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The CANADIAN MANUFACTURER

The following Editions are published each month:
"Power Edition," "Office Edition," "Machinery Edition," "Construction and Equipment Edition."

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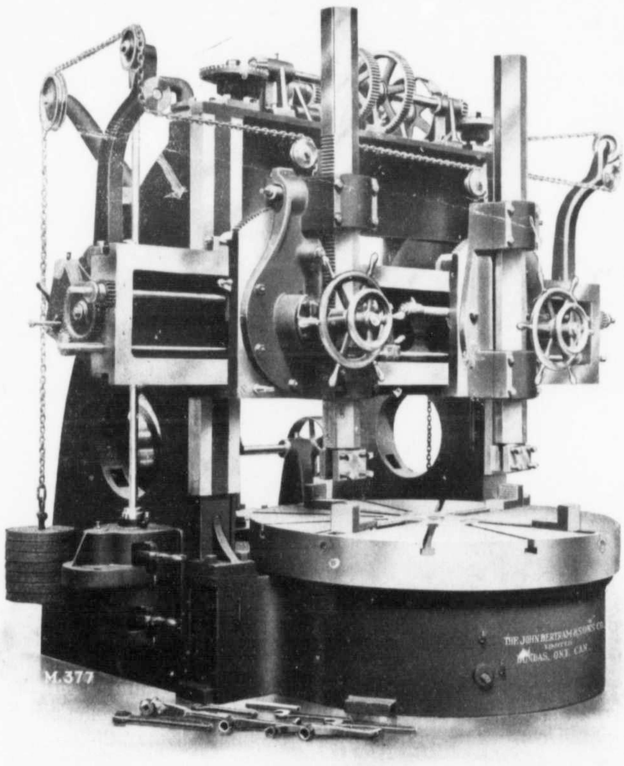
DEVOTED TO THE PROBLEMS AND NEEDS OF THE MACHINE SHOP, FOUNDRY AND PATTERN ROOM.

VOL. 57. No. 15. TORONTO, NOVEMBER 20, 1908. New Series—VOL. 1. No. 11.

BERTRAM BORING MILLS



72-Inch BERTRAM HEAVY BORING and TURNING MILL

The table has wide flat annular bearing near the circumference eliminating tendency to wedge under heavy cuts, or to lift table under side cuts. A lower step bearing, running in oil enables the table to be raised off the annular bearing when running at high speed. The heads, which are operated in all directions by power, are entirely independent in their movement both as to direction and amount of feed. Each bar has an independent counterweight. Bertram Mills are readily changed from belt to motor drive.

Our Boring Mill Catalogue will be sent to any address on request.

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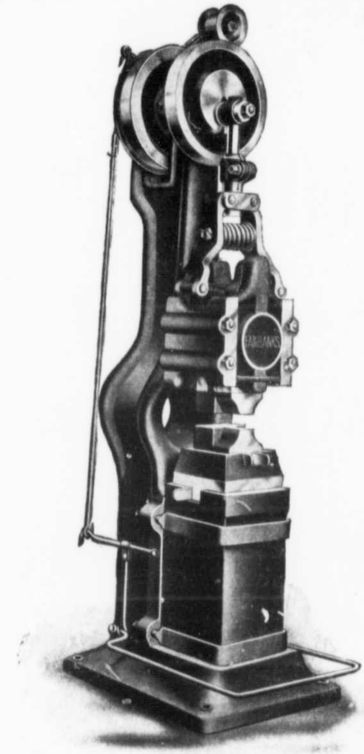
POWER HAMMERS



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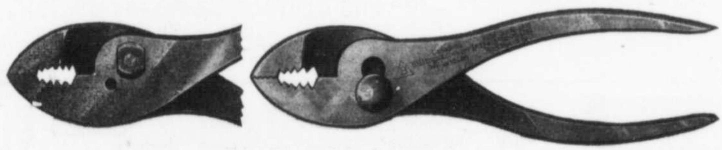

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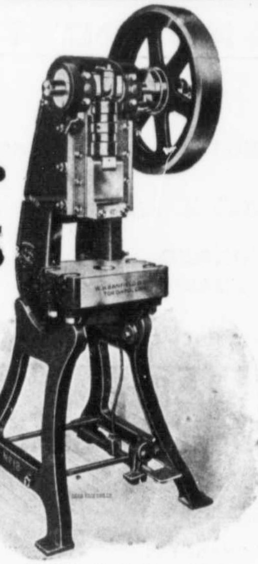

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The above cut represents our No. 18 Inclinable Power Press, with positive knockout in slide and treadle lock

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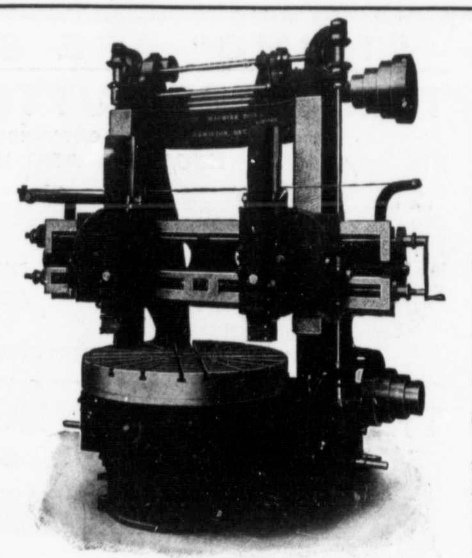

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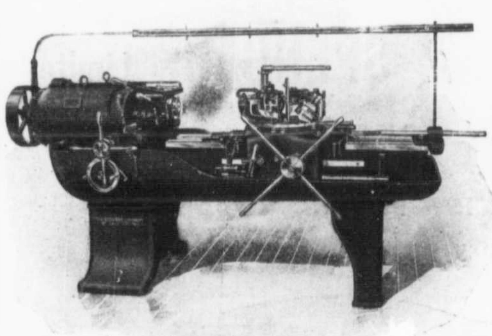

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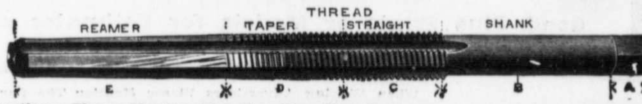
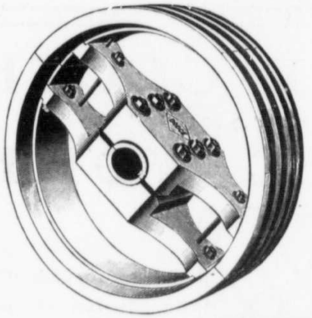


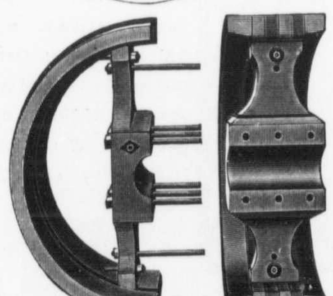
WHY

Dodge Pulleys

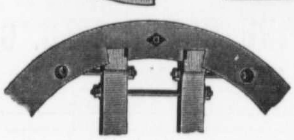
ARE BEST.



This superior appearance is the result of design, construction, principle, workmanship, selected materials and good finish, all of which go to make the **DODGE** Pulley the most popular wood pulley the world over.



This pulley in halves shows you something of our construction, and will give a mechanic an idea why the **DODGE** Pulley will hold on to the shaft better than any other pulley made.



This shows how Arms are dovetailed into rim and anchor bolted, making it an impossibility for rim to work loose on arm, and it still leaves face of pulley a perfect belt surface.

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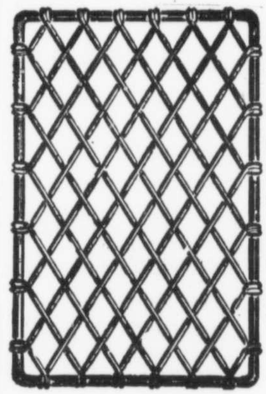

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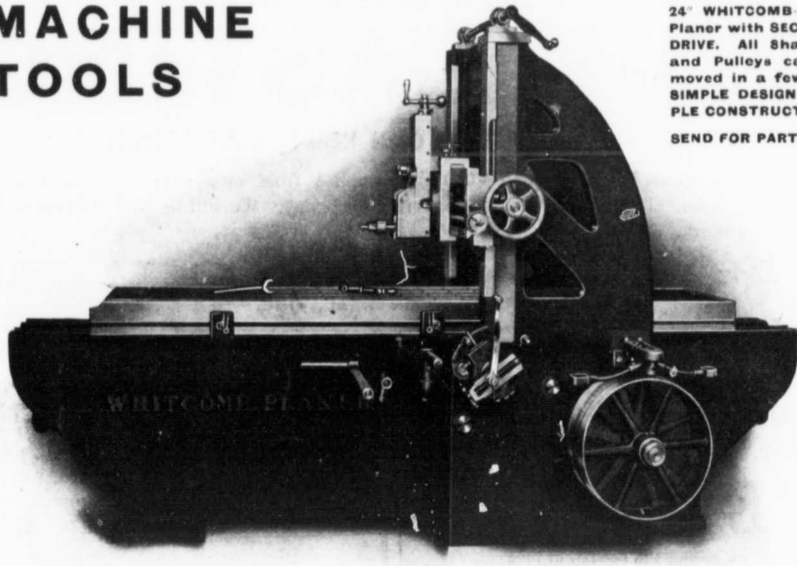

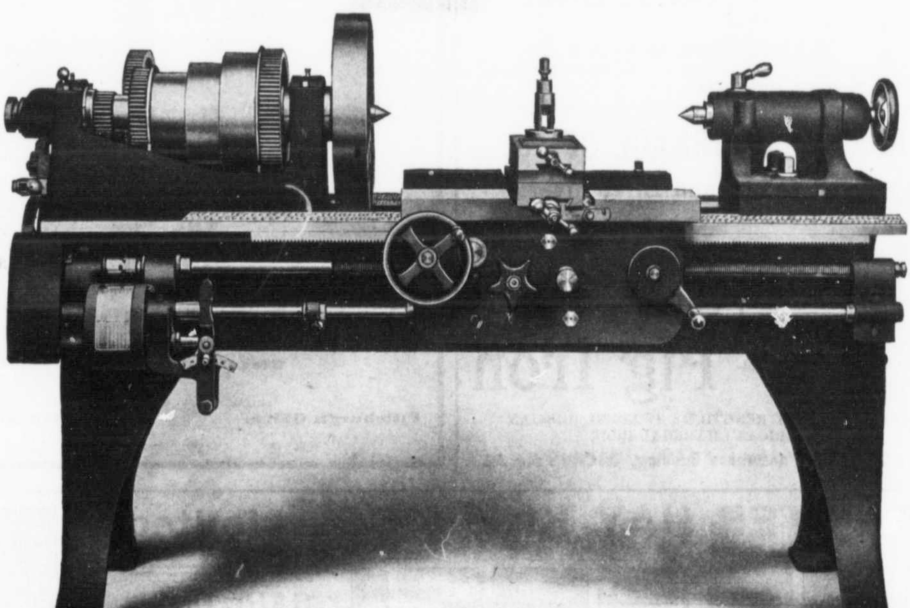

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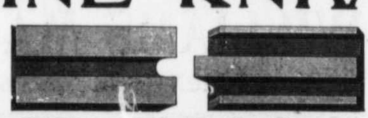

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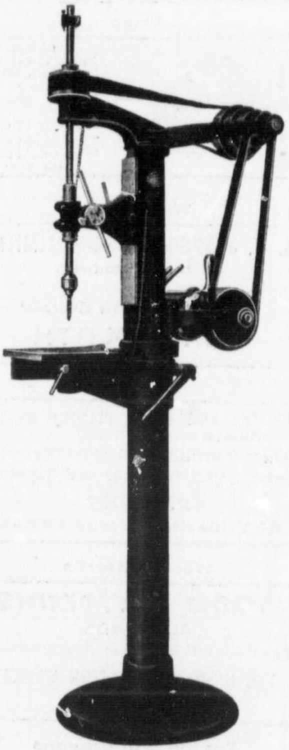

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These machines will take any drill with No. 1 taper shank, directly in the spindle, which is accurately bored to suit.

When used with chuck, any size from No. 0 to ½ inch straight shank drills may be used.

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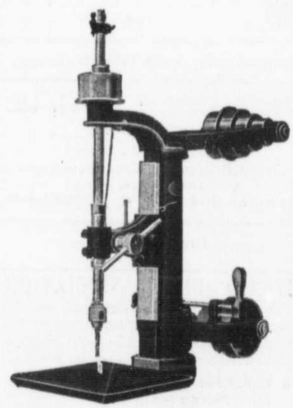

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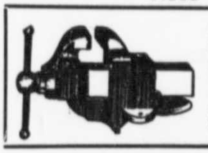

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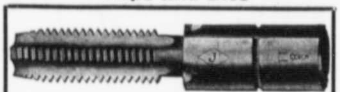

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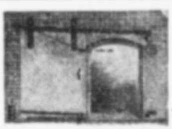

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Have you any Pipe Cutting and Threading Work to do?

The best machine is cheapest; and a comparison of the

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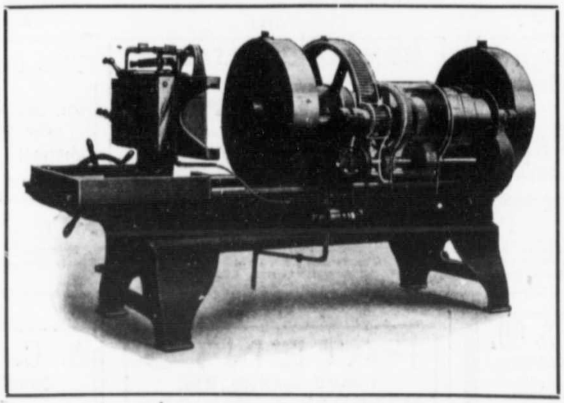

PIPE CUTTING and THREADING MACHINE

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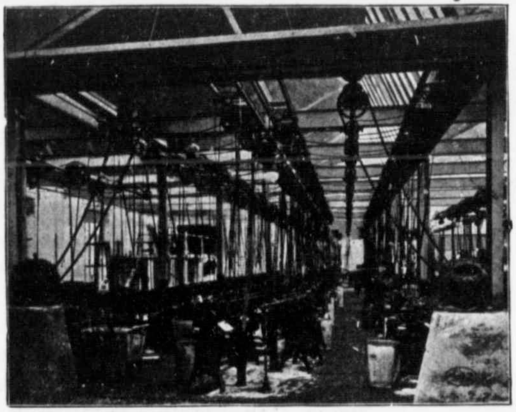

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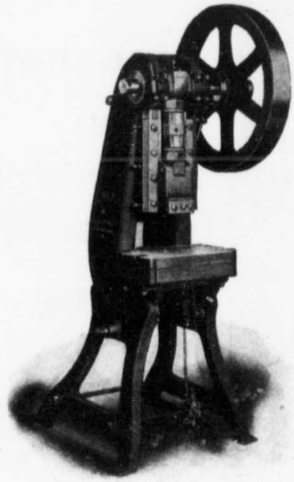

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OF THE

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THERE SHOULD BE NO FALSE ECONOMY.

