PAGES

MISSING

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Mechanical Superintendent, Consumers' Gas Co., Toronto.

Retiring President of The Central Railway and Engineering Club of Canada.

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

OFFICIAL PROCEEDINGS

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PROCEEDINGS OF THE CENTRAL RAILWAY AND ENGINEERING CLUB OF CANADA MEETING

Prince George Hotel, TORONTO, January, 18, 1910.

The President, Mr. Duguid, occupied the chair.

Chairman,—

The meeting will now come to order.

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

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

Chairman,—

The next order of business is the remarks of the President.

In my estimation the remarks of the President are a waste of time. You do not come here to hear the remarks of the President. Nothing will help the meeting along better than members coming to the meeting prepared to discuss the paper after it has been read. It is much better for members to read up some article along the lines of the paper and be prepared to take part in the discussion without waiting to be called on.

I will not take up any more of your time, so will close my remarks.

The next order of business is the announcement of new members. I will now call upon the secretary to read the list of new members.

NEW MEMBERS.

Mr. S. G. Dabner, Machinist, Canada Foundry Co., Toronto.

Mr. J. Tocher, Engineer, G. T. Ry., Stratford.

Mr. J. C. O'Brien, Secretary, Toronto Laundry Machine Co., Toronto.

Mr. F. W. Slade, Machinist, Bawden Machine & Machine Tool Co., Toronto.

Mr. J. F. Hartley, Machinist, G. T. Ry., Toronto.

Mr. C. Shook, Storeman, G. T. Ry., Toronto.

Mr. S. Best, Machinist, G. T. Ry., Toronto.

MEMBERS PRESENT.

R. Kellogg.	E. B. Allen.	G. S. Browne.
A. E. Cottrell.	W. Marchington.	J. Cave.
S. G. Dabner.	C. A. Jefferis.	W. J. Commins
J. W. Hetherington.	E. J. Friend.	G. A. Young.
H. A. Mosher.	J. F. Campbell.	J. T. Fellows.

T. Slade.
C. G. Herring.
A. Taylor.
A. Stewart.
J. McAllister.
E. Logan.
J. Tocher.
J. P. Law.
G. Boyd.
J. Duguid.
A. Laird.
W. Dony.
J. Griffin.
J. A. England.
J. Bannon.
H. H. Wilson.
J. Barker.
W. J. Keating.
G. Baldwin.
W. A. Manion.
A. H. Kirby.
J. R. Armer.
G. Blyth.
L. S. Hyde.
G. C. Keith.
H. C. R. Horwood.
J. Adam.
G. D. Bly.
J. H. Shales.
A. W. Durnan.
R. H. Brown.
H. W. Robinson.
G. Shand.
C. L. Worth.
C. H. Bull.
R. Titlaw.
E. B. Allen.
J. S. Grassick.
A. M. Wickens.
A. W. Carmichael.
F. W. Barron.
H. G. Fletcher.
J. Herriot.
H. Cowan.
F. R. Wickson.
F. Mathewes.
C. Martin.
C. A. Durham.
W. E. Archer.
G. P. Beswick.
W. J. McCallum.
C. H. Durnan.
G. A. Mathewes.
W. R. Maynard.
J. McWater.
N. E. Nash.
A. E. Hawker.
H. Donald.
L. Salter.
W. Philpotts.
R. Marsh.
G. Bernard.
W. E. Cane.
J. M. Clement.
E. Southby.
H. E. Rowell.
T. Henry.
A. Slute.
W. H. Aumbling.
O. Burt.
L. Westwood.
T.R.Hollingworth.

Chairman,—

At a meeting of the Executive, held last night, it was moved and seconded that a Social Evening be held on Friday, February 25th, the arrangements to be left in the hands of the Reception Committee. They have always been able to look after this part of the business so well that there is no doubt that they will again get busy and give us a good time.

A meeting of the Reception Committee will be held immediately after the close of this meeting.

I have now much pleasure in calling on Mr. Jefferis to accept the usual past-President's charm.

I am sure it is not only a great pleasure to me, but also to the other members present to see Mr. Jefferis presented with this charm after the very effective way he has run the business of the Club during the past year, and the keen interest he has taken in the business and social welfare of the Club.

I am not going to make any further speech.

Mr. Jefferis, on behalf of the Club, I have great pleasure in presenting you with this past-President's charm, and trust you will live long to wear it.

Mr. Jefferis,—

I am going to say "Boys." You all know how much I detest making speeches. I was thinking this over coming down to-night, and I decided that I would just simply say "Thank you."

Mr. Chairman, and fellow members of the Club, in accepting this beautiful gift which you have so kindly given me, I want to say that when you elected me as President of the Club last year no one knew better than I did how unfitted, how utterly incompetent I was to fill the chair. I refused the position, but I want to tell you I was forced into it, and had it not been for the splendid Committees we had last year, I am afraid The Central Railway and Engineering Club would have been wrecked before the year passed by.

This is a grand Club, and to my mind stands in a class by itself. Just think of it, we have blacksmiths, master mechanics, engineers, owners, boiler-makers, salesmen, pattern-makers, steamfitters, moulders, and draftsmen, all sitting here side by side discussing subjects of mutual interests. Now I ask you, where can you find such a body of men as this Club represents. I have never belonged to a Club like it before where there was so much harmony among so many different branches of the engineering profession. To my mind there is a great future before this Club, there are great possibilities if we stay right on the lines we are now working along and continue to work for the benefit of the Club as a whole, unselfishly and harmoniously as we have done in the past, rather than stand in the limelight as individuals.

Let us help the President to make this year the best year that we have ever had.

I do thank you sincerely for this present, and I shall always wear it with pride, coming as it does from such a body of men as you are. Gentlemen, I thank you.

