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Railway and Engineering . . . . Club . . . .
OF CANADA

OFFICIAL PROCEEDINGS

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Toronto, Can., April 23rd, 1912

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PROCEEDINGS OF THE CENTRAL RAILWAY AND ENGINEERING CLUB OF CANADA MEETING.

Court Room No. 2, Temple Building,

TORONTO, April 23rd, 1912.

The President, Mr. J. Bannon, occupied the chair.

Chairman,—

The first order of business is the reading of minutes of previous meeting. As you have all had a copy of the Proceedings it will be in order for some one to move that they be adopted as read.

Moved by Mr. Baldwin, seconded by Mr. Cole, that the minutes of the previous meeting be adopted as read. Carried.

Chairman,—

The next order of business is the "Remarks of the President."

I do not know that the President has anything startling to say, except that I am very sorry to say that owing to sickness I was unable to be present at the banquet the other night. I understand that everything went off very well and that everyone had a good time. This was the first banquet we have had, and I hope that the next one we have will be even better than the last.

I want to thank Mr. Baldwin for taking my place, and for the efficient manner in which he handled the position of "Toastmaster."

I also want to thank the members of the Committee for working so hard and carrying the banquet through so successfully.

It is my earnest hope that the members will appreciate our new quarters. We shall feel that we are somewhat more at home and have some place that the members can feel that they are not under any obligation to anyone, and another thing we are always sure of being able to meet here, whereas in the past we never knew that we would be able to get the old room.

Members are earnestly requested not to smoke in this room. If any member wants to smoke he is perfectly at liberty to do so in the ante-room during the meeting or after the meeting.

I also want to call your attention to the fact that all meetings in future will be held on the fourth Tuesday in each month. Do not forget that we have only one more meeting before our Annual Outing.

Our friend, Mr. Adams, who so kindly entertained you at the banquet, has stated that he will be pleased to entertain the members of the Club in the near future, and I am in hopes that something along this line can be done before the next meeting, so that we can have the ladies and have a nice little entertainment.

The next order of business is the reading of list of new members.

NEW MEMBERS.

C. T. Jackson, Salesman, Harbison-Walker Refractories Company, Buffalo, N.Y.

H. N. Dorling, Rep., Canada Foundry Company, Limited, Toronto.

C. H. Stainton, Engineer, S. Frank Wilson & Sons, Toronto.

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B. Riordan
H. G. Fletcher
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R. H. Fish
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G. F. Milne
E. A. Morrison
A. W. Ritchie
W. R. Gardner
E. Logan
D. Cairns
T. H. Hawkins
G. H. Davis
C. Daniels
R. Yemen
W. C. Sealy
J. Dodds
J. Herriot
J. Barker
T. B. Cole
W. H. N. Davis
F. Slade
J. Herriot
W. M. McRobert
C. G. Herring
H. Goodes
H. H. Wilson
J. W. Walker
J. F. Campbell
J. Bannon
G. Cooper
W. Evans
L. S. Hyde

Chairman,—

Under the head of "New Business," I would ask if there are any members present who have any suggestions to offer in regard to the Annual Outing.

We will now pass on to the order of business "Reading of papers or reports and discussions thereof."

We have with us to-night Mr. Helps, who has kindly consented to give us a paper on "Cost Accounting."

Mr. Helps is one of the Power Engineers of the Hydro-Electric System, and one of our new members, and I know you will be pleased with the way he has gone into this paper, and I hope the discussion will bring out something new and of benefit to the members, and I take great pleasure in asking Mr. Helps to read his paper.

SOME NOTES ON COST ACCOUNTING IN RELATION TO INDUSTRIAL POWER.

BY J. W. HELPS, POWER ENGINEER, TORONTO.

Quite recently there was held in the City of Toronto a Congress of Printers from North, South, East and West—from the Maritime Provinces, Boston and New York; from Seattle and Vancouver; from Texas and Colorado and from Northern Ontario. And the sole purpose of their gathering might be expressed in one word—"COST." They wanted to "Compare notes" as to what did and did not come into their real first costs.

There was a time when the world was moderately easy going —when accuracy in such matters did not very much matter. That time has on account of age died a natural death and been decently buried. Its place has been taken by a time of stress and competition, when everything counts, and when the only man who can hope to achieve success is the one who is entire master of the situation. There is probably no case where cost so much matters as it does in the question of power. The importance of this is too obvious to need argument.

At the same time it is at least equally important that we should have something like a standardized conception of what should or should not be charged to the cost. This will become apparent the moment we begin to analyze the supposed costs of various installations. One man omits any allowance for interest on the capital invested; another omits depreciation costs; another forgets the repairs, the oil, waste, and supplies or insurance, whilst another simply puts down coal, oil and wages, as representing total cost. It is not enough to say, "Some of these things would have to be paid even if you used some other form of power." The point is—what is this costing? The "something else"—whatever it may be—must bear its own cost in the same way.

