TEST OF AN EVAPORATIVE CONDENSER TO DETERMINE THE COEFFICIENT OF HEAT TRANSMISSION

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A TEST OF AN EVAPORATIVE CONDENSER

TO DETERMINE THE

COEFFICIENT OF HEAT TRANSMISSION

A THESIS

PRESENTED BY

ROBERT T. EVANS

TO THE

PRESIDENT AND FACULTY

OF

ARMOUR INSTITUTE OF TECHNOLOGY

FOR THE DEGREE OF

BACHELOR OF SCIENCE IN MECHANICAL ENGINEERING

HAVING COMPLETED THE PRESCRIBED COURSE OF STUDY IN

MECHANICAL ENGINEERING

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"TEST OF AN EVAPORATIVE CONDENSER FOR THE DETERMINATION OF THE COEFFICIENT OF HEAT TRANSMISSION"

Object.

The object of this investigation is the determination of the value of U, the coefficient of heat transmission, for various velocities of the cooling medium and for different degrees of saturation of the cooling medium.

It is also proposed to obtain curves to show the horse power necessary to mave the air and water vapor used as the cooling medium, and to show the relative amounts of the air and vapor necessary to condense given amounts of steam at various vacuua.

Preliminary Calculations.

Before starting the test of the condenser it was thought advisable to make calculations and draw curves to aid in the calculation of the data from the test. The curves thus

obtained are shown in Figures 1 to 7 inclusive.

Figure 1. shows the vapor contents of air at various temperatures and degrees of saturation. The higher the temperature of the air the more water vapor it will absorb. As the temperature of the air increases the greater is the pressure of the vapor and as the total or barometric pressure is the sum of the vapor pressure and the pressure of the air, the pressure of the air is less at high temperature. In the curves the unit is taken as one cubic foot of air at zero degrees Fahrenheit and 29.921 inches of mercury. Therefore the water vapor contents is obtained in the following manner. From the steam tables the pressure of the vapor is found for any given temperature and added to the standard barometric pressure. The voulme of the air and therefore the vapor contents will increase by the amount of the ratio of the pressure thus obtained to the barometric pressure, and also by an amount equal to the absolute temperature to the absolute

zero. The combined ratio is then multiplied into the weight per cubic foot as taken from the steam tables for the given temperature. This gives a point on the curve for the vapor contents of saturated air. The curves for the various degrees of saturation are obtained from this one.

Figure 2. shows the heat absorbed by one cubic foot of dry air in becoming saturated at various temperatures with the barometer at 29.921 inches of mercury. Curve 1 shows the B.T.U. absorbed by the dry air contents and Curve 2 the B.T.U. absorbed by the vapor contents in becoming superheated. Curve 3 shows the total heat absorbed. The weight of one cubic foot of dry air at zero Fahrenheit and 29.921 inches of mercury was taken as .0864# and the specific heats of the dry air and the water vapor were taken as .2375 and .5 respectively. The head absorbed by the dry air contents was found by multiplying the weight of the air by the rise in temperature and by the specific heat. The heat absorbed by the vapor contents was found in the same manner.

As the unit was taken as one cubic foot of dry air at zero it was first necessary to find the volumes at the various temperatures and then from Figure 1. the vapor contents. The heat absorbed by the two elements of the mixture were found and plotted and the added together and plotted.

Figure 3. shows the relative volumes of air and water vapor contents at various temperatures for saturated air at 29.921 inches of mercury. The volume of the dry air contents was found in the same manner as explained in Figure 1. taking into consideration the pressure of the vapor and the barometric pressure and the absolute temperature. The volume of the vapor was found from the steam tables for the various temperatures, by multiplying the weight of the vapor contents by the specific volume.

Figure 4 shows the heat and water vapor absorbed by one cubic foot of dry air in becoming saturated at various higher temperatures. Two standards were taken and the results computed for each. One standard was

one cubic foot of dry air at zero, and the other was one cubic foot of dry air at 70° F. and both at 29.921 inches of mercury. The water vapor absorbed by the air was found from Figure 1. The heat absorbed was found in the same way was that described for Figure 2. The heat absorbed by both the dry air contents and water vapor contents were found and the two added together and plotted as shown.

