PAGES

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

COURT ROOM No. 2, TEMPLE BUILDING, TORONTO.

May 27th, 1913.

The President, Mr. A. M. Wickens, 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 I hope you will accept them as read.

Moved by Mr. Wright, seconded by Mr. Herriot, 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 have nothing very serious to say to you to-night, except to be sure and call your attention to the picnic to be held to Erin on June 21st. All arrangements have been practically completed and a special train will leave the Union Station at 8.30 a.m.

Most of you have been there before and know the excellent grounds on which the picnic is held. We have made arrangements for the meals to be served on the grounds, which will save the long walk to the hotel. The picnic will be self-contained, and there will be no necessity to go away from the grounds. The grounds are only about 400 yards from the station, and we should have a very agreeable and pleasant time.

The Committees have got things in good shape and the programme will be somewhat similar to former years, and I hope we will have a large turnout.

Mr. Worth has tickets here to-night and any of you who can sell any to members or their friends can obtain them from him.

You will notice in the last journal that we started a page of Club Notes. We ought to make that an interesting page, and if the members will forward to the Secretary any items of interest to the other members of the Club, we will see that they are published. I want to make the book more interesting than it has been, and we can do it with the co-operation of the members.

Mr. Newman has notified myself and the officers of the Club that next Saturday he would like as many members of the Club as possible to visit Polson Iron Works around 12.30 o'clock to witness the launching of a steel suction dredge. This is the largest boat of this type on the continent, and a remarkable feature is that the dredge while being 650 tons, has been got ready for launching in five weeks—rather a wonderful piece of engineering, and we ought to be proud to number among the members of this Club one who has been instrumental in getting out this excellent piece of engineering work in such a short time, and I would like as many of you as possible, who can get away, to be on hand.

I might say that Mr. Hill, who promised us a paper for to-night, has failed to put in an appearance. He wrote me a few days ago that he thought he would not be able to get the paper ready, and so as there was not time to look around and get someone to give us a paper, I decided to do what I could along that line myself, so as to fill in the gap.

I will now ask the Secretary to read the list of new members.

NEW MEMBERS.

R. Choyce, Machinist, G.T.R., Stratford.
F. Bausch, Sales Agent and Inventor, Toronto.
J. H. Vance, Purchasing Agent, B. F. Goodrich Co., Akron, Ohio.
S. Jones, Millwright, Gurney Foundry Co., Toronto.
J. J. McCarthy, Salesman, Keystone Lubricating Co., Buffalo, N.Y.
P. Wilkie, Mechanical Engineer, Consumers' Gas Co., Toronto
R. Littlefair, Machinist, Gurney Foundry Co., Toronto.
S. N. Faulkner, Iron Worker, Consumers' Gas Co., Toronto.
J. Brough, Iron Worker, Consumers' Gas Co., Toronto.
J. McCartney, Steamfitter, Consumers' Gas Co., Toronto.
W. G. Self, Contractor, Toronto.
W. J. Boland, Manager Ideal Engine & Packing Co., Toronto.
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W. T. Thompson, Engineer, Drakes Limited, Halifax, Eng.
P. Arnold, Decorator, Toronto.
C. Russell, Stationary Engineer, Board of Education, Toronto.
R. B. Murray, Boilermaker, Consumers' Gas Co., Toronto.

J. Scott, Machinist, Consumers' Gas Co., Toronto.
H. Cohen, Sanitary Engineer, Toronto.
G. Cook, Jr., Painter, Consumers' Gas Co., Toronto.
F. Wells, Engineer, Dominion Bridge Co., Toronto.

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G. Cook
J. Adam
H. Reynold
W. A. Davis
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G. A. Young
G. S. Powell
F. Smith
L. Salter
W. M. Forbes
J. Shields
A. M. Wickens
C. Herring
W. Kirkwood
J. Anderson
Marshall Wright
N. A. Davis
T. Graham
D. Campbell
S. L. Pearson
J. McKinney
G. D. Bly
H. Lamont
G. M. Smith
G. H. Boyd
F. W. Barron
W. Dony
W. Newman
T. Brown
W. J. Jones
W. Evans
A. Hallamore
L. S. Hyde

Chairman,—

The next order of business is the reading of papers and discussion thereof, and while I am reading the paper and during the discussion I will ask Mr. Wright, our First Vice-President, to take the Chair.