A reader writes us concerning the articles which have been appearing in THE CANADIAN MANUFACTURER on technical and industrial education. He is the manager of a large manufacturing concern. The contents of his letter shows him to be deeply interested in the question. He suggests lines along which we might give information which would be appreciated. He also calls attention to the fact that certain sections of the Canadian Manufacturers' Association are opposed to the sending of a Commission abroad at the great cost of $25,000. It is believed that there is available all the information necessary as to the different systems of education which are in existence in the United States and on the Continent; and that this information can be obtained in Canada without any cost to the Association. They are in favor, however, of a Commission going round to the different industrial centres in Canada to ascertain which of the several systems of industrial education would be most suited to the requirements.

In our opinion this question of industrial education is the biggest problem facing the manufacturing industry in Canada to-day. Upon the efficiency of the way in which this problem is handled will depend in no small measure the future industrial expansion of Canada. Therefore, the problem must be handled thoroughly. There should be no half hearted or inefficient method adopted. If it costs $25,000 to do the thing efficiently, by all means let the Association spend that amount, if it can be raised, However, this fact should not be lost sight of, that a very great amount of money will be required for establishing systems of education after they have been adapted to the requirements, and needless expense should not be indulged in.

This issue contains a complete description of the system of co-operative engineering education in operation at the University of Cincinnati, as well the opinions of the University authorities and manufacturers interested as to the success of the system are quoted at length. We are advocating that a somewhat similar system be tried out in Toronto and Montreal; but we do not advocate that this be done without a thorough investigation by a committee or commission appointed jointly by the Universities concerned and the Canadian Manufacturers' Association. This investigation would probably include a visit to Cincinnati.

In the same way detail information might be gathered concerning various systems of education in operation in Great Britain, United States and on the Continent by the Committee without leaving Toronto. But none of these systems should be adopted without a thorough investigation, which might necessitate a visit to England, Germany, France or the United States, any more than the co-operative system of engineering education should be adopted without a thorough investigation even although detail information is furnished. Detail information is not everything. Impressions of men capable of judging are absolutely necessary in many cases before an adequate decision can be reached. In the investigation such as will be carried on by the Commission of the C.M.A. there will be many instances where these impressions of capable men will be needed; and there is no doubt but there will be many cases where detail information can not be obtained except by a personal visit.

It will not be obligatory for the Commission to spend the $25,000; but it will be very advantageous to have that amount if such be found necessary to make a complete investigation

The duties of the Commission should be to make a thorough investigation and report. If this does not necessitate going abroad, the Commission need not go; but if it is necessary the Commission should not hesitate to spend the money at their disposal in such a way. It is our opinion that more or less travelling by the Commission will be absolutely necessary if a thorough investigation is to be made.

ANNUAL MEETING OF A.S.M.E.

The annual meeting of the American Society of Mechanical Engineers will be held at New York City in the Engineering Societies' Building, 29 West 39th St., on December 1 to 4. There will be some important papers on steam and power plants, on machine shop practice, besides several good general papers. Two papers will be given before the Gas Power Section.

Visits will be made to the many points of engineering interest in the vicinity of New York—the large and efficiently operated power plants, the tunnels, the construction work constantly in progress.

At the last semi-annual meeting in Detroit, there were only two Canadians present. It is to be hoped that more Canadian engineers will take advantages of this meeting.

Full information as to railway rates, programme, etc., can be obtained from the secretary at the Engineering Societies' Building, 29 West 39th St., New York City.

Co-operative Engineering Education

A Detail Description of the Co-operative Courses in Mechanical, Electrical and Chemical Engineering, Inaugurated by the University of Cincinnati, Whereby Theoretical Traing is Given in the University and Practical Training in the Manufacturing Shops of the City.

In a preceding issue of The Canadian Manufacturer in an article entitled "Why Not Co-operative Education in Canada?" it was suggested that the University of Toronto and McGill University in Montreal should co-operate with the Canadian Manufacturers' Association in establishing systems of co-operative education in Toronto and Montreal whereby students would receive a thorough technical training in the University and a thorough shop training in the manufacturing shops of these cities and districts.

The reasons advanced for such a suggestion were:

First: Canadian manufacturers need now and will continue to need in greater numbers technically trained men who will be able to take important positions in their shops. Men for the shops are needed as much as men for the engineering department.

Second: The system of training in vogue at these Universities is not such as to give men that practical training which will enable them to take such responsible positions in the shops as to pay salaries which will attract men of their age and education.

It was stated that in a future issue of the paper a detail account of the co-operative engineering courseswhich have been worked out at Cincinnati would be given. In order that readers of The Canadian Manufacturer will get as close an idea of the scheme as possible the account of which will be given to a great extent in the words of those who are most interested and who have now had more than two years' experience with the scheme.

Origin of Co-operative Educational Scheme.

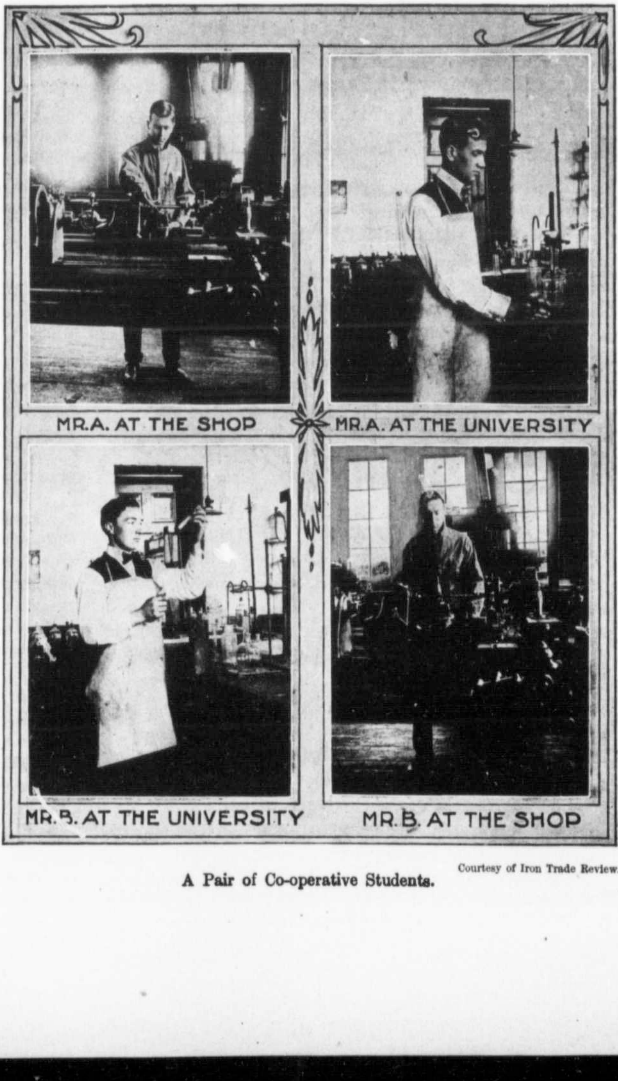
This system of co-operative education originated with Herman Schneider, Dean of the College of Engineering, University of Cincinnati. The idea was the result of six years' investigation of the problem of engineering education which included visits to the largest manufacturing concerns in the eastern and middle States, in order to obtain the views of employers of engineers; and in very many cases the men consulted were graduates of the best engineering institutions in the United States.

Before making public his conclusions after these years of investigation it was decided to thoroughly try out the scheme in Cincinnati. It was tried out and has now been in successful operation for more than two years.

What the Course Includes.

The scope of these engineering courses can be outlined as follows, which is taken from the University of Cincinnati Record or 1908-9:

These courses are so planned that students taking them work alternate weeks in the Engineering College of the University and at the manufacturing shops of the city. The classes are divided into two sections which alternate with each other so that when one section is at the University the other is at the shop. The length of the course is six years. During the summer students work full time at the shops, but are given several weeks' vacation; there is a week's vacation also at Christmas. The practical work at the shops is as carefully planned as the theoretical work at the University and in all cases the students follow as nearly as possible the path of the machines manufactured from the raw material to the finished product sold. For instance a student in electrical engineering spends his first year in the foundry; the next year and a half in the machine shop; the next two years in the commutator, controller, winding, erecting, and testing departments; and the subsequent time in the



A Pair of Co-operative Students. Courtesy of Iron Trade Review.

drafting rooms and sales offices. A contract is signed by the student, the University and the firm. This contract has a blank space to be filled out with the shop work the student is to receive during the six years of the course. In all cases the Dean of the engineering college and the professor of electrical, mechanical or chemical engineering, as the case may be, confer with the manufacturers in planning this course of shop work, so that the students get a logically and carefully arranged shop and business training.

There is no Co-operative course in civil engineering.

Students are paid for their services while in the shops on the following scale of wages:

For the first period*	10 cents per hour.
For the second period	11 " " "
For the third period	12 " " "
For the fourth period	13 " " "
For the fifth period	14 " " "
For the sixth period	15 " " "
For the seventh period	16 " " "
For the eighth period	17 " " "
For the ninth period	18 " " "
For the tenth period	19 " " "
For the eleventh period	20 " " "
For the twelfth period	21 " " "

The University expenses for tution and laboratory fees are about as follows:

First year	$90 00
Second year	80 00
Third year	65 00
Fourth year	65 00
Fifth year	65 00
Sixth year	65 00
Total	$430 00

The total earnings for the shop work approximate $2,000 for the six years.

Students desiring to enter this course are required to begin work in the shops on or about the first of July preceding their entrance to the University. Their admission to the University in September is in a measure dependent upon the character of work they do during this probationary period from July 1 until the college opens.

The entrance requirements for this course are precisely the same as for the regular four-year course. The theoretical work given at the University is exactly the same as the work given in the regular four-year courses except that it is given over a period of six years.

The number of positions is limited each year and an announcement will be made on or about the first of April of the number of openings for student-apprentices in this course.

The Manufacturers' Views.

This system of co-operative education was inaugurated by the University of Cincinnati and the Cincinnati branch of the National Metal Trades Association. The University Proposed the plan to the manufacturers and the manufacturers were interested. Their attitude towards the proposition at the time is well expressed in the words of Chas. S. Gingrich, M.E., of the Cincinnati Milling Machine Co., in an address before the Society for the Promotion of Engineering Education:

"*The manufacturers of my city have for some time past been face to face with the very serious problem of getting the right kind of men.* Our industries are diversified, including machine tool, steam pump, steam engine and electrical shops. The machine tool industry predominates. We are rapidly becoming known as the chief machine tool manufacturing centre of the country, but we need more technically trained men in the further development of this industry. It is our good fortune to have the University of Cincinnati centrally located among us. *When it proposed to us Professor Schneider's plan of a Co-operative Engineering Course, it appealed at once to the business sense of each individual manfacturer.* The plan looked attractive from the business standpoint. *It promised us an immediate supply of boys of a much higher grade than those who take up the regular apprenticeship. It held out the prospect of our getting, in a few years, engineering graduates with practical shop experience.* We have all tried to give a shop training to young men from the colleges, but it is never entirely successful. A man who has put in four years of his young manhood getting a university education cannot get into the shop atmosphere even if he does don overalls and work at the bench or run a machine as a regular hand; *such men have passed beyond the age and experience at which boys freely ask questions and learn quickly all those little details which are such an important part of the training and experience of shop men.* They feel that they cannot afford to be laughed at. They do not want to expose their ignorance. *Therefore they get at best only a very superficial knowledge of what is going on inside of the shop.*"

This attitude made it possible to arrange with the manufacturers of the city in all sorts of mechanical, electrical and chemical industries whereby the co-operative student is put into the shop as an apprentice in the way outlined in the plan. The plan has the united and enthusiastic support of all the manufacturers.

No Opposition from Labor Organizations.

There has been no opposition to this system from the labor unions. The judgment of the labor leaders in the city showed them that the plan provided opportunities for the sons of workingmen; and therefore it was for them to support and not to oppose.

What the University President Says.

Chas. William Dabney, President of the University of Cincinnati, says:

"*The great advantage of the co-operative plan is that it gives an opportunity to test the candidates fitness for the profession in the beginning.*"

"For the present our standard is that of the best engineering colleges—sixteen units—including all the customary mathematics, liberal studies, elementary sciences and modern languages. If so accepted the young man is put in a factory the 1st of July and works as a regular apprentice under the observation of the superintendent of the shop and our supervisor throughout the summer months. He usually finds out very soon for himself what he is fit for; if he does not the superintendent and the supervisor do. When the college opens in September, the young men to be admitted finally have been selected and paired up for the factories. *The result of this test is a class of students superior in physique, mind, energy, initiative, and 'engineering sense.' Naturally and unconsciously they do at least twenty-five per cent. better in the college classes than other engineering students.* Their attitude is entirely different. Others need to be led if not driven; the co-operative students come nearer leading their teachers than any we have ever known. They are keen to know the application of everything taught, but are still appreciative of the cultural studies.

* A period is approximately 990 hours.

"At first the regular engineering college courses were used, modified to suit the alternating plan. *It is evident already, however, that both our courses of study and methods of teaching will gradually be changed to meet the needs of these earnest students.* For example, they are causing their instructors to give up traditional methods. The instructor in mathematics demonstrates a formula and then asks 'Do you understand that?' Quickly comes the reply, 'Yes, but what shall we do with it?' In the shop the student is handed a tool and taught to use it, and then return it to the tool-room. Handed a formula or theory in the University, he demands to be shown its use and application. The ordinary student will only hold it until examination time and then hand it back.

"The co-operative students often declare that if a thing has no practical application, it is useless to them. *The instructor is driven thus to hunt up applications of every theory.* This system has developed a new method of instruction which the students call the 'reverse quiz.' At the end of the hour the instructor gives them permission to ask any questions bearing on the subject, and he always finds this the most interesting, and often the most difficult, part of his work. *These things are rapidly demonstrating that much of the scientific and technical instruction given in our colleges is not only archaic, but out of place, and often entirely wrong.*

"From the administrative standpoint, 'The Co-operative Course in Engineering' is highly satisfactory. *The college saves all the expense of buildings, equipments, supervision, and instruction in extensive practice shops.* Consider what a vast plant the University would have to maintain if it provided itself the varied and excellent facilities given it free by the fifty great co-operating factories. The repetition of lectures, recitations and laboratory work does not cost much. In any case the large classes must be divided into sections. Laboratory facilities are used to better advantage when the sections alternate by the week, for the students work through longer periods and with less interruption. The only additional expense results from the repetition of illustrative experiments and general lectures which could be given to large classes.

"From the educational standpoint, the success of the co-operative course is most interesting, because it conforms perfectly to the latest theories. *No more effective scheme was ever devised for educating by real work for real life or for training men in schools for efficient service to society.* It promotes the heartiest sympathy and co-operation between the community and the school. An illustration of this in Cincinnati is the existence of an association of the co-operating manufacturers formed for the purpose of supporting the University in this and similar enterprises."

VIEWS OF THE DEAN OF THE COLLEGE OF ENGINEERING.

Professor Herman Schneider says of the plan:

"While there is no cloud on the horizon now, it is possible that a combination of unfavorable circumstances may work harm to the course. But we have operated it long enough to know that under normal conditions it is a good thing.

"*It is believed this system of education will furnish to the manufacturer a man skilled both in theory and in practice, and free from the defects concerning which so much complaint is made.* It is not held, of course, that this method of training will supply full-fledged, engineers aged twenty-three years or thereabouts; but it is believed that it will provide a better preparation, a stronger foundation for the successful practice of engineering. The qualifications which the engineering graduate should possess will be more nearly attained. He will be just as thoroughly grounded in the fundamental principles of science as he is under present conditions, but he will have greater facilities in applying them to practical problems. He will be much more highly specialized, but not at the sacrifice of fundamentals. A knowledge of the achievements in other fields of engineering will result from his constant association with the best practice in electrical, mechanical, structural, and chemical engineering, as exemplified in the construction of the co-operating works, in their methods of power generation and transmission, and in their processes of manufacture, his attention having been called to these details in the classroom, and his observation of them having been checked by searching questions thereon. He will become familiar with business methods by constant contact with business conditions, supplemented by classroom instruction and practical talks on business law. He will obtain a knowledge of men by working intimately with all sorts and conditions of men in his gradual rise through the various departments of the co-operating plants. The cultural parts of his education will be planned to make him a man of good address and broad sympathies."

