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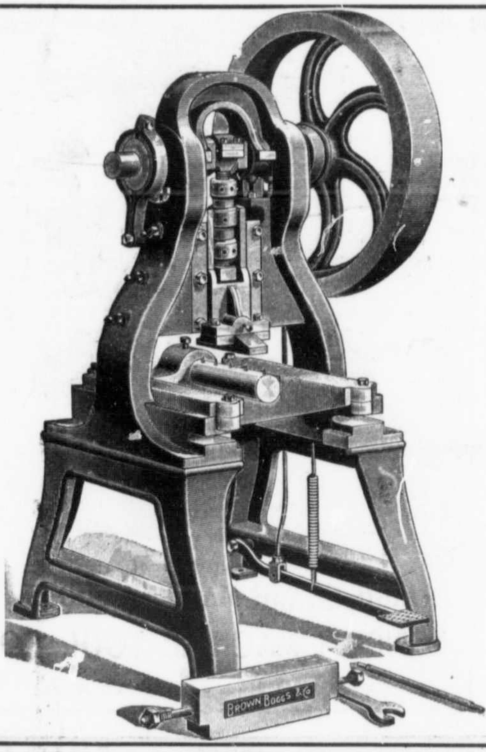

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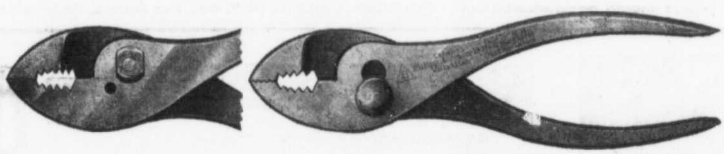

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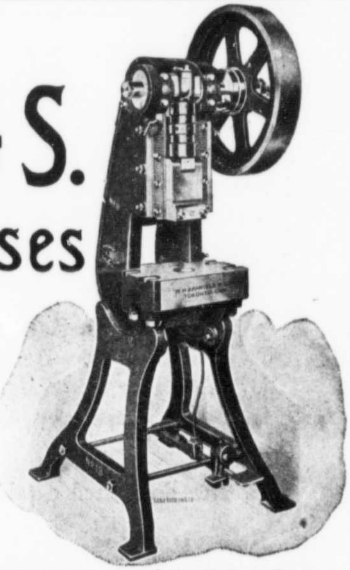

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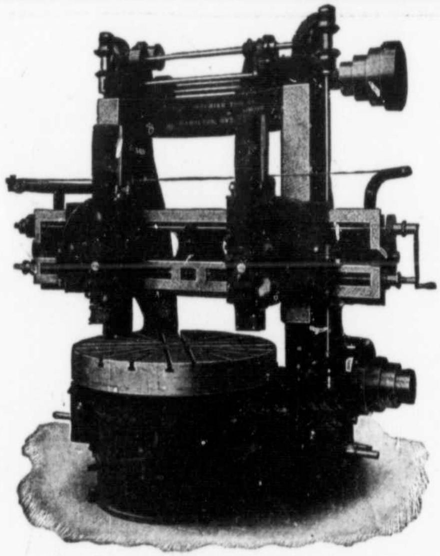

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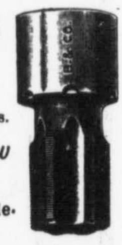

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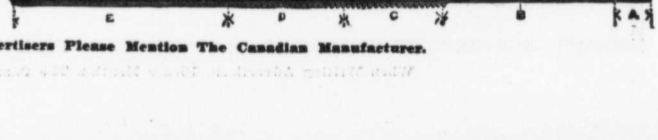

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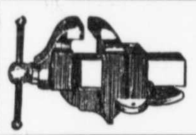

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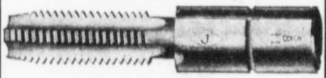

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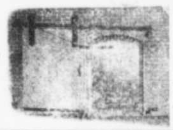

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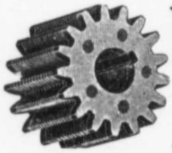

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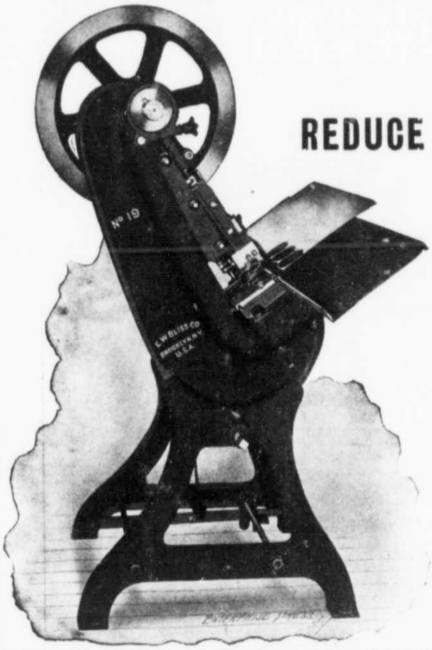

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By James Hartness, Springfield, Vt.

This paper sets forth a turning tool that is intended to cut without clearance.

It consists of a cutter and a holder so constructed as to allow the cutter a slight oscillatory freedom in the holder. The center line on which the cutter oscillates is substantially coincident with the cutting edge. The oscillation of the cutter about the center line does not affect the position of the edge, but it does allow the face of the cutter to swing around to conform to the face of the metal from which the chip is being severed.

The objects of this construction are to make possible the use of more accurate cutting edges in order to reduce the cutting stresses; to equalize wholly or partly the unbalanced side pressure on the cutting edge; and to obtain a rubbing contact to prevent lateral quivering.

In order to bring out these objects it is necessary to analyze briefly some of the conditions under which metal is worked in a lathe, dealing particularly with cutting angles, clearance of cutting edges, and the importance of minimizing the tendency of the work and tool to separate under cutting stresses.

No attempt is made to discuss the forms of cutting edges for withstanding the heat of high speed service. High speed tool forms have been ably and perhaps conclusively treated in the paper by Mr. Fred. W. Taylor and its discussion, and in the papers of Dr. Nicolson before this Society and before the Manchester Association of Engineers.

The generally accepted cutting angle of greatest endurance under high speed is about 75 degrees, and the angle of least resistance, according to some of Dr. Nicolson's tests, is about 60 degrees, with an increase below as well as above that angle.

The cutting angles of the tool described in the present paper may be varied from the present orthodox angles down to 30 degrees or less, according to the nature of the work.

The results obtained by Dr. Nicolson, which showed an increase in cutting stress for tools more acute than 60 degrees, may have been due to the cuts having been run without cutting oil or suitable cutting lubricant. Furthermore, the comparative lack of durability of the more acute edge below 70 degrees, may have been due either to heat or lateral quivering or both. The heat would have been greatly reduced by a liquid cooling medium, especially one having some suitable lubricating qualities, and the lateral quivering may now be eliminated by means explained in this paper. The thin edge of an acute tool is obviously the least suited to carry off heat or to withstand the quivering incident to cutting.

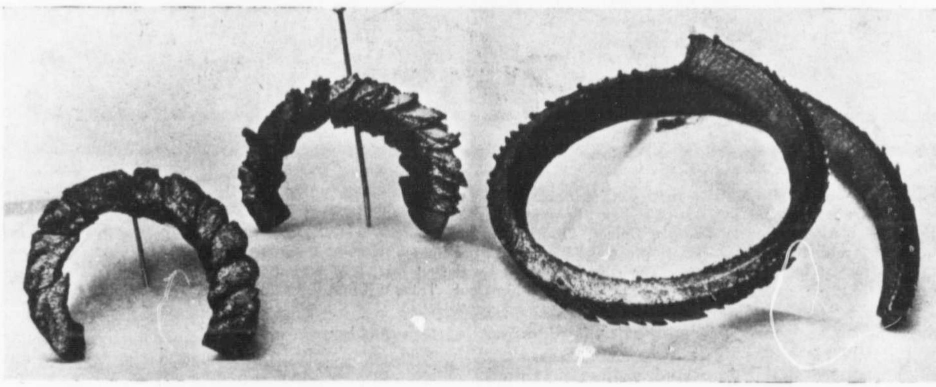


Fig. 1.—Characteristic Chips (about double size). Chips at the Left made by Diamond Point Tool having 70 Deg. Cutting Angle. Chips at the Right made by No-Clearance Tool, 45 Deg. Cutting Angle.

Having mentioned the great work of Mr. Taylor and coworkers and of Dr. Nicolson, it is necessary at once to disclaim any pretension at contributing valuable data, such as are found in the papers of these truly scientific researchers. Nothing of the kind is possible at this time. All that is attempted is to suggest a scheme for widening the field of investigation.

Instead of approaching the subject as a scientist bent on getting exact data regarding performance of certain existing forms of tools and machines, the writer's line of approach has been from the standpoint of a designer and manufacturer of lathes, and particularly lathes of the character of the flat turret lathe.

The Class of Work Here Considered.

The means for cutting set forth should be considered from the standpoint of one who sees nothing but lathe

*Presented at the New York Meeting (December 1908) of The American Society of Mechanical Engineers.
References mentioned: Dr. J. T. Nicolson's papers in Transactions of Manchester Association of Engineers, 1903, and in Transactions of this Society, p. 637, vol. 25, 1904; Mr. Fred. W. Taylor's paper, vol. 28, 1907; also cuts on p. 333 in Dr. Nicolson's discussion of Mr. Taylor's paper.

work under 20 inches in diameter, and of the kind usually found in any machinery building plant, whether it is a navy yard, railroad shop, or automobile building plant; not that the means are of no value in larger work, but being out of the writer's range of experience, such work was not considered in designing the tools described.

A more exact description of the range of work for which this tool is intended would be: lathe and turret lathe work under 20 inches, and over 4 or 5 inches in diameter, and less than 8 or 10 inches in length; also work up to 2 and 3 feet in length, of diameter under 3 to 3½ inches and generally over ¾ or 1 inch.

It includes three classes of work: a, chuck work, having diameter generally exceeding length, and held wholly by a chuck or face plate; b, bar work, which is held in a chuck and steadied by back rests; and c, work having dimensions similar to bar work, but which must

In engine lathe practice these shoulders are "squared up" by a side tool after the other turning has been done by a round nose or diamond point tool, but in the turret lathe for bar work these shoulders are produced by the same tool that takes the stock removing cut.

The tool used in turners for bar work cuts on the same principle as the engine lathe side tool; that is, its rake or top slope is almost wholly side slope, and its cutting edge stands at an angle of 90 degrees to the axis of the work.

In the engine lathe a tool of this character has generally been unsatisfactory for rapid turning, yet in the turret lathe this very tool seems to be universally used for all bar work. The difference in performance seems to be due to the difference in mounting. It works well where there is no chance of vibration, but trouble begins when it is used in a machine like the engine lathe or

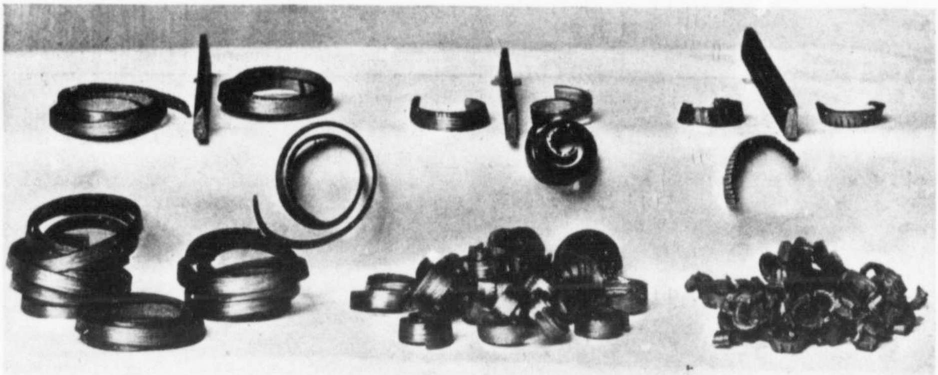


Fig. 2. Samples of Chips and Cutters: Cutting Angles from Left to Right 45 Deg., 60 Deg. and 75 Deg. These Chips were Produced in an Engine Lathe with Holder Shown in Fig. 12. The Chips were Confined Edgewise Between the Body of Work and the End of the Holder. The Breakage of Chips Taken by the 45 Deg. Tool were due to Chips Getting Caught Between the Work and Tool Holder, Usually due to the Irregular Winding of the Chip. The Chips Produced by the 60 Deg. Tool Wound up till the Circle was Greater than the Chip Could Take Without Breakage.

be turned on center points, with or without following and fixed steady rests.

It will be noticed that this excludes all of that kind of larger and heavier lathe work in which the principal duty of the lathe is the rapid removal of the stock. In the particular branch of work under consideration the rapid removal of stock is important, but not paramount.

Although the field of work includes all kinds of steel and cast iron, this paper will deal only with the standard open hearth machinery steel of about 20 points carbon

In work supported on centers and in chucking work, the connection between the work and tool includes a number of joints, both for sliding the tool in relation to the work, and for the rotation of the work. Each of these joints has more or less slackness, and each of the slides and other members is more or less frail in structure. With a mounting of this kind the cutting edge of the tool does not pass through the metal without swerving and flinching.

Type of Tools Used.

In the class of work under consideration each piece has several diameters, with shoulders which should be accurately spaced and formed. Nearly all the shoulders required in this class of lathe work are the so-called square shoulders.

turret-chucking lathe in which the work is supported by one part of the machine and the tool by another, and the true path of the cutting tool through the metal is dependent on the entire structure of the machine, there being nothing to prevent quivering.

The no-clearance tool to be described is a side tool without clearance. Its under face bears flatly against the work, thereby preventing the lateral quivering which has previously made this type of tool inefficient.

Means for Improving Efficiency.

A machine's efficiency is proportional to its strength to resist its working stresses. There are two ways to increase this efficiency; a, by strengthening the machine; and b, by reducing the stresses for a given result.

In the writer's previous work the strengthening of the machine has been accomplished by the elemination of unnecessary features, and placing the necessary joints for obtaining the various motions in the least objectionable positions. But since this has been so fully outlined in a semi-commercial treatise entitled The Evolution of the Machine Shop, it is unnecessary to make further reference to the special forms of design therein set forth, except to say that a single-slide scheme of lathe design was adopted to eliminate the complicated and frail construction of the multi-slide tool carriage which is now in almost universal use in all standard machine tools.

