

**PAGES**

**MISSING**



.. THE CENTRAL ..  
**Railway and  
Engineering  
Club** .. ..  
OF CANADA

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OFFICIAL PROCEEDINGS

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No. 7.

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PROCEEDINGS OF THE CENTRAL RAILWAY AND EN-  
GINEERING CLUB OF CANADA MEETING.

ROSSIN HOUSE, TORONTO, Oct. 15th, 1907.

The President, Mr. Kennedy, occupied the chair.

Chairman,—

As the hour is advancing I think we had better open the  
meeting. There are quite a number of members down stairs

listening to the music, however, when the meeting opens they will come in.

I regret to say that the Minutes of last meeting have not been published and forwarded to each member, owing to the fact that the gentleman, Mr. Groves, who was so kind to give us a paper at the last meeting, failed to send the Secretary copy of his paper. You understand the way a paper is given, so many references being made to cuts, figures, and so on, that it is next to impossible for a stenographer to get a correct report, therefore we have to rely upon the lecturer to make corrections, unless he gives us a forecast of the paper as the lecturer has done to-night. We made every effort to get the paper with the proceedings of the last meeting out in time for this meeting, but owing to Mr. Groves' time being fully occupied, we were unable to do so, however, we expect to get it out next week.

Therefore, under the circumstances I wish some member would move that minutes of last meeting be disposed of until the secretary receives report.

Moved by Mr. Black and seconded by Mr. Fletcher and carried.

I wish to say again, gentlemen, before leaving this matter, that it was no neglect on the part of our Secretary that the Minutes of previous meeting has not been published. He has devoted a great deal of time trying to get it; however, we hope to be able to publish the proceedings of last meeting next week.

Chairman,—

The next order of business is "Remarks of President." As chairman, I do not know that I have anything of great interest to bring up, other than to say that at the opening of our last meeting, which was the opening meeting of the season, we had a very fair attendance, but we are a little disappointed that there are not more members coming in at the opening of the season. For a time it seemed that each member was desirous of getting others interested in the Club, and in consequence our membership increased very rapidly, but as time passed on the number of applicants for membership started to decrease. Our Secretary informed me that up to the time of our last meeting we had only received five new applications for membership. I feel confident that if the members of this Club would take the same interest in it now as they did at the commencement, we would have more applicants than five, and I also feel satisfied that if any applicant should come once he will find it interesting enough to come back again. I would again request each member to do what he can towards increasing our membership. The year of the Club

is drawing to a close, and we would like to have our membership increased.

Chairman,—

The third order of business is the "Announcement of New Members," and will call upon Secretary to read same.

#### NEW MEMBERS.

Mr. W. H. Bowie, Mechanical Expert, Toronto.  
 A. J. Lewkowicz, Mechanical Engineer, Toronto.  
 F. W. Landymore, Telegraph Operator, G.T.R., Toronto.  
 R. Graham, Mechanical Engineer, Toronto.  
 Samuel Harris, General Foreman Machine Shop, Canada Foundry Co., Toronto.  
 Alex. Russell, Machinist, Consumers Gas Co., Toronto.

#### MEMBERS PRESENT.

J. W. Harkom.	I. O. Frost.	H. M. Paton.
J. M. Clements.	D. C. Hallowell.	A. G. McLellan.
Jno. C. Blanchflower.	Geo. M. Wilson.	J. R. Armer.
R. L. Frost.	J. W. McLintock.	F. W. Brent.
J. McWater.	Geo. McIntosh.	A. J. Lewkowicz.
I. Jefferis.	Wm. Sharp.	J. A. Mitchell.
N. MacNicol	W. R. McRae.	Jas. J. Fletcher.
R. G. Gilbride.	J. C. Garden.	Geo. Shand.
J. E. Houghton.	C. A. Jefferis.	W. Kennedy.
W. H. Bowie.	J. Ried.	Geo. Black.
J. H. Stortz.	C. M. Wilson.	R. A. Miller.
W. E. Saylor.	C. A. Livingston.	S. W. Price.
A. E. Hawker.	C. L. Worth.	J. Duguid.
J. Dodds.	W. Evans.	R. Patterson.
J. B. Wilson.	J. Mooney.	G. Cooper.
W. Gell.	J. Hay.	W. H. Farrell.
W. J. McKee.	R. Preston.	Jas. Bannon.
I. W. Evans.	Frank Stortz.	Jas. F. Campbell.

Chairman,—

Next order of business is "Report of Standing Committees": nil. Unfinished business: nil.

Under the heading of New Business, it might be here in order to say that we would like a meeting of the Executive after the close of this meeting. It will only take up a short time, and we would like each member present to remain for a few minutes.

"Reports of Special Committees": nil. "Discussion of unfinished papers read at previous meetings: nil.

Reading of papers and reports and discussion thereof.

Chairman,—

We have with us to-night Mr. G. M. Wilson, Machinist Expert of the Grand Trunk Railway at Fort Gratiot, who has kindly consented to give us a paper on Leather Belting. Mr. Wilson has had a long and varied experience at this work, and I think by what I have already seen of the paper, which he is going to present to you to-night, that Mr. Wilson has given this question a lot of attention and care, and no doubt the paper will be very interesting to you all.

Mr. Wilson has some drawings and sketches on the way down here and we expect them any minute. I think perhaps we had better wait until they arrive and thereby prevent any interruption in the lecture.

It might be of interest to the members to know that we will only have one more meeting before the month of December in which we have the election of officers. I wish you would bear this in mind and hope to see good turn-out of the members at the next meeting. Where we get a number of officers interested in the Club, and at the same time satisfactory to all members, we may expect the club to flourish.

(The President explained here how the election of officers took place).

I simply say this in order that you may know the order of procedure.

Chairman,—

While we are waiting for the illustrations of Mr. Wilson's which we expect to locate in a few minutes, we shall be pleased to know whether any member of the Club has anything to bring up.

Mr. McRae,—

I do not know whether this will be of particular interest to the Club, but I understood that three or four meetings ago—prior to the close of the season—that we would inaugurate "The Question Box System" in our Club. We have had some nine papers given at our meetings, but so far the question box system has not been started. This question box system has met with great success in all clubs where it has been inaugurated. There is not one of us who, at some time during the month, does not meet with some particular object in his work which he would like to get the opinion of others on. I know, myself, quite frequently I get up against a proposition of this kind. At the present time, for instance, there is considerable controversy regarding cast gray iron brake shoes and inserted brake shoes. As this is partly a Railway Club, I think this is the best place to have such matters settled. I would like to see at the next meeting a number of questions

brought up of a similar nature. Or if the questions were turned in, our Secretary might write to some of the members of the Club who would be best to answer the questions.