Figure 5 shows the effect of humidity upon the water and heat absorbtion of air. Curves 1 and 2 show the vapor and the B.T.U. absorbed by one cubic foot of dry air at 70° F. in becoming 70% saturated at various temperatures. Curves 3 and 4 show the water vapor and B.T.U. absorbed by one cubic foot of dry air at 70° F. in becoming saturated at various temperatures. The pressure of the barometer was assumed to be 29.921 inches of mercury in both cases.

Figure 6 shows the volume of air and water vapor necessary to contain one pound of vaopr at various temperatures and degrees

of saturation. These curves are the reciprocals of the curves in Figure 1. which show the vaopr contents of air at the same temperatures and degrees of saturation.

Figure 7 shows the volume of air and vapor necessary to absorb one B.T.U. in becoming saturated, and 70% saturated at various temperatures. Curves 1 and 3 are for the air dry at 70° F. and becoming saturated and 70% saturated respectively. Curve 2 is for the air dry at zero and becoming saturated. These curves are the reciprocals of the curves showing the B.T.U. absorbed by one cubic foot of air in becoming saturated at various temperatures shown in Figures 4 and 5.

Figure 1.

Vapor Contents of Air at Various Temperatures and Degrees of Saturation.

Figure 2.

B.T.U. Absorbed by One Cubic Foot of Dry Air in Becoming Saturated at Various Temperatures.

Figure 3.

Relative Volumes of Air and Water Vapor Contents at Various Temperatures.

Figure 4

Water Vapor & B.T.U. Absorbed by 1 Cubic Foot of Dry Air in Becoming-Saturated at Higher Temperatures.

Figure 5.

Effect of Humidity on Water and Heat Absorbtion.

Figure 6.

Volume of Air and Water Vapor Necessary to Contain One Pound of Vapor at Saturation For Different Temperatures.

Figure 7.

Volume of Air and Vapor Necessary to Absorb One B.T.U. in Becoming Saturated at Various Temperatures.

Apparatus.

In Figure 9 is shown a sketch of the arrangement of the apparatus as it was used in the test. The condenser is shown at N. It is of the same design as those used for water cooling except that both ends of the tubes were open into two galvanized iron funnels. The body of the condenser is made of cast orio and has two supports on the bottom for fastening the condenser to the foundation. The cooling medium consisting of air and vaopr and water in varying proportions comes through the condenser tubes at varying velocities. The air at various degrees of saturation came through the tin pipe L from the outside air and the spary water was injected at M. The steam used in the condenser for the test was taken from the live steam line and entered the condenser through the pipe at the left side of the drawing. The steam was throttled to a pressure of 2.7# gauge in the pipe before the condenser. As the steam entered at the left end and the cooling medium at the right end the flow of

each was counter to the other and the cold air cooled the steam just before it was exhausted through the pipe D to the air pump. There is a baffle plate with numerous holes in it directly under the inlet pipe of the steam. The heads of the condenser are of brass and the tubes are fastened into them by means of caps into which the tubes are expanden slightly. The tube sheet of the condenser is shown in Figure 11. There are 204 tubes of hard drawn seamless tubing about 68 3/8 inches long. The internal diameter of the tubes is .52" and the external diameter is .60". This gives an internal area of 160.768 square feet and an enternal area of 182.478 Square feet.

In the pipe L there was a window of celluloid at a level so that it might readily be seen into. On the inside of the pipe at this point there was a wet and dry bulb hygrometer to determine the humidity of the entering air As there was a rapid current of air in the pipe the reservoir of the hygrometer would not

Figure 11.

Head of Condenser.

