CIRCULATES IN EVERY PROVINCE IN CANADA

The CANADIAN MANUFACTURER

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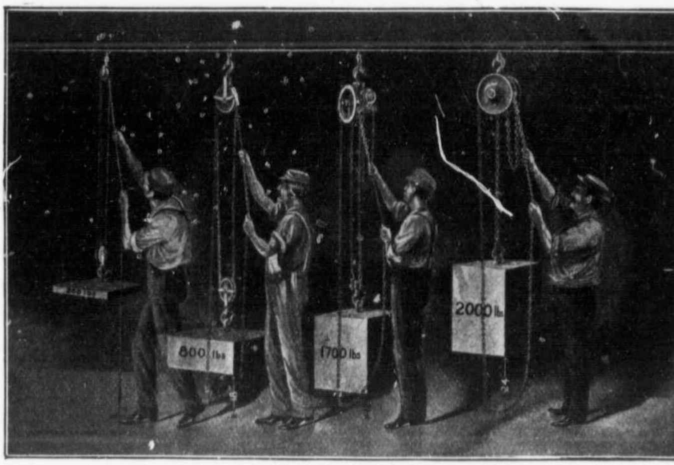

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Facts Concerning Niagara Power Scheme*

A Resume of the Facts and Events Connected with the "Cheap Power" Movement Since Its Inauguration Seven Years Ago. The Article is Shorn of All Comments or Criticisms. It is Intended to Give Readers a Good Understanding of the Situation as it Now Exists, and the Events Leading Up to It.

For the past few years the manufacturing and power using interests of Canada, and Ontario particularly, have been stirred to their depths by the "cheap power" movement. The problem of obtaining power at the lowest possible cost is an important one to the manufacturer and other power user. During the past few years the daily press has devoted very considerable space to this question. Sometimes it has been discussed in a common sense and unbiased way. Sometimes it has been made a political issue. Sometimes it has developed into a dispute between private and public ownership interests, and very often it has been discussed by those knowing practically little or nothing about the real problems of the question. In fact so much has been said and by so many people, that the average manufacturer has no definite idea as to just what has been done, and what the present situation is.

The object of this article is to give an account of facts without discussing in any way the "pros" and "cons" of the situation. The idea is to give a simple statement of what has transpired during the past few years in what is known as the "power movement," and the present situation of affairs. This resolves itself, more or less, into an account, shorn of all comments or criticisms of any kind, of what has been done so far by the Hydro-Electric Power Commission of Ontario, and the different municipalities which are interested in Niagara Power. Private corporations and companies have at times played an important part in the movement, and are still doing so at the present time.

Early History of Movement.

The movement was first started in 1900 as a result of the fuel famine at that time and the interest which was being taken in the development of hydro-electric power on the American side of Niagara Falls.

On April 25, 1900, a committee was appointed by the Toronto Board of Trade. The investigation of this committee had specific reference to the needs of Toronto. This committee suggested that power might be brought from Niagara; and that, the Toronto Electric Light Co. having signified their intention of bringing their power from the Falls, there was the question as to whether or not the city of Toronto should control this proposed Niagara Power connection.

During 1902 several meetings of representatives of different cities in the Province were held as well as those of the Canadian Manufacturers' Association and Boards of Trade.

Up to this time two franchises had already been granted on the Canadian side of the Niagara River to private corporations, viz., the Canadian Niagara Power Company to generate 100,000 h.p. and the Ontario Power Co. to generate 180,000 h.p., and a little later one with a right to generate 125,000 h.p. was granted to Messrs. Henry M. Pellatt, Frederic Nicholls and Wm. Mackenzie, who subsequently disposed of their holdings to the "Electrical Development Co."

On June 9, 1902, a meeting of the manufacturers of mid-western Ontario was held at Berlin, at which were representatives from Toronto, Galt, Guelph and a number of other towns, to confer respecting the best method of securing electric power for manufacturing purposes from Niagara Falls. It was suggested at this meeting that the municipalities should ask for the appointment of a Government commission which would have the power to arrange for the transmission of electricity to the various municipalities desiring it, the cost to be met by Government guaranteed municipal bonds, the municipalities to sell to manufacturers at a uniform rate. A committee was appointed to draft a practicable scheme and report later

In July, 1902, the matter was again taken up at a meeting of the municipal representatives held at Berlin, and a committee was appointed to obtain information. This committee reported at a meeting in Berlin on Feb. 17, 1903.

The report stated that, after discussion with the officials of the various power companies, the committee believed that power could possibly be obtained in large quantities at a price of about $7.00 to $8.00 per continuous h.p. per annum, delivered at Niagara Falls, or from $14.00 to $15.00 per h.p. delivered to the various municipalities. The report also recommended that prompt action be taken to obtain from the Legislature powers enabling municipalities to purchase and sell power, and

Cecil B. Smith,

Late Chief Engineer of Hydro Electric Power Commission and now Engineer for F. H. McGuigan Construction Co.

* Since the above article was written, the contract with the F. H. McGuigan Construction Co., for the construction of transmission line has been signed. This was done at a meeting of the Ontario Cabinet, Oct. 8, and the members of the Hydro Electric Power Commission were present. The Premier stated also, that the contract for the electric equipment of the transformer stations would also be let at once.—Editor.

to co-operate, to develop and transmit or distribute electrical energy, or to buy power and to sell and distribute the same to the several municipalities.

As a result of this report a resolution was passed urging that the Government of Ontario build and operate transmission lines from Niagara Falls to the towns and cities of Ontario.

In January, 1903, the city of Toronto made application to the Legislature of Ontario for the right to generate and transmit power from Niagara Falls, but the application was refused.

On February 27, 1903, a committee from the municipality waited upon the Government and were promised a measure giving the municipalities the right to transmit power from Niagara Falls. In furtherance of this promise, on June 12, 1903, an act was passed by the Legislautre of the Province of Ontario authorizing any two or more municipalities to appoint commissions to examine into and report upon the desirability of establishing works for the production of power, heat and light, the probable cost of such works, the desirability of the undertaking, and the proportion of the cost to be borne by each of the contracting municipalities. This Act also conferred upon the municipalities the power to accept the Report of the Commissioners, and to carry out the works under a Board of Commissioners to be appointed by the Chief Justice of Ontario, which Board were granted very wide powers for the acquirement or construction of works for the generation, transmission and distribution of electrical and other power and energy, and for the fixing of the rate or price which should be charged for the power in each instance. Authority was also granted for the issue of bonds for the carrying out of the works.

Acting under the powers given in this Act a meeting of the representatives of the seven municipalities chiefly interested was held in Toronto on August 12, 1903; money was voted and a Commission formed, consisting of four prominent manufacturers of the Provinces, viz., Messrs. E. W. B. Snyder, Waterloo; Adam Beck, London; W. F. Cockshutt, Brantford; P. W. Ellis, Toronto; and Prof. Fessenden, of Washington, D.C., an electrical engineer of international repute. Associated with them were R. A. Ross, electrical expert, and Henry Holgate, hydraulic expert, both of Montreal. These municipalities were Toronto, London, Brantford, Stratford, Woodstock, Ingersoll and Guelph.

Report of Municipal Commission.

This Commission prepared a lengthy and comrehensive report, which was published on March 28, 1906. This report contained estimates of the cost of a development capable of supplying 100,000, but equipped for the supply of: 1st.—30,000 h.p., being approximately one half of the net requirements of the seven principal municipalities at the time; 2nd — 60,000 h.p. representing approximately the total net requirements of the said seven municipalities at that time; 3rd—100,000 h.p., representing the supply of the net requirements of the eighteen municipalities interested with a margin of growth of demand.

The capital costs of the development, transmission and distribution of the three amounts of power indicated, including interest and sinking fund for construction period, were estimated and apportioned between the participating municipalities as follows:

	Cost of 30,000 h.p.	Cost of 60,000 h.p.	Cost of 100,000 h.p.
Toronto	$4,323,096	$6,265,424	$6,216,137
London	847,119	1,095,356	945,185
Brantford	429,152	571,097	509,248
Guelph	$317,441	$425,386	$377,821
Stratford	329,923	431,018	368,154
Woodstock	216,226	278,939	244,589
Ingersoll	221,672	287,391	249,754
Hamilton	....	......	1,163,812
St. Thomas	....	....	399,438
Paris	....	....	123,322
Dundas	....	....	66,359
Mitchell	....	....	97,847
St. Mary's	....	....	130,136
Berlin	....	....	426,393
Waterloo	....	....	189,628
Preston	....	....	106,243
Hespeler	....	....	48,095
Galt	....	....	246,939
Total	$6,684,629	$9,354,611	$11,909,100

The costs of the 30,000 h.p. and the 60,000 h.p. developments include the complete transmission and distributing plants required to serve the seven municipalities concerned. The cost of the 100,000 h.p. development includes the complete transmission and distributing plants required to serve the seven municipalities; but it includes only the development and transmission plant outlay required in connection with the eleven subsidiary municipalities, the distributing plants required being excluded from consideration.

The total annual expenses of all kinds, including water rental, repairs, renewals, contingencies, interest and sinking fund, but excluding taxes, were estimated as follows:

	30,000 h.p.	60,000 h.p.	100,000 h.p.
Interest and sinking fund	$317,163	$519,425	$661,266
All other charges	488,447	619,126	752,368
	$859,610	$1,138,551	$1,413,634

Interest was computed at rate of 4½ per cent. per annum, and the sinking fund charge was computed upon the basis of retiring in 40 years the whole bond issue required to pay the original capital cost.

Rates to Consumers

The rates necessary to charge consumers in order to make the undertaking self sustaining on the three developments were estimated as follows. The rates were computed on a 24 hour basis.

I. Motor service per h.p. per annum: 24-hour service at consumers' premises.

Municipality.	30,000 h.p.	60,000 h.p.	100,000 h.p
Toronto	$21.97	$15.73	$14.60
London	53.07	23.87	20.34
Brantford	30.02	17.93	15.57
Guelph	27.68	18.26	16.70
Stratford	33.67	21.45	19.42
Woodstock	34.48	21 05	17.53
Ingersoll	33.96	21.61	17.99

II. Arc lighting: Cost per lamp per year.

Municipality.	30,000 h.p.	60,000 h.p.	100,000 h.p
Toronto	$42.02	$37.61	$36.48
London	54.08	44.89	41.36
Brantford	49.73	42.91	40.55
Guelph	47.84	40.69	39.13
Stratford	56.83	47.23	45.20
Woodstock	56.16	48.16	44.64
Ingersoll	72.58	64.02	60.40

III. Incandescent Lighting: Cost per k.w.h.

Municipality	30,000 h.p.	60,000 h.p.	100,000 h.p.
Toronto	$.0741	$.0640	$.0614
London	.1150	.0925	.0839
Brantford	.0945	.0778	.0720
Guelph	.1140	.0965	.0926
Stratford	.1218	.0983	.0934
Woodstock	.1307	.1091	.0995
Ingersoll	.1321	.1112	.1023

IV. The surplus power generated and transmitted with the object of serving the subsidiary municipalities would cost at the municipal substation switchboards—that is, without any allowance for the local distributing cost—as follows:—

Municipality	Cost per h.p. per annum at municipal switchboard
Hamilton	$8.89
St. Thomas	15.09
Paris	12.19
Dundas	11.13
Mitchell	24.62
St. Mary's	19.67
Berlin	12.68
Waterloo	14.55
Preston	16.00
Hespeler	20.06
Galt	15.85

There figures raised storms of criticism from many sources. It was claimed that it was impossible to do the work at those figures. The figures were the topic of the engineering and daily press for long after they were published. The controversy even extended to public meetings.

Hydro Electric Power Commission Incorporated.

Meanwhile, through the influence of Hon. Adam Beck in July, 1905, an Hydro Electric Power Commission of Ontario was incorporated by the Legislature. It was the first definite step taken by the Government. The Commission was composed of the Hon. Adam Beck, chairman; George Pattison, M.P.P., Preston; P. W. Ellis, Toronto. Afterwards, owing to ill health, Mr. Ellis resigned, and Mr. John Milne, Hamilton, was appointed in his stead. The chief engineer of the Commission was Cecil B. Smith, M.E.

The Commission made an exhaustive investigation into the water-powers of the Province, both developed and undeveloped; also the industrial requirements of the Province and electrical distribution. The scope of the investigation was very wide, and resulted in the publication of five valuable reports, as follows:

1. The Niagara District, covering the territory between Niagara Falls and the Detroit and St. Clair rivers.
2. The Trent District, covering, roughly speaking, the territory lying north of Lake Ontario, but not including Toronto.
3. Lake Huron and Georgian Bay District, covering that portion of Lake Ontario bounded on the west by Lake Huron and the Georgian Bay, and on the southeast and north by the districts covered by the Niagara and Trent reports already issued.
4. Ottawa Valley and St. Lawrence districts, covering that portion of the Province lying east and north of the territory dealt with in the second and third reports.
5. Algoma, Thunder Bay and Rainy River District.

All these reports are in print; any person really interested could secure them from the Hydro Electric Power Commission, Continental Life Building, Toronto.

Meantime the daily press were devoting considerable space to the question and the public became very much interested in obtaining "cheap power." As a result a deputation waited on the government, and a second commission was appointed in May, 1906, composed of Hon. Adam Beck, chairman; Hon. John S. Hendrie, Hamilton, and Cecil B. Smith, Toronto. P. W. Sothman became chief engineer. One year later Mr. Smith resigned and Mr. W. K. McNaught, M.P.P., Toronto, was appointed in his place. This Commission were invested with all the powers necessary to control the rates to be charged for light and power by various companies utilizing water powers in the Province, and to build and construct all necessary work for supplying power to municipalities desiring it.

Report of Hydro Electric Power Commission on Niagara District.

It is with the Commissions' report on the Niagara District that we are chiefly interested at present. This report included the generators, transmission, and distribution of power from the Falls to different districts. The estimates for the cost of generating power were based on three quantities, 50,000 h.p., 75,000 h.p., and 100,000 h.p. For capital costs the estimates were:

Capital cost	50,000 h.p.	75,000 h.p.	100,000 h.p.
	—24 hour capacity—		
Capital cost	$5,350,000	$6,490,000	$7,980,000
Interest, 2 years at 4 p.c.	436,560	529,584	651,168
Total capital cost	$5,786,560	$7,019,584	$8,631,168
Per h.p.	$116	$94	$86

P. W. Sothman,

Chief Engineer Hydro Electric Power Commission.

Estimates of yearly charges, including operating expenses, maintenance and repairs, replacement fund, interest at 5 per cent, and rental of water, were:

	50,000 h.p.	75,000 h.p.	100,000 h.p.
Total yearly charges	$544,300	$661,700	$811,100

In order to determine the cost per h.p. per year at the high tension bus-bars of the transformer station, an allowance was made for transforming losses, which taken at 2½ per cent., gives net amounts of power as follows:

Net amounts of power	48,750 h.p.	73,125 h.p.	97,500 h.p.
Yearly cost of 24 h.p.	$11.16	$9.05	$8.32.

For the transmission of power the Commission based the calculations upon an arbitrary price of $12,000 per 24-hour h.p., at the high tension bus-bars of the generating plant, the price being determined upon a knowledge of sales of large blocks of Niagara power which had been made. This price is above the cost estimated by the Commissioners, as shown by the figures. From these estimates the following table of costs of 24-hour low tension power delivered at the different municipalities, substations included, has been computed:

	Full load	¾ Load	½ Load
Hamilton	$15.36	$15.59	$16.29
Toronto	16.53	16.91	17.15
Orangeville	23.66	25.90	30.54
Brampton	21.23	22.45	25.37
Georgetown	20.14	21.18	23.70
Milton	19.89	20.72	22.40
Brampton	26.00	28.84	34.91
Georgetown	21.93	23.58	27.25
Milton	20.92	22.11	24.36
St. Mary's	25.86	28.38	34.20
Stratford	20.48	21.48	24.04
Tavistock	23.50	25.14	29.12
New Hamburg	22.34	23.37	26.08
Baden	23.91	25.08	28.06
Berlin and Waterloo	17.36	17.82	19.27
Guelph	18.39	19.08	20.95
Hespeler	18.48	19.02	20.57
Preston	17.99	18.40	19.75
Galt	17.35	17.79	19.19
Brantford	16.87	17.29	18.48
St. George	17.14	17.54	18.62
St. Thomas	21.89	23.54	27.21
London	19.51	20.52	23.03
Tilsonburg	24.30	26.67	31.86
Ingersoll	18.81	19.75	21.93
Woodstock	18.26	19.10	21.11
Paris	18.12	18.81	20.50
Windsor and Walkerville	27.13	29.41	35.47
Wallaceburg	30.74	34.01	42.02
Dresden	30.87	33.74	40.79
Chatham	24.62	25.95	30.15
Thamesville	27.83	29.65	34.43
Bothwell	25.45	27.02	31.11
Glencoe	27.04	28.70	32.90
Sarnia	29.28	32.55	39.91
Petrolia	25.52	27.43	32.47
Oil Springs	26.00	27.99	33.28
Alvinston	27.64	29.48	34.19
Strathroy	27.82	30.48	36.83

The towns which are bracketed are in the same transmission district.

The Commission also went into the charges which would have to be made by several municipalities for different kinds of service in order to cover the cost of distribution within the municipality. These were merely as examples, as the Commission were not called upon for data of that kind. The municipalities must handle the distributing system in its own limits.

Action Taken by Municipalities.

The appointment of a government commission which had powers to supply power to municipalities, brought the situation to the place where the individual municipalities had to take action, and in January, 1907, a by-law was passed in the city of Toronto authorizing the incoming Council to enter into a contract with the Hydro Electric Power Commission for the supply of 15,000 or more of continuous h.p. at from $14 to $15.10 per h.p. per annum. This price was somewhat above the price quoted by the Commission. The following are the towns and cities to which the Commission quoted prices at the request of the municipality:

	Price.	No. of h.p.
Toronto	$14.00 to $18.00	15,000 or more
Berlin	17.85 to 23.50	3,000 or 1,500
Hamilton	13.97 to 17.50	15,000 or 8,000
London	17.49 to 22.50	10,000 or 5,000
St. Thomas	21.10 to 26.50	1,500 or 1,000
Brantford	16.57 to 21.50	3,000 or 1,500
Galt	17.37 to 22.00	2,500 or 1,500
Stratford	17.84 to 24.50	5,000 or 1,500
Woodstock	18.95 to 23.00	1,200 or 900
Guelph	18.01 to 24.00	3,000 or 1,500
Waterloo	19.02 to 24.50	900 or 600
St. Mary's	19.85 to 29.50	2,000 or 500
Hespeler	19.02 to 24.50	750 or 500
New Hamburg		not more than 400

All these towns had passed by-laws giving the council the right to enter into a contract with the Commission. The following municipalities have signed contracts with the Commission for power:

	Amount of power.
Ingersoll	500 h.p.
Toronto	10,000 h.p.
London	5,000 h.p.
Guelph	2,500 h.p.
Berlin	1,000 h.p.
St. Thomas	1,500 h.p.
Woodstock	1,200 h.p.
St. Mary's	500 h.p.
Preston	600 h.p.
New Hamburg	250 h.p.
Hespeler	400 h.p.

The Galt council had passed a measure entering into a contract with the Commission, but the mayor, refused to sign it, and Justice Anglin upheld the mayor in his decision. The city of Hamilton have entered into an agreement with the Cataract Power Co., for the power supply of that city, thus turning down the quotations from the Hydro Electric Power Commission. The mayor did not wish to sign this agreement, but was forced to do so. Brantford is now hanging fire, the council having been carrying on negotiations with an allied company to the Cataract Power Co.

Contract Awarded For Transmission Line.

In April of this year the Hydro Electric Power Commission signed a contract with the Ontario Power Co., Niagara Falls, for the supply of electric power needed by the Commission. So that the work of the Commission has resolved itself into the building of transmission lines and sub-stations to supply low tension power to the municipalities. Plans and specifications for the transmission line have been prepared, and the contract awarded to the F. H. McGuigan Construction Co., their's being the lowest tender. This contract has not yet been signed, although several months have elapsed since the awarding of the contract. Cecil B. Smith is engineer for the F. H. McGuigan Construction Co.

This contract includes the transmission of power to Brantford, but if Brantford does not sign a contract with the Commission, arrangements can be made with the contractors.

Plans and specifications for the transformer sub-stations in the municipalities which have contracted for power have also been prepared, and tenders called. These tenders are being considered at the present time by the Commission, and contracts will be awarded at an early date, it is said.

Western Municipal Power Union.