SUPERHEATED STEAM.

By A. M. Wickens, Executive Special, Canadian Casualty & Boiler Insurance Co., Toronto.

In these days of strenuous competition in all lines of manufacturing, the cost of power for factories and the cost of steam used in many manufacturing processes has become a vital point to all concerned. This applies not only to the manufacturer, but also the superintendent, the foreman, and various employees having charge or control of different departments, and more especially the engineer and his staff—consequently any project that will reduce power costs, including installation and maintenance charges should be carefully considered. This applies more particularly in localities within reasonable distance from the many Hydro-Electric plants now in operation and being erected, and, perhaps, more particularly in this portion of Ontario.

In all steam power plants that are modern, that are well-equipped and intelligently operated, and in which the conditions are such that exhaust steam from the engine can be utilized for heating buildings, dry kilns or any other process of manufacture, the cost of operation can be reduced to such a figure that electricity cannot successfully compete.

Steam engine builders are steadily improving the construction of engines and thereby reducing the amount of steam required per h.p. hour. There are also many improvements in the setting and construction of steam boilers, thus increasing the amount of water evaporated per lb. of coal. While the engine and boiler manufacturers in Canada and the United States have made rapid strides along these lines, there is still room for further improvements. One reason for our slowness is most likely the fact that our fuel is cheaper than it is in some of the European countries where their engines and boilers are giving power at a much lower cost, than we have as yet reached.

One of the most marked savings can be made by superheating the steam, which can be done at a small cost in already existing plants. Now the first question is: What is superheated steam? It is steam that has heat added to it without increasing the pressure. We call steam as generated in our boilers dry saturated steam, and any steam that carries 2 per cent. or less of moisture or water in it is called dry or steam saturated with dryness, hence the name dry saturated steam.

For example: Steam at 100 lbs. gauge pressure has a sensible, or a heat that can be measured by a thermometer of 323.7 degrees, and just so long as the steam remains in contact with the water from which it was evaporated, any additional heat would only evaporate more water at the same temperature. If, however, we conduct the steam to a separate vessel and add heat to it, then it becomes superheated steam and will not increase in pressure. It does increase in volume, and is, in fact, a perfect gas and so follows the laws of gases. This is one point wherein it is better than dry saturated steam, and is to a large extent the advantage of its use.

The benefits of superheated steam have been known for many years. During the period from 1850 to 1860, Mr. Isherwood, Chief Engineer of the American Navy, conducted some tests and reported that a considerable saving could be made by adding from 100 to 200 degrees of superheat. He also reported that it was not practical on account of the difficulty in lubricating pistons, valves and packings under such high temperatures. At that early date we used animal and vegetable oils to lubricate all valves and pistons, these oils were not suitable to use in temperatures above 350 degrees. Very little progress was made in the use of superheated steam until natural or mineral oils were in use.

In Germany, no steam plant is now considered up to date unless superheated steam is used. The economy of it runs from 10 to 30 per cent. demonstrated by thorough tests, the accuracy of which have been checked by years of operation.

This steam is used sometimes at a temperature of 800 degrees, but in all cases where the temperature is over 500 to 600 degrees specially designed engines and valves are used.

To obtain superheated steam, the saturated steam after leaving the boiler is passed through a superheater, consisting of a series of tubes, placed in the path of the heated gases, where the temperature is greater than that of the intended heat of the superheated steam. The temperature of these gases should be several hundred degrees higher than the superheated steam so that the transfer of heat will be very rapid, thereby keeping the heating surface down to a minimum and reducing the size of the apparatus down so that it can be set without seriously blocking the combustion spaces. In all cases where the heat from the passing gases is used, the superheater is placed in the boiler setting in such a position as to secure heat from the passing gases, shortly after they leave the fire and before their temperature is much decreased by contact with the boiler heating surface. In some cases the superheater is operated by a separate fire, when it must have a setting of its own. This is often more advantageous because it can be placed anywhere in the steam line where it will do the most good and be most convenient.