VIEWS OF THE CO-OPERATING MANUFACTURERS.

Charles S. Gingrich, M.E., Cincinnati Milling Machine Co., says:

"*The chief criticism of modern technical education results from the fact that we try to take the shop into the school, whereas we should bring the school into the shop. The Co-operative Engineering Course plan practically brings the school into the shop.* Our present schedule of half time during the school year and full time in the shop during school vacations, puts the boy in the shops eight months out of the twelve; in other words, during the six years he is taking the course, we have him in the shop four years—the same length of time that is served by our regularly indentured apprentices. The fact that these students are capable of taking the University course is in itself proof of their high quality, and men of their class will grasp the principles as well as the details of shop work very much more quickly than our regular apprentices.

"The shop work will include experience in: (a) machine shop; in several important branches, as lathe, planer, miller, vice work; (b) pattern shop; (c) foundry; (d) drawing room; (e) in some cases also stock and cost keeping, and in still others, sales work.

"While they are getting this, they will also be in close touch with the men and gain an intimate knowledge of the condition and attitude of labor, which will be of value to them later as managers of men in the shops with which they will become associated. These boys will also learn the commercial value of time. Do any of our present engineering graduates know that? *We are, therefore, giving these young men a thorough shop training while the University is giving them an engineering education at the same time. In this way we expect to mould each of them into a fully rounded out engineer—an engineer with an actual shop training obtained in a manufacturing establishment under regular shop conditions and in commercial work.*

"Now as to the direct value of it all. That man does not make the most efficient foreman or superintendent who does not know all the 'kinks' of the various trades under his supervision. He may be ever so efficient as an executive and have other necessary qualifications but all these can not fully compensate for the one thing which he lacks. The designer also must have more than a knowledge of kinematics and the strength of materials. These will enable him to design a machine, but unless he applies additional practical shop knowledge, it will not be a commercially successful machine. *There are in existence many beautifully worked out pieces of machinery, designed by highly educated men, which accomplish in a very satisfactory manner the object for which they were designed, but which were never put on the market because they were so costly to the manufacturer that they could not compete with other similar machines of more practical design. Indeed, a great deal of the machinery that is in use will, upon close examination, be found to contain parts which could be made very much more cheaply, and in many cases better, if the designer had had a more intimate knowledge of machining, pattern making, and foundry practice.* A lack of thoroughness in the drawing room leads to tremendous expense in the shop, because it keeps on multiplying as long as the designs are in use. *A designer should, therefore, be first of all a thoroughly trained shop man. These things will be required to even a greater degree of the chief engineer of the future. The general manager himself will be a far more efficient man if he has, in combination with his other abilities, a thorough knowledge of the things that the men under him are doing.* This knowledge will aid him, not only to form a better judgment of matters for which he is responsible, but will also enable him to make correct decisions more quickly, and thus economize his valuable time.

Views of Industrial Education Committee.

The following abstracts from the report of the Committee on Industrial Education presented at the annual meeting of the National Association of Manufacturers, New York, May 1908, have a close bearing on co-operative education, and coming from such a source should have some weight:

"The technical colleges, ridiculously enough, still withdraw young men for four years or more from all contact with commercial production so that they may be prepared for commercial production. The hard headed manufacturer complains that the technical college graduate as he comes out of college is a pretty poor sort of finished product as far as his commercial value to his employer is concerned.

"*The colleges attempt to correct this error by erecting shops, where their students are taught to use tools, but the traditional teachers do not, and simply cannot operate such shops on a commercial basis, so that even in college or university shops the work is a little better than advanced kindergarten work.*

"The college cannot teach, and does not teach any thing more than the scientific theories of engineering, together with a certain amount of cultural work. Therefore the graduate student comes to the employer without any sense of business and entirely ignorant of the problems of labor, and without any knowledge of the every day methods of production.

"*We realize that when the average student has graduated from the present kind of college courses, he is of an age and habit of mind that will prevent him learning elementary parts of the practical and business side of his career.* He is of an age that prevents him asking foolish questions. His book learning makes him think only of the big things. He wants a big salary to start with and thinks he is entitled to it and it takes him a long time to readjust himself to hard commercial conditions and to get a true prospective of his own value to the commercial world. *The co-operative engineering course at Cincinnati overcomes these difficulties.*"

Why Not This System in Toronto and Montreal?

An investigation of the conditions by the University authorities and the Canadian Manufacturers' Association would determine whether such a system of co-operative engineering education is possible in Toronto and Montreal. There is no doubt that such a course would enable the Universities in Toronto and Montreal to do broader work in technical education. There is no doubt that many manufacturers throughout Canada would be glad to get graduates from such a course. There is no doubt that there are many manufacturers in both these cities and districts who would be glad to co-operate in such a course. The question is whether these cities are large enough industrially—whether there are a sufficient number of manufacturers in the different lines who would take an interest—to make such a course successful. Cincinnati is a large city, with many large industries. Places can be found for the students with comparatively little difficulty. It is possible that the same might not hold in Toronto and Montreal.

However it is a big question, and is worthy of the most careful consideration and investigation by the University authorities in these two cities, and the Canadian Manufacturers' Association.

[In future issues we will take up other phases of industrial and technical education which will be of interest to manufacturers and others.—Editor.]

A Patent Milling File

The accompanying illustration is of a new file, the "Dreadnought" patent milling file, manufactured in Canada by J. H. Hanson Tilley Co., Limited, Montreal.

This file has semi-circular teeth on both sides, cut exceptionally deep. A special back or holder is used in conjunction with the file. The filings produced by this file are of the nature and shape of turnings or shavings produced by a lathe or milling machine, and this has led to the name hand milling tool being applied to it.

The "Dreadnought" Milling File.

This file can be resharpened four or more times, the cost being it is claimed about one-half that of re-cutting an ordinary file. The shape of the teeth make the file self-cleaning, which is of great advantage especially with soft metals.

This file will cut soft and tool steel, cast and wrought iron, bronze, brass, lead, aluminum, wood, slate, marble, etc.

The file is made both in regular and fine cuts.

The mind travels instinctively from the known to the unknown, and a sure way of carrying conviction is to postulate the statement you wish believed and remembered on some widely known parallel fact or belief. —Edward Litton.

Ball Bearings: Construction, Application

Translated and Abstracted for The Canadian Manufacturer by Emil Stern from an Article in Leitschrift Des Vereines Deutscher Ingenieure.

The purpose of this article is to give a view of the present development of ball bearings, to show to what extent they have replaced the ordinary sliding bearings, and to what kind of machinery they can be applied without difficulty.

The most valuable experience concerning ball bearings has been gained within the last eight or ten years in the automobile industry, where ball bearings have greatly improved the mechanical efficiency of the product.

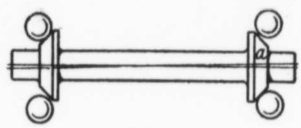


Fig. 1.

If dust gets into an ordinary bearing it is liable to heat up and get solid. Dust in a ball bearing will only cause it to wear out more quickly. This has been the experience with axle bearings. After considerable wear the wheels will start to wiggle. The weight on the front axle has been up to 1,800 pounds, on the back axle 2,000 up to 2,200 pounds. For heavy work where the load of the back axle is from two to four tons no definite conclusion has been formed up to the present time. It seems, though, as if ball bearings are only advisable in connection with rubber tires. With iron rims it is necessary to use sliding bearings with large surface, as the pounding which results from heavy roads makes the balls act like hammers on their bearings. Ball bearings may revolve at from 3,000 to 4,000 revolutions per minute, for instance in gear boxes, without any more noise than plain bearings. When changing gear, splinters resulting from the knocking of the teeth against one another will not do any harm, because even large splinters will be cleared away by the balls before they get to the running surface.

The ball bearing requires a larger diameter, compared with a plain bearing of the same capacity and less width, which permits of using a shorter shaft. Ball bearings are easier fitted than plain bearings. A plain bearing must always be scraped, and for this reason the gear which is fitted with ball bearings need not be tried or tested before being loaded. Ball bearings require less lubrication than plain bearings. If a ball bearing is not

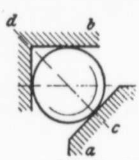


Fig. 2.

Fig. 3.

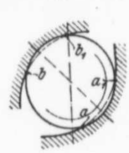


Fig. 4.

oiled it will get warm and wear out quickly, but it will not grind, like a plain bearing.

Recently, ball bearings have been standardized to a large extent, and can be bought ready for installation. As the bicycle and automobile industry used to consume the whole output of the ball bearing factories, their application to other machinery has been somewhat neglected. However, lately, all classes of machinery which run at high speed have been fitted with ball bearings.

Ball bearings, according to their construction, are either cone bearings, ring bearings, or thrust bearings. With cone bearings the pressure from the shaft to the hub is transmitted by two bevels. These bearings will take horizontal and vertical pressure at the same time. Cone bearings are largely used for light machinery. They are not suitable for heavy work, as they cause heavy side stresses, when heavily loaded.

Ring bearings transmit pressure only vertically to the shaft.

Thrust bearings transmit pressure in the same direction as the shaft. Both ring and thrust bearings are used for heavy work. Where heavy side pressure and vertical

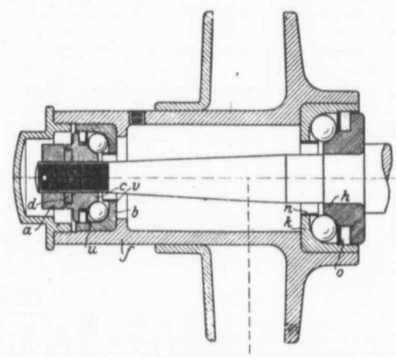


Fig. 5.

pressure prevail it is more advisable to install two bearings, one ring bearing for the vertical pressure and one thrust bearing for side pressure, than to use one cone shaped bearing.

For all ball bearings curved running grooves have been adopted (Fig. 3). Height surfaces (Fig. 1 and 2) may be found in some constructions, but they are considered out of date. The angle shaped grooves (Fig. 2) have been abandoned because the balls are bound to grind one or the other side according to the direction of pressure.

For a ball diameter D the radius of the inner groove should be 7-10 D, the radius of the outer groove should be 5-6 D (Fig. 3). Fig. 4 shows how all grooves wear out according to the ball diameter forming edges (a, a, b, b, Fig. 4), which will keep the balls from running smoothly unless the bearings are readjusted in time. The straighter the running surface the sharper will be the edge formed; this was the main reason for making the running surface a groove (Fig. 3) instead of using the straight surface (Fig. 1). The above dimensions have been adopted because the balls would grind and wear out quickly if the grooves fitted exactly the diameter of the balls. (Fig. 4.)

The less play there is between two balls, the more quietly the bearing runs. The distance between the balls should be between .05 and .02 inches.

If P = the pressure on the whole bearing;
Z = the number of balls;
Po = the pressure on each ball;
then $Po = \frac{5 \times P}{Z.}$

Fig. 5 shows the construction of a cone ball bearing.

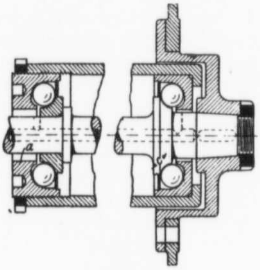


Fig. 6.

There are two cones (h and c): one (h) is connected solid to the shaft; the other (c) is adjustable, and is held in position by a washer (d) and lock nut (a).

The balls are held in position by the ball receivers (b and r); by two short pipe-ends (v and n); and by two washers (u and o).

The spaces between the shaft cones (h and c) and the washers (o, v and u) are packed with felt, to keep the dust from getting in, and the oil from getting out. The whole hub (f) is filled with oil.

Fig. 6 shows a cone ball bearing used in the crank bearing of bicycles in this case one of the ball receivers (a) is used for adjusting. One cone is part of the shaft, the other is pressed on the shaft, and the ball receivers are shaped to hold the balls in place. Figs. 7, 8, and 9 show ball bearings where several sets of balls are used.

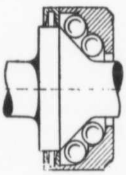


Fig. 7.

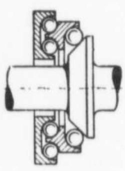


Fig. 8.

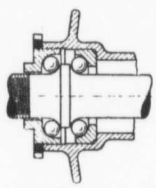


Fig. 9.

These constructions have not proven successful. In Fig. 7 the grooves will wear differently because the pressure on them is uneven; in Fig. 8 it is intended to get the best results by having an intermediate ring, and this bearing would work satisfactorily if it could be kept tight all the time, but a slight wear of one of the seats will give the shaft considerable play. The bearing in Fig. 9 has a better chance of success as it can be evenly adjusted.

Cone shaped ball bearings have not been standardized so far as they are only used for light machinery which requires special construction in many cases. Another reason is there is no standard for the threading of adjustable cones.

Ring Ball Bearings.

The oldest type of ring ball bearings is shown in Figs. 10 and 11. The balls run in the groove of a ring (a), which is fastened to the shaft, and are kept in their position by two cone shaped ball receivers (c and c), that are screwed into the hub, one of the two can be adjusted and may be held in position by a slotted washer (Fig. 11). Though it would seem right and necessary to make ring ball bearings adjustable, practice has shown it to be wrong and unnecessary. For one reason, it is very hard to thread ball receivers true, and if not true, the balls will not rest on four places; and if the receiver is screwed too tight it will spoil the whole bearing as uneven wear cannot be made good by adjusting.

Fig. 2 shows another attempt made to adjust ball bearings by placing very thin washers (c), between the two plain ball receivers (a and b); the tightening of this bearing was to be affected by removing one of these washers. At present the adjusting of ring ball bearings has been entirely abandoned to lessen the number of parts, and so cheapen and simplify their manufacture.

Fig. 13 shows an up-to-date ring ball bearing. Its four main parts are: balls, inner ring, outer ring, and ball cage, which last, however, is not necessary in every case.

Three types of ring ball bearings have been adopted: bearings for light work, fitted with small balls; bearings

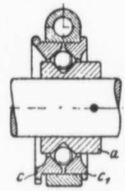


Fig. 10.

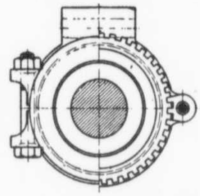


Fig. 11.

for medium heavy work, fitted with medium sized balls; and bearings for heavy work, fitted with large balls.

The measures D-d-b, as in Fig. 13, are standardized.

The different manufacturers can only change the method of introducing the balls into the ring, the shape of the ball cage, and the shape of the running surface. The rings are hardened and the outside diameter (D) and inside diameter (d) are ground to the exact size; the variation in size permitted is .00004 to .0002 in. for d, and .0006 to .0012 in. for D.

Three sizes light, medium, and heavy, will suit most requirements. Ball bearings will stand double the strain for the same width of bearing as babbit bearings. For instance, a $1\frac{1}{2}$ inch shaft requires a babbit bearing 1 inch wide for 1,000 pounds pressure, a ball bearing of the same width will stand 2,000 pounds pressure.

