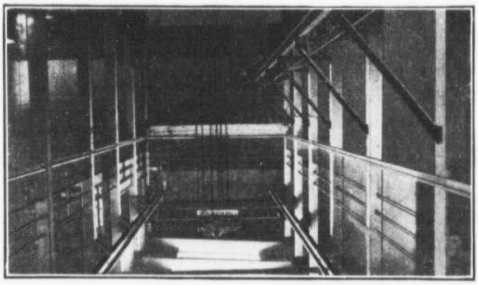


Fig. 4—Interior of Machine Shop, E. & T. Fairbanks & Co., Limited.

arrangement of the departments is such that the metallic raw materials come in at the west end and travel through the foundry, cleaning room, machine shop to the sealing room. The wood-work enters from the opposite end and reaches the sealing room, where the parts are assembled together and tested.

The work of construction was started in April last and was completed by September 1st, 1908.

Electric power for operation of works is being supplied by the Sherbrooke Electric Power Co., at a potential of 110 volts and transformed to 220 volts outside the building for the power. The electric lighting for the plant is at 110 volts, both Adams-Bagnal arc lamps and incandescent lamps being used.

The heating of the building will be accomplished by means of the boiler already referred to with a low pressure direct radiation system, Bundy traps being installed throughout the plant to return all condensation back to the boilers.

The plant is well supplied with shipping facilities, having, besides the one already spoken of on the north side of the building, one on the south side from the same main line of the Canadian Pacific Railway, which will serve the space set aside for the lumber yard.

The heating system was installed by A. R. Wilson, Sherbrooke, the electric wiring being done under a sub-contract by Scott & Rubenstein, Montreal. The structural steel was fabricated by the Structural Steel Co., Limited, Montreal. The elevators were installed by the Otis-Fensom Elevator Co., Limited, Toronto. The electric motors, cranes and many of the machine tools were supplied by he Canadian Fairbanks Co., Limited, Montreal.

T. Pringle & Son, Limited, Montreal, were the engineers and architects, and had charge of the design and supervised the construction.

The Man Who Cheats His Work

An employer of thousands of men was asked what thing in all his large operations gave him the most concern. "The man who does a little less than is expected of him," was the reply. "He is the dangerous factor in all business. The absolute failure we readily discover and discharge, the 'almosts' escape detection for months and often for years, and they make our losses as well as our fears," and with a very serious smile he added. "The drip in business is worse than the leak."

It is a condition that is as old as human experience. Eighteen and a half centuries ago Seneca put it in these words: "Some portion of our time is taken from us by force; another portion is stolen from us; and another slips away. But the most disgraceful loss is that which arises from our own negligence and if thou wilt seriously observe, thou shalt perceive that a great part of life flits from those who do evil, a greater from those who do nothing, and the whole from those who do not accomplish the business which they think they are doing."

Thousands of men fancy they are fulfilling their duty to their employers and to their tasks by keeping hours and performing just enough to hold on to their positions. They have an idea that to do more would be to give larger service than their compensation required. They object to what they believe would be extra values. "The old man shan't get more than he's paying for," is the vernacular.

Possibly it never strikes these trimmers that in cheating their work they are doing double damage; they are injuring their employers much, but they are robbing themselves more; they are, in fact, losing everything in life that is worth while.

They fare worse than if they did nothing at all, for time with all its precious values slips entirely from them and leaves no substance or satisfaction.

Half doing soon brings undoing. It is the nine-tenths doing or the ninety-nine one-hundredths doing that bleeds business and saps character.—Saturday Evening Post.

Opening Up Undeveloped Country

An important event to the people of Canada is the recent opening up of 650 miles of the Grand Trunk Pacific for limited traffic. It means the beginning of the development of distant territory—land which has been little thought of until lately, as nothing but frost bound and barren lands. Evidence given last session before the Commons Committee on Agriculture shows that it is probable that large tracts of land may be utilized for wheat growing, which have been heretofore considered too far north for profitable cultivation. These facts are but another indication of the wonderful resources of Canada which are as yet untouched.

Why Not Cooperative Education in Canada

Why Should Not a System of Co-operative Engineering Education be Inaugurated in Toronto and Montreal, the Two Universities Providing the Technical Training and the Manufacturers the Practical Training? A Consideration of the Subject.

Many a graduate of the Engineering Department at the University of Toronto, at McGill University, at Queen's University and at all the other Canadian Universities, has been repulsed by Canadian manufacturers when looking for a position with this statement: "*We do not want college men: they are no use to us.*

"*The biggest field for graduates in mechanical and electrical engineering from Canadian Universities is the manufacturing and industrial field.* An ever increasing demand will be felt by Canadian manufacturers for technically trained men. The keen competition demands that manufacturing be conducted on a scientific and economic basis.

Why then is the engineering graduate—the technically-trained man—met repeatedly with this bald and discouraging statement, "*We do not want college men: they are no use to us!*"

There are reasons. Wide awake manufacturers in Canada do not turn university men away without reason. *It is not mere prejudice. There is something wrong somewhere.*

Not every man is made for an engineer. *Too many men are turned out from universities with an engineering degree, who should have been lawyers, doctors, business men, politicians or gentlemen.* A manufacturer having had experience with one of these gets a bee in his bonnet. If he has two experiences, he cannot be blamed if he says to the third "We do not want college men: they are no use to us." The third may be a good man, but there is no feasible way of discriminating.

Then again, many a good man is graduated from the engineering department of universities *with a very meagre idea of practical work*, that is the every day work around a manufacturing plant. The experiences manufacturers have had with such graduates is quite as discouraging as with the first class.

The result is that there are very few engineering graduates holding good positions with manufacturers in Canada at the present time; *and most of those few are in such places as the testing floor of electrical works or in the engineering departments of bridge works. They are not in the machine shop, the foundry or the works.*

This is not because there is not work for the technical graduate in the actual manufacturing. There is. It is because the average technical graduate is not in close enough touch with the details, to enable him to turn his technical training to good account. In order to make the money, he thinks he is worth, he must do work where his college training is more in demand than his detail knowledge of pattern making, of molding, of machinery, of assembling and all the rest.

This is certain. The Canadian manufacturer needs the technically trained man. He must have him to compete with manufacturers in other countries who do have technical men.

This also is certain. The average technical graduate of our Canadian universities is not the kind of technical man required by our manufacturers.

Here is something else that is certain. If our universities continue to turn out the number of technical graduates that they have during the past few years, *those graduates must find employment with manufacturers or go without it. The other fields are limited, and are already crowded.*

This brings us to the point Canadian manufacturers need technically trained men. The average graduate turned out under the present system is not suitably trained for practical manufacturing work. *Therefore some change must be made in the systems of training used in our Universities whereby some of the graduates at least will be well equipped to take good positions with manufacturers; or else the number of engineering graduates should be curtailed.* There can be no compromise to that statement. It is borne out by facts, and is attested by technical graduates and manufacturers throughout the country.

This does not necessarily mean that the work carried on at the Canadian universities is not done well. The high standing taken by the graduates of Toronto and McGill Universities in the United States, when working side by side with graduates from the best engineering colleges over there, is a good recommendation for the engineering courses in both these universities. Canadian universities are doing good work as far as technical training is concerned. *But to best fit students for machine shop work, for foundry work, for chemical manufacturing work, and for the many other phases of manufacturing, they should get a thorough training in the practical side of the work as well as the technical; and the technical and practical training should go on at the same time.* After a man has graduated from the university, in the great majority of cases, it is too late to get a thorough training in the practical work. Facts bear out this statement.

The systems in the Toronto and McGill Universities provides for a practical training; and these systems work out all right in the majority of cases where graduates intend to follow up certain lines of work; *but as preparation for positions in manufacturing these systems are altogether inadequate.*

For instance, before conferring a degree the university of Toronto demands that the student show a certificate of having spent eight months working at one of the trades. The weak point in this is that *the university has no means of determining the accuracy of such certificates*; and even should the certificate happen to be correct in time, such time might have been spent by the student in operating a bolt cutter or some other equally automatic or more automatic machine; and his eight months will have been months of impressions at the best and not of experiences.

The curriculum at McGill includes practical work, and although the training may be systematic no adequate commercial practical training can be given.

The Canadian universities should endeavor to make their technical or engineering courses of greater and wider usefulness to the country in general. The solution to this *problem readiest to hand is co-operative education—that is a system of training in which the universities and manufacturers will co-operate.*

The universities should be anxious to become a greater factor in the building up of this country. They are a large factor at present; but here is a field of usefulness yet to be developed.

The Canadian Manufacturers' Association have for the last four years been advocating the appointment of a government commission to thoroughly investigate technical and trade education requirements. Canadian manufacturers realize the necessity of doing something.

Then why should not the university authorities and the Canadian Manufacturers' Association co-operate in solving this problem?

Why should not a system of co-operative education be inaugurated in Toronto and Montreal, the two universities providing the technical training and the manufacturers the practical training?

This is not a system altogether untried. It has been in successful operation in Cincinnati for the last two years, and both the university authorities and the manufacturers interested have expressed themselves as more than satisfied with the results so far.

These courses are so arranged that students work alternate weeks in the Engineering College of the University of Cincinnati and the manufacturing shops in the city. There are two sections, so that a manufacturer always has the same number of students. The course is six years in length.

Whether a co-operative system of education such as this could be inaugurated in Toronto and Montreal could only be proved upon a thorough investigation. Perhaps it would be necessary to go outside Toronto to secure the number of manufacturing shops necessary; but that should be feasible as there are several large manufacturing towns within easy reach of the city, such as Hamilton and Galt.

Systems of co-operative education could be established in mechanical, electrical and chemical engineering

[In a future issue we will give a detail description of the system of co-operative education as established by the University of Cincinnati and the manufacturers of Cincinnati, two years ago; and also opinions of those concerned as to the success of the idea, after two years operation, including the manufacturers participating, the Dean of the Engineering College and the President of the University.—Editor]

A New Automatic Railway Signal System

A System to Automatically Control Trains. To Prevent Wrecks Due to Rear-End or Head-On Collisions, Broken Rail, Misplaced Switches. Open Drawbridge Tested Out on I.C.R. in New Brunswick.

By H. W. Price*

One scarcely ever picks up a daily paper, but some railroad accident glares at one from the front page. So often do they occur that we become accustomed to reading them. Their horrors do not come home to us, unless we are personally concerned. Only then do we realize what it means to the injured and the friends of the injured.

For this reason the following description of a new automatic train controlling system, which has been tried out in practice and found to do excellent work should be of great interest to readers of The Canadian Manufacturer. This system was invented and developed by the writer. It was tested out on the Intercolonial Railway.

This system is an automatic one. "Automatic" refers in this case to spacing the trains, without depending upon the driver, who with other systems must observe and obey visual signals.

Purpose of the System.

It is intended that this system shall automatically assist in the prevention of accidents to trains in motion, such as rear-end collisions, head-on collisions, on single or multi-track railways; derailment, caused by broken rails, misplaced switches or open draw-bridges; and shall prevent running past the order board at intermediate stations.

It will also bring under control an approaching train, should a car or a portion of a car standing at a siding project over the main line.

Provision is also made at long sidings between stations,

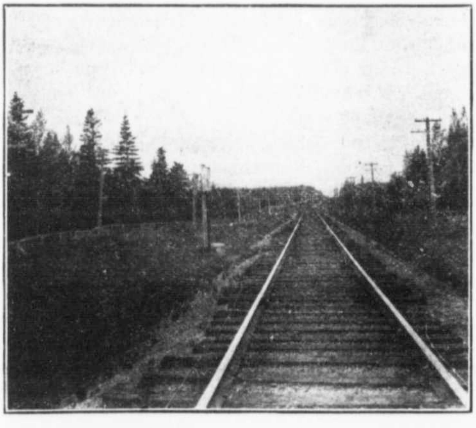


Fig. 1—Showing a Section of the I.C.R. Equipped with this System.

where by a superior train standing on the main line can allow an approaching inferior train to make the siding without running danger signals.

* Lecturer in Faculty of Applied Science, University of Toronto

Description of Equipment.

The means employed in the working of the system consist of two parts:—an equipment on the track at intervals through the sections requiring protection, the

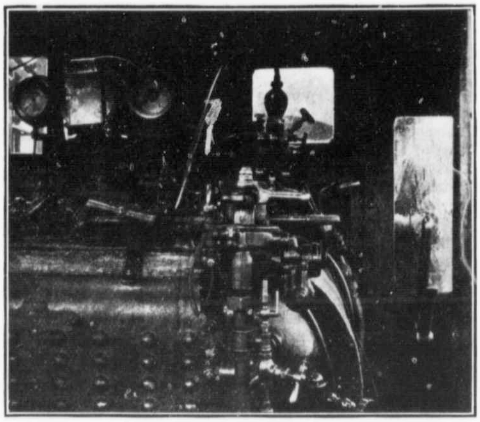


Fig. 2—Showing the Engineer's Brake Valve, which in Fig. 3 is equipped with the brake valve controller.

duty of which is to automatically arrange to bring under control trains in case their undue proximity should render it necessary; an equipment on each locomotive, the duty of which is to automatically do the work of slowing down or stopping the train when started into operation by the track equipment.

The rails of track equipped with this system are divided into blocks of any desired length by insulated rail joints. At end of each block is located a post carrying a relay box which contains a track relay and line relays; also at this place a chute, containing a track battery and a line battery. The track battery at one end of each block normally energizes, through the rails of the block section, the track relay at the other end of the block. A train anywhere in a block between a track battery and its relay, will short circuit the track relay and cause it to release its armature. Each and every train has a like effect on the track relay of the block occupied. Each track relay armature when caused to drop, opens contacts in the line circuits, which results in establishing permissive connections at the relay posts, ahead of the moving train, provided no other train is ahead and nearer than two clear blocks. Thus a train on a clear track or running at a safe distance away from other trains is permitted to pass all relay posts, without having its train controlling mechanism in the engine put into operation. If, however, two trains be running so as to leave only two clear blocks between them, the track relays de-energized by the two trains upon the line circuits in such manner that all permissive connections between the trains are broken, and trains then passing the relay posts between them are automatically brought under control.

In general, one train on a single track equipment is free to travel in either direction. Two trains can travel in the same direction on one track, provided they remain apart at least one and a half to two miles, according to the length of blocks chosen. Should the following train attempt to reduce the distance between them, it would be automatically braked at the next relay post ahead of it, while the leading train would not be interfered with. If the two trains were approaching each other, so as to be in danger of head-on collision, both would be stopped.

Equipment in Engine Cab.

The engine equipment required is in no way complicated. A trip coil in a "signal receiver" in the cab of the engine, is normally energized by a small current, which flows continuously except when interrupted by the presence of another train ahead. When de-energized, this coil drops its armature, and as a result the "receiver" turns air at a pressure of 90 lbs. per square inch (from the main drum supplying the air brakes) into a "brake valve controller" which then forcibly moves the engineer's brake valve handle to service position and automatically holds it there an adjustable interval made long enough to bring the train to caution speed, or a full stop if so desired, by suitable reduction of train line pressure. The brake valve controller is shown at A, Fig. 3, and the signal receiver at B, Fig. 3. After the interval of brake valve control has expired, the receiver exhausts the air from the brake valve controller, and automatically leaves everything in the engine equipment ready for future duty. The driver can not prevent the setting of brakes but can, if he wishes, release them immediately after the air has been exhausted from the controller. The brakes are not automatically released—the engineer must release them. He is also free to move the handle on to emergency position at any time.

Some of the Advantages.