Chairman,—

I might say regarding the remarks of Mr. McRae, our Vice-President, that the matter of a "Question Box System" was brought up sometime during the first meetings of the Club. The great difficulty with the Question Box System has been that we have had such lengthy papers and we have opened our papers so late, that we have not had time to bring up any questions. I think the only way to make a success of this Question Box System is to devote an evening to it.

Either idea might be a good one which would allow the members to bring up questions of this kind, but in doing so we should not lose sight of the fact that the questions should be sent in early so that the Secretary can notify the members of the questions and they can come prepared to discuss them. If I recollect rightly it was decided at one of our meetings that members should send in questions to the Secretary, but up to the present time he has not received any.

Now if Mr. McRae will put a motion before the Club we will proceed.

Mr. McRae,—

I take pleasure in moving that we should devote our next meeting to questions to be submitted in time for that meeting. I have attended a number of conventions and the question of cast gray iron brake shoes being superior to that of inserted brake shoes was discussed but no decision was arrived at. I would like to have the opinion of the steam railroad men on this matter. I have been unable to find where any railroad men have given an opinion on it. The electrical men have their ideas concerning it, but I would like to hear what the steam railroad men think about it.

I move that the next meeting be given to answering questions.

Chairman,—

I would suggest that Mr. McRae state some date by which these questions should be in.

Mr. McRae,—

I would not care to state a date.

We may get one or two questions in between now and next meeting, and the Executive will likely have the Secretary write three or four gentlemen whom we know will be able to answer the questions. No doubt there is some here to-night who are anxious to answer the question I spoke of, however,

I would leave this open until the next meeting night. Let us have all the questions we can get.

Chairman,—

You have heard the motion of Mr. McRae. Seconded by Mr. Fletcher and carried.

Chairman,—

Is there any other member present who has anything to bring before the Club while we are waiting for the illustrations in connection with this paper?

Mr. McRae,—

We have with us to-night the father mechanic of a number of the men present. I think it would be in order to have Mr. Harkom give us a few words.

Chairman,—

I have great pleasure in calling upon Mr. Harkom for a few words. I know there are a number here who have served under Mr. Harkom. I, for one, started my apprenticeship at 13 years old under him, and it affords me a great deal of pleasure to have Mr. Harkom here with us to-night and to hear some remarks from him. Applause. ■

Mr. Harkom,—

Gentlemen: You have got me at rather a disadvantage. I am only a youth in this Club and this is my first appearance, however, I must express my gratification of being able to speak to you this evening.

One of the things I wish to say is that some years ago while visiting Toronto frequently on railroad service, it was considered that a club of this kind was a great need here, and I was approached by a number of gentlemen—I do not know whether any of them are here to-night—who wished me to assist in forming such an Association as this. The formation of this club, therefore, has certainly filled a want in the life of railroad men of Toronto, more especially those whose duties bring them into contact with the technical part of the work, and will give a bright spot to gather on.

I have read occasional reports of your meetings, and they have been very interesting, indeed. This is the first night I have visited this Club, and perhaps might have overlooked the date if it were not for one of the youngest members of your Club reminding me of it, and I made up my mind to come.

Regarding this Question Box System, if you will allow me to say, I certainly agree as to the necessity of allowing the members time to prepare for the discussion of the questions. Many of the members can look up something either from

memory of from books bearing on the subject, and their views, therefore, can be presented on the question more intelligently. I would suggest that the questions be embodied at one meeting and discussed at the next. This method would perhaps take a little more time but I think it would be the best. On the other hand there should be a limit as to the time for questions to be received for discussion, if the members are to be notified by circular.

Mr. Chairman, I would ask you to excuse me from any further remarks, as I really feel I am not prepared to take up the time of the meeting any further. In conclusion I thank you for your kind expression this evening.

Chairman,—

I am sure we are all pleased to hear the remarks of Mr. Harkom, and I trust Mr. Harkom, you will continue to take a kindly interest in this Club, as it is the attendance of such men as yourself that encourages other to come here. I assure you we all appreciate the time you took attending this meeting, and we trust that at some future date, not far distant, you will be kind enough to prepare and give us a paper that, with your long and varied experience, will be of interest to this Club. We leave the subject of this paper for you to decide upon, and I am sure if you will make it known to the Secretary the date you will give this paper, we will all be pleased to hear this announcement.

Mr. Harkom,—

Asking me to present a paper to you, brings up an incident which occurred sometime ago when I was sitting in my office at Davenport. The School of Practical Science asked me to give them a paper, which I consented to do. I was, however, under the impression that it was to be given at 8 o'clock in the evening, when they called me and said the lecture was to be given at 4 o'clock and they were waiting there now for my appearance.

I am sure, gentlemen, it will be a great pleasure to give a talk to you. I was over in England for about three months a short time ago, and if you wish, will give you a talk on what I saw while travelling on the railroads over there. Of course it will be from general observations.

Chairman,—

I am sorry to say that the illustrations for the paper to be given by Mr. Wilson to-night, have apparently been mislaid or gone to some other place, and I am sure we all regret very much this occurrence, however, I hope Mr. Wilson will be able to manage without them.

I have much pleasure in introducing Mr. Wilson.



## LEATHER BELTING.

By Mr. Geo. M. Wilson, Machinist Expert, Grand Trunk Railway Shops, St. Gratiot.