The next step was to devise a means for minimizing the stresses at the cutting edge, and the object of the pre-

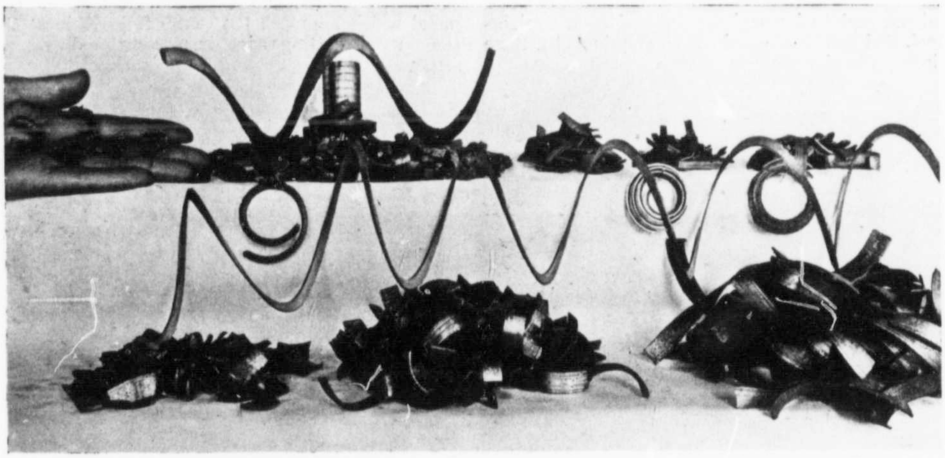


Fig. 3.—Samples of Chips: Those Held in Hand Were Produced by Blunt Side Tool Having 75 Deg. Cutting Angle. All Other Chips were Produced by Tools Having Cutting Angle of 45 Deg. or Less. The Chips in the Three Small Piles at the Right on the Top Row and Those on the Lower Row Were Broken by Chip Controller Shown in Fig. 15. These Chips Were Produced by Cutters No. 2 and 3 in Fig. 4 and 5, Running at 40 to 45 Feet per Min. (Periphery Speed) and 22 Feed per Inch; Depth of Cut 7-16 In., Reducing from $1\frac{3}{4}$ In. Down to $\frac{7}{8}$ In.

sent paper is to explain how this result has been obtained. This reduction of stresses may not be important in roughing work in which a flinching of the work or machine may be disregarded so long as the machine continues to crush off the metal, but for the kind of work mentioned in this paper it has been considered of first importance.

Direct Cutting Stress.

For the purpose of analysis the cutting stress may

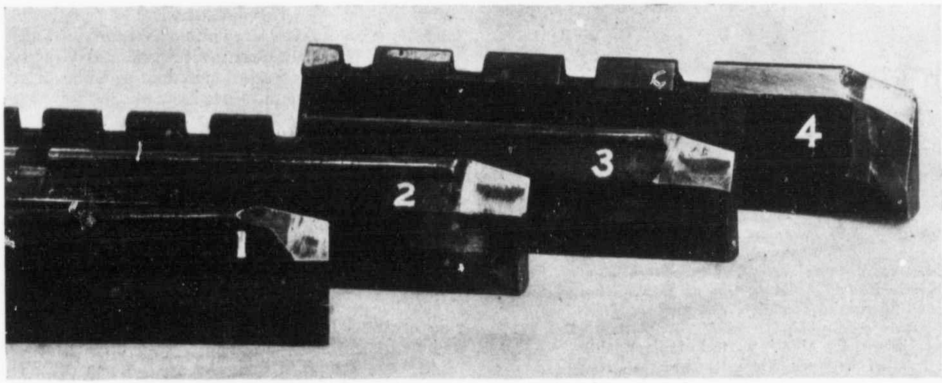


Fig. 4.—Cutters Used in the Flat Turret Lathe. Illustration Shows the Abrasive Contact of Chip on the Top Slope. No. 1, 2 and 3 Were Used in Turner, Fig. 10. No. 4 Shows one of the Earlier Forms.

be divided into three elements: the direct cutting stress, the separating stress, and the tendency to quiver, which we will consider in turn.

By direct cutting stress we mean that part of the stress that is directly downward in a lathe. With all other conditions unchanged, we should expect to find that an acute-edged tool would offer the least resistance, and that the difference in direct cutting stresses for tools of varying cutting angles would show a marked reduction in favor of the more acute tools.

Dr. Nicolson's experiments below 60 degrees, already mentioned, showed an increase in cutting stresses and a marked loss in endurance, but these tests were on dry cutting without the benefit of a lubricant or a cooling solution. The thin edge tool is undoubtedly benefitted more than the blunt edge tool by lubricant or cutting medium. Just what cutting angle would be the best under conditions of most efficient cooling medium may not yet be fully known.

That there is no marked difference in the blunter tool of varying cutting angles really does not affect the situation when we try the real cutting or sliding angles, which may be roughly stated to be efficient in proportion to their acuteness.

It is obvious that the least direct cutting stress for a given depth and feed would be obtained by a straight-edge tool, and one that would take a chip in which there is the least molecular change.

A flat top slope should have a straight cutting edge. The more the edge is rounded the greater the conflict of the metal crowding to the edge. The flow of metal on the top slope of the round nose does not move in one direction wholly, but tends to travel towards the centre of the curve. The conflict of currents of metal which approach the centre from various parts of the curved cutting edge increases the direct cutting stress.

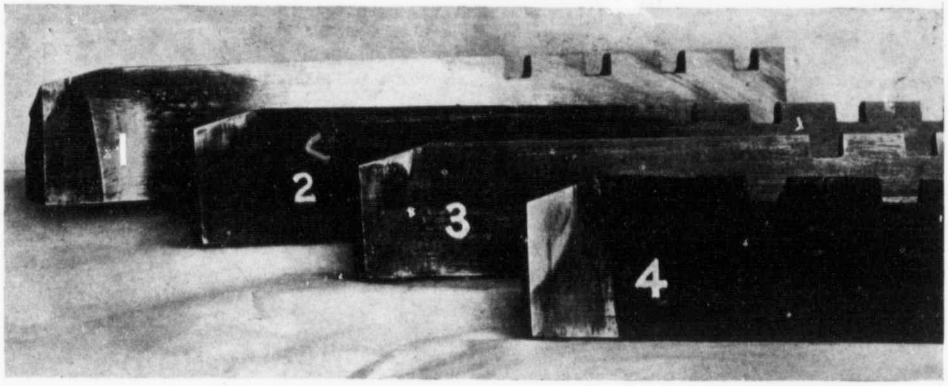


Fig. 5.—Reverse Side of Cutters Shown in Fig. 4. Illustrating the Rubbing Contact of the Tool Against the Shoulder of the Work. Each Tool Bears the Same Number in Both Cuts.

Crushing and partially or wholly shearing the chip into chunks which are three or four times the thickness of the feed undoubtedly increase the working stresses and heat.

The cuts accompanying Dr. Nicolson's discussion, page 33, vol. 28 of Transactions, clearly illustrate the great distortion that takes place even in cutting with an acute tool of 60 degrees and a straight edge. This tool does not have even the disturbing element of shearing

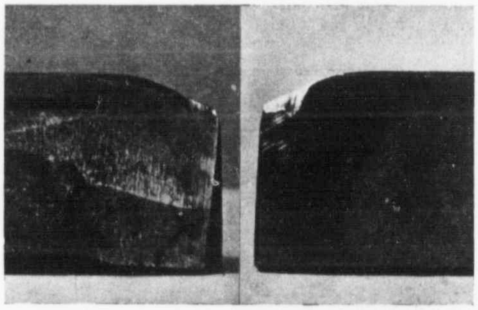


Fig. 6.—No-Clearance Tool, Full Size. Showing an Equal Abrasive Effect on Each Side of Edge. View at the Left Shows the Top Slope, the Angle of Which Was Increased by Chip Abrasion. View at the Right Shows the Abrasive Effect of the Shoulder of the Work Which Reduced the Cutting Angle, but Not as Much as the Abrasion of the Chip Increased It.

action at the edge of the chip, but the experiment shows the distortion of nearly every part of the chip. A tool having a round nose or a blunt edge would doubtless show still greater distortion.

The crushing process of the present scheme of turning is due both to the bluntness of the cutting angle and the shape of the edge. A curved edge should have a curved top slope in order to remove the chip with the least distortion of the metal. The curved top slope for this purpose would make the shape of the cutting edge similar to the cutting edge of a carpenter's round-nosed chisel. This form of tool is not offered as a practical form, but is mentioned to emphasize the unnatural flow of the chip that must take place on the flat top slope of a round nose tool.

Separating Stress.

By separating stress we mean that stress which, in turning a shaft, forces the tool outward radially. Increasing this stress causes the work and tool to move apart, and results in variation in diameter, also in irregular and generally inaccurate product, particularly when the rough stock runs eccentric or irregular. Although this separating stress may be lessened by giving the tool more back slope, this is possible only in tools taking light depth cuts. A lathe tool, however, which takes a cut like a side tool, gives little or no tendency to separate radially.

With the side tool set at an angle of 90 degrees to the travel of the feed, the feeding stress does not tend to force the work and tool apart; in fact, this tool may be set so so as to produce a slightly beveled shoulder either side of the 90 degrees, so as either to draw the work and tool together when making an overhanging shoulder or to force the work and tool apart when producing an external bevel.

Quivering Stress.

The quivering stress due to the nature of the chip is affected by the cutting angle of the tool. The chunks which make up the parts of a chip are less firmly united in a chip taken by a tool of 70 degrees. cutting angle than by a tool of 50 degrees, and of course the more firmly united chunks give a more continous chip with the least vibration of stresses.

In turret lathe practice, especially in bar work, the tool and work are held together by a back rest which

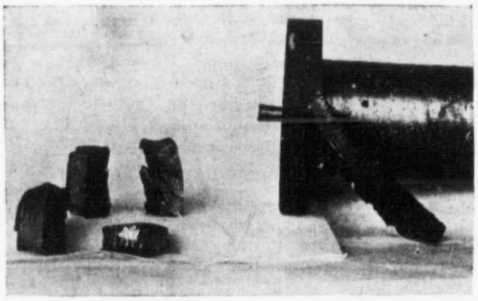


Fig. 7.—Sample of Broken Chips and Work with an Unbroken Chip. The View is About One-seventh Larger than Sample, the Exact Dimensions Being 1¾ In. Down to About 1 In. Diameter. The Feed was About 7 per Inch, Cutting Angle of Tool About 38 Deg., Extreme Edge 1-32 In. Flat. These Chips Were Broken by a Scheme Similar to that Shown in Fig. 16.

follows on the surface produced by the cutter, and in some kinds of turret-chucking work the tools for interior work are mounted on boring bars which take bearing either in the work or in the chuck which holds the work. When tools get this steadying support directly on or in the work, they are freed from the chattering due to the machine mounting, but not free from that due to their own frailty or to the intermittent flow of the chip as it is taken off in chunks.

Relative Destructive Effects of Heat and Lateral Quivering.

The writer is not unmindful of the effect of heat in the destruction of the cutting edge, and fully realizes that no perfection of mounting of the work and tools will prevent destruction of the cutting edge of the tool by heat, but wishes to bring out the importance of the destructive effect of chattering which is ever present in standard types of machine tools. Heat is undoubtedly most destructive when roughing at high speeds, but

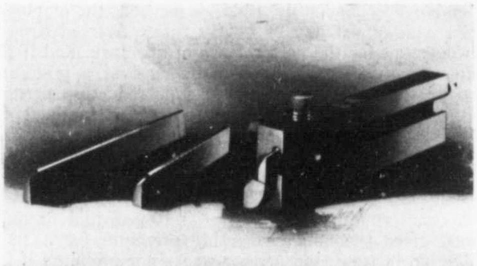


Fig. 8.—No-Clearance Tool for Standard Engine Lathe Tool Post With Three Cutters of Different Angles.

the quivering plays a very important, if not the greatest, part in edge destruction when finishing at the usual speeds.

Many machines are not run up to the high speed limit of the cutters. Even when provided with ample driving power, the strenuous life of attending a high speed machine is a little too much for the average man. As the speed is reduced, the quivering gains in relative importance, which should be taken into account in considering the no-clearance tool. With the slower speeds, tools should be used that give the best results at those speeds.

Other Considerations.

The failure of the keen edge under normal cutting conditions, and its surprising endurance under some abnormal conditions, seem to indicate great possibilities open to any scheme that would maintain the best conditions. For instance, at one time, we have seen the edge of a diamond point broken off by an ordinarily heavy chip and at another time we have seen a similar tool deeply imbedded into the metal without breakage, the tool having taken a plunge and lifted or plowed up a chip of enormous proportions without breaking the tool. Every lathe hand has seen this performance. Usually it ends with breaking the tool or the centre of the lathe, or both, but occasionally the lathe is stopped without breakage; then the lathe hand by great care

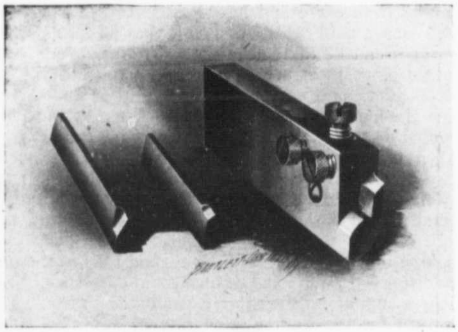


Fig. 9. View of Other Side of Tool Shown in Fig. 7.

may separate the work and tool without breaking the edge. The immense chip plowed up by a frail tool demonstrates what a cutting tool can do under some conditions.

We are also aware that under some conditions a cutting tool will actually sharpen itself in the process of cutting, yet neither of these results is regularly maintained. They suggest, however, the possibility of supplying a means by which they can be maintained in regular work.

(To be Continued in January Machinery Edition.)

Performance

By Douglas Malloch

That man is strong who does the tasks
Made his by place and circumstance,
Who falters not nor questions asks
Nor leaves results to time or chance—
Who turns from finished things to new
And does the work he's told to do.

Yet stronger is this other man,
(However well may serve the one),
Who meets a problem with a plan
And does the thing that must be done—
With firmer grasp and wider view,
Does that he sets himself to do.—System.

Different Plans of Paying Employees*

The Advantages and Disadvantages of Each Plan to the Employer and Employee. A Summary of the New Ideas on the Subject.

By Harrington Emerson.

That system of paying wages is best which guarantees a minimum wage in return for time surrendered, which varies wages to suit different ages, trades, time and character of service, which in addition to guaranteeing wages sets up a definite equivalent in work or output for each minute of employment, which enables each man to show his own personal efficiency and rewards him accordingly, which gives both employer and employee an absolutely square deal. This is the standard by which to judge any system of wage reward for work done. Day wages, piece rates, premium systems only partly fulfill this standard, and each in its way has both good features and bad features.