A word should be said about the Western Municipal Power Union, an association formed about the same time as the Hydro-Electric Power Commission, composed of representatives of different municipalities interested in obtaining electric power from Niagara Falls. Recently several new municipalities were admitted, namely, Dundas, Georgetown, Weston, Norwich, Oshawa, Cobourg, Whitby and Acton. This association has worked hand-in-hand with the Commission.

Contractors Ready to Start.

The contractors for the transmission line are ready to start right into the work, as soon as the contract has been signed. The transmission line when completed will be 293 miles in length, the contract price for the undertaking being $1,270,000. Though intended to cover western Ontario only, the line will ultimately be extended to Eastern Ontario, and perhaps northern Ontario, there being a proviso in the contract by which, roughly, 300 miles may be added upon the same terms. It is also part of the agreement that the McGuigan Co. will, if requested in writing, on or before February 4, 1909, supply from 50 to 125 tons of aluminum cable for the low pressure transmission line at the same price as the high tension. The line will be of aluminum, of which 507 tons will be required; the number of towers will be 3,176; their height, 66 feet each, and they will consume 6,554 tons of steel, costing $621,000. There will also be 140,000 pounds of telephone wire used for the double telephone line to be strung on the towers. The Canadian Bridge Co., of Walkerville, and the Ontario Iron & Steel Co., of Welland, will build the towers, while the aluminum, both wire and pig, will be manufactured by the Northern Aluminum Co. of America, at Shawinigan Falls, Quebec.

What Toronto has Done.

Toronto has gone farther than the other municipalities which have contracted for power from the Hydro Electric Power Commission in that last year estimates for a distributing system were prepared, and in January of this year a by-law was passed authorizing the expenditure of $2,750,000 in a distributing system. A few weeks ago Mr. K. L. Aitken, electrical engineer, was retained by the city to draw up plans and specifications for this distributing system. It is expected that these will be ready by the latter part of this year, when tenders will be called. The other municipalities passed by-laws to raise the money for distributing systems, but so far no definite action has been taken.

A writ has been issued in behalf of Walter D. Beardmore by Messrs. O'Brien & Lundy, to prevent any action being taken by the city in the power question, claiming that the city had no right to enter into a contract with the Commission. A similar writ has been issued by Mr. James Pearson, of Pearson & Denton. These are to be tried next January, but in the meantime the city has decided to get everything in readiness.

Difficulties Met by Commission.

The Commission have had a good deal of trouble in different parts of the country over the transmission line. The Commission proposed to erect their towers on easements, and trouble has been experienced in different parts of the country in buying these from the farmers. A writ was issued in London against the Hydro Electric Power Commission.

A Question of Producer Gas.

During the campaign of the Hydro Electric Power Commission, a good deal was heard about producer gas as against hydro electric power. Several public meetings in different parts of the country were addressed by men interested in the promotion of producer gas. Figures were produced showing that power could be obtained from producer gas cheaper than from water power. The Hydro-Electric Power Commission then got up a report on producer gas plants and engines in Canada and the United States and also on steam plants. The gist of this report was that although great economy could be secured from producer gas, it was not absolutely reliable enough at present to call for serious consideration except in places where gas engines were specially adapted. This report received much criticism both from those interested in steam engines and producer gas plants. It was claimed that the average steam plant practice and average gas engine practice was being compared with the best hydro electric practice. This report is still to be had from the Hydro Electric Power Commission.

K. L. Aitken, Electrical Engineer.

Retained by the City of Toronto to Construct the Distributing System for Niagara Power.

As It Stands Now.

As the situation is now, the contract for the transmission has still to be signed. The various injunctions have to be tried. The contract for the transformer stations has still to be let. Toronto is going ahead getting out plans and specifications for a distributing plant. It is felt that the other municipalities will start work on their distributing plants as soon as the contract for the transmission line has been signed.

THE POWER EDITION

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THE C.A.S.E. DESERVES SUPPORT.

It is a good thing for an industry to have its leaders awake to the possibility of extending and increasing their knowledge and skill by study and research.

It is a good thing for the manufacturers of Canada who are probably the largest users of power in the country, and it is a good thing for the engineers who operate the power plants that the latter are able, in most of the leading industrial centres of Canada, to join an organization like the Canadian Association of Stationary Engineers.

This organization is purely inspirational and educative. It has risen above the petty squabbling which would have taken up its attention had it been merely a labor organization, and has devoted its meetings to the promotion of technical efficiency.

The purpose of the association is made clear in the preamble to the constitution of the Executive Council, which reads as follows:

"This Association shall at no time be used for the furtherance of strikes or in any way interfere between its members and their employers in regard to wages. It shall recognize the identity of interests between employer and employees and shall not countenance any project or enterprise that will interfere with perfect harmony between them. Neither shall it be used for political or religious purposes. Its meetings shall be devoted to the promotion of educational, professional and mechanical knowledge."

Engineers throughout Canada should show their approval of this association by seeking membership within it. We are sure that manufacturers of all classes and in all parts of the country will also give their support and approval to such an organization.

RESUMÉ OF NIAGARA POWER QUESTION.

In the past few years so much has been said about the "cheap power" problem, about Niagara power, about the Hydro-Electric Power Commission and what it has done, that but few people have any sort of a comprehensive idea of what has really transpired. The question has been discussed so much and from so many points of view; facts have been so interwoven with fancies; so many incompetents have spread themselves on the subject; and there has been so much misrepresentation; that the whole thing is in more or less of a jumbled state in the minds of most people.

For that reason we thought that a clear statement of facts, made without interest or prejudice, shorn of all comment or criticism, would be welcome to our readers. In another part of this issue we have endeavored to carry out this idea, to publish facts in order of their happening, so that our readers can look back over the past eight years, and, having the important events laid before them, recall the controversy, the discussion, and the many little happenings which were too many to receive attention in short article.

The endeavor has been to publish all the facts and events which have an important bearing on the subject; and if anything has been omitted which should have been included because of its close connection with the subject, we will be glad to have our attention called to it.

SERIES OF ARTICLES ON PRODUCER GAS.

For the past three or four years gas producer plants and gas engines have been much in the public eye. Four years ago the number of gas plants in Canada were very few. Now the number which are in operation is little short of surprising, considering the short time which has elapsed. In view of the foregoing, the series of articles which will appear in the Power Edition of THE CANADIAN MANUFACTURER will be interesting and valuable. This series will take up the properties, manufacture and use of producer gas; the early history and features of gas plants, the design, manufacture, operation and features of modern plants. It is probable that this series will be followed by another series of articles on large power gas engines. The article in each issue will be complete in itself, covering some phase of the question.

The value of this series of articles is unquestionable. Information has been gathered by the author from wide sources—England, Germany, United States and Canada, and the opinions of experts on the subject are quoted frequently.

If there is anything appears in this series of articles which is questioned by any of our readers, we would be glad to have them make their views public through our columns; or if any reader can contribute anything which would be additional information, or which would throw more light on any part which is not clear, we will be glad to have him do so.

Steam Power Plant Questions and Answers

Useful Pieces of Information for the Engineer and Power Plant Owner, Put in the Form of Question and Answer for the Sake of Convenience. The Information is Educative. To Some it will be Well Known. To Others it will Prove Valuable.

ECONOMIC STEAM PRESSURE.

Question—What is the economic limit in steam pressure for simple engines?

Answer—It has been shown in theory and practice of late years that increased economy in the use of steam is to be obtained from increased pressure location limits for single expansion. In a simple non-condensing engine this limit of economic pressure is given by Hiscox as 115 pounds, gauge pressure, and in simple condensing engines as about 90 pounds. It is not well to exceed these pressures because of the loss from condensation which would result from extreme pressures in a single expansion.

SUPERHEATED STEAM REDUCES LEAKAGE.

Question—What effect has superheating steam on the steam leakage past the valves and pistons of engines; also what other influences bear on leakage, to increase or decrease it?

Answer—Experiments have determined that this leakage is reduced by about 25 per cent. with the use of superheated steam. The explanation given for this is that a less weight of superheated steam will flow through a given orifice in a given time.

The design of the valve naturally has an effect on the leakage losses. Experiments have determined that the leakage is practically universely proportional to the amount of overlapping of the port and valve. It is a fact also that good lubrication of values and cylinders reduces the leakage materially.

UNIT OF RATING OF BOILERS.

Question—What is the unit, upon which the capacity of boilers are based—what is a horse-power when referred to a boiler?

Answer—Strictly speaking the term horse-power as applied to a boiler is not quite logical, as a boiler cannot be said to generate power, However, it is a convenient term and will express the capacity of a boiler as well as any other term. The capacity of a boiler is measured by the amount of water it can evaporate in a given time. An evaporation of 30 pounds of water per hour from 100 degrees Fah. and at 70 pounds gauge pressure is equivalent to 1 boiler h.p. This standard is the same as the evaporation of 34.5 pounds of water from and at 212 degrees Fah. Boilers are now sold on a rating figured from the amount of its heating surface, allowing from 11 to 12 square feet per h.p.

The power which can be obtained from a h.p. of a boiler depends upon the steam economy of the engine. The style of engine in its economy of steam used in pounds per h.p. is the factor which gives the power that can be obtained from a boiler h.p. A boiler h.p. divided by a steam engine h.p. in pounds of steam, equals the steam engine h.p. available per boiler h.p.

As an example of this: In a series of tests on marine engines of large and medium size with a boiler pressure of 80.5, one engine showed a steam consumption per h.p. per hour of 21.7 pounds. Considering the standard of 30 pounds of water per hour from 100 degrees Fah. at 70 pounds gauge pressure for one boiler h.p., we can divide the 30 by the 21.7, assuming gauge pressures close enough for an approximate result, we have 30 divided by 21.7 equals 1.4 steam engine h.p available per boiler h.p. Depending upon the efficiency of the engine this may be greater or less than one. So that in purchasing a boiler and deciding as to the necessary h.p., the efficiency of the steam engine to be used with the boiler must be taken into account.

ECONOMICAL TYPES OF BOILERS.

Question—Is there any difference in the economy to be obtained in the different types of boilers?

Answer—There is very little difference in the economy of the modern types of boilers, the water-tube, the horizontal return tubular or the internally fired, provided they are properly designed with the correct proportion between heating surface and grate surface. The evaporation per pound of coal in each will be about the same, that is provided the boilers are clean inside and outside, water surface, and fire surface. The importance of keeping boilers clean cannot be over-estimated. A very small deposit of scale and soot will mean a loss of as high as 20 per cent of the total fuel consumption, and with a large deposit this percentage will increase considerably.

In the matter of economy the water tube and the return tubular boilers, that is externally fired boilers, are claimed to have some advantage over the internally fired boilers in combustion because of the heat of the brick furnace. However, the internally fired boiler has an advantage over the externally fired boiler in that there is no loss from air leakage, which cannot be said of the other as the setting grows older.

CAUSES FOR LOSS IN STEAM PLANTS.

Question—What are some of the chief causes for poor economy in steam plants?

Answer—One of the chief causes of loss or poor economy in steam plants is the use of engines which are over-loaded, undersized, or which are not suited to the condition under which they are called upon to operate. Badly arranged steam and exhaust pipes is another frequent reason. In large plants particularly too small sized piping, resulting in a reduction of pressure, between the engine and boiler, is a source of considerable loss. Imperfect drainage in the piping is another evil. The boilers are often sources of serious loss. Imperfect boiler conditions, such as air leakage through the setting and the neglect of scale and soot, will account for serious losses in the power plant. Poor operation of the boilers, due to some large or small defect or to ignorant handling will also cause considerable loss.

The exhaust steam is wasted in many power plants, which might be used for heating; and in some plants where the exhaust steam is utilized, power is wasted with excessive back pressure. This back pressure should be relieved by drawing the steam and water through the heating pipes with a vacuum pump. With an ordinary sized exhaust-steam heating system with good sized exhaust pipe and coil connections, the back pressure on the engine should not exceed 3 pounds per sq. in., and may be as low as ½ pound.

CAUSES OF KNOCKING IN ENGINES.

Question—What are usually the causes of knocking in steam engines and how can these causes be located?

Answer—These knockings or noises in the engine are warnings to the engineer. The location of these may generally be found by the ear, or by touching the fingers to different parts where loose joints may occur. A method of location suggested by one engineer is by a small piece of wood placed between the suspected point and the finger.

Water or hard foreign substance in the cylinder can be detected easily. Water gives a swish and blow, while hard matter gives a click or thump. Looseness in the piston rings; looseness in the follower; rattling of nuts, set screws, etc., all have their indication to the practical ear. Springs used to set out the packing rings are the cause of a click at every stroke, should they be cast loose in the inside of the piston. Looseness of the rod in the piston, looseness of the end of the valve rod or of any of its parts, looseness in the cross head boxes and bearings, piston rod key or lock nut, are all causes of noises. Loose joints in the made-up parts of the fly wheel or in the side bearings are often noise producers. Squeaking always denotes the necessity of oil.

Novel Construction of Open Feed-Water Heater

S. P. Morrison.

On taking charge of my present steam plant, I replaced three old two-flue boilers 48 in. by 22 ft. with two tubular boilers 72 in. by 18 ft. with 72 4-in. tubes.

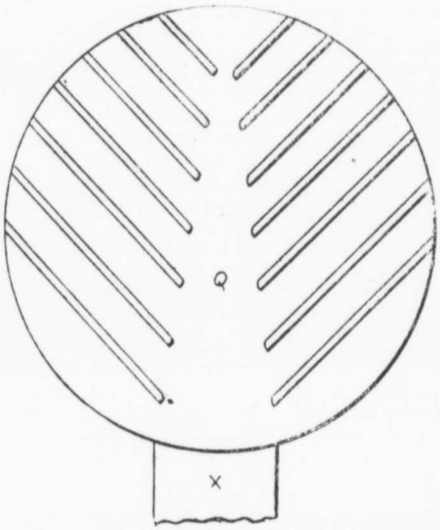


Fig. 1.—First Baffle Plates in Feed-Water Heater.

The heater consisted of a lot of 1.25-in. piping put inside of an old iron tank, and taking up all the available space in the engine room. One of the old boilers was converted into an open heater, by removing the two 15-in flues and bolting a patch over the holes made by the removal of the flues. This heater was raised and set up over one of the main engines near the roof of the engine room, where it is entirely out of the way, besides giving a good head of water to the hot water pump, helping the pump to work full stroke and to move smoothly.

This heater has been in operation for ten years and always giving perfect satisfaction. A glance at the cut will show the large capacity for heating, filtering, settling, and oil extracting, besides having a large body of hot water to draw on to fill the boilers, after the engine and cold water pump have stopped for a day. The heater is usually emptied of the water that is left from the day previous before starting which tends to wash

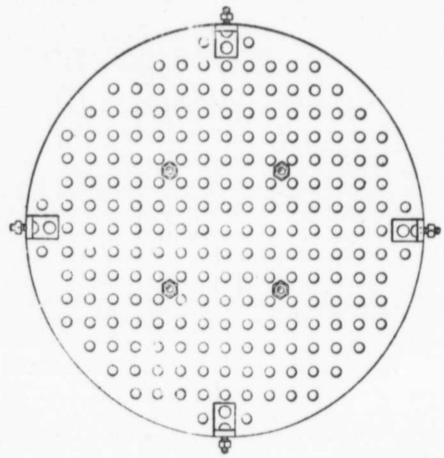


Fig. 2.—Second Baffle of Open Heater.

out the heater and pipes. The heater is refilled as soon as the engine and pump are started again.

Referring to Fig. 1, Q, is the first baffle plate 16-in. in diameter made of 0.25-in. iron or steel plate with 0.5-in. square iron riveted to the plate with a path, XX, left for the oil to run down as it is caught by the 0.5-in. square irons. From this plate a piece of heavy sheet iron is riveted on the back and reaching to the bottom of the separating chamber as shown in Fig. 3. Figure 2 shows the second baffle plate made of 0.25-in. steel with $\frac{7}{8}$-in holes punched in line with each other leaving a blank pace of 1.25 or 1-5-in. as a pathway for the oil and water to run down to the bottom of the separating chamber. These plates are made in halves in order to get them into the shell, and are afterward bolted together. Both the large and the small baffle plates are bolted together with three 0.5-in. rods, with the nuts screwed on the

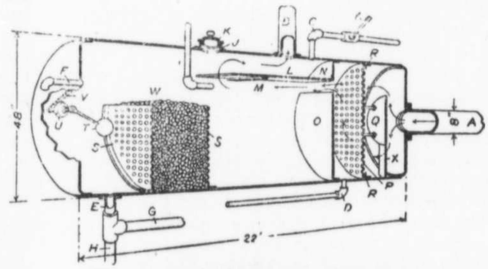


Fig. 3.—Longitudinal Section of Heater.

rods on either side of the plates, thus making the two as one and the whole is made fast to the shell with four lugs and bolts. In Fig. 4, O is made of 0.25-in. material flanged 2 in., and is bolted to the shell as shown in Fig. 3. O is made 1 in. smaller than the shell to make room for water-proof cement to be driven between the shell and the flange. N is put on in the same way.

L is two pieces of heavy sheet iron of the proper width and length laid on the flange N and made fast with two bolts. M, is a bar of iron made fast to the shell to hold the sheet iron. S in Fig. 3 is also punched sheet steel;

two of these are bolted together about 3 or 4 ft. apart, and the space filled with coke or brickbats. T is a 10 or 12-in. copper float to regulate a butterfly valve in the cold water supply pipe. U is a bonnet from an old 3-in gate

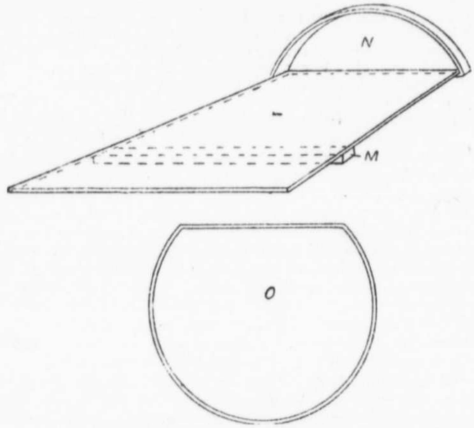


Fig. 4.—Front Head of Water Compartment.

valve bolted to the shell with the float connected inside and the lever V outside. F is a 2-in. overflow pipe. I is a drain pipe from the traps and elsewhere.

Should steam leak through any of the traps or bleeders it will help to heat the feed water besides returning the condensed steam to the boilers. J is the manhead frame and K the outside cover, with a soft packing between. A is the exhaust inlet and B the outlet. D is a 1.25-in drain pipe. E and G are hot water pipes to the boiler feed pump. E and H settling and blowoff pipe. Y and Y is the wire to connect the float to the butterfly valve.

This heater should be set on an incline of about 4 or 5 in. so that it will wash out and drain better.—Practical Engineer.

Initiative Revolution Counter.

A very compact and convenient little revolution counter is being placed on the Canadian market by Schuchardt & Schutte, 91 Yorkville Square, Montreal.

The form of the "Initiative," as this revolution counter is called, is shown in the accompanying cut. It does

Initiative Revolution Counter

away with the dial, commonly used, and gives the count in the form of an ordinary number. It will register right and left hand revolutions from 0 to 10,000, and then repeat.

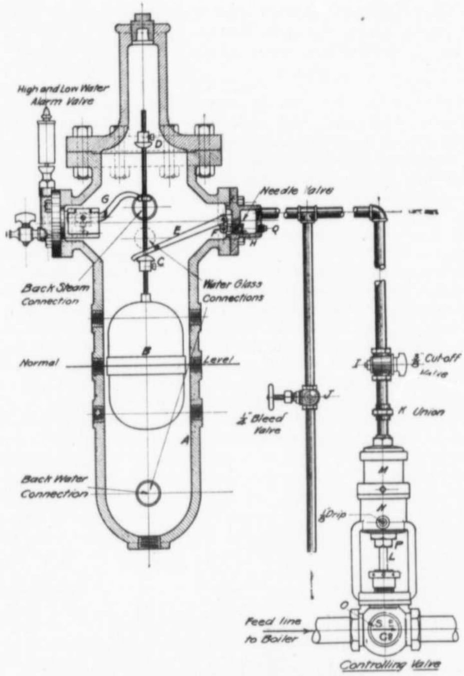
New Automatic Boiler Feed Regulator.

The accompanying illustration shows something quite new in boiler feed regulators. This automatic regulator is being manufactured and placed on the market by the Standard Engineering Co., 43 Scott St., Toronto.

A description of this regulator is as follows:

The cast iron column A, is installed, to take the place of the ordinary water column, and has therein the float B, which operates up and down as the surface of the water rises and falls. Under normal conditions, the water will not vary more than one half inch from the fixed point.