The man is frequently met with who talks about power costing so much per horse power per year. This is, perhaps, the most uncertain, unsatisfactory and misleading expression imaginable. Two considerations will suffice to show this. An article appeared in a technical paper recently on steam power costs, and the supposed results in certain cases were brought down to a basis of "— per horse power per year." On examination it was found that whilst reasonable care had been exercised in making the costs inclusive, the whole value of the deduction was destroyed by an error. The engine was described as 200 horse power; the total cost obtained was divided by 200, and the result described as the cost per horse

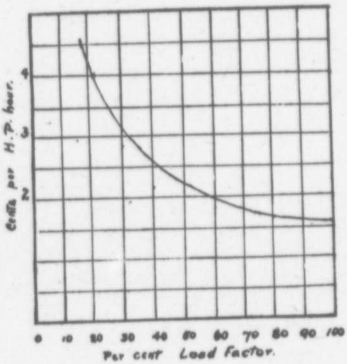

FIG. 1

power per year. Now the maximum load on that engine might have been 160 or 220, and the load factor might have been 40 or 70 per cent., but was certainly not 100 per cent.

Again—in one case the plant is in operation for eight hours daily for five and one-half days in the week; in another case for ten hours daily, and six days in the week; and in a third case for sixteen hours daily for five and one-half days. Now, assume these plants to be identical in construction doing exactly similar work, under exactly similar conditions —excepting only in the matter of time. It will be seen at once then that although the efficiency will be as great in either case, yet the annual costs will vary. But more than this—*the cost will not vary exactly as the number of hours*. Take the first and third cases mentioned. The operating time in the latter is twice that in the former. But the cost will not be double, in fact, it will be found that the shorter runs—forty-four hours,—will cost somewhere about two-thirds of the longer run of eighty-eight hours, obviously because the fixed charges remain fixed. For the same reason the price per horse power hour will be less in the latter case than in the former.

This brings us to three important considerations:

1. Each case must be treated on its own merits.

2. That in order to arrive at any useful figures we must carefully discriminate between fixed costs and operating expenses.

3. That under ordinary conditions the cost per horse power hour varies with the number of hours during which the plant is being operated.

These we will consider in the order given:

First. Each case must be costed on its own merits. It is probably not too much to say that there are not two cases,

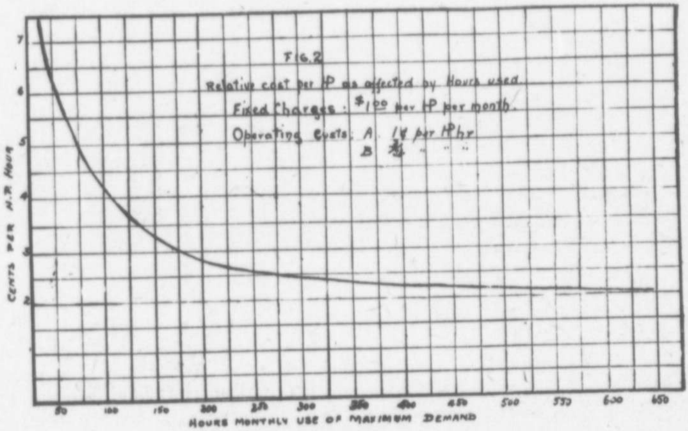

FIG. 2

where all conditions exactly correspond. One of the most important considerations is that of the load factor. This will vary from 10 per cent. in some cases to 85 per cent. in others. The effect of this will be seen from the accompanying diagrams, (see Figs. 1-2).

Local conditions also play an important part. The engine house may be occupying very valuable space, whilst in other instances there may be special advantages in the matter of fuel, etc.; what other special circumstances there are can be ascertained usually, but they are usually there.

Second. Now we come to the actual accounting. What are *fixed* costs? In a word, those which exist as annual charges, irrespective of the amount of use of the plant, whilst operating costs are those more or less dependent upon the amount of work done.

Now in order to get anything like an approximately correct estimate we have to go right back to the time of the purchase of the plant and ascertain the cost of the following items:

1. Engine and boiler house (or if included in building the additional cost on building in consequence of such inclusion).
2. Boiler and stoker.
3. Foundation.
4. Setting.
5. Stack and flues.
6. Pumps.
7. Heaters.
8. Injectors.
9. Valves and guages.
10. Installing.
11. Covering.

PIPE SYSTEM.

12. Pipes.
13. Covering.
14. Valves.
15. Drains.
16. Steam traps.
17. Sundries.
18. Installing.

ENGINE ROOM.

19. Engine.
20. Foundation.
21. Installing.

22. Condensors.
23. Pipes, valves, etc.
24. Installing.
25. Sundries.

DISTRIBUTING SYSTEM.

A.