Chairman,—

The next order of business is the reading of papers, and the discussion thereon.

We have a paper to-night by Mr. Bannon, Chief Engineer of the City Hall, on "Temperature Regulation," and we will now be pleased to listen to Mr. Bannon's paper, and after it has been read I hope you will take hold of the discussion and not wait to be called on so that we will not lose any time that can be used for the discussion of the paper.

Mr. Bannon,—

In getting up this paper I have tried to make it as practical as possible without being too technical.

This is a very broad subject, but the paper I have prepared is not a very long one, in fact it is short, but as the Chairman has said, I think that probably there will be plenty of discussion.

TEMPERATURE REGULATION.

BY MR. J. BANNON, CHIEF ENGINEER, CITY HALL, TORONTO.

The automatic control of artificial temperature is a comparatively new art. With the crude methods of heating employed by our ancestors nothing of this sort was possible and even with the advent of more modern steam systems the operators were for years forced to be content with such regulation of temperature as could be obtained by manually operating heater drafts, ventilators, etc. As heating appliances approach perfection, however, and the knowledge of hygiene becomes more widely disseminated the question of temperature in our living and working rooms has gradually assumed the importance it deserves and to meet the demands for means of automatically controlling these temperatures, various appliances have from time to time been placed upon the market. It is a matter of anxious interest in this connection, as showing the difficulty of the problem, that out of the many appliances introduced for this purpose very few have proved practicable and out of the many hundreds of patents that have been issued for automatic temperature regulation only a few are required to cover the appliances that are in successful operation to-day.

A temperature regulator is an automatic device which will open or close as required to produce a uniform temperature, the values which control the supply of heat to the various rooms. Although these regulators are often constructed so as to operate the dampers of the heater they differ from damper regulators for steam boilers by the fact that the latter are unaffected by the temperature of the surrounding air, although acting to maintain a uniform pressure and temperature within the boiler, while the former are put in operation by changes of temperature in the rooms. Heated from a hygienic point of view the close regulation of temperature in a building is important and from an economic point of view it is even more important. When the air volumes used are large such regulation cannot be entrusted to people who, absorbed in their work, fail to note a change of temperature until it becomes sufficiently extreme to attract notice. A radical and speedy change being then called for, windows and doors are resorted to until rooms become chilly, the inevitable results of such methods of regulating the temperature are wasteful escape of heat.

The heating surface for the warming of a building must be made sufficient for the demands of the severest weather at other times only fractional parts of the heat producible from it are needed. This may be obtained and works very satisfactorily by placing a number of thermostats on the outside of the building. The number to be determined by the size of the building. Those thermostats are set to operate at a low temperature and to control one or more radiators in the room the other radiators are controlled directly by the thermostat, placed in the room, and indirectly the inside thermostat controls all the heating surface when the temperature falls below the temperature that the outside instrument is set at. Such control is as essential to the evenness of temperatures furnished by a heating system and to the economy of its working as is a governor to the steadiness, and economy of the working of an engine. That reliable results are obtainable with the best forms of thermostats properly installed, cared for and used has been abundantly demonstrated. At the present time the cost of such apparatus for buildings of ten or more rooms should be estimated at about 6 per cent. of the cost of installing the entire heating and ventilating system. Aside from the undoubted value of a reliable system for control of temperature in protecting health, its service in economizing fuel is important.

A simple calculation will show the value of a method to control the heat supply. The average outside winter temperature during which the heating appliances is in use is about 40° Fahrenheit, and assuming 55° as a comfortable inside temperature the difference of 15° has to be supplied by the consumption of fuel and if the heat of the room by being made to run up to 70° that is 15° more, then the quantity of fuel used will be doubled again. Suppose that 70° be taken as the temperature needed for comfort and that this be run up unnecessarily to 73°, one tenth more fuel will be consumed in adding this undesired 3° which can readily be seen is a great extravagance. Yet many of our rooms, especially in large office buildings are kept at a much higher temperature with the result, especially in humid conditions of the atmosphere, that the occupants of the room become uncomfortable and the windows are thrown open to admit of the escape of the excess heat which is lost so that not only the unnecessary 3° is wasted, but much more of the normal heat of the room besides and the occupant of the room is unwittingly attempting the Herculean task of heating the town. Experience has shown that these calculations are verified in practice and in many cases the waste is much in excess of any of our supposed instances. I have in mind a test being made in New York city in one of its large office buildings, where a saving of 16 per cent. of the fuel consumed for heating has been affected by the installation of temperature control.

The temperature regulator in general consists of three parts as follows: first, a thermostat which is so constructed that some of its parts will move because of change of temperature in the surrounding air the motion so produced being used either directly or indirectly to open dampers or valves, and so control the supply of heat. Second, means of transmitting and often of multiplying the slight motion of the parts of the thermostat produced by the change of temperature in the room to the valves or dampers controlling the supply of heat. Third, a motor or mechanism for opening the valves or dampers, which may or may not be independent from the thermostat.

In some systems the thermostat is directly connected to the valves or dampers and no independent motor or mechanism is employed. In this case, the power which is used to open or close the valves or dampers regulating the heat supply is generated within the thermostat and is obtained either from the expansion or contraction of metallic bodies or by the change in pressure caused by the vaporizing of some liquid, which boils at a low temperature. The force generated by slight changes in temperature is comparatively feeble and the motion produced is generally very slight so that when no auxiliary motor is employed it is necessary to have the regulating valves constructed to move very easily and not be liable to stick or get out of order. In most systems, however, a motor operated by clock work, water, or compressed air is employed and the thermostat is required simply to furnish power to start or stop the motor.