Should the water fall due to the evaporation within the boiler, the float falls with it and allows the lever E. to fall, thereby closing the valve F. The steam pressure



New Automatic Boiler Feed Regulator.

is thus cut off from the brass pressure pipe leading to the controlling valve, and the pressure falls as the steam within this pipe is vented through the bleed valve I.

As soon as the pressure falls, the spring in the controlling valve forces the piston upward and with it the valve stem L, thus opening the feed pipe to allow the pump to deliver water to the boiler, and to restore the water level to the normal position.

When the water reaches this point, the float with its rod and knocker, will have risen and be in contact with the lever E, which it raises slightly, thus opening the needle valve F, and allowing the steam pressure to enter the pipe line to the controlling valve and to act on the piston of the same. The piston is thus forced down against the spring and the valve is closed, shutting off the water from the boiler, and checking the rise of the water level.

As a guard against accident, a high and low water alarm has been added. Its operation is as follows:—Should the controlling valve fail to open, the water will fall to a point 4 to 6 inches below the normal level, at which point the top knocker D will come in contact with the level G, causing steam to pass through the alarm whistle, thus sounding for low water. Should the water rise above the normal level, lever E will be brought in contact with lever G, lifting same slightly and giving alarm for high water.

Producer Gas and Gas Producer Plants

First of a Series of Articles to Appear in the Power Edition, Taking up This Subject in an Educative Way. Information Has Been Gleaned from Various Noteworthy Authorities, Names of Authorities Being Given. Absolute Confidence Can be Placed in all Statements and Claims, as They Come from Some of the Highest Authorities on This Subject. This Series of Articles will be Followed by Another Series on Large Power Gas Engines. Each Article will be Complete in Itself. This Article Deals with the Compositon of Producer Gas and Methods of Manufacture

BY J. C. ARMER

COMPOSITION OF GAS.

In writing of producer gas the first consideration with which we are concerned is that of the composition and character of the gas. Producer gas as spoken of commercially not the producer gas which is so called in a scientific consideration. The commercial producer gas is a mixture of producer gas and water gas. The producer gas or air gas, as it is sometimes called, is formed by the partial combustion of coal by air, while water gas is formed by the pressing of a jet of steam through a bed of incandescent coal. In very few instances are these gases used separately in commerce, and henceforth in speaking of producer gas it will be the mixture of the two gases which will be referred to.

Air gas, resulting from the partial combustion of coal by an air supply insufficient for complete combustion, has three chief constituents nitrogen, carbon monoxide and hydrogen, the nitrogen coming from the air, the carbon monoxide from the partial combustion of the carbon in the coal by the oxygen in the air and the hydrogen from the coal. (The proportion of nitrogen in this gas reaches 56 to 60 per cent.; that of carbonic oxide 21 to 32 per cent.; and that of hydrogen from traces to 17 per cent.)*

Water gas is produced when water is decomposed at high temperatures by fuels containing but little hydrogen, such as anthracite, charcoal and coke. This gas forms the chief constituent of the illuminating gas used in America, there being hydro carbons mixed with it. Mixed with air gas it has become a powerful means of heating, especially where high temperatures are required.

The chief advantage of water gas over air gas is that the former contains practically no nitrogen, such a large percentage of which inert gas is contained in air gas.

The chemical reaction which takes place in the formation of air gas is comparatively simple. The oxygen in the air combines with the carbon of the fuel to form carbon dioxide, CO_2, which in passing up through the bed of fuel unites with more carbon forming carbon monoxide, C O. Any hydrogen in the fuel will take part of the oxygen from the air forming water vapor, but this may again be decomposed by coming in contact with incandescent coal, leaving the hydrogen free.

This gives the three chief constituents before mentioned.

The carbonic oxide consists of carbon monoxide and carbon dioxide in the proportion of about 20 : 5. There are then present the two inert gases, nitrogen and carbon dioxide.

CHEMICAL REACTION.

The decomposition of water by carbon is not represented by the simple equation:

$$H_2O+C=CO+H_2$$

but rather by the equation:

$$5H_2O+3C=2CO_2+CO+10H.*$$

Then the carbon dioxide CO_2 in passing up through the fuel, becomes wholly or partially converted into carbon monoxide, according to the depth of fuel bed. In this gas the we have only one inert gas, carbon dioxide, although there are always traces of nitrogen in water gas from the small amounts of air which necessarily accompanies the steam.

MAKING OF PRODUCER GAS.

It is the mixture of these two gases, producer gas, in which we are interested. This producer gas is made by passing a mixture of air and steam up through a bed of incandescent coal. This bed of coal is contained in a producer, which is a vessel made of cast iron or sheet iron lined with fire brick. The bed of fuel rests on grates at the bottom of the producer, and commonly the mixture of air and steam is admitted through these grates. The fuel is fed in at the top of the producer. The gas is taken off from the side and conducted to what is called the scrubber, where it is cleaned and cooled.

From the scrubber the gas is conducted to the holder, or to the engine or other appartus in which it is to be used. Examples of the producer and scrubber may be seen at A and C respectively, Fig. 1, but detail descriptions of different producers and scrubbers will be given later.

The steam is produced either in a steam boiler, or in a vaporizer, the heat in the gas as it comes from the producer being utilised to vaporize the water. A form of vaporizer is shown at B, Fig. 1.

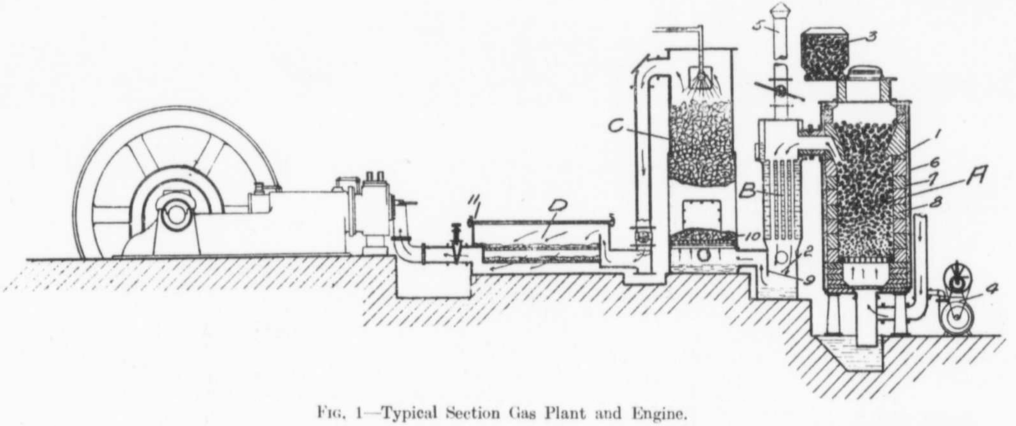


FIG. 1—Typical Section Gas Plant and Engine.

CONSTITUENTS OF PRODUCER GAS.

Upon the type of fuel used, upon the proportion of air and steam, upon the velocity of the mixture through the fuel and upon the thickness of the bed of fuel, will depend the composition of the gas.

Experimental work has determined the best proportion of air and steam and the most suitable velocity through the producer and the correct thickness of fuel bed; and the producers are designed in accordance. These conditions vary very little with the different plants, and thus it is upon the style of fuel that the composition of the gas depends chiefly.

The following table will give an idea as to

* Herman Poole, F.C.S., in Calorific Power of Fuels.

the composition of producer gas relative to the composition of the coal used in its generation:

AVERAGE COMPOSITION OF COAL AND GAS.

Coal.	Per cent.
Moisture	1.99
Volatile matter	28.89
Fixed carbon	60.30
Ash	8.82
Sulphur	.79
Gas by Volume.	Per cent.
Carbon Dioxide	10.16
Oxygen	.24
Carbon monoxide	15.82
Hydrogen	11.16
Methane	3.74
Nitrogen	58.88

The following tables show the average composition of producer gas as given by different authorities.*

Constituents.	Per cent. by volume.
Carbon monoxide, C O	25
Hydrogen, H	12
Hydro carbons, $C H_4$	01
Carbon dioxide, $C O_2$	05
Nitrogen, N	57

The desirable constituents, which are variable with a given fuel, are carbon monoxide, C O, and hydrogen, H. The undesirable constituents of the gas are carbondioxide, $C O_2$ and nitrogen, N. Now it is apparent the more steam there is the greater will be the per cent. of hydrogen, and the less will be the per cent. of nitrogen. However, there is a limit to increasing the proportion of steam to air, governed by the damping effect of the steam upon the fire. There is a proportion whereby the fuel in the producer is kept at the proper state of incandescence. This proportion has been determined by experiments, and the resulting constituents in the average sample of good producer gas is an indication of this proportion.

At the temperature of about 1,900 degrees Fahr., the minimum amount of carbon dioxide is formed, when the air and steam blast is passed up through the fuel; this, therefore, is theoretically the best temperature at which to work the producer. A deep bed of finely divided and porous fuel tends to the maximum production of carbon monoxide; but this feature cannot be carried so far that excessive resistance to the blast would result. A weak blast, i.e., a blast with a low velocity through the producer, is beneficial to the maximum conversion of carbon dioxide to carbon monoxide as may be readily understood; but there is also a limit to the smallness of the velocity in that the temperature of the incandescence must be maintained at the most efficient height, and dimensions of the producer must be kept within reasonable bounds.

Hydrogen has been spoken of as one of the desirable constituents in producer gas; and it is true that the more steam that can be used, and thus the greater the per cent. of hydrogen that can be had in the gas without damping the fire so much as to increase the percentage of carbondioxide, the greater will be the heating value of the gas.

But for gas engine work too much hydrogen in the combustible is not economical, owing chiefly to the facts that hydrogen upon ignition in the engine cylinder produces water vapor H_2 O, and thus, if the percentage of hydrogen is large, there will be a considerable quantity of the heat liberated at combustion tied up in the latent heat of the water vapor, and that the velocity of the propogation of the explosion of hydrogen is too high for gas engine practice. If no deduction is made for the latent heat, volume for volume, carbon monoxide and hydrogen upon combustion give approximately the same quantity of heat, but actually hydrogen is decidedly inferior to carbon monoxide, owing chiefly to the latent heat absorbed by the resulting water vapor.*

Besides producing a gas of greater heating value per unit volume, the mixing of steam with the air blast is advantageous in several other ways. If steam were not used and other conditions were constant, the temperature of the producer would increase with the amount of fuel turned into gas. The grates and other parts of the producer would have to be cooled to save them from destruction. That would result in a considerable loss of heat. But when the steam is used the temperature of the grates and the walls of the producer can be kept below the destructive point very effectively, and at the same time some of the heat in the generated gas can be utilised to vaporize the water instead of going to waste in the scrubber; this is a question of efficiency which will be discussed fully in a succeeding chapter.

FUELS USED IN THE PRODUCTION OF THE GAS.

In discussing the constituents of the gas in the foregoing section, nothing has been said about tar and other impurities which may be in the gas as it comes from the producer; it is assumed that in passing through the scrubber and other purifying apparatus these impurities and the moisture is removed from the gas. For gas engine work it is absolutely necessary that the gas produced be uniform in quality and free from tar and other impurities.*

This purifying of the gas is one of the serious problems which had to be solved in designing plants for the manufacture of this gas. The dust and moisture are easily removed, but the tar and similar impurities have given considerable trouble.

Now practically all carbonaceous fuels can be used in power gas plants, among these being anthracite, coke, lignites, charcoal and common bitumous coal.* It is the last named fuel which gives the most trouble because of the large percentage of tarry matter which it contains. Anthracite coal is an ideal fuel for gas producers since it gives off little or no condensable hydrocarbons or tar, and is a non-caking fuel.* Number 1 buckwheat is a very satisfactory coal, and is the kind of anthracite commonly used in pressure producer plants.† In suction producer plants only anthracite coal has been used with any degree of success and because of the resistance to the air blast which it offers it should not be smaller than pea size.†

The per cent. of ash in a coal is an important consideration since a coal that contains more than 10 to 15 per cent. of ash tends to choke up the air passages,† and under these conditions it is difficult to keep the generator clean. A coal that contains much moisture or more than 5 to 8 per cent. of volatile matter tends to cohere in the producer and to form arches, which prevents the proper operation of the plant.*

Tar tends to clog up the pipes and valves of the producer system and engine, and it also forms a slow burning mixture which tends to cause premature explosions in the engine cylinder. This indicates that unless special stress is laid on purification, the coal should contain as little tar as possible.

In most coals there are traces of sulphur, from which sulphuretted hydrogen is formed in the producer and mixed with the gas; to which constituents there are two objections, i.e., its odor and the probability of its attacking any copper with which it comes in contact. It is therefore advisable, since it is practically impossible to get coal continuously without these traces of sulphur, to use as little as possible of this metal in the gas passages. Ammonia gas is also obtained in the generator, which has a corrosive action on copper, but fortunately this is absorbed in the scrubber.

The requirements of a fuel may then be summed up in a statement. For suction producers the hazel nut size of anthracite coal is most suitable. The driest coals should be selected, containing a minimum of volatile matter and having no tendency to coke or to cohere. Coal which breaks up and pulverizes under the action of the fire is not to be recommended. The coal should also be such as to avoid the formation of arches which would interfere with the proper settling of the coal during combustion. Coal containing more than 10 to 15 per cent. of ash should not be used in generators or producers when the discharging of the ashes is done automatically; the reason for this is that the ash will obstruct the generator, since the furnace cannot be cleaned safely in a case of that kind without hindering the production of gas. Unless special chemical cleaners and purifiers are employed, the coal used should yield as little tar as possible during distillation; for the tendency of the tar to choke up the pipes and to clog the valves is one of the chief causes of defective operation of producer gas engines.

From the foregoing fuel consideration it is evident that the satisfactory operation of gas generators does not depend upon pure anthracite, but that a good dry coal is quite suitable for the generation of producer gas; and that with specially designed producers and purifying apparatus almost any style of carbonaceous fuel can be used satisfactorily.

USES OF PRODUCER GAS AND ITS ADVANTAGES FOR POWER PURPOSES.

Producer gas is used for heating and for power purposes. In Canada the first producer gas plants which were installed were pressure plants supplying gas for heating ovens. For this purpose it has become popular, because of the efficient way in which the heating is done and because of its cheapness. Then too, this gas is very suitable for heating where high temperatures are required, because of the large amount of hydrogen present.

There are plants installed where water gas is made for heating purposes, this gas giving of course a higher temperature than the mixed gas because of the greater per cent.

* Julius J. Wile.

* Thomas Rigley, in paper "Power Gas Plants," presented before the Manchester Association of Engineers.

† Chas H. Day in article "Producer Gas and Gas Producer."

* Chas. H. Day, in article "Producer Gas and Gas Producers."

of hydrogen present, alternately with air gas or a producer gas, the steam blast being small, for use in gas engines. The bed of fuel in the producer is blown into a high state of incandescence during the making of the air gas; then the steam blast is substituted for the air blast, and water gas is made until the fires become so dampened as to be no longer efficient, when the air blast is again turned on and fuel blown up. Such a plant is installed in the Ramapo Iron Works, Ramapo, near New York, the water gas being used for heating furnaces and the air or mixed gas for the gas engines operating the rolls in the mills.

However, producer gas proper is used very widely for heating milling furnaces in steel and glass works. The advantages of producer gas for this purpose over direct heating by coal are several, the chief of which is the economy obtained by the complete combustion of the fuel as occurs with gas. The rapidity of output of the furnaces is also increased owing to the efficient manner in which the heat can be controlled. The introduction of producer gas for fuel into steel works has increased their capacity one-third, and has lowered the fuel consumption 25 per cent.* Another advantage is the efficient way in which the gas can be transmitted, which allows the centralization of the coal supply.

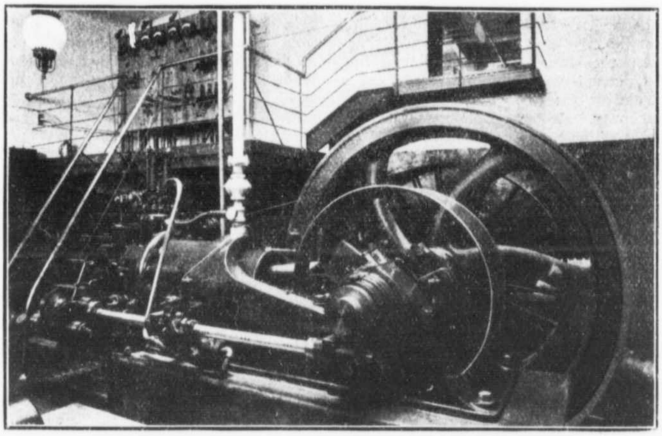
The transmission pipes for producer gas will be large compared with those used for illuminating or natural gas, and the burners must be specially designed for burning producer gas if the best efficiency and economy is to be obtained.*

Temperatures as high as 2,000 degrees Fahr. can be obtained with producer gas burners, without preheating the air supply to the burners; but if higher temperatures than that are required as in steel and glass works the air supply must be preheated; and this is done in regenerative furnaces. The advantages of producer gas over other gases are the higher temperatures which can be obtained with it, and its relative cheapness.

The gas used in steel and glass works for heating is made of bituminous coal, nor is there any necessity for the removal of the tar and volatile matter.

The gas is transmitted from the producer to the furnaces through large brick flues. Because of the depositing of tar in these flues, they are cleaned weekly.

But it is for power purposes that producer gas should receive chief attention. The first advantages of generating power through the medium of producer gas, rather than that of steam, is economy; and this will be discussed fully in a succeeding chapter. But it may be advantageous to here make a few general statements regarding the universal adaptability of this method of generating power. Any form of carbonaceous fuel can be utilized in the producer; the plant can be installed at any point where fuel material and water can be obtained, and it is not dependent on any manufactured product for its maintenance and operation; the intial cost of the installation is low; the amount of water actually used is small, the cooling water for the scrubber being used over and over again; the cost of maintenance and repairs is small; and stand-by losses are low. Then the producer gas system is simple and compact and the space occupied is small. The erection and arrangement of the system is not complicated, and there are few parts, little auxiliary apparatus being required.



One of the Hornsby-Stockport 100 H.P. Engines and Switchboard in Ames-Holden Plant, Montreal.

The system is efficient also because of the uniform quality of the fuel used; no fuel is wasted; the fuel is consumed in proportion to the load; perfect combustion of the fuel is attained at the point of power production; a very high per cent. of the thermal units in the fuel is utilized in the production of power; the same thermal efficiency can be had in small as in large installations; fuel storage in the most compact and valuable form can be had without any loss of energy in the fuel stored, and the thermal losses in transmission in the system are reduced to a minimum.

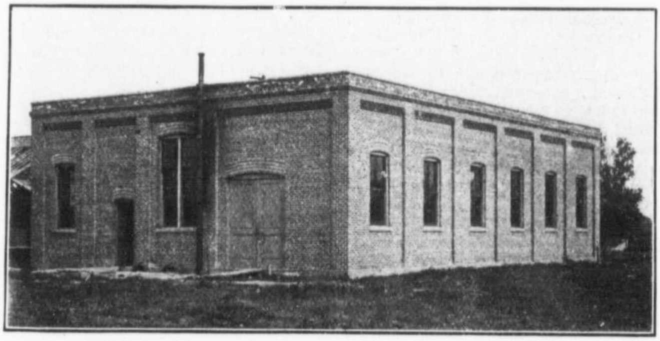
It is safe because there is no high pressure steam boiler required, no high pressure in the piping, no danger from fire or explosions, it can be started and stopped instantly and there is perfect and automatic control of the system.

It is sanitary because no smoke or deleterious vapors are given off, and the installation is clean, unobtrusive and not a nuisance in the neighborhood.

The attendance and attention required is small because the fuel and ash is centralized, all being handled at one point; the installation is always ready to operate, is automatic in operation; there are no delays for cleaning or starting fires or getting up steam, and the system can be operated continuously on long runs without injury, breakdown, or adjustment.*

At the present time when there is so much agitation in the large cities in Canada and the United States for some remedy for the smoke nuisance, the fact that no smoke is created in the generating of power through the producer gas plant and engine should receive considerable attention.

In commerce costs are the first considerations, and it is the economy of the producer gas system which has been, and will continue to be, the talisman in the development of the system of power production.



Exterior View of Chatham Municipal Electric Lighting Plant.

The name of the Caguas Tramway Co., Limited, has been changed to The Caguas Electric Co., Limited.

* Julius J. Wile.

* E. R. Knowles.

Fuel Saving by Using Suction Gas

Suction Gas Plants Installed by Colonial Engineering Co., in Ames-Holden, Ltd., Shoe Factory and Municipal Lighting Plant of Chatham. Fuel Economy of thes Plants.