26. Belts.
27. Shafting.
28. Pulleys.
29. Hangers.
30. Couplings.
31. Sundries.
32. Installing.

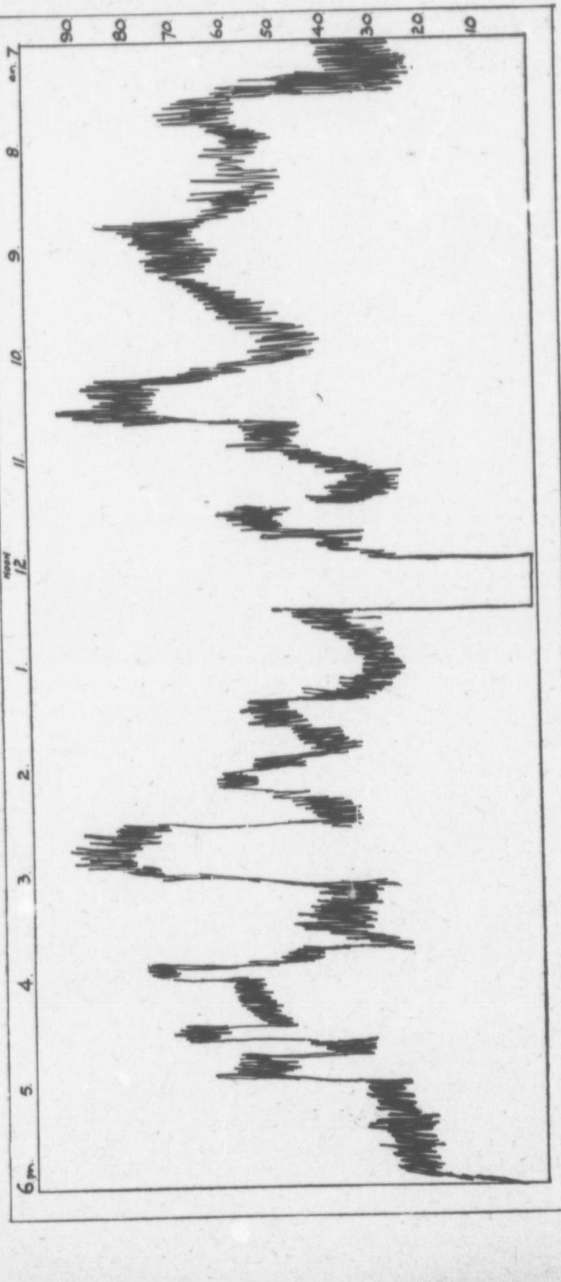

FIG. 3

B.

26. Dynamos.
27. Switchboards.
28. Wiring.
29. Motors.
30. Motor starters.
31. Sundries.
32. Installation.

33. Engineering and supervision.
34. Transportation, teaming and incidentals.

The sum of these items will give us the initial capital expenditure, upon which we base the principal items in our fixed charges, which are made up of:

A. Charges on account of capital.

B. Other annual charges.

Having then ascertained the capital involved we now have to take our costs arising therefrom, including:

A. INTEREST on capital investment—6 per cent.

B. DEPRECIATION. This will vary on different items, depending on the life of the article referred to. For instance, fourteen years is generally allowed for boilers, but for stack fifty years may be allowed in some cases; this would mean 7 per cent. in the former case and ½ per cent. in the latter. The plant may, of course, outlive these ages, but in that case the difference is more than offset by the disadvantage and risk of obsolescence.

C. PROFIT. Many experts think that 15 per cent. on the capital invested is a very conservative amount to charge under this head, but the principle on which this charge is based is that the manufacturer is justified in charging to the plant account only the same percentage of profit as he would actually make if that amount were invested in another department of his business, as shown by the actual profit he is really making.

The other annual charges will include:

D. INSURANCE. On the plant, for employers' liability and the proportion by which other insurances are increased as the result of having steam plant on the premises.

E. TAXATION. This is another uncertain quantity which can only be assessed as circumstances warrant. Many experts charge 2 per cent. on 75 per cent. of the cost value of the plant, but in some cases the taxation on a property will be greatly increased by reason of an expensive steam plant having been installed.

F. REPAIRS. This will in most cases be taken care of fairly by an annual allowance of 2 per cent. on the total investment. Some engineers, however, prefer charging 1 per cent. on the capital investment, and add 2 per cent. on to the total operating costs. Leaving the accuracy of the figure aside, there appears to be some logic in this method.

G. LAND RENTAL. As the value of real estate is liable to vary from year to year, the fairest way is to charge a rental equivalent to a percentage of—say 6 per cent. on the value of the land during the year in question. When the boilers and engines are included in the main building instead of in a separate engine house, this charge item takes the form of a rental for floor space.

The operating costs will need little or no comment. They include:

H. Coal.
I. Water.
J. Ashes (removal).
K. Oil and waste.
L. Supplies.
M. Wages.
N. Executive attention and office costs.

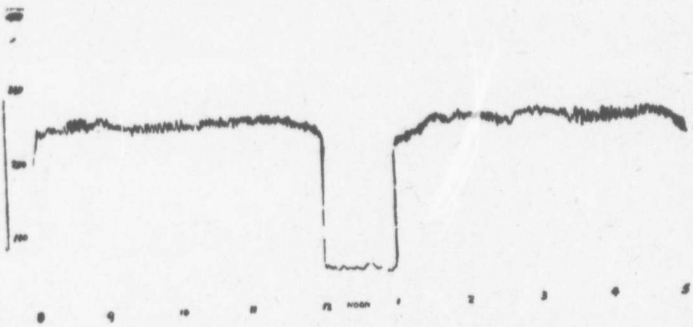

Fig. 4—Connected load, 525 h.p. Maximum demand, 260 h.p.