Some of the advantages claimed for this system of automatic train control are as follows:—

It can operate alone as a complete train-controlling block system, or as an auxiliary to enforce indications given by visual signals. Its electric circuits are normally closed, so that defects in line circuits, exhausted batteries, etc., automatically report themselves by causing false danger indications. The type of automatic train control adopted is safe because "service" brakes

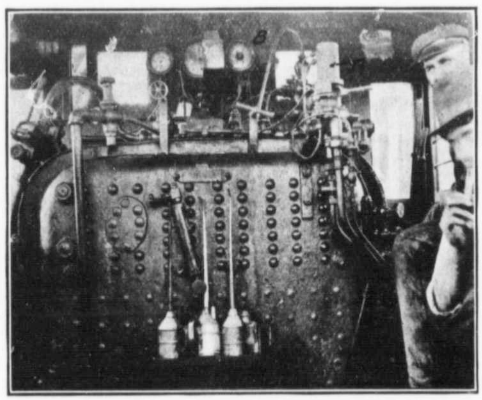


Fig. 3—Showing the brake valve controller at A and the signal receiver at B.

are applied gradually but hard in accepted manner by the engineer's brake valve. Other systems "bleed" the train line which will cause "emergency" braking, and almost certainly wreck long trains from shock.

The equipment is much cheaper than that required for visual systems. Maintenance is much less, as the battery equipment is much smaller, and there are no lamps to require daily attention.

The system is owned and controlled by the Universal Signal Co., Limited, of Toronto.

Allowing for Depreciation of Machinery

A System of Dealing with Repairs, Renewals and Depreciation of Machinery and Equipment. A Complete and Valuable Treatise on the Subject. Abstract of a Paper Before The Institute of Mechanical Engineers, October 16, 1908.

By J. E. Darbishire

Most of the details of the management of an engineering establishment have, within recent years, been systematized. Systems now govern general office, drawing office, and works, from the filing of correspondence onwards; and no modern business can be economically carried on without them. They are the result of careful study of the requirements common to all engineering establishments, and the fact that they are systems points to a general consensus of opinion that what is good for one, is good—with modifications—for all, and that certain definite principles are applicable to all cases.

It therefore appears strange that the method of dealing with the wear and tear, repair and renewal, and depreciation of plant and machinery, has escaped attention, and that there seem to be as many different ways of treating this question as there are engineers, or perhaps it should be said, as there are accountants.

Possibly a discussion of the subject may tend towards some approach to uniformity of practice amongst the mechanical engineers having control of manufacturing works; and the author has therefore endeavored to bring forward the points which govern the question, and to make some suggestions for a system which shall provide for the proper upkeep of machinery, and for its replacement when no longer useful.

The matter is very far from being, as many seem to believe, merely a matter of accountancy; in fact, the first reform would be to transfer the control of the machinery stock book, and everything connected with it, from the accountant to the engineer.

First Consideration on the Subject.

It is beyond dispute that the efficiency of a manufacturing establishment depends upon the quality and condition of the plant and machinery therein, and that any neglect to maintain this equipment in the highest working condition promptly results in a falling off in both quality and quantity of output. The first question, therefore, to be considered is:—What is the best system to be adopted for maintaining the whole factory equipment in proper repair, and for discarding obsolete or worn-out machines, and replacing them with new machines when necessary? The second question is that upon which opinions differ so greatly, viz.:—How is the necessary financial provision for the maintenance and renewal to be made? Needless to say the two have to be considered together.

THE..........................ENGINEERING CO., LIMITED.

MACHINERY STOCK ROOM.

Date: December 31, 1897.

No. of Machine.	Description.	Depreciation Class.	Present Value. £ s. d.
	Machine Shop A.		
1	18-inch Sliding, Surfacing and Screw-cutting Gap Lathe, with 24-foot Bed, Driving Apparatus, etc., complete. (By A. B. & Co. New; probable life 30 years)....................	2 (7½%)	400 0 0
2	4 feet 6 inches square by 15 feet long Planing Machine, 2 Tool-boxes on Cross Slide, Driving Apparatus, etc., complete. (By C. D. & Co. New; probable life 30 years)...........	2 (7½%)	500 0 0
3	Special Horizontal Milling Machine for light work, Vice, Set of Mandrills and Driving Apparatus, etc., complete. (By E. F. & Co. New; probable life 20 years)...............	5 (15%)	100 0 0
4	10-inch Stroke Slotting Machine, with Driving Apparatus, etc., complete. (By G. H. & Co., second-hand from X. Y. & Co.'s Sale. Was new (£100) in 1885; probable life 25 years)	3 (10%)	28 0 0
	Carried forward ...		

Fig. 1. Showing the System of Posting the Machinery Stock Book for New Works.

The Maintenance of Factory Equipment.

The maintenance of the plant and machinery of a manufacturing establishment is generally one of the duties—and not the least important one—of the works manager, and much depends upon his judgment in deciding upon and executing the necessary repairs and renewals from time to time. It is, however, very unusual for this official to have any concern with, or knowledge of, the money value of the plant he is dealing with, and there would be an obvious advantage in the introduction of the reform previously indicated; placing the control of the repairs and renewals and of the valuation in the same hands, and limiting the accountant's duty in this connection to the use of the valuation provided for him by the engineer for the purpose of his profit and loss account and balance sheet.

The following system is suggested for adoption with the object of ensuring proper attention to upkeep of machinery and plant, which in a manufacturing establishment will consist of boilers, producers, furnaces, steam or gas-engines, electric generators, transmission (pipes, cables, shafting, etc.), possibly hydraulic and air-compressing and other machinery, together with cranes and similar gear, all only indirectly productive; with machine tools, steam-hammers and similar machines which are directly productive. The quality of the output is absolutely dependent on the quality and condition of the latter; the quantity and the cost, on the whole equipment. Besides the above, there are "loose tools," which are, in modern establishments, controlled by the "tool room" and may be left out of the present consideration.

Under the suggested system the control of everything would be vested in the works manager, or, in the case of large works, in a special official. The limit of his powers, as regards incurring expenditure, would be defined by the general manager, directors or partners according to circumstances; he would be responsible for the upkeep of the whole of the machinery and plant, and it would be his duty to report his requirements when he found them to exceed his financial limit; but it is essential that he should have considerable latitude in incurring expenditure on repairs, because obviously time is of the utmost importance in most cases, and he ought not to be bound by too much red tape; in machinery repairs "a stitch in time" often saves many times nine. There is no doubt whatever that if the right man be appointed there will be no difficulty on this point.

His first step must be to prepare a proper schedule of the plant and machinery in his charge, entering each item in the machinery stock book, with its distinguishing number. Against each item there should be entered its present value, calculated according to its age, in the manner to be explained later. Also a figure representing its probable life in years; this second figure will be required when provision for depreciation comes under consideration. Fig. 1 shows the system of posting the machinery stock book for new works.

Estimating Probable Life.

Probable life must always be a matter of opinion, but the development of mechanical engineering is now so rapid that it would certainly be unsafe to anticipate for the machinery of to-day the life of that of fifty years ago. For example, machine tools fifty years old may be very interesting and still capable of doing work, but their use is not conducive to commercial success, and it will not do to look forward to following the practice of previous generations in keeping old machinery at work.

The importance of properly estimating probable life will be apparent when deprecia-

THE............................ENGINEERING Co., LIMITED.

REPORT ON DEFECTIVE MACHINE.

Department.................................
Machine No.....................Description.......................................
Defect noticed
Attendant's name.......................... No............. Date..............

Repair recommended.......................................Foreman.
Date..............
Approved...Works Manager.
Date..............
Works Order No......................... Date..............

Report of Repairs completed. Date..............
Particulars.

....
Foreman responsible for Repairs.

Passed for Work..Works Manager.
Date..............
Re-started..Foreman.
Date..............

Cost of Repairs.

Remarks.

Fig. 2—Card for Works Manager's Inspection.

tion is considered, and it is in this that the engineering skill and experience of the works manager or the special plant engineer will have their opportunity. The matter seems to have had no consideration whatever in the past; but a short time will suffice to produce plenty of men with the experience necessary to form a sound judgment on the probable life of any machine, that is, on the chances of its becoming obsolete by the arrival of new methods of working, and also of its wearing out in use.

LOOKING AFTER REPAIRS.

The next step must be to make provision for proper care of the various machines, and for repairs being executed when required without delay. To ensure this, each attendant or workman in charge of a machine or group of machines, being the actual attendant or operator, and not a foreman, would be made, in the first instance, responsible for its being maintained in the highest possible condition, the fireman for his boilers, the turner for his lathe, and so on. It would be his duty to report immediately to his shop foreman any defect becoming apparent, and to enter on a card the description and number of machine, nature of defect, date, and his (the attendant's) name.

The foreman's duty would then be to inspect the machine, and if in his opinion the repairs are necessary, to initial the card, and submit it to the works manager for final authority, the works manager initialling and dating the card and assigning a Works Order No. to the job. The repairs would then be executed at once, and on their completion the machine would be inspected and passed by the works manager, and their execution certified (with date) on the card; to which would be also added the cost incurred. This system would ensure proper care by the attendants of every machine, and would prevent ill-usage, which used to be one of the workshop troubles, though in this respect the modern workman is a great improvement on his predecessors, and the care of machines —especially machine tools—now leaves very little to be desired. It would also afford the works manager the opportunity of deciding when the time has come to replace instead of repairing—and it will be remembered that

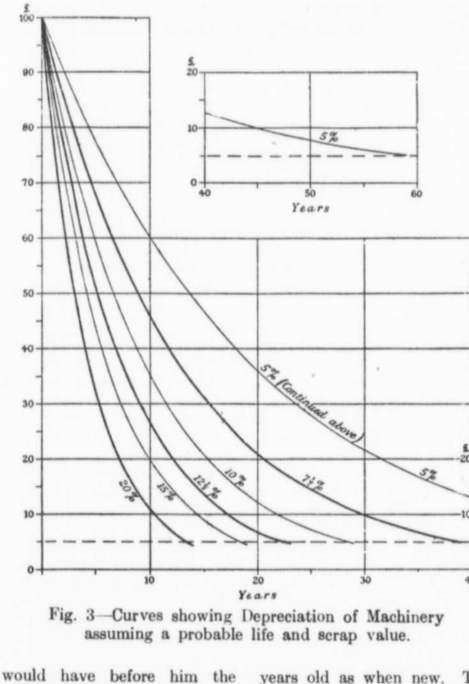


Fig. 3—Curves showing Depreciation of Machinery assuming a probable life and scrap value.

this official would have before him the "stock book" valuation of the machine under consideration, and therefore would know how far the cost of renewal had been provided for. He would see the whole situation at a glance, and decide whether to replace, thoroughly repair, or partially repair.

In addition to the workman's or attendant's daily watching of each machine, periodical inspection should be made by the works manager as a check upon workmen and foremen, and each such inspection recorded. A suitable form for the card is given in Fig. 2.

In the first space, the workman or attendant reports the defect noticed by him. In the second place, the foreman and the works manager recorded their inspection, and the latter his authority for the repair. The works manager, having assigned a Works Order No. for the repairs, can through that order authorize any further repairs necessary to the machine; there will generally be other defects to remedy, besides that originally reported by the attendant. In the third space, details are given of all the repairs when finished, this being signed by the foreman responsible for the repairs, who may, or may not, be the same as the foreman of the shop to which the machine belongs. In the fourth space, the works manager records his authority for the machine to be set to work again, and the foreman gives the date of re-starting. Finally, the cost is added in the fifth space, and the record is complete.

METHOD OF RECKONING DEPRECIATION.

It is sometimes argued that if machinery be maintained as indicated above, it does not depreciate, and that, so long as its output does not fall off in quality or quantity, it is as valuable to its owner when ten or twenty years old as when new. This, however, is absolutely incorrect, for although a machine could of course be kept "alive" for ever, by renewing its parts one by one as they wear out, supposing that it never grew obsolete, its value at any given time would depend upon the state of deterioration of its various parts at that time, because since each part has a "life," the effluxion of the life of that part is proceeding from day to day. But machines do grow obsolete, and are not renewed in this way; and the depreciation now to be considered provides for that effluxion of life of each machine as a whole which actually takes place, the amount depending upon the time which a machine can be profitably used for the purpose of producing the output required by the works in which it is installed—this being its "life."

It is therefore absolutely necessary to make provision for a fund by means of which the various items of a workshop equipment can be renewed from time to time—which provision obviously has to be made without any reference to the profits or losses of trade. It must be made as part of the working expenses of the business, and in this respect the author protests against the system frequently adopted by accountants of showing a so-called "profit" out of which so much is set aside for depreciation, the amount apparently being at the discretion of the directors or the accountants, and frequently depending upon the amount of the so-called "profit." It is clearly wrong to make the provision for depreciation a charge on profits, for depreciation is really a loss of the capital assets, which has to be made good out of income, and is just as much a charge on revenue as rent or taxes; there is no escape from its incidence, and there is no profit until adequate provision for depreciation has been made. That the provision should be adequate goes without saying; the amount must be determined without reference to the result of trading, but must be an absolute charge, so that the depreciation may be truly representative of the loss of value of the machinery, which occurs whether trading is profitable or not.

When therefore a machine is new, the probable life having been estimated, the depreciation on that machine can be determined, the sum of the loss during life being the new value less the scrap, or ultimate value. This has to be written off during the life in gradually decreasing increments by fixing a percentage to write off each year from the last year's value, this percentage being such that at the end of the life the depreciated value shall equal the scrap value.

It must be noted that the ultimate values of machines expressed in percentages of their new value vary considerably, because an expensive special light tool will probably have a lower scrap value than a much less expensive heavy tool, such as an ordinary planing machine or a heavy lathe.

It is clearly impossible to foresee either probable life or ultimate value with absolute accuracy, and it would be a refinement of detail to treat each machine on a basis of its own, even if it were possible; but having estimated the probable life and ultimate value individually, each machine may, for depreciation purposes, be assigned to one or other of the classes indicated by the curves, Fig. 3, the class selected being that giving the nearest resultant scrap value at the end of the probable life.

Such a provision as the above is sufficient to cover loss due to deterioration beyond that made good by repairs; because in estimating probable life, the chance that a machine may wear out before it becomes obsolete is taken into consideration.

Details of Writing off Value.

It must, however, be borne in mind that special conditions apply, in the case of leasehold premises, to certain machinery which passes with the hereditament; and when the period of lease is shorter than the probable life of any such machinery, it becomes necessary to apply a rate of depreciation which will entirely extinguish the valuation at the expiry of the lease, not even scrap value remaining. In such a case, it is simplest to write off an equal instalment each year, dividing the present value by the number of unexpired years of the lease.

The amount of depreciation on each item being determined, the total on the whole plant must be charged against the income of every year, if the balance sheet is to show truly the value of the plant, and consequently the actual profit or loss of trading.

The author believes that it is essential to schedule every item, and to write off the depreciation separately, so that the stock book may show the actual present value of every machine. It may prove, in the course of a machine's career, that for some unexpected reason it is found that its life is likely to fall short of, or to exceed, the estimate to some considerable extent. In such a case there is no reason why it should not be considered on its merits, and the rate of depreciation increased or reduced from the time when its unexpected weakness or vitality became apparent. This would provide against the absurdity of a useful machine standing in the stock book at scrap value—but any changes in depreciation should only be made with authority; accurate judgment in estimating probable life will prevent such cases occurring.

When a machine is replaced it disappears from the Stock Book, and its successor takes its place at its new value, being paid for out of the accumulated funds. Thus the valuation would be unchanged in the event of new machines replacing old ones to the exact extent of the total sum set aside for depreciation in any year.

Provision for Cost of Repairs.

There is still a provision to be made for the cost of repairs, which is usually met out of income, as it is incurred each year. This is perfectly sound in works which have been established for some time, but in the case of new works equipped with entirely new plant—as the repairs for the first year will be practically nil, and for the next few years very slight, whereas they will fall heavily on some later years—it is wise to set aside a sum during each of the early years to provide for this. After a few years, the requirements for repairs equalize themselves, owing to the varying rates at which the different items require expenditure.

Increase in the productive power of works due to the installation of additional machinery warrants a charge upon capital, and such machines appear in the Stock Book as additions to plant, although no additional capital may have been raised to pay for them.

If additions to individual machines increase their productive capacity, the cost of such additions may fairly be added to their Stock Book value, but they must then be depreciated at such a rate that the additions are written off by the end of the life of the machine.