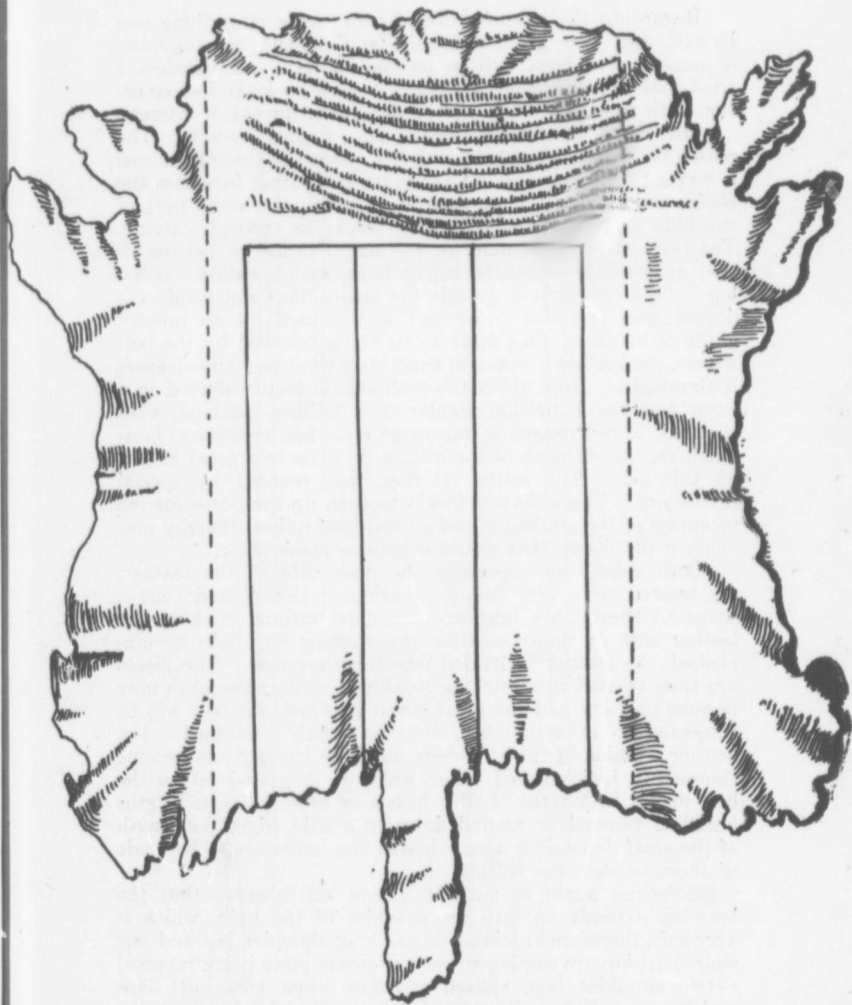
I feel it a favor to see the attendance at this meeting to-night and I trust that the paper I will give you will be interesting. While most of the things in it will be old to you, yet you may have forgotten some of them, or if you are possessed of the knowledge, your memory may be favorably refreshed by the reading of this paper.

Before proceeding with the subject of Leather Belting, it has occurred to me, that a few remarks might be made in reference to the article from which belting is made, viz., leather. The earliest information that we have regarding the manufacture of leather, as far as I am aware, is about 1490 years B.C.

As regards the methods of preparing the leather at that date, I have seen no account, and this remark will also apply to the time of the Romans and that of the Middle Ages—the records appear to have been lost.

We are, however, certain that somewhere in the neighborhood of the year 1700 A.D., accounts are given how tanning, or the conversion of animal hide into leather was accomplished. The process of time necessary for the manufacture covering a period of nine to eighteen months. In later day practice this time has been reduced to four months, while a still later date shows the time reduced to forty-five days by the introduction of quebraco and other extracts, to take the place of oak bark. It might be interesting in this connection to say, that in Sweden a process for tanning electrically has been successfully brought about. The hides are hung in the tanning liquor between two copper plates or electrodes, through which an alternating current of 50 volts at 100 amperes is passed, completing the tanning in about seventy hours. In the judgment of some of the best manufacturers of leather, the process of tanning by oak bark extending over at least a period of four months is decidedly the most advantageous. I understand, however, that there is a leather manufactured in the following manner: The hide is tanned (not, it is stated, by the oak bark process) on the surfaces only, the interior fibre being rendered pliable by some patent process; thus it is claimed securing all the advantages of tanned leather, while retaining the strength of the rawhide. It is contended that this treatment is superior to tanning by oak bark.

During the past hundred years patents taken out for tanning extracts, machines for stretching, etc., number about 1,600. The capital invested in the United States leather industry a few years ago, in a year reached nearly \$173,000,000 while the wages paid to 52,000 employees were about \$22,600,000.



Cut No. 1.

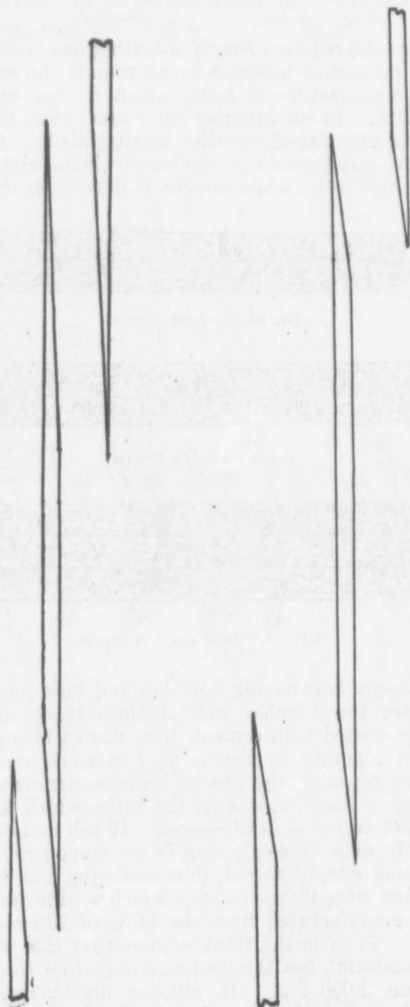
## THE MANUFACTURE OF BELTS.

Regarding the manufacture of belts, little or nothing can be said that you are not already familiar with, as a number of essays have been written on the subject; nevertheless I trust that the few remarks which I propose to make in connection with the subject will not be altogether devoid of interest.

Cut No. 1 is a representation of a tanned ox-hide. The reason for selecting the hide of the ox instead of that of the cow is owing to the fact that while the back of either furnishes the choice portion for the purpose in question, the same part of the hide of the cow is subject to weakness through calving. The best part of the hide for the manufacture of belting, is that enclosed between the heavy lines, and is called "short-lap" while the portion outside the heavy lines and inside the dotted lines is called "long-lap" and is used for an inferior grade of belting. Previously to its being received by the belt maker, the leather is taken in hand by the currier, who cleanses it thoroughly, after which the flesh side is finally shaved in a large machine somewhat similar to a milling machine, with the view of not removing any more vein than necessary, inasmuch as, the strength of the leather depends to a great extent on this side. The leather is then well scoured by special machinery. The object of this is to open up the pores for the reception of the stuffing of cod oil and beef tallow, thereby preventing the decay that would otherwise come about.

Both sides, but especially the flesh side of the leather, are treated to a very free application of the oil and tallow, so as to thoroughly lubricate the fibre without making the leather soft or flabby. After the stuffing has been accomplished, the leather is divided into three sections. The pieces are then treated in stretching machines so that the fibre may become uniform and the great strain to which the belt will be subjected to in actual use, may be evenly sustained. The leather remains in the stretchers until the stuffing has become thoroughly incorporated, after which it is passed on to the belt maker in lengths of fifty inches or more. These lengths are then tapered or scarfed down to a thin edge, the length of the scarf depending upon whether the joints are to be made of short or long lap belting.