The last mentioned is often overlooked, but such is always an error. There is necessarily an executive and office staff to every business and their costs must be borne by the departments. Some proportion of this is chargeable to the power. It is the practice with many engineers to make a little discrimination in the operating costs. It is found that the first few hours in each day will cost a little more than the later hours, for obvious reasons. Hence a little higher proportion is allowed for one hundred hours each month than for all succeeding hours. Thus two rates are used in Fig. (2) marked "A and B."

Now, suppose we have made our costs for the year. What is this the cost of? It has to be admitted that many engineers do not actually know what they are really doing. To say you are running a 200 horse power engine for ten hours daily on a steady load is not sufficient. As a matter of fact, it is saying something which is neither intelligible nor useful. We have to find the actual work we are doing. This is got by ascertaining:

First. The maximum demand on engine.

Second. The actual output in horse power hours or kilowatt hours.

The first item should be obtained either by installing a graphic recording meter if electrical distribution is made use of, or by frequent tests if mechanical distribution only is applied, and will be entirely independent of the size of the engine. Then if we take our total fixed charges and divide by the number of horse power of maximum demand we get our annual cost per horse power per year in fixed charges. This in practice is found to come anywhere from $15.00 to $27.00 per horse power of actual maximum demand.

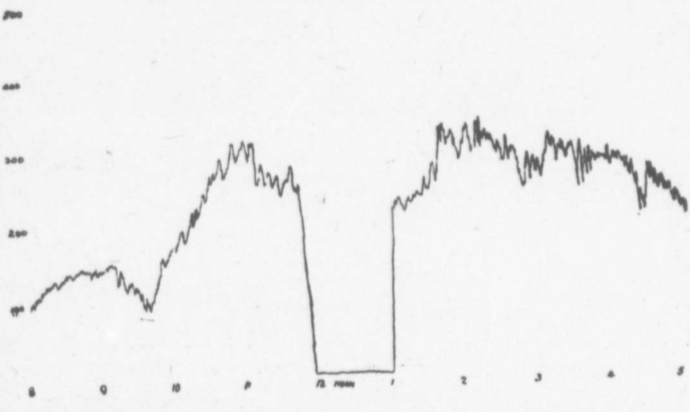

Fig. 5—Connected load, 400 h.p. Maximum demand, 340 h.p.

It is interesting to note the curious difficulty some people experience in grasping the meaning of the term, "maximum demand." For instance, here is a mill employing a large number of small motors, ranging from 3 to 35 horse power. They are all carefully selected to meet actual requirements, e.g., the 35 horse power motors are connected to machines which actually require 35 horse power, and there is no instance of overmotoring to any noticeable extent. The combined horse power is 525. Now what will the maximum load be? Fig. 4 gives the load curve on this installation as shown on a graphic recording meter and here we see what the maximum actually is—viz., 260 horse power. Now suppose that the fixed charges in this instance amount to \$312. If we followed the erroneous method all too frequently taken we would say that represented \$312.00 ÷ 525 = 59 cents per horse power. But actually this is \$312.00 ÷ 260 = \$1.20 per horse power. Because the only real and sensible basis is the actual maximum demand. Many an engine which is rightly rated as 200 horse power will be found to be carrying a maximum demand of only 50 per cent. or 60 per cent. of that horse power.

But to what extent is the maximum horse power employed? Many power users will say, "Oh, but my load is steady." By "load factor" we usually mean the ratio of the average load to the maximum demand, over a given time. This will vary with different classes of manufacture. The average results in a few instances will serve to illustrate this, each case being taken on the basis of ten hours daily.

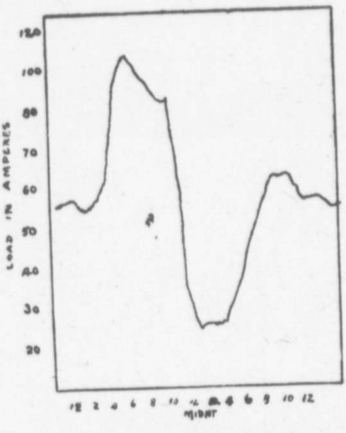

Fig. 6—Typical hotel curve.

Cement mills..........................	80	per cent.
Textile mills (cotton and woolen).....	65	"
Tanneries.............................	45	"
Ice machines..........................	53	"
Refrigerators..................	60 to 85	"
Flour mills....................	50	"
Machine shop...................	35 to 45	"
Boiler shop....................	25 to 30	"
Soap manufacture...............	28 to 35	"
Wood working (carpenter shops)	10 to 25	"
Planing mills..................	20 to 30	

Thus a flour mill, having a maximum demand of—say, 180 horse power, and running for 200 hours in a month, will have used approximately $180\times200\div2=18{,}000$ horse power hours in the month.