The Three Forms of Paying Wages.

The reward for work done is a very old problem, as old as life. The writer has watched and studied all the extremes from slave and forced labor to $15 a day men in the Alaska gold fields. He finds that all forms of paying wages can be divided into three; time rewards irrespective of performance; performance rewards irrespective of time; and reward of personality irrespective of either time or performance. These three systems may be called day wages, piece rates and bonus rewards.

All living things work more or less for their existence. In early humanity when men had the morals and practices of wolves, the man that put forth the most exertion generally landed the biggest reward. He was on piece rate. Women were not on piece work. Their work was from dawn until dusk if not a good part of the night in addition. It was not measurable, and all they got out of it was support. Slaves were also on day work, getting in return for the work a support very much as a horse or dog is supported. There was a third form of reward, as when herds were kept or crops grown. In this case the reward depended partly on the intensity of work, and partly, even to a greater degree, on the intelligence of the worker, so that the more intelligent man was able to earn more than the average as in the Bible story of Jacob and Laban. These three systems have persisted into modern industrial life. We have day wages, a commuted form of slave support. We have piece rates, a return to the earliest individualism. We have modern wage systems which permit the employee to determine in a measure his own rate of pay.

The Day Rate.

One advantage of day rate to employers lies in the simplicity of the system. So many days, so much pay. It is almost as simple as ordering oats and hay for street car horses. On the Assouan dam in Egypt, employing 5,000 men, they were all paid off daily at sunset. The advantage to employee is the certainty of pay without individual responsibility, just as children or horses are fed whether they work or not. The disadvantage to employer is that there is no equation between pay and work. A man may work with only 10 per cent. efficiency yet receive full wages. The disadvantage to employee is that even if he is a man of 200 per cent. efficiency he receives no more wages than the man who shows only 10 per cent. efficiency.

*Read before the National Machine Tool Builders' Association, New York City, October, 1908.

Day wages are all right for such work as street car drivers, for sailors, for policemen and gate keepers, for all kinds of work where the worker's presence is more important than the output.

The Piece Rate.

The advantages of piece rate to employers are that it fixes the labor price of the product, that it substitutes a measure of cost certainty for cost uncertainty, that it relieves him of responsibility for conditions, that it secures the active interest of the men. The advantages to employee are that it enables the energetic pushing worker to earn more than the slow, indifferent worker.

The disadvantages to employers are very many, a few of which are:

1. No piece rate can permanently stand. However fair it was when first put in, conditions change so rapidly that it soon becomes unfair to the employer, the change is resisted and there are accusations of bad faith.

2. It relieves the employer of a responsibility which is distinctly his. It is the employer's business to force up output by improved conditions, not the business of the employee. It is immeasurably more difficult to cheapen output under piece rates. Piece rates almost invariably result in limitation of output, thus increasing overhead charges.

The disadvantages to the employee are that it makes him a machine. Under piece rate the most recent and untrustworthy apprentice may earn as much as the oldest and most reliable man. An employee is not a machine. A faithful man of long experience, service and reliability is worth more to the employer than the untried youth who as yet is merely dexterous. Nothing can be more disheartening than to have all qualities of character sunk in a uniform piece rate.

Premium Systems.

An improvement on either the day rate or piece rate was evolved by F. A. Halsey, editor of the American Machinist. He evolved a system which retained all the advantages of the day rate system to the employee, with many of the advantages of piece rate to either employee or employer. Under Mr. Halsey's methods the employee has a guaranteed day or hourly rate. A fixed time is however, set for the performance of any task, and if the employee reduces the set time he receives a premium. The relation of the premium to time reduction permits of many variations without altering the fundamental principles of Mr. Halsey's plan. One employer may give the employee all the time he saves, in which case the plan virtually results in a different piece rate for each different rate of pay.

Another employer, as under the Rowan and Cardullo plans, gives the employee a big premium for a small reduction in time, and neither wages nor premium if the work is done in no time. The Santa Fe bonus plan applied to the work of 8,000 men, carefully determines a standard time for the operation, gives the employee at standard rate all he saves below this time and 20 per cent. premium on wages for time actually busy. If the employee takes longer than standard time, the premium rapidly diminishes, until at time and a half there is no premium. These different variations of the Halsey plan have more or less advantage for employer and employee.

Standard Time Determination.

In connection with wages, F. W. Taylor introduced the new principle of standard time determination. By means of a time study the exact time is determined in which any job, of any kind whatever, ought to be done. Standard time can be applied to day work, or to piece work, or to premium work. A standard amount could be determined for a day's work, and the worker be credited with his pay when it was done whether sooner or later. In such a case by means of standard determination day work passes over into piece work. Having determined time, Mr. Taylor paid an increased rate if the tale of pieces was turned out in this time. He therefore paid an extra reward above the piece rates for standard performance.

Mr. Gantt also established standard time, guaranteed day rates, and paid a bonus for doing the task in standard time. The bonus line is on the Halsey principle of giving to worker higher pay per hour the more he does. The Santa Fe bonus system also used standard time determinations, and applied them to a slight modification of the Halsey plan. The linking of scientifically determined standard time with wages, whether paid by the day, by the piece, or with a premium, constituted a great advance.

The Efficiency Principle.

The adoption of the efficiency principle in connection with all shop operations of every kind and description constitutes a further advance. The method of paying employees not by the day or by the piece, but for their efficiency over a long period of time, irrespective of what jobs they are doing, is part of an advanced system of shop management and shop control. Efficiency is the relation between what is and what ought to be. It is of universal applicability.

If a train is scheduled to run from New York to Chicago in 18 hours and carry 125 passengers and it actually takes 20 hours and carries 100 passengers, the time efficiency is 90 per cent. and the carrying efficiency is 80 per cent. Efficiency is, however, preferably applied to the records of a whole month rather than to those of a single train. Efficiency can be applied to a day rate system, to a piece rate system or to any of the Halsey premium plans. In day rate, if for example the monthly hours are 250, and the worker was present only 200, his day's efficiency is only 80 per cent.; and we could well pay him an increased bonus up to 100 per cent. attendance using the Santa Fe curve for this purpose. If the man is working on piece rate we can determine that his output ought to be 1,000 a month, and if it is only 800, his efficiency as a piece worker is 80 per cent., and we could pay a bonus for increased efficiency. Efficiency, however, has been most extensively applied to the Halsey premium methods.

The Efficiency Principle Analyzed.

Under "efficiency" three questions that are usually jumbled together are carefully separated and each one studied and settled without reference to the other. The jumbling of these problems is responsible for most of the difficulties between employer and employee. These three questions are: 1. Current rate of wages. 2. Standard times for given work. 3. Individual efficiency.

1. It is to be assumed that current rates of wages will fluctuate. There will always be bargaining between employer and employee, or the employer may decide what rates he will pay per hour and employ only those willing to work at this rate, or a union may decide that none of its members can be employed at less than a given rate. No employer can force wages downward in a time of great industrial activity and employees cannot force wages upward in a time of great industrial depression.

2. The scientific, accurate and constantly corrected determination of standard time for any and all work is probably the most important yet most neglected part of modern shop control. We know perfectly well what furnaces, boilers, steam engines, dynamos, machine tools, race horses, bicycle riders, and athletes ought to be able to do, and similarly there is not a job in any manufacturing plant in the United States that cannot be more or less accurately standardized, most of them with extreme accuracy. In work under my direction my assistants have had to give standard times for the repairs of an exploded locomotive and have succeeded within 5 per cent. Standard times compared with actual times show exactly where the losses are, why output is costing more than it should.

3. In a given standard time of 5 hours one man will always take 3 hours or less, another will always take 10 hours or more. The standard time is all right, but the men vary in ability, skill, energy, ambition and persistence. This quality of the man is his own private property, and under this latest system we may pay a man day wages, but we also determine his individual efficiency, so that we knew what men are 120 per cent. men and what men are 50 per cent. men, not as single job, but as to a whole week's or month's or year's work. To pay a man a bonus related to his efficiency is an easy way of securing his co-operation.

A Square Deal Essential.

I do not care how strongly a shop is unionized, no union can consistently object to or prevent either standard time or efficiency statements of employees, provided the intention is a "square deal." They can and do object to a time study of their jobs or to particular forms of bonus. As both of these matters are capable of being met in many different ways the objections accomplish nothing. The main thing for the employer to know is the exact measure of the men and the efficiency of results. The particular method of encouraging efficiency and eliminating the unfit is a question to be handled according to local conditions. It may be encouraging to know that when the square deal was kept in view the handling of the men has always been the easiest part of the problem. Certain men by character and disposition are normally 100 per cent., others normally 110 per cent.

No schedules average correctly which pull down a 110 per cent. man below this figure; no schedules are correct which give a 110 per cent. man an efficiency of 125 per cent. Schedules are tabulated and followed just as closely as men. Schedules that prove uniformly too high on a good man are reinvestigated, and, if necessary, corrected. Schedules that prove uniformly too low on a 100 per cent. man are also investigated and bad conditions are either eliminated so that the schedule comes up, or after full investigation if neither men nor conditions are at fault, it is raised.

The higher a man's efficiency, the lower the cost of his output. If a man falls in efficiency, up goes cost; if a man increases in efficiency, down goes cost and up goes pay, so that any man who is not treated fairly can drop his efficiency and punish his employer. Even if he drops to 90 per cent. he may still be a very good man, but the loss to the firm is severe.

This system applied to a shop of about 1,000 men brought the average efficiency of the shop as a whole up from 60 per cent. to 101 per cent., increased output 67 per cent. and lowered direct labor and overhead costs 36 per cent., although the pay of the men increased an average of 20 per cent.

Advances in Machine Shop Practice

Short Synopsis of Papers and Discussion at the Shop Session of the Annual Meeting of A.S.M.E., Showing Some Radical Advances in Machine Shop Practice.

At the session of the annual meeting of the American Society of Mechanical Engineers, New York, December 1 to 4, devoted to machine shop practice, some papers were presented which showed that some radical changes were being brought about in machine shop practice. Not since the presentation of Mr. Fred. W. Taylor's paper on "The Art of Cutting Metals," some years ago, has there been so many interesting shop experiments and experiences presented to the Society. Many of the most important problems confronting machine designers and shop men came up for discussion, including the much discussed question of the lubricating or cooling of cutting tools and the best form of involute gear tooth. A short synopsis of each paper is given below, together with the important discussion:

Design of Milling Machines and Cutters.

"Efficiency Tests of Milling Machines and Milling Cutters" was a paper by A. L. De Leeuw, Cincinnati Milling Machine Co., Cincinnati, O. This paper points out the desirability of indicating the power of a machine tool by the amount of metal which it is capable of removing rather than by the size of driving pulley and belt. It describes some tests made for the purpose of ascertaining the metal removed and the capacity of several makes and sizes of milling machines. It also shows the results of tests made for the purpose of finding the net horse power required to remove a given amount of metal under various conditions of feed and speed. It further gives the results of tests determining mechanical efficiency of the feed mechanisms of various milling machines, and shows why it is important that this efficiency should be made higher than is usual. It describes the tests determining the mechanical efficiency of the driving mechanism of one make of machine. It further gives results of tests showing that improvements in cutters, more than improvements in machines, may ultimately reduce very materially the power required for removing metal on a milling machine.

In a future issue of the Machinery Edition of The Canadian Manufacturer, will appear a fully illustrated abstract of this paper.

Experiments with Milling Cutters.

"Development of the High Speed Milling Cutter, with Inserted Blades, for High Power Milling Machines" was a paper presented by Wilfred Lewis and Wm. H. Taylor, both of the Tabor Mfg. Co., Philadelphia. This paper told of the development of this high speed milling cutter, and some of the remarkable cuttings made with it were distributed among those present in the convention hall.

The main point in this milling cutter is the use of inserted helical blades of high speed steel, mounted in a steel holder to give a solid backing for the blades on the driving side, against which they are held by a soft metal filler on the opposite side, thus giving a uniform support for the cutter blade on both sides from end to end.

Another point is the form of groove adopted to give a slight curvature to the blade across its width, and thus favor the realization of a lip angle from the cutting side. Not only are the blades held more securely in position by the method adopted, but they are also more easily removed when damaged, and new blades can be easily inserted.

The cutting power of a milling cutter built up in this way appears to be beyond the capacity of any machine now on the market, and the endurance of the cutters, as far as experiments have been made, is phenomenal.

At a later date an illustrated abstract of this paper will be published in The Machinery Edition.

Lubricating or Cooling Cutters?

The discussion on this paper led to the introduction of the question of lubricants for cutters, and Fred. W. Taylor claimed that the best lubricant for cutters was cold water, with sufficient soda or oil in it to prevent rusting of the machines. His reason for making this claim was that the high pressure with which the cutting edge was held against the work in heavy milling operations there was no possibility of the liquid being carried between the cutting edge of the tool and the material, the natural inference being that the work of the lubricant is the cooling of the cutter, and water is the best cooling agent. Other speakers disagreed with him on this point and referred to the well known fact that cutting tools supplied with lard oil, soda water or other lubricants produce a smoothly finished surface where with the tool operated dry a rough surface is left on the work; the difference in the character of the surface being undoubtedly due to the effect of the liquid as a lubricant rather than as a cooling medium alone. Reference was also made by one speaker to the practice in drawing tubing where with the heavy pressures required in passing through the dies the lubricant used is an important factor in the production of satisfactory work. He stated that the results varied with the nature of the lubricating material and that if a lubricant could be made to follow metal passing through dies under the heavy pressure necessary for this kind of work it would seem reasonable to expect it could be carried by the edge of a cutting tooth into a piece being milled.

Oberlin Smith, in discussing the cooling of tools mentioned some interesting experiments conducted by him several years ago with liquid air as a cooling medium. The results then obtained indicated that very high cutting speeds were possible with ordinary steels when cooled in this manner, but the problem of supplying the liquid air to the tool involved too expensive an equipment to warrant the adoption of this method of cooling tools in general shop operations.

A Tool to Cut Without Clearance.

The paper "Metal Cutting Tools Without Clearance," by James Hartness of Jones & Lamson Machine Co., Springfield, Vt., described a turning tool he had devised which cuts without clearance. This paper is published in full in this issue.

Effect of Varying Pressure Angle and Addendum in Involute Gearing.