Referring again to cut No. 1 you will observe that the long-lap extends up into the shoulder of the hide, which is very soft, therefore in joining it, one long shoulder lap and one short butt lap are employed, each alternate piece being reversed—two shoulder laps spliced together, then two butt laps and so on. This is illustrated by cut No. 2. In short lap belting, pieces and butts are both short and the leather all runs one way of the hide; see cut No. 3. The laps are fastened together by a specially prepared cement, being lightly spread



Cut No. 2—LONG LAP.

Cut No. 3—SHORT LAP.

over the surfaces which are to be joined; hydraulic presses from one to twelve tons being employed to secure them together.

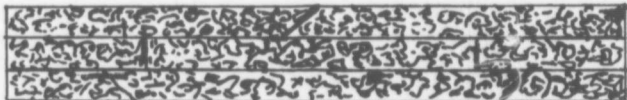
As soon as the required length of belting has been obtained, it is passed through a machine which rounds the edges, completing the manufacture of belts, which do not exceed fifty inches in width. In constructing belts wider than fifty inches, several pieces are placed together longitudinally. Cuts No. 4 and 5 show end sections of double-ply belts with butt and lap joints respectively, while cut No. 6 illustrates the end sec-



Cut No. 4.—BUTT JOINTS.

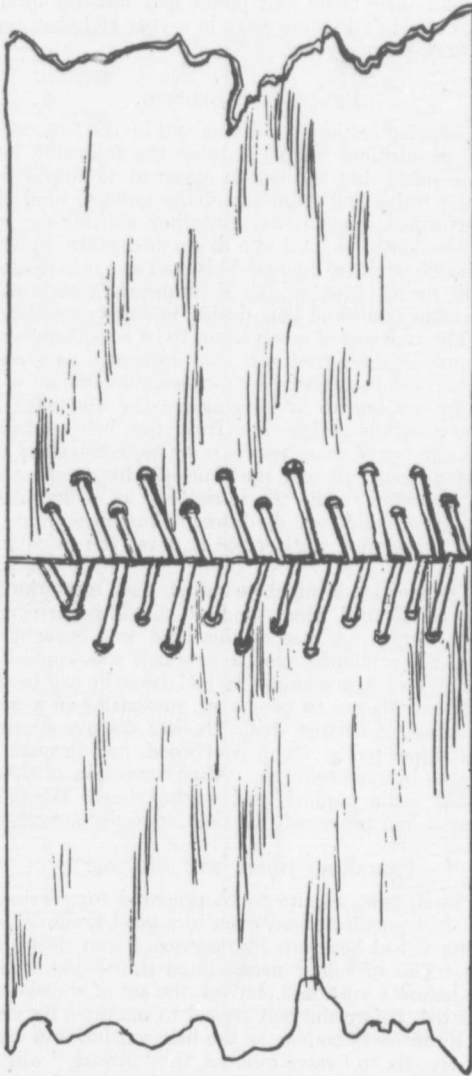


Cut No. 5.—LAP JOINTS.



Cut No. 6.—BUTT AND LAP JOINTS.

tion of a three-ply belt having both lap and butt joints. The laps which are three inches wide, besides those surfaces to be spliced, are coated with cement, then the various pieces are firmly pressed together by means of hydraulic presses, each over 200 tons capacity, the presses being so arranged that an equal pressure is distributed over the entire width of the belt, insuring perfect adhesion of the pieces. It will be noticed that the center ply of a three-ply belt is not lapped, which is unnecessary, being simply butted, thus rendering the belt more pliable. A first class three-ply belt 72 inches wide and 100 feet in length is manufactured from the hides of 225 cattle, says "Belt Book." (You might think at first that this was a prodigal use of material, but think what a belt like this will do. It will transmit 2,000 h.p. It will run machinery, and one such belt is known to be now doing this, which turns out \$1,000,000.00 worth of finished product in a year, and will continue to do this for twenty years without losing any of its virtue. If you had 225 steers working for you with their



Cut No. 8.—HINGE PLAN OF LACING A BELT.

hides on and their blood and bones and muscles inside their hides, they couldn't do more work in a year and they certainly couldn't work twenty years.

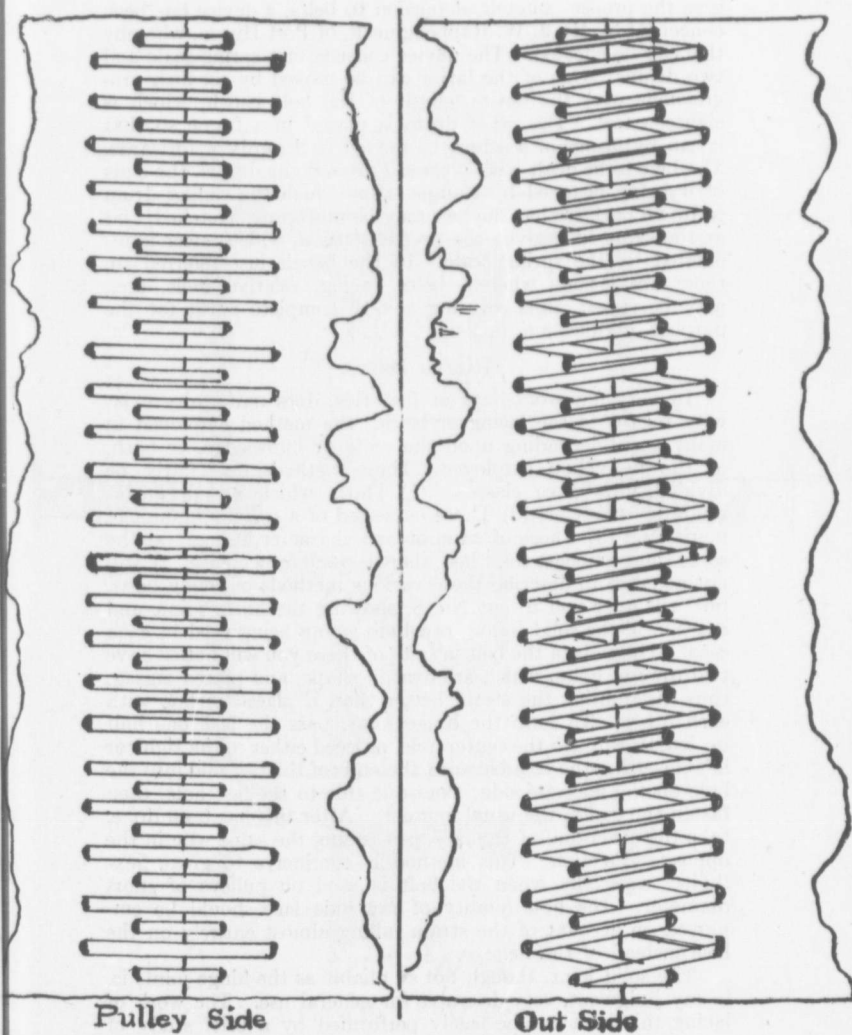
#### PURCHASING BELTING.