Let us now compare Fig. 4 with Fig. 1. Fig. 4 shows the same plant ten years later, the items having been dealt with in the manner previously indicated. It will be noticed that the planing machine has had an addition to its productive capacity; also that the slotting machine, which was second-hand when the works started ten years before, is now at a figure which permits of its replacement by a more modern machine.

The Necessity for Good System.

The results of unsound finance in dealing with depreciation are so serious that it may

The......................Engineering Co., Limited.

MACHINERY STOCK BOOK.

Date: December 31, 1907.

No. of Machine.	Description.	Depreciation Class.	Present Value. £ s. d.
	Machine Shop A.		
1	18-inch Sliding, Surfacing and Screw-cutting Gap Lathe, with 24-foot Bed, Driving Apparatus, etc., complete. (By A. B. & Co. New in 1897)................................	2 (7½%)	184 0 0
2	4 feet 6 inches square by 15 feet long Planing Machine, two Tool-boxes on Cross Slide, Driving Apparatus, etc., complete. (By C. D. & Co. New in 1897)........................	2 (7½%)	230 0 0
	Two Tool-boxes on Uprights added in 1905, then cost £50.	4 (12½%)	38 0 0
3	Special Horizontal Milling Machine for light work, Vice, Set of Mandrils and Driving Apparatus, etc., complete. (By E. F. & Co. New in 1897)..............................	5 (15%)	20 0 0
4	10-inch Stroke Slotting Machine, with Driving Apparatus, etc., complete. (By G. H. & Co. New in 1885)..............	3 (10%)	10 0 0
	Carried forward.......		

Fig. 4. Showing Same Plant Ten Years After.

surely be said that every establishment ought to be put on a sound basis, the actual present value of the machinery and plant determined, and systematic provision made for depreciation, so that when renewals become necessary, their cost is provided for. It is often stated that when a business is working at a loss, there can be no provision for depreciation, which in a sense is true; but depreciation is going on all the same, and the accounts ought to show the loss fairly and squarely—that is, the depreciation sum should be written off, whatever the results of trade. If a recovery takes place, the position is sound; if not, continued losses mean the end of the business, and the valuation of the plant at its right figure will not affect this.

The danger of under-provision for depreciation, and especially of allowing the amount to depend upon the results of any year's trading, is that in lean years what ought to be set aside for depreciation may be entirely or partially distributed in dividends, which is nothing more or less than paying dividends out of capital. This may be done in the expectation of better times to come, when the depreciation deficiency may be made up; but it is quite unsound, and in many cases has brought about the results which might have been expected. Even now, there are too many works equipped with machinery which is so out of date as to be a serious handicap in manufacturing, but which cannot be thrown away and replaced because past years have not provided the means to meet the expense. To raise fresh capital for this purpose, even if feasible, is absolutely unsound finance, for the new machinery has to produce sufficient to provide interest on the lost capital as well as on the new.

In fact, over-valued machinery is one of the most dangerous enemies to financial safety; it would be far better to distribute less and set aside more for depreciation, than to live in a "fool's paradise," and wake to find that the time has come when machinery must be modernized to meet competition, and that the funds to do this are non-existent.

As a matter of accountancy, in order that the balance sheet may show the true value of the plant, this should be entered at its depreciated value; the depreciation should not be treated as a separate or "Reserve" fund, though if this separate fund be sufficient, the financial position is quite sound. The essential thing is that it should be sufficient, and that it should be provided for before the word "profit" is as much as thought of. This means that the statement or valuation must show the real value of the plant and machinery. However fascinating mechanical engineering may be, the aim of all manufacturers is to work at a profit, and no true profit is shown if the valuation of the plant is incorrect.

Book Reviews

Road Preservation and Dust Prevention.—By William Pierson Judson. Published by The Engineering News Publishing Co., 220 Broadway, New York City. Contains 146 pages, 6x9 inches; well bound, illustrated. Price, $1.50. The information for this book has been compiled from many sources, and of the results reached only the most important have been used. The author has for many years been recognized as an authority on the building and maintenance of roads, and in this book he has made the first compilation and condensation of the experiments made and the conclusions reached by road builders, who have been working on the important matters of preservation of existing roads and the prevention of dust on them.

The book contains chapters on the following subjects: road dust, its control and prevention; moisture; oil emulsions; oils; coal tar preparations; tar spraying machines; tar macadam; rock-asphalt macadam; bitulithic pavement; and index.

Seamless Products.—Something exceptionally useful and valuable is the small handbook published by the National Tube Co., Pittsburg, Pa., on the mechanical properties of Shelby seamless steel tubing, prepared for the purpose of providing useful data for the solution of the multitude of problems that arise in connection with the application of seamless steel tubing. This is advance information which will later be contained in the Book of Standards, published by this firm. Original information is contained in this book, something that will be found in no other hand book.

It is being distributed by the National Tube Co., Pittsburg, free of charge to those directly interested.

Electrical Contracting.—Shop system, estimating, wiring, construction methods, and hints for getting business; by Louis J. Auerbacher; 150, 5¼x8½ inch pages; well illustrated and indexed. Published by McGraw Pub. Co., New York City. Can be supplied by The Canadian Manufacturer Pub. Co., Toronto. Price, $2.00.

The author's preface states that this work was written for the wiremen and contractor, but it will prove to be of value, as well, to electricians in manufacturing and other plants where new installation work and repairs are carried on.

It is written in a clear, concise, explanatory style, and shows that its author thoroughly understands the practical side of the work of the wireman and electrical contractor and has written from his own experience. There are many illustrations and diagrams of wiring methods and half-tones showing standard fittings. These devices and methods are only such as are approved by the underwriters. The first chapter discusses a shop system for electrical contractors and is especially timely. Too often such a shop has no system whatever, to its own hurt. The system as described is free from red tape and can be narrowed or broadened to meet requirements. Standard forms are shown in profusion. The second chapter treats of estimating, and the following five chapters with methods of wiring. Chapter eight is given up to the wiring of residences; chapters nine and ten take up the installation of motors, small generators and switchboards; chapter eleven treats of electric signals, and chapter twelve of special lighting and heating devices.

CONVENTION OF BRICK MANUFACTURERS

The twenty-third annual convention of the Nati nal Brick Manufacturers' Association will be held in Roche.ter, N.Y., February 1-6, 1909.

Catalogues Worth Having

These Catalogues will be sent by the firms upon request. Mention The Canadian Manufacturer.

Pumping Engines. Bulletin No. 1611 of Allis-Chalmers-Bullock, Limited, Montreal, illustrating and describing the design and equipment of the 39th Sstreet, sewage pumping station at Chicago, Ill. This is a most interesting and instructive bulletin, as it contains a sound technical description of the installation and of the conditions leading to the designing of the plant. The illustrations and diagrams are many and good.

Type E.M.D.C. Motors. Illustrated circular No. 1138, of the Canadian Westinghouse Co., Limited, Hamilton, describing the new Westinghouse type E.M. motors, which were designed to meet a growing demand for large power units to operate on direct current circuits. The detail construction of these machines is illustrated and described in the usual thorough way. None interested should fail to investigate this type of motor. They are built in constant, varying and adjustible speed types.

Carborundum. Catalogue No. 5 of the Carborundum Co., Niagara Falls, N.Y., containing articles on the manufacture, characteristics and uses of carborundum; also articles on the manufacture of grinding wheels from carborundum for different purposes; and lastly a complete price list of wheels and complete illustrations of the various styles of wheels with dimensions. It is a most complete catalogue, and is exceptionally well gotten up. It would be a most valuable and useful addition to a mechanical reference library.

Rubber Belt Conveyers. Bulletin of Jeffrey Mfg. Co., Columbus, O., and Montreal, Que., containing numerous illustrations of Jeffrey "Century" rubber belt conveyors. These include installations in boiler plants, in locomotive coaling stations, handling chips in a pulp mill, handling ore in mining camps, etc. Valuable suggestions are contained in these illustrations as to what can be done with these conveyors, and how it is done.

Dodge General Catalogue.—New general catalogue of the Dodge Mfg. Co., Toronto, makers of power transmission machinery and elevating and conveying machinery. This catalogue contains 269 pages, and is gotten up in the usual way. It furnishes a book of reference which manufacturers will find of very great value.

Roofing Information.—Anyone considering a roofing proposition will be interested in booklet on "Amatite," issued by the Paterson Mfg. Co., Toronto. This booklet is full of practical information. It gives pointers that will enable you to know what's what in the roofing line. This booklet is published by the oldest roofing manufacturers in the country and may be relied upon for accuracy. It is mailed free to anyone sending their name and address. A sample of amatite, with its mineral surface, which has made such a success as a lasting protection against the weather, is also sent with the booklet. Both are free and are well worth inspecting.

Coal Tipples and Shaking Screens.—Bulletin No. 22, published by The Jeffrey Mfg. Co., Columbus, O., and Montreal, Que., containing fine illustrations and line drawings of coal tipples and tipple screens of various kinds.

NEW TOOLS AND SHOP EQUIPMENT

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

New Cam Milling Machine

In Fig. 1 is shown a new cam milling machine which was designed for form milling the cams on cam shafts of motor cars such as shown in Fig. 2. Possibly a description of the machine may suggest uses to which a similar machine might be put. The machine is used either for shaft with cams solid on shaft or for milling loose cams; in the latter case the cams should be fixed on the shaft before milling, as this insures accuracy of the relative positions of the cams to each other.

The cam shaft is prepared in a lathe as usual, collars being turned to the finished width of the cams, and of just sufficient diameter to allow of a slight cut being taken off the highest part of the cams. It is then ready for milling. When being milled the shaft is held in a sleeve that passes through the main headstock spindle, and which may be moved longitudinally. For extra security a three-jaw, self-centering chuck is provided on the end of the spindle, in which the shaft is gripped close to the cam being operated upon. This chuck has to be released to enable the shaft to be moved longitudinally, but the shaft is held at all times by the internal tube, so that the indexing motion which is connected thereto may give the correct relative positions of the cams.

The steady for the cam shaft consists of a long guiding tube, which is part of a stiff bracket supported directly from the saddle, and bushing are used which fit the tube on their outside diameter and the cam shaft on their inner diameter, so that as each cam is milled the shaft is held on one side by the chuck and on the other by the steady bushing, thus securing the utmost accuracy in the finished cam.

The formers are carried on the main spindle, and as many as six can be carried at the same time, thus doing away with the consequent loss of time for changing. When changing from one cam to the other all that is necessary is to move the roller over from one former to the other, a momentary operation. Arrangements are made so that formers may easily be marked off on the machine. All that is necessary is that a proper finished cam is put in the machine in the usual way and a roller is put on in place of the cutter, and a scriber point where the former roller should be; the machine is then pulled round by hand, thus marking the correct shape on the former plate, which may then be taken out and given the correct shape.

This machine was made by Schuchardt & Schutte, Canadian office at 91 Youville Sq., Montreal.

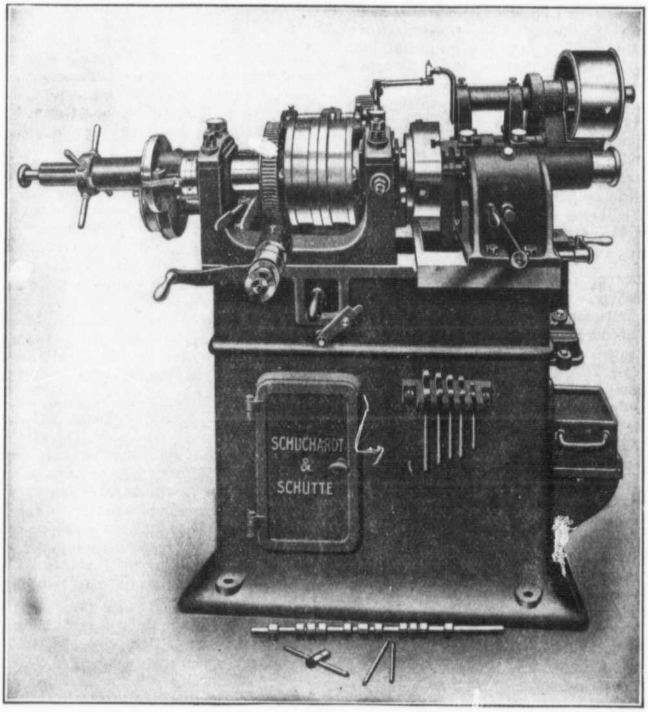


Fig. 1—New Cam Milling Machine.

Shaper With All-Geared Drive

The accompanying illustrations furnish an example of machine every piece of which was built to do its work in this particular machine. It is a specially designed all-geared drive shaper. This shaper embodies several new features that will add quite materially to its productiveness. The all-geared drive is the most important of these, the gear box being shown in Fig. 2.

From the illustrations, Fig. 1 and Fig. 2, it will be seen that in all 10 changes of speed for each position of ram can be had, 5 with the direct drive and 5 with back gears. The handle (A) operates the plunger which in turn raises the wedge pin which expands the friction ring on which the gear is carried. The gear necessary to give the required speed to ram is found from the dial (B) in the center of the hand wheel. This dial is marked with numbers giving strokes of ram per minute for each gear. A single turning of this dial brings the gear desired in position to be engaged, when the plunger is operated, without engaging any inter-

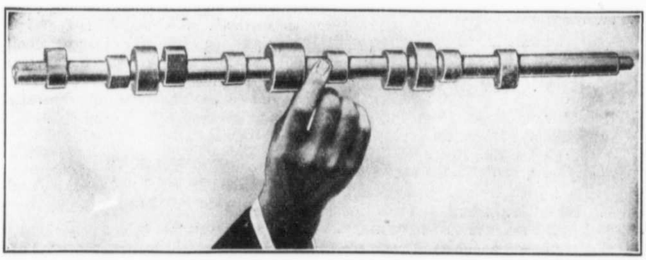


Fig. 2—Cam Shaft Milled on this Machine.

mediate gears. Any adjustment of the friction ring that may be necessary, owing to slight wear, is provided for by means of a screw which can be adjusted through the hand hole in back of gear box. Hand wheel (C) is of use in moving ram by hand in case it is desired to do so. The gears run in oil and the boxes are all bronze bushed and provided with self-oiling bearings. The gear box is at the back of the shaper and is bolted direct to the column.

The Stockbridge patented two-piece crank is used on this machine. The features of this crank are provision for increased power application, and quick return of between 3 to 1 and 4 to 1.

The rocker arm is of special design. It is made with a cored U-shaped rib on either side, giving a very rigid construction. The slot in the rocker arm is made of unusual depth and width to provide ample bearing surface for crank pin block. The rocker arm is held between two boxes at the bottom and tied to the ram at the top, preventing the possiblity of any tendency to twist.

The ram is of new design. The object of carrying the top down part way on a small circle with the straight sides the rest of the way is to gain in stiffness, preventing possiblity of buckling.

The method of attaching the bar to the column, while not in itself different from practice that is familiar to every one on milling machines, for instance, yet is the first application to shapers, so far as we know. Just why this construction has never been used, in view of its recognized advantages, is a question, for with this construction, we have one solid rib cast to the bar, which, in addition to extra stiffness, prevents all possibility of bar tipping away from column, when gib on the opposite side is loosened. The adjusting gib (G) is on the working side of machine, and by simply tightening the two binder screws, the bar is locked to column, as if it were part of it. In this way the time necessary for the operator to go around on the opposite side of machine to unloosen and then to tighten binder bolts, where two loose gibs are used, is done away with.