Now supposing our fixed charges on the plant amount to \$3,240.00. This is equivalent to \$1.50 per horse power of maximum demand on a monthly basis. Then our fixed charges for the month are $\$180\times1\frac{1}{2}=\$270.00$. Our operating costs have totalled, say: $\$225.00=1\frac{1}{4}$ cents per horse power hour. Our total cost then is $270+225=\$495.00$, and this divided into horse power hours will be $49{,}500\div18{,}000$ or 2.75 cents per horse power hour.

This would look strange to a man who described this as a 250 horse power plant, "with a steady 10-hour full load"—as indeed it was described, as the following will show.

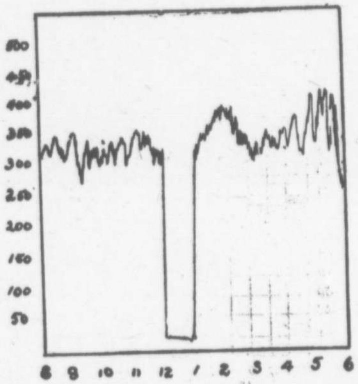

Fig. 7—Connected load, 500 h.p. Maximum demand, 420 h.p.

Here is the way in which the cost was summed up. The engine was set down as 250 horse power and the fixed charges were divided by that amount, i.e., $\$3{,}240\div250=\$12.95$ per horse power year, or \$1.08 per horse power month.

The monthly operating costs were set out as $250\times200=50{,}000$ horse power hours, and the operating cost—\$225.00, divided by this amount equals 0.45 cents per horse power hour.

The annual running cost per horse power was then said to be:

Fixed charges	\$12 95
Operating costs	10 80
Cost per horse power per year	\$23 75

The actual cost was at the rate of $33.00 per horse power per year, because it was the total cost divided by 180, and not by 250 and the actual horse power hours developed monthly amounted to $\frac{200\times180}{\cdot50}=18{,}000$ and not $200\times250=50{,}000$.

Of course the load curve is not often so even as that shown in Fig. 4. A very different condition is shown on Figs. 3-5, whilst a typical hotel curve is shown on Fig. 6, that of a jute mill in Fig. 7, and of a foundry in Fig. 8. Fig. 9 is the load curve of a large railway station in Ontario and Fig. 3 of a leather goods factory in Toronto. Note the great disparity between the average load and the maximum demand.

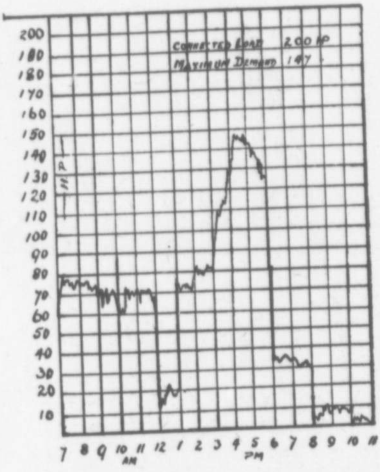

Fig. 8—Connected load, 200 h.p. Maximum demand, 147 h.p.

Of course, *the actual output must be taken* in every case. Not, however, the gross output from the engine. This is not the power used in doing work. We must deduct from the results shown by actual engine test all losses between it and the machinery to be driven. Thus, in an electrical distribution, the losses in generator, leads and motor; in a mechanical distribution, the friction losses in belts, pulleys and shafting. And in each case the actual engine loss.

The question of the allowance to be made for the exhaust steam used—say for heating a building, is too complex to be taken up to-night. I would merely suggest that the right basis upon which this should be calculated is as follows: Find out what would be