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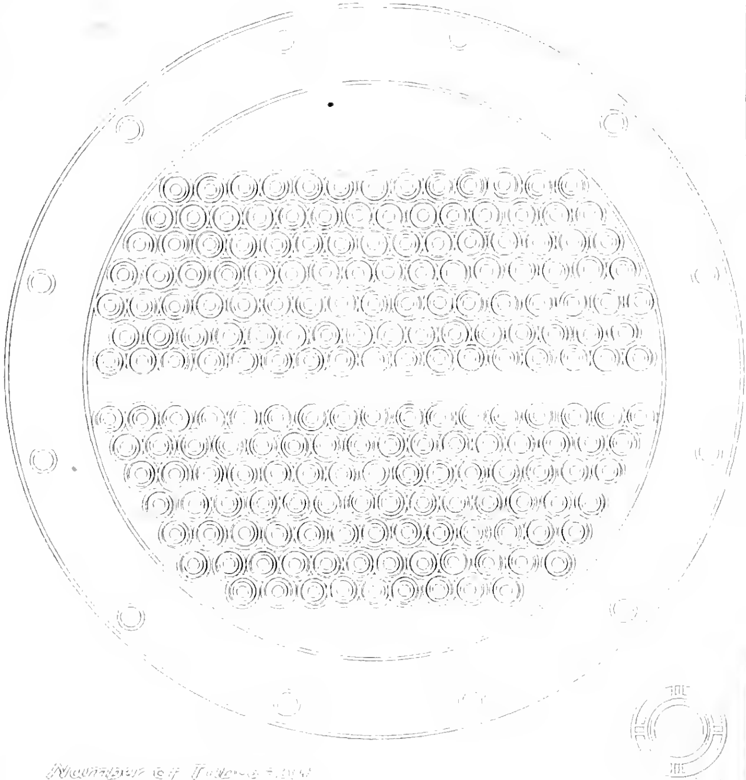


Number of Tubes = [illegible]
Internal Diameter = [illegible]
External Diameter = [illegible]
Length of Tubes = [illegible]
Internal Area = 160.166 Sq Ft
External Area = [illegible] Sq. Ft.

Figure 11.