The limits of this paper will not permit an extended sketch of many of the earlier forms used. Those which are in use may be classified either according to the general character of the thermostat or the construction of the motor employed to operate the heat regulating valves as follows:

Thermostats	Moved by expansion or contraction.	
	Moved by change of pressure.	
Temperature regulators	No auxiliary motor.	Expansion or contraction.
		Pressure.
	Motor	Clock work.
		Water.
		Compressed air.

Regulators operated by direct expansion metals of various kinds expand when heated and contract when cooled and this fact has often been utilized in the construction of temperature regulators. A single bar of metal expands so small an amount that it is of little value for this purpose unless very long or unless its expansion is multiplied by a series of levers. Several forms have been used some of which may be mentioned: A bent rod with its ends confined so that expansion tends to change its curvature. A series of bent rods of oval form resting on each other with the ends confined resting on two fixed bars. Two metallic bars having different rates of expansion arranged parallel and the variation in length multiplied by a series of connecting levers, an amount sufficient to be available in moving dampers. Two strips of metal of different kinds bent into the form of an arc and fastened together so as to form a curved bar, with the metal which expands at the greater rate on the inside, so that expansion tends to straighten it when heated. The difference in expansion between an iron rod, which is not heated and the flow pipe of a hot water heater multiplied by a series of levers. The constructions described have all been tried for the purpose of moving the dampers of heaters or for opening or closing valves in general. However, they have not proved satisfactory. Because of the slight motion caused by expansion, and the uncertainty of operation obtained with multiplying device . Certain organic materials have the property of bending or curling when heated, and this has been utilized in the construction of the Howard regulator. This regulator consists of a thermostat of the form of a plaque of triangular form, 11 inches long and 9 inches wide, which is located in the room, as the temperature of the room increases the plaque bends. It is connected by means of cords running over pulleys to a very light and easily moved cylinder damper arranged so as to regulate both fire and check drafts. The regulators of the motor type operate the regulator valves with a feeble force, acting through a considerable range, or with a considerable force, acting through a short distance they are consequently liable to be rendered inoperative by an accident to the levers or connecting tubes or by any cause, which renders the valves difficult to operate. To overcome such difficulties, several systems have been devised, in which the power for operating the dampers should be obtained from an independent source, in which the work required of the thermostat would be simply that of starting and stopping an auxiliary and motor. In the first system of this kind the motor employed was a system of clock work, which had to be wound at stated intervals in order to supply the force required for moving the dampers. In recent systems, water, electricity or compressed air have been employed to generate the power required, and in some instances regulators are arranged to operate not only the valves, which supply heat to the rooms, but also the various dampers which supply hot or cold air to the rooms. In all of the early forms of this kind of regulator the thermostat consisted of a tube of mercury or a curved strip made of two metals of different kinds soldered together and arranged so that a change of temperature would produce sufficient motion to make or break electric contact. A current was obtained from a battery on connecting wires led to the motor and the various terminals. When electric contact was made, at a position corresponding to the highest temperature, the current would flow in a certain direction and cause a magnet to release a pawl, which would start a motor revolving in the proper direction for closing the valves when the temperature fell below a certain point the thermostat would make electric connections so that the current would flow in an opposite direction and cause the motor to reverse its motion and open the valves. If the motor was operated by water, the electric current would open and close a valve in the supply pipe. If the motor was operated by electricity the current from the battery would move a switch on the wires leading to the motor.

Many systems of heat regulation are in use and are doubtless worthy of extended notice, but the systems most in entensive use and giving the best satisfaction are the Nash, the Johnson and the Power systems. In any of these three systems the motive force for operating or closing the valves which regulate the heat supply is obtained from compressed air, which is stored in a reservoir by the action of an automatic motor. The thermostat acts with change of temperature to turn off or on the supply of compressed air. When the air pressure is on, the valves supplying heat are closed, when if they are opened by a strong spring placed on the spindle of the valve the compressed air is supplied at a pressure of about 15 pounds to the square inch, which is operated automatically to maintain a given pressure. An air pipe leads from the air compressor to the thermostat and another from the thermostat to the diaphragms in connection with valves or dampers. The action of the thermostat is simply to operate a minute valve for supplying or wasting compressed air in the pipe leading from the thermostat to the diaphragm valves.

The expense of constructing a perfect system of heat regulation is met in a short time by the saving in fuel bills. The cost of maintenance is light when the system is properly installed and attended to and repairs made at the proper time.

The manufacturers of Nash, Johnson and Power systems of heat control have also designed instruments, which move adjusting dampers in any indirect system of heating slowly and hold it in any intermediate position as desired. This is considered an advantage for systems of ventilation in which it is always desired to admit the same volume of air, but in which the relative amounts of hot and cold air are varied to maintain the desired temperature.

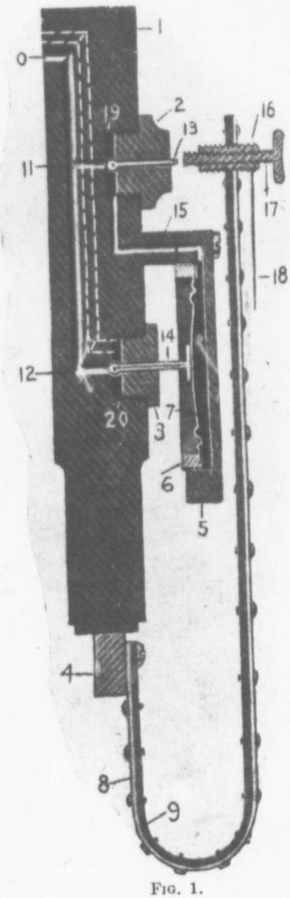

FIG. 1.