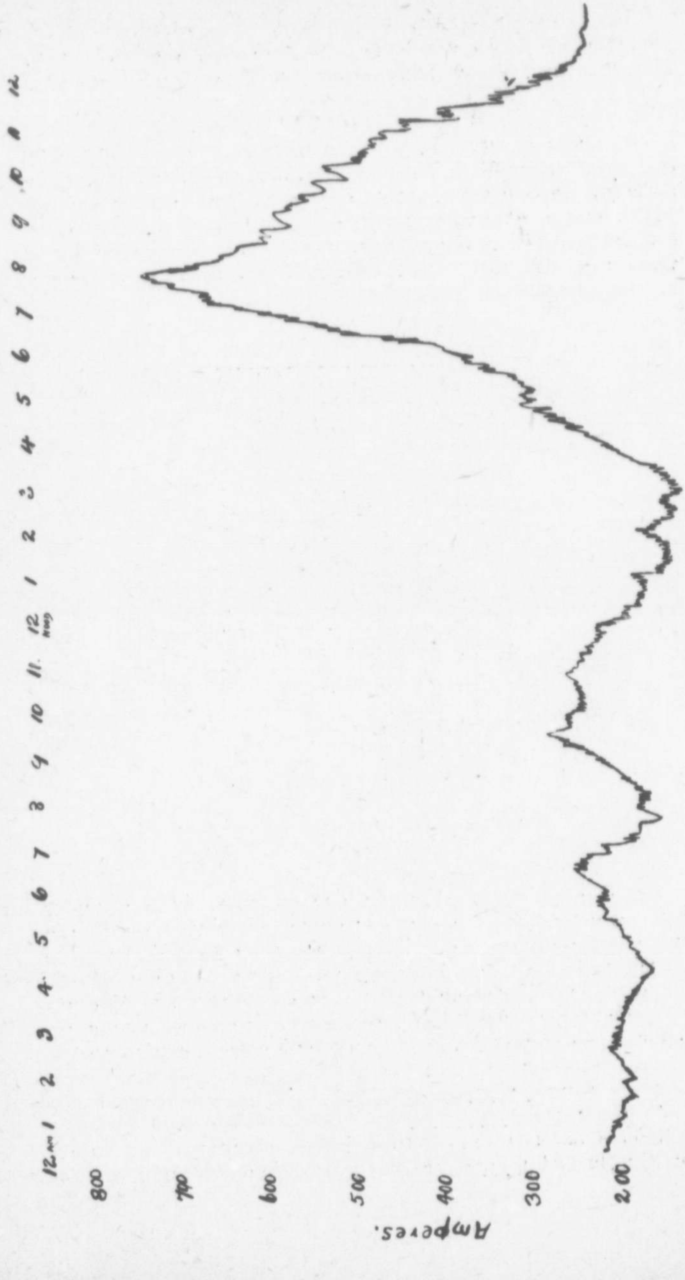
12 AM 1 2 3 4 5 6 7 8 9 10 11 12 NOON 1 2 3 4 5 6 7 8 9 10 11 12
800
700
600
500
400
300
200
100
Amperes.

Fig. 9

the cost of fuel for heating with a properly devised heating plant, and deduct this from the cost of your steam power. It is a fallacy to suppose that because you get 90 per cent. of the heat content in the steam from the exhaust you must credit the boilers with that 90 per cent. in favour of your steam power. The accompanying chart (Fig. 10), shows the relation between the coal bill and temperature in heating a large building in Toronto, the upper line showing the mean temperature for the month and the lower line the coal consumption. It will be obvious then, that if the exhaust steam is sufficient in the coldest weather, it will be more than sufficient during all other times, and just as you can't use all of the steam heat in your engine, neither can you in your radiators.

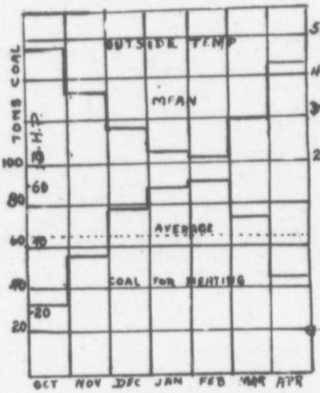

Fig. 10

However, the subject of this paper is not exhaust steam vs. live steam. It is only intended to suggest the main lines along which we may arrive at a proper method of costing.

One thing only remains to be touched upon, viz., that under ordinary conditions the cost per horse power varies with the number of hours during which the plant is operated. "If the foregoing has not made that clear, a brief study of figures 1—2, should do so. Thus, the same power which will cost $4\frac{1}{4}$ cents per horse power hour on 100 hours monthly use of the maximum demand, will only cost $2\frac{3}{4}$ cents per horse power hour, when the amount of use is doubled. This explains why so-called "flat rates" for power are rapidly—and justly—going into the waste paper basket.

This paper is intended to be introductory, rather than exhaustive, but let us hope that we may find in our discussion something which shall help us to get a better grasp of our own conditions. In the past men talked price "per k.w.h." or "per h.p. per year." We have to live in the present and the future. Let us seek to in every way improve. Cheap power is everything to-day. It is our duty to try to obtain it. But don't get disheartened at what the other fellow is said to be doing.. When you hear of the wonderful achievements just remember that Mr. Smart has probably omitted half of his fixed charges, quarter of his operating costs, and has forgotten to tell you what is his actual maximum demand or his load factor.

As the world progresses, we will not be left out in the cold, so take heart, do your best, and let it be as good as the other fellow's best. But take the advice given by a member at a recent meeting—"Don't worry."

Chairman,—

You have all heard the paper read by Mr. Helps, and if anybody wishes to ask any questions I am sure Mr. Helps will be only to pleased to answer them.

Mr. Wilson,—

The paper has certainly been a most exhaustive one, and does not leave room for much to be said.

There is one thing that is not taken into consideration: In most cases, when figuring up the cost in a private plant, and that is the amount of work done by the engineer outside the plant itself. To my mind, if in these private plants, the engineer was not called upon to do other work, he would probably be able to do with less help. It has always been my experience that too much work is expected of the engineer outside of the engine room. We cannot be looking after the plant and getting the highest efficiency if we are called upon to do other work. The paper has certainly pleased me inasmuch as in addition to the actual cost of the operation of the plant consideration has been given to the many other charges which should be considered and which are often lost sight of.