In purchasing belting, quality should be the first consideration, and requisitions should furnish the following information: The speed that the belt is expected to run in feet per minute, the width and diameter of the pulleys, kind of work to be performed, horse-power, whether shifting or straight running, whether to be used in a damp or dry atmosphere, and whether inside or out of doors. This, and any other particulars that might be requisite, would, if furnished, greatly aid both the purchasing agent and belt dealer in supplying the proper article. The true cost of a belt is not to be considered necessarily the same as the initial cost, but can only be ascertained after the belt has been tested by a reasonable amount of actual service. In coming to a conclusion, the following points should be carefully weighed: How the belt performs its work, the number of times it breaks or requires taking up, the time taken to repair it and the time lost by stopping of machinery. Therefore, while the initial cost of a first-class belt may seem excessive, it will doubtless be manifest from time to time, that considering the service it gave, the price was not unreasonable.

In this connection it might be stated, that, often the quality of a belt is condemned when the fault should be attributed to some other source. A case of this kind was brought to my notice only a few months ago; a new belt was applied to the stepped pulley of a machine. It had been in use barely ten minutes when it began to turn over, presenting in a measure, the appearance of a twist drill. It was discovered that the face of the upper pulley which is of wood, had through a long period of use, become concave. After correction of this fault, the belt was again applied, and worked fairly satisfactorily, considering it had previously become unevenly stretched.

#### PREPARING BELTS FOR SERVICE.

Belts, when new, require to be prepared for service. For instance; we have all noticed even in a good grade of belting, shortly after it had been put into service, it ran slack through stretching. This of course necessitated shortening, and more than once before a week had elapsed, the act of shortening had to be repeated, before the belt ceased to manifest its yieldingness. As a matter of course, as the belt continues in use for a period of, say, six to twelve months, the "stretch" which previously was unequal, has then become almost uniform, consequently, few, if any, more shortenings are necessary. In order



Cut No. 9—SOLE JOINT RAWHIDE LACING.



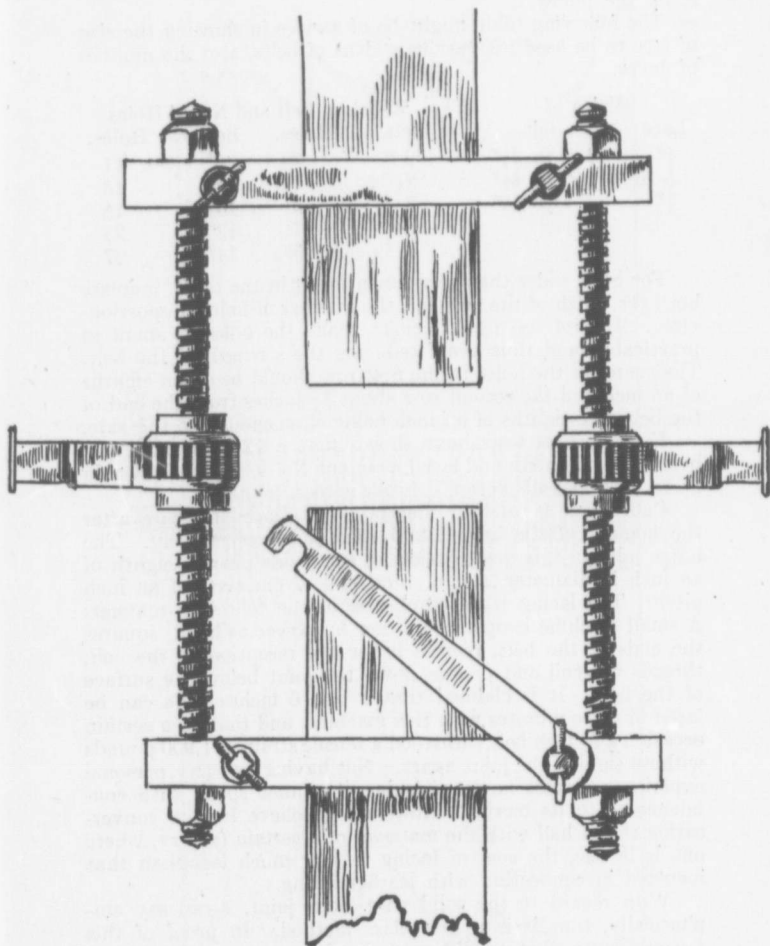
however, to minimize the shortening processes, as well as to give the proper amount of tension to belts, a device has been conceived by Mr. J. W. Rappenglueck, of Port Huron, whereby this can be effected. The device consists of a spring scale and two drums. One of the latter can be moved by six inch progressions over the entire length of the belt bench, which is eighteen feet. The other drum is placed in a frame so that it can by means of a screw, be moved backwards or forwards. The belt to be dealt with is passed around the drums, the ends of it being fastened by clamps, after which the sliding drum is drawn back so that the belt may be uniformly stretched, and at the same time given the proper tension, which latter is indicated by the spring scale. In the bench just referred to, there are lockers wherein belts, lacing, relative tools, etc., may be stored, thus securing a very complete outfit for the purpose in question.

#### LACING BELTS.

In very few workshops or factories, does uniformity exist with regard to the lacing of belts; the method employed in many cases depending upon the taste or knowledge, or both, of the individual employee. These methods may fairly be divided into three classes. (1) Those which are decidedly crude in character, (2) Those possessed of a certain amount of merit, and (3) Those of an approved character, though, at the same time, amongst these last, there is room for a choice. I will not attempt to describe these various methods of lacing belts, but will refer you to cut No. 8, showing the hinge joint, and cut No. 9, the solid joint; raw-hide lacing being used in each case. The ends of the belt in both of these you will notice have two rows of holes, which are oval in shape, and placed zigzag, thus distributing the strain better than if placed in line with each other. To form the hinge joint, pass the lace one half its length through the center hole, proceed either to the right or left, inserting the lace between the ends of the belt and into the hole on the opposite side; continue this to the last hole, then fasten the end in the usual manner. After this has been done, take the other half of the lace, proceeding the same way in the opposite direction. This method is conducive to great flexibility, especially when the belt is used on pulleys of short diameter. The best quality of raw-hide lace should be employed on account of the strain falling almost entirely on the lace instead of the belt.