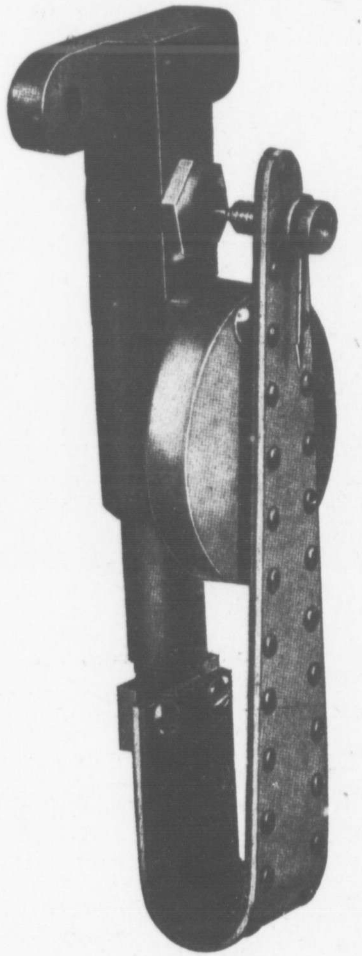

FIG. 2.

Figure one is a vertical side section of the Nash improved thermostat. (1) is a shell having inlet and outlet (10) and port with dotted line for connection by means of pipes, not shown, respectively to a source of supply of air under pressure, such as a tank or motor, not shown, whereby the radiator valve is operated in one direction. In the present case the radiator valve is open, air is admitted from the reservoirs at about

15 pounds to the square inch through the passages (10) and (11) forcing valve (13) on to the inner seat of plug (2). In this position it will be seen that the air has free communication through the passage (15) to the diaphragm below in case (5). This diaphragm being so much larger than the area of the valve (14) it is forced off its seat at passage (12) and being removed from its seat in plug (3), communication is established between the radiator valve and the atmosphere around the stem of valve (14), through the dotted passage to the radiator valve which is opened by means of spring on spindle of radiator valve as mentioned before. Steam being now admitted to the radiator the temperature in the room rises and acts upon thermo blades (8 and 9). These blades are composed of two metals, preferably zinc and steel. The zinc having about four times the expansion of steel under the same temperature, it will be seen that when the surrounding air rises slightly the V-shaped blade expanding on the outside more than upon the inside, causes the set screw (17) to come in contact with the valve (13) in plug (2), forcing said valve onto its seat in passage (11). The movement of this valve between its seats is the one thousandth part of an inch. The inner seat being now closed and the seat in plug (2) being open to the atmosphere, the air in the diaphragm below, which up to this time has held the valve (14) upon its seat in passage (12), is now released to the atmosphere and the valve (14) due to its pressure of 15 pounds to the square inch, is now forced on to its seat in plug (3). Communication between our pressure tank and the radiator valve is now established through the dotted passage, closing radiator valve and shutting off steam to the radiator.

To adjust this thermostat to any desired temperature the plug (16) has a pointer (18) which moves on an arc, not here shown, to the desired temperature, and as soon as the temperature desired is reached, the screw (17) is then carried forward until the radiator valve closes. It is then left in this position. This thermostat will act upon the fraction of one degree in change of temperature.

Fig. 2 shows a perspective view of thermostat.

Chairman,—

We have listened with a good deal of interest to Mr. Bannon's paper. We all know that it is a very important subject, and I think we have a good illustration of the necessity of heat regulation in this room to-night.

The meeting is now open for general discussion of the paper; either to ask for enlightenment on any part of Mr. Bannon's paper or to differ from him in any of his opinions.

I would like the members to start the discussion without my having to call on any particular member.

Mr. Wickens,—

I have been very much interested in Mr. Bannon's paper, and I feel he has covered the ground very thoroughly. It was within my province to have something to do with thermostats when they were first instituted in Canada.

In buildings, especially large office buildings, it requires a little more than the actual handling of the steam pressure to regulate the temperature, and to keep the building at a proper temperature there must be control of ventilation as well as control of heat.

Some of the earlier schemes did not reach the full usefulness of the thermostat of the present day. The thermostats were arranged to open and close the steam valves on the different radiators, but in the larger buildings there is always indirect heat to be contended with, and one of the difficulties that we experienced with the earlier forms of heat controlling devices was that it was very difficult to go part way. The room would get a little too warm and the thermostat would shut the steam off the radiators, but where there was indirect animal heat it was not only necessary to shut off the heat but to let the cold air come in, this very often made uncomfortable draughts in the rooms which were supplied with this indirect ventilation and thermostat system. At first there was considerable difficulty in handling this cold air because it was supplied directly from outside and for that reason, at that time, there were a good many devices that would shut off part of the cold air and part of the heat. There were also electrically controlled thermostats, which as the temperature rose or fell, threw the electricity from one side to the other of the magnet, thus opening or closing the regulators, but they were not a success as there was frequently a hitch somewhere, making it impossible to regulate the temperature.

I believe the best means of controlling the valves to-day is by air pressure. The air pressure is maintained by some kind of motor or pump, the air being stored in a reservoir, and a very small amount of air is required to open or close the valves. The air is carried to the rooms by a small pipe which can be buried in the walls, and I do not think that there is any better means of controlling the heat than by this method.

I think that Mr. Bannon has gone into the matter quite lucidly in his paper. Although I got a copy of the paper yesterday I did not have a chance to read it over until to-night, as Monday is my busy day, but he seems to have covered most of the ground. Perhaps there are others here who can tell us something more about this, as my experience with thermostats was something like eighteen or twenty years ago, and there may have been some improvements which I have not kept up with.