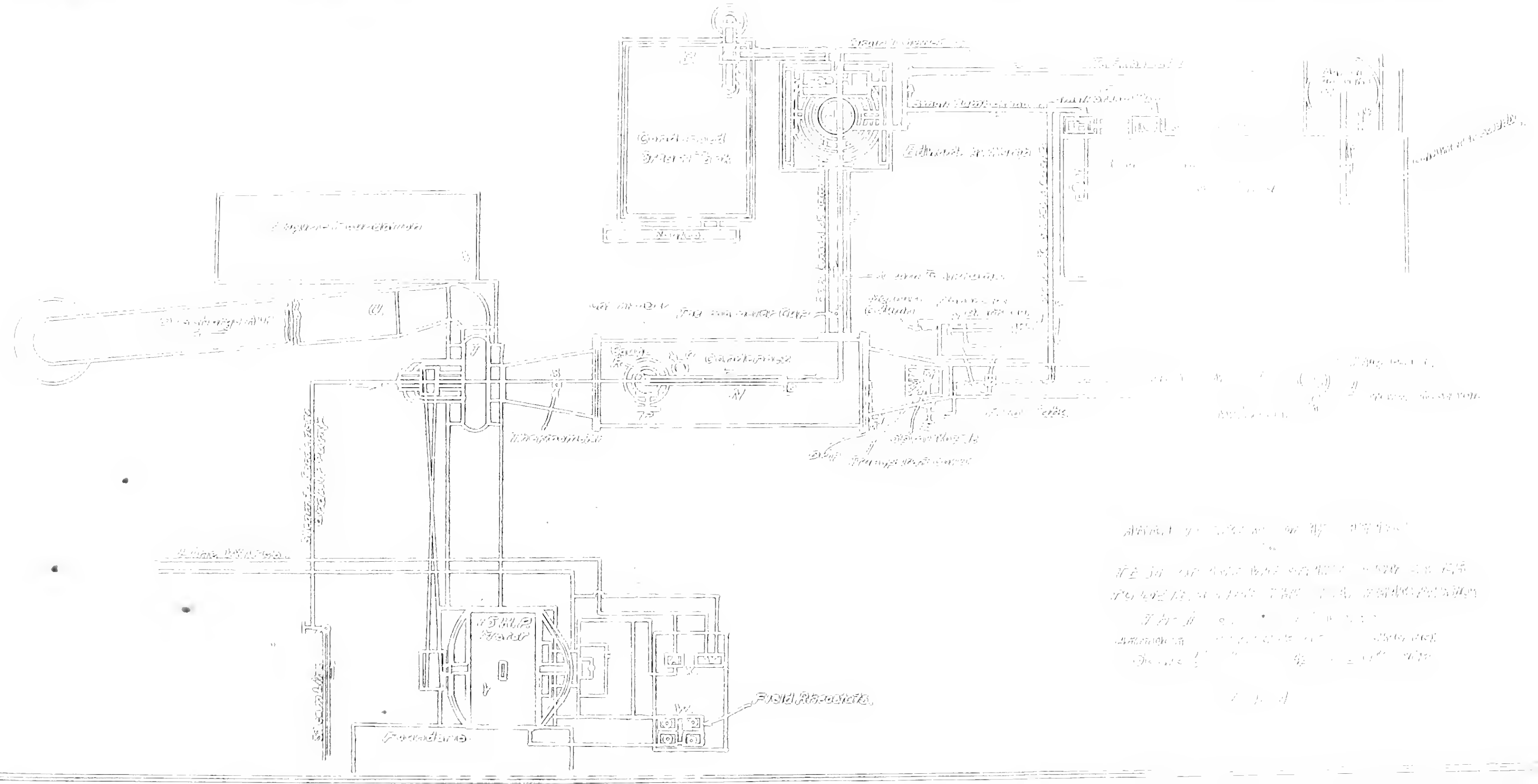
last long and a small tube was put through the window and antered a large long glass tube through a rubber stopper. The glass tube was fastened to the outside of the pipe by means of friction tape and had another rubber stopper in the top of it. This tube was filled with water and when the water in the reservoir ran out the top stopper was taken out long enough for the reservoir to fill.

The velocity of the air was measured by means of a pitot tube at a short distance from the condenser to get as far away from the bend in the pipe as possible to avoid eddy currents. The velocity head was measured on a differential gauge and the static head on an ordinary U-tube. These were mounted on a stant just back of the pipe.

The water was first let into a tank at H in Figure 9, which rested on scales. From there the water was taken by means of the small steam pump E and pumped through the pipe GE to the spray nozzle M. There was a transparent air tight window at E to watch the spray nozzle and this was removed to make the adjustments of the nozzle to get different

Figure 9.

Arrangement of Apparatus.


Field Rheostats

amounts of water. The nozzle gave some trouble at first in getting the correct adjustments and several different diameters of opening were tried. The first nozzle tried had a hole in a thin plate about a thirty second of an inch in diameter with vanes back of it to give the water a whirling motion. This was fairly satis factory for large quantities of water but when it was shut down to give small quantities of water the spray would become coarser and finally squirt out in a straight stream. The next scheme tried was to plug up the hole in the center of the nozzle and drill four small holes in place of it. This did not work right as there were four straight streams and the holes were so small that they plugged up with any small amount of dirt in the water. The next and final trial was with a nozzle made like a garden hose nozzle. It had a cap with a circular hole in it which screwed over a cone so that the spray was alwasy thrown out to the edges of the pipe. This was fairly satisfactory and the only objection to it was

that in the course of fifteen to twenty minutes the cap would work down on the cone and nearly close the hole.

The air pump used in the test was an Edwards pump and as it was new and the bearings were not worn down there was some difficulty experienced in keeping it running.on the first few runs. The pump exhausted the steam from the condenser and threw it into the tank B, Figure 9. which rested on scales.