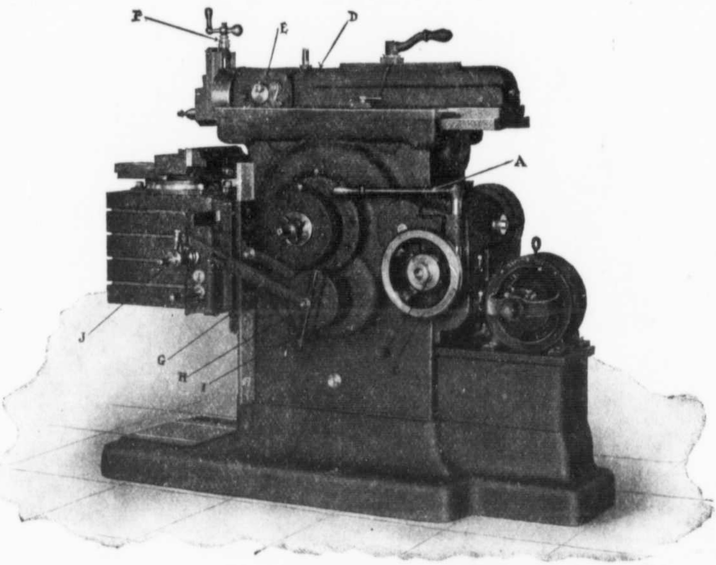


Fig. 1—Shaper With All-Geared Drive.

The cross feed arrangement is especially interesting because of the entire absence of exposed parts; the mechanism being entirely inclosed. The cross feed block (H) is so constructed that the direction of the feed is determined by the position of the block, whether on one side of center or on the other side. Adjusting the block by means of the screw (I) from one side of the center to the other changes the direction of the feed. The adjustment of feed can be made while shaper is in operation. Cross feed screw (J) has a micro-meter collar graduated to read to one-thousandth of an inch.

The driving gear, in addition to the large bearing surface on its face, has its hub supported both on the outside and inside, thus doing away with all possibility of buckling, when shaper is on a long stroke.

This machine is made by the Stockbridge Machine Co., Worcester, Mass.

New High Speed Radial Drill

The advent of high speed steel twist drills, particularly those designed after the Celfor pattern, has opened up a new field for extremely rapid drilling. The style of drill mentioned is such as to afford such liberal clearance as to overcome the crowding tendency of chips at high speeds and heavy feeds, which absolutely prevent the ordinary twist drill from being operated to the limit possible with this new style drill.

This is the reason for the new triple geared high speed radial drill which has just been brought out by the American Tool Works Co., Cincinnati, O., and shown in the accompanying illustration.

This machine has a wide range of spindle speeds, twenty-four, ranging from 18 to 356 in geometric progression. The high driving power of this machine makes it particularly adapted for severe tapping requirements. The following results taken from a table of test results will show what the machine can do, test being made with pipe taps with a 4-inch tap, cutting speed 21.2 feet per minute, a feed of 2¼ inches per minute was attained, 6.6 h.p. being used; with a 6-inch tap, cutting speed 30.8 feet per minute, a feed of 2¼ inches per minute was attained, 9 h.p. being used.

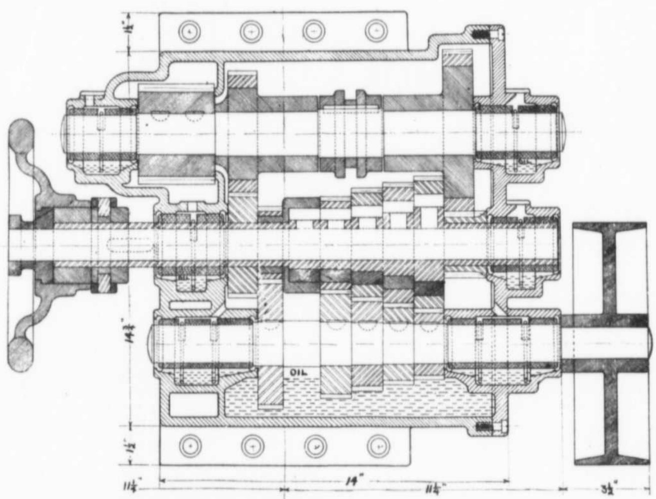
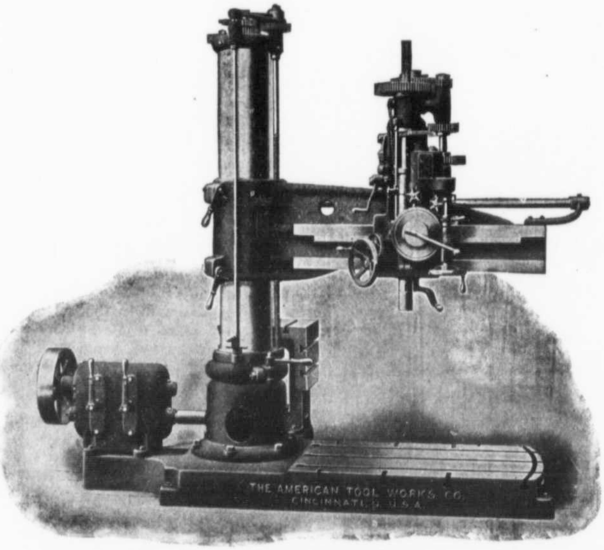


Fig. 2—Sectional View of Gear Box.

In drilling tests some remarkable results were secured on tests. In cast iron 2 inches thick, some of these are: 1 inch carbon drill, cutting speed 56.6 feet or 216 r.p.m., feed 9.9 inches per minute, horse power 5.45; 1 $\frac{1}{32}$-inch high speed drill, cutting speed 845 feet or 313 r.p.m., feed 14.4 inches per minute; horse power, 13.2; 3½-inches high speed drill, cutting speed 55.0 feet or 60 r.p.m., feed 1.44 inches per minute, horse power, 10.2. In steel 1 inch thick, some of the results are: $\frac{9}{16}$-inch high speed drill, cutting speed 52.3 feet or 356 r.p.m., feed



New 4-Foot Triple Geared, High Speed Radial Drill.

4.27 inches per minute, horse power, 42; 1 $\frac{1}{32}$-inch high speed drill, cutting speed 50.9 feet or 188 r.p.m., feed 4.51 inches per minute, horse power, 9; 1 $\frac{31}{32}$-inch high speed drill, cutting speed 86.2 feet or 167 r.p.m., feed 2 inches per minute, horse power, 7.8.

Attention is called to the extreme power of the frictions in the speedbox, tapping attachment and feed worm wheel, the latter operated by quick return handle, for, as the test sheets show, these frictions withstand more than it is possible for the drill or tap to stand up to, which makes them practically a positive clutch so far as the power needed is concerned.

By rounding the edges of the teeth of the gears in the triple gear mechanism and by a special feature, which the company do not feel at liberty to mention at this time, the gears may be thrown in at high speed with practically no shock to the parts, thereby making the machine fool-proof and facilitating very rapid manipulation without danger of breakage. These features and the fact that all other speeds are thrown in by frictions, demonstrates the possiblities of rapid handling with no danger to the machine.

THE RAYMOND IN PRISON.

The C. W. Raymond Co., of Dayton, Ohio, have just informed us that they had been given a life sentence in the United States Military Prison, at Ft. Leavenworth, Kansas.

Their information states that the Constructing Quarter Master, Major Slavens, has been authorized by the Secretary of War to accept their contract for a complete brick making plant of from 50 to 60 thousand daily capacity. This authority was given after much investigation by the department and speaks well of the energy of the Raymond people, as well as the merits of their goods.

The equipment consists of two 9-inch standard dry pans, elevators, screens, 10-foot double geared pug mill, Raymond "777" brick machine, automatic cutting table, represses, etc., and a complete installation of an 8-track Raymond radiated heat dryer, including cars. The Raymond Co. will furnish the power plant and the entire outfit will be as complete and up-to-date as can be made.

Trade Notes

Ontario.

TORONTO.—The Canadian General Electric Co., Limited, and the Canada Foundry Co., Limited, will be in their new building, 212-218 King Street West, after November 1.

WOODSTOCK.—The Canada Furniture Co.'s factory here has started operations again with a full force of hands.

Winnipeg.

MANITOBA.—W. E. Skinner proposes spending $1,000,000 in establishing a steam heating system here if the council grants him permission to lay pipes in the streets.

Quebec.

MONTREAL.—The water committee have awarded a contract for an engine and motor to the Canadian Westinghouse Co., at $1,560.

British Columbia.

FAIRVIEW.—The Malcolm Lumber Co. have taken over the business of the Telford Lumber Co. here and are putting up a 50,000 foot sawmill.

Nova Scotia.

POKIOK.—Millers' sawmill here has resumed operations.

RAILWAY AND CONSTRUCTION NEWS.

Quebec.

HULL.—A one million dollar company has been organized by prominent citizens here to construct a railroad 28 miles in length from Lake Temiskaming to the Upper Satika lake.

POWER PLANT OPPORTUNITIES.

Newfoundland.

TWILLINGATE.—Plans are being made to establish an electric light and power plant here by Boston capitalists, which will be installed under the supervision of Frederick S. Palmer, Boston, Mass.

COMPANIES INCORPORATED.

Saskatchewan.

YELLOWGRASS.—The Yellowgrass Electric Light & Power Co. have been formed under a municipal franchise for the purpose of erecting an electric light and power plant.

Ontario.

ORANGEVILLE.—The Dufferin Light & Power Co., Limited, have been incorporated with a capital of $200,000 to carry on the business of an Electric Light and Power Co. The provisional directors include F. H. Silk, E. C. Campbell and K. F. Dewar.

NIAGARA FALLS.—The Thompson & Norris Co., of Canada, Limited, have been incorporated with a capital of $100,000 to carry on a business as manufacturers of paper, pulp, etc. The provisional directors include F. W. Griffiths, W. H. McGuire and A. L. Johnston, all of Niagara Falls.

LONDON.—The London Concrete Machinery Co., Limited, have been incorporated with a capital of $100,000 to manufacture and sell all kinds of machinery, tools and appliances. The provisional directors include Henry Pocock, J. C. Doidge and W. J. Garside.

TORONTO.—The Huron Construction Co., Limited, have been incorporated with a capital of $40,000. The provisional directors include T. Vernon, J. C. Hallamore and W. Graham, all of Toronto.

Quebec.

QUEBEC.—The Sorel Light & Power Co., Limited, have been incorporated with a capital of $500,000 to manufacture gas, electricity, etc. The provisional directors include A. E. Pontbriand, L. T. Trempe and C. O. Paradis, all of Sorel, Province of Quebec.

MONTREAL.—The Railroad Track Gauge Co., Limited, have been incorporated with a capital of $100,000 to carry on the business of manufacturers of machinery, tools, etc. The provisional directors include Louis Demers, Romuald Delfausse and Joseph Laurent, all of Montreal.

CAPTAINS OF INDUSTRY

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

BUILDING NEWS.

British Columbia.

VANCOUVER.—A large sawmill will be erected on False Creek by John Hanbury, of Brandon, Man.

GRAND FORKS.—The Carson hotel, owned by John McLaren, has been destroyed by fire.

SALMON ARM.—A saw mill will be erected here at Canoe Creek Siding, by Brayden & Johnston.

VICTORIA.—J. Guthrie, of the F. H. Rice Lumber Co., will build a large sash and door factory here, with a capacity of 2,000 doors per day.

GRAND FORKS.—A large saw mill with a capacity of 100,000 feet will be erected on Smelter Lake north of here by E. B. Dennison and Geo. Meyer, of Chicago.

Ontari .

TORONTO.—The establishment of Brooks-Sanford, hardware merchants, Bay Street, has been destroyed by fire. Damage amounts to $70,000.

ESSEX.—The agricultural and other buildings on the fair grounds have been completely destroyed by fire. Damage amounting to $3,500.

WHITBY.—The evaporator works of the Whitby Fruit & Vinegar Co. were destroyed by fire; loss amounting to $1,500.

DUNNVILLE.—The evaporators of the Erie Evaporated Co., owned by W. J. Aikens, were totally destroyed by fire, damage amounting to $80,000.

TIFFIN.—The elevator erected here by the Grand Trunk Pacific Terminal Elevator Co., Limited, has been completed. The storage capacity being 2,000,000 bushels with the two marine towers.

HESPELER.—G. F. Baetz, Berlin, Ont., has the contract for the new $18,000 Presbyterian church to be erected here.

SMITH FALLS.—The Rideau Stone & Plow Co. will build a distributing warehouse here.

MERRICKVILLE.—The Percival Plough Works have been considerably damaged by fire.

WYOMING.—A large grain warehouse owned by Mr. A. Laing, has been destroyed by fire.

FORT WILLIAM.—The Dominion Bank has purchased a site where they will erect a three story brick and cut stone bank building.

KINGSTON.—A small isolation hospital will be erected here at a cost of $2,500 by the city council.

LONDON.—A new station will be erected at Hyde Park by the Grand Trunk Railway.

PORT ARTHUR.—Plans have been prepared by C. W. Wheeler, architect, for the Finnish Operative Society's new building to be erected at a cost of $45,000.

LEAMINGTON.—The Canadian branch of the Heinz Pickle Co. propose to erect a factory costing in the neighborhood of $10,000. They have been granted free water and tax exemption for ten years.

TRENTON.—A handsome bank building costing about $20,000 is to be erected by the Bank of Montreal. The architects are Messrs. Peden & McLaren, Montreal, and Messrs. Byers & Anglin, Montreal, are the general contractors.

Manitoba.

OAK RIVER.—A public school building here has been destroyed by fire.

DELTA.—A summer hotel will be erected here next spring.

Quebec.

MONTREAL.—Fire broke out in the building occupied by O. Poirier Co., Limited, doing considerable damage amounting to $8,000.

MONTREAL.—One of the warehouses of the Montreal Cotton & Wool Waste Co., Limited, has been destroyed by fire, the damage amounting to $50,000.

MONTREAL.—Permit for a four story warehouse at 235 Notre Dame Street West, to cost $12,000, has been taken out by Shapiro and J. Ryan, 335 Notre Dame Street West.

MONTREAL.—The electrical work for the Masonic Temple, Dorchester Street, is being done by C. Lapriere, electrical contractor, Lindsay Building.

MONTREAL.—Contracts for excavation, masonry and brick work for the St. Thomas Aquinas church, St. Antoine Street, has been awarded to Messrs. Sparrow & McNeil, Coristine Bldg. J. A. Karch, 17 Place d'Armes Hill is the architect.

MONTREAL.—The Bank of Montreal, St. James Street, are making alterations to their branch at the corner of Davidson and Nolan Streets, costing about $3,500.

Saskatchewan.

ASQUITH.—The School Board are about to issue debentures to the amount of $1,400 to raise funds for the completion of the new school.

LANIGAN.—The Lanigan Creamery Co. are stated to be planning the erection of a creamery here.

MOOSE JAW.—An oatmeal mill and storehouse are being erected here and a flax mill will probably be erected next season.

REGINA.—A large warehouse will be erected here by Gordon, Ironsides & Fares.

SASKATOON.—The Western Plumbing & Heating Co. will erect a two-story building, of cement blocks on 20th Street here.

SASKATOON.—Jas. Clinkskill will erect an adition to his warehouse on 21st Street.

SASKATOON.—Plans are being prepared for the erection of a new Baptist church by Jas. Webster & Noel, architects, here.

WILKIE.—Plans have been prepared for the erection of a public school building here.

LAIRD.—The British-American Elevator Co. is preparing to erect an elevator here.

Alberta.

MEDICINE HAT.—Tenders will shortly be called for the erection of the new building for the Merchants Bank.

New Brunswick.

RICHIBUCTO.—The grammar school building here has been destroyed by fire.

WATERWORKS, SEWERS AND SIDEWALKS.

Ontario.

WELLAND.—J. F. Connoly, Toronto, has secured the contract for building a large sewer here estimated cost $51,000.

British Columbia.

VANCOUVER.—Extensions will be made to the waterworks sytsem here.

Alberta.

MEDICINE HAT.—The ratepayers have approved a by-law to raise $15,000 by debentures for extensions to the waterworks.

Alberta.

CALGARY.—Calgary proposes greatly extending its waterworks system next year.

FACTORY AND MILL EQUIPMENT.

Nova Scotia.

KENTVILLE.—A manufactory for the building of marine gasoline engines will be established here shortly.

Alberta.