Another important advantage of separate firing is that the amount of superheat can be nicely regulated by the intensity of the fire, by that means giving a range of from no superheat to the maximum capacity of the superheater without in any way affecting the production of steam in the boiler. By the use of this apparatus we have added a certain amount of heat and it might be supposed that this, less the ordinary losses, is all we can get out of it. By the addition of this heat we have changed the properties of the steam and so have greatly increased its efficiency. The specific heat of superheated steam is less than half that of water, being about .48, and with the expenditure of 1 B.T.U. we raise the temperature of 1 lb. of steam about two degrees F. If we superheat steam at 150 lbs. gauge pressure 200 degrees, we expend 96 B.T.U.'s in doing it. The total heat necessary to evaporate 1 lb. of water at 150 lbs. pressure is 1225.5 B.T.U.'s, so that in securing this amount of superheat we have only added 7.8 per cent. of the heat necessary to obtain 1 lb. of dry saturated steam at 150 lbs. pressure. But by adding this superheat we have increased its volume which, following the laws of a perfect gas is proportionate to its absolute temperature. The volume of 1 lb. of saturated steam at 150 lbs., pressure is 2.726, and its absolute temperature is $365.6+461=826.6$ degrees. The absolute temperature of 1 lb. of steam at 150 lbs. pressure superheated 200 degrees is $365.6+200+461=1026.6$ degrees, and its volume is $\frac{2.726\times1026.6}{826.6}=3,386$, an increase of .66 cubic feet, or 24.2 per cent. You will see by this that by adding 7.8 per cent. to the heat already in 1 cubic foot of steam at 150 lbs. pressure, we have obtained 1.24 cubic feet—now if we assume that we have a cylinder consuming 1 cubic foot of steam per stroke, we can fill it with superheated steam one and one-quarter times at an expense of only 7.8 per cent. more heat. We must bear in mind that heat directly represents energy. By superheating saturated steam of 150 lbs. pressure 200 degrees, we have added 96 heat units and the total heat per pound is $1225.5+96=1321.6$ B.T.U.'s, which is the heat contained in 1 lb. of saturated steam at a pressure exceeding 1,000 lbs. per square inch. In other words, by adding 200 degrees of superheat to steam at 150 lbs. pressure we can obtain the same amount of energy per pound as we would if it were possible to use steam at a pressure of 1,000 lbs.

It is well-known that cylinder condensation is one of the large losses in steam engine practice. Steam entering the cylinder and coming in immediate contact with the cylinder walls, which have just been swept by the exhaust steam at a low pressure and temperature, must give up heat very rapidly to so heat the metal up to or near the temperature of the entering steam. When saturated steam loses heat some part of it must be condensed to water. The resulting water is not only dangerous, but it has a greatly reduced volume and more steam must follow to take the place of the steam condensed. If superheated steam be used, the loss of heat takes place just the same, but its temperature can be reduced to that of saturated steam without any condensation showing, and even should all the superheat be lost we still have a change in volume in proportion to the absolute temperature only, which is much less than when steam is condensed to water. In practice it has been shown that a very moderate degree of superheat will furnish dry steam up to the point of cut-off. Again the advantage of being able to prevent water carrying over to the engine with the steam will be appreciated by all operating engineers. Even a steam jacketed cylinder using superheated steam shows a better result with the steam jackets cut off than the same engine using saturated steam with the jackets in use.

It is impossible to have any moisture in superheated steam so the engine is supplied with steam free from water and without the use of such apparatus as steam separators, traps, etc., it is not possible to get all the heat out of the gases in a superheater any more than out of the boilers, but the waste gases from the superheater can be utilized in the same way as the waste heat from the boiler.

The superheater tubes are made either of cast iron or heavy seamless drawn tubing. The cast iron tubes are of heavy construction and having their outer surface greatly increased by rings, much like a radiator section in appearance. These tubes are placed very close together and are connected longitudinally by ribs running the entire length of the element. This arrangement largely increases the heating surface and adds to the strength of the element and resists any possible tendency to warp from the heat. The several elements are connected with heavy cast iron bends at one end and the header joints are of special construction which is the result of years of experience and has proved satisfactory for the purpose. The large quantity of metal in these cast iron superheaters acts as a reservoir of heat and so takes care of the fluctuations in the intensity of the fire, as well as preventing them from burning out. They are connected up in series, thus insuring perfect circulation.