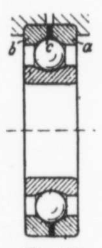


Fig. 12.

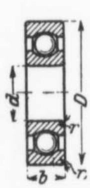


Fig. 13.

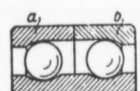
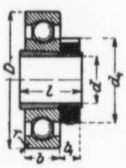


Fig. 18.

The pressure guaranteed by the manufacturer of ball bearings should not be exceeded to insure safety and to hold him responsible. For sudden load variations, ball bearings should be selected which stand 1.6 times the guaranteed pressure.

The individual construction of a machine will influence largely which type of ball bearing should be selected. For rolls, blowers, and gas engines the effect of heat in other cases springin ; of the shaft and alignment have to be figured on. Ge erally speaking light bearings should only be used fo: small shafting and fine mechanical gears; medium sized bearings should be applied most generally for shafting, for lathes, other tools, also automobiles; heavy bearings should only be used exceptionally for



F . 14.

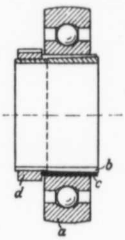


Fig. 15.

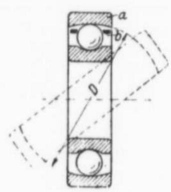


Fig. 16.

special purposes such as axles of drays, crank shafts of gas engines cranes and elevators.

Most manufacturers make their ring ball bearings interchangeable. For straight shafting they are fitted with cone shaped sleeves, and lock-nuts as in Figs. 14 and 15.

For long shafting the ball bearings are sometimes made adjustable in all directions, either by putting a standard ball bearing into a ball shaped ring or by giving the outside of the ring of the ball bearing a ball shape (Fig. 15). It is not advisable to slot the cone shaped sleeve or construct it of two cone shaped rings (b and c), which are wedged into each other by the lock-nut (d), Fig. 15, this device being too complicated. Fig. 16 shows another ring bearing which is adjustable in all directions; here the whole outer ring is ball shaped inside. For a large diameter the ball shape resembles the cylinder shape so much that it is not suitable for heavy pressures. The balls are placed in this bearing thus: the ring (a) is turned aside, while the balls are held together by an auxiliary ring (b). Ring bearings with several rows of balls are easily built by arranging ordinary ring bearings side by side as in the I-beam trolley bearing (Fig. 17).

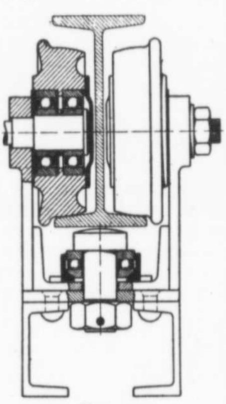


Fig. 17.

Fig. 19 shows a bearing where two rows of balls are put into one bearing. These will stand a slight thrust pressure. With ring bearings several rows of balls should be avoided as well as with cone bearings, as it is a hard proposition to divide the load evenly.

For heavy work the sliding friction of the balls against each other has to be avoided by arranging partitions between the individual balls, so called ball cages. The shape of the outside ring and of these ball cages are to-day the only open question in connection with ball bearings. That bearing will be the best which takes the largest number of balls, in spite of the use of ball cages.

Book Reviews

Smoley's Parallel Tables of Logarithms and Squares—The fiftieth edition of this book, by C. S. Smoley, C.E., published by The Engineering News Publishing Co., 220 Broadway, N.Y.; flexible morocco; 4¾ x7 inches; 448 pages. Price, $3.50.

Smoley's tables have for a number of years been recognized as a standard by structural engineers, and is used in a number of colleges. This edition is a combination of the old set of tables of the previous editions, to which has been added a multiplication table for rivet spacing, with a new set of 5-decimal logarithmic-trigonometric tables, comprising the following separate tables:

1. Common logarithms of numbers from 0 to 10,000, with tables of proportional parts.

2. Logarithms of the sine and tang, from 0° to 3° and of the cosine and cotang. from 87° to 90°, varying by 10 seconds, with proportional parts for single seconds.

3. Logarithms of the sine, tang., cotang. and cosine for each minute of the quadrant, with proportional parts for seconds.

4. Natural functions.

The book is designed for engineers, architects and students.

With the inclusion of the new set of tables, this book not only completely covers the field of all classes of technical work, but it has become a Universal Calculator, being available for computations with the United States or English measures as well as with decimals (metric or feet)

Catalogues Worth Having

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

Air Compressors—A well gotten up and well illustrated catalogue of steam and power driven air compressors of the Canadian Rand Co., Limited, Montreal. 100 pages 6 x 9 inches. The details of the construction which characterizes the Rand machines are fully illustrated and described, which makes interesting and instructive reading. A section is devoted to the endeavor to aid purchasers in selecting the proper design of compressor for the work to be done.

Applications of Thermit.—Booklet illustrating and describing various applications of the Thermit in foundry practice, issued by the Goldchsmidt Thermit Co., 103 Richmond St. W., Toronto. It also contains an illustrated and instructive article on the methods used to avoid piping in steel ingots which are applied in the Hungarian Government steel foundries at Diosgyor.

Perfora. ed Metal.—Bulletin No. 1425 sent out by the mining machinery department, Allis-Chalmers-Bullock, Limited, Montreal. In this bulletin complete information is contained concerning the use and advantages of perforated metal, and all the different styles and sizes.

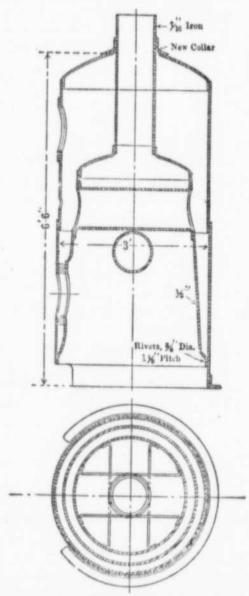
Presses.—Complete catalogue of the Consolidated Press and Tool Co., Hastings, Mich. The catalogue is very completely illustrated showing all the different styles of presses supplied by this firm. The special features of the "Consolidated" are illustrated and described in detail.

Estimating the Cost of Repair Work

A Practical Article Discussing the Estimation of the Cost of Several Repair Jobs. Renewal of Cone of Upright Boiler: Converting a Galloway Type Boiler into an Oil Tank: Repair of Scotch Marine Boilers.

By James Crombie*

In the present article the writer will take up the estimation of the cost of a few repair jobs, trusting that some of our successful veteran boiler makers will be led to do the same and thus give the younger men in the trade the benefit of their experience on this important point.



Job No. 1—Vertical Donkey Boiler.

In a contract shop one is called upon to face all kinds of problems, especially in a shop where much repair work is carried on. It may be that a steel mast must be replaced or that several plates must be taken from the bottom of a steamboat, and the floor plates, frames and plating in the way of repairs made good, or it may be that 30 or 40 feet of the bulwarks must be taken down and renewed, or the bow of a boat may have been smashed in a collision, so that the stem and shell plating are badly twisted, all of which must be made good to pass the inspector. It may be necessary to put in new coal bunkers or to take down the old funnel or smokestack and erect a new one. The donkey or upright boiler may be in need of repairs. Repairs may be necessary on a water-tube, locomotive, return-tube, Scotch marine, or any other type of boiler, but in every case, no matter how large or how small the job, the question with which we are confronted is: "What is your price on the job?"

The foregoing gives but a suggestion of the many different phases of repair work on which it is necessary to estimate the cost and to estimate it correctly, not only so that there will not be any loss, but also so that the price will stand favorably as a competitive bid.

Take the following job of repair work as an example. The price is asked on the work necessary to renew the fire-box or cone of an upright or donkey boiler, including a new uptake pipe and a new collar or flange to fit the up-take pipe and outside head. In the following analysis no account will be taken of the cost of material, as that is not so much a question of estimation, since it can be figured out exactly.

Assume that the boiler is 36 inches in diameter, 6 feet 6 inches high and has two cross-tubes riveted in the cone. The up-take pipe is 8½ inches in diameter by 33 inches long. The top of the cone is flanged in the centre to fit this pipe, the pipe then extending up through the crown or top of the boiler. It was found that the flange for the pipe on the outside was pitted and grooved so that it had to be cut off and a new collar made to fit the pipe, this collar, of course, to be riveted to the top of the boiler.

A fair estimation of the time taken for this work would be as follows: Removing the old fire-box, a boiler maker and an apprentice, 17 hours; flanging the bottom of the cone to fit the outer shell, which is 36 inches in diameter, and recessing the fire-door hole, welding the up-take pipe, which is 8½ inches in diameter and 33 inches long and made of 7-16 inch Lowmoor iron, and flanging the collar for the up-take pipe (the collar must be machine flanged and all the other work hand flanged) will take a boiler maker 22 hours and two helpers 22 hours each; laying out the new cone (two plates in the cone), punching, scarfing four corners, rolling up, fitting in the head and two cross-tubes, rivetting up on the hydraulic machine, calking and testing the job will take a boiler maker 170 hours, an apprentice boiler maker 30 hours, helpers 130 hours and a boy 30 hours.

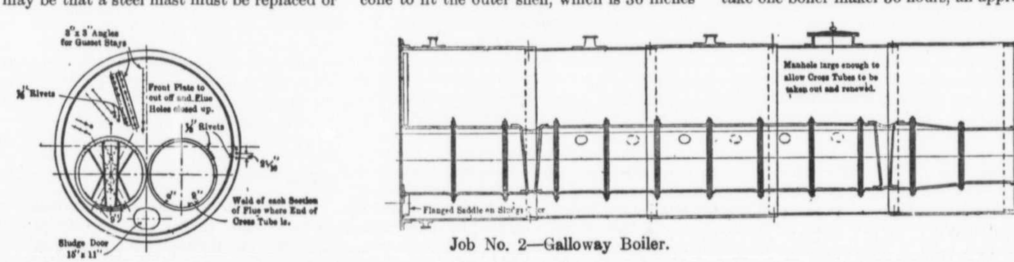
Total time on the job:

	Cents per hour.	Hours.	
Boiler maker	24	209	$50.16
Apprentice boiler maker.	10	47	4.70
Helpers	15	270	40.50
Boy	10	30	3.00
Estimated cost of labor			$98.36

All material extra (two cross-tubes were bought, welded and flanged, but had to be fitted into the boiler, allowance being made for this in the above estimate for the time of the helpers).

As another instance of estimating the cost of repair work, figure out the cost of converting an old land or Galloway type boiler into an oil tank. The boiler is 30 feet long, 8 feet mean diameter; all rivets ⅞ inch in 15-16 holes, machine driven. The work required for this job is as follows; Removal of two flues, closing up the flue holes at each end of the boiler, calking and and testing with cold water.

Both flues must be cut at each end where they are riveted to the boiler heads, and the front head must be cut out in order to allow the flues to be taken out. Cutting out the rivets from the back end of the flues, the front end of the boiler and all the rivets attaching the gusset stays to the front end plate would take two boiler makers 20 hours each. The flues would have to be worked out with chain blocks and rollers if there were no crane near the job. Taking out the flues and fitting on the front plate, also fitting on two plates, each 36 inches in diameter, and two plates, each 42 inches in diameter, to cover the flue holes in both the front and back boiler heads would take one boiler maker 36 hours, an apprentice boiler maker 40 hours, and helpers 165 hours. The time required for riveting, including the riveting of the front head to the shell, also to the gusset stays and the riveting of the four plates on the flue holes, would be as follows: One boiler maker 49 hours, one helper 39 hours, one boy 24 hours. The calking and testing would take one boiler maker about 30 hours.



Job No. 2—Galloway Boiler.

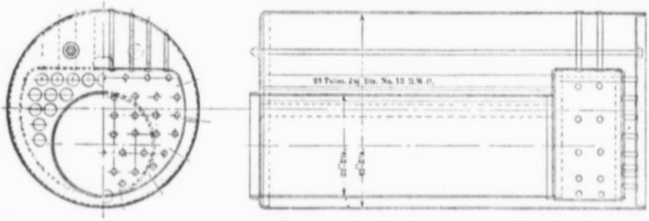
* Foreman Boiler Maker, Sawyer & Massey, Hamilton.

Total time on the job:

	Cents per hour.	Hours.	
Boiler maker...........	24	125	$30.00
Apprentice boiler maker.	10	40	4.00
Helpers................	15	204	30.60
Boy..................	10	24	2.40
Estimated cost of labor..........			$67.00

All material extra.

As a third example of the estimation of the cost of repair work consider the repair of a small Scotch marine boiler. On examination it is found that the water has been allowed to



Job No. 3—Single Furnace Scotch Boiler.

get low, causing the crown sheet and back of the fire-box to buckle and draw in the stay-bolts. The tubes are also in bad condition and the sides of the fire-box grooved and pitted. There is no manhole in the boiler, only small sludge doors or handholes. The boiler is 42 inches in diameter by 84 inches long, and contains a single furnace 22 inches in diameter, 23 tubes 2½ inches in diameter by 5 feet 6 inches long. The plates are 5-16 inch thick, except the tube plates, which are ⅜ inch thick.

To do this job in good shape the boiler must be sent to the shop and the back head cut out, all tubes taken out, all stay-bolts cut out, all rivets around the furnace mouth cut out, and the furnace itself removed. The crown, sides and back of the fire-box must be removed as well as all the stay-bolts and tubes. Of course, in laying out the riveting and stay-bolt work, one must be governed by the stay-bolt holes and rivet holes which are already in the boiler. There are 82 stay-bolts, 72 rivets around the flange of the back head, and 38 rivets around the furnace mouth, besides those connecting the fire-box to the inside tube sheet and tubes. The rivets are ¾ inch in diameter, spaced 1⅞ inches between centres.

The quickest way to get the boiler apart would be to drill the stay-bolts out of the shell plate on each side. Then cut and back out the rivets in the flange of the back head and at the furnace mouth and cut the tubes at the front end. The boiler could then be turned up on end and the back head, together with the fire-box, furnace and tubes all lifted out of the boiler at the same time. The stay-bolts could then be broken off between the back head and the fire-box, after which the head could be taken to the drill and the pieces drilled out. If the tubes are not beaded at the fire-box end they could easily be worked out of the tube holes and the tube plate cut adrift from the fire-box.

The cost of the above work would be estimated as follows: Cutting out, two boiler makers 18 hours each, at 24 cents an hour, total, $8.64; laying out, spacing the holes in the flange of the fire-box back sheet after it has been flanged, 1 hour at a cost of 25 cents; shearing and flanging the back sheet of the fire-box, which is 36 by 28 inches, finished size, the flanging to be done on a hydraulic machine, one boiler maker 1½ hours at 24 cents per hour, two helpers 1½ hours at 16 cents each per hour; total cost 84 cents. Rolling the side sheets, fitting up the side, top and back sheets of the fire-box, also punching all stay-bolt holes for 1-inch stay-bolts; one boiler maker, 19 hours at 24 cents per hour, two helpers, 15 hours at 15 cents per hour each; total cost, $9.06.

The fire-box can be riveted around the flange of the top sheet and across both seams at the bull machine and then calked inside before the back sheet is bolted on. The fitting up and riveting at the bull machine would require 2 hours' work for one riveter at 20 cents per hour, two hours for one helper at 16 cents per hour, and 2 hours' work for one boy at 10 cents per hour, making the total cost 92 cents.