EDMONTON.—A large cloth manufactory will be erected here this fall by R. T. Lowther, Oxford, England, and Mr. McDonald, Pictou, N.S.

BRIDGES AND STRUCTURAL STEEL.

Ontario.

SMITH'S FALLS—Surveys of the proposed new bridge across the Rideau river were recently made.

Builders' Exchange Handbook

The Montreal Builders' Exchange are preparing a new Builders' Handbook for 1909. It will include the Official Directory of the Montreal Builders' Exchange for 1909, with constitution and by-laws, and business classification of members; complete membership lists of the following affiliated associations: Master Carpenters' and Joiners' Association, Master Plumbers' Association, Master Plasterers' Association, Master Painters' and Decorators' Association, and Electrical Contractors' Association; also legal and practical information for all engaged in the building industry. The publication is in the hands of Henry Russell, Builders' Exchange, Montreal.

Construction of One-Story Shops

An Example of Good Practice of Mill Construction in One Story Shops, With Suggestions for Efficient Protective Apparatus Against Fire Loss. Information Gathered from the Report of the Boston Manufacturers' Mutual Fire Insurance Co., on Slow Burning or Mill Construction.

For work shops on cheap level land, especially where the stock is heavy, one-story buildings have proved to be more economical in cost of floor area, supervision, moving stock in process of manufacture; and machinery can be run at greater speed with less repairs than when in high buildings. While the saw-tooth form of roof is applicable it may not always be necessary or advisable; and a type common for machine shops, foundries, and similar occupancy, where increased head room is required and travelling cranes used is here illustrated. The centre section over the crane is often provided with saw-tooth skylights with excellent results, and the side bays in others made higher for a gallery. These buildings are readily warmed and ventilated, and the heavy plank roofs are free from condensation in cold weather. Window areas should be as large as practicable and extend as high as possible. Forced circulation of heated air is very desirable in connection with overhead steam pipes.

ROOF CONSTRUCTION.

Roofs should be of 3-inch pine plank, spiked directly to the heavy roof timbers and covered with 5-ply tar and gravel roofing.

Trusses in roofs are ordinarily from 8 to 20 feet on centres, the 3-inch plank spanning the distance between the trusses, as in Fig. 1, or resting on purlins not less than 8 feet on centres and running longitudinally, as in Fig. 2. It is of importance that monitors be of substantial plank construction with wide bays, as in the main roofs.

Figure 1 illustrates the overhanging cornice with drip outside without gutters. The internal gutters, as shown in Fig. 2, are preferred, as outside drip is often objectionable. When in locations exposed by other buildings of hazardous construction or occupancy, parapetted brick walls and cornices are needed.

TIMBERS AND COLUMNS.

All woodwork in standard construction, in order to be slow-burning, must be in large masses that present the least surface possible to a fire. No sticks less than 6 inches in width should be used, even for the lightest roofs, and for substantial roofs and floors much wider ones are needed. Timbers should be of sound Georgia pine, and for sizes up to 14x16 inches, single sticks are preferred, but timbers 7 or 8 inches by 16 are often used in pairs, bolted together without air space between.

Columns of Southern pine should be bored through the centre by a 1½-inch hole, with ½-inch vent holes top and bottom, and ends should be carefully squared. They also should not be painted until thoroughly seasoned, to prevent dry rot. Columns should be set on pintles, which may be cast in one piece with the cap, or separately, as preferred. Columns of cast iron are preferred by some engineers, and when the building is equipped with automatic sprinklers, have proved satisfactory, but are not as fire-resisting as timber. Wrought-iron or steel columns should not be used unless encased with at least 2 inches of fireproofing.

CONSTRUCTION OF FLOORS.

If earth or cement concrete floors are not suitable and wood floors are necessary, they may be made up of broken slag or stone several inches thick and thoroughly rolled, upon which is a layer of 4 inches of tar concrete and on this one inch of asphalt evenly rolled. On this 2-inch or 3-inch hemlock plank bedded in hot pitch are laid and over them a ⅞-inch or 1⅛-inch maple floor is laid at right angles to the plank.

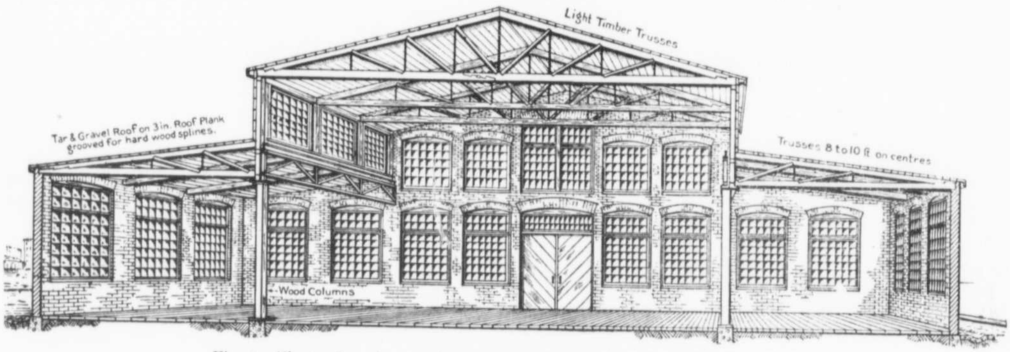


Fig. 1—Illustrating the Overhanging Cornice with Dip Outside the Gutters.

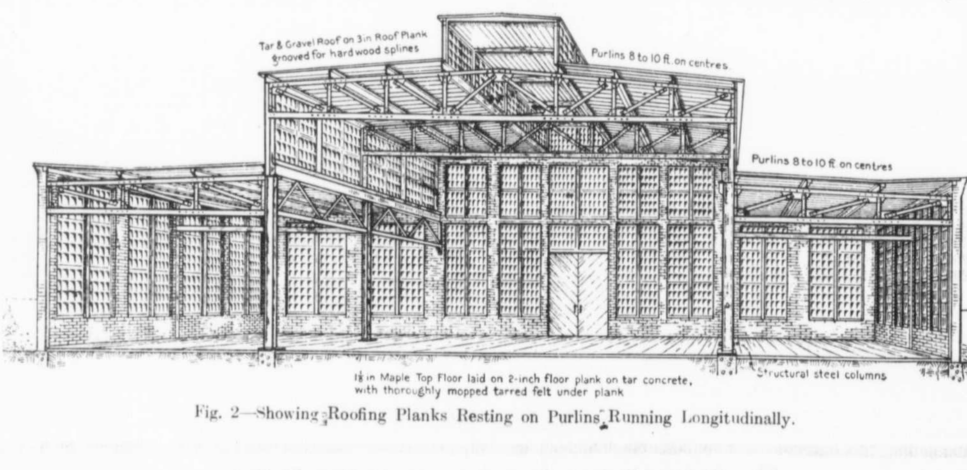


Fig. 2—Showing Roofing Planks Resting on Purlins Running Longitudinally.

Electric Motor Drive in the Clay Plant

Abstract of a Paper Before The Iowa Brick and Tile Association, Showing the Economy and Efficiency to be Obtained with Electric Drive in Clay Working Plants.

By J. A. Saville

Although the art of clayworking is one of the oldest known to history and even held an important place in the activities of uncivilized peoples, the methods employed in this industry have not been greatly improved until in comparatively recent times. However, the improvements that have been made in recent years in clayworking machinery have brought about truly remarkable results and at the present time, the facilities of the up-to-date clay-working plant, like all other modern industrial plants, have reached such a degree of convenience and efficiency as would have been considered little short of unbelievable a few decades ago. Processes that were performed slowly and laboriously by hand are now carried through with the greatest economy and convenience by means of power machinery. The utility of these machines is now generally recognized by all clayworkers, and hand processes are practically obsolete in all but the smaller, temporary plants.

With the introduction of such machinery in the clay working plant came the problem of selecting an equipment to apply the power to this machinery. In clay working the cost of the raw material is comparatively low. The cost of the finished product, therefore, depends almost entirely upon the cost of the manufacturing processes. Consequently, if the clayworker is to meet competition most successfully it is very essential that the most efficient and inexpensive methods of operating the machines used in clayworking be employed in his plant. Consequently, the fact that electric motor drive has proven to be the most efficient and economical method of machine drive in other classes of manufacture has caused the clayworker to look to this system for the proper solution of his power problems. The satisfactory results which have been obtained in every case in which electric motor drive has been adopted, indicates that it will be but a short time until this system of machine drive will replace all others in clayworking plants.

Common Applications of Electric Motors.

Let us consider briefly some of the more common applications of electric motors in the clayworking plant. The model plant would be equipped something as follows: the pumps used in supplying the water-streams for loosening the soil would be motor driven; motor-driven shovels would handle the raw material, and electrically operated tramways would transport the raw material from the mine to the manufacturing plant. At the manufacturing plant the material would be ground in the motor-driven dry-pans, and carried from here to the motor-driven pug-mills by means of motor-driven conveyors. The brick machines, cutters, represses, etc., would all be equipped with individual motors, permitting of absolute control of their operation with the greatest convenience. There would also be motor-driven blowers to supply air for heating and ventilating, drying the products and for forced draft in the kilns, a condition that permits of the use of rougher fuel than would otherwise be possible. Throughout the plant motor-driven conveyors would furnish rapid and convenient transporation of the material.

To anyone familiar with the operation of electric motors, the convenience and efficiency of such a plant is readily apparent. The use of motor-driven apparatus at the mine eliminates the expense of transporting fuel to that point, as the electric power is economically transmitted from the central power house to any point in the plant by a system of wires. This system also permits the power house to be located at a point that is most convenient for handling the coal and ash. The electric tram cars are convenient of control, require the minimum attention and afford a much more rapid means of transporation than is possible with cars drawn by horses or cables, so that one car, electrically operated, would take the place of several with the slower means of locomotion.

Great Gain in Economy and Efficiency.

At the manufacturing plant proper, we would find the greatest gain in economy and efficiency. With belt or rope and shaft transmission of power there is a constant loss of power, due to the friction, belt slippage, etc. This amounts to from 30 per cent. to 60 per cent. of the output of the engine, and is practically the same whether all or only a small part of the plant is in actual operation. With individual electric motor drive these large frictional losses are eliminated and only those machines in actual operation use power; as soon as any machine is shut down the power expense for that machine is stopped. With a system of belts and shaft transmission the maintenance expenses are high, and considerable annoyance is occasioned by shut-downs due to broken belts or worn bearings. With individual motor drive the only moving parts are the rotors of the motors, and as the remainder of the power transmission system consists merely of wires, it is practically free from depreciation expenses.

The flexibility of the system of individual electric motor drive is also of considerable value in the clayworking plant. The motor takes very little more room than is usually required by the driving pulley used with a system of belt transmission. Each step of the manufacturing process may be located in such a way as to make possible the most rapid and economical transfer of the product from one department to the next in succession. Addition to, or changes in the plant equipment can be quickly made without the trouble and expense involved when shafting has to be rearranged.

The continuity of the manufacturing process is highly important in the clayworking plant. With belt and line shafting, accident to any machine necessitates a large part of the plant being shut down. However, with electric motor drive, shut-down of any machine does not interfere with any other; each machine being entirely self-contained.

With a mechanical system of drive, in case any machine becomes clogged, there is no provision for shutting off the power automatically; as a result both the machine and the mechanism driving it are in danger of becoming injured. However, with electric-motor drive when any machine becomes dangerously clogged the circuit breaker or fuses in the motor circuit open automatically, shutting off the power and preventing any injury to the equipment. The absolute protection afforded by such apparatus and the perfection of the oiling devices of the electric motor makes a system of motor drive especially free from trouble of any sort, and very little attention is necessary for the maintenance of the system.

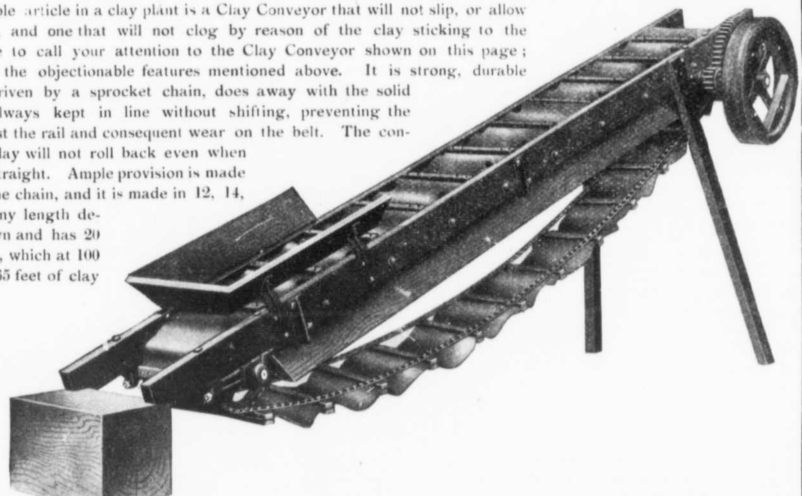
Because of the large starting torque required by a part of the apparatus used in clayworking, there is nearly always trouble experienced with belt slippage, where belt drive is used. If the belts are made tight to prevent this slippage there will be heating and wear on the bearings because of the excessive pressure, belt preparations being practically useless in the clayworking plant, because of the dust. However, with the direct-geared motor, this trouble is entirely eliminated as the motors may be designed so as to obtain the exact characteristic required for driving each type of machine.

With motor drive, meters may be so arranged that the power used by any machine or department can be read directly from the switchboard. A study of such data often makes possible greatly increased economy in the cost of production. The importance of this data is quite generally recognized and it may be interesting to note that the German Clay, Cement & Lime Manufacturers' Association has offered three prizes of 1,000, 500 and 250 marks for a contrivance that would give the power consumption of a machine with the old methods of drive. The following properties are required of the device: It must be simple; it must be of such a nature that it can be easily connected with the machine without extensive preparations; an appliance which can be transformed from one machine to another will be given preference, but this requirement is not indispensable; the appliance must accurately indicate when and to what extent the consumption of power varies; it is not absolutely necessary for the consumption of power to be indicated in kilograms per minute; such appliances will also be admitted which only have conditional indications such as tension indicators. The indications must, however, be such that they can be easily compared with each other. The chief feature of the appliance is to consist of enabling the workman to know when the normal consumption of power is not reached, or is exceeded, owing to the clay reaching the machine in too soft or too hard a condition, or other irregularities.

CLAY CONVEYORS.

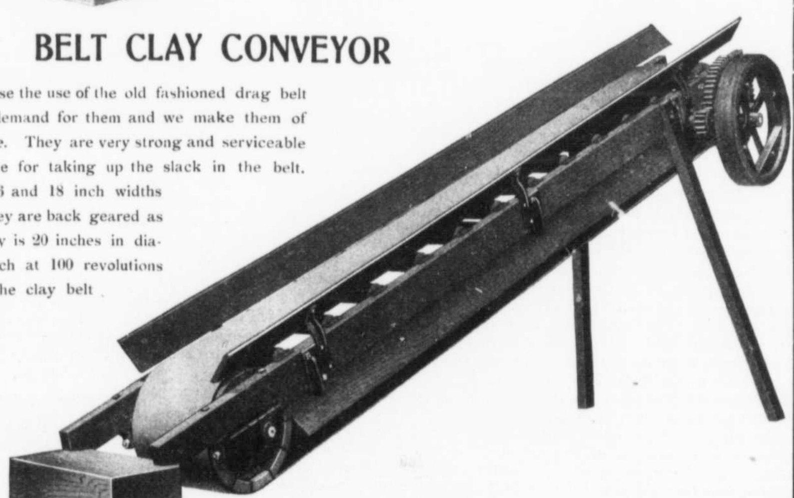
SPROCKET CHAIN CLAY CONVEYORS

An almost indispensible article in a clay plant is a Clay Conveyor that will not slip, or allow the clay to roll backward, and one that will not clog by reason of the clay sticking to the rolls or spools. We desire to call your attention to the Clay Conveyor shown on this page; it is entirely free from all the objectionable features mentioned above. It is strong, durable and positive, and being driven by a sprocket chain, does away with the solid rolls or spools, and is always kept in line without shifting, preventing the rubbing of one edge against the rail and consequent wear on the belt. The construction is such that the clay will not roll back even when the Conveyor is set almost straight. Ample provision is made for taking up the slack in the chain, and it is made in 12, 14, 16 and 18 inch widths and any length desired. It is geared as shown and has 20 inch by 4 inch driving pulley, which at 100 revolutions will give about 65 feet of clay belt per minute.