The cooling medium was moved by an exhauster shown at T in the drawing. The exhauster was made by the Buffalo Blower Co. and had a twenty inch wheel. It was run at speeds varying from 800 to 2500 r.p.m. The hot air was blown through the pipe U to the sewer where the water was carried away, and the hot air blew out into the boiler room.

The exhauster was driven by a variable speed motor V. of fifteen h.p. capacity.
The power put into the motor was measured on the voltmeter and ammeter shown at X. The speed

of the motor was controlled by adjusting the field rheostats shown at W.

There was a calorimeter in the steam pipe at Q to get the quality of the steam in the pipe. There were thermometers in the condensed steam pipe, in the discharge air pipe, the wet and dry bulb thermometers, and in the calorimeter. These thermometers with the exception of the wet and dry bulb thermometers were calibrated and found to indicate correctly at the temperatures for which they were used. There was a pressure gauge at the point R to give the pressure of the steam in the pipe. This was calibrated and found to read .3# too high.

The apparatus was blocked in place from the foundations of the engines in the engine room where it was set up.

Method of Running Test.

When all the apparatus was in position and the thermometers inserted in the cups the air pump was started and it was found that it gave only sixteen of seventeen inches of vacuum when running with no steam flowing into the condenser. This showed that there was a leak in the pipes ofthe condenser. The leak was found to be around the paking of the pump. When this was fixed the blower was started and the air was found to be too warm so the pipe was run to the outside air. The steam was then turned into the condenser and several trial runs were made. When everything was in good order the test was started.

To start the run it was first necessary that all conditions be constant. It was decided to run the first series of tests at a vacuum of about six inches of mercury. The valves O and P were then manipulated to get the desired conditions. It was found that when the pressure in the pipe Q was 2.7# gauge that the steam was dry and saturated, and that the pressure in the condenser could be controlled much more easily than it could be when the pressure was

higher. The pressure was therefore kept at this point in the runs. When the required pressure was obtained in the condenser and all conditions were seen to be constant by observing the thermometers the gauges and the mercury column which showed the pressure in the condenser, the run was started.

First the weights of the condensed steam tank and the water barrel were taken. Next the readings of the discharged air temperature, then the mercury column, the differential gauge, the static head, the wet and dry bulb thermometers, the condensed steam temperature, the pressure in the pipe Q, the voltage and the current were read in the order named. These observations were taken in the same order at intervals of five minutes.

The first runs were made with no spray water being injected and were one hour runs. It was seen from t e observations that all conditions could be mantained constant and that the same results could be obtained in half hour runs so the runs were shortened to.

that length of time. Later it was seen that the same results could be obtained in a fifteen minute run and the balance of the runs were made of that length.

There were thirty five runs made with varying conditiong of velocity of air and with different amounts of water flowing through the spray nozzle. There were two series of runs made. One was made at a vacuum of about six inches of mercury and the other was made at about twenty inches. At the higher vacuum it was more difficult to keep the conditions constand.

To get the weight of the water which was sprayed and which went through the tubes of the condenser there was a drain put in the funnel at the inlet end of the tubes so that tha water which struck against the sides and on the head between the tubes would not run through the tubes. If this water was allowed to run through the tubes it would not be evenly distributed and the results would not

show the amount of spray. The water from the drain was collected in a bucket and paured back into the water barrel before the final weight of the barrel was taken. In this way the weights gave the amount of water that was sucked through the tubes.

During each run a small plug in the bottom of the funnel at the outlet end of the tubes was removed to see if all of the water was being sucked through the tubes or whether it was running through the lower tubes. No water was seen in any of the runs so it is certain that all the water was drawn through mixed with the air.

The reservoir of the hygrometer was watched and filled when necessary as described under Apparatus.

The data from the runs is given at the conclusion of this report.