The solid joint, though not so pliable as the hinge joint, is, in my judgment, very desirable for general use. The work of lacing this joint can be easily performed by a brief study of cut No. 9.

In lacing belts six inches wide and over, a pair of clamps as shown by cut No. 7 should be employed. By so doing,



Cut No. 7—BELT CLAMP.

danger to the person putting the belt on, is averted, besides which the belt is not apt to be stretched on the edge, by sliding it on the pulley.

The following table might be of service in showing the size of lace to be used for various widths of belts, also the number of holes.

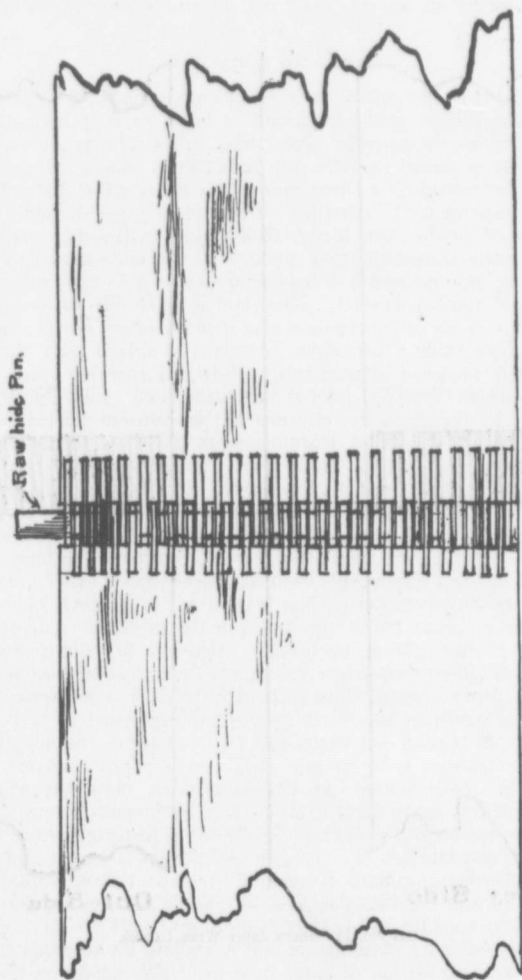
Lace	Width of		Width of Belt and No. of Holes.			
	Belt.		Belt.	Holes.	Belt.	Holes.
$\frac{1}{2}$ "	1 "	to $2\frac{1}{2}$ "	2 "	3	6"	11
5-16"	$2\frac{1}{2}$ "	to $4\frac{1}{2}$ "	$2\frac{1}{2}$ "	4	8"	15
$\frac{3}{8}$ "	5 "	to 12"	3 "	5	10"	19
			4 "	7	12"	23
			5 "	9	14"	27

For belts wider than those mentioned in the table, increase both the width of the lace and the number of holes proportionately. Do not use thick lacing; make the holes as small as practicable, and thus avoid reducing the strength of the belt. The center of the holes in the first row should be seven-eighths of an inch and the second row about  $1\frac{1}{4}$  inches from the end of the belt, five-eighths of an inch being close enough to the side.

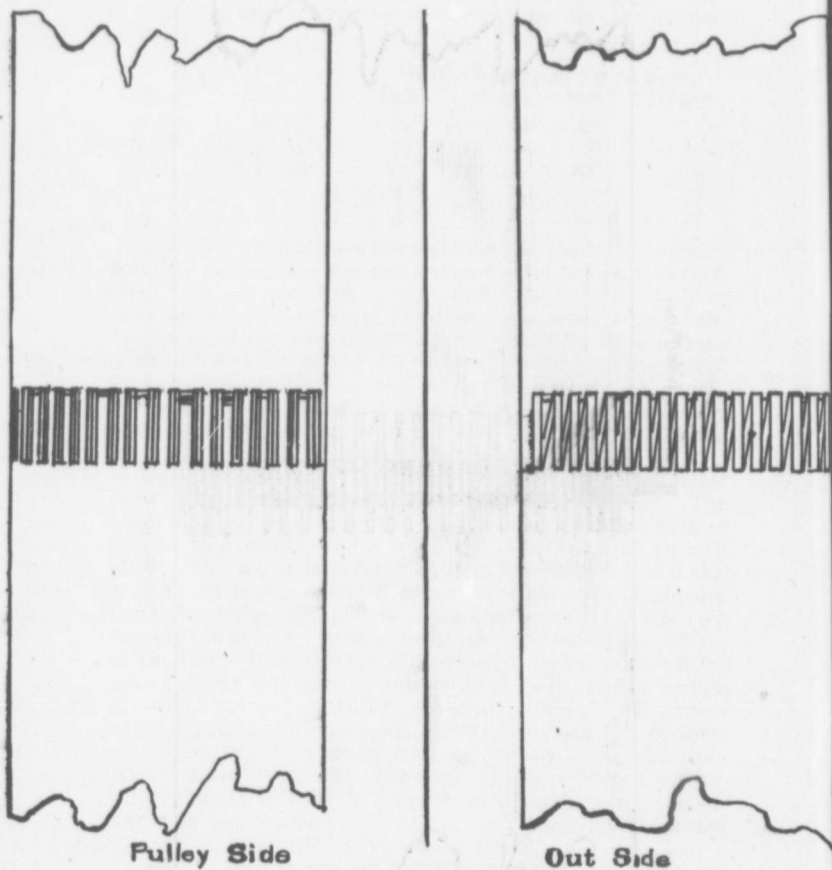
Experimental tests have shown that a 12 inch single ply belt having 23 holes and laced as in cut No. 9, endured a strain up to 5,272 pounds before it broke across the holes.

Cuts No.'s 10 and 11 illustrate belts laced by wire after the manner of the hinged and solid joint respectively. The hinge joint in this case consists of a rawhide pin one-eighth of an inch in diameter, and a spiral coil of one-sixth of an inch pitch. The lacing is accomplished in the following manner: A small machine is operated either by power or hand, squares the ends of the belt, pierces it for the reception of the coil, threads the coil and presses down the joint below the surface of the belt. It is claimed that a belt 6 inches wide can be laced in three minutes with this machine, and that on a certain occasion a  $2\frac{1}{2}$  inch belt withstood a tensile strain of 1,900 pounds without pulling the joint apart. Not having had any personal experience in this mode of lacing, I cannot speak with confidence as to its merits. However, I believe from a conversation that I had with the manager of a certain factory, where one is in use, the cost of lacing is very much less than that incurred in connection with leather lacing.