With the seamless drawn tube construction the tubes are expanded into a header and extend into the gases in a series of bends. It is necessary in this case to have a flooding device to fill the tubes with water to prevent them from burning out while raising steam in the boiler. When these tubes are flooded they add to the heating surface of the boiler, but when steam is being taken from the boiler, the water must be drawn from the tubes and then the steam started to circulate through them. All types should be accessible for inspection and cleaning. In return tubular boilers, the superheater is placed under the shell back of the bridge wall or in the rear combustion chamber.

VARIOUS USES FOR SUPERHEATED STEAM.

In steam engines, whether simple or compound, condensing or non-condensing, the steam consumption may be reduced from 10 to 40 per cent.

For ordinary conditions it is not recommended to use above 125 to 150 degrees of superheat which would make the temperature of the steam in the pipe before reaching the engines, where working pressure is 125 lbs. per square inch about 480 to 500 degrees.

The more wasteful the engine, the more economy by using superheated steam—more can be saved on a simple engine than on a compound, but with superheated steam a compound can be run as economically as a triple expansion, because superheated steam at a lower pressure can carry the same energy per pound as saturated steam at a higher pressure.

There is less friction when using superheated steam and in consequence the steam pipes, etc., can be greatly reduced in size. It is safe to figure on a velocity of from 30 to 40 per cent. greater than when saturated steam is used, or say an increase in speed from 60 feet per second to 100 feet.

Superheated steam has shown a marked economy when used in turbine engines. One authority says that with superheat of from 60 to 70 degrees the economy was increased 30 per cent. I have not succeeded in getting any reliable data upon the use of superheat for locomotives, but I learn that many of our railroads are doing away with the compound engines and using superheated steam instead. The cost of construction is less and there is a marked improvement in economy and draw bar power.

In Germany the use of superheated steam has made rapid strides and it is used upon all the best engines with a result that is far in advance of any practice in this country. The Stumpf engine which is built without exhaust valves, the cylinder being twice the length of the stroke and the depth of the piston. It uncovers openings at the centre when the piston reaches the end of the stroke, with this arrangement the cylinder, taking steam at each end for one stroke is never cooled at the initial end of the stroke, and the cylinder condensation is greatly reduced. These engines, by using superheated steam and condensing give a h.p. for from 10 to 12 lbs. of steam per h.p. hour.

The locomobile, another German engine, is always made compound whether a condenser is used or not. This engine is set up on top of the boiler and is built up to 500 h.p. The high pressure cylinder is in the uptake and the steam is superheated before entering it. The steam is again sent through a re-heater on its way from the high pressure cylinder to the low pressure. These engines are guaranteed to give a h.p. for 12 lbs. of steam per h.p. at high pressure, and when used condensing have been operated at from 8 to 9 lbs. per h.p. per hour. In these engines all losses from cylinder condensation are eliminated and superheat up to about 600 degrees used. The many other uses that superheated steam is very useful for is in chemical factories and asphalt works, where high heat is required in vessels that it is difficult to make strong enough to withstand the pressure of saturated steam of a high enough pressure to furnish the required amount of heat.

Again where extra power is required and the boiler is not strong enough to carry a higher pressure, superheat will supply the deficiency and save the cost of a new boiler. In cases where the pipe lines are long for the transmission of steam for power, superheat sends the steam forward for 1,000 feet or more before all the extra heat is lost and the engine receives dry steam for its operation.

There is almost no end to the usefulness of steam thus treated and very few instances where it will not pay for the cost of installation.

I understand that one of the American engine builders have just started to manufacture an engine of the locomobile type, they call it the Buckeyemobile. They are making these engines up to 200 h.p. copied entirely after the German pattern. They advertise results and have been running for over eight months. The figures they give are as follows:

Engine cylinder 9½ and 19-inch diameter, stroke 18-inch.

Speed 205 revs., indicated h.p. 128, water per h.p. hour 9.78 lbs.