Mr. Bly,—

The paper I think does a great deal of credit to the reader. The way it is got up and the explanations given are very clear. Mr. Wickens has covered the ground pretty well, I think, on the earlier defects of thermostats. I have had practically no experience with these myself, but while the paper was being read it came to my mind that there was very little in the paper regarding the cost of installation, maintenance and operation, and I wondered if thermostats were such a good thing why there were not more in use in large buildings in the city. I believe there are only a few in the city that have heat control, those being the Government Buildings, the City Hall, Temple Building, Home Life Building, and the King Edward Hotel. There may be one or two others, and it has occurred to me why were there not more in use.

When the Traders Bank was erected, which is one of the largest, most commodious and best buildings in the city, they did not put in heat control there. Why not? One would have thought they would be the first to install it. Then again there is the building going up at the corner of Adelaide and Yonge and I believe they are not putting it in there.

One of the reasons seems to be the cost of installation. I am informed that for a building of about 110 rooms, the installation of the Johnson thermostat would be about, in round figures, $12,000, somewhere in the neighborhood of $110 a room, and when one takes into consideration the interest on the money expended on a heat control system of that kind and the amount of coal consumed to heat the building, it seems to me that it would take a considerable time to pay a dividend on the $12,000 expended.

Mr. Bannon said he has a thermostat in his building that he has not touched in three years. In making inquiries I find that some users experience considerable trouble with the diaphragms becoming vulcanized by the heat going through them, and also that it is almost absolutely necessary in a building where thermostats are used to have a man who has considerable experience in heat control devices to operate them, which brings up the cost of maintenance considerably.

Perhaps Mr. Bannon could give us something along the line of cost of installation and maintenance that would enlighten us a little.

I do not know that I have anything further to say on the subject.

Mr. Bannon,—

What Mr. Bly says is true. Of course all instruments, especially automatic instruments, have their faults.

In going into the cost of installation, I have in mind a school in this city which was installed with a heat regulating system at a cost I believe, of $30.00 an instrument. The cost of installing heat regulating systems has now been cut down very fine on account of the competition of the various systems which are trying to get business here.

When the system in the City Hall was put in there were 320 instruments and I think they cost about $125.00 each. The same building could now be installed with a similar or better system for a quarter of that amount.

The cost of maintenance after the instruments have been installed is very slight. I might say that in my building I have always several thermostats out of order. Some of them go wrong through the diaphragms vulcanizing owing to the heat, and I must say that there is nothing worse in a room than a thermostat that does not work, you have to depend on it entirely for the regulation of the heat and it is very disagreeable to the occupants of the room if it is out of order as you cannot shut off the heat.

I have instruments that were installed when the building was put up in 1899, which I have never touched.

When I take down an instrument that requires repairs I mark on the back of it the date so that I have a complete record of the amount of labor expended in keeping it in working order, the cost of maintaining the instruments is very light outside the labor attached for making the repairs. Another great trouble with heat control is the dampness of the compressed air. The air is taken, as a rule, from outside, and the compressor in the engine room compresses the air to about 15 pounds to the square inch. If the air is taken in at zero and the temperature raised to 90 degrees in the engine room, it passes on to the instruments carrying with it a considerable amount of moisture, caused by the various changes in temperature, it is very bad for the instruments. With the Nash instruments there are no perishable parts and therefore nothing to vulcanize. The diaphragms in other systems are made of rubber, but in this one it is made of metal which opens and closes like a concertina.

The air used in the Nash system is absolutely dry owing to the air passing through a filter, extracting all the moisture, and I have not been able to get a hydrometer that would give me a reading; this dry air could not be used in any other system, that I know of, because it would take the moisture out of the rubber and the instrument would be useless in a few days; that is the big trouble in most of the systems.

Some men think when anything goes wrong with a thermostat the best thing to do is to throw it out. I know an engineer in this city who had five or six instruments in his building; it was through my instigation that he put them in and one day he called up and said he would like to see me; unfortunately, I was not available at the time. The next day I met him and he told me that the instruments would not work and that he had taken them out. I asked him what was the matter, and he told me that they could not stand the heat, as the instruments got out of order and they could not shut the valves. I then asked him if he had tried to fix them, and he told me that he did not. I suggested to him that if his engines went wrong would he throw them out, and of course he said he would not do that. I know of several cases where thermostats have gone wrong and been thrown out without any attempt made to fix them.

Then again there is the trouble of excessive radiation in a room. Let us take for example that we have 200 feet of radiation in this room; when the temperature rises to 70 the valves automatically close but the temperature in the room still rises owing to the amount of steam in the radiators; this can be overcome by having outside thermostats which regulate part of the heating surface in the room.

There is another thing which affects the temperature of a room considerably and that is humidity. The more moisture there is in the air the less heat there is required in the rooms.

About four years ago we installed humidifiers, and I remember one man who was very particular about the temperature of his room. He wanted it at 70; 69 would not suit him, or 71. He has got two or three thermometers in his room and I had a lively time with him for a while. He called me in one day and said that the thermostats were all out of order; that they were registering 70 when the radiators were quite cold and the room was hot. You will see by this that you have all kinds of trouble to put up with. When I put in the humidifiers and raised the humidity in the air to about 45%, he was nearly roasted out; so that it was necessary to lower the temperature to about 65° to give him satisfaction.

Chairman,—

I would like to have that City Hall official in railroad service for a while and he would not be so particular about temperature.

Mr. Wilson,—

I have not much to say as I am not very well posted on this matter.

In regard to the thermostats getting out of order, is there no way to shut the steam off. Would it not be advantageous to install an emergency valve?

Mr. Bannon,—

It would be quite possible to put on an emergency valve on top of the diaphragm, but I would not put in heat control if I had to put in emergency valves.