In view of the widespread interest now manifest in the suction gas engine and its claims in the production of cheap power, it is of particular interest to note what it has really accomplished in Canada by way of actual results.

For some years past it has made a showing in England and on the Continent which, for economy has not been equalled. But England is 3,000 miles away, and in England the user of suction gas engines has the famous Welsh anthracite pea coal at his disposal, a coal which does not clinker; is exceedingly high in fixed carbon, low in ash, no slate or tar and altogether the ideal coal for this type of engine.

In Canada on the other hand we are confronted by the disadvantage of having to use an anthracite pea which carries a comparatively high percentage of slate and tar and a consequent tendency to clinker, the formation of which is fatal to the successful operation of the suction gas producer. Therefore it is natural that a power user in Canada would wish to see plants which are operating successfully in Canada before he is impressed with the suction gas engine, especially in view of the fact that several improperly designed and poorly installed suction engines and plants have failed and been taken out.

The accompanying illustrations are of two plants installed by the Colonial Engineering Co., Montreal, one being in the factory of Ames-Holden, Limited, Montreal, and the other the recently installed municipal lighting plant at Chatham.

When the Colonial Engineering Co. was organized it did so with the aim of meeting and overcoming the coal problem and the lack of experience in Canada with the gas engine and plant. It is interesting to note the methods adopted in handling their first installation.

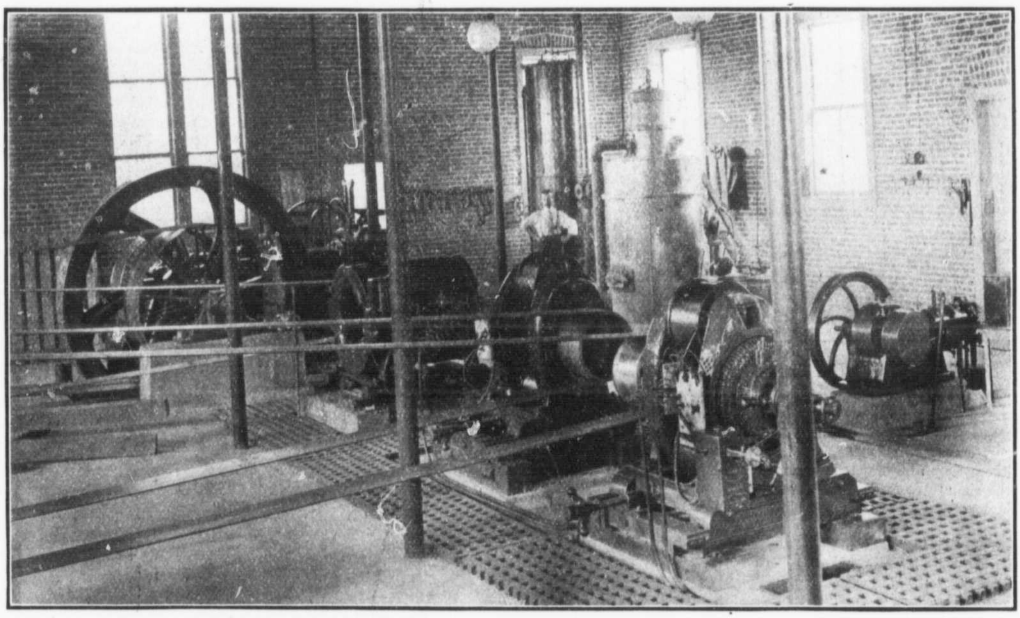
The first was a 200 h.p. plant for the new shoe factory of Ames-Holden, Limited, Montreal. Before the equipment was constructed the Colonial Engineering Co. shipped over to England, to Richard Hornsby & Sons, Limited, the well-known builders of suction gas engines, 50 tons of ordinary American anthracite pea coal, such as is always obtainable in the Montreal market, the first object being to design, construct and put into actual operation, at the builders' works, the entire Ames-Holden power equipment, using only the coal thus shipped over. In other words, the exact fuel conditions which were to obtain at the Montreal factory were created at the builders' works, thus affording the necessary facility for the special design required for continuous successful operation in Montreal. The plant was then shipped over and installed—with the result that it has been running constantly since the first of May, last, and with a high degree of satisfaction to its owners.

The plant consists of two 100 h.p. engines two suction gas producer equipments, two 60 k.w., 220 volt, D.C. generators, a very handsome four-panel blue Vermont marble switchboard, an independent compressed air starting system and every modern appliance for flexibility and smoothness of operation. At present their average load (which naturally is less than in winter), of 70 engine h.p., consumes about 700 pounds of coal per day—whereas, in their old plant and with the same load, their coal consumption averaged about 3,500 pounds, meaning a reduction of about 75 per cent. in their coal bill. The amount of water, oil, attendance and incidentals were also reduced by about 50 per cent.

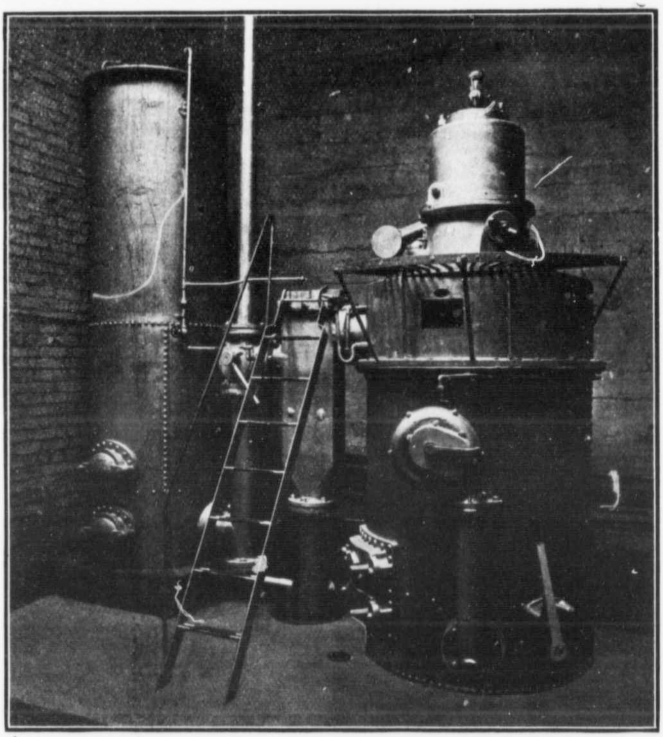
The same policy—of building the equipments to suit the exact local requirements and doing all testing with the same fuel as is actually to be used—has prevailed with this company in all of its other Canadian installations, including the large municipal street lighting plant, which was installed for the City of Chatham, Ont., and which has now been in constant service for some months. In point of fuel economy the Chatham plant has shown even better results than that of the Ames-Holden Co.

The Chatham plant is installed for the use of either natural gas or producer gas.

The engines have demonstrated that with coal at $5.00 per ton they can carry the load as cheaply as with natural gas at about 15 cents per thousand. Formerly the Chatham street lighting was done with a high speed tandem compound steam engine and consumed about $5.00 per day in fuel. Now—with exactly the same load—the new gas engines consume only 60 to 75 cents in



Interior View of Chatham Municipal Lighting Plant, Equipped with 2-100 H.P. Hornsby-Stockport Suction Gas Engines and Producer. Other Engine at Other End of Room.



The Producer Gas Plant in Plant of Ames-Holden, Ltd., Montreal.

fuel per day, a reduction of over 80 per cent. in fuel cost.

Truly these figures seem hard to believe—but there they are, covered by reports bearing the signatures of experts whose standing in England and Canada is too high to question.

Similar plants with similar results have been installed for the Empire Mfg. Co., London, Ont.; Dominion Brewery Co., Toronto; Anchor Fence Co., Stratford; Queen City Printing Ink Co., Toronto, and other large plants are now in process of installation.

In view of the economy and reliability of such plants as these, one would think that suction gas engines would claim all confidence. But human nature is prone to doubt anything that looks too good, and, furthermore, in the United States and Canada, too, there have been many failures in attempted gas installations—by builders who have not had the years of experience which is the first requirement to success in this very special branch of engineering and by agents who are not at all qualified to effect the installations successfully—even though the equipment itself be of good design and construction—for the reason that the very elements which render such a high degree of efficiency in suction gas equipments possible are, in the same degree, exceedingly sensitive and easily thrown out of balance by the slightest error in the installation detail.

STANDARD CHAIN CO. TO REBUILD.

The Standard Chain Co., of Canada, Limited, Sarnia, Ont., have commenced to rebuild their factory, which was destroyed by a tornado last June. They expect to be in a position to manufacture a full line of chain within thirty days. They have a considerable quantity of chain on hand, and are in a position to ship promptly such sizes as they have on hand, at Sarnia, at present.

Mr. Alexander Gibb, 13 St. John Street, Montreal, is the selling agent, and will be glad to give full information.

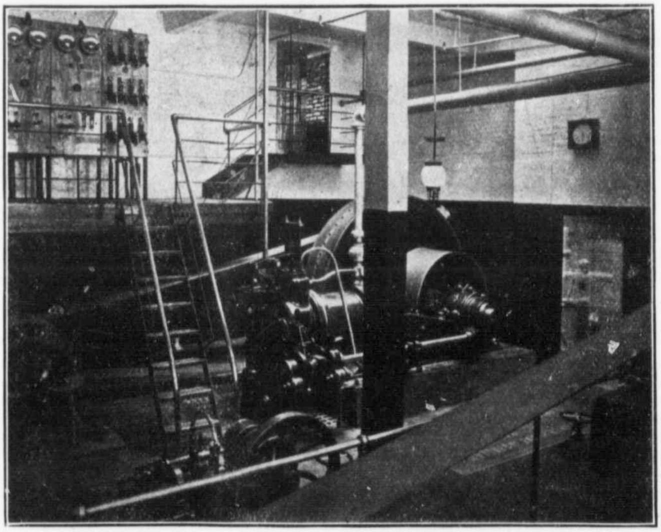
UNDER THE COMPETITIVE SYSTEM.

Under the competitive system by which a building contractor, for instance, works and gets work, even though he has the disposition to pay good wages and work his men decent hours, yet he would be compelled to accept the hours and wage-scale of an oppressive taskmaster in order to compete with him.

The general manager of a machine shop might have the individual disposition to pay higher wages and work the men shorter hours; but he can't so long as his competitors maintain a lower scale.

So long as competitive conditions are equal, what's the difference if men work but eight hours? Conditions would soon adjust themselves, and all would come out in the public laundry.

A man doesn't progress sitting in front of a punch-press. The necessities of life are all there is in it. It's the way he puts in his time after the whistle blows. The fewer hours required for earning necessities, the happier men will be. The tendency of all is higher rather than lower—men will have more time to pursue the higher—the world will get better by strides and bounds.—Silent Partner.



Part of the Interior of the Engine Room at Ames-Holden, Ltd., Shoe Factory, Showing No. 2 Gas Engine, 60. M.W. Dynamo, Compressor Unit, and the Producer through the Doorway.

System to Determine Detail Power Cost

A Good System must give Information which will Show Opportunities for Betterment of Power Plant, if There be any. Consideration of Grouping of Costs. Rent, Adminstration, Operation and Maintenance.

By W. A. Polakow

To determine accurately the cost of power, every detail of expense must be properly accounted for; otherwise, the total amount expended will be nothing more than the sum of a mass of indefinite expenses. The correct method of determination must clearly and immediately show the amount of, and the reason for, each indirect expenditure, giving thereby a clear idea of the economical control and opportunities for betterment of the power plant. It must make possible the comparison of the cost of power, no matter where or under what conditions the power is produced. It must give an exact answer to each of the following questions:

1. Does producing any kind of power cost too much?
2. In which period of the production and transmission of power are there unproductive expenses, and why?
3. How and in what relation does the cost of producing power vary?

Detailed Grouping of Costs.

In order to answer these questions, we cannot limit ourselves to the primitive and inaccurate method of finding the relation between the totals of fuel burned, money spent and power produced. Neither should we compare such figures with the same incorrect or accidental figures of last month or last year, to ascertain whether power is produced at a less or greater cost to-day.

The actual total cost of producing power is made up of four major items: Rent, administration, operation, and maintenance. The total of these four accounts may be subdivided under four headings showing the absolute cost or percentage cost of each kind of power produced, viz., steam, electric, pneumatic or hydraulic. The total cost of power is charged to the shops in proportion to their consumption, and goes into the shop expenses under the heading "Power."

Rent.

Land rent may be figured generally for the whole plant and charged to power in proportion of the area occupied for power purposes to the total rent area. Rent of buildings may be figured on the basis of the valuation of the buildings used for power purposes. It would not be correct to pro-rate the building rent on a basis of floor space, because usually buildings used for power purposes far exceed in value buildings of an equal floor space that are used for general manufacturing purposes.

Administration.

Administration expenses charged to power may be taken as an arbitary per cent. of the amount for the whole plant. Under this heading are charged all expenses which do not properly belong either to rent, operation or maintenance, such as watchmen, stationery, etc.

Operation.

Under this heading are included all expenses for the following accounts: Fuel for power plants, fuel for other boilers, fuel for yard engines and cranes, handling fuel, miscellaneous supplies, lubricating materials, water for boiler and water-backs, engineer's, firemen's and helper's wages, power purchased.

A diagram should be drawn showing the consumption of fuel by month and 12 months' average, also a diagram showing the cost of fuel on the same basis.

Maintenance.

This heading includes the three following groups of expense: (A) Repairs and renewals; (B) fixed charges; (C) other charges.

Group (A) includes all expenses for repairs and renewals of power equipment, whether used for production or transmission, and each item of expense should be charged to one of the following accounts: Boilers, engines and pumps, electric plant, steam, water and gas pipes, pneumatic pipes and fittings, hydraulic pipes and fittings, warming and ventilating systems, rolling stock (10 per cent.)

Group (B) includes such items as depreciation, interest on investment, etc.

In a system of accounting based on the above foundation, it is comparatively easy to locate a leak affecting economy or efficiency, such as expensive repairs or unnecessary expense for lubrication, but alone it cannot give an exact idea of the quality of the general management.

Unit Cost.

It is necessary to know the actual cost of producing a unit of each kind of power. Since all kinds of power are derived by various transformations from the same or similar sets of boilers, there should be weekly and monthly statements showing the amount of water evaporated per pound of fuel, also the pounds of fuel per brake horse power. The cost per brake horse power of the steam produced is the base of all figures on the cost of operation in the production of power. Any excess cost here, any inefficiency, such as a poor up-keep or uneconomical handling of fuel, would cause the unit cost of each kind of derived power to be higher than it should be.

Figures on unit cost are obtained from a statement similar to Fig. 2, with figures of recording meters giving daily, weekly and monthly amounts of brake horse power produced, for live steam per brake horse power hour, for light and power, cubic feet of air, or gallons of water per minute under constant pressure, etc.

Having these figures of the cost of a power unit, we only have the raw material, but by observing these figures we have a foundation for judging as to whether the enterprise is run on an economical or non-economical basis; the expressions "warm" or "warmer" would not give an idea of temperature until there is fixed a certain basis from which to measure.

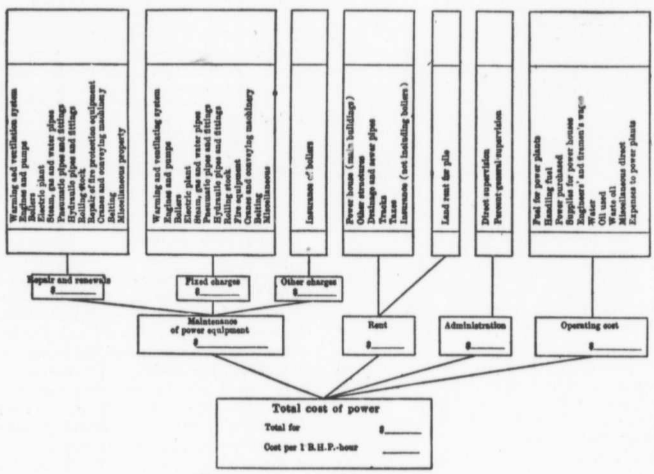


Fig. 1—Costs of Power Classified

Standard Unit Cost.

An authority on this question, Harrington Emerson, says: "It is impossible to make comparison unless there is something with which to compare, and it is more rational, more correct, more instructive to compare with a determined standard than to compare with last week's or last year's accident, and nothing can be more profitably instructive than to compare local standard cost, line by line, with the basic standard cost and the actual expenses, in order to get busy according to what would be correct and enduring, or otherwise overcoming handicaps beyond individual control."

We must have a standard unit cost for a base and make all comparisons against it. Herein we have to the same degree of accuracy that our standard unit cost has been figured, a measure of the efficiency of the plant.

Standard unit cost may be considered to be formed of two distinct parts, and may be expressed as

$$S = T + O$$

where T includes that group of expenses relating to the theoretical transformation of energy from heat to some other definite form. It is figured once for all as a general standard cost independent of local or construction conditions.

For example, in the generation of electric energy, for every 100 units trans itted from the switchboard, we figure, the:

1. Least resistance in the switchboard.
2. Least resistance in the generator.
3. Least loss in the engine.
4. Least loss in the steam piping.
5. Least loss of heat from fuel while generating steam.

In this way, taking everywhere the most advantageous coefficient, we are certain of the quantity of kilowatt-hours per unit of fuel, or the standard cost of one kilowatt expressed in units of fuel.

The second part O of the formula includes the least possible cost of all other expenses of operation per unit of a certain kind of energy. Here again we have not only a correct idea of the efficiency of operation, comparing the standard cost and the actual expenses, but we can compare and determine at any time the source of unproductive expenses. Comparing the results from the formula

$$S = T + O$$

with results from

$$S' = T' + O',$$

we can direct our efforts without loss of time or guessing, either to the technical or business improvement of the plant.

In determining the cost of power produced for sale, the total must include, of course all expenses, even to the cost of advertising and selling, the total cost differing from the selling price by a fixed amount which will be the per cent. of profit.

From the foregoing it is clear that only by such preparatory work and with the actual figures for as long a period of time as possible in the form of 12 month averages, in order to eliminate accidental fluctuations, is it possible efficiently to carry out the work of bettering the power plant and lessening the cost of power generation. The work must be done carefully and systematically, not losing sight of one moment of operation in the production and transmission of power, taking for granted that each step made is erroneous and uneconomical, and giving special attention to places where errors were discovered by previous analysis.—Power and the Engineer.

Plants / Power Delivered		East Side				West Side				Pumping Plant				All Plants		
		No. of B.H.P. Hrs. Equal 1 Unit	Monthly Total: Power Delivered	Monthly Total: Cost	Cost per Unit	No. of B.H.P. Hrs. Equal 1 Unit	Monthly Total: Power Delivered	Monthly Total: Cost	Cost per Unit	No. of B.H.P. Hrs. Equal 1 Unit	Monthly Total: Power Delivered	Monthly Total: Cost	Cost per Unit	Monthly Total: Power Delivered	Monthly Total: Cost	Average Cost per Unit
Live Steam																
Unit: B.H.P.-Hrs.	B.H.P.-Hrs.															
Electric Power	Generated K.W.-Hrs.															
	Generated B.H.P.-Hrs.															
	Purchased K.W.-Hrs.															
Unit: K.W.-Hrs.	Total															
Electric Light	Generated K.W.-Hrs.															
	Generated B.H.P.-Hrs.															
	Purchased K.W.-Hrs.															
Unit: K.W.-Hrs.	Total															
Compressed Air	Cu. Ft. Free Air per Min. at 100 # □"															
Unit: Cu. Ft. Free Air per Min. at 100 # □"	B.H.P.-Hrs.															
Hydraulic Power	Gallons per Minute at 100 # □"															
Unit: 1 Gal. per Min. at 100 # □"	B.H.P.-Hrs.															
Total Power Delivered to Works	B.H.P.-Hrs.															
Total Power Generated in Plant, Based on Coal Burned. Unit: Tons Coal Burned per Month.																

Fig. 2—Unit Costs

Hangers and Supports for Piping Systems

By William S. Fischer.

Where it is required to suspend a line of piping from the floor or roof beams overhead, the hanger shown in Fig. 1 is best suited to the purpose, providing there is sufficient room (see dimension O) between the under side of the beam and the center of the pipe to accommodate the beam clamp, pipe clamp, turnbuckle and rods, as shown. It is a good plan to make the rods R with upset screw ends, making the area at the root of the thread greater than the area of the rod. The upset ends, with round or square shanks, as desired, are furnished with the turnbuckles, if so specified when ordering. One is to have a right-hand screw thread and the other a left-hand thread, and when making up the hanger, they may be welded to the rods to suit the dimension O.

Table 1. Standard I-Beam Clamps.