Speed 205 revs., indicated h.p. 163, water per h.p. hour 10.8 lbs.

Speed 205 revs., indicated h.p. 200, water per h.p. hour 9.9 lbs.

There is an illustration of the engine in this week's *Power*, and any of you who take this paper can look it up.

In each case, respectively, the coal consumption per indicated h.p. is: 1.62 lbs., 1.6 lbs., 1.95 lbs.

The superheat in each case is 273 degrees F., 302 degrees F., 170 degrees F.

The average vacuum for all three tests 27.4 degrees.

Chairman,—

I am sure you have all listened with a great deal of pleasure to the paper Mr. Wickens has read, and if there are any of you who have any questions to ask I am sure Mr. Wickens will be only too pleased to answer them.

Mr. McRobert,—

In the event of the cylinder lubrication ceasing when using superheated steam, what would happen? With the extremely high temperature and dryness of the steam, would the walls of the cylinder not be likely to become scored before the engineer could provide a further supply of oil?

Mr. Wickens,—

I think it would take quite a few minutes before any damage would be done to the cylinders.

Mr. McRobert,—

According to what I have read by Professor Thurston, who is supposed to be one of the greatest authorities on this subject, the whole of the saving effected by superheated steam is in the overcoming of cylinder condensation, and according to the paper this must amount to about 10 or 15 per cent. Superheated steam has absolutely no thermo-dynamic value. The low temperature of uptake gases in modern boilers lessens the destruction of superheaters, but necessitates a larger area of superheating surface. The larger the waste, the further should superheating be carried. The value of the maximum measure of ideal efficiency T $(T_1—T_2)$ is in no manner altered by the introduction of superheated steam.

Mr. Wickens,—

I think the gentleman whose report you were reading has missed part of the idea. The fact that we increase the volume without increasing the pressure seems to be overlooked. As stated in my paper if we take a cubic foot of steam and superheat it we get 1¼ cubic feet of steam, by this we increase the volume of the steam practically one-quarter for the small expenditure of 7.8 B.T.U.'s over the amount required to get the original cubic foot. I think that nearly all the men who first went into the matter of superheated steam missed the fact that the volume was increased.

Of course, the idea of eliminating condensation altogether is a big thing in steam engines. There are engines running to-day with the cylinder condensation amounting to 20 per cent. If you eliminate that loss you are going to get much greater efficiency.

Another thing, you take the reports from men who have been using superheated steam in Germany for ten years. They have been working at it daily and their reports have been all gradually got together and show improvements right along as far as water consumption per h.p. is concerned, and it is fair to say that if they are cutting down the water consumption there must be something in superheated steam.

For my part, I think if we have any locomotive men here who have been using engines of the superheat type after using the ordinary engines they will bear out my contention in regard to the superiority of superheated steam.

Mr. McRobert,—

Is there any means of regulating the temperature? For instance, if your steam went up to 700 degrees and the flash point of the oil was 550 degrees or 600 degrees, would the oil not burn and score your cylinders? Is there any means of regulating the temperature that would not require the constant attention of the engineer to prevent the carbonization of the cylinder oil?

Mr. Wickens,—

There is no doubt that the man buying the oil would know what temperature it would have to stand and if it flashed at 600 degrees he would not buy it.

To-day with forced oil feed it is not a difficult matter to get oil to all parts of the engine and keep every part properly lubricated without the constant attention of the engineer, therefore the matter of lubrication in regard to superheated steam I would not consider as an important factor against the scheme at all.

A short time ago I was at Smith's Falls and saw two Bettes & Morcom engines there 150 h.p. each. I forget the exact size of the cylinders. One was running 325 r.p.m. and the other 355. They run those engines with the smallest possible amount of clearance. There was only 1/32-inch between the piston and cylinder head at the top, and 1/16-inch at the bottom. If they had not been using superheated steam, the condensation under ordinary conditions would have knocked the heads out of those cylinders at once. In the contract for these engines they called for a pressure of 140 lbs. at the throttle and they superheated the steam 160 degrees. They had no difficulty with regard to the lubrication. They were oiled under pressure. About 25 lbs. was the pressure used, and the oil circulated round and round. The engines had been running 18 months and they had never had a wrench on them and they were fully loaded all the time.