The back sheet of the fire-box must then be riveted up by hand; since a man could not go into the fire-box, the rivets must be held on through the tube holes. Riveting up this plate would take two boiler makers 3 hours each at 24 cents per hour, one holder-on 3 hours at 16 cents per hour, and one boy 3 hours at 10 cents per hour, making the total cost $2.22. Drawing the furnace and fire-box into place and bolting it up ready for riveting would take one boiler maker 5 hours at 25 cents per hour, two helpers 5 hours each at 15 cents per hour, making the total cost $2.75.

There are 110 rivets to drive around the furnace mouth and backhead, all of which must be driven with a pneumatic hammer, taking about 3 minutes for each rivet. Including turning the boiler around on rollers, this work would take one riveter about 5½ hours at 20 cents per hour, two helpers 5½ hours each at 15 cents per hour, and one boy 5½ hours at 10 cents per hour, making a total cost of $3.30.

By slinging the boiler from the flange of the back head, the furnace mouth could be riveted on the bull machine, and then by turning the boiler upside down and suspending it from the tube holes, the back flange could also be riveted up on the bull machine. Although 60 rivets could easily be driven per hour with the bull machine, in order to allow for the time taken to sling the boiler and turn it upside down, it would be safer to allow 1.34 hours for driving 60 rivets. This would take one riveter 2½ hours at 20 cents per hour, one helper 2½ hours at 16 cents per hour, one helper 2½ hours at 15 cents per hour, one boy 2½ hours at 10 cents per hour, making the total cost $1.53. Thus we see that by driving these rivets on the bull machine the work can be done for $1.53, whereas when driven with a penumatic hammer the cost is $3.30, making a difference of $1.17 in favor of hydraulic riveting in this case. Therefore, it would be better to use the hydraulic riveter, not only as it is cheaper, but also because better work can be done than with the pneumatic hammer.

Tap all the stay-bolt holes, run in the stay-bolts, fit them and cut them off with the machine. With a good air drill each hole can be tapped in one minute. Allowing six minutes as the total time required for each staybolt, for 82 stay-bolts the total time would be approximately 8½ hours, requiring two men at 16 cents per hour, or making a total cost of $2.72. Riveting up the stay-bolts would take two boiler makers 9 hours at 24 cents per hour, and one helper 9 hours at 16 cents per hour, making a total cost of $5.76.

It would take a boy about 1½ hours to get the new tubes from the storeroom and grind off the sharp edge from one end of each tube, making a cost of 15 cents. Inserting and expanding the tubes would take one boiler maker 10 hours at 24 cents per hour, making the total cost $2.40.

Inserting the through stays in the steam space at the top of the boiler, of which there would be two 1½ inches in diameter, would take one boiler maker 2 hours at 24 cents per hour, costing 48 cents.

The remaining items of this job are testing; two boiler makers 5 hours each at 24 cents per hour, making a total of $2.40; taking off and replacing valves and fittings; one engineer 20 hours at 22 cents per hour, costing $4.40, and fitting on the up-take, two helpers 5 hours each at 16 cents per hour, costing $1.60.

Having found the cost of each different operation we will now find what the total cost is:

Cutting out.......................	$8 64
Laying out........................	25
Shearing and flanging back of fire-box	84
Fitting up fire-box and punching stay-bolt holes.....................	9 06
Riveting fire-box at hydraulic riveter..	92
Hand riveting back of fire-box.......	2 22
Drawing furnace into place in shell of boiler.........................	2 75
Riveting furnace mouth and back end of boiler, hydraulic riveter.......	1 53
Tapping holes and fitting in stay-bolts	2 72
Riveting stay-bolts................	5 76
Boy getting out tubes from stockroom	15
Inserting and expanding tubes......	2 40
Inserting through stays............	48
Testing..........................	2 40
Fitting on old up-take.............	1 60
Engineer at valves, etc............	4 40
Estimated cost of labor..........	$46 12

Adding 5 per cent. for unexpected expenses, as the furnace may be tight or the stay-bolt holes may be pitted inside and require tapping out for large stay-bolts, our total now is $48.43, say $49.00.

The new material required for the entire job and its cost is as follows:

One plate 41 by 32 by 5-16 inch for back of fire-box.......	263 pounds.
One plate 72 by 15 by 5-16 inch for sides of fire-box.......	
One plate 42 by 15 by 5-16 inch for top of fire-box........	

All flange steel at 2¼ cents per pound	$5 92
126.5 feet 2½ inch diameter tube at 15 cents per foot	18 98
Rivets, 75 pounds, at 3½ cents per pound	2 63
82 stay-bolts at 20 cents each	16 40
Fusible plug	75
Total for material	$44 68
Total for labor	49 00
Total for material and labor	$93 68
30 per cent. for fixed charges	$28 10
	$121 78
Profit, 10 per cent. of total	12 18
	$133 96

The total estimate for the repairs would be quoted at $135.

The stay-bolts in this estimate are quoted at 20 cents each, but can be made for less than this. They may be made like rivets in the rivet header, six being squared on the head and cut off at each heat. With a good long heat on the bar and the fires kept full, a man can make from 300 to 500 per hour. A handy man at 18 cents per hour will thread 120 per hour on a good machine.

In the early part of this article the writer has not given the material, as that is always an easy matter to work out; it is the time that is the most uncertain thing to figure on. We must know our men when we are working out our estimates and decde who will be the best man to put on each class of work. —The Boiler Maker.

New Plant of Berlin Machine Works

Well Equipped Plant Making Woodworking Machinery Just Started Operations in Hamilton. Construction of Buildings. Equipment of Machine Shop and Foundry.

The new plant of the Berlin Machine Works, Limited, Hamilton, has now been in operation for some months. This factory is owned by the same interests as the Berlin Machine Works, Beloit, Wis., makers of wood working machinery. The same machinery will be made in Hamilton as is made in Beloit. This is one more United States manufacturing firm who has realized the possibilities in Canada, and as a result have established a Canadian factory in order that their business in Canada can be handled to the greatest advantage. These works form a large and important addition to Canada's industries.

The company have selected an excellent location for their factory, as Hamilton is practically the centre of manufacture in Canada and has exceptionally good shipping facilities. Shipping facilities for the plant include direct connection with the Grand Trunk Railway and the Canadian Pacific Railway, and as well good facilities for shipping by water.

The factory occupies a twenty acre tract at the intersection of the Grand Trunk and Toronto, Hamilton and Buffalo Railways, and the company's private tracks connect with both lines. In order to expedite shipments, the company maintains its own locomotives and has more than a mile of track to secure direct connection with the Grand Trunk and Toronto, Hamilton & Buffalo Railways.

This manufacturing plant is one of the most complete, well designed and well equipped plants in Canada. The buildings are well constructed; floors are excellent; there is a wonderful amount of floor space; cranes have plenty head room; lighting is excellent; buildings are well heated and ventilated. There is good fire protection; and the atmosphere in the shops is such as to make working in them a pleasure.

General Features of Construction.

The buildings are of steel and concrete, on concrete foundations. All buildings are completely equipped with a sprinkler system, which is connected to the city mains and also to an auxiliary reservoir of 100,000 gallon capacity. The system was installed by the Automatic Sprinkler Co., Montreal.

The floors in the machine shop, stock room, etc., are a feature of the construction. The foundation for the floors is cinders and tar. On top of this is laid a rough flooring running at an angle; and the hardwood floor is placed on top of this. All the tools in the shop are placed on this floor without further foundation; as well all the machines built are tested on this floor without further foundation. This is good indication of the stability of this flooring.

The Machine Shop and Tool Room.

The largest building is the machine shop which is built of steel and brick. It has almost 100,000 square feet of floor space. The roof is of "saw tooth" design, giving admirable light as well as furnishing fine ventilation. A gallery in this building has over 10,000 square feet of floor space, and is used for a tool room.

The tool equipment for the machine shop, with the exception of more or less special tools, was supplied by the London Machine Tool Co., Hamilton. This equipment included some large lathes and planers and an 8-foot high power boring mill.

The Cincinnati Milling Machine Co. supplied the milling machines, and the American Tool Works Co., Cincinnati, the radial drills. A cylindrical grinding machine for grinding the feed rolls for the woodworking tools was supplied by the Norton Grinding Co., Worcester, Mass. The turret lathe equipment was supplied by the Jones & Lamson Machine Co., Springfield, Vt. B. F. Barnes, Rockford, Ill., supplied the drill presses. The machine shop is served with two Pawling & Harnischefeger electric travelling cranes. In addition to regular shop equipment there are several special tools designed specially for work carried on in this shop. One of these is a floor drill for boring the large machine frames. Another is a special tool for milling the slots in the cutter heads. Another is a special machine for grinding band saw wheels absolutely true after the spokes have been welded in. To have these wheels true is very important, as upon that depends the smooth running of the band saw and the wear.

The tool room equipment includes London Machine Tool planer, B. F. Barnes drills, Hendey Machine Co. lathe, Cincinnati Milling machine and tool grinder, and American Tool Works planer. Repair work and some manufacturing is done in this room.

The tools in the machine shop are group driven with the exception of the 8-foot London Machine Tool boring mill, which is driven direct by D.C. variable speed motor. Nine changes of speed can be secured, 3 to 1 in the motor and 3 to 1 in the gear box. The group drive is by induction motor.

The Foundry.

The foundry building, separate from the others, is splendidly lighted from roof and sides. The building is high, giving plenty of head room for the crane. Up-to-date equipment is the feature of the building. The main moulding floor covers 28,000 square feet. The floor is served with a 20-ton Pawling & Harnischefeger electric travelling crane, and the side floors with ten jib cranes. There are two 66 inch cupolas, one a Whiting Foundry Equipment Co., and the other a Northern Engineering Works.

One part of the moulding floor is equipped with Pridmore stripping plate moulding machines for moulding pulleys and gears.

A feature of the wood-working machinery turned out by this firm is the one piece frame. They use no bolted frames. This means some large work in the foundry in frames. All the large moulds are skin dried.

The foundry equipment included a set of W. W. Sly Mfg. Co., Cleveland, O., steel exhaust tumbling mills and patent dust arrester.

The Berlin Works are fortunate in having moulding sand on their grounds, there being a supply not many yards from the foundry door.

Castings are taken from the foundry to the machine shop by industrial railway, and in fact there is an industrial railway system throughout the plant.

Blacksmith Shop.

The blacksmith shop is equipped with Buffalo Forge down draft forges, Hurlbut Rodgers cutting off machine, a special shaft straightening machine and a Williams-White & Co. trip hammer. Next the blacksmith shop and also next the machine shop is the stock room.

The Power Plant.

Power is received from the Cataract Power Co., at 22,000 volts. This is transformed to 220, and at that voltage is applied to the induction motors throughout the plant. A motor generator set supplies direct current for the boring mill motor for the crane motors and for the lighting. The distribution is two wire at 220 volts. The electrical equipment, including switch board, is Westinghouse throughout. In the transformer room is situated the motor driven air compressor supplying air for penumatic tools and for cleaning purposes.

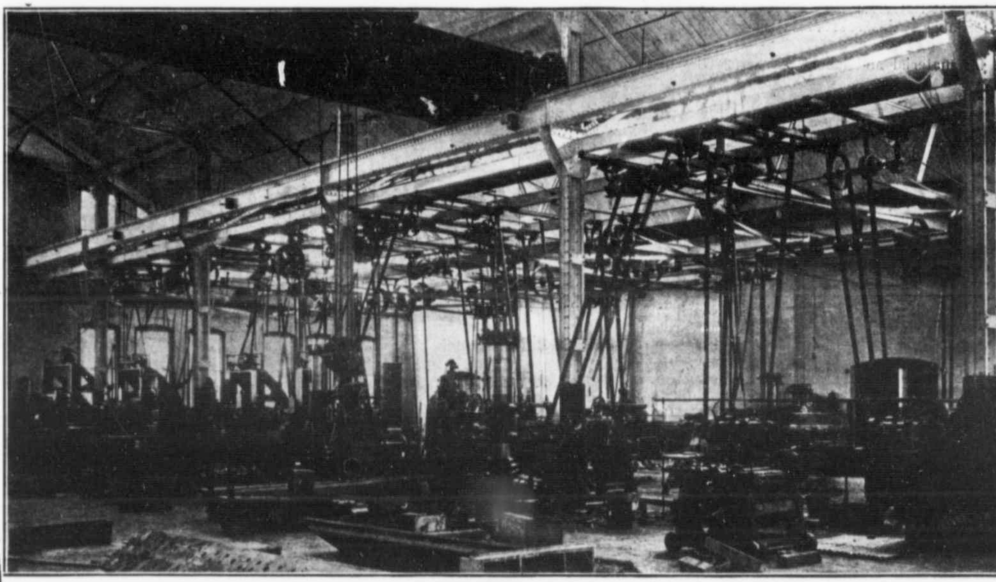
For heating there are installed two brass foundry and machine works boilers, equipped with Parsons blower regulator. There is a 150 foot steel concrete chimney built by the Weber Steel Concrete Chimney Co., Chicago. The coal is handled in a very efficient way. The bins are on a level with the boiler room. The coal all comes in dump bottom cars. A siding is elevated to the roof of these bins, and coal is dumped from the cars into the bins. There is thus only the one handling of coal.

Facilities for Loading Machinery.

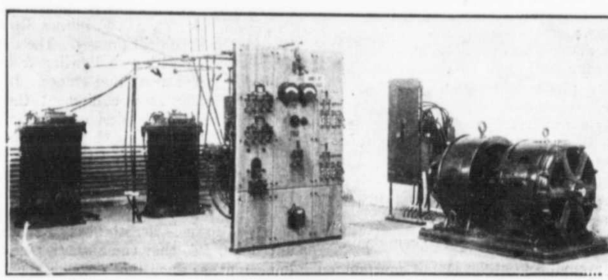
The facilities for loading machinery into or onto cars are good. There are two depressed car pits in the shipping room, the floor of the car thus being brought to the level of the floor of the shipping room. The company always ship in end-door cars. The depressed pit and the end doors facilitate loading of machinery very materially. Cars come into receiving room on the level.

Something of Which to be Proud.

This is a plant of which the owners may well be proud; and it is a plant of which the manufacturing interests in Canada may well be proud. If the business methods of this company show the same progressiveness and thoroughness as is shown in the building and equipment of their manufacturing plant, there is a large future for them in Canada.



View of Machine Shop: Berlin Machine Works, Hamilton, Showing Line of London Machine Tool Planers.



The Transformer Room: Berlin Machine Works, Hamilton.

LOOK AFTER YOUR DISCOUNTS

I started in business in a very small community—not over 600 people. The only industry was that of raising musk melons. The greater part of our business—general merchandizing—was during the melon season, when hundreds of people moved into the district to assist in picking and shipping melons.

At first the matter of discounts did not occur seriously to me. Then one day I figured out how much I would have made if I had saved my discounts, and the figures actually astonished me. From that time on you may be sure that I was very careful about the matter.

When I started in business, money interest was high. Business houses with which I did business would give discounts of from three to five and even more on special deals. I began to take them. Besides, I always took my family to the city two or three times a year and the wholesalers would fit us out with all sorts of wearing apparel and household goods.

In fact, our clothes and furniture cost us very little while I was in business, and it was all because they knew that I paid my bill promptly and took the discounts. A wholesaler, you know, appreciates ready cash, and he is sometimes almost lavish with his presents if you get on the good side of him by paying cash.