Size Beam.	Dimensions. A	B	C	D
3	$2\frac{3}{8}$	$\frac{3}{4}$	$\frac{1}{8}$	1
4	$2\frac{3}{4}$	$\frac{7}{8}$	$\frac{3}{16}$	$1\frac{1}{4}$
5	3	1	$\frac{1}{4}$	$1\frac{1}{2}$
6	$3\frac{3}{8}$	$1\frac{1}{8}$	$\frac{1}{4}$	$1\frac{3}{4}$
7	$3\frac{3}{4}$	$1\frac{1}{4}$	$\frac{1}{4}$	2
8	4	$1\frac{1}{2}$	$\frac{1}{4}$	$2\frac{1}{8}$
9	$4\frac{3}{8}$	$1\frac{5}{8}$	$\frac{5}{16}$	$2\frac{1}{4}$
10	$4\frac{3}{4}$	$1\frac{3}{4}$	$\frac{5}{16}$	$2\frac{1}{4}$
12	5	$1\frac{7}{8}$	$\frac{3}{8}$	$2\frac{3}{4}$
15	$5\frac{1}{2}$	2	$\frac{3}{8}$	$2\frac{3}{4}$
18	6	$2\frac{1}{8}$	$\frac{1}{2}$	3
20	$6\frac{1}{4}$	$2\frac{1}{2}$	$\frac{5}{8}$	3

All dimensions in inches. See Fig. 1.

With this arrangement the rods extend

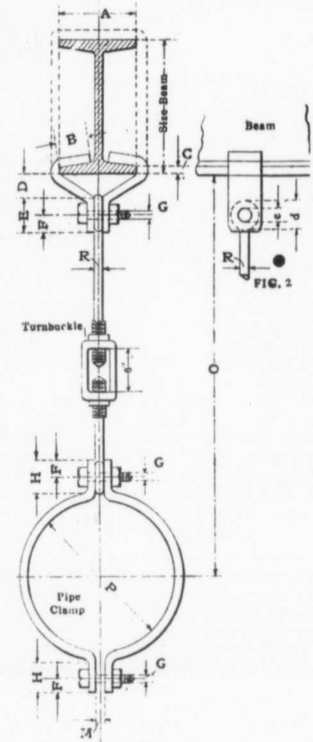


Fig. .

or stretch evenly along their entire length, whereas if the rod itself is threaded, the area at the root of the thread will necessarily be much less than the area of the rod. Consequently, all the extension occurs in the short length at the bottom of the threads, and the threaded portion breaks before the rod has even passed the elastic limit.

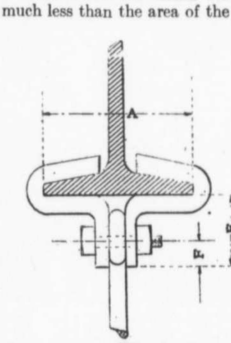


Fig. 3.

Many concerns, however, prefer using the plain rods with threaded ends in place of the upset ends here shown, as the weld, if not carefully made, is the first point to give out in the hanger. If this method is preferred the rods should be at least 1-8 inch greater in diameter than shown in Table 2, in the column headed R.

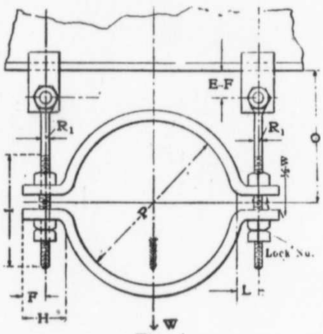


Fig. 4.

The dimensions A, B, C and D, Fig. 1, are fixed by the size of I-beams from which the pipe is to be suspended. The dimensions in Table 1 are for standard I-beams from 3 to 24 inches inclusive. All other

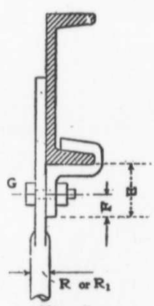


Fig. 5.

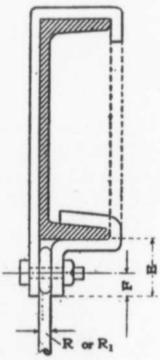


Fig. 6.

dimensions are determined by the size and weight of piping to be suspended. The dimension P should equal the outside diameter of the pipe, valve or fitting to be clamped, according to the position of the clamp. For ordinary steam, exhaust, air or vapor lines,

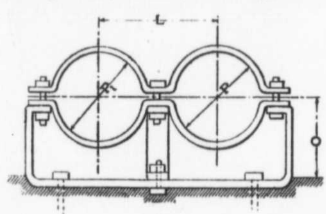


FIG. 7

the dimensions given in Table 2 are well on the safe side for strength and stiffness. For extra heavy cast-iron water mains and similar heavy pipe, the dimensions should be slightly increased according to the size and weight of the piping used.

TABLE 2. STANDARD PIPE HANGERS.

Size of Pipe.	Size of Iron in Beam Clamp.	Size of Iron in Pipe Clamp.	Diameter of Rod.	Size of Turnbuckle.	Diameter Outiside of Eyebolt.	Diameter of Hole or Bolt.					Diameter of Bolt.
			R		d	e	E	F	H	m	G
1½ to 3	¼ x 2	¼ x 2	⅝	⅞	⅞	2⅛	2¼	⅞	2	½	¾
3½ to 5	⅜ x 2½	¼ x 2½	¾	1	1	2½	2½	1	2¼	½	⅞
6 to 8	½ x 2½	⅜ x 2½	⅞	1¼	1⅛	2⅞	3	1¼	2½	¾	1
9 to 14	¾ x 2½	½ x 2½	1	1⅜	1¼	3¼	3½	1¼	2¾	¾	1⅛
16 to 20	¾ x 3	½ x 3	1⅛	1½	1⅜	3⅝	3¾	1⅜	3	1	1¼
22 to 30	⅞ x 3	⅝ x 3	1¼	1⅝	1⅝	4⅛	4¼	1⅝	3¼	1	1½

All dimensions in inches. See Fig. 1.

Hangers should be spaced about 12 feet apart, as a general rule, and where three or more heavy fittings and valves are placed close together in the line, one or two extra hangers should be used to prevent sagging and to take the strain off the flanges and joints.

Fig. 2 is a side view of the beam clamp shown in Fig. 1, giving the dimensions of the eyebolt and drilling for bolt G. In Fig. 3 is shown another form of I-beam clamp. The disadvantage of this is, that it cannot be adjusted in the field as easily as the form shown in Fig. 1 in case of any variation in the

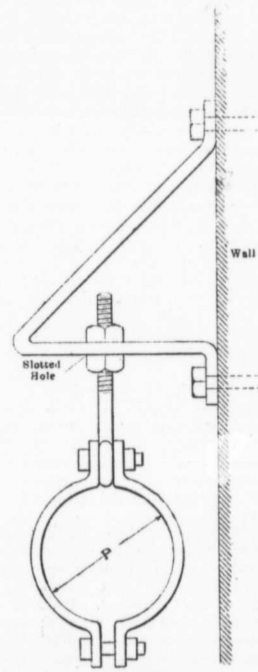


Fig. 8.

width of the flange A. Owing to the short grip (dimension B) on beam clamps, for beams up to 6 inches in size, it is desirable to carry the clamp over the top of the I-beam, as shown by the dotted lines in Fig. 1. In some cases this may not be possible owing to the position of the beams.

Where there is insufficient head room for the type of hanger shown in Fig. 1,

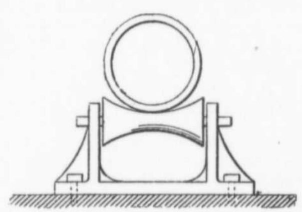


Fig. 9.

the hanger shown in Fig. 4 may be used. Here there are two rods, and two beam clamps supporting the load, so that their proportions, as given in Table 2, may be reduced accordingly. The lower pipe saddle should be increased in thickness, however, as there is a bending moment, ½ W X L, at its outer edge. The upper pipe bend is not absolutely necessary, as it plays no part in the support of the pipe and may be omitted or not according to the judgment of the designer.

In Table 3 are given satisfactory dimensions for hangers of the type shown in Fig. 4. All the other dimensions not given in Table 3 are the same as Tables 1 and 2. The rods R should be threaded on the ends from 6 to 9 inches for convenience in adjusting the position of the piping.

Fig. 5 shows a method very often adopted for clamping to a channel beam. The rod R is welded to the flat piece directly above it. With this arrangement the total load is supported by the single clamp to the right. The bolt G is in single shear, and unless made of heavy iron, the clamp is liable to bend, causing a sag in the pipe line at this point. The arrangement shown in Fig. 6 is to be pre erred. The bolt is double shear, and the whole clamp is much more rigid than the one shown in Fig. 5. The clamp may be made in one piece, if preferred, as shown by the dotted lines.

Fig. 7 shows a form of pipe support which may be made up of wrought iron for one or more pipes where run above the floor line. This is made much easier and quicker than a casting, and in most cases answers the purpose equally as well.

Fig. 8 is a wall bracket, made of wrought iron in one piece, to support small pipes. The hole for the bolt is slotted for ease in adjusting the piping when erecting. For heavy pipes the bracket should be made up of

TABLE 3. STANDARD PIPE HANGERS.

Size of Pipe.	Size of Iron in Beam Clamp.	Size of Iron in Lower Pipe Saddle.	Size of Iron in Upper Pipe Band.	Diameter of Rod R1.
$1\frac{1}{2}$ to 3	$\frac{1}{4}$ x 2	$\frac{1}{2}$ x 2	$\frac{1}{4}$ x 2	$\frac{5}{8}$
$3\frac{1}{2}$ to 5	$\frac{1}{4}$ x 2	$\frac{5}{8}$ x 2	$\frac{1}{4}$ x 2	$\frac{3}{4}$
6 to 8	$\frac{3}{8}$ x $2\frac{1}{2}$	$\frac{5}{8}$ x $2\frac{1}{2}$	$\frac{3}{8}$ x $2\frac{1}{2}$	$\frac{3}{4}$
9 to 14	$\frac{1}{2}$ x $2\frac{1}{2}$	$\frac{3}{4}$ x $2\frac{1}{2}$	$\frac{3}{8}$ x $2\frac{1}{2}$	$\frac{7}{8}$
16 to 20	$\frac{3}{4}$ x $2\frac{1}{2}$	1 x $2\frac{1}{2}$	$\frac{1}{2}$ x $2\frac{1}{2}$	1
22 to 30	$\frac{3}{4}$ x 3	1 x 3	$\frac{1}{2}$ x 3	$1\frac{1}{8}$

All dimensions in inches. See Fig. 4.

structural shapes, such as channel beams or angle irons riveted together.

Fig. 9 is a cast-iron bracket and pipe roller, as ordinarily made to allow for any movement of the pipe due to expansion and contraction.—Power.

Manufacturers' Catalogues.

METER TESTING. "Warrantable Expenses for Meter Testing" is the name of a special circular issued by the Canadian Westinghouse Co., Limited, Hamilton, which is a reprint of a paper read before the Northwestern Electrical Association at Chicago by Oliver J. Bushnell. In this article valuable information is given as to how often electric service meters should be tested, methods of testing and cost of testing. The article is illustrated with different Westinghouse meters. No central station man or any other interested should neglect procuring a copy of this booklet.

ROBB-ARMSTRONG ENGINES. Complete engine catalogue of the Robb Engineering Co., Amherst, N.S., containing complete description and illustrations of the Robb-Armstrong Corliss engines of the several types, horizontal and vertical; also of their other types of engines, including compound engines, single valve engines, side crank engines, vertical compound enclosed engines, vertical single crank enclosed engines and their parts.

MERCURY RECTIFIER ARC LIGHTING SYSTEM. Circular No. 1155 of the Canadian Westinghouse Co., Hamilton, descriptive of the mercury rectifier arc lighting system, that is the operation of direct current series arc lamps on alternating current circuits with mercury rectifier constant current regulating transformers. This system allows the utilization of the superior efficiency and light distribution of D.C. series arc lamps on the A.C. system of distribution. This is a 24 page circular with complete descriptions and illustrations.

HANDLING COAL AND ORES. Bulletin No. 25 of the Jeffrey Mfg. Co., Columbus, O., containing advance pages of catalogues Nos. 20-A and 28, now in press. The bulletin is taken up entirely with photographs and line sketches, with short explanatory paragraphs, of Jeffrey installations for handling coal and coke. Many useful suggestions are to be gathered from these illustrations.

POTENTIAL REGULATORS. Circular No. 1017 of the Canadian Westinghouse Co., Hamilton, illustrating fully and describing the operation of the Westinghouse potential regulator.

Book Reviews

MANUEL DU PROPRIETAIRE ET DU CONDUCTEUR DE GASOGENES A ASPIRATION ET DE MOTEURS A GOZ PAUVRE, PAR JULES DE CLERCY, Ingenieur diplomé de l'Ecole Centiale des Arts et Manufacture de Paris. For sale at La Librarie St. Louis, St. Catharine St., Montreal, from the author, 62 Ontario Street West, Montreal. Price, $1.00.

Power users and engineers will welcome this handbook of gas engines and suction gas plants, and those who do not read French will look forward to the publication of the English edition which the author announces will be published in the near future.

M. Jules de Clercy has been a specialist in gas power plants for many years and has installed a number of the most successful suction gas plants in operation in Canada today. In this treatise he has given in nine chapters about ninety pages, a great deal of both theoretical and practical information dealing with all phases of the problems connected with the installation and operation of suction gas plants. M. de Clercy speaks from experience and writes with authority. The book is well indexed, making it very convenient for reference.

WATER POWERS OF WISCONSIN.—By Leonard S. Smith, C.E., Engineer, Wisconsin Geological and Natural History Survey; published by the State of Wisconsin, at Madison, through the Wisconsin Geological and Natural History Survey.

In view of the interest which is being taken in the water powers of Ontario at the present time, this book should prove of interest to many engineers and others in Canada. This book contains detail information regarding the waters in Wisconsin available for power development. It is profusely illustrated with photographs of water powers and developments, and with typographical maps.

The State of Wisconsin is far removed from coal fields, which make the many water powers she possesses, probably more than any other state in the Union, all the more valuable.

This book can be obtained for a nominal sum to cover postage, from the Wisconsin Geological & Natural History Survey, Madison, Wis.

Personal Mention

Mr. Willis Maclachlan, recently installing engineer for the Canadian Westinghouse Co., at Toronto, has been appointed electrical superintendent of the new government grain elevator at Port Colborne. Mr. Maclachlan had charge of the installation of the electrical equipment in this elevator, and upon its completion a few weeks ago was offered the position of electrical superintendent. Mr. Maclachlan is an honor graduate of the University of Toronto in electrical engineering.

* * *

Mr. H. C. Austen was married on September 17 to Miss Edna Erb, at Kenilworth Baptist Church. Mr. Austen's many friends in engineering circles wish him their heartiest

Mr. H. C. Austen.

congratulations and best wishes. Mr. Austen has been in the rubber business for ten years, and for the last two years has been with the Dunlop Rubber & Tire Co., in which position he has made many warm friends.

* * *

NEW PRESIDENT OF C.A.S.E.

Mr. Chas. Kelley, President of the Canadian Association of Stationary Engineers, has had 26 years' experience as a stationary engineer, and he is still at his post with the Chaplin Wheel Co., Chatham. He joined the C.A.S.E.

Chas. Kelley, Chatham,

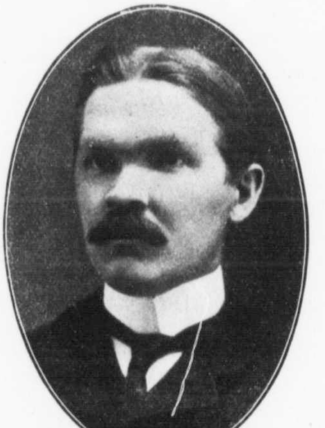
New President of the C.A.S.E.

in 1904, and he says he would recommend all engineers to join the C.A.S.E., as it is one of the best ways of making an engineer thoroughly proficient, as the education and elevation of engineers is the aim of the association.

J. M. ROBERTSON A CONSULTING ENGINEER.

It is announced that Mr. J. M. Robertson, Mechanical Superintendent and Superintendent of Shops for the Montreal Light, Heat & Power Co., has tendered his resignation to take effect at the end of September. Mr. Robertson has been connected with the Power Co. or its predecessors for more than thirteen years, having been appointed assistant electrical engineer of the Royal Electric Co., in 1895. Aside from an absence of about a year during which time he was in charge of the electrical and mechanical work of the Montreal Park & Island Railway Co., he has been connected with the company continuously since that time, having during this period been identified with nearly every department of the company's business. The department in which his work is perhaps best known is that of alternating current power supply, of which department he took charge at its inception and for the great development of which he has been largely responsible.

More recently Mr. Robertson organized for the company a shops department in which is manufactured practically all the electrical and mechanical apparatus and supplies required by the company for its great business



J. M. Robertson, Montreal.

in addition to the carrying on of all repair and testing work of every kind required by the very divergent branches of the company's business.

Mr. Robertson intends entering the consulting engineering field and is opening an office in Montreal where he will be prepared to undertake engineering work in either the mechanical or electrical lines. His wide acquaintance throughout Montreal and in fact throughout Canada coupled with his acknowledged ability in his profession should guarantee for him a very successful career in his new field of activity.

LEAD LINED AND TIN LINED IRON PIPE.

Lead lined and tin lined iron pipe, for use wherever iron, copper, brass or lead pipe is used, is being placed on the Canadian market by the Garth Co., Montreal, agents for the Lead Lined Iron Pipe Co., Wakefield, Mass.

For many years attempts were made both in Europe and in the United States to make lead lined iron pipe and tin lined iron pipe that would successfully combine the non-corrosive qualities of lead and tin, with the strength and cheapness of iron.

To attain this end, it was necessary that the two metals, tin and iron or lead and iron, should be so fused that there could be no separation, as liquids, especially hot water and hot acids, getting between the two metals would cause them to collapse.

It remained for the Lead Lined Iron Pipe Co., of Wakfield, Mass., to perfect the methods of producing such a pipe, and one that will stand the hardest kind of usage, and can be bent and cut without injury to the lining, it is claimed.

The process of manufacture is briefly as follows: A length of iron pipe is taken and thoroughly pickled. It is then given a bath of tin, which solders it inside and outside, making it, even before the introduction of the lining, a positive pipe that can have no pinholes in it, such as often occur in iron pipes, either black or galvanized. It also solders the weld from end to end. The lining of lead or tin is poured into the iron pipe in a molten state around a mandrel, and is thus thoroughly fused on to the iron pipe.

For Boiler Feed or Hot Water.

Even pure water acts on ordinary iron pipe, causing the pipe to wear out and carrying a good deal of rust in to the boiler, where it forms a scale. Various waters act differently, some having a very bad effect on brass or copper pipe, weakening them and after a time causing them to split. A little salt or sulphuric acid in the water makes it especially destructive. These, however, have no effect on the pure chemical lead used in lead lined iron pipe, and for this reason lead lined iron pipe is becoming widely used for boiler feed or hot water. It is stronger than copper, will withstand a higher pressure, and the cost is about one half.

For Salt Wells and Mines.

A special pipe for pump columns is made to stand any pressure specified. In this pipe, the joints are flanged together and the lead is reduced into the flanges to make the gasket, making one continuous lead lining. This pipe is especially valuable in salt wells, copper mines, coal mines, and for all water containing sulphuric acid or other corrosive properties.

For Steam Coils.

It often happens that steam must be forced at a very high temperature through coils submerged in corrosive liquors. The high temperature makes the corrosive liquors extra active in attacking the pipe.

For such work a lead covered pipe is made. Lead covered coils can be had made of either brass, copper, or iron. A lead covered pipe, or coil, will outlast a plain one in such conditions many times over.

Tin Lined Iron Pipe.

Tin lined iron pipe is largely used for vinegar, wines, liquors, carbonating plants, distilled water, and for pure drinking water. Brass pipes lined with tin is used for open plumbing work.

The Lead Lined Iron Pipe Co. also make all kinds of lead and tin lined fittings, as elbows, unions, stop cocks, valves, etc., for use with these pipes. In the unions, the lead lining extends down into a portion of the threads, and acts as a washer, preventing all danger of corrosion.

It is important in buying lead lined or tin lined iron pipe to specify the liquids for which it is to be used, as the preparation of the lining differs for different conditions, and what is suitable for one purpose is unsuitable for another.

NEW ENGINEERING AND CONTRACTING FIRM.