BELT CLAY CONVEYOR

While we do not advise the use of the old fashioned drag belt Clay Conveyor, there is a demand for them and we make them of the style shown on this page. They are very strong and serviceable and ample provision is made for taking up the slack in the belt. We make them in 12, 14, 16 and 18 inch widths and any length desired. They are back geared as shown and the driving pulley is 20 inches in diameter with 4 inch face, which at 100 revolutions will give about 90 feet of the clay belt per minute.



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OTHER ADVANTAGES OF ELECTRIC DRIVE.

Other important advantages obtained with electric motor drive are that lighting can be obtained from the same circuits that supply power for the motors, furnishing the plant with a highly efficient, convenient and safe lighting equipment. By the use of the many valuable labor saving devices such as the motor driven conveyors, etc., a much smaller number of workmen are required. All machines being entirely self-contained can be moved at will and every machine can be so located as to give the greatest economy of floor space.

Unless the plant is so located that electric power may be obtained at an exceptionally low cost, it will be found advisable to install a generating equipment for supplying the power. This arrangement will not only be the most economical in power cost, but also has all of the advantages of making the plant entirely independent of outside conditions.

PLANT OPERATED WITH ELECTRIC DRIVE.

As an example of a modern clayworking plant, electrically equipped, a brief description of the plant of the Columbus & Hocking Clay Construction Co., located at Kachelmacher, O., may prove of interest. The Columbus & Hocking Clay Construction Co. owns 20,000 acres in Hocking county, which contain both coal and clay, the coal forming the top stratum. This plant is being constructed for a capacity of 450,000 brick per day, the part now completed having a daily capacity of 160,000 brick.

The power plant equipment installed at the present time consists of three 350 k.w., three-phase, 2,300 volt, 60 cycle, Western Electric alternators; each direct-connected to a 500 h.p. Snow gas engine, running at 150 r.p.m. Power and lighting circuits are distributed throughout the plant by means of a six-panel, blue Vermont marble switchboard.

The engines are operated with producer gas, coal for the producers being supplied by the deposits which cover the clay. These producers are of a new type and are constructed so as to consume the coal completely, a fine ash being the only product left. The water supply for the plant is furnished from a large reservoir, located on the peak of a hill near the mill. This reservoir is about 200 feet above the level of the plant and gives ample pressure for all purposes. The water is delivered to the reservoir by means of an electric motor driven pump, having a capacity of 1,000 gallons per minute.

The order of the various manufacturing processes as carried on at the plant is as follows: At the mine which is about 1¼ miles distant from the mill, the clay is mined by means of an electrically operated mining machine. The clay is then delivered to the crusher by means of electric cars of two-ton capacity. The motor driven crusher reduces the clay to the size of a hickory nut, and has a capacity of about 90 ton per day. From the crusher the clay is delivered into a chute which conveys the clay to the dry-pans where it is reduced to the powdered condition necessary for mixing. There are two dry-pans, each being connected to a back-geared, individual motor. From the dry-pans the clay is elevated to bins, located above the pugmill by means of a motor-driven conveyor. The clay is steamed as it falls into the bin, where it is allowed to lie for 24 hours for amalgamation.

A brick machine is located directly below the pugmill so that after mixing, the material can be allowed to drop directly into the brick machine. The brick are then cut to the proper length in a rotary cutter. Those brick which are to be repressed are delivered to a repress which has a capacity of 25,000 brick per day. The motor driving this machine also drives a line shaft from which the elevator and conveyors are operated. From the repress and brick machine the brick are transported to the driers on motor cars. The driers are heated by gas from 100 to 300 degrees F., and are supplied with air by means of two motor driven fans, about 24 hours being allowed for the drying process. From the drier the cars are hauled into the kilns by the motor car. There are six down-draft kilns of 160,000 brick capacity each and one Youngren continuous kiln of 16 chambers, each chamber having a capacity of 60,000 brick. The kilns are heated to a temperature of from 2,200 to 2,300 degrees F., from 8 to 10 days being required for burning.

The satisfactory results obtained in the plants that have been equipped with a system of electric motor drive speaks strongly for the value of such a system for clay-working plants. When we consider this fact and review the condtions that have controlled the clayworking industry in the past, and anticipate those that would seem to be of the first importance in the near future; it is safe to predict that the most economical and convenient system of machine drive, as represented by the electrical system at present, will not only be highly desirable, but will soon be considered as a necessity in the clay-working plant.

To Revolutionize Bricklaying

Time-Saving Devices to Increase the Efficiency of Bricklayers and Reduce Cost of Brick-Work, Thus Meeting Concrete Competition.

FROM BRICK, CHICAGO.

The rapid strides made by concrete as a structural medium during the past few years have changed the entire aspect of the building trades. Where before, various types of construction more or less divided honors as to frequency of use and adaptability to varying purposes, concrete has gradually assumed many of the functions previously conceded to brick-work, slow burning mill construction and terra cotta.

The reasons for this change are many. Through the instrumentality and enterprise of the cement makers, thousands of contractors, builders and others have been encouraged to enter the field of concrete construction, the initial cost of engaging in the manufacture of block and other concrete products being comparatively small. The public has been misled by the representations of the concrete enthusiasts, and has been educated to the belief that concrete is suitable for many purposes for which it is unfit.

Concrete of proper manufacture is a good material, but it is not a competitor of brick because of its greater cost.

Concrete of inferior quality is cheaper than brick and is therefore a competitor.

If the devices of Mr. Gilbreth, described in this article, will lower the cost of the brick construction so that it can compete with inferior concrete construction, then he has indeed won a marked victory for the clay industries, which have suffered serious loss through the inroads of concrete.

Bricklaying, as an art, has remained stationary for a long period of time. The inventive genius which has accomplished such great changes in the various fields of industry during the past century, has left little traces of effort toward improvement in the methods of bricklaying. The methods of the past are still in vogue and present practice varies but little the processes by which the oldest brick-work now standing was laid.

It is to lack of advance, to non-absorption of the labor-saving spirit of the times, that the impending decay of the art of bricklaying may be blamed, rather than to the perceptible retrogression.

Bricklaying has never been affected by the invasion of women, machinery, or competitive products manufactured in a foreign country. In this respect its history presents a marked contrast to that of almost any other of the leading industries. It also appears improbable that bricks will ever be laid by machinery for the reason that the cost of operation would be far in excess of the saving over human effort accomplished by the machine.

It is rather a curious fact in consideration of their universal use that practically no innovations or inventions have been made for the purpose of expediting the laying of bricks. The one exception worth noting is found in the bond now used—that is, the relative position of the joints and of the headers to the stretchers. In other respects there is no difference between the brick-work of to-day and that of the oldest ruins in existence.

IMPROVEMENTS IN BRICKLAYING METHODS.

It seems clear, then, that progress in bricklaying is more to be expected from the improvement of existing methods than from attempt at radical change. In this connection an interesting light is thrown upon possible improvements and their effect on the industry by a study of the work done along these lines by Frank B. Gilbreth, of New York.

As a successful contractor who has gained a national reputation for the execution of large contracts in phenominally short time, his observations are worthy of note as emanating from a practical man of affairs.

In approaching the subject Mr. Gilbreth, from past experience in actual bricklaying, followed by later accomplishments as a contractor in many parts of the country, was able to combine the varying points of view of both

the actual worker and the theorist. It was through practical knowledge of the positions assumed by the bricklayer in placing a single brick in position and a careful dissection of the motions involved that he became convinced that the same result could be attained with the elimination of much unnecessary movement and a consequence shortening of time.

EFFECT OF MOTION STUDY ON BRICKLAYING.

For lack of a better name the process by which this most desirable end may be attained is called "motion study." As it indicates it is a study of movement with the idea of eliminating waste energy, in much the same manner that modern science aims to eliminate the waste of "raw material" of any sort.

First, it was thought unnecessary for the bricklayer to stoop over to the scaffold on which he stood and again straighten up with no more work accomplished than lifting two bricks weighing but eight or nine pounds. In fact, there was no more reason for his stooping over than for the carpenter to stoop to the floor in order to plane a board instead of utilizing a bench to execute his task more conveniently, more economically, and more quickly. This line of thought soon resulted in the invention of the Gilbreth scaffold with a bench so arranged that the workmen need not stoop at all.

Later investigation had in view shortening the distance from where the tender left the brick on the scaffold to its final position in the wall. Definite conclusions were arrived at in this connection as embodied in the Gilbreth packet system of brick laying. It has been proved in actual practice that the output of the bricklayer may be doubled by this method at the start, accomplishing even more after the workman becomes more accustomed to the change and therefore more adept.

The practical results of "motion study" as investigated and developed by Mr. Gilbreth, is proven by the fact that it is now being carried further and is finding application in all branches of construction work. Brickwork was, however, the first to be benefitted and herewith are shown photographs of the Gilbreth scaffold, packet system and fountain trowel. These are the principal mechanical devices which have, up to date, resulted from he line of work outlined above.

THE FOUNTAIN TROWEL.

The last mentioned device, the fountain trowel, is a metal can, shaped something like an oxford shoe. The heel is used to scoop up mortar from the mortar box while the toe has a long opening the entire width of the can, through which mortar is poured upon the brick. This device makes it possible to spread a far greater quantity of mortar within a given time and permits the bricklayer to use mortar sufficiently soft to fill the joints better, not only because the mortar runs down into the unfilled joints of the course below but also because it permits the shoving of the joints full of mortar in the course that is being laid.

The Gilbreth scaffold permits building a wall in different sequence than has heretofore been observed. When erecting a thick wall, the exterior four inches are built up first header high and the interior face is built up header high. The fountain trowel is then particularly valuable for filling in the middle of the wall, where the work can be done with great speed and without the constant interruption occasioned by stopping to lay the line course once or twice every course.

THE PACKET SYSTEM.

Now a word about the packet system. A little wooden frame or tray is made the construction which of is such as to allow the bricklayer to place his fingers underneath the brick while it is resting on edge. The bricks are piled, as stated, on edge, in what the bricklayers call "bull headers," in two rows of ten bricks each. This is done by tenders at the car or cart that brings the bricks to the job. After the tenders have so stacked the bricks they remain undisturbed until the bricklayer picks them up from the packet, one at a time, and places them upon the wall.

The time saved by the bricklayer in not being obliged to pick up two pieces of a broken brick instead of a whole brick, nor to especially select the best bricks for the exterior four inches of the wall, nor to discard broken bricks, are some of the advantages claimed for the packet system. Thus, in the course of a day, the advantage of having all the best bricks put on the same packets and the inferior, chipped and broken bricks put on others, amounts to a surprising increase in the total work accomplished by a large gang of bricklayers.

The process in using the system is, in brief, as follows: the packets (costing about eight cents apiece), are filled by laborers at the car or cart in the street. The bricks are put face up in two rows of ten each, a weight of about ninety pounds plus the weight of the packet. The whole is placed on specially constructed wheelbarrows and wheeled to the place where the men are working. The packet is then lifted from the wheelbarrow, placed on the stock platform of the scaffold, and pushed over to the bricklayer. The bricklayer lifts the packet and deposits it on the wall. The last step, that of placing the bricks in the wall, requires but the moving of the arms and hands.

PACKET SYSTEM REDUCES EFFORT TO MINIMUM.

Everyone who has watched a bricklayer at work has noticed that he tosses a brick about in his hand before laying it. This is not, however, mere playful juggling. It is necessary for him to toss the brick in order to grasp it in such fashion that he can lay its best face for the face of the wall. With the packet system, the best face is always upward and the bricklayer is spared the juggling movements which resulted, under the old method, in an enormous waste of energy in the course of a day.

This, together with other time-saving practices, as described, makes it possible for a given bricklayer to accomplish between two and three times the quantity of work done before. In addition, a better wall results, since the scaffold is constantly hoisted to such a position as to enable the bricklayer to work to the best advantage watching his work as it progresses. The ease with which the lifting jack accomplishes its purpose makes it possible to lay bricks in such sequence as produce both the best and the strongest wall.

There has always been a great deal of time lost by requiring bricklayers to change from one position to another while a scaffold is being set up. The Gilbreth system perfectly overcomes this difficulty and many others.

Portland Cement Should be Tested

A Consideration of Reasons Why Portland Cement Should be Tested. Good Work Done in Testing Laboratories Cement Mills Not Blameworthy.

BY R. A. PLUMB

With the larger cement consumers, the matter of cement testing has long been a settled fact. The railroads and the larger concrete construction companies have shown their opinion in this matter by the establishment and perfection of elaborate systems of cement inspection. In connection with the engineering departments of these companies are some of the most finely installed and equipped cement testing laboratories in the country, in charge of capable staffs of trained technical men.

If cement testing is not necessary in concrete work, as the writer occasionally hears it stated, why then the establishment of such elaborate inspection bureaus? Why the installation of expensive testing laboratories? Why the employment of the best technically trained men to operate these laboratories? There certainly must be some basic reason for this procedure; there must be some material value and profit derived from these testing departments, or surely no sane company would take the extensive action in the matter which they have.

The writer has had extensive correspondence and personal interviews with the leading architects and engineers engaged in concrete construction, and can state definitely that their invariable conclusion is that cement testing is absolutely an indispensable part of all concrete work.

SOME OPINIONS ON THE SUBJECT.

The following statement comes from one of the leading reinforced concrete engineers in the West. He says:

"I fully appreciate the value and indeed the necessity of testing all cement going into reinforced concrete, and it is my invariable practice to prohibit the use of any untested material."

Again, one of the foremost architects of this country writes:

"I am most rigorous in my requirements and specifications on cement and have directed all my superintendents to insist absolutely that contractors have careful tests made on every barrel before it is consigned to actual construction."

The president of one of the largest reinforced concrete construction companies in

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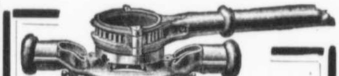

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the country made the following statement to the writer:

"Our experience has taught us that the use of untested material is very unwise, and for the past three years we have erected no building without first having our cement carefully inspected and tested by a reliable engineering laboratory."

The above statements are representative of the general feeling among the leaders in concrete work. We ask the individual whom we occasionally hear depreciating the value of cement testing to reconcile his statements with them. Demonstrate why cement testing is unnecessary, in the light of the above representative opinions and the reasoning to be set forth in the latter discussion.

Cement testing is a business proposition. The consumer has his specifications, showing very definitely the requirements that cement should possess to give satisfactory results. The leading technical societies have formulated standard specifications which are sufficiently severe to insure good material; but they in no way unnecessarily hamper the manufacturer. These specifications contain no ambiguous statements, but are very clear, concise and definite.

When the manufacturer contracts to supply cement on these specifications there is no opportunity for any misunderstanding on the interpretations of the requirements. It is the testing laboratory that stands between the manufacturer and consumer, demanding of the former that his product is of the quality guaranteed, and assuring the latter that only material meeting requirements is accepted.

Cement Mills Not Blameworthy.

With the assurance from the cement mill that every shipment is carefully tested and examined, why is there any need for inspecting laboratories? And yet, what inspecting laboratory does not find a percentage of poor cement among the samples submitted for tests? To reconcile the reliability of the cement mill tests with the actual conditions met by inspecting laboratories in testing marketed material is rather a difficult undertaking.

The inspecting laboratory deals with a great variety of brands and must determine the fundamental characteristics of each brand in order to conduct the tests satisfactorily. This requires a concentration of energy on each sample, resulting in the exercise of careful and conscientious attention.