I do not think that any trouble should be encountered with regard to the lubrication. The great trouble, to my mind, should be with the valves. I saw some photographs in regard to the Buckeye-mobile engine, the valve of which had been running eight months, and as far as the photos were concerned the condition of the valve was perfect.

I think that the Germans are using superheated steam up to 800 degrees. In cases of this kind they do not use an ordinary valve. They have specially constructed pistons and the cylinders are made of special metal and the steam valves are two Poppett valves, so that there is no rubbing at all. In all cases where superheat is as high as that special arrangements must be made to handle the steam at this temperature.

Mr. Marshall Wright,—

I have been running one of the new superheater locomotives on the Grand Trunk and find a great saving in fuel. Instead of the fireman having to shovel coal down from the back of the tender during the 184-mile trip, we cannot get the front gates open at the end of the 184 miles.

The only trouble I find with the superheater engines is that I cannot get my train started nearly as quickly, but once I get the train started they do much better work. With the old slide valve and saturated steam I could get the train started and do far quicker work than we are able to do now. However, the saving in coal must be great. I have started out in the old days from Sarnia with eight cars and by the time we got to Hamilton the fireman would have to start shovelling the coal down from the back of the tender. Now, with the same size tender we make the 184 miles, and as I said before, are not able to open the front gates at the end of the trip.

We have on one or two occasions had a little trouble with our flues. I find that if the flues start leaking on the superheater engines, you are just about down and out, whereas with the old way you could nurse the engine along and limp in with your train. However, we have had none of this trouble for the last two months.

Mr. Wickens,—

Superheaters were first applied to locomotives as an experiment, and they were found to work all right. Superheaters cannot be applied any old way. Like everything else they have got to be properly applied if they are to be satisfactory.

I do not think it will ever be possible to have a fixed plan of applying superheaters to plants, each particular case will have to be studied out and the superheater applied according to the requirements of each case.

In Germany ten years ago it was a big thing to superheat up to 90 degrees, now they are adding 200 and 300 degrees of heat and using steam as high as 600 and 800 degrees.

I was unfortunate in not being able to get more data in regard to the application of superheat to locomotives. I was hoping to get some, but, unfortunately, have not been able to do so.

Mr. Marshall Wright,—

In regard to lubrication. We have two Grand Trunk Pacific engines to which have been applied a graphite lubricator.

I saw a piston drawn the other day and I can only say that I have never seen a prettier looking piston drawn from an engine.

The piston rings after a while take on a sharp edge, but they are taken out and after the sharp edge is removed they are as good as ever again.

Mr. Barron,—

In regard to the statement you read out. There were two methods of superheating, one had an individual superheater, and the other superheated the steam with the same heat that generated the steam.

I should think if the superheater were placed on the chimney side of the tubes it would be better as you would then be able to heat the boiler and use the gases coming through the tubes for the superheater without detracting from the gases any of the heat that could be used for heating the boilers to generate the steam, but if the superheater uses the heat from the gases before they pass through the flues it would appear to me that the separate superheater was the better.

Where is the superheater placed at the back end of the tubes or in the firebox? If the boiler is properly constructed I should think that all the heat generated in the firebox would be required to generate the steam, such being the case, is there sufficient heat going up the chimney to operate the superheater? It seems to me that if the heat from the grates is going to operate the superheater you are taking that much heat from the boiler which should go to make steam, and you are operating the superheater at the expense of the boiler; therefore I should think the separate superheater would be the best.

I think Mr. McRobert hit it about right when he asked if there was any means of regulating the heat, if you could keep it about 300 or 400 degrees it would be all right, but when it gets up to 800 degrees and you have got to have special engines, special valves, special lubricators, and so on, it seems to me that it is going to be very expensive.

How are the tubes arranged in the superheater locomotives?

Mr. Clements,—

The superheater tubes in locomotives run the full length of the boiler.

Mr. Barron,—

That does not alter my contention. If you are going to place those tubes in such a way that they are going to take heat that is being supplied for the boiler you are not getting the full benefit of the fire. One must rob the other.