Years ago they used to put an extra valve on top of the radiator valve, but I do not think they do it now.

Mr. Wilson,—

Mr. Bannon, what would you do when a thermostat went out of business, how would you manage to keep clear of trouble?

Mr. Bannon,—

I usually have a number of thermostats on hand all the time, so that when one goes out of order I can put on a new one and there is no inconvenience to any one provided that when the thermostat goes out of order the matter is immediately reported to me.

Mr. Tushingham,—

At what height from the floor do you put the thermostats to get the best regulation?

Mr. Bannon,—

They are usually placed about 4 ft. 6 ins. from the floor.

In placing thermostats in a room they are always placed on an inside wall and kept as much as possible away from draughts, and in this way you would obtain the best results.

Mr. Tushingham,—

You do not pay any attention to the height of the ceiling?

Mr. Wickens,—

It does not make any difference how high the room is. The thermostats are placed so as to register the temperature of the air in which we are living and not up above.

Speaking of the care and expense of thermostats, we had in the Parliament Buildings, when I was there, I think, 67 instruments and in twelve years we did not have to renew one of them, although we had to tinker at them occasionally. We had about six diaphragms give out in twelve years. One or two years we had trouble occasionally when a room became very full of people on account of the room becoming too hot after the people were in. If there was to be a public reception, or anything of that character, and we knew that there would be a lot of people in the room, we always went and set the thermostats back, as the animal heat that the crowd would bring in would keep the room warm without any heat.

When we received complaints about a room being too hot, it was not the fault of the thermostat, which would shut off the heat at the required temperature, the over-heating was caused by the crowd of people in the room.

One difficulty I found with thermostats was, when some smart Aleck thought he would fix the thermostats himself, and after he had roasted for a while he would send for an engineer to come and fix the thermostats, but we would leave him there to roast, and after a while we got most of the people in that building educated so that when there was anything wrong with the heat they would send for the engineer at once.

Thermostats are like all automatic arrangements, while you can get them almost perfect, it is absolutely necessary that the man in charge of them should understand them and look after them himself. There is no reason why thermostats should be any trouble if they are properly looked after.

Mr. Bly,—

I would like to ask Mr. Wickens why the thermostat would not work as well with ten or twelve people in the room as it would with four or five?

Mr. Wickens,—

I did not say that. I said the thermostat was useless if a room was crowded full of people.

Mr. Bly,—

We might assume that twenty-five people would be a crowd, why would not the thermostat work and keep the radiator shut off if there were twenty-five people in the room with all the animal heat they could bring in just as well as if there were only four or five. The temperature from the radiator works the thermostat, it would only be the temperature of the people that would raise the temperature in the room.

Mr. Bannon spoke about maintenance, and Mr. Wilson about putting on an extra valve. I am of the same opinion as Mr. Bannon, what would be the use of the thermostat if you had to use a valve to control the heat, you would have just the same trouble that Mr. Wickens spoke about of some one closing the valve, and forgetting to open it.

Mr. Bannon,—

I understood Mr. Wickens to say that supposing the room is at a temperature of say 70°, the thermostat closes the heat off, and a crowd of people come into a room the temperature begins to rise on account of the heat brought into the room by the people, that of course is no fault of the thermostat. The thermostat will close off the heat when the temperature rises to whatever the thermostat has been set to.

Mr. Bly,—

As long as the thermostat shuts off the heat when the temperature rises to 70 degrees, I do not see why it should be necessary to set the thermostat back.

Mr. Bannon,—

If I were in charge of this room, and expected as many people as there are here to-night, I would set the thermostat back to 65 or 63 degrees f I wished to keep the room at 70 degrees and depend on the people coming in to bring in the extra amount of heat required to raise the temperature to 70 degrees, as this room is much overcrowded and the outside temperature to-night is, I believe, about 50 degrees, so you will readily understand that it is quite impossible to cool this room under present conditions.

Mr. Tushingham,—

I think Mr. Bly has made a good point. The thermostat should close the valve, and keep it closed. Supposing you were anticipating 100 people, and only 50 came, where would you get the extra heat if the thermostat was set back? Is it a practice to regulate thermostats?

Mr. Bannon,—

Sometimes it is necessary. On a really cold night when the temperature is below zero, and you have your room heated at 70 degrees, the room is comfortable, but if the temperature suddenly rises 40 degrees, the room would then be too hot, although the thermostat is working right along. This, as I explained before, is caused by the humidity in the air. As the outside temperature rises the humidity becomes higher.

Mr. Shales,—

When you bring people into a room you raise the humidity of a room, it is the humidity from our breaths that causes the heat.

Mr. Wickens,—

I think I have one more word to say. When I spoke of bringing crowds into a room I had several instances in my mind.

Take the present Legislative Assembly room at Parliament Buildings. They usually have in that room about ninety people, and it is a large room. I have seen 600 people crowd into that room in the course of an hour, and those 600 people have animal heat enough to heat that room without any other heat. Before that crowd came we knew that the temperature would go away up, and in order to keep the room from getting too hot we used to set the thermostats back because we knew that we would not require any steam when the crowd came in.

Chairman,—

We would like to hear from Mr. Nash, who invented the Nash Thermostat, I believe he is here to-night.

Mr. Nash,—

I think Mr. Bannon has covered the ground pretty well.

Mr. Bly,—

I would like to say another word on this paper, it is very interesting.

We have heard a good deal about humidity, and that humidity in a room tends to raise the temperature, that being the case as far as I can see from the discussion that has taken place it is necessary to install an apparatus to control the humidity of the atmosphere. If we can heat with a temperature of five or six degrees less, and be comfortable, when the humidity is high, we certainly ought to be able to save considerable fuel and it would be well to install an apparatus for the control of the humidity, then the thermostats could be set at a lower temperature.