A very interesting paper was that of Ralph E. Flanders, New York, on "Interchangeable Involute Gear Tooth Systems," which gives diagrams showing the effect of varying the pressure angle and addendum on the various practical qualities of gearing, such as interference, number of teeth in continuous action, side pressure on bearings, strength efficiency, durability, smoothness of action, permanency of form. After comparing typical examples of interchangeable gear systems in these particulars, the author advocated that a new standard for heavy, slow speed gearing was advisable. In this connection it would be interesting to read the article which appeared in The Machinery Edition of The Canadian Manufacturer for October, on the advisability of shortening the addendum and increasing the pressure angle.

There was considerable discussion on this paper, L. D. Burlingame suggesting that the determination of the tooth forms best suited to the needs of the various classes of gears users had best be left to the cutter makers. But other speakers highly commended the paper, and upon the motion of Wilfred Lewis, the council of the Society was asked to appoint a committee to investigate the question and recommend a system of interchangeable involute gearing.

Spur Gearing on Railway Motors.

The last shop practice paper was that by Norman Litchfield, New York, on Spur Gearing on Heavy Railway Motor Equipments. This paper deals with the breakage of gearing in heavy electric railway service; and a resume is given of the methods employed to overcome the breakage, and the strains in the teeth as calculated by the Lewis formula are shown. Attention is called to the fact that this formula is not entirely applicable on account of the difficulty in maintaining alignment of gear and pinion.

SEARCH FOR THE WORK FOR WHICH YOU ARE BEST FITTED.

While it is often desirable, and sometimes necessary, to take the first work which opportunity offers, it should be the settled ambition of every worker in the field of business to secure that particular class of work in which most interest can be taken, and in connection with which the best work can be done, as in this direction only can actual success ordinarily be expected.

A woman holding an excellent position in the business world, once said: "I would be willing to pay for the privilege of doing the work in which I am engaged if I could get the work in no other way."—Book-Keeper.

RAILWAY AND LOCOMOTIVE SHOP

Department Devoted to Matters of Particular Interest to Master Mechanics, General Foremen and Expert Mechanical Men in Locomotive and Car Shops and Railway Repair Shops.

Forced Lubrication for Axle Boxes

Paper Presented to the Institution of Mechanical Engineers, England, July 1908.

By T. H. Riches and B. Reynolds.

This article describes a system of forced lubrication as arranged for the driving axle-boxes of some of the steam cars of the Taff Vale Railway Co. Before entering into a detailed description of the system used, it will perhaps be advisable to give a few of the more necessary particulars concerning these cars.

The engine is carried on a four-wheeled truck of 9 feet 6 inches wheel base and 2 feet 10 inches diameter wheels, the boiler of double-ended locomotive type, lying transversely across the frame) being placed immediately over the centre of the leading or driving-axle. The front end of the coach is supported by means of a bogie centre, carried between the frames at a distance of 4 feet from the trailing axle, or 5 feet 6 inches from the leading axle. When the car is loaded with its full complement of passengers, the weight on the driving axle is 15 tons 13 hundred-weight, the weight at the rail being 17 tons 6 hundredweight. The journals are 6 inches diameter by 9½ inches length; therefore, the pressure, taking two-thirds of the projected area of the brass as bearing area, is 466 pounds per square inch, the number of the revolutions of the journal, at a speed of 30 miles per hour, being practically 300. With this pressure and high rubbing velocity an undue amount of oil was being used with the ordinary method of lubrication, while cases of the bearings running hot were not infrequent, therefore, the following arrangement for lubricating the journals under pressure was adopted.

To a cross-stay in front of the driving-axle, Fig. 1, a small gun-metal tank of rectangular section, Fig. 2 is fixed. On the side of this tank, nearer the driving-axle and in connection with the tank, two small rotary pumps—right and left-handed—are fitted, the one for forward running and the other for backward running. These pumps are driven directly from the driving axle by means of a belt passing over a flanged pulley carried midway between the pumps, the pulley containing on each side of it a roller-clutch, somewhat similar to a free-wheel arrangement, fixed to the driving spindle of the pumps. By these means, the one belt drives either pump forward or backward, the other pump being free.

Following the process through, for the lubrication of one of the journals, when the car is in motion, oil is pumped from the tank and forced through a coiled copper pipe to the top of the axle box, Fig. 3. An oil channel, 8½ inches long, 9-16 inch deep, is cut in the crown of the box, leaving a margin of metal at each side of the channel of ⅜ inch flat, which is found, when the box is properly bedded to the journal, to be quite sufficient to insure that it shall be perfectly oil-tight at the pressures attained.

After passing round the journal, the return oil is collected in the axle box keep, and from there is brought back to the tank by means of a flexible pipe which allows for the rise and fall of the axle box, care being taken that the reservoir into which the oil is returned is sufficiently below the keep to drain it. At each side of the axle box keep a half ring is fitted with bearing area about ⅜ inch wide. These half-rings are bedded well to the axles, and are supported upon a couple of small coil springs which hold the rings up to the journal with a fair pressure, and so prevent the escape of oil along the journal on the bottom side. The supply tank is so arranged that the return oil, after draining from the keep into it, shall pass through a filter before being again sent through the pump. Such briefly is a general description of the method adopted.

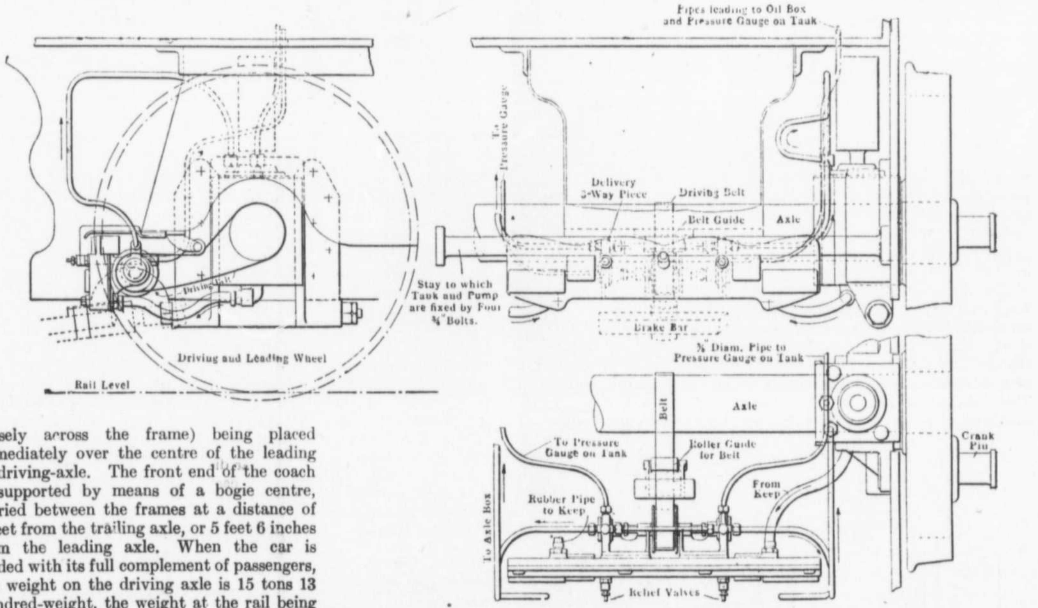


Fig. 1—A System of Forced Lubrication for an English Freight Car.

Many points arise, however, in regard to the working of the arrangement which it will be well to explain. In the first place, the pumps when running fast (at a speed of 30 miles per hour, the revolutions of the pump are 440 per minute) deal with a greater quantity of oil than can be accommodated in the circuit at a pressure of, say, 20 pounds per square inch, above which, in practice, it has not been found advisable to work. A relief valve is, therefore, fitted at each pump with an adjustable spring which enables the pressure at which each pump shall work to be regulated. The excess oil, when pumping, simply passes back into the tank again, through the relief valve against the pressure of the spring. A small pressure-gauge connected to each pump, and fixed in the driver's cab, shows the pressure of the oil pumped on both forward and backward running, while also acting as an indicator should failure of either pump occur at any time. Should this happen from any cause, the ordinary system of lubrication, by means of a lubricating box in the cab, is at hand. This lubricating box is also necessary to enable oil to be put into the axle boxes after the car has been standing for a day or two, and so avoid starting away with dry axle boxes.

To prevent the oil from the running pump flowing into the other pump and causing it to run backward, a small ball valve is placed in the three-way piece leading from each pump to the circuit. The movement of the axle boxes relatively to the tank and pumps was met in the first instance by trying different sorts flexible piping, but finally, ordinary coiled copper piping was adopted, both on account of its comparative durability and of its accessibility at any time.

The belt drive for the pumps at once gives a simple method of driving and one which allows for a small relative motion of the axle and pulley. It is apt, however, to soon become saturated with oil and then slipping occurs. An occasional application of one of the various belting mixtures, however, greatly reduces this slipping. When equal relief valve springs were put in, it was noticed that the pressure indicated for forward and backward running varied considerably, probably due to the difference in the slip of the belt in each case. The filters in the tank are removable, and are taken out and cleaned at the end of each day's work, the oil being first drawn off through the stop-plug, the thicker part of the oil, after straining, being then replaced by a small supply of fresh oil.

The foregoing description shows one method of dealing with an everyday problem in connection with the running of railway motor cars, or any rolling stock in which the pressure on the bearings, combined with the rubbing velocity, is excessive. The matter is one of importance to all concerned in the design and care of such stock.

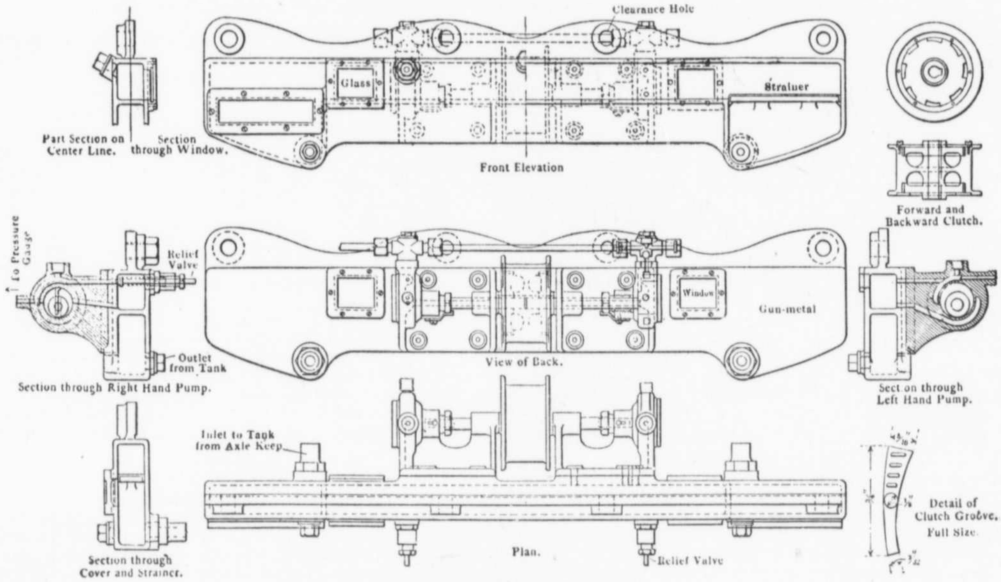


FIG. 2. THE OIL TANK AND PUMP

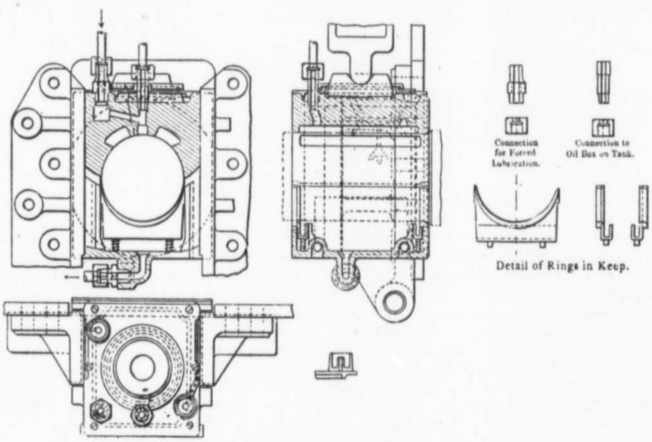


Fig. 3—Driving Axle Box and Keeps.

One Hundred Ton Electric Gantry Crane

The accompanying illustration will be of particular interest to railway men. It shows one of six 100-ton electric gantry cranes furnished the Great Northern Railway, St. Paul, Minn., by the Whiting Foundry Equipment Co., Harvey, Ill. The illustration shows the class of work for which the Great Northern Railway will use these cranes, namely for lifting and unwheeling locomotives; and they are specially adapted for this work. For the work which can be accomplished, this installation is quite inexpensive.

The dimensions and capacities of these cranes are as follows: capacity, 100 tons; one motor type; hand and electric power; span, 14 feet 6 inches; clearance inside of legs, 13 feet; height from top of rail to underside of girder, 20 feet; distance centre to centre of hook, 11 feet; lift, travel of hook, 14 feet 6 inches.

The load is hoisted by means of a steel wire hoisting rope, winding on hoisting drums. These drums are driven by a system of spur and worm gearing, operated by an electric motor.

The trucks consist of structural steel section, provided with bearings for the main axles, to which are fitted double flanged cast iron wheels. The hoisting gearing is supported on bridge girders by means of structural framing. The design of the drum insures equal distribution of load upon girders. The safety factor in the crane design is five.

The hoisting motor is comparatively small as only low speed is required. The motor is fitted with an improved automatic electric brake. This brake is operated by an electric solenoid in circuit with the hoisting motor and is so arranged that it will come automatically into action when the electric current is off the hoisting motor circuit.

All parts easily accessible for oiling and repairs.

Sandless Castings*

By John H. Shaw.

Casting in so-called chills is a method well known at the present time. Outside of the making of rolls and ingot moulds, we find the method used for making bedsteads, sash weights, and other simple castings where there is no difficulty from undue expansion and contraction. The troubles arising from an iron mould, and the lack of understanding the regulation of temperatures in casting into chills, have caused many a failure of an otherwise good idea.

The greater part of these objections have been overcome by the construction of a peculiarly arranged mould, as shown in Figures 1 and 2. The parts of the mould are so arranged that they automatically open out sufficiently to take care of the expansion due to heating without destroying the correctness of the castings made. The further manipulation of the moulds in filling them with molten iron depends upon a proper knowledge of the temperature they must be kept as to insure the best all around results.

Construction of the Mould.