It was not exactly what I made that enabled me to retire to private life when I was fifty years old. It was what I had saved, and the most of the saving came in the discounts that were allowed me. One of the slack ways that eats into the profits of the business is in the neglect to pay bills when they are due. When a bill is presented you may not have sufficient funds on hand to make prompt payment and the first thing you know you have let an opportunity slip by—an opportunity to take a discount

Although a discount of a few dollars now and then may not seem to be any great affair, yet in the course of a business career the discounts that can be saved amount many times to a small fortune.

I once asked a man of wealth how he had made his money. "By taking my discounts," was the reply.—System.

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.

PORT ARTHUR.—A large elevator will be erected here by W. H McWilliams, of the Canadian Elevator Co., at a cost of $500,000.

CORINTH.—Grand Trunk depot and freight sheds have been destroyed by fire.

TORONTO.—It is stated that the Canadian Bowling Club may erect a modern club house here on Avenue Road at a cost of $10,000.

FORT WILLIAM.—A large apartment house will be erected here by H. J. Tharle.

HAMILTON.—The sum of $10,000 will be spent in decorating St. Mary's Cathedral here.

PORT ARTHUR.—The Thunder Bay Elevator Co. will erect an elevator here to cost $500,000.

TORONTO.—Shea's new theatre will be erected here at the corner of Victoria and Richmond Streets. The building will be built of brick, stone, steel and concrete.

TORONTO.—The parks committee here have accepted the plans for the new palm house for Allan Gardens and have forwarded to the Board of Control a recommendation that $30,000 be provided for the erection of the building.

Quebec.

MONTREAL.—Contracts for the heating and ventilating of the new McGill Medical Building has been awarded to James Ballantyne, Montreal. Messrs. Brown & Vallance are the architects, and Peter Lyall & Sons are general contractors.

MONTREAL.—A new postal station "D" will be erected in Point St. Charles, Mr. Alphonse Piche, Victoria Building, Montreal, is superintending architect.

MONTREAL.—Cote Bros. & Burrett, Conde Street, are installing a large freight elevator for Chas. Gurd & Co., Jurors Street.

Two warehouses of the Montreal Cotton & Wool Waste Co., Montreal, were recently destroyed by fire. Estimated loss about $15,000.

MONTREAL.—Contracts for flooring for the Tuberculosis Hospital, Ottawa, College St. Hyacinthe, St. Hyacinthe, Grace Hospital and Rolph & Clark's warehouse, Toronto, have been awarded to the Eadie, Douglas & Co., Montreal. The flooring specified is Terrano.

MONTREAL.—Contract for the new police station, No. 12, at 1394 St. Lawrence Boulevard, has been awarded to Francois Xavier Aube, 690 Laval Ave. Mr. Jos. Art Godoin, 120 a Parc Lafontaine, is the architect.

MONTREAL.—The Catholic School Commissioners will erect a new school costing about $60,000. Mr. C. Bernier, 70 St. James Street, is the architect.

MONTREAL.—The Campbell Mfg. Co. will erect a four story warehouse on Cadiux Street and Colonial Ave. Mr. J. A. Karch, 12 Place d'Armes Hill, is the architect.

British Columbia.

KAMLOOPS.—The newly organized Mounted Rifles here will have a new armory building.

Jamaica.

KINGSTON.—The Walker Fyshe, Co., Limited, Montreal, have the contract for the first large church building to be built of reinforced concrete which is the cathedral of the Holy Trinity here.

KINGSTON.—The Walker Fyshe Co., Limited, Coristine Bldg., Montreal, have completed a handsome bank building for the Bank of Nova Scotia here.

Manitoba.

WINNIPEG.—The large two story plant of the Prairie City Oil Co. here has been completely destroyed by fire. The damage amounts to $40,000.

WINNIPEG.—A permit has been issued to the Canadian Northern Railway for the erection of a warehouse to cost $28,000.

Manitoba.

SOURIS.—The Government have bought a $5,000 post office site at Souris.

WATERWORKS, SEWERS AND SIDEWALKS.

Ontario.

LONDON.—The last of the trunk sewers here have been completed, $50,000 having been spent in the trunk system.

British Columbia.

VANCOUVER.—The waterworks of North Vancouver will be extended.

Saskatchewan.

SASKATOON.—The citizens have voted $26,000 for the extension of waterworks and $30,610 for extensions of the sewer system.

MILL AND FACTORY EQUIPMENT.

Ontario.

PEMBROKE.—The factory of the National Mfg. Co., which has been destroyed by fire, will likely be rebuilt.

WELLAND.—The Dain Mfg. Co., of Ottumwa, Iowa, will establish a Canadian plant here for the manufacture of farm implements.

PORT PERRY.—A new saw mill will be erected here by the Carnegie Milling Co.

BANCROFT.—A pulp mill may be established here by St. Catharines parties.

Quebec.

MONTREAL.—The sawmill of Jos. Pacquette, Montreal, was damaged by fire to the extent of about $5,000.

POWER PLANT OPPORTUNITIES.

Quebec,

MONTREAL.—The Canada Electric Co. have secured the contract for electric wiring for 35 dwellings being erected for Dr. Dubeau, on Sherbrooke Street. G. A. Monette is the architect.

MONTREAL.—C. Lapierre, Lindsay Bldg., has secured sub-contract for electrical work for the Dominion Express Co.'s stables in Ottawa, Ont. The general contractors are Messrs. John Quinlan & Co., Montreal, and Messrs. E. & W. S. Maxwell are the architects.

MONTREAL.—Messrs. John Stewart & Co., general contractors, have awarded subcontract to Messrs. McDonald & Willson, 588 St. Catherine Street West, for electrical work of the St. Andrew's Presbyterian church, Westmount.

Nova Scotia.

HALIFAX.—It is proposed to instal electrical apparatus at the County Academy at a cost of $1,500.

COMPANIES INCORPORATED.

Quebec.

MONTREAL.—The General Fireproofing & Construction Co., of Canada, Limited, have been incorporated with a capital of $20,000 to carry on the business of general contractors, manufacturers and dealers in contractors' supplies. The provisional directors include C. A. Duclos, W. L. Bond and J. E. Coulin, all of Montreal.

MONTREAL.—Investment Trusts Co., Limited, have been incorporated with a capital of $500,000 to carry on business as investors. The provisional directors include G. V. Cousins, C. G. Heward and A. J. Nesbitt, all of Montreal.

Ontario.

TORONTO.—The Hargrave Silver Mines, Limited, have been incorporated with a capital of $2,500,000 to carry on a mining, milling and reduction business. The provisional directors include W. N. Ferguson, R. D. Moorhead and J. T. White.

CALEDONIA.—The Caledonia Evaporating Co., Limited, have been incorporated with a capital of $40,000 to evaporate fruit and to can fruit and vegetables. The provisional directors include A. J. Hamm, I. M. Corman, and H. W. Rogers.

BRIDGES AND STRUCTURAL STEEL.

Ontario.

BARRIE.—Tenders will be received until November 24, 1908, for the construction of a steel bridge over the Nottawasaga River, by J. T. Simpson, Barrie, Ont.

Some Heavy Machine Tools Made in Canada

The Railway Shops and Some Large Manufacturing Plants Have Been Responsible for the Building of Some Large and Heavy Tools by Canadian Builders. Illustrations and Descriptions of Some of These.

In the past two or three years there have been quite a number of large and heavy tools made and sold in Canada. The use of high speed cutting steels have been reponsible for the demand for heavily built tools. The equipping of several large manufacturing plants and railroad shops have been responsible for the building of large tools. The Canadian Westinghouse Co. have had several large tools made in Canada, notably a large planer by the John Bertram & Sons Co., and a large boring mill by the London Machine Tool Co. This planer was described in the mechanical papers some months ago; an illustration of the boring mill appears in this article. The Grand Trunk Railway recently had the London Machine Tool Co. build a large and heavy wheel lathe for the Stratford shops, which lathe made a record of 13 pairs of driving wheels per day of 10 hours. Now the Berlin Machine Works, Hamilton, which plant has now been in operation some months, are using some big tools made in Canada by the London Machine Tool Co. In the Toronto shops of the Grand Trunk Railway, two very heavy rail planers, built specially by the John Bertram & Sons Co., are doing splendid work in removing metal economically. The Intercolonial Railway and the Grand Trunk Pacific are now making similar demands on the Canadian tool builders.

This is all evidence of the present trend in machine tool practice and of the industrial growth of Canada which makes necessary the installation of so many heavy tools. It is also a compliment to Canadian tool makers that these orders are coming to them.

The accompanying illustrations are of three of these newly designed heavy tools built by the London Machne Tool Co. At the time the demand came for these tools the London Machine Tool Co. secured the services of a designer who had had wide experience with some of the best tool builders in the United States, and in that way met the requirements of the situation.

The result has been that during the past couple of years, this firm have placed many new tools on the market.

Eight Foot Boring Mill.

In Fig. 1 is shown an 8-foot boring mill, several of which have been made by the London Machine Tool Co., two of them now operating in Hamilton in the Canadian Westinghouse shops and in the Berlin Machine Works. Others have been sold for railroad shops. This is a high power tool, heavily and rigidly constructed, as can be readily seen from the illustration.

The drive is by 25 h.p. variable speed Westinghouse motor direct connected through gear box to the machine. Speed variation in the motor is 3 to 1, and in the gear box 3 to 1, making 9 speed changes possible. The cross rail is elevated and the heads moved by means of a 5 h.p. Westinghouse variable speed motor. The gearing throughout is all steel.

Forty-two Inch Extra Heavy Lathe.

This lathe, shown in Fig. 2, was specially designed to stand up to the severest strains to which it might be subjected by high speed cutting; and it also has very heavy driving power.

It is a triple geared lathe equipped with instantaneous speed changes. The swing over the bed is 42 inches, and over the carriage 32 inches. The back-gear ratio is 8 to 1; and the triple-gear ratio is 45 to 1. The bearing surfaces are liberal: front bearing is 6¾ inches in diameter by 11 inches long; the rear bearing is 6 inches in diameter by

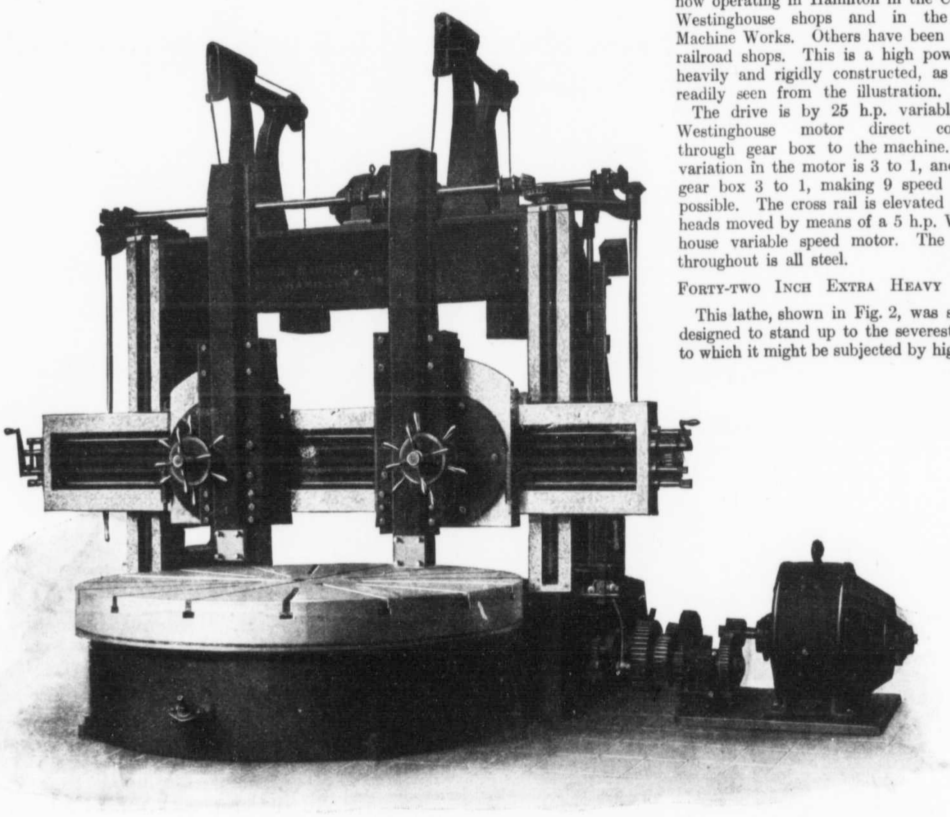


Fig. 1—Eight Foot London Machine Tool Boring Mill.

8 inches long. The hole through the spindel is 3⅜ inches in diameter.

EXTRA HEAVY BRASS FINISHER'S LATHE.

In Fig. 3 is shown a brass finisher's lathe, 18 by 30 inches by 3 feet. It is extra heavy build throughout. The design of the machine is such that the operator can handle everything conveniently without moving from his regular position, all levers being within easy reach. A glance at the illustration will show instances of this. The turret is provided with screw feeds, longitudinal and crosswise.

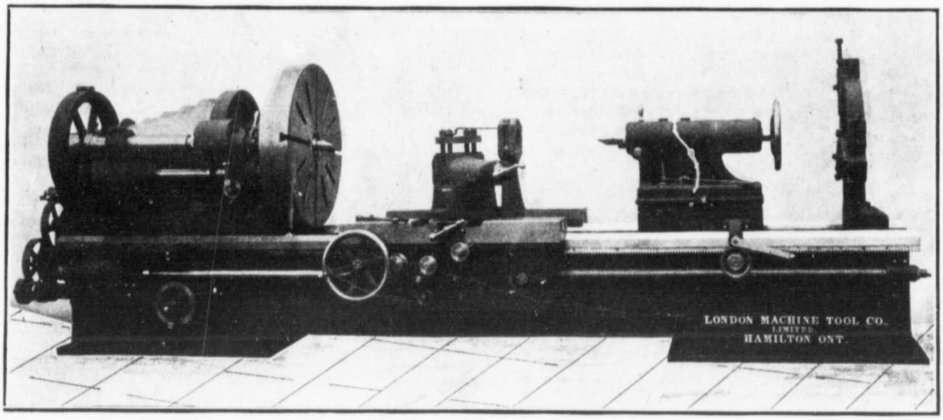


Fig. 2—New Style London Machine Tool Triple Geared Lathe.

Large Order for "Reid" Molding Machine

The Reid Foundry & Machine Co., Ingersoll, Ont., have just made the first shipment on a large order of the Reid molding machines—thirty-two machines including patterns and flasks—to a Leeds, England, firm. The machines are for heel plates for shoes.

The manager of this concern came to Canada for the Convention of the American Foundrymens' Association, held in Toronto, last June, with the specific purpose of selecting molding machines for making this product. He made a thorough investigation of the various machines at the Convention which were at all suitable for his requirements, and finally approached Mr. David Reid, of the Reid Foundry & Machine Co., and placed the proposition before him. Mr. Reid made a working model, which resulted in this large order being placed with his firm.

Trade Notes

Ontario.

ST. CATHARINES.—The city council have decided to purchase a new Waterous fire engine at a cost of $5,000.

TORONTO.—The authorities of Knox church will put in two fire escapes from the gallery at a cost of $800.

HAMILTON.—Among the firms who have purchased Smart-Turner pumps during the last few days are the Westminster Co., Brantford; Robt. Simpson Co., Toronto; McColl Bros. & Co., Toronto; Grant's Spring Brewery, Hamilton; the Quebec Gas Co., Quebec; Arscott Bros., Teeswater, Ont.; Janet & Reid, Perth, Ont.

Quebec.