The Pitot tube in all the runs was put in the center of thepipe and therefore in getting the velocity of the air in the pipe there was a correction factor necessary. This was found

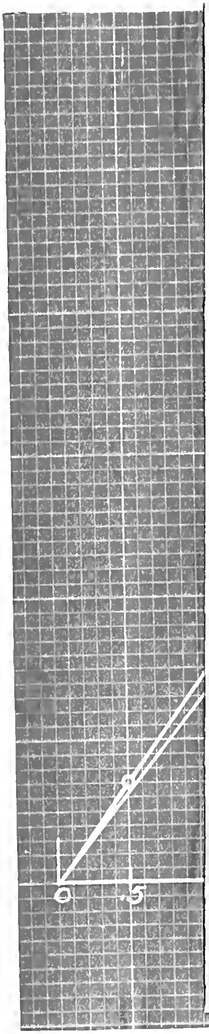


Figure 8.

Determination of Mean Radius.

by taking readings with the tube in different positions across the pipe and then plotting the velocities as they are shown in Figure 8. The velocitiesare shown as the ordinates and are all laid off on the center line. The distance of the tube from the center of the pipe is shows as the abscissae and lines were drawn from the zero point to the value of the velocity on the vertical center line. The points where the last lines drawn cut the perpendiculars to the points on the horizontal axix were points on the corve. The area under the curve was then integrated and a triangle drawn with the same base and same area. The point where the hypothenus of the triangle cut the curve projected down gave the mean radius of the pipe. It may be seen from the curve that the mean radius for the top is not the same as that for the bottom. This is due probably to eddy currents caused by the bend in the pipe. The velocity at the center of the pipe was greater than at the sides and by the curves was seen to be too great by 3.3%.

Calculations.

The following calculations apply to run Number 1.

Power to the motor = 112 X 17 = 1900 Watts.

$$\text{Quality of Steam} = \frac{H + .48(t_1 - t_2) - q}{r}$$

$$= \frac{1146.3 + .48(219 - 211.2) - 189.4}{959.9} = 100\%$$

Total weight of steam.per hour = 121#

Heat in steam per hour above temperature of leaving condensed steam = $W(x_1 r_1 + q_1 - q_2)$

= 121(959.9 + 189.4 - 168.2) = 118900B.T.U.

Heat absorbed by the air per hour. B.T.U.

Dynamic head = (5.5 - 2.15 + 1) = 3.35" water

Velocity at center = $\sqrt{2gh} = \sqrt{64.4 \times 5.84 \times 3.35}$ = 35.5 ft per sec. Mean velocity = .967 X 35.5 = 34.3 ft per sec.

The air was 32 percent saturated and the barometer was 29.42" hg. Static head = 1"water. Weight of water perc ubic foot of air at 85°F. and 29.92 " hg. = .006# . Weight of one cubic foot of air at 85°F. and 29.92" hg. = .073# From steam tables vapor pressure = .591#/sq.in. = 1.199 " hg. Static head 1" water = .0734" hg. Pressure of air in duct = 29.42 - 1.199 - .0734 = 28.148 " hg. = 13.89#/ sq.in.

Weight of one cubic foot of dry air at 85°F. and 28.148 " hg = 28.148 ÷ 29.921 X .0730 = . .0685# per cubic foot.

Weight of moisture per cubic foot of air in the duct = .00181 from steam tables. Weight of one cubic foot of moist air in duct = .00181 + .0685 = .07301# Area of duct = .441 Square feet.

Cubic feet of air and vapor per hour = .441 X 34.3 X 3600 = 54400
Pounds of dry air per hour = 54400X.0685 = 3730
Pounds vapor per hr. = 54400 X .00181 = 98.6#
Rise of temperature = 186-85 = 101°F.
B.T.U. absorbed by air = 101X.2375X3730=89500
B.T.U. absorbed by vapor =101X.5X98.6 =4980
Total Heat absorbed = 94480 B.T.U. per hour.

When spray water was used it was assumed that the air became saturated ata mean temperature in the condenser. The calculation for run number 5 follows.

Spray water absorbed by the air per hour. Total spray water = 7.2# Temperature of entering air = 85°F. Leaving air = 186°F.