The mould is constructed essentially in two parts. The outer shell which may be locked readily, and the inner dies in close contact with the shell, and securely fastened to it. The design of the mould is such that expansion in two directions may readily take place unhindered except for powerful springs. The arrangement of dies and shell allows of a ready replacement of the former when damaged, this depending upon the thickness of the mould and the temperature they are allowed to reach, their composition, of course being such that a high melting point is attained. Further attention is given to the moulds in designing them, so that they may be closed and opened very quickly, and thus rapid work accomplished.

Operating the Mould.

In operating a sandless mould, it is necessary to coat the metal in contact with the molten iron occasionally with a compound containing graphite and crude oil, or other refractory substance carried in a vehicle which in being driven off by heat will not ruin the surface of the casting.

In operating the mould, after spraying it, the first few castings are rejected, the intention being to heat up the mould, though in continuous work, this may be accomplished in a special heating furnace or oven if desired. All cores are set in the regular way before casting. The metal is poured in rapidly, and the mould opened as quickly as possible provided that the metal is set sufficiently that no bleeding takes place. The elastic condition of the mould, however, prevents trouble if this time is not kept properly and the casting allowed to remain in the mould too long, the disadvantage of such a procedure in allowing the mould to heat up too much is naturally evident. The casting is then taken out and piled up so that the whole mass may cool slowly, so that the chilling effect of too rapid cooling may not cause hard spots.

The moulds should not be allowed to get too hot, that is beyond 900 degrees Fahr., otherwise they are liable to expand permanently and cause trouble.

Coating the Dies.

It is only necessary to coat the dies every fifth pouring, more or less, the idea being to get a thin layer of the refractory material evenly spread over the face of the dies, which layer is properly kept up. Between this and a hot mould, and fairly soft iron, no undue chilling effect results in the casting beyond the very desirable closing up of the grain of the metal. In the case in point, the making of brake-shoes, every fifth cast requires a spraying of the mould.

Disadvantages.

In presenting a method to the foundry, it is always well to look at both sides of the problem. That is to show its advantages and disadvantages. Here are the latter.

The sandless mould is best adapted only to work of fairly large size, though practically everything can be made in this way if proper care is taken in the niceties of the construction and manipulation.

The heating of the mould consumes some time and uses metal which must be returned to the cupola, though this can be avoided by heating in the oven. Moulds are naturally expensive at first, and hence advisable only when a large number of castings are to be made of a kind.

The red hot castings, if small, where machinery is to be done, or special requirements are demanded, must be practically annealed, either in pile, or by an oven. The silicon of the metal also must be a little higher than for sand castings.

Advantages.

The advantages are as follows:

A limited number of moulds will make a large number of castings with very little labor, and this is not high class.

The surface of the castings being practically smooth, and accurate in dimensions, the loss of extra metal through excessive rapping of patterns in sand work is avoided, and no expensive cleaning department is required beyond some little grinding of thin fins.

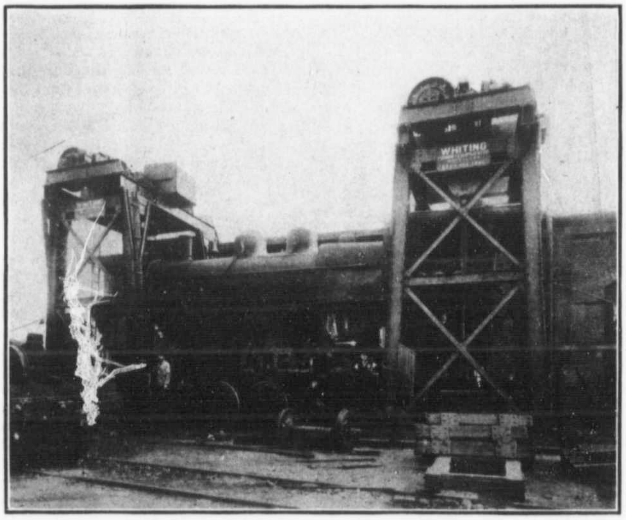
The life of the moulds is long, as may be seen in ingot moulds for brass, and iron bedsteads.

The foundry plant is very small for a heavy tonnage.

The process is adaptable for continuous melting and operating.

Interchangeability of the dies in the shell makes it easy to keep the moulds up to standard, and these dies being of cast iron are inexpensive.

The installation of an expensive power plant is eliminated, the only power required being electricity sufficient to run cupola blower.



One Hundred Ton Electric Gantry Crane.

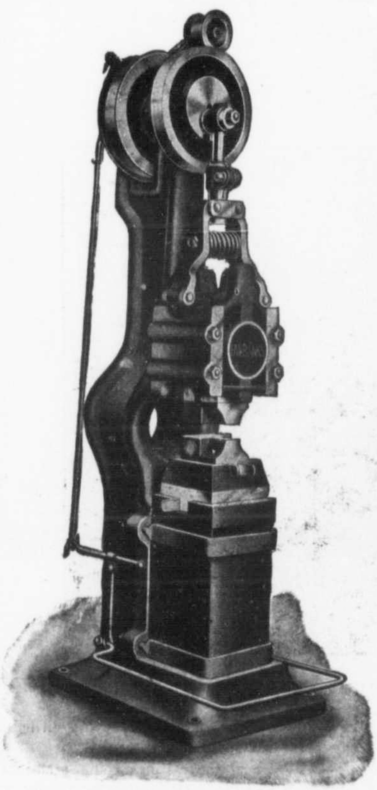
*Presented before the American Foundrymen's Association.

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.

A New Power Hammer

A new power hammer is being made by the Canadian Fairbanks Co., at their new plant at Sherbrooke, Que., the features of which can be seen in the accompanying



A New Power Hammer.

illustration. The features claimed for this hammer are: simplicity of construction; easy adjustment; economy of space; and great range of work.

No hammer made at the present time has fewer parts than this one. The solid head of frame in which the crank shaft runs precludes all possibility of cap bolts getting loose or shaft getting out of line.

The illustration shows the spring mechanism. This is regarded by the makers as a more practicable way of securing the elastic feature of a power hammer, than any arrangement of leather straps, rubber cushions, compressed air, leaf springs, or curved grooves, that has ever been invented.

All the working parts of the hammer are at the top, in full view of the operator, and every part is readily accessible, being easily operated by men of ordinary experience.

Stroke adjustment is accomplished by loosening one nut on wrist pin, and one bolt on cross head, and when at required places, again tightening.

The spring is adjusted at the factory for the correct blow, but one each 1 $\frac{1}{16}$ inch and $\frac{1}{8}$ inch washers are sent with each hammer, one or both of which may be inserted at the ends of the springs should it become necessary.

There is treble adjustment to accommodate the height desired by the operator.

There is die adjustment so as to bring the upper and lower forming dies to conform exactly to each other.

There is also special adjustments so that the hammer can be operated from the other side.

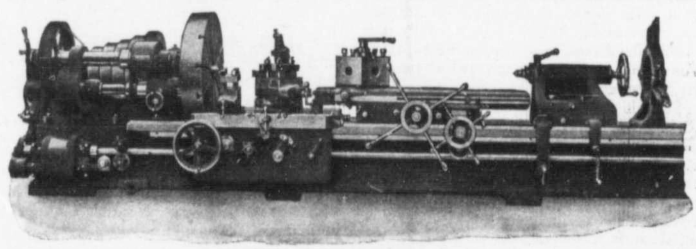
The economy of space is well shown in the illustration. The small amount of power required to run this hammer is an agreeable surprise to all who use it.

In the construction of this hammer all parts are of such proportion as to insure durability. The ram or hammer-head, links, sleeve and connection, are of steel castings, the crank, joint pins and side arms of forged steel; the castings for the other parts of a special formula to insure strength and durability, and every piece used is of iron or steel except the bronze bushing in the crank connection.

The Fairbanks' power hammer can be adapted to a great variety of work by providing special dies. With proper dies large quantities of forgings of uniform size and shape can be turned out, as for instance, carriage work, stone cutter's tools, edge tools, scythes, hatchets, shoe dies, welding gas tubes, etc. The dies always come squarely together in any size or thickness of work, so that parallel sides are insured when wanted.

Modern Heavy Pattern Lathe

The accompanying illustration is of a 36 inch heavy pattern triple geared lathe, with triple geared head and turret on shears, which the makers, the American Tool Works Co., Cincinnati, O., say is the largest lathe of this type with this equipment, that has ever gone out of Cincinnati, and is the finest tool in design and workmanship ever made by this company.



Modern Heavy Pattern Lathe.

The following description covers the features of the tool:

Rack gears are automatically disengaged when slipping pinion into internal gear and vice versa. Longitudinal feed of carriage is controlled by a friction, and the cross-feed by a saw-tooth clutch, operated from "Star" handle on the apron, which is "cam actuated." Rack pinion in apron can be withdrawn while thread cutting. Feed box, on front of machine beneath head stock, supplies three (3) instantaneous changes for feeding and screw cutting, for every change of gears on quadrant at head end of lathe. Gears are covered wherever possible, and all loose running gears are bronze bushed. Compound rest is fitted with "four stud" tool holder; with tool resting on a seriated steel base. Tool is clamped by the four nuts and two straps, which straps may be set in the opposite direction. Compound rest may also be fitted with double T slotted top-slide and equipped with regular tool posts set in tandem, which prevents slippage of the cutting tool, under heavy strains, and subsequent spoiling of the work.

The turret is of new design throughout, possessing many new and valuable features. It is equipped with this company's new "indexing mechanism," which is self-compensating for wear. This mechanism is located at the front of turret top-slide, which brings the locking-pin very near to the tool.

The turret can be tripped or revolved automatically or by hand; also, the mechanism can be set so as to be inoperative, when wishing to run the slide back to extreme limit, without withdrawing the locking-pin or revolving the turret. This is accomplished by the small lever shown near the large pilot wheel. The turret top-slide is supported on its outer end by a gibbed bracket attached to the front of the slide which travels along the V's of the bed and through its support eliminates all tendency to spring under a long reach. This feature is original with us. The bracket can be removed should the work require that the turret slide pass over the carriage of the lathe.

The bottom slide of turret is moved along the bed by the pilot wheel shown at rear end. It is clamped to bed by two eccentrics, one at the front and the other at the rear end. It is further secured from slipping, due to severe end-thrust, by a pawl, which, dropping from the turret, engages a ratchet toothed rack cast in the centre of the lathe bed.

Eight well selected feeds are supplied to the turret, ranging from .005 in. to .162 in., which are entirely independent of the regular carriage and apron feeds. Turret feeds are controlled by the two "star" knobs, carrying index dials, which are shown one directly above the other on the front of the bed near the feed box. The dials and pointers thereon, indicate at once the feed in inches as set, and all changes can be made while the lathe is running. The "star" knobs operate through shafts, extending through the bed to the quick-change turret-feed-box at the rear of head-stock, which is provided with a neat and substantial cover.

Provision is made on the compound rest slide to quickly attach the turret top-slide to same. This is very valuable when wishing to impart to the turret the feeds of the carriage, such as in large tapping operations. In such a case the taps get a "positive lead" since the screw cutting mechanism can be engaged in the apron and the proper lead thereby transmitted to the turret slide, carrying the tap. This feature relieves the tap of all "dragging at the start," and the "positive lead" prevents the reaming tendency of the tap on the hole at the start, which would spoil valuable work, if not provided for in this way. This feature is also of value in ordinary jobs of chasing internal threads with a turret tool.

Feeds of turret can be reversed, which is a valuable feature when wishing to "back face" or "counter-bore." Reversal of feeds is controlled by the lever, conveniently located on driving sprocket of quick-change turret-feed-box.

The taper attachment is of very heavy and substantial construction and is so designed as to eliminate all binding tendencies of the parts, thereby insuring smooth and uniform action. Is given a support on the bed and is supplied with a vernier attachment to facilitate very fine adjustment. Is graduated and the entire attachment is bolted to and travels with the carriage. May be quickly engaged or disengaged at will, without disturbing the taper as set.

A New Style of Chuck

The accompanying illustration is of a new style of chuck for monitor lathes and screw machines. This illustration shows the front view of a monitor lathe equipped with the chuck, air cylinder and power lever. The makers bring forward a number of features which are new in this chuck:

It can be operated by hand lever or air pressure. Should the air line fail, the hand lever can be used, thus obviating delays.

The jaws open and close parallel with each other.

The stops on the pull rod can be set to allow the jaws to open full, or not, as required.

No chips or dirt can get into or clog up the working parts of the chuck.

The jaws can be adjusted individually 3-16 of an inch to and from the centre so that if for any reason the castings or jaws should be out of true they can be set to perform the work satisfactorily

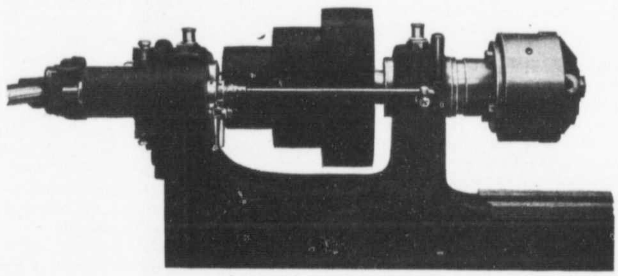
Pieces larger in diameter than the chuck can be gripped because the jaws are detachable and other jaws can be made, to fit any requirement.

The chuck can be furnished at a slight extra cost to take bar stock up to $\frac{7}{8}$ inch diameter.

This chuck is being marketed in Canada by the A. R. Williams Machinery Co., Toronto.

The Secretaryship of the Foundry Supply Association

H. M. Lane, who has been secretary of the Foundry Supply Association (connected with the American Foundrymen's Association) since its formation, recently tendered his resignation. Mr. Perkins, president of the Supply Association, has appointed C. E. Hoyt, of the Lewis Institute, Chicago, to complete the remainder of Mr. Lane's term. Mr. Hoyt is well known to the foundry supply trade, as he has been secretary of the Chicago Foundry Foremen's Association for several years and has conducted the exhibits of foundry equipment that have been held at the Lewis Institute for the past two years.



A New Style of Chuck.

Companies Incorporated

Ontario.

TORONTO.—Victoria Paper & Twine Co., Limited, have been incorporated with a capital of $80,000 to buy and sell paper, pulp, and wood. The provisional directors include C. F. Hubbs, W. H. Howe and C. S. Nicholls.

TORONTO.—Wettlaufer Lorrain Silver Mines, Limited, have been incorporated with a capital of $1,500,000 to carry on a mining, milling and reduction business. The provisional directors include G. G. Plaston, F. J. Dunbar and H. T. Smith.