Mr. Clements,—

The superheater tubes in locomotives are $5\frac{1}{2}$-inch. diameter and wedged down to $4\frac{1}{2}$-inch. at firebox end.

Mr. Wickens,—

Mr. Barron's contention is quite right, but as I stated in my paper when you superheat steam you are not evaporating more water, you have only to add 7.8 per cent. of the heat necessary to obtain one pound of dry steam saturated at 150 lbs. pressure to increase the volume of the steam when superheated to $1\frac{1}{4}$ times, or again of 25 per cent. of B.T.U.'s for an expenditure of only 7.8 per cent. of the heat units supplied.

As I understand it, the idea of placing the superheater at the head of the flues is so that the gases which are hotter than the temperature you intend to superheat your steam to, will quickly raise the temperature of the steam or superheat it as it is necessary in order to obtain superheated steam economically to have the gases hotter than the superheated steam.

I think that the reason the superheaters are constructed in this way is to give the largest heating surface possible, the result being much more effective than if they were placed at the bottom end of the boiler or in any other place where the gases would have a chance to cool before striking the superheater.

I think there is very little doubt that the use of superheated steam in a reasonably large plant would be of great advantage, but in a smaller plant it would hardly pay on account of the cost of construction. The separate fire in a larger plant for superheating the steam would, in my opinion, be much the best.

Mr. Barron,—

That answers my question. As I understand it, now the amount of heat required to superheat the steam is small in comparison with the heat required to evaporate water to make steam.

Mr. McRobert,—

If you put the superheater in the front end of the boiler it would be impossible to regulate the temperature of the steam. What means have you of preventing it getting too much superheat?

Mr. Wickens,—

The means you have of regulating your steam is simply to proportion your superheater to such a size that the amount of heat you use is just enough to give the superheater the necessary amount of heat to superheat the steam to the required temperature.

Take the case of the cast iron superheaters. They will hold enough heat to make up for any fluctuations in the fire. I have never operated a superheater, but so far as I can learn the superheaters are proportioned so that they will not make the superheated steam too hot.

Mr. Bly,—

Is there any pressure at which it is most economical to superheat at 150, 200 or 250 lbs.?

Mr. Wickens,—

I do not think there is any fixed amount of superheat that is most economical. It is like everything else. There is some particular point for each particular case according to the engine that is being driven and the amount of work the engine is called on to do. I believe it is safe to say that in ordinary practice it is not good to superheat more than 150 degrees. If you superheat 150 to 200 degrees you keep the total heat down to a little above 500 degrees at an ordinary pressure of 125 lbs.

There was one case I spoke of in the paper wherewith a turbine engine they only superheated 60 or 70 degrees, with a saving of 30 per cent. Of course everything in that plant was just right for that much superheat, and it is like everything else if you use steam for any purpose you can use it wastefully or figure out what your requirements are and use your steam accordingly.

Mr. Taylor,—

I think from the way this discussion is going it would seem as if some of the engineers are trying to see how they can get something for nothing.

I cannot see where the economy comes in in taking the heat away from the boiler and giving it to the superheater. Where would the saving and economy be? I think the point is well taken. They cannot see anything in superheated steam and higher temperature when money has to be spent on special packing, lubrication and repairs. It is a question that requires a lot of discussion. No doubt big concerns that have large engines and want close results in order to obtain this high efficiency will be willing to pay for this, but I think the small man will be satisfied with the small engine, and it will be a long time before he puts in superheat.

Mr. Wickens,—

It does not make any difference if it is a small man or a big man. It seems to me that if the man buying the coal could save about 30 per cent. by using superheat he would be mighty glad to do it.

I might say that I have read up quite a lot of literature on this matter and there are engines in Germany as low as 30 h.p. that are getting that h.p. for 16 to 18 lbs. of water per h.p. Our engines of the same size are using anywhere from 38 to 40 lbs. So that while it may look a little bit far fetched when we see these kind of reports, I can assure you that they are to be relied on. I have seen records taken day after day where small engines were giving those results right along.