Assume that the air was saturated when it left the condenser. Water vapor per cubic foot of air at 186° F. = .02170# Weight of water per hour = .0217 X 54400 - 98.6 = 1081.4# Since there was only 7.2 pounds of spray water and the air was capable of absorbing 1081.4# all of the water was absorbed by the air. This was the case in all of the runs.

The results of the test are given on the table in figure 10.as they were calculated.

Curves were then plotted and are discussed in the "Conclusion of this report.

The calibration curves for the electric motor used are given in Figure 12 on page 31.

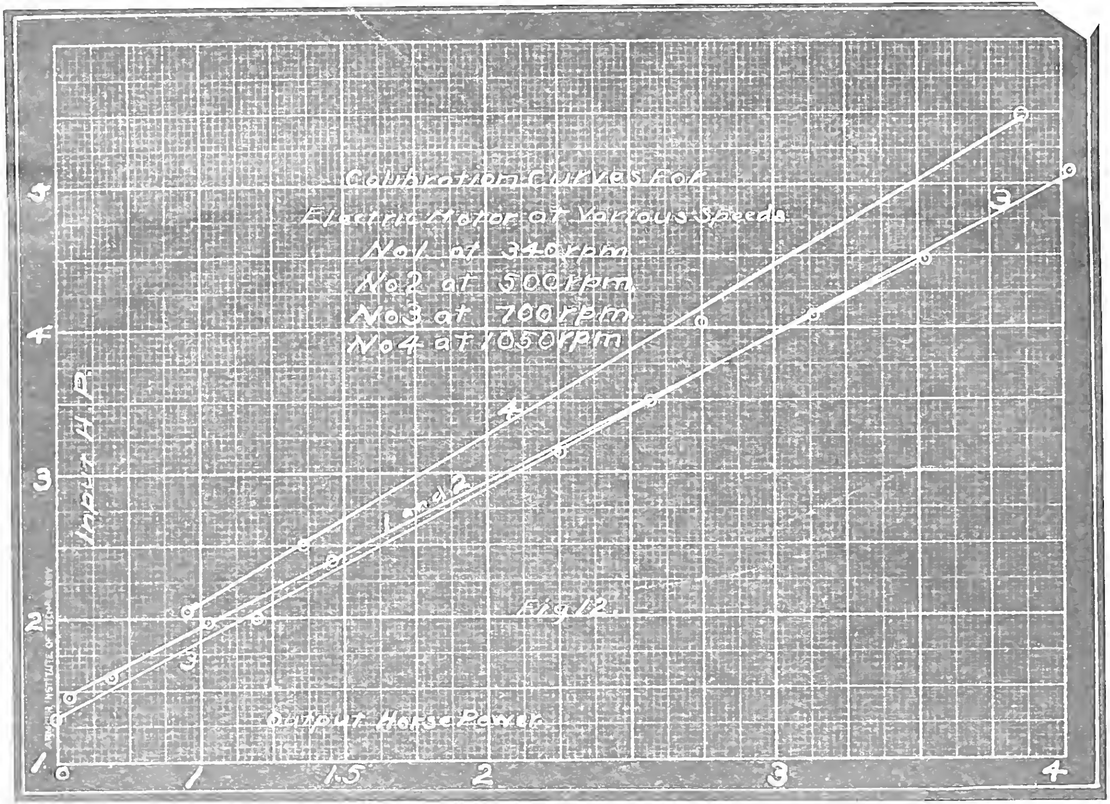

Calibration Curves For
Electric Motor at Various Speeds
No1 at 340rpm
No2 at 500rpm
No3 at 700rpm
No4 at 1050rpm
1 and 2
3
4
Input H.P.
Output Horse Power
1
2
3
4
1.5

Fig 12.