We have not yet heard why the humidity in the atmosphere helps out the heating of the room, we have only heard that it will make it more comfortable at a lower temperature.

Mr. Bannon,—

There is no question about it that the higher the humidity carried in a room, less temperature is required to give the desired comfort.

I do not know a better way of describing it than to take a day in July, when the humidity is very high, say 91%, you are sweltering in the heat, and go and look at the thermometer and find it only 85 or 86 degrees when you thought it must be about 110 degrees, as a matter of fact the temperature is low, but the humidity is high. That is what causes the trouble in New York during the dry spells, it is not the high tempera-true, but the high humidity.

I cannot explain why this is, but it is a fact.

Mr. Wilson,—

I think there must be something in the humidity that prevents radiation of heat, that is the air would be denser and radiation slower, without radiation the heat will not move away from our bodies.

Mr. Bannon,—

There might be something in that.

Mr. Wickson,—

I think the advantage to be gained by putting in instruments to regulate the moisture in the air to save coal by cutting down the temperature would largely depend on the operative cost of the apparatus.

In regard to the cooling of the body, as I understand it, the air with less moisture in it will absorb the moisture from the surface of the body which accounts for a person feeling colder with a lower amount of moisture in the air at a uniform temperature.

Mr. Bannon,—

I may say, that as far as putting in instruments to regulate the amount of moisture, that I have never yet seen a case where. you could get something for nothing.

Humidifiers work on the same principle as the thermostat They have a thermal blade which is made of wood, which expands or contracts according to the amount of moisture in the air, and opens or closes a little valve, and admits more moisture through the ventilator or shuts it off as the case may be.

In my building we have an inch pipe through which the steam blows into the chamber from which the air that is pumped through the building is taken.

I have never gone into the cost in dollars and cents.

With humidity control it is absolutely necessary to have temperature control as well, you cannot have one without the other. It you have temperature, say at 60° and humidity at 35%, then raise the temperature to 70°, your humidity is down low, say to 20%, so that you cannot have humidity control to work successfully without temperature control.

Mr. Herring,—

I would like to ask Mr. Bannon, whether a thermostat could be applied to a gas heating plant?

Mr. Bannon,—

It can be applied to any means of heating, hot water heating, steam heating, or any other kind of heating.

In the case of a gas plant the thermostat would close the gas valve, except the pilot light, and when the temperature falls the thermostat would open the valve again and admit more gas.

Mr. Wilson,—

I would like to ask Mr. Bannon if the controlling valves are right on the radiator, and if anything goes wrong if they can be changed without shutting off the steam?

Mr. Bannon,—

The only thing to go wrong with the valves is the rubber diaphragm and these sometimes will become vulcanized, and all you have to do is just to change the diaphragm.

Mr. Wilson,—

And this can be done while the steam is on?

Mr. Bannon,—

Yes. All you have to do is just to take the diaphragm off and put another one on.

Mr. Shales,—

With other systems that is not necessary, because they do not use rubber in the diaphragms. They can use the air absolutely dry making a perfect system, that cannot be done where rubber diaphragms are used, because the rubber would not stand it.

Mr. Wilson,—

Supposing the steam drops below the atmospheric pressure, what effect would that have upon the thermostat in general?

Mr. Bannon,—

Of course if there is no heat in the radiator it would have no effect on the temperature of the room.

Mr. Wilson,—

It can be done by putting so little steam into the system, that it will condense so fast that it will really form a vacuum on the pressure side.

Mr. Bannon,—

I have in mind the Johnson system where they put a diaphragm valve on each side of the radiator. The temperature rose and the steam condensed in the radiator forming a vacuum from twenty to twenty-four inches, then when the thermostat opened and released the air from the tops of the diaphragms, the springs placed on the spindle of the valve in the diaphragms raised them from their seats destroying the vacuum and admitting steam to the radiator very rapidly. That system is not perfect because it is absolutely necessary that the valves be tight at all times.

Mr. Nash,—

I would like to make a suggestion. It is good practice to put a spring of sufficient tension to open the valves under any conditions.

Mr. Allen,—

I have been very much interested in all that has been said, and I would like to explain why the room is warmer when the humidity is high than when it is low.

The case of a man taking a bath will illustrate the point. Let us suppose that the temperature of his body, the water in the tub, and the air in the room are the same, and that the humidity is very low. When he gets out of the bath his body is covered with moisture which evaporates. This evaporation requires heat which is drawn from his body and results in the sensation of cold. If, on the other hand, the humidity in the room had been 100%, the air would not have been capable of absorbing more moisture, then there would have been no evaporation from his skin and he would not have felt at all chilly, hence there is a feeling of greater warmth when the humidity is high than when it is low, although the temperature of the room remains the same.

Steam engineers will readily recognize a similar phenomenon taking place in a steam boiler. After the water is heated to the steaming point it requires an addition of a great deal more heat to cause it to burst into steam. This is termed the latent heat of evaporation. In the same way latent heat of evaporation is required in evaporating water from the body at atmospheric temperature and this heat must come from somewhere, which in this case is supplied by the human body.

It would not be desirable to maintain the humidity of a room at 100% since the body depends on a certain amount of evaporation to throw off impurities, and this action would not take place, hence a desired humidity of from 40 to 65%, which amount really depends on the physical characteristic of the person who is occupying the room.