TORONTO.—Silver Alliance Mines, Limited, have been incorporated with a capital of $1,000,000 to carry on a mining, milling and reduction business. The provisional directors include C. W. Kerr, C. C. Robinson and M. Gleeson.

OTTAWA. — Murphy-Gamble, Limited, have been incorporated with a capital of $350,000 to carry on business as dealers and manufacturers of all kinds of merchandise. The provisional directors include John Murphy, Samuel Gamble and T. H. Hammill, all of Ottawa.

Quebec.

MONTREAL.—Floor Planing & Surfacing Co. have been incorporated with a capital of $100,000 to manufacture, buy, sell and dea in all composite building materials. The provisional directors include T. B. Gould, J. W. MacDonald and K. McPherson, all of Montreal.

MONTREAL.—The Walker Fyshe Co., Limited, have been incorporated with a capital of $190,000 to carry on the business as engineers and contractors in all kinds of railway, canal, mining and other undertakings. The provisional directors include D. S. Walker, T. M. Fyshe and W. Sutherland all of Montreal.

QUEBEC.—The Ideal Biscuit Co., Limited, have been incorporated with a capital of $20,000 to manufacture and deal in flour, biscuits and confectionery. The provisional directors include F. J. Vermette, Odana Beland and W. A. Bertrand, all of Quebec.

MONTREAL.—The Nadeau Realty Mining and Milling Co., have been incorporated with a capital of $299,000 to carry on the business as real estate dealers. The provisional directors include Arthur Nadeau, Alfred Lacroix and Maurice Loranger, all of Montreal.

MONTREAL.—The Dougall Varnish Co., Limited, have been incorporated with a capital of $150,000 to carry on the business of wholesale and retail merchants of varnishes, oils, and paints. The provisional directors include J. H. Dougall, J. E. Coulin and G. Gylling.

WESTMOUNT.—The Sterling Press, Limited, have been incorporated with a capital of $20,000 to carry on business as printers, lithographers and engravers. The provisional directors include W. R. Shanks, F. G. Bush and S. C. Simpson.

SHERBROOKE.—Crown Scale Co., Limited, have been incorporated with a capital of $2,000 to carry on the business of manufacturers and dealers in scales. The provisional directors include J. C. Clark, C. H. Turner and C. H. Horton.

CHAMBLY CANTON.—Willetts, Limited, have been incorporated with a capital of $500,000 to carry on a general manufacturing and commercial business. The provisional directors include A. G. Alexander. W. Dick and A. Holden.

MONTREAL.—The government has promised $50,000 towards the new armory here.

FOUNDRY AND PATTERN SHOP

Department Devoted to Foundry Practice and Pattern Making: For Owners and Foundry and Pattern Shop Foremen.

The Purchase of Molding Machines

Pertinent Suggestions Which the Foundryman Should Consider When Selecting this Labor Saving Equipment.

By R. V. Notbur.

Sooner or later every foundry manager will be confronted with the question, "Is there anything in machine moulding for me?" The question may arise from two sources, a desire to reduce costs to increase profits, or the fact that competition forces cost reduction by making low prices. From the intense interest that centers around the exhibits of moulding machines at foundry exhibits it is perfectly clear that this is a burning question in the minds of thoughtful men who are determined to make every dollar they can out of their foundries.

In dealing with the subject there are many things to be considered. It must be settled beyond all doubt that the casting under consideration can be made by machinery. If it can be made, it must be determined that the saving in labor, increase in output and a larger quantity of perfect castings, will pay a sufficient return on the money invested in the machine and equipment. The rapid development of the moulding machine during the past five years has made it possible to produce moulds by machinery for almost all castings that are made in two part flasks.

Considering the Purchase of Moulding Machines.

In considering the production of a certain casting by machinery, if there is any doubt whatever about its being successfully made, the manufacturer of moulding machines should be consulted. Every responsible manufacturer of moulding machines understands that the reputation of his product depends upon the accuracy of his judgment on this point and his opinion should have great weight. Granting that a certain casting can be made on a moulding machine, the next question to decide is whether it will pay to make it in this way.

Economies of Machine Practice.

Every practical man will admit that a machine is more accurate in duplicating work than a human being. Take for example the process of drawing patterns from the mould. It is a fact that no two moulders exert the same energy in rapping a pattern by hand when it is being drawn from the mould. In other words, if two moulders are producing work from patterns that are exactly alike in every measurement there will be a variation in the size of the castings which they produce. With castings that are to be fitted, this is an important matter. A machine-made mould on the other hand is always the same size, granting that the machines are correctly operated. This is a very important advantage in favor of the machines and one that is often overlooked. In some cases the saving in the machining of castings made necessary by variation, will alone pay for the installation of the moulding machine. The writer knows of one case where a brass foundry saved 30,000 pounds of metal in overweights by the use of a moulding machine, on one job running for about a year.

Losses Reduced.

Theoretically, the mechanical making of moulds should remove the subject of discounts from consideration, but it is a fact that there are bound to be imperfect castings in a day's run of a moulding machine. It may be said truthfully, however, that these are caused more from careless handling of the completed moulds than from the failure of the machine to do its work. A searching examination into this one point shows that machine moulding reduces discounts to a point where the economy thus effected pays a liberal rate on the investment.

Coming to the actual output of the moulding machine on a certain casting, it must be frankly stated that it is very seldom that this can be exactly determined before the machine is operated in the foundry where it is to be used, but an estimate can be made by one experienced in machine moulding which will be accurate enough for all practical purposes.

Output.

The manufacturer of moulding machines is constantly in touch with results secured by this method of moulding and his experience should enable him to give anyone interested a conservatively estimated output of a certain casting made under average conditions. Of course, he cannot run the foundry where the machine is to be used nor select the machine operators, but he knows what his machine will do when properly used and should be given the credit of having wider practical knowledge of the subject than anyone else can have.

It is to his advantage to underestimate rather than overestimate the machine's output, because if he estimated the output at 25 moulds per hour and the user gets 30 moulds, the moulding machine manufacturer can always count on an enthusiastic user which, to the far sighted business man, is one of his best selling assets.

Attitude of the Manufacturer.

If one who is interested in this subject will approach the manufacturer in the spirit of co-operation rather than one of antagonism, the general use of moulding machines would be widely extended. The experience of the manufacturers of machines of this kind should certainly convince them that it would be poor judgment for them to deliberately make misstatements in order to sell their products, for they must realize that the increase in output is only one element in the advantage of machine moulding.

In writing this we are assuming that the party who is contemplating the purchase of a moulding machine is not acquainted by actual observation with the splendid results that are being obtained by their use. To his reproach it must be added that there is hardly a large foundry centre in the country that does not now have some plant producing moulds by machinery where the opportunity for personal investigation is very convenient.

Estimating the Saving Effected.

After the figures have been obtained on all of the points covered thus far, it is then necessary to determine whether the total saving will be large enough to warrant the capital invested in the machine. The most accurate and simple method is to keep a record of a journeyman moulder producing the casting under consideration; determine an average day's output of castings; the average number of imperfect castings that appear during the same space of time, and also keep a record of the machine work required to overcome castings that are made overweight. Compare this with the machine moulding results as estimated by the manufacturer of the machine or with actual results of users of machines in a corresponding line of work.

In considering the result of machine moulding it is safe to practically eliminate the item of variation in castings entirely and in calculating the discounts in machine moulding it is safe to place this below 5 per cent. of the total output. It is safe to say that such calculation will result in an enormous saving by machine moulding.

When the economy is calculated, the price of equipment should be considered and the percentage of return on the investment should be determined.

Pattern Expense.

There is one feature of machine moulding that has not been covered thus far and that is the saving in pattern expense. The majority of moulding machines now in use are equipped with pattern plates which are not subject to the damage that comes to gated patterns used with sand matches or follow-boards. This is an important detail.

It is astonishing that there are hundreds of foundries in this country to whom the expense of installing moulding machines is not a consideration, who have totally ignored the innovation that machine moulding has made in foundry economy. They are spending large sums of money in elaborate cost departments and have difficulty in understanding how their competitors produce competitive articles at such low prices. When it is considered that in many instances, moulding machines have effected savings amounting to as much at $10 per day on every machine in use, or $3,000 per year, the reason for their inactivity along this line becomes more perplexing.—The Foundry.

Saving Money in Operating Cupola*

Conditions of Operation, Coke and Moisture, Sulphur, Heat Units, Limestone, Lining, Blast Pressure, Mixing Irons, Action of Elements, Future of Iron and Steel Castings.

By W. E. Riepen.†

The operation of the cupola has become a question of dollars and sense of the keenest importance, and future operation must bow to the will of intelligent furnacemen, and must no longer hold the position of "man of mystery" it once held.

Cupola Mystery and History.

In years gone by it was customary to consider the cupola as a "mysterious thing," quite beyond the control of human beings. But those times have changed. Every year has marked an advance in the detail of cupola operations, until to-day we stand face to face with the scientific explanation of the once seemingly impossible.

Let us consider the practical side and ask what are the conditions necessary to successful operations. There are many kinds of iron that may be obtained from the cupola; some may be quite soft, others quite hard, and both be desirable. The soft iron may be made from a mixture of entirely different composition from the hard mixture, and between these two limits exist all the important irons obtained from the cupola.

Coke Conditions.

Coke, of course is the common fuel, and with a fairly good coke, which should run uniform as to composition and cellular structure, a good iron should be obtained.

What should be done, however, is to keep the coke dry. It is wrong to expect the cupola to work well and feed wet fuel into it. I will try to explain why wet fuel is detrimental. First, let us assume we wish a charge of 600 pound of coke per charge of iron. If, as is possible, especially in winter where the coke is exposed to the weather, it contains as high as 33⅓ per cent. moisture, for every charge of 600 pounds of wet coke weighed, 200 pounds is water and only 400 pounds is coke that is serviceable to produce heat. Of this amount of heat produced some is necessary to drive that very 200 pounds of water, put in with it, out of the cupola, so that the actual amount of heat available to melt iron is still lowered by that amount. It naturally follows that, if a reduction of one-third of the amount of coke required to melt iron at the proper temperature were made, the iron obtained would be too dull to pour.

Calculation of Moisture.

There is a way by which this evil of wet coke may be overcome, which is both simple and easy to carry out. To do this it is only necessary to determine the amount of moisture the coke contains and make proper adjustment of the scale weight of coke per charge, to be added. This determination of the moisture content is very easy and simple: first, weigh out say 10 pounds of the wet coke, put it in a hot oven or other warm place to dry. The loss in weight, as found by again weighing the coke (which of course is the dry coke), represents the amount of water that was present. It is only necessary then to add extra coke to make up for this difference so that when the coke descends in the cupola to the melting zone the requisite amount will be there to do the work intended for it.

This method has been tried at several plants and has been found highly satisfactory. Of paramount importance is the condition of the coke as it enters the cupola to form the bed before lighting up. This coke should, by all means, be thoroughly dried; in fact so important is this item that whatever expense is incurred in drying this bed coke is amply repaid by the good work it does.

Sulphur in Coke.

Another evil of the fuel is the ever-present sulphur. The amount of sulphur absorbed by the iron from the fuel is not at all constant. It is an established fact that all the sulphur in the coke does not go into the iron, although the amount absorbed by the iron may render it unsuitable for the work in hand. Only a chemical analysis will determine the amount of sulphur a fuel may contain and still be safe as a fuel.

Combustion and Coke Charges.

Assuming the coke is of average quality, the manner in which it is to be used will next claim our attention. We add fuel for the heat units it gives up on combustion. It is also added to support the burden and to maintain the proper melting points. To do this a careful watch of the melting conditions must be maintained. It is quite possible to spoil an otherwise good heat by the improper feeding of the fuel. It should always be carefully leveled off after each charge is in the cupola or slightly dished. By dished I mean it should be drawn toward the outer edge or against the lining, leaving a slight hollow in the centre. By charging in this manner more resistance is offered to the blast, which escapes more or less freely around this part of the furnace. It sometimes happens that the coke bed in the melting zone becomes uneven and it is at once necessary to rebuild it to the proper and uniform height This can be done most effectively by adding a few hundred pounds of extra coke over the weak spot when only half of the iron charge is in the cupola, then finish charging the balance of that iron charge and proceed as usual. The extra coke is added when one-half of the iron charge is in the cupola to insure its being placed and retained in the proper position in the cupola. In a short time, depending on the speed of melting, this extra coke will be down to the melting zone and will very materially rebuild that part of the bed.

It is very important, for economical reasons, that the melting proceed as even and regular as is possible, for the result of bad melting manifests itself throughout the entire plant and is the cause of otherwise valuable castings being thrown out on the scrap heap.

Use of Limestone.

To keep the furnace open and free for a long period of time, the dirt of the charges must be separated and removed from the iron. This is both easily and cheaply effected by adding a substance along with the charge that will unite with this foreign matter and become so fluid that it may be drawn from the cupola. The substance commonly employed is limestone, although other materials can be used. This limestone should be broken to about the size of eggs.

There are many different grades of limestone, and before a furnaceman can decide intelligently what is wanted he should obtain a complete chemical analysis of the particular kind he desires to use.

Burning the Shell.

The use of limestone, however, is not altogether without limit, for too much stone is as bad or worse than too little, The repeated large doses of limestone are apt to cause the cupola to burn through the shell. The writer remembers one experience of this character. He was working on a 100-inch cupola, lined to 81 inches at melting zone, melting 22 tons of iron per hour for several consecutive hours, when the report came up that the cupola had gone through the shell. It was necessary to act quickly, and this is what was done. About 16 or 18 lining brick were placed in the cupola on the top of the iron charge, over the place where the cupola had eaten its way through. These brick were allowed to descend along with the other charges. While they were descending, the hole (which was about 4 inches above the wind box) was stopped with mud and the outside cooled with a stream of water. When the brick reached this place they lodged in the depression of the lining, and were found there next morning, having performed the work intended for them. The heat was finished successfully, after taking the blast off for about 10 minutes only, while mud was being placed in the hole.

Character of Slag.

It is possible to completely change the character of the slag. If the mixture carries a large percentage of sulphur which requires let us say 100 pounds of stone to produce a low sulphur iron (the stone effecting the removal of some sulphur) and we drop the amount of stone to 40 or 50 pounds per charge, or even less, the iron will be changed from soft to hard or even white iron. I am speaking now of a heat of 10 or 12 hours' duration. For a heat of but an hour or so, little stone if any will be required, but for a heat of several hours or even days special precautions must be taken in order to keep the quality of the iron the same.