Mr. McRobert,—

There is one question I would like to ask in reference to the boilers. In the first part of your paper, I think you mentioned that fourteen years is generally allowed for the life of the boilers. Am I to infer from this that you mean boilers running 10 hours per day, or are the boilers supposed to be run night and day during that period?

At the same time I would like to ask you in reference to forced draft. What experience have you had with forced draft? In some systems they simply take the air in through the ash pit and blow it up directly through the grate. The system that I have been accustomed to, was the one where they brought the air through ducts right through the smoke-box, and in that way heated the air before it went into the ash-pit. Do you think it is detrimental to take the air directly from outside and blow it up through the ashpit, or do you get more efficiency by bringing it through ducts through the smoke-box? I think that if you should have any holes in your fire, the direct draft is detrimental to the heating surfaces, especially in return tubular boilers.

I understand that this is getting somewhat away from the paper, but still it has reference to efficiency and economy.

Mr. Helps,—

In reference to the life of the boilers, fourteen years was stated in my paper and 50 years for the stack simply to show that in figuring the cost of depreciation, the same percentage should not be figured in the case of the boilers as in the case of the stack, as I explained that, for instance, 7% might be allowed for the boilers and only ½% for the stack. For instance, I said you might put the life of the boilers at 14 years and the life of the stack at 50 years or 60 years, but in figuring up the cost of depreciation you should figure on each as a separate unit. The life of the boilers would, of course, vary according to the conditions under which they were working, etc.

In regard to forced draft. This is a little outside the paper, and it is a matter to which I have not given much thought. However, I think the latter method described would certainly meet with my approval in preference to the former. I think the method first described is likely to be detrimental to the flues.

Mr. McRobert,—

Coming back to the question of cost. Do you think it more economical to use forced draft or natural draft? Of course, we know that with forced draft you can burn so much more coal to the square foot of grate area, but what has been your experience as regards the use of forced draft compared with natural draft as regards the matter of cost?

Mr. Helps,—

I think, Mr. Chairman, this is a little too far out of the realm of the paper. However, I will say this, that I consider this is a matter which would have to be adjusted to meet the special requirements of each case, and should be dealt with on the spot.

Chairman,—

My experience has been that if it is possible to obtain a good natural draft, it is more preferable to the forced draft, and one would in all cases use natural draft if possible.

I might explain to Mr. Helps that it is the custom at these meetings for the members to ask any question they please, while some of them may not be directly connected with the paper, yet they are questions that interest the members, and we like the members to feel that they are free to ask any qustions that arise in their minds. That has been the custom in the past and we earnestly hope that it will be carried on. I feel quite satisfied that Mr. Helps will endeavour to answer all questions as near as he can. Mr. Helps is a steam engineer as well as an electrical engineer.

Mr. Helps,—

An apology is due from me, Mr. Chairman, if I seemed to be in any way lacking in respect for the principle you mention, or towards the gentleman who asked the question. The question relates to something I have no very special knowledge or experience of, and I felt that perhaps there were some others here who would be better able to answer the questions asked by Mr. McRobert than I am.

Mr. McRobert,—

Of course I do not want Mr. Helps to feel that I am cross-examining him in any way. There are many questions that might be asked that are indirectly connected with the paper which may be of benefit to everybody to have them discussed.

Mr. Wilson,—

If you are buying a plant, say of 200 h.p., would you buy a high efficiency plant or a low efficiency plant. A low efficiency plant might cost say $6,000.00, whereas a high efficiency plant might cost $12,000.00. Would the saving in coal bills, repairs, etc., warrant this much greater expense in the purchasing of the high efficiency plant?

Chairman,—

That is just like a man going to buy a pair of boots. If he can afford it he knows that he will get greater efficiency out of the better quality of boots than if he purchased a cheaper pair. Naturally if a man is going to buy a steam plant he would want to buy the most efficient, even if it was only a 200 or 300 h.p. plant. It is merely a matter of dollars and cents, as in the case of the boots, if he wants the highest efficiency he has got to pay for it.

Mr. Helps,—

I think the matter is very simple. One plant has a small cost and low efficiency as compared with the high cost and high efficiency. The plant with low efficiency is small in fixed charges, but heavy in operating costs, whereas the high efficiency plant is heavy in fixed charges but low in operating cost, but it has always been found that the plant with the high efficiency and heavy fixed charges has the smallest total cost in proportion to the actual output.

Mr. McRobert,—

In regard to the cost of power. What would you think would be a fair estimate of the coal consumption per indicated h.p. for an up-to-date plant, that is, competing on an electrical basis?

Mr. Cole,—

Mr. Wickens read a paper some time ago and mentioned something about producer gas plants, and I thought I would take some figures from our plant, as I thought they might interest you.

I might say that I take meter readings every day. I took three weeks at random from my books and these are the figures. On February 8th I took in 2760 lbs. of coal, February 11th 1990, February 21st 2220, and the next lot was on February 29th, total 6970 lbs., less than a ton and a quarter a week for 100 h.p. engines during that three weeks. The meter showed an output of 4592 k.w., which means 1.51 coal per k.w. hour. You can figure that out and it will give you ⅞ lb. of coal per h.p. hour at switchboard. I think these figures might interest some of the members.