With regard to the solid wire laced joint, I can say emphatically, that it is a first class method. In proof of this I would state, that on different occasions to my own personal knowledge the leather lace of two fan belts broke, necessitating the employment of a new lace as frequently as once or twice a week, but after the introduction of the wire lacing, these belts would run for months without re-lacing. It is of great importance that the ends of a belt in transmitting power,



Cut No. 10—COIL CLASP BELT LACING.



Cut No. 11—SOLID JOINT WIRE LACING.

should be joined in such a manner that it will run smoothly over the pulleys. This is easily accomplished by wire lacing, as the joints are not any thicker than the rest of the belt.

#### EFFICIENCY OF BELTS.

With reference to the efficiency of leather belts, it is a well known fact that in order to obtain the best results, the conditions under which the belts work, play an important part. Experiments have shown that the average breaking strain of leather is 3,200 pounds per square inch of cross-section, but a belt when in use should not be subjected to a greater strain than one-eleventh of this, which would equal about 55 pounds for each inch of width in a single belt three-sixteenths thick. The strain can of course be increased in direct proportion as the thickness of the belt is increased. Knowing, therefore, the limit of strain beyond which it is undesirable to go, it naturally follows, that if this be exceeded, while for a short period the belt may perform its work, its strength becomes impaired and its efficiency to a great extent lost. Where the appliance for indicating tension at the time, is not at hand, its service can be dispensed with approximately by shortening the belt half an inch for each ten feet of its length. As previously remarked, the flesh side of the belt is the stronger and constitutes about one-third of the thickness of the belt. It is of much importance that the grain side of the belt should be the one coming in immediate contact with the surface of the pulley. Were it otherwise, the flesh side, which constitutes the principle strength of the belt, would be exposed to a wear and tear which would in a comparatively short time, reduce the lasting quality of the belt. Therefore, in all cases the grain side should be kept next the pulley. Another point, the grain side possesses a surface of greater smoothness, which is conducive to increased driving power, estimated at thirty per cent. It is generally supposed that the larger the pulley, the greater the transmitting power. This theory may appear on the surface plausible, but it should be remembered, that the horse power transmitted by a belt is dependent upon the number of degrees contained in the arc of contact on the pulley, and the number of feet it travels per minute. It matters not whether the pulley be 36 inches or 72 inches in diameter, provided that the tension and the number of feet travelled per minute be the same. This is based on the fact that the co-efficient of friction is the same on all pulleys of like material, having the same arc of belt contact. We have seen cases in actual practice where smaller pulleys were replaced by larger ones, and an increased belt power followed, but this increased belt power was the result solely of the higher velocity at which the belt was run. I suppose it will not be questioned, that within certain limits,

the greater velocity at which a belt is run, the greater the amount of its transmitting power. It is well known that a one inch single belt having 180 degrees of contact running 900 feet per minute, constitutes one horse power. Therefore by the use of the following formula, the proportions existing between the width, speed and horse power of single-ply belts, relatively to one another, may be determined.

W—Width in inches.  
 S—Speed in feet per minute.  
 H—Horse power.  
 900—Constant.

$$W - \frac{900 H}{S} \quad S - \frac{900 H}{W} \quad H - \frac{W S}{900}$$

For double ply belts use the constant 630. If, however, the pulleys are of unequal diameter, the following table may be resorted to:

Arc of Contact On Smaller pulley	Percentage of Efficiency.
90 degrees	65%
100	70
110	75
120	79
130	83
140	87
150	91
160	94
170	97
180	100

To find the arc of contact on the smaller pulley of an open belt, multiply the difference of the diameter of the pulleys in feet by 57.3 and divide by the distance between the centers of the shafts. Subtract the result from 180 degrees.

#### CARE OF BELTS.

We have now arrived at a division of our subject which is surely of more than passing interest, the division to which I allude is the proper care of belting, to which is annexed a number of miscellaneous hints. The interest of all companies making use of leather belts, will be materially advanced, when none but the best methods for their maintenance are in use. I am led to make this remark from what I have observed, namely, that there are numbers of employees who, as a result of carelessness and improper methods, are the authors of a large amount of waste of valuable material, which loss falls upon the employer. That this loss should fall upon the employer, seems to them quite equitable, which conclusion is sometimes

voiced in such an utterance as "The Company's rich, they can stand it." Therefore, in every shop the care of the belting therein should be entrusted to a man possessing a thorough practical knowledge of the subject, who should be held primarily responsible for the good working condition of the material under his charge, and the avoidance of any unnecessary loss in connection therewith. He should be equipped with all the necessary tools for effecting repairs, etc. It has been claimed that the expenditure per year for repairs on belting, including labor and material, should not exceed 20 per cent. of the original cost of the belting, whereas these items have been known in many cases to exceed 100 per cent. A shop register should be kept by the belt man, the pages of which should give in detail the following particulars. When and where each belt was applied, its length, width and thickness, date and nature of repairs made thereon; each belt to be identified by a certain number in the register.

#### MISCELLANEOUS.

In applying belts for use on flanged or stepped pulleys, see that they are at least half an inch narrower than the face of the pulleys. Nothing stretches a belt unevenly more quickly than rubbing against the flange or side of a pulley. Belts should not be fastened with rivets, especially where the pulleys are small, as the rivets cause slippage which means a loss of belt efficiency. To test the quality of a leather belt place a cutting of it about one-sixty-fourth of an inch thick in a strong solution of vinegar; if the leather is thoroughly tanned, it will remain for months immersed without alteration, simply changing to a little darker color. If of a poor quality, the fibres will swell and very soon it will be transformed into a gelatinous mass.

Do not allow a belt to hang on a revolving shaft. Long belts transmit more power than short ones. Narrow belts should have a length of 15 feet between pulleys, larger ones 20 feet to 25 feet. The angle of the belt with the floor should not exceed 45 degrees.

The motion of driving should run with, not against, the laps of the belt. Belts adhere better to wooden pulleys than iron ones.

Belts should be kept free from grease and accumulation of dust, especially from contact with lubricating oils, protected and kept pliable by an occasional application of cod oil and beef tallow, equal parts, applied hot.

To find the change required in length of belt when one of the pulleys is changed for one of different diameter, three times half the difference between the diameters of the pulleys and the result will be the length to cut out or put in.



Fast running belts should be made as straight and uniform as possible and endless if practicable.

In making endless belts the following table will show the proper length of scarf.

Width of Belt.	Length of Splice,
1"	5"
2"	5"
3"	6"
4"	6"
5"	7"
6"	8"
7"	8"
8"	9"

All over 9" splice should be the same length as width of belt.