A short time ago the stock and business of the British American Sign Co., Toronto, was purchased by Death & Watson, electrical engineers and contractors, 25 Jarvis Street, Toronto. This new firm intend carrying on the old business and as well will branch out into all kinds of electrical repair work and contract work. In short they will carry on the business of electrical engineers and contractors.

Mr. N.P.F.Death is an honor graduate of the University of Toronto in electrical engineering and has had a broad experience in electrical repair and contract work. His last position was with C. H. Mitchell, consulting engineer, Traders Bank Building, as electrical designer.

Mr. Lionel Watson has had long experience in building and repairing electrical machinery and also storage battery work. He was with the Canada Cycle & Motor Co. and afterwards the Dominion Automobile & Supply Co., in charge of their electrical and storage battery department. He was also in partnership for two years in the business of the Colville Electric Co.

Both these men are well fitted for the business in which they have embarked. There is no doubt but that in a few years they will build up a good sound business.

BUSY TIMES AT GUELPH.

The plant of the Raymond Mfg. Co., Guelph, which has been running slack, without either a full staff or full time, during the summer, has started on a full-time schedule, with plenty of work in sight and with fair local conditions and transient trade to last through the winter.

Also the Standard Fitting & Valve Co. have resumed operations in their new plant with nearly full staff.

Of the other industries the Canada Furniture Co. is the only one closed down, and the promise is that a start is to be made in the near future. With this exception almost every plant throughout the city is working on good time.

The Railways and Manufacturers Committee of the council are in communication with the White Candy Co., of St. John, N.B., a large confectionery concern, who are considering an amalgamation with the Imperial Biscuit Co., of this city, and the location here of the joint plant.

HAMILTON.—Tenders for the new waterworks pumps and motors were opened a few days ago. The lowest tender for pumps was from the John McDougall Caledonian Iron Works, Montreal, $7,220. For the motors, the Canadian Westinghouse Co., Hamilton, put in the lowest tender, $9,570.

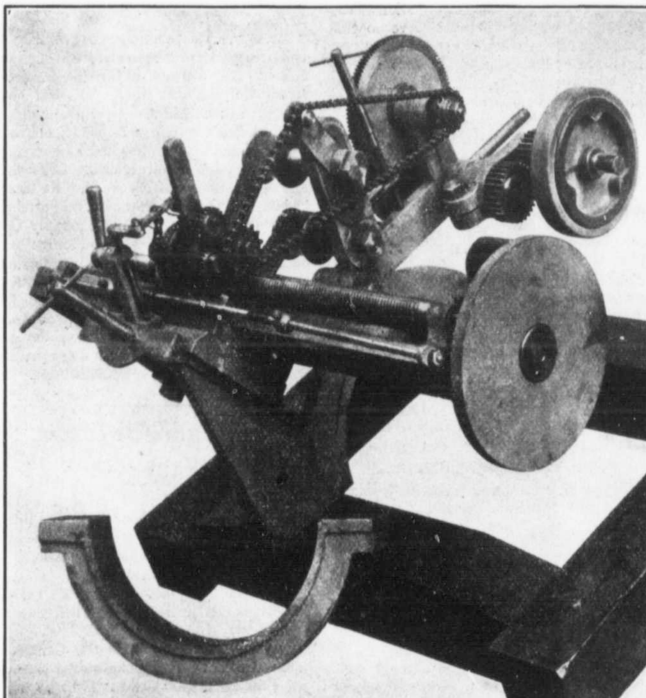
NEW EQUIPMENT FOR POWER PLANT

Only Descriptions of New and Interesting Equipment Can be Published. No Mere Manufacturers' Write-Ups Can be Used.

Machine for Grinding Commutators.

Something altogether new on the Canadian market is the commutator grinding machine which is being sold by the Langdon-Davies Motors, Canada, Limited, 15 Alice Street, Toronto.

This machine was exhibited at the National Exhibition, at Toronto, this year, and is shown in the accompanying illustration. This photograph was taken by THE CANADIAN MANUFACTURER at the company's works at Alice Street.



Commutator Grinding Machine.

This machine can be attached to a dynamo or motor commutator in 15 minutes, and it is claimed that a commutator can be trued up in one-half the time taken with the ordinary means.

The grinding spindle is driven direct by means of a specially prepared rubber friction wheel running on the commutator, so that no motor is required to drive it. The spindle is carried by a long slide and is absolutely rigid.

The bearings are of great length, and the spindle and drum are evenly balanced so as to run at the necessary high speed without causing vibration.

The grinding spindle, when working, moves to and fro across the face of the commutator, and is automatically reversed at each end; and is so constructed that stops can be set as in a plating machine, grinding the surface right up to the connecting wires and back to the edge.

The only thing required of the attendant is to watch the feed.

The hand feed machines are designed for commutators up to 12 inches diameter and 10 inches face, but for commutators of a larger size the automatic machines are recommended.

The frames of the machines are specially constructed so that they may be easily attached to practically every kind of dynamo.

The machines are made in three sizes.

(1) To true up commutators from 3-9 inches diameter and 6 inches deep light hand feed; (2) Heavier hand feed. To true up commutators from 6-12 inches diameter and 10 inches deep; (3) Automatic feed will take any sized commutator at present in use. The latter was used on a commutator 8 feet diameter with perfect success.

The machines can also be easily fixed to a cast iron bracket which can be fixed to the bed of a lathe, for the purpose of grinding up commutators of motors used for street railway work.

The grinding wheels are made up in a special manner so that they keep themselves free from particles of copper or mica during the whole process of grinding.

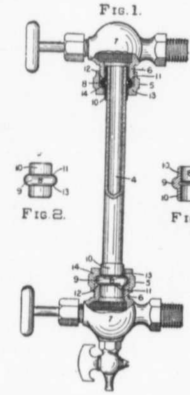
Specially insulated grinding wheels are supplied when it is desired to true up live commutators.

New Gasket for Guage Glasses

The tip or lip bulb gaskets, shown in accompanying illustration will be welcomed by those who have suffered the inconvenience of broken water guage or lubricator glasses.

The application of the lip gaskets to a guage glass is shown in Fig. 1. In Fig. 2 the gasket and in Fig. 3 a cross section of the gasket is shown. It is globular in form, and compresses easily, making a steam and water tight joint, and avoiding all danger of breakage by expansion. They are easily adjusted. The lip or tip gaskets are made in five sizes, and two special sizes having the bulb without the tips are made for the use of plumbers and others in steam and hot water packing.

FIG. 1.



Tip or Lip Bulb Gaskets.

These gaskets are manufactured by the patentees, Gilbert & Hawkesworths, and are sold by Alfred Hawkesworth & Sons Co., Limited, Montreal.

"Can you tell me what steam is?" asked the examiner.

"Why, sure, sir," replied Patrick, confidently. "Steam is—why—er—it's wather thot's gone crazy wid the heat."—Everybody's.

Automatic Drain Value for Lubricator

In Fig. 1 is shown an automatic drain valve used in the lubricator made by the Michigan Lubricator Co., Detroit, Mich., the one with the two ball floats in the cage being the valve used in locomotive lubricators.

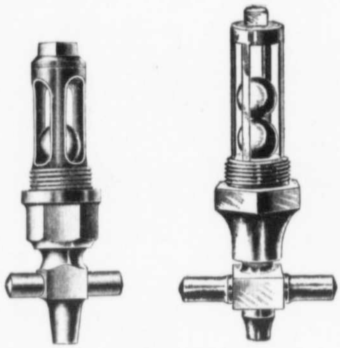


Fig. 1.

The valve consists simply of a ball float which is free to move in a vertical direction in a cage, shown clearly in Fig. 1. In Fig. 2 is shown the value attached to the lubricator. The float rises and falls with the water level in the lubricator cup, always remaining below the level of the oil but at the surface of the water, when the reservoir contains both oil and water.

When about to fill a lubricator fitted with this drain valve, the water level will be near the top and the ball float at the top of the cage. Upon opening the drain plug, the water level will fall, and when below the top

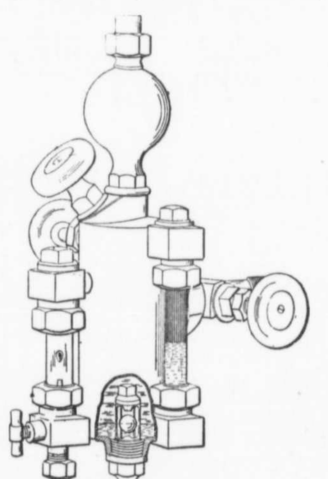


Fig. 2.

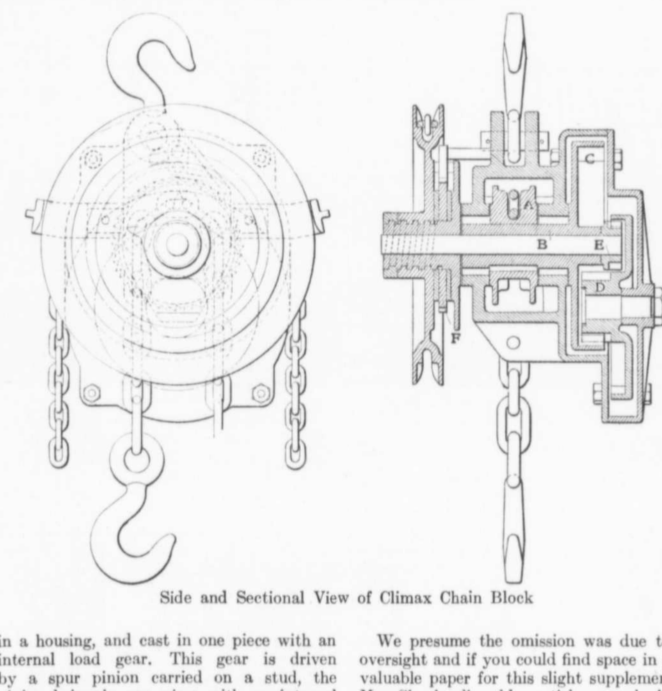
of the cage, the ball float will descend with it to the bottom of the reservoir and, seating, retains the oil in the reservoir, the water having been drained out. After filling the reservoir, the float unseats itself when water accumulates, and rises with the water level to the top of the cage.

When the reservoir is to be cleaned or blown out with steam, the ball float is unseated by screwing the drain plug nearly to its seat, when the pin projecting from the top raises the float sufficiently to permit the reservoir to be entirely emptied, after which the plug is screwed into its seat and the lubricator filled. Fig. 2 shows the device attached to a lubricator.

Climax Spur Geared Chain Block

The accompanying illustration shows sectional and outside views of the climax chain block, which views explain the hoist well.

The load chain runs on a sprocket wheel keyed to a long hub or sleeve supported



Side and Sectional View of Climax Chain Block

in a housing, and cast in one piece with an internal load gear. This gear is driven by a spur pinion carried on a stud, the pinion being in one piece with an internal gear, and driven in turn by a spur pinion carried on the hand-chain wheel shaft which passes through the hub of the load gear to the opposite side of the block where the hand-chain wheel is located. Hoisting is accomplished by pulling on the right-hand side of the hand chain, thereby rotating the mechanism. Lowering is done by pulling on the left-hand side of the hand chain, which releases the friction brake and permits the load to descend.

The load is carried on hardened and ground steel rollers, which, it is claimed, give an efficiency of more than 80 per cent. The gears are all inclosed in a dust-proof case and run in an oil bath. Owing to the few parts and simplicity of construction, the cost for repairs should be small. The retaining brake is extra strong, and smooth and noiseless in operation. The chains are made of high-grade iron.

This block is made by the Climax Hoist Co., 1753-55 N. Howard Street, Philadelphia, and is sold in Canada by the Milroy-Harrison Co., 196 King Street West, Toronto.

The Hochelaga Power House

Editor of The Canadian Manufacturer:

Dear Sir,—We have read with interest the article under the above heading, which appeared in your "Power" issue of September 11, 1908, from the pen of Mr. Harry L. Shepherd. In his description of the plant we notice this gentleman has not mentioned the fact that the coal and ash handling apparatus, together with the steam piping and the Holly drain system were all supplied and installed by Babcock & Wilcox, Limited, as well as the boilers and stokers to which he makes reference.

We presume the omission was due to an oversight and if you could find space in your valuable paper for this slight supplement to Mr. Shepherd's able article, no doubt it would prove of interest to your readers.

Thanking you in anticipation, we are, yours very truly,

Babcock & Wilcox, Limited,
H. W. Weller,
Manager for Canada.

A German peddler rapped timidly at the kitchen entrance. Mrs. Kelly, angry at being interrupted in her washing, flung open the door and glowered at him.

"Did yez wish to see me?" she demanded in threatening tones.

The peddler backed off a few steps.

"Vell, if I did," he assured her with an apologetic grin, "I got my vish; thank you."

The Adoption of a Trade Mark

By C. Augustus Dieterich in American Industries.

Next to determining upon the particular line of merchandise he is going to manufacture or sell, there is very likely no other problem which confronts the enterprising business man that causes him more worry and concern than the selecting or devising of a suitable trade-mark to distinguish and differentiate his product from similar goods in the market manufactured by his competitors in business.

How often, too, after he has finally settled upon a trade-mark, and used the same for some time, does he find that the trade-mark is one which he cannot lawfully appropriate for sole and exclusive use, or for which he cannot obtain registration in the United States Patent Office under the existing law providing for the registration of trade-marks.

The purpose of this article is to give such general information and instructions as will enable the manufacturer or dealer intelligently to select or devise a trade-mark, and in so doing avoid the unfortunate and wholly unnecessary mistakes so often made; so that when he has finally determined upon a definite trade-mark, he may feel reasonably assured that it is a legally valid one which he may protect by registration in the Patent Office.

At the very outset it should be borne in mind always that the sole purpose of a trade-mark is to indicate the origin or source of the product upon which it is used, or, more plainly stated, who makes it.

Trade-marks of some kind or other have been used in commerce for many centuries by all nationalities, and are now regarded, if not as an absolute necessity, at least as an extremely useful adjunct to the transaction of business.

According to the writer's mind, the ideal trade mark is a simple one, and the simpler the better. Where the trade-mark is to consist of a pictorial representation composed of an object or group of objects, it should be reduced to its simplest form and the smallest number of elements or parts possible. Where the trade-mark is to consist of a word—and most of the best trade-marks in use to-day do—it should be a short, arbitrary one; that is to say, a word which does not in any way describe the character or nature of the article upon which it is to be used.

In regard to the selection of a pictorial device to be used as a trade-mark little need be said, except that the number of such devices is legion, and as a rule they embody valid, legal and registrable subject-matter. With words, however, it is much different.

In selecting or coining a word-symbol the mistake is frequently made of adopting one which is either non-euphonious or difficult to pronounce. A word possessing either of these defects is worse than useless, and had best be abandoned at the earliest possible moment, for a customer cannot ask for one's goods if he does not remember the name, or will not ask for the goods if he is ashamed or fears to pronounce the name. In either case the result is the same to the manufacturer, and a sale is lost.

On the other hand, it is just as important to know what cannot be appropriated lawfully as a trade-mark, and in this respect the law declares that a trade-mark possessing any of the following characteristics will not be accorded registration, and such a one is very often invalid or incapable of exclusive appropriation. A trade-mark falling within any of the following classes will be refused registration.

1. If it consists of or comprises immoral or scandalous matter;

2. If it consists of or comprises the flag, coat of arms or insignia of the United States, or any simulation thereof, or of any State or municipality, or of any foreign nation;

3. If it is identical with a registered or known trade-mark owned and in use by another, and appropriated to merchandise of the same descriptive properties, or belonging to the same general class, or which so nearly resembles a registered or known trade-mark, owned or in use by another, and appropriated to merchandise of the same descriptive properties as above, as to be likely to cause confusion in the mind of the public, or to deceive purchasers;

4. If it consists merely in the name of an individual, firm, corporation or association. (Such name, however, will be accorded registration if it be written, printed, impressed or woven in some particular or distinctive manner, or associated with a portrait of the individual.)

5. If it consists of words or devices merely which are descriptive of the goods with which they are used, or of the character or quality of such goods;

6. If it consists of words which are merely a geographical name or term;

7. No portrait of a living individual may be registered as a trade-mark, except by the consent of such individual evidenced by an instrument in writing.

This mistake is frequently made by many who believe that, by merely altering the details of a known trade-mark, and retaining its general effect, they can avoid the charge of infringement. This, however, is not so, for the Court, in determining a question of infringement is governed largely by the general appearance of the whole—the tout ensemble, and if both the original and the imitation when subjected to such test leave the same impression upon the mind, the imitation will be adjudged an infringement of the original, and its further use prohibited and enjoined.

Trade-marks are designed primarily to provide the purchaser a ready means of knowing what goods or whose goods he is buying, and when there is a similarity in trade-marks it often becomes impossible to determine this, unless both the original and the imitation are placed before the purchaser, and even then it is sometimes impossible for him to say which of the two is the one he really wants.

There is no need for a manufacturer to imitate another's mark, unless he wilfully intends to commit a fraud. If he wants to be fair, it is not a difficult matter to procure a really distinctive and effective trade-mark if he will only apply himself to it in the proper way.

TENDERS FOR TRANSFORMER EQUIPMENT.

The Hydro Electric Power Commission have opened tenders to-day for the supply of the transformers, switching control and protection apparatus, wiring, bus-bars, service equipment, etc., in connection with the power transmission lines. Transformer equipment for 700,000 h.p. is being advertised for.

Members of the Commission are hopeful that the tenders will be found well within the estimates of their engineers, as was the case with the transmission line tenders and the securing of the right of way. The situation arising out of the injunction proceedings in a number of municipalities in the power union is likely to be further discussed at the meeting. There is reason for believing that the Commission has already decided upon a plan of action, and that it will be put into effect with the assent of the Cabinet. The Commissioners are anxious that the work of building the transmission line should be commenced this fall.

There are yet to be called for tenders for the mechanical equipment, such as the pumps, etc., and afterwards for the erection of the transformer stations.

TRADE NOTES.

Ontario.

LONDON.—The Jones Underfeed Stoker Co., Limited, Montreal, have just completed an installation of stokers for the London Asylum.

OTTAWA.—Jones underfeed stokers are being installed in the Imperial Realty Co.'s new building, Ottawa, Ont.

OTTAWA.—The sale of the Dominion Methodist church has been approved by the church board to C. Ross & Co., for $125,000. The congregation will now seek new quarters.

ORILLIA.—Two money by-laws were voted on favorably, one for $30,000 for the extensions to the town's power plant and the other for $10,000 for extensions to the waterworks.

TORONTO.—The boilers for the addition to the Confederation Life Building, Toronto, are being equipped with Jones Underfeed automatic mechanical stokers. This makes a total of 400 h.p. used in this building. The other boilers were equipped with Jones stokers in 1904.

New Brunswick.

FREDERICTON.—Elwood sawmill was completely destroyed by fire; also a large quantity of lumber and shingles.

LEPREAUX.—J. A. Gregory's saw mill was totally destroyed by fire, together with half a million feet of lumber.

BRADFORD.—The John Hill Carriage Works have been destroyed by fire. Loss, $10,500.

Quebec.

MONTREAL.—The Dodge Mfg. Co. have received an order for the transmission equipment for the new addition to the Belgo-Canadian Pulp & Paper Co.'s plant at Shawinigan Falls, Que.

ST. LOUIS.—Fire broke out in the Canadian Pacific Railway roundhouse which did damage to the extent of $20,000.

CAPTAINS OF INDUSTRY

Opportunities for Business. News of Building or Enlargement of Factories, Mills, Power Plants, Etc.—News of Railway and Bridge Construction—News of Municipal Undertakings—Mining News.

WATERWORKS, SEWERS, SIDEWALKS.

Quebec.

MONTREAL.—Contracts for the continuation of the conduit in connection with the waterworks department of the city of Montreal was awarded to the Ruford-Bishop Co., Montreal.

Ontario.

TORONTO—will spend $5,180 on sewer extensions.

NEWMARKET.—Work on the new reservoir for waterworks at Newmarket has been commenced. The contract price is $3,000.

TORONTO.—The new experimental station for the testing of water and the treatment of sewage at Toronto is expected to be completed this fall.

OTTAWA.—An $8,000 drainage system will be made in Rockcliffe, Ont.

British Columbia.

VANCOUVER.—Extensions will be made to the waterworks system on Seventh Avenue, Thirteenth Avenue, Venables Street and Alder street.

BUILDING NEWS.

Quebec.

MONTREAL.—Plans have been prepared for the erection of a baggage and passenger building for the Ottawa Railway Terminal Co.

BORDEAU.—Contracts for 160,000 feet of tiles for the new gaol has been awarded to Messrs. Hamon & Hess, Tile & Mosaic Works, 207 St. James Street, Montreal.