The inspecting laboratory has done more to improve the quality of the American product and bring it up to standard than it is given credit for. The manufacturer who understands that his cement is to be carefully inspected is under a constant incentive to improve his quality and establish and maintain a clear record with the inspecting laboratories. The efficiency of inspecting laboratories is quite well represented in the experience of the testing bureaus of one of our largest railroads. During the first year of the operation of the laboratory the percentage of rejections due to undergrade material was nearly fifty per cent. During the second year the percentage dropped to about twenty per cent., while in the third year the total rejections were less than three and a half per cent. During these three years the specifications and requirements of the consumer were exactly the same. This point of efficiency of an inspecting laboratory in obtaining for the consumer a product of higher quality is quite conclusively demonstrated by the record of one of them during the past year. The percentage of rejection on samples taken from shipments which the manufacturer understood were to pass through an inspecting laboratory was less than two and a half per cent. Such records as this thoroughly prove the value and necessity of the inspecting laboratory.

It is certainly an encouraging fact to the inspecting laboratories to note that the manufacturers are recognizing that the inspecting laboratories are working with the best possible motives, and the old feeling that they were instituted to make continual trouble for the manufacturer is fast passing away. The manufacturer no longer looks upon the inspecting laboratory with undue suspicion, nor does he rise up in denunciation of the laboratory when a rejection of his product occurs, but he is now ready to co-operate and endeavor to find out where the mistake was made.

It is to be hoped that even closer co-operation may be manifest between the two parties and that the laboratory will maintain full consideration for the integrity of the manufacturer, who in turn will recognize that the laboratory is to protect the interests of the consumer in every way and demand a square deal for all concerned, the manufacturer as well as the consumer.—Concrete.

Economy in Factory and Office Heating

Synopsis of Facts Bearing on the Economy of Steam Heating. Detail Description of New Compound Vacuum System of Steam Heating.

By Frank A. Simonds.

A point that is generally overlooked in factory or block designing and equipping, at the same time one that, in many respects, is of much more importance than others that receive more consideration, is in choosing the heating system to be used; and this is more noticeable to persons that are thrown in direct contact with such line in the different buildings, under actual working conditions, than it is to building owners or architects, who either know only of their own system in use or who do not follow up results and compare such with the results secured by others.

Economy of Operation of Most Importance.

In building construction, the material and expense of same entering into such construction, after being paid for, is of no further expense to the owner, except the natural wear and tear; therefore, outside of its durability and strength is not to be compared in importance with the heating system, which outside of the same items of expense, also demands a continuous outlay for fuel during the heating season of each and every year thereafter, and on account of which, the first cost is of little importance compared to economy in operation.

There are several points that should be considered in deciding on what constitutes the most economical system, also just what would be possible if a system could be installed that would secure all of the heat units in the heating medium. As steam is the medium most convenient for factory, as well as block heating, also, as more or less exhaust or waste steam is available in such buildings, it will be considered as the standard for this duty.

Facts Which Decide Economy.

As steam at atmospheric pressure has a temperature of 212 degrees, this is the maximum temperature to be considered, and in order to secure the most economical results, the system that will utilize the largest number of heat units in this steam must be employed.

In order to secure this heat from this medium in the heating coils or radiators throughout their entire surface, and to secure the benefits from every square inch of such radiation, it is necessary to provide a means of removing all air and water from the radiators.

Also, if exhaust from engines or pump is to be used, the pressure necessary in heating system to secure a circulation must be kept down to the minimum, to avoid back pressure and its attending loss of power in such engines or pumps.

The heat units in the steam must also be utilized entirely in the radiating surfaces and none lost in any other way, in order to secure all of the economy possible.

Furthermore, any device installed to produce these results must be such that they are of ample capacity, and so designed as to perform their duties without any great amount of attention.

If a heating system could be installed to conform to the above outline, a perfect system would result. As however, perfection is not generally attained, the next point is in choosing a system that approaches the nearest to such.

Vacuum System of Heating.

The vacuum principle of steam heating has long been conceded to be the only positive method for insuring a complete circulation of steam throughout the entire system at the minimum pressure.

Such a system having a partial vacuum, produced by mechanical means, in the return line of the system must be provided with an automatic vacuum valve in the return connection of each radiator or coil of the sys-

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tem, that will allow only the water of condensation and the air to be drawn out of the radiation.

This draft or suction on the return line secures a circulation throughout the system without the need of steam pressure at the inlet or steam main end of the system.

Up to this point about all of the vacuum return line systems are the same, so that the only difference between them is in the particular design and construction of the automatic vacuum valve.

As there are many such valves on the market, it is not necessary to discuss the merits of each in this article, but instead will cover the important points that must be embodied in any such valve to secure satisfactory results.

As a result, when the ordinary vacuum system is installed, the only advantage one system possesses over another, is the advantage in the vacuum valve only. There has, however, recently been brought out an improved vacuum system that possesses advantages over the standard vacuum system, as installed for the past fifteen or twenty years, that allows of still further economy, beyond that of the vacuum valve alone.

Compound Vacuum System of Steam Heating.

This system is termed the "Compound Vacuum System of Steam Heating," as it conforms very closely in principle and advantages to the compound engine, and secures proportionate economy over the simple or ordinary vacuum system. It consists of dividing the radiation into primary and secondary sections. The primary is an ordinary radiator connected in the usual manner and with an automatic vacuum valve in the return pipe, and the secondary is connected with the discharge side of the vacuum valve and receive no supply outside of the hot water of condensation that is discharged from the primary section. The primary section has the same pressure as the steam main supplying it. The secondary section has the same degree of vacuum in it as the return line, to which it is connected.

The one steam valve controls both sections, and no other valves are needed on either, except the automatic vacuum valve. No air valves whatever are used on the system. The secondary section has such proportion to the primary section that it utilizes to the minimum, the vapor formed from the re-evaporation of the water that condenses in the primary section. This re-evaporation is caused by reason of the lower pressure in the secondary and the heat in the water of condensation, due to its pressure in the primary, being sufficient to cause much of this water to vaporize when the pressure on it is reduced to that of the secondary.

It will be observed that with this system it is not necessary to fill the entire amount of radiation with steam from the steam main, as with all other steam systems, but instead, only the primary section is so supplied. For this reason, much smaller mains, risers and connections are required than with any other system; the secondary being considered as a part of the return line (being on the vacuum side of the vacuum valve).

With the simple or ordinary vacuum system, the water of condensation discharged into the return line under the vacuum of the same, will vaporize, and the vapor from it, will have to be condensed by a jet of cold water at the vacuum pump in order to maintain the required vacuum, and all of the heat units so destroyed there, are wasted, as in destroying them, their heat is not given out in the rooms to be warmed.

By the compound system, these units of heat are destroyed in the secondary section of radiation, which acts as a surface condenser, and the benefits of such heat units is given off in the rooms to be heated.

At the same time, when a system is fully compounded, there is absolutely no injection water needed at the vacuum pump, whatever, thus saving in water, as well as heat units, at the same time causing no waste of water, which is necessary in an isolated plant, as the injection is just that much more needed in the boiler and often results in cooling all of the water that is returned to the boiler to a lower point than that at which it is returned from the compound system.

Heat Regulation with Compound System.

Another feature when this improved system is used in office, school or block heating, is in the regulation of the heat during moderate weather, that can be made by the attendant.

Ordinarily, if a pressure of atmosphere to one pound above is carried on the steam mains, a vacuum of eight or ten inches (4 to 5 pounds negative pressure) is carried in the return lines and secondary sections. This allows all radiators to heat throughout. If, however, all of the radiation is not needed owing to moderate outside temperature, the pressure in steam mains can be reduced to three or four inches of vacuum (1½ pounds to 2 pounds negative pressure) in which case, the secondary sections will not be heated to any extent, owing to the difference in pressure between the primary and secondary sections not being sufficient to cause sufficient re-evaporation in the secondary. This simple adjustment of the reducing valve controlling the steam pressure in mains, cuts out from twenty-five to thirty per cent. of the radiation in each room, without any individual adjustments at each radiator, and results in an economy of steam and more agreeable temperature in the rooms.

If the occupant of a room desires to have less heat at any time, it can be secured by adjusting the steam valve on radiator even to the point that only one-quarter of the radiator is heated. At the same time, the radiator is at all times free of air and water and the system is without the snapping and pounding so common in steam heating systems.

Compounding radiation, can be done by using a separate hot water radiator for the secondary, if two or more radiators are required in a room, or one secondary can be supplied by two or more primaries.

But when only one radiator is required for each room, a compound radiator can be secured that has the two sections in one unit, and having the appearance of one ordinary radiator. Pipe coils in factories can be compounded on the same plans as radiators and the combinations of such compounding are numerous, and allow in many cases when heating plants are already installed, of some of the coils being cut off from the steam supply and fed from the discharge of other coils without any expensive changes in the system.

Some Other Features of Compound System.

The only point that governs any combination of compounding is in maintaining the proper proportion between primary and secondary sections. To show the extremely small connections needed for supplying steam to compounded radiation, a ½ inch pipe will take care of 90 square feet of radiation; a ¾ inch pipe of from 90 to 150 square feet, and a 1 inch pipe up to 300 square feet, with steam in the main at ¼ pound pressure. Steam mains are proportionately small. As systems on this compound principle have been in successful operation for three seasons now and second and third orders received from some of the users, it is evidence that the principle is correct and is borne out in actual practice.

Owing to the extreme low pressure required for this system the saving in power and fuel, when exhaust steam is used for heating, is apparent, as if a certain amount of steam under, say four or five pounds pressure is expanded to atmospheric pressure or ¼ pound or ½ pound above, it will owing to this expansion, fill a great deal more radiation and result in a saving of fuel, or if exhaust steam is used, and the amount is limited, it will heat much more radiation than if necessary to carry the higher pressure.

While it is true that the temperature of this lower pressure is not as high as the steam at higher pressures, this is offset by the fact that with this vacuum system, every square inch of radiation is effective heating surface, while with the usually poor circulation in systems requiring the higher pressures, much of the radiation is air, and water bound, and therefore not effective.

This description of the compound system, although brief, will show the many advantages it possesses over the ordinary or simple vacuum system and the possibilities of greatly increasing economy and satisfactory working of old systems by adapting this principle to them, also the wisdom of investigating the results of such, before any great outlay for a new system or additions to an old one.

The compound features of vacuum heating, as well as the automatic vacuum valve, are covered by two basic patents, in the United States and Canada, which are controlled by the Simonds Heating & Specialty Co., 106 Washington Ave., Detroit, Mich. The Simonds Automatic vacuum valve, which is perfectly balanced, and while it freely relieves the system from air and water, does not blow steam through in vacuum line, and is perfectly tight in its seat between discharges. This valve has large discharge openings one half inch being the size of such opening in the smallest valve.

These systems have been in use in the United States and Canada for three years, with universal satisfaction, as second and third orders have been received from some parties after using the system for a season.

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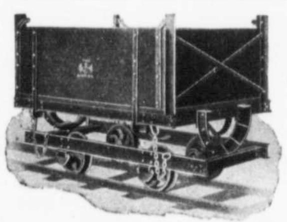

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Application of Motors to Machine Tools*

A Thorough Consideration of the Subject, in Which Some New Ideas are Brought Out. Comparison Between Individual and Group Drive as Regards First Cost, Maintenance and Depreciation, Provision for Extension, Sectional Operation, Flexibility as to Location, Efficiency and Positive Application of Power. Detail and Reliable Information as to Types of Motors Best Under Different Circumstances.

By Dexter S. Kimball.

The introduction of electrical distribution and the electric motor gave to engineers of large plants a solution to a problem that had for a long time been very troublesome. The old method of power distribution with its wide belts and large shafts, and, when the plant was large, its detached engines and sometimes boilers, was quickly recognized as far inferior to the new method. By this method the great friction losses due to large shafts and belts were eliminated, and centralization with its accompanying economy could be carried to its highest form. The larger the plant the greater was the advantage to be gained, so that it quickly became good practice to distribute power electrically, and run the various lines of small shafting by motors belted to them.

Group or Individual Drives.

By an easy extension of this system the larger tools were soon belted to their own individual motors, and the advantages so gained were evident to all, and up to this point engineers were fairly well agreed. But engineers soon came forward with the claim that great economy could be obtained by attaching a motor to every tool and doing away with all belts and shafts. On this point, however, engineers were not so unanimous, and a discussion arose as to the relative merits of the two systems, and many tests were made to determine which was the more economical way, these comparisons generally being drawn between the so-called group system and individual motor system.

This method of comparison, while in general not unfavorable to the individual motor, was not conclusive, for the reason that the item of power is a small one in most manufacturing establishments, and a very great saving must be effected by any system to make economy a determining factor. The question of economy alone was not sufficient to settle the problem, but out of the discussion came much valuable data and some well-defined principles. It was clearly shown that conditions exist where either or both systems have a place, and that again conditions may exist where neither is desirable, as in cases where heavy machinery is to be operated close to the prime mover, as in certain kinds of mills driven by water wheels.

The plant must be very small and compact, however, when electric distribution cannot be used to advantage, and in large plants it is indispensable.

It is also now conceded, by engineers in general, that large and portable tools can be best driven by individual motors, and the greatest bone of contention in this regard is the question of just how far individual driving should be used as against group driving, with a gradual growing sentiment in favor of the individual drive.

That the individual drive has not met with more favor was due in the past mainly to two causes: 1. Imperfect motors; 2. The general attitude of machine-tool builders.

Motors and Machines.

When motors were first introduced in this work, electrical designers had not studied the peculiar problems presented, and as a consequence the first motors were not very satisfactory. The machine-tool builder, on the other hand, saw at once that the motor was going to impose a new set of conditions on these machines, compelling him eventually to alter his patterns; and many of them naturally did much to discourage what some of them characterized as a fad.

As might be expected, the combinations designed, under these circumstances were fearful and wonderful. A standard gas-engine fastened to an ordinary carriage would not make a very good automobile; yet in comparison it would show up well with some of these early efforts.

But these difficulties are now being rapidly overcome. Machine-tool builders and electrical men are getting together on the problem, and it will not be long till growth or consolidation will give us a machine company which will make a specialty of turning out complete motor-driven tools. When that time comes, and only then, will the individual drive reach its highest development and lowest production cost. The latter item will have a great bearing on the final adjustment of the question of group drive versus individual driving, as will be seen later. In the meantime it is possible to buy almost any machine tool, motor-driven in some way, although not always in in a very desirable manner.

Deciding on Method.

With these general principles established the engineer is confronted with the problem of connecting up his electrical system of distribution to his medium-size and small machines, and in making his decision as to the method to be used he will be governed largely by the following considerations: 1. First cost of installation; 2. Maintenance and depreciation; 3. Provision for extension; 4. Sectional operation; 5. Flexibility as to location of tools; 6. Efficiency of system; 7. Positive application of power.

It may be well to consider these points in some little detail.

1. Undoubtedly the first cost of individual driving is considerably greater than group driving, and unless it can be shown that the individual drive has great advantages in other ways which offset this important item, it is not likely to be considered by the man supplying the money. This is often a very difficult thing to do, and first cost will remain a drawback to the motor drive for small tools till different conditions of manufacturing reduce the costs considerably from where they stand at present.

Depreciation and Upkeep.

2. On the second point we have as yet not a great deal of data that the writer is aware of; but his experience has been that the cost of maintenance and the depreciation were somewhat less in group driving. In the group drive the great item of expense is that of belting, which is costly and wears out rapidly; on the other hand, when motors do need repairing, the repairs are costly, so that, on the whole, there does not seem to be much choice. Reliable data on this point would be of great service.

3. Regarding the third point, the individual drive has all the advantage. No system has ever been devised that provides so easily for extension. Changes in arrangement are also more quickly and easily made with the individual drive.

4. Here, again, the advantage is all with the individual drive, particularly with large tools which may be required to run overtime. Further, the breaking down of an individual motor affects but the one tool. This last, however, is not of great importance, as the motors now built are quite reliable.