The "pulling strand" of horizontal belts should be on the bottom.

Main shafts in machine shops should run 150 and in wood-working shops 300 revolutions per minute.

#### RULES FOR FINDING SPEED OF PULLEYS AND THEIR DIAMETERS.

Dia. of Driven X Rev. of Driven  
 ————— Equals Dia. of Driver

Rev. of Driver.

Dia. of Driver X Rev. of Driver  
 ————— Equals Dia. of Driven.

Rev. of Driven.

Dia. of Driven X Rev. of Driven  
 ————— Equals Rev. of Driver

Dia. of Driver

Dia. of Driver X Rev. of Driver  
 ————— Equals Rev. of Driven.

Dia. of Driven.

To find the length of a cross belt, take the square of one-half the sum of the diameters of both pulleys, also the square of the distance between centers, add these together, and multiply it by 2. To the product add the result obtained by multiplying half the sum of the pulley diameters by 3.14.

To find the length of an open belt, multiply half the sum of the pulley diameters by 3 1-5 and add twice the distance between the centers of the shafts. Use 3.14 if diameters differ much and centers are short. If the pulleys are of the same size or nearly so, with centers not too close, add the diameter in inches and multiply by .1309. Add to this twice the distance in feet between centers and the result will be the approximate length in feet.

To find the number of feet contained in a roll of belting: Add the diameter of the roll in inches to the diameter of the center hole in inches; multiply by the number of coils and the product by the decimal .1309.

In presenting the foregoing remarks, I wish it to be understood that I have not gone thoroughly into the subject, but if I have furnished some information that was not already in your possession before, and is deemed by my listeners as worthy of being acted upon, I would feel that what labor I have bestowed upon it at odd times, owing to a pressure of regular business, has not been in vain.

Chairman,—

I am sure, gentlemen, we have all listened with a great deal of interest to Mr. Wilson's lecture, it being more interesting as it comes from one of our own shop men who has had the practical experience in this work, and at the same time attending to his daily duties, we can realize the amount of labor he has given in preparing this paper.

Perhaps some of the members present may not be interested in belting, yet I think the majority of us will be deeply interested in this lecture. We had a number of fine papers, but some of them were so long that there was no time for discussion afterwards, however, to-night I think we can all remain a few minutes and discuss this subject.

I shall be pleased to hear from any member present.

Mr. Black,—

I would like to ask Mr. Wilson one question. He spoke of different sized pulleys requiring the same weight to move the belt over. It did not quite get this part. He said one pulley was one-half the diameter of the other, and still it required the same weight to slip the belt over.

Mr. Wilson,—

It is a question of frictional contact. The friction is independent of the extent of surface. It depends upon the perpendicular pressure, therefore, the extent of surface does not count. As I explained there were two pulleys, one 6" dia. and the other 3" dia., with weights on either end of belt of 14 lbs. and 28 lbs. respectively. Although you changed these weights around, yet it did not move the belt over the pulleys, as the pressure was the same. It does not matter about the friction, it is the perpendicular pressure which counts. You may have a machine which is driven with 24" pulley on your main shaft and 20" pulley on your countershaft, belt 12" wide, and you find there is not belt capacity enough to do the work which the machine is required to do. You change the pulley to 36" dia., and find this does the business for you.

What has happened there? Simply you have increased the velocity of your belt. Remember a belt running 900 feet in one minute develops 1 h.p. We must bear in mind then that it is the velocity of the belt which gives the power. You have not increased the revolutions of the shaft but have only increased the diameter.

Mr. Harkom,—

The longer I live the more I believe in the old adage,—“There is nothing like leather.” Of many papers I have heard, I do not think I remember one better presented than that given to-night. The subject has been handled in an extremely practical and intelligent manner. It has confirmed the opinions I have been led to form, that there is certainly nothing like the leather belt, and the best that has ever been said of substitutes for leather belting is, “That they are just as good as leather.”

As regards to “hinge” joint, last February I was in a shop in England, and I think of all the shops I was in in my life, I will give the honor to that shop for good shop management. There they showed me something “from America,” which was nothing more than the wire joint mentioned by Mr. Wilson. There is no question that there is nothing better than the wire joint. In the first instance there is no loss in strength of belt. Again there is no depreciation. They have a little machine to wire the belt, and a pin put through the coils will join the belt so that it could not break under ordinary use. I must confirm Mr. Wilson's recommendation that it will hold to the pulley better than anything else.

Regarding the power of the belt, as has been said, it is the speed of the belt which gives the power acting on a practical succession of levers governed by the size of the pulley, and the old axiom that “what you gain in speed you lose in power, and vice versa,” is exemplified by the illustration given, viz., that increasing the diameter of the pulley with belt running at same speed, increased the power, but reduced the speed of shafting in revolutions per minute.

With regard to what Mr. Wilson says regarding the care of belts, I think this is a very important matter. Great care should be given in not allowing lubricating oils to get on belts, as they are often the death, or shorten the life of a good belt.

I am very sorry we did not have the diagrams which Mr. Wilson had so kindly prepared. It is a matter for which we have to express our regret for more reasons than one, in that Mr. Wilson has gone to a great deal of trouble in preparing them, but unfortunately they were not obtainable. Mr. Wilson has, however, explained the subject very clearly, and given us a good mental picture of them.

With regard to the endless belt, which he did not touch

on very much; of course, there is no lacing in this class of belts, but at the same time it has to be most carefully handled, and if you get it running crooked, look out, as you will have a great deal of trouble with it.

I think it is in order that a vote of thanks be given Mr. Wilson for his attendance here to-night, and presenting us such a fine paper. I take great pleasure in moving this vote of thanks. Seconded by Mr. Fletcher, carried.

Chairman,—

I am sure, gentlemen, the paper presented to us to-night by Mr. Wilson has been very instructive to us all, and I think everybody will go away with something more than he had formerly.

I have great pleasure in extending the vote of thanks of this meeting to Mr. Wilson for his very able lecture, and must again express our regret that the diagrams for the lecture have gone astray.

Mr. Wilson,—

Thank you, gentlemen, for your kind vote of thanks, which I assure you is appreciated. That my humble efforts have met with your approval is a source of gratification to me.

Chairman,—

I would ask one question more. Is there any other member present who wishes to give a question for answer as Mr. McRae has done? (None).

As there is none we will pass on to the next order of business: "Appointment of Committees": nil. Announcements.

Is there any other member with anything to bring before the Club before the meeting is adjourned?

As there are no more questions to be asked, we will adjourn until next meeting, of which you will be notified by our Secretary.