MONTREAL.—The St. Thomas Aquinas Church will erect a new church building on St. Antoine Street. J. A. Karch, 17 Place d'Armes Hill, is the architect.

MONTREAL.—Contracts have been let for the building of Salvation Army Barracks on Alexander Street and on De Montigny Street. Major Miller, of the Salvation Army, is the architect.

PLESSISVILLE.—A public school building will be erected.

Ontario.

BROCKVILLE.—A $3,600 addition will be built to Brockville's isolation hospital.

TORONTO.—Dr. Cuthbertson will erect a block of stores and offices, the cost being $20,000.

EARLSCOURT.—The Orange Lodge intend erecting a large hall.

ORANGEVILLE.—The Queen City Oil Co., Toronto, are planning the erection of a large gasoline tank in Orangeville.

OTTAWA.—The Dominion Methodist Church intend selling their property and building a new church.

PETERBORO.—The Park Street Baptist Church intend erecting a new building.

CHATHAM.—A large business block is to be erected here by William Baby.

PETERBOROUGH.—The St. James Methodist Church have taken out a building permit for the erection of a new Sunday school at a cost of $11,000.

STRATFORD.—The Stratford Mfg. Co's. plant will be enlarged by a two story addition.

OTTAWA.—Work has been commenced on the Ottawa Club building which will cost $20,000.

FORT WILLIAM.—Alterations and additions will be made to the post office building.

PORT STANLEY.—A large brick school will be erected.

OTTAWA.—The King's Daughters' Guild have collected $20,000 for the erection of a new building.

NIAGARA FALLS.—Plans have been received for a new armory, estimated cost, $40,000.

BURFORD.—An addition will be erected to the public school at a cost of $4,000.

SARNIA.—Extensive enlargements will be made to the plant of the Imperial Oil Co., at an estimated cost of $250,000.

TORONTO.—New churches will be erected by the Presbyterian congregations of Davenport and Queen Street East.

BERLIN.—The Berlin Orphanage building will be improved and enlarged.

FORT WILLIAM.—A new laundry will be erected by the Fort William Laundry & Dye Works Co.

TORONTO.—Plans have been completed by Leonard Foulds, 43 Victoria Street, for the Standard Publishing Co.'s plants.

Plans are now being prepared for the new Shea's theatre, estimated cost, $200,000.

Saskatchewan.

KEELER.—A large Union church will be erected here.

MOOSE JAW.—The Rex Fruit Co. will instal an elevator in their warehouse.

A 25,000 bushel elevator will be erected by A. McMichael, at Beatty.

ELSTOW.—The Canadian Elevator Co. and the Winnipeg Elevator Co. will build elevators here.

ESTEVAN.—The Farmers' Elevator & Trading Co. will pull down their old warehouse and have a new elevator erected.

GRASSY LAKE.—The Medicine Hat Milling Co. will erect a new elevator here.

REGINA.—The Christie-Brown Co., Toronto, are considering the erection of a biscuit factory or warehouse here.

RADISSON.—A Greek Presbyterian church will be erected here. Rev. Shekora is in charge.

SHEHO.—A new school will be erected for the Fishing Lake district.

SASKATOON.—Plans have been secured for a new Baptist church to be built on Third Avenue.

SASKATOON.—A rectory will be erected for St. George's church. T. A. Horne is in charge of arrangements.

GRENFELL.—The Massey-Harris Co., Toronto, will erect a large warehouse here.

ESTEVAN.—The Estevan Farmers' Elevator & Trading Co. have decided to erect a 40,000 bushel elevator.

REGINA.—An addition will be made to the Cockshutt Plow Co.'s warehouse.

PRINCE ALBERT.—A new fire hall will be erected here.

Alberta.

STRATHCONA.—A large brick school will be erected.

SUTHERLAND.—A new station will shortly be erected.

PONOKA.—The Provincial Government have secured 800 acres, a mile and a half south of town where an asylum will be erected. The estimated cost is $200,000.

VERMILION.—A 30,000 bushel elevator will be erected here.

KILLAM.—The Alberta Pacific Elevator Co. will build three elevators at Taber, Gleicher and Killam.

LETHBRIDGE.—The Sunny Belt Grain Co. will erect elevators at different points near here.

LACOMBE.—A new sanitarium will be erected here by the Seventh Day Adventists.

Nova Scotia.

HALIFAX.—A new Children's Hospital will soon be erected.

MONCTON.—An isolation hospital will be erected.

Manitoba.

WINNIPEG.—A large parish house will be erected here.

WINNIPEG.—William G. Gillman will erect a theatre costing $40,000.

PORTAGE LA PRAIRIE.—The Canadian Pacific Railway have decided to spend $29,000 to improve the depot and freight shed and to erect 100,000 gallon tank.

WINNIPEG.—The Canadian Elevator Co., of Winnipeg, are now building eight elevators along the line of the Grand Trunk Pacific.

Plans are being prepared for the new Elmwood postoffice by Architect J. R. Greenfield.

WINNIPEG.—Pattinson & Eilbeck have been awarded the contract for the erection of St. Matthew's Anglican church, at a cost of $11,500.

MINITONAS.—Plans are being prepared for a new school building to be erected here.

PORTAGE LA PRAIRIE.—The I.O.O.F. have decided upon the erection of a new temple this fall, estimated cost, $100,000 to $150,000.

BELLE PLAIN.—Plans are being prepared for a large new school house.

BROWNLEE.—A new brick school will be erected this fall at a cost of $8,000.

British Columbia.

KAMLOOPS.—A large brewery will be erected by the Enterprise Brewing Co.

VANCOUVER.—The contract for the Kitsilano school has been awarded to Baynes & Harrie, at $10,700.

POWER PLANT OPORTUNITIES.

Quebec.

MONTREAL.—Under authority of a resolution passed by the city council of Montreal a committee of engineers has been appointed to examine the question of underground conduits for electric wires.

Ontario.

BROCKVILLE.—The Brockville Electric Light Co.'s plant was damaged by fire.

BROCKVILLE.—The electric light station was recently damaged by fire with an estimated loss of $5,000.

Alberta.

LACOMBE.—The Blindman River Electric Power Co. purpose installing a new auxiliary steam plant at Lacombe.

British Columbia.

FERNIE.—Arrangements are being made to provide sufficient money to rebuild and operate the Crow's Nest Electric Light & Power Co.'s system.

ALERT BAY.—White Brothers Lumber Co. have been incorporated with $2,000,000, and will erect a sawmill to have a capacity of 1,000,000 feet per day.

Alberta.

LETHBRIDGE.—Plans are being prepared for the new electric power and lighting plant.

MORDEN.—A new heating and ventilating plant will be installed in the Maple Leaf school district. The school will also be refloored and renovated at a cost of $6,000.

FACTORY EQUIPMENT OPPORTUNITIES.

Ontario.

SOUTH BAY.—The South Bay Canning Co.'s plant was destroyed by fire. Loss, $30,000.

MADOC.—A large grist mill owned by F. Whytock & Sons was completely destroyed by fire.

PETERBORO.—The William Hamilton Works will resume work shortly after being closed down for six months.

ST. CATHARINES.—The Lincoln Paper Mills are re-fitting a mill.

TEESWATER.—The Canadian Pacific Railway roundhouse and Thompson's saw mill were totally destroyed by fire. The loss is estimated at about $6,000.

ORIENT.—The cheese factory belonging to A. Lalonde was recently destroyed by fire.

FLESHERTON.—Boyd Bros.' saw mill has been destroyed by fire.

BELLEVILLE.—The works of the Belleville Iron & Horseshoe Co. have been destroyed by fire. Loss, $15,000.

LINDSAY.—The Kennedy & Davis Milling Co., are enlarging their plant to manufacture woodenware.

PORT COLBORNE.—The Lake Erie Grain Milling Co. will erect a 1,000 barrel flour mill.

MILTON.—The C. R. Wilmott Co., will erect an $80,000 building for the manufacture of agricultural implements.

COBALT.—A large dynamite factory will be erected in Cobalt by Messrs. E. Winter, F. M. Henry and Jason Wigle, of Leamington, Ont.

LEAMINGTON.—The Leamington Basket Co. have decided to manufacture handles for spades, hoes, forks, etc.

STRATFORD.—Stuart Bros. will enlarge their flour mills.

MEAFORD.—W. A. Moore Mfg. Co. are re-modelling the Cleland factory.

INGERSOLL.—The Reid Foundry & Machine Co. will soon commence operations at their new factory.

TORONTO.—Virtue & Co. have been incorporated with a capital of $49,000 to manufacture books, maps, charts and printed matter. The provisional directors include H. B. Lockhart, A. W. Ballantyne and Arthur Cohen, Toronto.

OTTAWA.—The Fleming Grate Bar Co. have been incorporated with a capital of $40,000 to manufacture furnaces, boilers, machinery, etc. The provisional directors include H. W. Chamberlain, J. R. Gardner, and J. B. Fraser, Ottawa.

British Columbia.

VICTORIA.—The following companies have been incorporated, Head Office at Victoria:—Cariboo Timber Co., Limited, capital $500,000; Refining Co., Limited, capital, $500,000; Duncan's Lumber Co., capital, $25,000; Westward Ho Publishing Co., Limited, capital, $50,000; and the Vancouver Fiber Co., Limited, capital, $600,000.

Manitoba.

ROSEBANK.—The Farmers' Elevator was totally destroyed by fire, destroying 30,000 bushels of wheat.

Saskatchewan.

ASQUITH.—A new 125 barrel flour mill will be erected here,

Quebec.

MONTREAL.—H. P. Labelle & Cie. have been incorporated with a capital of $150,000 to manufacture furniture, mats, carpets and machinery. The provisional directors include Olivier Robert, J. E. Beaulieu, and H. P. Labelle, Montreal, Que.

QUEBEC.—Boivin's sawmills were recently destroyed by fire.

FARNHAM.—F. M. Fortier, cigar manufacturer, intends building a factory to employ 100 hands.

OFFICE EQUIPMENT OPPORTUNITIES.

Quebec.

MONTREAL.—The Dominion Soda Water Co., Montreal, Que., have been incorporated with a capital of $49,000 to manufacture soda water. The provisional directors include Abraham Rudner, Berll Roseberg and Gerst Bell, Montreal.

MONTREAL.—Thomas Wood Co., Limited, have been incorporated with a capital of $100,000 to buy and sell coffee, tea, etc. The provisional directors include A. L. Brown, F. L. Cook and A. R. McMaster, Montreal, Que.

Ontario.

HAMILTON.—Large new offices are being erected by the Hamilton Steel & Iron Co.

MINING OPERATIONS AND NEWS.

Quebec.

BROUGHTON.—The Brome County Asbestos Development Co. have been incorporated with a capital of $200,000 to carry on a mining industry. The provisional directors include F. A. Olmstead, of Sutton; C. A. Nutting, Waterloo, and H. H. Williams, Broughton, Que.

MINING AND CONSTRUCTION NEWS.

Ontario.

MILVERTON.—The Phœnix Oil & Gas Co. have been incorporated with a capital of $100,000 to produce petroleum, gas and minerals. The provisional directors include F. Torrance. R. Miller and R. Lederman, Milverton.

OTTAWA.—Union Construction Co. have been incorporated with a capital of $40,000 to carry on the business of general contractors. The provisional directors include John O'Leary, M. F. O'Leary and T. J. Brigham, Ottawa, Ont.

British Columbia.

LANGLEY.—The contract for a new 30,000 capacity circular sawmill for the Langley Lumber Co. has been awarded to the Schaake Machine Works, New Westminster, B.C.

MINING AND CONTRACTING NEWS.

Ontario.

DUNDAS.—The Dominion Heating & Ventilating Co., Hespeler, have the contract for the installation of a heating and ventilating system in Knox church and Sunday school.

GUELPH.—Stevenson & Malcolm have secured the contract for the installation of a heating plant in the city hall.

NORTH BAY.—Maitland & Moore, Peterboro, Ont., have obtained the contract for roofing the new Normal school.

PETERBOROUGH. — Alderman McIntyre has been awarded the contract for the construction of Peterborough Cereal Co.'s plant.

WELLAND.—Jos. Battle, Thorold, has secured the contract for the erection of a dock and wharf to be built by the Government on the Welland canal at the Ontario Iron and Steel plant.

TORONTO.—Baker & Fordahl, Toronto, have received the contract for the concrete foundations for the new buildings for the Harris Abattoir Co.

WEST TORONTO.—Contracts have been let out for the new Carnegie library.

SELKIRK.—The Holmes Gas Co., Limited, have been incorporated with a capital of $40,000 to construct and operate work for the production of natural gas. The provisional directors include J. W. Holmes, W. C. Holmes and O. B. Holmes, Selkirk, Ont.

TORONTO.—The United Oil Fields have been incorporated with a capital of $100,000 to operate the plant of the Amalgamated Petroleum Producers. The provisional directors include W. H. Cooper, L. K. Cameron, and J. F. Lennox, Toronto.

PROFESSIONAL DIRECTORY

Patent Attorneys, Mechanical and Electrical Engineers, Hydraulic and Constructing Engineers, Chemical and Mining Experts, Contractors and Builders, Architects, Auditors, Accountants, Etc.

RAILROAD CONSTRUCTION NEWS.

Ontario.

WEBBWOOD.—The Canadian Pacific Railway round house was recently destroyed by fire.

British Columbia.

NELSON.—The Canadian Pacific Railway are constructing a new spur on their Lardo branch for the Canadian Granite & Marble Co.

BRIDGES AND STRUCTURAL STEEL.

Saskatchewan.

SASKATOON.—A new steel bridge is being erected at Battle River on the Grand Trunk Railway near Saskatoon, Sask.

Quebec.

MONTREAL.—Tenders are being received for the re-erection of the overhead bridge on Victoria Pier.

MATAPEDIA.—Tenders will be received for the construction of two abutments and additions to four piers of the Intercolonial railway bridge.

British Columbia.

SASKATOON.—A bridge will be built in the city park. Concrete piers and wood trusses will be used. Wiggins & Cavill are the engineers.

Ontario.

HAMILTON.—A new cement bridge will be erected at Wolf Creek.

SHUNIAH TOWNSHIP.—A by-law has been carried to raise $10,000 for the construction of roads and bridges.

MISCELLANEOUS NEWS.

British Columbia.

NELSON.—The Daly Building was recently been destroyed by fire.

New Brunswick.

MONCTON.—The Maritime Coal Co., Limited, have been incorporated with a capital of $2,500,000 to purchase and obtain mining licenses and leases. The provisional directors include Isaac Purdy, of the State of New York; M. F. Keith, Moncton, N.B., and Eugene Mead, Adamsville, N.B.

Ontario.

PORT ARTHUR.—The capital stock of the Port Arthur Elevator Co., Limited, has been increased from the sum of $100,000 to $500,000.

The capital stock of the Smith Marble & Construction Co., Limited, has been increased from the sum of $40,000 to $100,000.

OTTAWA.—Union Construction Co. have been incorporated with a capital of $40,000. The provisional directors include P. J. O'Leary and M. O'Leary, Ottawa.

BOLTON.—Bolton Telephone Co. have been incorporated with a capital of $20,000. The provisional directors include Robert Smith, A. A. McFall and H. A. Rutherford, Bolton.

WEBBWOOD.—The Canadian Pacific Railway roundhouse was destroyed by fire recently.

BOND LAKE.—The Metropolitan Railway Co.'s hotel was recently destroyed by fire.

SMITH'S FALLS.—Smith's Falls Pressed Brick Co. have been incorporated with a capital of $75,000. The provisional directors include H. S. Hunter, C. W. McBride and H. F. Smith, Smith's Falls.

Heckston Rural Telephone Co. have been incorporated with a capital of $5,000. The provisional directors include G. J. Cumming, W. Sloan and J. W. Shaver, of South Gower township.

RENFREW.—The Renfrew Knitting Co. have been incorporated with a capital of $500,000. The provisional directors include T. A. Low, F. G. Barnet and A. Francis, Renfrew.

WINDSOR.—Ontario Silica Co. have been incorporated with a capital of $100,000. The provisional directors include C. E. Green, H. C. and G. J. Leggatt, Windsor.

HAMILTON.—People's Brewery have been incorporated with a capital of $250,000. The provisional directors include S. Hill, F. A. Lee and Henry Carpenter, Hamilton.

MILTON.—C. R. Wilmott Co. have been incorporated with a capital of $200,000 to manufacture agricultural implements and machinery. The provisional directors include G. Noble, C. R. Wilmott and A. O. Hurst, Toronto.

TORONTO.—Dominion Contract Co. have been incorporated with a capital of $40,000. The provisional directors include C. A. Hull, G. A. Marchant and O. K. Wingrove, Toronto.

TORONTO.—Canadian Foresters Hall have been incorporated with a capital of $100,000 to erect a building for lodge purposes. The provisional directors include T. W. Gibson, G. G. Miles and R. L. Baker, Toronto.

TORONTO.—Canadian Flax Mills have been incorporated with a capital of $1,000,000. The provisional directors include D. F. Keith, A. C. Campbell and A. F. White, Toronto.

SUDBURY.—Spanish River Improvement Co. have been incorporated with a capital of $20,000. The provisional directors include W. J. Bell, G. R. Gray, A. G. Gordon, Sudbury.

TORONTO.—Canadian Barrel, Handle & Veneer Co. have been incorporated with a capital of $50,000. The provisional directors include J. B. McKinnon, J. B. Climo and W. E. Lount, Toronto.

MARMORA.—The Marmora cooperage mill has been destroyed by fire. Loss, $5,000.

BERKELEY.—Mitchell Brothers' sawmill was recently destroyed by fire.

PICTON.—The factory of South Bay Canning Co. has been destroyed by fire. Loss, $28,000.

TORONTO.—Canadian Cleveland Drill Co., Limited, have been incorporated with a capital of $7,500 to manufacture machinery and tools. The provisional directors include Richard Credicott, W. B. Livett and W. Gilchrist, of Toronto.

MITCHELL.—Stuart Bros., Limited, have been incorporated with a capital of $40,000 to carry on the business of flour millers and grain dealers. The provisional directors include S. R. Stuart, W. A. Stuart, Mitchell.

Quebec.

QUEBEC.—Marier & Tremblay have been incorporated with a capital of $48,000 to carry on business as painters and decorators. The provisional directors include J. A. Marier, N. Pelchat and Leon Marier, Quebec.

MONTREAL.—Daoust & Laforce, architects, Three Rivers, Que., are inviting tenders for a Catholic church and Presbytery, a hotel, thirty stores and ten residences at Three Rivers.

MONTREAL.—F. Hyde & Co., Montreal, have taken out a permit for an addition to their warehouse on Wellington Street.

MONTREAL.—J. P. Mallaskey has been awarded the contract for the construction of the Canadian Northern Railway extension to Rawdon, by Messrs. MacKenzie, Mann & Co. Its construction will make Rawdon the distributing centre for seven or eight parishes and a most desirable suburb of Montreal.

MONTREAL.—A school will be erected by the Catholic School Commissioners at St. Hyacinthe, Que.

A new bank building for the Bank of Montreal will be erected at Sterling, Ont. Peden & McLaren, Montreal, are the architects, and Byers & Anglin, of Montreal, are the contractors.

Antoine Vims, 787 Cowan Street, Montreal, has taken out a permit for seven houses containing eighteen dwellings on Ontario Street East, at a cost of $20,000.

ST. SAUVEUR.—Plans are being prepared by Alderman Lemay for the proposed $100,000 technical school.

MONTREAL.—St. Lawrence Realty Co., Limited, have been incorporated with a capital of $100,000 to carry on a real estate business in Canada. The provisional directors include Oscar Gagnon, T. E. Gadbois and J. M. Montle, of Montreal.

MONTREAL.—The Godwin, Murray, Barnhart, Limited, have been incorporated with a capital of $18,000 to deal and trade in all kinds of manufactured and unmanufactured goods and merchandise. The provisional directors include C. B. Godwin, E. D. Murray and A. C. Barnhart, of Montreal.

MONTREAL.—Lyman Sons & Co., wholesale druggists, Montreal, are erecting a large warehouse, facing on St. Paul, St. Nicholas and Gourville Square. It will be six storeys and basement reinforced concrete with stone and brick facings. The concrete work, now almost complete, is being done by the Ferro-Concrete Construction Co., of Cincinnati, Ohio. Their Montreal branch is in the Coristine Building, Montreal.

Manitoba.

WINNIPEG.—Chamber of Commerce Co., of Winnipeg, Limited, have been incorporated with a capital of $50,000 to establish grain and produce trades. The provisional directors include W. R. Bawlf, E. J. Bawlf and Dennis Bawlf, all of Winnipeg.