MONTREAL.—The Hill Electric Mfg., Co., 1560 St. Lawrence Boulevard, Montreal, have been awarded the contract to supply the New Workman Building of McGill University with its equipment of main switchboard and panel boards. The panelboards and cabinets for the new Eastern Township Bank building, Montreal, are being built by the Hill Electric Mfg. Co., Montreal.

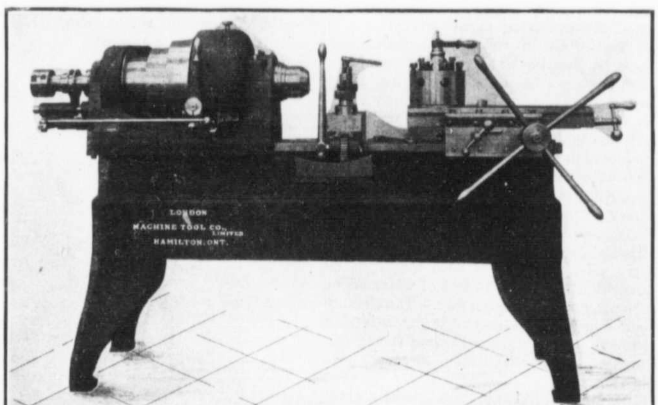


Fig. 3—New Style London Machine Tool Brass Finishing Lathe.

MONTREAL.—The plant of the Laing Packing & Provision Co. is being equipped with sprinkler systems by the Standard Automatic Fire Sprinkler Co., 177 Common Street.

SMITH'S MILLS.—Tilton & Raymond, Smith's Mills, Que., have installed a Thompson improved spark extinguisher in the pulp and shingle mill. It was supplied by Geo. W. Reid & Co., Montreal, the Canadian agents.

MONTREAL.—J. W. Williamson, Montreal, has installed a 16 inch and an 18 inch Hendry's patent laminated belt, and also a 14 inch power track saw for the Dominion Wire Mfg. Co.'s works at Lachine, Que.

The International Jury of the Franco-British Exhibition have awarded two Gold Medals to Hans Renold, Limited, for their display of driving chains in the classes, (a) apparatus for the transmission of power, and (b) machine appliances and accessories. This will not come as a surprise to those who are familiar with the correctness of design and excellence of workmanship embodied in Renold chain, which gained for them also the highest award in their class at the Paris "Salon" last year.

The Moose Mountain Iron Range

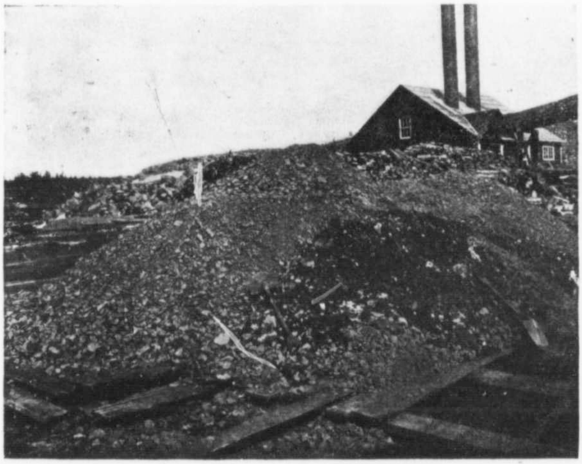
Another Valuable Deposit of Ore in Northern Ontario the Development of Which will Tend Greatly to Increase the Iron and Steel Industry in Canada.

The largest deposit of iron ore in Canada, according to Professor Miller, of the Ontario Department of Mines, is that in the township of Hutton, 30 miles north of Sudbury, and known as the Moose Mountain iron range. It extends northwest from Lake Wahnapitae, in the District of Nipissing, to Lake Onaping, in the District of Algoma, a distance of 40 miles. Its existence has been known for some years, prospectors for gold on the Vermilion River having made portages across the ridge at a point known as the Iron Dam, where the wearing away of the moss by the feet of the portagers exposed the rock, but steps were not taken for its development till the Canadian Northern Railway undertook the construction of a branch line, which was completed in 1907, when active mining operations were commenced. This line, 35 miles in length, connects with the Canadian Pacific Railway near Sudbury, and will form part of the main line of the Canadian Northern between Toronto and Winnipeg. A branch of six miles will connect with the Keys, an excellent harbor with 24 feet of water beside the dock, on the Georgian Bay. The distance from Moose Mountain to the Keys is only 80 miles, a shorter distance than the Minnesota ores have to be hauled to reach Lake Superior.

The Moose Mountain iron deposits occur in rocks of Keewatin age, which is the oldest series known in that part of North America. The ore is a magnetite, and analysis shows it to be of very superior character. An essay given by Professor Coleman in the report of the Ontario Bureau of Mines for 1904 is as follows:

Iron	62.64
Phosphorus	0.011
Sulphur	0.056
Titanium	None.

The ore contains more metalic iron than the Lake Superior ores.



The Ore Pile, Moose Mountain Mines, Showing the Ore Ready for the Smelter.

Mining operations have been carried on at Moose Mountain for about a year, and a considerable quantity of ore is ready for shipment. It is expected that a train-load a day will be sent out this season.

The surface of the ore body is 140 feet above the railway track, at what is known as No. 1 deposit. The ore is extracted by overhand stoping from an open face 60 feet to 70 feet high. It is trammed to a chute, discharging 30 feet below the bottom of the present stope into a No. 8 Austin gyratory crusher, which reduces it to a maximum size of five or six inches diameter. It then passes through a revolving screen with quarter inch perforations. The rejections go to the foot of an elevator pit, the balance to a No. 5 Austin gyratory crusher, discharging into the buckets of a 52 foot centre belt elevator, which elevates it into loading bins, whence it is discharged through hoppers into the cars. The crushing plant is driven by a 16 inch by 42 inch Jenckes Corliss engine. Steam is supplied from two 150 h.p. return, tubular boilers.

Extensive preparations are being made at the Keys for the shipment of the ore. A trestle a mile long has been built, on which the ore-trains will run up. The ore will be dumped into pockets and transferred to a rubber belt-conveyor running through a tunnel cut in the rock, then elevated on another belt to a trestle 60 feet above the water, where it will be held ready to be shot into vessels. The capacity of the dock plant is 8,000 tons per day of ten hours. It has been constructed under the superintendence of Mr. R. M. Pratt, who built the elevator and coal docks at Port Arthur on Lake Superior.

The ore will, in the meantime, be shipped to Cleveland and other United States ports, but it is in contemplation to establish a smelter at the east end of Toronto. Mr. D. D. Mann, on behalf of Moose Mountain, Limited, applied some months ago to the city council for 350 acres of the marsh at Ashbridge's Bay, which will be filled in and used as a site. The financial stringency of last fall prevented the project from being carried out at once, but when the money market becomes easier it will be proceeded with. It is intended to erect a smelter with a capacity for treating 1,400 tons of ore daily, and ultimately to establish a steel plant, rolling mills, steel plate works, steel car works and kindred industries, which, it is expected, will give employment to a force of 15,000 men and make Toronto the Pittsburg of Canada.

Moose Mountain was visited last year by the American Institute of Mining Engineers, on the occasion of their annual meeting at Toronto. Many of the members expressed themselves in no measured terms as to their appreciation of the valuable character of the deposit.—Canadian Life and Resources.

The Power and Crushing Plant, Open Pit and Ore Stock Pile, Moose Mountain Mines.

The Design of Complicated Castings

Special Designs Required for Certain Castings to Prevent Trouble in the Foundry. Special Methods of Handing Difficult Work in the Foundry. Abstract of Paper Read Before American Society of Mechanical Engineers.

By William A. Bole.

Castings are often designed with a useless multiplicity of ribs, walls, gussets, brackets, etc., which by their synchronous cooling and their inharmonious shrinkage and contraction, may entirely defeat the intention of the designer. He may find some of his walls, ribs or brackets cracked before the casting is cleaned. It is sometimes possible to remove such superfluous walls, ribs and brackets, and thereby obtain not only a lighter but a stronger and more dependable casting. It is highly essential that the designer keep in mind, as nearly as he can imagine, the cooling processes through which the casting must pass, and the effect which will be produced upon any given wall or member of the casting if it is cooled faster or slower than the other parts of the same casting.

The outer walls of a casting, that is to say, those which are more nearly adjacent to the sides and radiating surfaces of the flask, are naturally the first parts to lose heat, to begin to contract and decrease all their linear dimensions. The inner walls of the same casting, being more isolated from the conducting surfaces of the flask, may remain hot for a much longer period. As a consequence the outer members of certain castings may cool and take on their ultimate dimensions while the inner members are still very hot. The latter will, of course, ultimately cool off by conduction, but they will also continue to contract until at normal temperature, and their freedom of contraction may be prevented by the already determined dimensions of the outer walls. As a result there is likely to be violent tension strains in the interior walls of such castings. Sometimes these strains are sufficient to cause rupture while the casting is still in the mould. Sometimes the casting does not rupture until it is out in service; and even if it breaks in service the rupture may not be produced by stresses of engineering design, but may be due to the original synchronous cooling of the various parts of the casting.

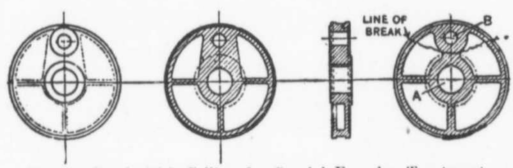


Fig. 1—Crank Disk Calling for Special Foundry Treatment.

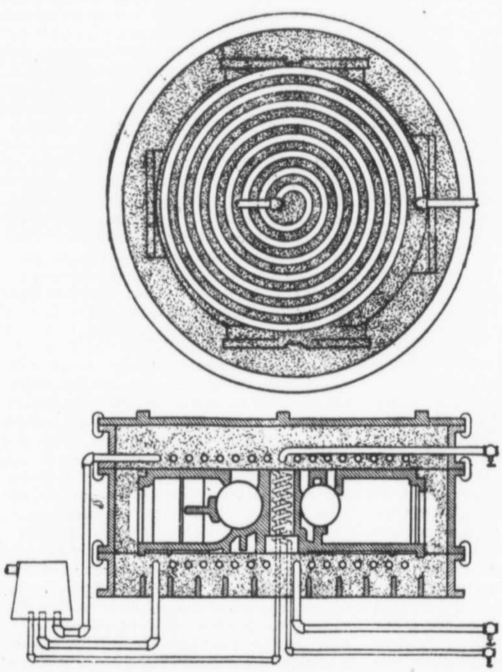


Fig. 2—A Cylinder Head Mold Requiring Special Provision for Cooling.

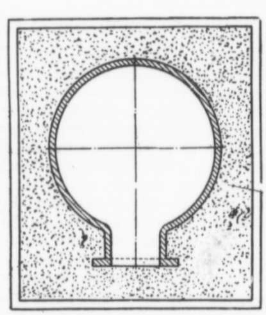


Fig. 3.—Mold for a Nozzle with Flange.

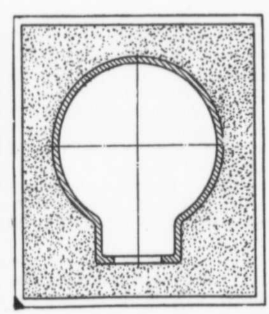


Fig. 4—Suggested Design for the Nozzle in Fig. 3.

Equalizing the Rate of Cooling

There are some castings, which, by virtue of their shapes, can be specially treated by the foundryman, and artificial cooling of certain critical parts may be effected in order to compel such parts to cool more rapidly. The strength of the casting may by such means be beneficially affected. In the case of a flywheel with heavy rim but comparatively light arms and hub, it may be beneficial to remove the flask and expose the rim to the air so as to hasten its natural rate of cooling, while the arms and hub are still kept muffled up in the sand of the mould and their cooling retarded as much as possible. Or in the case of a flywheel with an ordinary weight of rim and arm but with a heavy hub, the hub may be exposed and compelled to cool more readily than it naturally would, while the arms and rim are kept muffled in sand, and the synchronous cooling above referred to is at least approximated.

It is often thought that large fillets are fine features of design in work of this sort, but many times they are highly detrimental to good results. Where two walls meet and intersect, as in the shape of a T, if a large fillet is swept at the juncture, there will be a pool of liquid metal at this point which will remain liquid for a longer time than either wall because of its lessened facilities for quick cooling; and this pool of liquid metal is bound to act as a feeder, supplying metal for other parts lower in the mould that may shrink sooner. The result in practically every case is a void or "draw" at the juncture point, bad enough in any case, but made worse by the presence of the large fillet. Of course there may be trouble from such intersections where no fillets at all are used, but the fillets should be kept small, with the idea of allowing both walls and juncture to remain as nearly uniform in thickness as possible, and to have as nearly as may be the same capability for simultaneous shrinkage and solidification.

Jacketed Cylinders.

Among other classes of difficult castings I would place jacketed cylinders in the list requiring careful consideration in design. In considering the case of a gas engine cylinder which is to be jacketed, the inner wall which resists the strain of explosion must be quite thick in order to afford the requisite strength against explosion pressures of ordinary nature and also against abnormal pressures due to preignition and other causes. A cylinder of this sort, whose internal diameter might be 40 in., could well have a thickness of cylinder wall amounting to 3 inches or more. The outer wall forming the jacket has only to stand the ordinary pressure of the cooling water, which might be qu. 'ow, often not exceeding 60 to 80 pounds per square inch, even where water is used direct from the city mains, and an outer jacket wall 1 inch thick might on ordinary engineering assumptions, be regarded as ample to care for this pressure.

If the cylinder wall and the jacket wall are con uuous; that is to say, if each extends rigidly from one end of the cylinder to the other, there is likely to be trouble when such a cylinder is cast or cooled. Even if it does not break at the start it is quite likely to break in service because a wall of metal 1 inch thick located out near the sides of the flask, which act as cooling media, will not shrink in time with the inner wall whose thickness is three times as great and whose opportunity for radiation is quite inferior. It is reasonable to expect that the outer wall will cool first; will take on its final dimensions while the inner wall is still very hot. At a later period the inner wall will shrink to normal temperature and will find that its desire to contract is restricted by the compressive strength of the outer jacket wall. The effect is a high degree of tension in the working cylinder wall. In such a case one good feature of design is to interrupt the jacket wall, so that the inner or working wall may have its own way and be unhampered in contracting; afterward it is closed up and rendred water tight by suitable mechanical means.

In such a case as that just cited, if the jacket wall must be cast continuous with the cylinder wall, it should not be designed solely in connection with its own theoretical stresses, but should be thickened up and made to approximate the working cylinder wall, so that it may cool down and contract more nearly simultaneously with the latter. Such outer walls, and all such attachments to a large casting, as bosses and pads, should be designed not alone out of consideration to the working strains which will be applied to them, but the tendency of the iron to chill at such spots must be considered. Ofttimes the pads or the bosses require to be made several times as large as mere reasons of strength would dictate, to avoid a hardening and whitening of the iron in thin sections that would prevent its being machined to required dimensions.

Handling of Cores and Risers.

After the foundryman has accepted the design and begun the work he may have several things to do in order to produce a reliable casting. If it is a cored casting he must guard against the cores being so strong that when confined within the contracting casting they will produce rupture of the metal. Among the usual means employed for producing a collapsible condition of core may be mentioned the use of sawdust or coke or ashes, or a combination of them all, some of which ingredients will burn out as the casting cools and provide thereby for a collapse of the core. In other cases removable pieces, collapsible core arbors, straw wrapped core arbors and the like, tend to prevent castings from cracking because of an unyielding core.