Regarding another point that was brought up as to whether it would not be a saving of heat by maintaining a higher humidity; theoretically, yes, but as the process of humidifying the atmosphere now in vogue also includes a system of ventilation no separate tests have been made to my knowledge. The process of humidifying is generally accomplished with the fan system of distributing air for heating ventilation and humidifying. As the ventilation frequently changes the air you will, of course, require more heat than by direct radiation in a closed room. The air is first brought over tempering coils and assuming the air out of doors to be at a temperature of 20 degrees, and 100% humidity, and when this is heated to 40 degrees, by these coils and humidity would then be, say, 50%, because, as air is heated its capacity for moisture or humidity is increased. The air is then passed between baffle plates over which water is trickling and becomes saturated, that is, has a humidity of 100%. This air then passes through the fans and is blown over the heating coils which raises its temperature to say 65 degrees, and the humidity would then drop to about 45%.

Mr. Bannon,—

It is quite true what the last speaker said, he has referred to a ventilating system where they have air washers. We do not have air washers, we just take the air and pass it through cotton screens, if we had air washers it would bring down the cost.

Mr. Allen,—

In reference to the setting back of the thermostat. If you were designing a heating system for an office building, you would design your system to give a temperature of 70 degrees, but if you were designing a system for a theatre or large hall you would design it for a temperature of from 55 to 65 degrees.

If you take one room and use it, sometimes as an office, and sometimes as a room for a meeting when there are a large number present, the only way to make the temperature suitable for both occasions would be to set the thermostat back from 70 degrees to 60 degrees.

If you will go early to a theatre having a well designed heating system you will feel a little chilly at first. As soon as the people come in they supply enough animal heat to bring up the temperature to 70 degrees. Hence it is desirable when using one room, for either office or assembly purposes to set the thermostat back.

Mr. Wilson,—

The only thing I see is we save the fuel necessary to produce the amount of heat that the crowd produces, the working of the thermostat would be just the same if we left the room at the same specified temperature all the time, crowd or no crowd.

Mr. Bly,—

I have just one other question I would like to ask Mr. Bannon. What can he figure the actual saving in heating per cubic foot with heat control. Perhaps the best way to put it would be, if we were going to install a heat control system, that is, everything up-to-date, the first thing we want to know is, how much we can save when we install the system, and if we can save enough to pay interest on the money that is invested, maintenance, etc.

From what has been said, it seems very clear to me that, in heating our own houses, if we kept a little more water in the vapor pan in the furnaces, we would, perhaps, not have to burn quite as much coal. I find trouble with the plants dying in dwellings, the ladies say, it is the coal gas, but I think it is because the atmosphere is too dry, and absorbs the moisture from the plants.

Mr. Bannon,—

I might say that I have no data along that line. I know of one case where there was a saving of some sixteen per cent. coal required to heat a building after the installation of heat control apparatus.

There is no question that there must be a great saving by temperature regulators if they are properly installed.

Take the case of an office building where they have no heat control, and during the day the temperature outside is very low and all the radiators are opened up full. When the men go away the radiators are not touched and the temperature outside rises, consequently the temperature in the room rises also, if there was heat control in those rooms when the temperature rose outside, the thermostat would shut off the valves and this would require less steam and would certainly be a saving.

In July I can turn all my exhaust steam into the building and get no heat whatever from the radiators, that is if the temperature is as high as the thermostat is set at, except of course through some riser in a room which the steam passes which has not been covered up.

Mr. Duguid,—

I think there has been a very thorough discussion on the question, and Mr. Bannon has answered all the questions regarding thermostats.

While I think thermostats are necessary, we might not like to have to pay for them, as a man must be able to see a saving before he will install them.

There is no doubt that in the majority of cases there is about 50% of the heat wasted, through open windows and no control of the heat, which, although these thermostats may give considerable trouble and cost a lot of money, it would not only be a saving, but to my mind it would be a very great convenience, because there is no question about it, that every dwelling house, or public building in the city that has not got some heat control on but what the temperature will vary every half hour. I think it is only a matter of time when temperature control mechanism will be used in private dwellings and also in public buildings.

I think we have all enjoyed this paper, also the discussion, and Mr. Bannon has gone to a great deal of trouble to get this paper up, and I think it would be in order for someone to move a vote of thanks to Mr. Bannon.

Mr. Bly,—

I take very great pleasure in moving a vote of thanks to Mr. Bannon for the able manner in which he has given the paper and answered the questions which have been asked him. Seconded by Mr. Baldwin. Carried.

Mr. Bannon,—

I can assure you that I appreciate the vote of thanks very much. This is the first time that I have ever written a paper, and I do not think that I would ever have written it, if Mr. Wickens had not got after me.

I want to tell you that the fellow who gets the most information out of a paper is the man who writes it. I did not know that I knew so little about heat regulation, until I started to write up that paper.

I hoped that some of the railroad men would have opened up a discussion as to the heat regulation of trains. I have my own opinion about it, but that is only theoretical. I know that heat regulation on trains has not been successful. To my mind there are several reasons why they have not been successful, one of them is that the thermostats were not placed in a proper position in the coaches. The compressed air to operate same is usually taken from the train line which passes from one coach to another, this causes the temperature to vary owing to the air passing through the pipes which are exposed, and this causes precipitation of moisture affecting the instruments in the coaches. This being carried on from one coach to another finally causes considerable trouble. However, this may be overcome by installing a proper system of heat regulation in the coaches, and to my mind there is no reason why a perfect temperature regulation cannot be maintained on railroad coaches the same as in buildings.

I am sorry that this matter was not brought up in the discussion.

Chairman,—

The Secretary has received a letter from Professor Galbraith of the Toronto University extending an invitation to the members of this Club to attend a lecture on "Turbine Engines" on the 20th inst. in the University.

We appreciate Professor Galbraith's kindness in extending this invitation to the members of the Club, and I am sure the lecture will be very interesting.

Moved by Mr. Baldwin; seconded by Mr. Logan, that the meeting adjourn. Carried.