5. On this point the individual drive has an advantage that is particularly important. Machines so driven can be placed wherever desired, and in case of large tools, ideal conditions are obtained for overhead handling devices. In the case of small tools greater convenience can be obtained, and tools can be placed in the middle of the room without cutting out the light. Incidentally, the elimination of belts on such a floor greatly decreases the dust.

6. The question of efficiency has already been discussed, and needs no further com-

		Group Drive	Individual
1.	First cost	Considerably less	———
2.	Maintenance and depreciation	Probably less	———
3.	Provision for extension	———	Much superior
4.	Sectional operation	———	Much superior
5.	Flexibility as to location	———	Much superior
6.	Efficiency of system	Not of great consequence	
7.	Positive application of power	———	Much superior

* From the Proceedings of the Combined Electrical and Mechanical Engineering Societies of Cornell University.

ments here except that it has been found by actual measurement that there is little to choose between group and individual driving as far as efficiency is concerned.

Positive Power.

7. The seventh and last point is the one on which the individual drive has its greatest claim to superiority, and which has done more for the individual drive than anything else. It was soon found that where motors were directly geared to the machine, a greater output was possible on account of the elimination of the slip in the belt, and the consequent driving of the work up to the limit of the cutting tool. This, of course, greatly reduces the time of the operation, and as the cost of the time is two-thirds the total cost of the product, it is easy to see what a saving could be affected. The introduction of the new high-speed steels added still more to the necessity of positive driving, and it has been well demonstrated that where heavy cuts are to be taken, the positively geared motor will show a great saving of time over the belt drive.

The Place for Belts.

Herein, also, lies the solution of the problem so confusing at present to the engineer who is trying to find out just how far he can carry the individual motor drive idea and make it pay. In the case of large tools, it will be seen at once that the solution is plain, and a careful consideration will show that the individual drive can be successfully used down to a point where a belt of convenient size will have no trouble in driving the cutting tool up to its limit. Rules which fix some particular limit to the minimum size of motor to be used, or the minimum size of machine to which a motor should be attached, are very misleading, as it depends entirely on what the tool is intended to do.

At present it will not pay, outside of the advantages of better light and cleaner surroundings, to drive very small tools individually; but the writer believes that cheaper motors and properly designed tools will make the size of tool smaller and smaller till eventually it will be the prevailing system. At present each case must be worked out on its merits along the lines suggested above.

Installing Motors.

Having decided what tools to drive individually and what to group-drive, the next question is the matter of motors and the methods of connecting them to the machines. Here, again, a great difference of opinion exists, and conflicting literature has been written. In order to get a clear idea of what is needed in a motor for this work it will be well to look at the requirements of the tools themselves.

Classifying Tool Requirements.

Machine tools may for this purpose be classified into the following groups: a. Machines requiring a constant speed. The torque may vary with the demand for power. b. Variable speed machines requiring maximum power at minimum speed. In this class are most machine tools where automatic regulation is needed. Here the cutting speeds are practically constant for a given material, but the cuts are larger on the larger work. c. Variable speed tools requiring heavy starting torque, as cranes, etc., where regulation of speed is by hand. d. Machines requiring a torque increasing with the speed, as blowers and fans which give variable blast. This class is rather unimportant, and will not be discussed.

Speed-Changing Devices.

Of course there is no trouble in meeting the requirements of the constant speed machines, but the problem of variable speed is as old as the hills. If a good mechanical speed-changing device were to be had, the problem would be easy to solve. But so far none have been produced that will answer the purpose. Many have been made that will give any speed between the limits of the mechanism, but they all depend on friction, and hence to carry the work required must in most cases be very large and cumbersome; while those that are positive in their action give only special speeds between the limits, and hence are not all that is desired. Of the latter type a number are now on the market which can be used with success in many places.

A. C. or D. C.

When the electrical side of the problem is considered a choice of two distinct systems of distribution is presented, namely, the alternating-current and the direct-current systems, both of which have a place under proper circumstances in this work.

It may be said at the outset that when the alternating-current system of distribution can be used it is preferable, as the wiring is smaller in a large system, the generators and motors simpler and more reliable. It has, however, its limitations, as will be seen, as far as machine-tool driving is concerned.

The alternating-current system offers two kinds of motors, the synchronous and the induction motor. The first is not self-starting, and, except in a few cases, has no place in machine-tool driving. Where heavy shafts, as test shafts, are to be run for some length of time, and provision can be made for starting, a synchronous motor is an excellent thing in connection with induction motors, as it tends to steady the line and help the power factor. In small sizes, however, it is not suitable for machine-tool driving.

Induction Motors.

The induction motor is self-starting, and, like the synchronous motor, tends to run at constant speed. It is by its nature not a variable speed machine, although it can be made so in several ways, none of which, however, has so far proved adequate to the demands of the machine tool driving. It has been successfully used on cranes and similar devices, the speed variations being obtained by putting resistance in the secondary, and variable speed induction motors are now on the market controlled in this manner. One plant at least has been fitted out with induction motors, where several changes of speed were obtained by varying the frequency, with fair success. But as yet the induction motor cannot be considered as equal to the direct current motor for variable speed work, though considerable experimental work is now being done that may change the situation.

If the plant under consideration is to contain constant speed machines principally, the induction motor in connection with a mechanical speed changing device will generally prove to be the best, and where all the machinery is of constant speed type it is much preferable. Of course local conditions may affect this as, for instance, when the power is to be brought and only direct current is available.

Direct-Current Motors.

The direct current system offers three kinds of motors, their combined characteristics covering much more closely the requirements of the case than do those of the alternating motor, and there is little doubt as to the greater adaptability of the system for general machine-tool driving. These motors are: 1. Series-wound motors; 2. Compound-wound motors; 3. Shunt-wound motors.

The series motor is a variable speed motor with great starting torque. It can be controlled throughout its whole range of speed, and would seem at first glance to be almost ideal for lathes and boring mills. It is, however, very uneconomical, as the control is obtained by resistance in its circuit. It also requires an expensive controller on account of the heavy current to be handled, and must be controlled by hand, as its speed varies inversely with the load, and under light loads it will run away. It is an excellent motor for cranes, elevators, etc., and occupies a very important place in the equipment. It therefore covers the requirements of the tools under class c.

The compound-wound motor is suitable where small variations of speed are needed, coupled with a large starting torque. It will, of course, give constant speed when set for any set of conditions within its range.

Class of Machine	A. C. Motors	D. C. Motors
Constant speed torque varying with load	Induction motor Synchronous motor	Shunt or compound-wound motor
Variable speed, maximum work at minimum speed, automatic regulation	Induction motor with mechanical speed changing device	Shunt-wound motor with or without change gears
Variable speed. Heavy starting torque. Hand regulation	Induction motor	Series-wound motor
Variable speed, torque increasing with speed	——	Compound-wound motor

Table 1

Shunt-Wound Motors.

The shunt motor is, in its standard form, a constant speed motor. When set to run at a given speed it will not vary appreciably under varying load up to its capacity. It can be made to vary its speed in a number of ways, those which are most used being one of the following three: By varying the current in the armature; by varying the

strength of the field; by varying the voltage applied to the armature terminals.

These characteristics make the shunt-wound motor most suitable of any for the purposes of machine-tool driving, and by means of these methods of control, either singly or in combination with each other or in combination with gearing, most of such work is now accomplished.

Speed Control.

A discussion of the principal methods of speed control may be of interest. If the armature current in a shunt-wound motor be decreased by inserting resistance, the field remaining constant, the speed of the motor will decrease. But when this method of control is used the motor loses one of its most valuable qualities. It will no longer run at constant speed under varying load. Besides, this method of control, like that of the series-wound motor, is very wasteful, and the controller must likewise be large and complicated to handle the large current which must be broken. This method, therefore, has ceased to be used to any great extent.

If the field strength of the shunt motor is varied the speed will vary accordingly, and in this method of control the bad features of the above method do not appear. The field current is small, and therefore the resistance loss small and the controller simple and cheap. The motor, likewise, retains its good quality of steady running. The power, however, falls off, for now the commutating ability of the field has decreased, so that less current can be passed through the armature. In order, therefore, to get a given output at higher speed with field control the motor must be larger than one built for the same output at the normal fixed speed.

To illustrate: A 4 h.p. motor at 400 revolutions per minute will give only 1 h.p. at 1,600 revolutions per minute with field control. It will be seen at once that in order to get a large range in this manner the motor must be very large. It will be noticed, however, that the characteristic of the motor fits the requirements of tools in class b, and it is therefore much used for driving this class.

Theory and Practice.

If the field strength is kept constant and the impressed volts at the armature terminals be varied, the speed of the shunt-wound motor will vary accordingly. Theoretically, this is a most excellent method of speed control, as it allows the use of a smaller motor than in the method of field control, and the efficiency of the motor at the various voltages is high. In practice, however, the number of voltages that can be supplied, is limited, and therefore in its simplest form the system has the same defect as the method of controlling alternating induction motors by changing the frequency. It is usual, therefore, to make the motors large enough to have field control sufficient to reach between voltages, which makes a system that completely covers the range between voltages and extends the range beyond the speed normal at highest voltage.

The Four-Wire System.

To illustrate: Suppose the range is 4 to 1, as before, and let the voltages be 60, 80, 110, 140, 190, 250, as used by the Bullock Co. in its four-wire system. Let the minimum rate at which power is required be 1 h.p. as before. Neglecting losses, this range of voltages alone would give six fixed speeds, and if, as before, the lowest is 400, the fastest would be about 1,600 or directly proportional to the voltages applied. The motor for the system would only need to be 1 h.p. at 400 revolutions per minute, instead of 4 at 400 revolutions per minute, as in the case of shunt field control. If now the motor is made large enough to stand an increase of speed by field control of about 33 per cent., it can be speeded up in that way from voltage to voltage, and the whole range covered. Further, when running at 1,600 revolutions per minute at 250 volts, it can still be speeded up to 2,133 revolutions per minute, making the total theoretical speed range 5 to 1.

Multiple Voltage Peculiarities.

Undoubtedly this system works well, but like all the others it has its defects. It is not desirable to carry high voltage round manufacturing plants, for obvious reasons, so that in order to get a large range in this manner the lowest voltage must be very low. To obtain the full output at low speed—and it has been seen that generally the greatest output is required at the lowest speed—the current must be increased; so that the expense of wire runs up rapidly for wiring the low voltages, or if the mains are kept down in size, the line losses are heavy, and the impressed volts drop off, the motor slowing down accordingly. Further, the obtaining of only six voltages by a four-wire system introduces considerable complication, as is easily seen, besides the extra expense for controllers, wiring, and the machines for giving the various voltages. A description of the latter is beyond the scope of this article. Generally a motor generator set of some form is run from the main series of the principal generating set which splits the voltage of these mains. Thus a 250-volt circuit can be divided by two wires from such a set into 60, 80 and 110 volt steps, and the combinations of these give six voltages. (See illustration.)

A Three-Wire System.

If a three-wire system, giving, say, 110 and 220 volts, as available, a speed range of 4 to 1 can be obtained in the following manner: Let the data be the same as above, and then for this case the motor will be a 2 h.p. motor at 220 volts and 800 revolutions per minute. When running on 110 volts and full field it will develop 1 h.p. at 400 revolutions per minute. Since the motor is running below normal speed it can be speeded up through a considerable range and still commutate well. By this means probably 60 per cent. increase can be obtained with the ordinary motor, when the voltage must be changed to 220 and full field applied for any further increase. On the higher voltage the field can be again weakened till the speed is doubled, and at 1,600 revolutions per minute, as the motor is now large for the work to be done, it will commutate all right.

In order to make a close comparison with the other systems this motor should be somewhat larger, say 3 h.p. at 220 volts, or 1½ h.p. at 110, so as to cover by field control the whole range from 400 to 800. In such a case, however, a further increase in speed could be made when running on 220 volts, thereby extending the range somewhat.

Gearing with Field Control.

If it is not desired to use the excessively large motor resulting from entire field control or the complication of multi-voltage, a combination of field control and gearing can be used. Using the same data as before, the motor could be designed for a field control of 2 to 1, and a single set of change gears used in combination with it. Here the motor would be a 2 h.p at 800 revolutions per minute, giving 1 h.p. at 1,600, and not exceeding the speed limit originally assumed. This method, which is a compromise between the other systems, has many good points. The wiring and generating systems are simple, as only a single voltage is necessary, and the motor need not be excessively large for the work, as it can be worked at the maximum range of speed which is allowable for gear connection. The voltage is always the highest permissable, hence the wiring is small; and while the multi-voltage system gives somewhat quicker change of speed, the difference in well-designed machines will not be very great.

System	400 Revs. per Minute			800 Revs. per Minute			1600 Revs. per Minute		
	Maximum H.P.	Current for H.P.	Volts	Maximum H.P.	Current for H.P.	Volts	Maximum H.P.	Current for H.P.	Volts
4 to 1 field control.....	4	3	240	2	3	240	1	3	240
4-wire multi voltage ...	1	12	60	2	6	120	4	3	240
3-wire multi-voltage ...	1½	6	120	3	3	240	1½	3	240
2 to 1 field control, with 2 to 1 gearing.......	2	3	240	2	3	240	1	3	240

Column 1 under each speed gives maximum horsepower motor will give.
Column 2 gives the ampere per horsepower.

Table 2.

In the writer's opinion it is a logical system, and will be very widely used in machine-tool work, mainly on account of its electrical simplicity. The efficiency of such a system is good, and if the gearing is properly designed the range covered by the motor alone need not be great enough to make it large and clumsy.

Sizes of Motors.

Table 2 shows the relative sizes of motors which must be used in the systems described, to cover the range from 400 to 1,600

revolutions per minute, and with a maximum voltage of 240. It will be seen that the motor with the 2 to 1 field control and a single set of change gears is the smallest, requiring three amperes approximately when delivering 1 h.p., against six in the case of the multi-voltage at same speed. The figures for current used are, of course, approximate and are for the purposes of comparison only.

To get the lower range of speed, i.e., 400 revolutions per minute, the change gears with ratio 2 to 1 would be thrown in, and the motor put on full field, when it would run at 800 revolutions per minute. By decreasing the field strength its speed would be raised to 800, when the gears would be thrown out and the motor again put on full field. The further increase to 1,600 would be accomplished by again weakening the field.

SPEED VARIATION BY FIELD CONTROL.

Motors giving successfully a range of 2 to 1 by field control are at present not classed as standard motors, although there is no difficulty in obtaining them or motors which will give a much greater range. This distinction will, however, disappear as they are more widely used, and there is no reason why motors giving such a range or greater cannot be made as a standard product if the demand is sufficient. A number of makes are now on the market which offer a much greater range than this; but at present, as shown by Table 2 it would not seem advisable to go far beyond 2 to 1, except perhaps in special cases.

RANGE OF SPEED CONTROL.

From the foregoing it is easily seen that the range of any of the above systems of speed control is somewhat limited, the four-wire multi-voltage having the widest for the same size motor. But even this is limited as here laid down to about 6 to 1 when using field control on the highest voltage. It is true that it can be extended by using either higher or lower voltages, both of which are undesirable. Now machine tools which require variable speed may have a range as high as 50 to 1. While, no doubt, many tools are furnished with greater range than absolutely necessary, 6 or 8 to 1 being found sufficient for many purposes, at present it is easily seen that none of the systems outlined will conveniently cover such ranges. Resort must, therefore, be made in most cases to gearing to finish out the range even with multi-voltage. When the range to be covered is very great this last system has an advantage, but for most machines the range required can be covered with a field control of 2 to 1 and two sets of gears, and for the larger ranges which are not so frequent, a field control of 3 to 1 can be successfully used.

PLANNING A NEW PLANT.

Where a three-wire system is already installed the application of variable speed drives is easily accomplished by the system outlined above. But when the case of a new plant is under discussion, careful consideration should be given to the foregoing principles, and the system selected should depend largely on the ratio of variable speed tools to constant speed tools. If the plant is large enough, an alternating system, with proper transforming devices, might prove the best, and in the writer's opinion, many large plants now equipped with direct-current distribution would be much more economically run if so provided.

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