Lining the Cupola.

The best brick made from silica sand should be used for lining, and the patching material should be of the best. This material or mud should be mixed dry, for a more intimate mixture can be obtained in this way than when it is first wet and then mixed. Experience has proven that less fire-clay is necessary when handled this way than when mixed wet. After mixing it should be wet down and allowed to remain over night before using. In this way the plasticity of the clay is at its highest.

It is not uncommon to go into a cupola

* Abstract of paper read before Detroit Foundrymen's Association, Oct. 22, 1908.

† Detroit Testing Laboratory.

a short time after patching up and see the patching full of cracks where drying has set in. This allows an escape of heat from the melting zone and should not occur. It is very probable that the mud used for this patching was mixed or made up after first being wetted.

Cupola Dimensions.

The form of lining should be regular and should not have offsets in its contour. It should be kept to as near a standard form as is possible; this form to be determined by careful experimenting with each cupola as no two cupolas work exactly alike. As to the dimensions of a cupola, of course, the work to be done must be considered, but it is better to get a larger cupola and line it down to the size wanted than to try to force a smaller one.

Amount of Air and Coke.

For every pound of coke burned to complete combustion, 150 cubic feet of air is required, and in good practice one pound of coke will melt nine pounds of iron, so that to melt one pound of iron, 16 pounds of air will be necessary, or about 32,000 cubic feet per ton of iron melted. This air is heated by passing through the incandescent coke and carries that heat upward, heating the stack above the melting zone and finally passes out at the top of the stack. If the rate of driving be so fast as to drive more air into the cupola than is required to melt with, a larger loss of heat occurs. This extra amount of heat will be taken from the iron, where it belongs, and thus lower the temperature at which the iron is melted. Additional fuel in this case is of no benefit as the amount of fuel that can be used is limited to the dimensions of the cupola, so that to drive the blast faster than the cupola can take care of it results in a greater loss than would at first thought be considered possible.

Pressure of Blast.

The pressure should very seldom be higher than 18 ounces per square inch, and a lower blast is desirable, say 14 ounces or even 12 ounces. In order to determine the proper blast pressure for a given cupola, samples should be taken of the gases, about a foot below the charging doors, and a chemical analysis made. This sampling should be done while the cupola is running normally and should extend over two or three days' time.

When once the proper maximum pressure suitable for a given cupola is obtained, it should be a strict rule of the foundryman never to allow the pressure to exceed that amount. He thus not only secures more uniform iron but a more economical melting, in being able to utilize more heat than he otherwise could.

Economy in Melting.

On a heat of 100 tons per day, 3,200,000 cubic feet of air will be required. Should more than this amount be forced into the cupola it would only carry heat away. Let us say, for argument, that 1,600,000 cubic feet of air was forced into the furnace, over and above the amount actually required. Let us again say that the temperature at which the air leaves the charges at the charging doors is 325 degrees Fahr., and that the temperature of the blast entering cupola was 25 degrees Fahr. Then, reducing the excess air to pounds, multiplying by specific heat and dividing by 12,000 B.t.u. (average available heat units from one pound of foundry coke) we find it takes 760 pounds of dry coke to supply the heat carried away by this excess blast. In other words, forcing an excess of 600,000 cubic feet of air per day carries away the heat liberated by 760 pounds of coke. Extending this for a year of 300 working days, we have an enormous total of 228,000 pounds of wasted fuel, enough to melt 1,026 tons of iron. This is perhaps more than actually occurs in practice, but has purposely been made large in order to show how big an item of waste heat might result.

To avoid this useless expenditure a careful comparison of working conditions, day by day, should be kept, and it is a most excellent plan to plot these different conditions on cross-section paper. In that way a very ready observation may be made and ofttimes shows the furnacemen conditions existing that would have gone by unnoticed.

Making Up Mixtures.

One of the most, if not the most, important question that bothers a cupola manager is that of the mixture. It is necessary to obtain a mixture that will produce the castings desired, and in the attempt to meet competition as to quality foundrymen generally use a large percentage of pig iron in their mixture. Some managers go so far as not to allow the use of their own scrap, while others may be more lenient and permit a small percentage of their own scrap in the charge. As to the use of pig iron there can be no question, but it is not necessary to confine oneself to pig iron exclusively. In fact some mixtures are much better without a large amount of pig iron present. At one of the largest foundries in the country, making a high-class article, it is seldom that the pig iron is allowed to reach as high as 25 per cent. of the total charge, yet their product withstands shocks and strains that few castings are called upon to endure. The balance of that mixture is made up of scrap.

Saving by Chemical Analysis.

When once the theory of mixing irons is understood it is not hard to obtain a casting fully representative of the estimated analysis. Permit me to say here that by the use of chemical analysis many seemingly impossible things are brought about. So great is the standing of the chemical laboratory among the foremost foundries that it would be useless to try to dissuade them from its benefits. In no other way can so uniform a quality of iron be produced, and when once the foundryman decides to employ the information unfolded by a careful analysis he seldom goes back to the old way of "hit and miss."

At one foundry, making car-wheels, a saving of $80,000 per year was made. This was effected by carefully watching the market prices of material and employing a chemist to calculate the mixtures according to these market prices. If one kind of scrap increased in price, the amount used per charge was decreased and the kind of scrap which was less in price substituted. This substitution was immediately followed by a chemical analysis of the castings, and any variations noted in the mixture could be quickly corrected.

Composition of Mixture.

Now as to the composition of the mixture and how obtained. First it will be well to review the elements commonly occurring in cast iron. These are the carbons (hardening and graphitic), silicon, sulphur, manganese and phosphorus. The carbons are controlled largely by the silicon; sulphur effects the silicon by neutralizing its effect on the carbons; manganese is antagonistic to the action of sulphur and may even go so far as to eliminate a large portion of it; phosphorous is there by right of way and resists all efforts at elimination. As to the desirable amount of each of these elements only individual castings will determine, yet there is a limit, both maximum and minimum, which should be regarded. For instance, silicon should be present to some extent in order that the carbons may become separated. In chilled castings, for frictional wear, sulphur should be fairly high in order to produce a very hard wearing surface. For car-wheel work, sulphur may be as high as 180 per cent. and not be detrimental, but for soft work the sulphur should be kept below 100 per cent. This low sulphur permits the silicon to separate the carbons, or strictly speaking allows more hardening carbon to change to graphitic form, which might as well be called softening carbon. Each of these elements has an effect on the shrinkage of the castings.

The Elements and Shrinkage.

I have prepared a chart which shows the effect on shrinkage of the different elements. One striking peculiarity revealed by this chart is the fact of the great influence of combined carbon on shrinkage. In no other element do we find so great a power over shrinkage. Increasing this combined carbon increases shrinkage; manganese reduces it, as does silicon. Sulphur also increases it, but may be controlled somewhat by manganese. Without going any farther into the effects of the elements on the physical qualities of the metal I would say that to be able to produce good castings an understanding of these effects should be obtained. It is by this means that the status of gray iron may reach the high standard that its brother, cast steel, has attained. There are no less possibilities for gray iron than for steel, but it will require the united efforts of intelligent men to raise the standard of cast-iron castings to a point approaching the quality of steel castings.

Careful operations of detail work in and around the cupola will very greatly tend to a more uniform product, and the time will not be far distant when the cupola will force the steel castings to find new pastures, and the thanks of it all will be to those foundry men whose hearts have been in the work and who are not satisfied with less than the best.

Building News

Alberta.

DIDSBURY.—A by-law will be prepared calling for a debenture of $2,000 or $2,500 to erect a suitable building to contain a small fire hall, council chamber, lock-up, reading room and library.

CALGARY.—A permit has been issued to H. Thompkins for the erection of a three story business block.

New Brunswick.

ANDOVER.—The general store of J. E. Porter & Sons here, together with the adjoining store, have been completely destroyed by fire.

CAPTAINS OF INDUSTRY

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

BUILDING NEWS.

Ontario.

ST. CATHARINES.—The large two story warehouse of the Welland Vale Mfg. Co., with its contents, was destroyed by first last week, at a loss of $50.000

KEEWATIN.—The Bay City Hotel and Messrs. Allen Bros.' bakeshop here have been destroyed by fire.

BERLIN.—The two wings of St. Jerome's College here, which were recently destroyed by fire, will be rebuilt in the spring.

WINDSOR.—The Lufkin Rule Co., here, have decided to erect a large addition to their building next spring.

ST. THOMAS—A by-law will be submitted to the ratepayers of St. Thomas in January next for the purpose of authorizing the erection of septic tanks for the city sewer.

NEW LISKEARD.—The Local Library Board is making application to Andrew Carnegie for the erection of a library building at a cost of $3,000.

LISTOWEL.—The ratepayers have approved a by-law granting a loan of $25,000 to the Morris Piano Co., for the rebuilding of their factory.

LONDON.—A by-law to raise $6,000 by debentures will be submitted to the ratepayers on January 4 for the erection and equipment of public swimming baths in this city.

OTTAWA.—The Fire & Light Committee will ask the Board of Control to build a new fire station in New Edinburgh next season.

STRATFORD.—The Collegiate Board are in favor of building an addition to the present school at an estimated cost of about $15,000. The matter will be presented to the new city council early next year.

TORONTO.—A new stone and brick church will be erected by the congregation of Christ's church.

TORONTO.—A permit has been issued for additions to the Howard Park Avenue school to cost $13,988.

TORONTO.—G. Henderson has obtained a permit to build a two story brick veneer public hall on Essex Street at a cost of $3,600.

TORONTO.—A three story brick store will be erected on the corner of Albany and Bloor Streets by P. L. Slayer.

TORONTO.—A permit has been granted to T. N. Miller for a three story brick store and dwelling on Wilton Avenue at a cost of $6,500.

ST. CATHARINES.—The city council on December 15 appropriated a grant of $1,000 for the inauguration of a local sanitarium for consumptives, and Mayor Campbell has been authorized to forward the necessary provisional by-law to the Provincial Secretary for approval.

ST. CATHARINES.—The building formerly occupied by the Woodburn Sarnen Wheel Co., has recently been destroyed by fire.

Quebec.

MONTREAL.—Rodolphe Forget, M.P., honorary colonel of the 65th French-Canadian Regiment, has subscribed $5,000 towards the erection of the new armory which will cost $100,000.

VERDUN.—The Protestant Hospital for the insane has been damaged by fire to the extent of $30,000.

MONTREAL.—Alex. MacKay, Oldfield Avenue, Montreal, has taken out a permit for the erection of an apartment house at a cost of $12,000. J. S. Smith is the architect.

MONTREAL.—The Dufferin School, St. Urbain Street, here has been damaged by fire to the extent of $2,000.

QUEBEC.—The Roman Catholic parish church at St. Ambrose, Indian Lorette, near here, has been destroyed by fire. The loss is estimated at $100,000.

MONTREAL.—Three electric cars were destroyed by fire at the car barns of the Montreal Street Railway Co. on the night of the 10th inst.

MONTREAL.—The large jewellery establishment of Henry Birks & Sons, Phillips Square, was damaged by fire. Loss about $200,000.

MONTREAL.—La Banque Nationale have purchased from the Judah Estate the property at the rear of their offices on St. James Street facing on Fortification Lane and Place d'Armes Hill, for $40,000, and will erect a new building thereon next spring.

Saskatchewan.

WAINWRIGHT.—Plans have been prepared by E. Stimpson for a two story addition to the Wainwright hotel here.

SASKATOON.—D. W. Beaubier, owner of the Empire Hotel here, will build an extensive addition to be of red brick construction next year.

SASKATOON.—The Bank of Montreal will erect a new building here in the spring.

KELLIHER.—Mr. C. H. Prest, Kelliher, will at once rebuild his hardware store which was recently destroyed by fire.

CARLYLE.—The Farmers' elevator here has been completely destroyed by fire.

Manitoba.

GLENBORO.—The Northern elevator here has recently been destroyed by fire.

WINNIPEG.—The Burrows block at the corner of Main Street and Burrows Avenue, has been practically destroyed by fire. Loss is estimated at $20,000.

WINNIPEG.—The Molsons Bank Building has been damaged by fire to the extent of $20,000.

WINNIPEG.—The T. Eaton Co., Winnipeg, will erect a warehouse at the corner of Hargrave and Graham Avenue.

BRANDON.—The Canadian Northern Railway will in the near future commence the erection of the proposed new depot and freight sheds. The estimated cost of the depot is $45,000.

British Columbia.

NANAIMO.—The Imperial Laundry Co. are considering the erection of a solid concrete building. Plans are being drawn by Mr. A. W. Bowman, architect, for the Western Fuel Co.

VANCOUVER.—Plans have been submitted by the medical health officer for the proposed new isolation hospital at a cost of about $55,000.

WATERWORKS, SEWERS, SIDEWALKS.

Ontario.

WALLACEBURG. — The town council is contemplating the installation of a waterworks system here. It is estimated that the cost would be about $90,000.

PEMBROKE.—The council may submit a by-law to the electors to either install a new intake pipe at a cost of $50,000 or to have slow filtering sand at a cost of $90,000.

Quebec.

MONTREAL.—Tenders for sewer construction will be received until December 11, by John R. Barlow, city surveyor.

STRATFORD.—Sewers will be constructed along several streets in this city in the near future.

Saskatchewan.

ASQUITH.—A by-law will be submitted to the ratepayers here for the purpose of authorizing the raising of the sum of $16,000 by debentures for local improvements.

YORKTON.—The ratepayers have endorsed a by-law providing for the raising of $17,000 for additional waterworks connections.

MILL AND FACTORY EQUIPMENT.

Ontario.

WELLAND.—A large factory will be erected here for the manufacturing of farm implements by the Dane Mfg. Co., of Ottumwa, Iowa. The estimated cost of the plant is $250,000.

TORONTO.—The Toronto Plaster & Supply Co.'s factory, Florence Street, has recently been destroyed by fire. Loss, $2,100.

TORONTO.—A permit has been taken out by M. P. Warren, 90 York Street, for the erection of a two story brick factory at 782 King Street, at a cost of $5,000. H. R. Barbor is the architect.

WINDSOR.—The Heely Mfg. Co. have decided to erect a new building here.

Quebec.

LIMOILOU.—It is stated that the Canadian Northern Railway will build their new shops here at a cost of $250,000.

HULL.—A large sawmill will be erected here in the spring by the McMaster Lumber Co., of Kemptville, Ont.

British Columbia.