In order to serve engineering purposes, castings should be not only apparently sound but really so. For this purpose risers and sinkheads should often be employed on iron castings where they are not at present used. Steel foundry conditions compel such precautions to insure soundness, but in large iron foundry work interior cavities may exist without detection, and some of these may be avoided by the use of suitable feeding devices, risers and sinkheads. If risers are not employed, the upper or cope side of the casting is likely not to be solid, because of the metal in the upper portions flowing or bleeding away from the interior of these sections to feed the shrinkage and the contraction in the lower portions of the casting. The top surface of such a casting may apparently be solid, but if drilled deeply, as for stud bolts or other purposes, it is likely that cavities and extreme openness of grain will be disclosed. In some such cases good can be accomplished by the use of local chills placed under the top flange, if a cylinder, for instance, the chills setting the metal in the flange before it has time to feed out of this region into any lower portion.

Variations in Strength.

In some large castings intrinsic strength per unit section may not be a serious requirement. In other cases the engineering design may require high quality of material because high working strains per unit section are to be imposed upon the finished casting. In such cases engineering attention should be paid to the size of the test specimen which is to furnish an index of quality, and to the relation which exists between the strength of cast iron in light test pieces and that of the same metal when cast into heavy sections. The writer has taken specimens from an iron casting having at one point tensile strength as high as 30,250 pounds per square inch, and as low as 20,502 pounds per square inch in another and heavier section. The difference was wholly related to the thickness of the section and to the rate of cooling, with its consequent effect upon the grain. It might be said that large sections cannot be cast to yield the high strength that is sometimes associated in engineering minds with specimen test pieces cast in smaller sections of prevailing sizes.

It is well that the foundryman be acquainted to some extent with the purposes for which castings are intended. This will enable him to pay particular attention to such parts of the casting as are specially critical and to such as are to be machine finished. He can usually arrange to place his chaplets, anchors and core vents so as to keep them clear of the working or sliding machined surfaces, and he can then better provide for producing a casting which is a clean one at these critical points. The moulder, if left to himself will probably put chaplets and anchors d ectly in the path of a machined slide. Sometimes this kind of information would seem to be obvious, but often it is not so, and a hollow cylindrical casting with flanges on each end might, for all the moulder knows, be a pipe having no special requirements; whereas it was intended to be a cylinder which must be bored, faced and generally machined, and must be perfectly free from defects—a casting in which chaplets and anchors are utterly inadmissible.

Certain points on a large casting may require to be drilled and tapped and may demand a high quality at that spot. A suitably located chill will insure soundness and solidity here if the foundryman knows what is demanded; if he does not know, the casting is made, looks good to him, is shipped out, and when machined is found to be hollow, cavitated or spongy at the critical spot.

In ordinary cases designs for castings should be such that it will not be necessary for the foundryman to pay particular attention to heat treatment, because in the press of other matters such treatment may occasionally be forgotten and omitted, or it may be imperfectly done by inexperienced men. A casting is best designed if it can be uncovered promptly after pouring, lifted out of its bed and deposited on the floor of the chipping shop. This is what is done with 95 per cent. of the output of the average foundry, and it is what the workmen are accustomed to. Special cases soon become irksome and some one will perhaps assume the responsibility of saying: "This special treatment is all foolishness and the casting is just as good without it." There are, however, cases in which it is necessary to design castings that do demand this special treatment.

A Special Crank Disk.

Fig. 1 illustrates a peculiar crank disk which was made in an iron foundry under the author's management some five or six years ago. The first casting was poured in the usual and ordinary manner, and after a decent delay in the flask was uncovered and removed to the chipping shop. It lay on the floor of the latter department for a day or two after cleaning; it was then shipped to the machine shop, which is located about 12 miles away. When the casting arrived at the shop it was found that a large piece had not only broken away from the balance of the casting, but it had jumped clear off the railroad car on which it was being conveyed, the missing piece being found by a track walker alongside of the railroad track a few hours after its loss was reported. The line of breakage is indicated in Fig. 1, and the missing piece weighed perhaps 1½ to 2 tons. This case was studied carefully. The heavier interior member, being the last of the casting to cool, had set up violent internal strains which caused the casting to rupture.

We arranged the next casting so that a few minutes after pouring had been done, a small stream of water in a regulated quantity was caused to drop into the hollow cores A and B, as shown on the sketch, compelling the hubs surrounding these cores to cool in advance of their natural time, and at least approximate synchronous cooling with the balance of the casting. The other portions of the casting during this period were kept muffled up in the sand and their cooling was delayed, while the cooling of the crank hubs was accelerated. After this method was adopted 12 such castings were made, all good, and they have been in service for some years.

Special Cooling Treatment.

The writer had to produce a number of large cylinder heads for Corliss engines, with ports for steam and exhaust valves formed in the heads. Structurally considered, the heads were like a cylindrical steam drum of large diameter but very short, having a flat head at each end, and were required to stand internal pressure. Considering the resistance to internal pressure, the cylindrical shell or outer wall could be designed quite thin as the strains in it were all tensile strains, while the heads, being flat and of great area, were subject to bending strains which demanded that these be greatly thickened up to make the flat surfaces, not easily stayed or braced together, strong enough to carry safely the pressure. In addition to this greater thickness of flat head, allowance had to be made for a machine finish on the flat surface, which was not required by the shell, and the disparity thus became still greater. The port openings for the admission and exhaust of steam made large holes in this head or flat plate, which were to be tied across ports by bars or ribs. In cooling by natural processes these bars almost invariably cracked in the casting, because the cylindrical shell being thin, cooled first, and was assisted in doing so by its position which was very close to the sides of the flask, where radiation was active. The flat head, on the contrary, was at the bottom of the flask, where radiation was poorer, and it was practically twice as thick as the rim and cooled more than twice as slowly. With these divergent tendencies trouble ensued. The rim cooled early and took on its final dimensions and in the form of a circle opposed to compression—the strongest possible shape. The head or diaphragm cooling later had its contraction tendency resisted by the stiff rim and a struggle was set up. The tension member was of course the weaker, and the large openings in the latter made the result a foregone conclusion. The diaphragm simply had to shrink or be stretched—the rim would not give—and the ribs broke.

We cured this trouble by the following means, as illustrated in Fig. 2: In the drag portion of the mould we placed a spiral coil of iron pipe through which we could circulate cooling water. This coil was placed as close to the face of the pattern as was considered safe, about 1½ inches away. The inner cores by which the head was hollowed out were also provided with similar interior cooling coils and the cope had a coil like that of the drag. After the casing was poured we waited for a few minutes to enable solidification to begin, and then we turned water into these cooling coils, and connecting the overflow to sewer connection, let the water run all night. The casting lay in the mould, the rim kept muffled in sand to delay cooling, while the coils close to the heads accelerated cooling. The result was most satisfactory and the castings produced by this process have stood the severest tests of several years continuous duty without failure. Heads of similar design made by other foundries cracked systematically, sometimes while the casting was still in the foundry, sometimes in the machine shop, but quite frequently not until after the engines were put into operation. In all cases the stress was there and the only question was *when* would it cause breakage.

It might seem almost unnecessary to say that flanges and other projections should be so designed that the moulder may most easily produce the desired shape without having to use complicated means. If the designer or draftsman were a man who had a little practical experience in foundry work he would see numerous opportunities for making shapes that would "draw" easily, rather than certain other shapes that look well on paper but are much harder to produce. On work of considerable size a little more time required to deal with a detail may prevent doing any pouring to-day, with a strong probability that the moulder can make that job last him "until to-morrow night." The designer should try to put himself in the moulder's place and imagine himself making the moul in question. Then he will see what a small difference in design sometimes causes a big difference in cost and risk. An instance of this is Fig. 3, and represents a prospective nozzle with a flange for steam or water connection. If the flange in Fig. 3 is at the bottom of a complicated casting it will require the flange pattern to be cut into removable sections or a troublesome embedded core is required. If practicable to design as in Fig. 4, the neck draws naturally and the main core forms the flange. This sort of change may not always be possible, as certain designs will demand loose bolts, while Fig. 4 would call for stud bolts, but there are cases in which the foundry's troubles can be reduced in this manner.

Breakages are sometimes difficult to account for, and the designer may think the fault is with the quality of the iron, when in fact this has nothing at all to do with the trouble, the shape and design being the true cause. The "physics of the foundry" were not properly understood when the design was made.

Card System for the Pattern Shop

By C. J. Fry.

Of the many places where a system is welcomed as an expert helper, the pattern shop is a most important one. To be a helper, it must be a system, simple and complete, and not a burden to the man who has to keep it up. There have been many pattern systems developed which contain some good points, but they are too complex for a small shop where the care falls to the pattern foreman. Again, a system which will work nicely in one shop will fail utterly in another, as it deals with a different class of product.

The following system has proved to be very simple, yet very efficient in the shop for which it was developed. There may be a few new ideas in it and some readers will doubtless notice some familiar ones, as the father of it made use of the good ideas he had met in various other shops, with enough changes to suit the following conditions: A small shop manufacturing a line of pattern-shop machinery of various sizes, but without the use of a foundry of its own. Improvements are continually being made in the machines, and these require many changes in the patterns.

4-18-1908 Mat. Gray Iron Patt. No. 24-1

Name Bed 12"

Weight		No. Parts	16 Loose Pcs.	Patt. Mat.
Rough 319#	Pattern	1	4	Wood
Fin. 278#	Core Box	2	3	Wood

			Where Used No.	Where Used Machine
Out	4-19-08	Ideal Foundry		
In	4-26-08	O.K.		
Out			1	12"-No. 24 Lathe
In				
Out				
In				
Out				
In				
Out				
In				
Out				
In				
Out				
In				

Fig. 1—Card for Index.

The objects of the system are: First, to give each machine a number and the different parts on it another number, which in combination with the machine number forms the piece and pattern number, and to give similar parts of different machines a similar number. Second, to easily find out what castings have been ordered and how many of them have been received. Third, to know the location of each pattern, whether at the foundry, in the pattern shop, or in storage. Fourth, to record all changes in patterns. Fifth, to provide the foundry with an efficient method of properly filling their orders.

Naturally the system starts in the drafting room which, after designing a new machine, prepares a complete list of the parts on the said machine. This is then divided into three lists, a casting list, a steel list, and a bolt and screw list. The casting list is the only one which interests us here, the steel and screw lists being distributed to the foremen and to the cost department. These lists are typewritten on letter-size paper with a black ribbon and a black carbon paper with the carbon side against the back of the sheet, thus giving a list which may be blue-printed, and hence can be made very cheaply. The blue printed list like any blue print will stand plenty of handling in the shop before it is too dirty to be read. The casting list shows the pattern number, the name of the piece, the material, the number required for one machine and the drawing number.

In explanation of the first object, let us take a certain type of lathe made in four sizes, say 12, 16, 20 and 24 inches, and known as No. 24 lathe. There are several parts which are used on all sizes and these are given numbers above 400, for instance a certain sleeve is No. 24-423. All parts used only on the 12-inch are given numbers below 100, those on the 16-inch, 100 to 200 and so on. The bed for the 12-inch is 24-1, for the 16-inch, 24-101, for the 20-inch, 24-201, and for the 24-inch, 24-301, and similarly for each part like the leg, the headstock, etc. The bed on all lathes of other types is numbered 1 or 101 and so on according to the number of different sizes made.

When the pattern is made, a card like Fig. 1, is made out and put in its place in the index case. The weight spaces are filled out from the records of the casting-room foreman. The patterns are stored on shelves, divided into sections, which are plainly marked with the machine number. To fi'l up a production order for a number of 24-inch surfacers, the order clerk takes the casting list for that machine and makes out cards like Fig. 2, which are sent to the pattern shop. A duplicate like Fig. 3 goes to the casting room so the receiver will know what castings are coming and can check them off until the order is filled.

Foundry__________

Date__________ Order No.__________

No. Wanted__________ Patt. No.__________

Date	Made	Lost

This card properly filled out must be returned with castings to insure proper credit for same.

Fig. 2—Card Sent to Patternmaker.

Foundry__________

Date__________ Order No.__________

No. Wanted__________ Patt. No.__________

Date	Received	Total Weight

Fig. 3—Card Sent to Casting Room.

Upon receipt of the casting order, Fig. 2, the patternmaker consults his change index to see if any of the patterns from which castings are ordered, have been ordered changed and are still unfinished. If the pattern is ready and the card shows it to be in the storage, he obtains it, and fastens the order to it so it can be taken to the foundry. If the card shows it to be at the foundry, the card is sent there and on receiving it they know the moulder has the patterns. When the pattern goes to the foundry, the date and the foundry name are entered as shown in Fig. 1, and when it is returned the date is entered after the word, IN. In the space after the date the condition of the pattern is noted, or the loss of any parts is recorded.

The card shows at all times where the pattern is, and if in storage, its condition, and as the castings are ordered in large lots, the care of the card is nominal. On the back of the card is a space for entering the changes and the date of same.

Fig. 4 shows a pattern change card which is self-explanatory. —American Machinist.

PATT. NO.__________ DATE__________

PATTERN CHANGE CARD

Pattern Shop will change above pattern per drawing No.__________

Sign and return card to drafting room.

Changed__________Foreman

Fig. 4—Card for Ordering Pattern Changes.

Commercial Travellers' New Officers

At the general meeting of the Dominion Commercial Travellers' Association (the Eastern organization), held Saturday evening, Mr. S. J. Mathewson, of Montreal, was appointed president by acclamation. Mr. J. Bevan Giles was appointed vice-president, and Mr. Max Murdock was re-elected treasurer by acclamation. Messrs. A. J Brown, Louis Decelles, H. H. Hughes, H. M. Levin, C. D. O'Brien, J. T. McBride, F. N. Picard, G. W. Prescott, and Charles Roberts were placed in nomination to fill the places of the five directors whose term of office is about to expire. An election will be necessary. The annual meeting was fixed for Saturday, December 12, and it was decided to hold the annual dinner at a place and date to be arranged by a committee which has been appointed for the purpose.

At the general meeting of the Commercial Travellers' Association of Canada (the Western organization), held Saturday evening in Toronto, Mr. John Gibson was elected president by acclamation; Mr. Robert Gemmell, first vice-president; Mr. S. M. Sterling, second vice-president. Messrs. E. Fielding and John M. Kenney were nominated for the office of treasurer. The annual meeting will be held in St. George's Hall on Wednesday, December 23, and the result of the elections will be declared.

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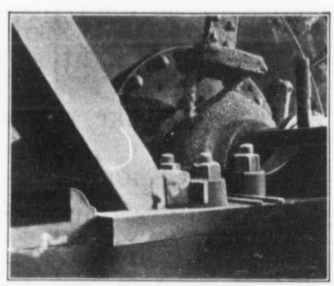

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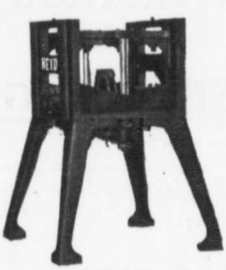

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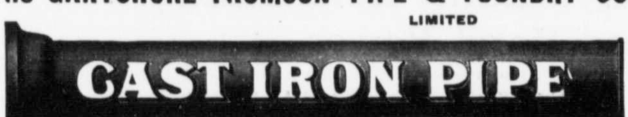

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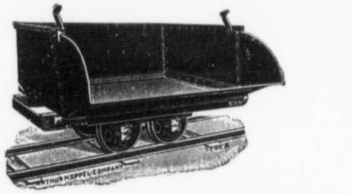

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