Mr. Marshall Wright,—

We have four of the superheater engines and eight men out of Sarnia and each engine does a little over eight thousand miles a month. The man that works opposite to me takes the engine out when I get back to Sarnia and I take the engine out when he gets back. We have had that engine since they first came, and the packing in the pistons and cylinders has never been renewed in six months. The boilermakers are not in the engine any longer than they were with the old type and the coal consumption is cut away down. The flues have never been renewed and we expect to take 75,000 miles out of these engines. Our engine is in better shape now than when we got it, for the simple reason that it has got worked down a little and the repairs to the engine have not been as much as before we got these superheaters. The flues are extra long, 21 ft. 6 in., and the only trouble I have had was when the flues gave out on the road.

I think the Grand Trunk is satisfied with them, I know I am.

Mr. Barron,—

I have enjoyed this discussion very much.

Referring to the German engine you spoke of, Mr. Wickens. It seems to me that it would be a very expensive business to install one of these engines. Take the small man you spoke of, it would be very hard on him to have to install one of these engines. The engine is practically built on to the boiler, and I think you would have a hard time persuading the small man that it would be to his advantage to install one of these engines on the evidence given here.

Mr. Wickens,—

It seems to me that if a man could operate an engine for 9 lbs. of water per h.p. hour that it would pay him in the long run. Then there is the low cost of operation. If you keep the cost of operation down the initial cost does not cut so much figure and you can afford to have a little higher overhead expense if the cost of operation is low.

The Locomobile is a self-contained engine and boiler. The boiler shell is made of heavy plate 7/8-in. or 1-in. thick, having a corrugated flue for the furnace, behind that is a set of tubes running direct to the combustion chamber in which is placed the superheater and a reheater. These heaters are made of drawn steel pipe. The combustion chamber is extended higher than the top of the boiler shell for the purpose of housing in the engine cylinders. A very heavy cast iron saddle, covering one-third of the circumference of the boiler carries the engine crank and shaft. The crosshead bearing is cast iron also, but is not fastened to the shell, thus allowing for expansion. The cylinders extend into the combustion chamber and are supported by a cast iron yoke which is outside of the combustion chamber. The steam passes from the boiler to the superheater, and from there to the high pressure cylinder. It is then returned to the reheater, and from that to the low pressure cylinder and from these to the condenser, which is operated by the main engine.

The discharge from the combustion chamber is at the bottom and is conducted by a breaching to the smoke stack.

Mr. Taylor,—

I do not think the gentlemen who was to have read the paper here to-night would have been able to do any better than Mr. Wickens has done. It seems to me that the superheater has had the best of the argument all round to-night, and I have great pleasure in proposing a very hearty vote of thanks to Mr. Wickens for stepping into the breach and giving us such an excellent paper and entering so heartily into the discussion.

Mr. Marshall Wright,—

I have great pleasure in seconding that motion. Carried.

Mr. Wickens,—

If I have said anything to-night that will help us along to understand this matter better I am quite satisfied. I have given this subject a great deal of thought, and I have been reading a great deal about superheat lately. My only regret is that Mr. Hill was not here himself to handle this matter, as he is very much more conversant with this subject than I am.

Chairman,—

If there is nothing further before the meeting it will be in order for someone to move that we adjourn.

Moved by Mr. McRobert, seconded by Mr. Taylor, that the meeting be adjourned. Carried.

CLUB NOTES

The members who attended the launching of the dredge "Port Nelson" at Polson Iron Works, Limited, on May 31st, felt proud that a fellow member of the Club, Mr. W. Newman, General Superintendent, Polson Iron Works, had successfully built a 650-ton dredge in the short space of five weeks, thus establishing a new Canadian record.

FLASHES FROM THE PICNIC.

It was a day in June; and, Oh me, Oh my?

If Jim McCaffery ever sees Bob Pearson's baseball team it will be all off with Joe Kelley and the Torontos in the International League.

Hail to the Chef:—

Toronto will lose a good citizen, if the manager of Delmonico's at New York ever tastes one of Tom's delicacies.

Those quoits they were great rollers, they simply wandered all around the pad.

Wonder of wonders, you should see that buttermilk.

Oh for a League Umpire—it was some umps. we had.

Jim Wright is some runner.