VANCOUVER.—The Royal City mills will be rebuilt at once. Plans have already been prepared.

BRIDGES AND STRUCTURAL STEEL.

Ontario.

PETERBORO.—Plans have been prepared for a new bridge to span the Otonabee River, at Smith Street. The estimated cost is $49,000.

STRATFORD.—Plans have been prepared for the erection of a new concrete railroad bridge on the Owen Sound line near the waterworks here. The bridge will be constructed next year.

Manitoba.

WINNIPEG.—The ratepayers have voted on a by-law to raise $400,000 to replace the Louise bridge, enlarge the Main Street bridge and construct a new bridge across the Canadian Pacific Railway yards at Brown and Brant Streets.

POWER PLANT OPPORTUNITIES.

Ontario.

BARRIE.—The ratepayers will vote on January 4 on a by-law to issue $12,000 4½ per cent. 20 year debentures for electric light purposes. C. Donnell is town clerk.

PORT ARTHUR.—The city council are said to be purchasing a new 4,000 light generator.

TRADE NOTES.

Ontario.

TORONTO.—The Smart-Turner Machine Co., Limited, Hamilton, have supplied the Robt. Simpson Co., Toronto, with a pair of their duplex outside packed plunger pumps, with pot valves.

GOLD ROCK.—The Imperial Gold Mining Co. have installed a steam-driven Ingersoll-Sergeant air compressor.

Quebec.

STE. THERESE.—The plant of the Dominion Furniture Co. is being equipped with sprinkler system by the General Fire Extinguisher Co., Montreal.

VERDUN.—The contract for electric wiring for the new Muncipal Building has been awarded to the Sayer Electric Co., Montreal. Mr. Isaac Collins is the general contractor, and MacVicar & Heriot are the architects.

SHERBROOKE.—The General Fire Extinguisher Co., Montreal, are installing sprinkler systems for the Paton Mfg. Co., the Canadian Rand Co., and the E. & T. Fairbanks Co., of Canada, Limited.

The plant of the Anglo-Canadian Pulp & Paper Co., Newfoundland, is being equipped with sprinkler system by the General Fire Extinguisher Co., Montreal.

MONTREAL.—The Smart-Turner Machine Co., Limited, Hamilton, are supplying a compound duplex pumping engine to the Intercolonial Railway at Montreal.

The Ingersoll-Sargeant Co., of Canada, Limited, Montreal, have recently shipped a compound belt driven compressor to the Dominion Mining Co., Nova Scotia, and a straight line compressor to the Ponhook Gold Mining Co., Tangier, Halifax Co., N.S.

MONTREAL.—Contract for the iron strairs in the new Lyman building has been secured by Mr. F. A. McKay, 251 Elgin Avenue. Messrs. Mitchell & Creighton, Inglis Bldg., are the architects.

MONTREAL.—The new Bank of Commerce Building, St. James Street, is being floored with Terrano patent flooring by the Eadie-Douglas Co.

MONTREAL.—All the iron pipe of the old Grand Trunk offices, Point St. Charles, recently demolished, has been purchased by the Imperial Waste & Metal Co., 5-9 Queen Street, Montreal, who will resell it in large or small lots.

ST. LAMBERT.—The new pen factory of the L. E. Waterman Co., Limited, commenced operations last week.

MONTREAL.—The plant of the Lang Packing & Provision Co. is being floored with Doloment, by the Montreal Doloment Co., Mark Fisher Building.

Nova Scotia.

DARTMOUTH.—The Canadian Rubber Co. have obtained a contract from the town council for the supply of 500 feet of fire hose.

TRURO.—A sprinkler system is being installed for the Truro Knitting Co., by the General Fire Extinguisher Co., Montreal.

Manitoba.

WINNIPEG.—The waterworks department is installing an Ingersoll-Sergeant air compressor in the waterworks for pumping purposes. This is the fourth well equipped with these compressors by the city.

British Columbia.

NORTH VANCOUVER.—The Canadian Pipe Co., here, have obtained from the city a contract for 10,000 feet of 4 inch wire wound stave pipe to be used for distribution purposes.

Catalogues Worth Having

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

FRICTION CLUTCHES.—Catalogue G of the Hill Clutch Co., Cleveland, O., describing the two types of friction clutches now made by this firm. It has been the aim of the firm to make this catalogue a standard for all interested in friction clutches. Complete detail information has been accurately listed, including horse power capacities, space required on shaft, cost of extra parts, etc. This firm have in preparation a new edition of a general catalogue covering their complete line of power transmission machinery.

ROCK DRILLS.—A very attractive catalogue of Ingersoll-Sergeant of Canada, Limited, Montreal, showing their rock drills and mountings for mining, tunneling, quarrying and general rock excavation. The Sergeant Auxiliary valve drill is illustrated and described in detail, including all the parts. Detail information concerning the Sergeant "Universal" tripod and the quarry bar are also described in detail. The latter part of the catalogue is devoted to blacksmiths' tools and air compressors. This is a catalogue those interested should have on file.

Canadian Manufacturers Buyers' Guide

Advertisers are requested to keep us informed as to what they sell. A nominal rate of $1.00 per line is charged to non-advertisers.

Abrasive Materials.
The Canadian Fairbanks Co., Montreal.
Canadian Hart Wheels, Limited, Hamilton.
F. B. Stevens, Detroit, Mich.

Alloys.
Goldschmidt Thermit Co., Toronto.

Barrels Tumbling.
Northern Engineering Works, Detroit.
The Smart-Turner Machine Co., Hamilton.

Belt, Tighteners.
Dodge Mfg. Co., Toronto.

Belting, Leather.
Canadian Fairbanks Co., Montreal.
Sadler & Haworth, Montreal.

Bending Machinery.
John Bertram & Sons Co., Dundas.
E. W. Bliss Co., Brooklyn, N.Y.
A. B. Jardine & Co., Hespler, Ont.
London Machine Tool Co., Hamilton.

Blowers.
Hamilton Facing Mills Co., Hamilton

Bolt and Nut Machinery.
John Bertram & Sons Co., Dundas.
London Machine Tool Co., Hamilton.

Boring and Turning Mills.
John Bertram & Sons Co., Dundas.
London Machine Tool Co., Hamilton.

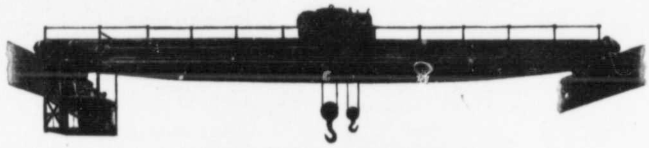
Brass Melting Furnaces.
Hamilton Facing Mill Co., Hamilton.

Brushes, Foundry.
Hamilton Facing Mill Co., Hamilton
F. B. Stevens, Detroit, Mich.

Bulldozers.
John Betram & Sons Co., Dundas.
London Machine Tool Co., Hamilton.

Burners, Core Oven.
Hamilton Facing Mill Co., Hamilton.

Canners' Machinery.
E. W. Bliss Co., Brooklyn, N.Y.
Brown Boggs Co., Hamilton.
Jeffrey Mfg. Co., Columbus, O.



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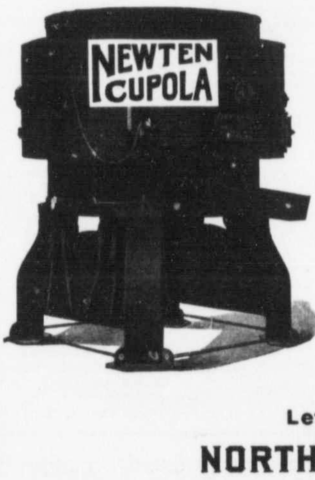

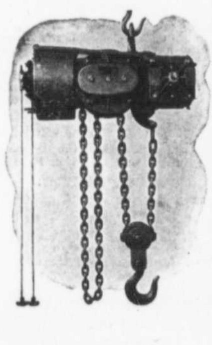

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Air Hoists	" 34
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Let us quote on your requirements

NORTHERN ENGINEERING WORKS,
DETROIT, MICH. U.S.A.

CRANES, CUPOLAS, OVERHEAD TRACKS, Etc.

Cars, Industrial.
Hammant Steel Car & Engineering Works, Hamilton.
Hamilton Facing Mill Co., Hamilton.

Castings, Brass.
Chadwick Bros., Hamilton.
Reid Foundry & Machine Co., Ingersoll.

Castings, Grey Iron.
Dodge Mfg. Co., Toronto.
Reid Foundry & Machine Co., Ingersoll.
Smart-Turner Machine Co., Hamilton.

Castings, Malleable.
McKinnon Dash & Metal Works Co., St. Catharines.
Smith's Falls Malleable Castings Co., Smith's Falls.

Castings, Semi-Steel.
Reid Foundry Machine Co., Ingersoll.

Centreing Machines.
John Bertram & Sons Co., Dundas.
London Machine Tool Co., Hamilton.

Charcoal.
Hamilton Facing Mill Co., Hamilton.
F. B. Stevens, Detroit, Mich.,

Chucks, Drill and Lathe.
John Bertram & Sons Co., Dundas.
London Machine Tool Co., Hamilton.

Conveyor Machinery.
Dodge Mfg. Co., Toronto.
Jeffrey Mfg. Co., Columbus, O.
Smart-Turner Machine Co., Hamilton.

Coping Machines.
John Bertram & Sons Co., Dundas.
London Machine Tool Co., Hamilton.

Corundum Wheels.
Canadian Hart Wheels Co., Hamilton.

Core Compounds.
Hamilton Facing Mill Co., Hamilton.
F. B. Stevens, Detroit.

Core-Making Machines.
Hamilton Facing Mill Co., Hamilton.
F. B. Stevens Co., Detroit.

Core Ovens.
Hamilton Facing Mill Co., Hamilton.
F. B. Stevens, Detroit.

Cranes
Hamilton Facing Mill Co., Hamilton.
Northern Engineering Works, Detroit.
Smart-Turner Machine Co., Hamilton.

Crucibles
Joseph Dixon Crucible Co., Jersey City, N. J.
Goldschmidt Thermit Co., Toronto.
Hamilton Facing Mill Co., Hamilton.
McCullough-Dalzell Crucible Co., Pittsburg, Pa.
F. B. Stevens, Detroit.

Cupolas.
Jules de Clercy, Montreal.
Hamilton Facing Mill Co., Hamilton.
Northern Engineering Works, Detroit.

Cupola Supplies.
Hamilton Facing Mill Co., Hamilton.
Northern Engineering Works, Detroit.
F. B. Stevens, Detroit.

Cutting-off Machines.
John Bertram & Sons Co., Dundas.
London Machine Tool Co., Hamilton.

Cutting-off Tools.
London Machine Tool Co., Hamilton.

Dies
W. H. Banfield & Son, Toronto.
E. W. Bliss Co., Brooklyn, N.Y.
A. B. Jardine & Co., Hespeler.

Draft, Mechanical.
W. H. Banfield & Sons, Toronto.
Butterfield & Co., Rock Island, Que.
A. B. Jardine & Co., Hespler.

Drawn Steel, Cold.
Canadian Drawn Steel Co., Hamilton.
Union Drawn Steel Co., Hamilton.

Drilling Machines.
John Bertram & Sons Co., Dundas.
The Canadian Fairbanks Co., Montreal
London Machine Tool Co., Hamilton.

Drills, Bench.
London Machine Tool Co., Hamilton.

Drills, Blacksmith.
A. B. Jardine & Co., Hespeler.
London Machine Tool Co., Hamilton.

Drills, Hand.
A. B. Jardine & Co., Hespeler.

Drills, Sensitive.
D. McKenzie, Guelph.

Drills, Twist.
Whitman & Barnes Mfg. Co., St. Catharines.

Dump Cars.
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Hammant Steel Car & Engine Works, Hamilton.
Jeffrey Mfg. Co., Columbus, O.
Arthur Koppel Co., New York.

Emery Wheels.
Canadian Hart Wheels, Limited, Hamilton.
Hamilton Facing Mill Co., Hamilton.
F. B. Stevens, Detroit, Mich.

Emery Stands.
D. McKenzie, Guelph.

Emery Wheel Dressers.
Canadian Hart Wheels, Limited, Hamilton.
Hamilton Facing Mill Co., Hamilton.

Excavating Machinery.
Jeffrey Mfg. Co., Columbus, O.

Fire Brick and Clay.
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Ontario Lime Association, Toronto.
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Canadian Billings & Spencer Co., Welland, Ont.
E. W. Bliss Co., Brooklyn, N.Y.

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Hamilton Steel & Iron Co., Hamilton.

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Northern Engineering Works, Detroit.
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Horsburgh & Scott Co., Cleveland.

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Hamilton Facing Mill Co., Hamilton.
International Acheson Graphite Co., Niagara Falls, N.Y.
F. B. Stevens, Detroit, Mich.

Grinders.
W. H. Banfield & Son, Toronto.
Canadian Hart Wheels Co., Hamilton.
D. McKenzie, Guelph.

Hack Saws.
The Canadian Fairbanks Co., Montreal.
D. McKenzie Co., Guelph.

Hammers, Drop.
W. H. Banfield & Son Co., Toronto.
E. W. Bliss Co., Brooklyn, N.Y.
London Machine Tool Co., Hamilton.

Hammers, Hand.
Whitman & Barnes Mfg. Co., St. Catharines.

Hammers, Steam.
John Bertram & Sons Co., Dundas.
London Machine Tool Co., Hamilton.

Hangers.
Dodge Mfg. Co., Toronto.
The Smart-Turner Machine Co., Hamilton.

Hoisting Machinery.
Dodge Mfg. Co., Toronto.
Jeffrey Mfg. Co., Columbus, O.
Northern Engineering Works, Detroit.
The Smart-Turner Machine Co., Hamilton.

Knives, Machine.
Peter Hay Knife Works, Galt.
Whitman & Barnes Mfg. Co., St. Catharines.

Ladles, Foundry.
Hamilton Facing Mill Co., Hamilton.
Northern Engineering Works, Detroit, Mich.
F. B. Stevens, Detroit, Mich.

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John Bertram & Sons Co., Dundas.
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London Machine Tool Co., Hamilton.
R. McDougall Co., Galt.

Lathes, Screw Cutting.
John Bertram & Sons Co., Dundas.
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Jones & Glassco, Montreal.

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Moulding Sand.
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Dodge Mfg. Co., Toronto.

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Sand, Moulding.
Hamilton Facing Mill Co., Hamilton
F. B. Stevens, Detroit, Mich.

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