British Columbia.

VICTORIA.—The Structural Material Co. have been incorporated with a capital of $100,000.

PORT HANEY.—L. M. Proctor has sold his interest in the Holden & Proctor Lumber Co. to Wm. Holden.

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The Application of Steam Superheaters

Paper Read Before the Liverpool Engineering Society. Methods of Superheating. Advantages of Superheated Steam. Various Ways in which Superheaters May be Heated. Handling Superheated Steam so That its Value May Not be Lost

By Professor W. H. Watkinson

Steam superheaters are now largely used in connection with both stationary and locomotive boilers, and as the author has had considerable experience in connection with the design and operation of such appliances it was considered appropriate that he should give some account of the advantages which may be derived from the use of superheated steam.

Steam is said to be superheated when it has a temperature greater than that corresponding to its pressure.

Superheating may be effected either by wiredrawing steam from a higher to a lower pressure or by supplying heat to the steam after it leaves the boiler. The former method, although apparently simpler, is never adopted in practice, because it would be necessary to have a very high initial steam pressure to give a useful degree of superheat at the pressure at which the steam is supplied to the engine. It is easy to show, by calculation, that if the steam is supplied to an engine at a pressure of 160lb. absolute, it would only be superheated by 34° F., if it was wiredrawn from 300lb. pressure to 160lb. pressure, absolute.

Before describing the construction and arrangement of superheaters it will be well to state, briefly, some of the advantages due to the use of superheated steam.

Advantages of Superheated Steam.

With all kinds of steam engines, both of the reciprocating and of the turbine types, it is found that the presence of moisture in the steam increases the amount of steam required per horse-power hour. The moisture in steam may be due to the boilers priming, to partial condensation in the steampipes, or to partial condensation within the engine, and it is usually due to all these three combined.

If superheated steam supplied to an engine is dry when it reaches the engine, some of it will condense during its expansion in the engine; and usually, in reciprocating engines, a considerable proportion of the steam is condensed during its admission to the cylinder. It would take too long to discuss the reasons for this here, but it is a fact well established by experiments, that the wetter the steam supplied to an engine the greater the condensation of steam within the cylinders and the greater the losses due to this condensation.

Many methods have been adopted for reducing the condensation of steam within engine cylinders, the most important of these being: Steam jacketing, compounding, and superheating. The last of these is the only method by which cylinder condensation can be entirely prevented, and it is of use even when both the others are also adopted.

In most, if not in all, engines leakage takes place both past the pistons and past the valves, and it has been found, by experiments, that this leakage is very much less when the steam is superheated than when it is wet. Superheated steam, on the other hand, flows through pipes, ports, and steam passages, much more freely than saturated steam, and there is, therefore, considerably less drop in pressure between the steam-chest and the cylinder during admission, and the back pressure during exhaust is also reduced when superheated steam is used. The advantages due to the reduced resistance to the flow of superheated steam were first brought to the notice of the author when some superheaters which he had designed were put into action to superheat the steam supplied to rolling mill engines. It was found that with the usual draught on the rolls the engines ran much more rapidly than before, and in order to reduce their speed to a safe limit it was necessary to screw down the rolls much more than usual for each passage of the steel through the rolls. The net result was that the time occupied in rolling boiler plates was reduced from 4½ minutes to 2½ minutes, and additional heating furnaces had to be erected in order to keep the rolling mills fully employed. This increase in the rapidity of rolling of large plates probably increases the quality of the plates, because the rolling is completed at a higher temperature.

During superheating, although the pressure of the steam remains constant, its volume is greatly increased. The amount of heat required to superheat 1lb. of steam by 150° F. is 72 British heat units, which is only about 6 per cent. of the heat required to generate 1lb. of dry saturated steam. The increase in volume due to this additional 6 per cent. of heat averages about 30 per cent.

In most cases where superheated steam is used the superheating is only carried so far as to reduce, or at most to annihilate, initial condensation. In these cases the steam, after it has been admitted to the cylinder of an engine, becomes ordinary saturated steam before or at cut-off, so that during expansion some condensation of steam takes place, due to work being done at the expense of the internal heat of the steam. In these cases there is no advantage due to the increase of volume of the steam during superheating, but there is a great saving in steam and in coal, due to the reduction of initial condensation and of leakage of steam past the valves and pistons.

The steam turbine is the only engine in which this condensation of the steam by previously-cooled internal surface does not take place; but the steam in turbines is, of course, wet from another cause—namely, on account of the expansion it has undergone while doing work, and the efficiency of this type of motor is also very considerably increased when the steam is superheated prior to its admission to the engine.

In steam turbines the reduction in the amount of steam required when superheated steam is used is due mainly to the increased volume of the steam, and to the decreased frictional resistance between the rotating vanes and the steam.

As there are no surfaces sliding over one another in turbines, this type of engine seems admirably adapted for the use of very highly superheated steam, but in turbines of the Parsons type, as at present designed, and with the very small clearance at the blade tips which is necessary in order to keep the leakage losses as small as possible, highly superheated steam cannot be safely used on account of the irregular distortion of the turbine casing due to uneven temperature conditions. Turbines of the De Laval, Rateau, and Curtis types are not similarly handicapped.

With a given percentage saving in steam, the percentage saving in coal depends on the way in which heat is supplied to the superheater and on the efficiency of the superheater.

In general, there is no appreciable advantage due to the use of superheated steam for boiling, heating, and drying purposes, because in these cases most of the heat given up by the steam is given up at the temperature at which it condenses.

How Steam is Superheated.

Superheaters may be heated by products of combustion in the following ways:—

1. The superheater may be heated by the products of combustion from a boiler furnace after the whole of these products have flowed over the boiler heating surfaces. When this method is adopted, the superheater is placed, for the case of a Lancashire boiler, between the boiler and the economiser, and in the case of a locomotive or a marine boiler, it is placed in or above the smoke box. The temperature of the products of combustion when they reach the superheater is, with this arrangement, between 600° and 700° F., and the heating surface of the superheater requires to be much greater than when it receives its heat from gases at, say 1,000° F. This arrangement has, however, the maximum possible efficiency, because the superheater acts, in this case, both as an engine economiser and, to a certain extent, as a boiler economiser.

2. The superheater may be heated by some or all of the products of combustion from the boiler furnace before these products have passed over the whole of the boiler heating surface, the products of combustion after flowing past the tubes of the superheater being sent over the rest of the boiler heating surface. This arrangement is as efficient as the first one, and it has the great advantage that the superheater can be much smaller, on account of the higher temperature (usually 1,000° F. or higher) of the products of combustion. When a superheater is subjected to gases at this high temperature, means should be provided for regulating the degree to which the steam is superheated, and for protecting the superheater when the engine is standing and during steam raising.

3. The superheater may be heated by products of combustion withdrawn from the firebox of a locomotive or from the combustion chamber of a marine boiler and conducted through a large diameter pipe to the superheater, these products, after passing the superheater, being discharged directly to the chimney. When this method is adopted it is necessary that the superheater should be so designed as to cool the products of combustion passing over it to approximately the same temperature as the remainder of the products of combustion are cooled during their passage through the boiler tubes. Unless this is accomplished the increased loss of heat to the chimney may nearly or completely neutralise the gain at the engine due to the steam being superheated.

4. The superheater may, in steelworks, be heated by the products of combustion from reheating and other furnaces.

5. The superheater may be heated by the products of combustion from an independent furnace provided for the purpose.

For cases where only one or two boilers are used, it is generally best to heat the superheater with products of combustion from the boiler furnace; but for larger installations it is better to use a separately-fired superheater. One reason for this is, that if a superheater is applied to each of a battery of boilers, it is not known what each one is doing. One of the superheaters may be supplying nearly red-hot steam, whereas another, the boiler of which is being lightly fired, may be acting as a condenser. The cost of a separately-fired superheater, and of the pipes and by-pass valves, is also less than the corresponding cost where a superheater is applied to each boiler. The greatest advantages, however, of the separately-fired superheater in a large installation are the greater certainty of action and the greater ease of control of the degree to which the steam is superheated

Handling Superheated Steam.

Where dirt is likely to be carried by the steam from the boilers to the superheaters, it is advisable to place a separator at the inlet side of the superheater to catch this dirt. Separators similarly placed should also be used in conjunction with large superheaters if the boilers are liable to prime. In this way the duty of the superheater is restricted to that for which it was constructed, and it is thus enabled to perform its duty more satisfactorily.

Some kinds of cylinder lubricating oil, when used with superheated steam, leave a sticky residue within the engine cylinder, and if any dirt happens to be carried by the steam into the cylinder, this dirt adheres to the sticky residue from the oil and thus accumulates within the cylinder, where it may, if it is of a gritty nature, cause serious scoring of the cylinder and piston rings. This theory of the cause of scoring in engine cylinders is due to Messrs. Worrall and Southcombe, who have recently published, in the "Journal of the Society of Chemical Industry," the results of experiments, made in our laboratories, on this important subject.

It is sometimes found that superheated steam loses its superheat before it reaches the engine, and in some cases the whole of the superheat is lost within a few yards of the superheater. In such cases the design of the superheater is defective, and only a portion of the steam passing through it is actually superheated. As soon as the superheated and wet portions of the steam have had an opportunity of mixing together in the steam-pipe, the resulting temperature is much less than that indicated by the thermometer on the outlet branch of the superheater. In order to ensure that the whole of the steam flowing through a superheater shall receive its due share of heat therein, it is necessary to use tubes of small diameter, and to proportion the superheater so that the velocity of flow of the steam through each tube shall be sufficiently rapid to ensure turbulent flow. The author has found, by experiments, that when these conditions are fulfilled the rate of cooling of superheated steam is only about 0.75° F. per yard run of steampipe, the lagging on the steampipe being of the usual type.

When the tubes are of small diameter and the velocity of flow of steam through them is sufficiently high, the tubes may be subjected to flame and products of combustion at a temperature of at least 1,600° F., without injury to the tubes.

When the whole of the products of combustion from the boiler furnaces flow over the tubes of the superheater, the products of combustion will be cooled by the superheater through, roughly, two-thirds the number of degrees by which the steam is superheated —that is, if the steam is superheated 150° F., the products of combustion will be cooled about 100° F. during their passage over the tubes of the superheater. It is evident therefore, that an economiser of the feed-water heater type or of the air-heater type may also be used with advantage to utilise the available residual heat of the products of combustion.

Superheated steam may be used with advantage and without difficulty in almost every type of engine, but in order to obtain the greatest possible saving, by using very highly superheated steam, say at 700° to 750° F., it is necessary that the engine shall have either piston valves or drop valves.

When superheated steam is used neither brass glands for the stuffing boxes, brass castings in the branches and stop valves, nor copper steampipes must be used, as these undergo molecular change when subjected to high temperatures.

Action of the Injector

By R. T. Strohm.

Despite the fact that it has been in use for almost half a century, the injector is still a subject of much misunderstanding and discussion. Numerous and varied have been the explanations of its action, and some of these have been so absurd in conception as to sound ridiculous. Let it be understood, then, that there is no mystery surrounding the action of the injector. Its operation is based on simple, natural laws which can readily be stated and understood. The mere fact that it has no moving parts need cause no confusion.

In Fig. 1, suppose that the tube A is connected with the steam space of a boiler, so that the steam, under pressure, is free to escape through the tube. It will emerge in the form of a jet, as shown, moving at a great speed. Just beyond the end of the tube, as at B, the jet of escaping steam has a slightly conical form, while at a still greater distance, as at C, the jet expands and is broken up by the resistance of the surrounding atmosphere.

A tube like that shown in Fig. 1 is usually called a nozzle. When steam from a boiler

Fig. 1 Fig. 2

flows through a nozzle of this kind, and escapes into the air, the velocity of the steam outside the nozzle may be from 1,500 to 3,000 feet per second, depending on the boiler pressure. This issuing steam has weight, and to give it such a high velocity requires that work be done upon it, just as it requires work on the part of a horse to move the weight on a truck. Now, work is produced by heat energy. Therefore, since the column of steam has had work done upon it in order to give it this high velocity, it is necessary to look for a source of the heat which is transformed into work.

This source of heat is in the steam itself. When the steam leaves the boiler it has a high pressure and temperature, and when it issues from the nozzle its pressure and temperature are both much lower. Evidently, the steam loses heat in its passage. But this heat is not lost by radiation from the pipe and nozzle. It is changed into work, which work, expended upon the steam, makes it move faster, so that while the steam in the boiler has practically no velocity, at the end of the nozzle it has a very high velocity.

Heat cannot be taken away from ordinary steam without allowing some steam to condense into water. Consequently the steam that emerges from the nozzle is not dry steam, but contains moisture in the shape of very fine drops. Under different temperatures this moisture may amount to from 10 to 20 per cent. of the weight of the steam.

As the steam passes through the nozzle, three things occur: (1) The pressure and the temperature both decrease. (2) The velocity of flow increases enormously. (3) The steam condenses to a greater or less extent. Then, for every pound of steam that passes through the nozzle, there is found to be a mixture of about .8 or .9 pounds of steam and from .1 to .2 pounds of water, at the mouth of the nozzle.

Now, suppose that the nozzle of Fig. 1 is so placed as to discharge through a cone-shaped ring, as in Fig. 2. The small end of the cone A is of such size that the expanded jet of steam had done, at first. But this jet of water, on account of the steam jet when the latter is turned on will be carried along and forced through the cone by the moving jet. Other air will then rush in at B, B and, meeting the jet, will be drawn along with it in the direction of the small end of the cone. The continued friction of the steam with the air inside the cone will then set up a continuous current flowing through the cone in the direction indicated by the arrows. The mingling of the air and steam will cause still more of the steam to condense, while the velocity of the steam jet will decrease somewhat, owing to the fact that a part of its energy is used in giving velocity to the air.

Instead of a simple cone, open at both ends, let the device in Fig. 2 be changed to that shown in Fig. 3. In the latter figure the nozzle A is inserted through the back wall of the cone B which is closed at the large end

with the exception of the opening C. The action does not differ in any way from the action of the device in Fig. 2. The air is driven and drawn out of the closed cone by the jet, causing a partial vacuum inside it, and to fill the space thus voided, air rushes in at C, and a continuous current is established, entering at C and emerging at the small end of the cone.

The devices shown in Fig. 2 and 3 will be recognized by many engineers as being the typical forms of various boiler room appliances, such as tube cleaners, soot suckers and blowers for producing draft, all of which depend on the production of a rapid current by the escape of steam through one or more openings.

It has just been shown that the flow of air upward through the pipe C, Fig. 3, is due to

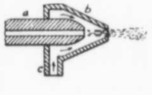

Fig. 3

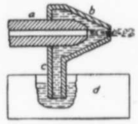

Fig. 4

the fact that the pressure inside the cone B is reduced somewhat below that of the atmosphere. Suppose, then, that the pipe C is lengthened, and that its lower end is placed beneath the surface of the water contained in a tank, according to the arrangement shown in Fig. 4.

When the steam is turned on, it forms a partial vacuum in the cone, B as already explained. But air cannot rush in to fill the space thus left vacant, since the pipe C is submerged in the tank D. However, the pressure of the atmosphere acts just as before, and it forces water from the tank up into the cone surrounding the nozzle A, completely filling that portion of the space not already occupied by the jet of moist steam. This action, of course, brings the water and the steam into contact, which can have but one result. The steam is condensed by the cool water, and the heat thus set free is taken up by the water. That is, the steam is cooled and the water is heated, the latter simply absorbing the heat that the steam gives up.

But the steam jet, just before it is condensed, is moving at a velocity of perhaps 2,000 feet per second. Therefore, if this steam could be changed to water without any other action, the water thus resulting would have the same high velocity. However, this is not the case. Besides being condensed, the jet mingles with the water that is forced up from the tank. Consequently, owing to the resistance thus offered, the velocity of the condensed jet is very greatly reduced.

Instead of a jet of steam, there is now a jet of water particles moving toward the small end of the cone. This jet is surrounded

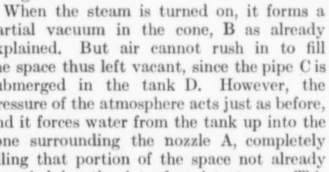

Fig. 5

by the water inside the cone, As a result, the friction between the jet and the water causes the latter to be drawn along, at an increasing speed, toward the outlet, the jet meanwhile decreasing in velocity. At the mouth of the cone the mingled jet emerges, now an almost solid column of water which, though it has not the velocity of the original steam jet, is nevertheless moving at a fairly rapid rate, say 400 to 500 feet per second.

The condensation of the steam inside the cone produces another important effect. When a volume of steam condenses to water, the space occupied by the water is only about $\frac{1}{1000}$ as great as that originally occupied by the steam. Hence, in condensing in the cone, a partial vacuum is formed, to fill which the water of the tank D is forced up into the cone. As the condensation in the cone is continuous, the flow of water up through C is likewise continuous, and a steady stream is delivered at the mouth of the cone.

This issuing stream is not a solid column of water. It is rather a mingled spray, composed of water and vapor, the greater part, however, being water. Now, such a jet, moving at a velocity of several hundred feet a second, has considerable energy stored in it. And if the jet be allowed to impinge against a flat surface, it will exert a pressure upon that surface. For example, if the velocity of the jet is 400 feet per second and the weight of the mixture of water and vapor is 50 pounds per cubic foot, the pressure exerted by such a jet impinging upon a stationary flat surface will be several hundred pounds per square inch. A pressure like the is capable of overcoming considerable resistance.

Suppose, now, that the apparatus shown in Fig. 4 is attached to a steam boiler in the manner shown in Fig. 5. A pipe A leads from the steam space of the boiler B to the nozzle C inside the cone D. Just beyond the edge of the cone is another pipe E, containing a swing check-valve F, by which the water in the boiler is prevented from running out. A pipe G connects the cone D with a tank of water H, and a chamber J having an outlet K surrounds the mouth of the cone and the end of the pipe E. A valve L controls the flow of steam through the pipe A. This apparatus contains the elements of the steam injector as commonly built. The action is precisely like that of the cone, as already described in connection with Fig. 4.

When the valve L is opened, steam issues from the nozzle C, escapes through the mouth of the cone D, and leaps across the narrow opening into the pipe E. Here, however, it meets the closed check-valve F, which it cannot lift, owing to its slight pressure. Consequently, as soon as the steam fills the pipe C it is forced out into the chamber J, whence it escapes through the overflow k to the atmosphere.

But the rush of steam from the nozzle forms a vacuum inside the cone, and water is forced up into the cone, where it mingles with the steam, is heated and condenses the steam. The combined current, on leaving the mouth of the cone at a high velocity, leaps across the gap into the pipe E, just as the steam has done, at first. But this jet of water, on account of its weight and velocity, possesses much greater energy than the steam jet. Hence, when the pipe E is filled up to the check-valve, the water that continues to come from the cone raises the pressure to a high degree, and this pressure, being so much greater than that in the boiler, lifts the check-valve and the water passes through into the boiler. As soon as the check-valve is lifted, the escape of vapor or water at K ceases, and to prevent air being drawn in at K on account of the vacuum formed in J by the jet rushing across from D to E, another check-valve, opening outward, is placed in the outlet pipe K.

This, then, is the action of the injector. The steam, escaping at a very high velocity, gives up much of that velocity to the water, and the pressure of the swiftly-moving column of water is sufficiently great to overcome the boiler pressure which it does.—Practical Engineer.

The English spoken by the "Pennsylvania Dutch," as the inhabitants of certain districts in the eastern part of the state are popularly known, affords some rare specimens of expression. A man who was passing a small house on the outskirts of "Sous Besselem"—that is the nearest possible spelling of the local pronunciation—heard the daughter of the family calling her brother in to supper. "George," she said, "you come right in, now; Pa's on the table, and ma's half et!"

A woman entered a police station in Holland, and asked the officer in charge to have the canals dragged.

"My husband has been threatening, for some time, to drown himself," she explained, "and he's been missing now for two days."

"Anything peculiar about him by which he can be recognized?" asked the officer, preparing to fill out a description blank.

For several moments the woman seemed to be searching her memory. Suddenly her face brightened.

"Why, yes, sir. He's deaf."

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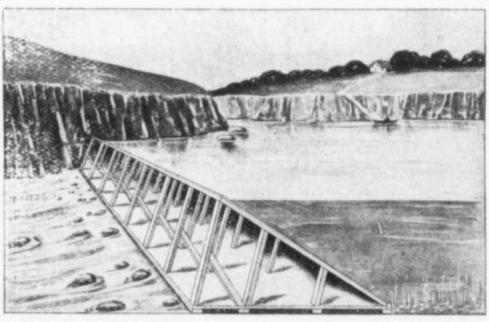

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