Mr. McRobert,—

In marine service if the chief engineer cannot produce, in all kinds of weather and under all kinds of climatic conditions an average of 1¾ lbs. of coal per I.H.P. he would not be kept in the service. There never seems to be this high state of efficiency in manufacturing plants. Manufacturers do not seem to encourage their engineers to try and produce the best that there is in the plant. I know of a plant running 10 hours per day with 10 to 15 per cent. overload. Everything has to be run to the limit to get the required power, and it is well known that there is a great waste of coal when you are running your plant over its capacity. For example, in marine service, supposing your ship's speed is 16 knots and you burn 125 tons a day to get the 16 knots, if you have to force your engines to produce 17 knots it will take almost as much coal to produce the extra knot per hour as it does to produce the 16 knots. The same applies to a stationary engine when overloaded.

Of course, in manufacturing plants where the load is erratic and part of the time you are working to capacity and part of the time with a light load you cannot look for high efficiency.

Mr. Wilson,—

In the matter of heating with exhaust or live steam. If we heat with live steam, we have to supply the chimney with a certain amount of heat which is lost out of the chimney just the same as if the plant was running, therefore you might as well put the steam through an engine and get a certain amount of work out of it. If you are doing enough work to supply your building with just nough exhaust steam to heat it, you are either heating your building for nothing or doing your work for nothing.

Mr. Bannon,—

To my mind, in the matter of cost of operating plants, there is an imaginary line to be drawn, and that line is not a straight line as there are so many conditions to be considered when talking of the question of efficiency.

Take the conditions in my plant, the efficiency there is very low during the night. During the day I am practically running 400 h.p. My wage account during the night is very high per h.p., but during the day it is low, but taking the mean average it is high all through. I am not an advocate of electrical power, but I think there are plants where it is more economical to use electrical power, and again there are plants where it is more economical to use steam. I think, personally, any man with an up-to-date plant of 200 h.p. and up can beat any electrical price, but he has got to have high efficiency, but if you do not have high efficiency the electrical power is cheaper.

Mr. Wilson,—

I was thinking to-night of the number of plants there are which do not have instruments for the engineers to take readings, and yet the engineers are supposed to successfully carry on the plants without knowing what they are doing.

Another thing, in my plant we are not only supposed to look after the plant, but to a lot of work outside, such as renewing the lamps, fixing the radiators and numerous other things of a similar nature, and yet no reduction is made in the cost of operating the plant for the time we spend doing other work. If we were not looking after the plant, they would have men to do this work, and it seems to me that all that time should be deducted from the cost of operation of the plant. I think engineers having to do such work should keep record of the time they spend doing such work and make a monthly report to the office of all such time, and the same should be deducted from the cost of operating the plant.

Mr. Bannon,—

I think this matter has been very thoroughly discussed and it will be in order for someone to move a vote of thanks to Mr. Helps for the excellent paper which he has prepared.

Moved by Mr. Baldwin, seconded by Mr. Campbell, that a hearty vote of thanks be tendered to Mr. Helps for the time and care he has taken in preparing the paper. Carried.

Mr. Helps.

Mr. Chairman, Gentlemen,—

I am sure, sir, it has given me great pleasure to be here. A gentleman remarked to-day that it looked like lots of nerve for me, with an electrical connection, to talk to steam engineers; it would be like walking into a den of lions. Well, my name is not Daniel—and the lions have stayed away. So I thank you cordially for the courtesy and attention you have given me.

However, there are conditions where the efficiency of the engine or the engineer does not count in competition with central station power. Take a look at Fig. 8. Here we have a plant with a high peak late in the afternoon. During the rest of the 24 hours a large block of possible power is lying idle. In the same district will be two or three others with peaks at other times in the day—one in the early forenoon, one nearer noon, and so on. These can all be taken care of by the central station without having behind the group a much larger engine than would be necessary in each individual case. It needs no argument to show which should be the most economic.

There seems to be a tendency amongst steam engineers to be afraid of the "cheap power" movement. Why? Don't be afraid of progress. When the "penny postage" system was first introduced there were people who said that this would do away with the need of commercial travellers. But there are more employed than ever before. Electric lighting was going to kill the gas business,—but I saw a man running a gas pipe to-day, so I suppose it is not yet dead. Automobiles were going to put the railways out of commission,—but they are still laying tracks. And, if the cheap power movement is a success in Toronto, it will mean a great increase in the number of factories locating here, and, incidentally, more steam engineers required than ever before. So, I say, don't be afraid of "cheap power"; as I said at the end of my paper—"Don't worry."

As to the other side—electrical costs, etc., perhaps we may be able to go into that further at another time. Gentlemen, I thank you for your kind attention.

Chairman,—

The next paper will be by Mr. Pratt on "Lubrication," and the meeting will be held in this room on the 4th Tuesday in May, which will be the last meeting before the holidays.

Moved by Mr. Herriot, seconded by Mr. Slade, that the meeting be adjourned. Carried.

George Black

Died

April 27th, 1912