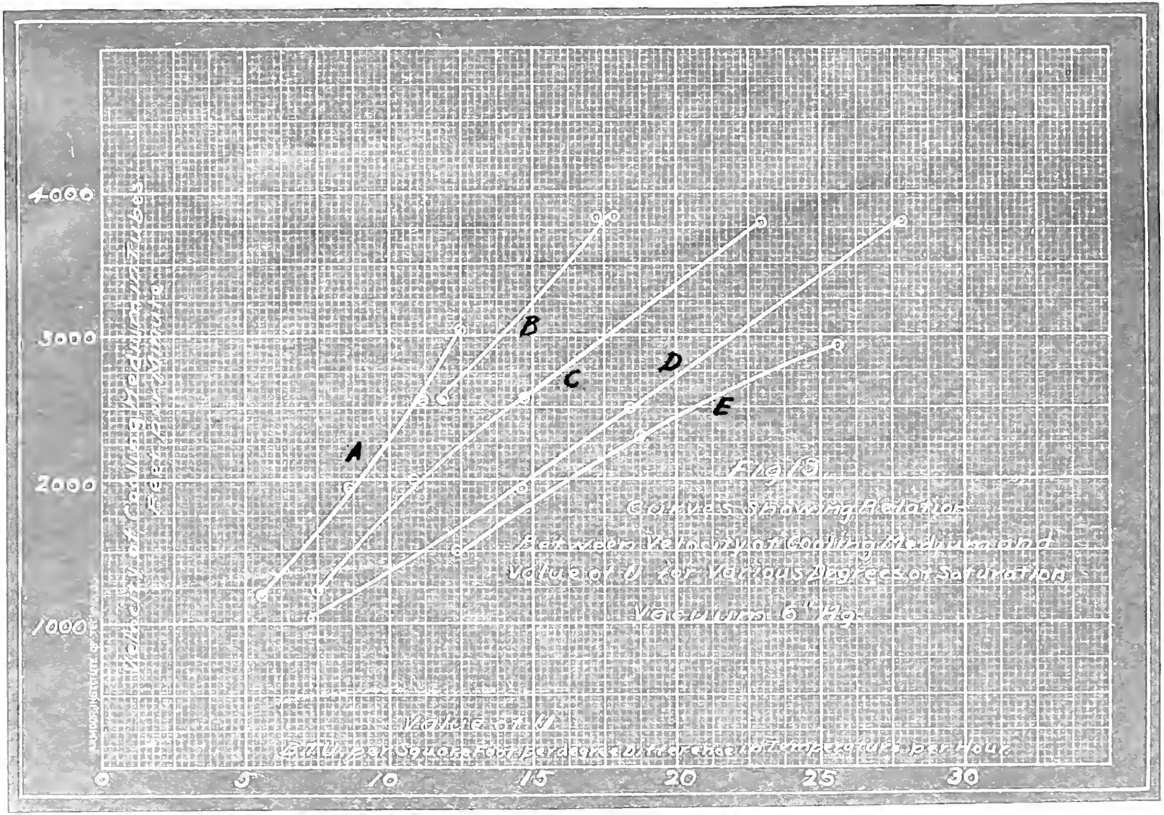
Conclusion.

When all of the results had been computed as explained before curves were plotted to show the results obtained. These curves are shown in figures 13 to 17 inclusive.

The values of U, the coefficient of heat transmission are given in the table of calculations and it may be seen that the value of the coefficient varies from 5.64 at a velocity of the cooling medium of 1223 feet per minute through the tubes and a saturation of 36%. to a maximum value of 44.2 at a velocity of 4125 feet per minute of the cooling medium and a saturation of 45% and with 138.4 pounds of spray water per hour. It is seen tha the value of U increases with the velocity and with the relative humidity, though no law could be determined from the results obtained. In Figure 13 the value of U is seen to increase withnthe saturation as the curves A, B, C, D, and E, are for increasing degrees of saturation. The exact saturation of the air at the points was determined but as spray water was used it was absorbed by the air and no exact knowledge

Figure 10.

Table of Calculations.


Velocity of Cooling Medium in Tubes
Feet per Minute
4000
3000
2000
1000
A
B
C
D
E
Fig 13.
Curves Showing Relation
Between Velocity of Cooling Medium and
Value of U for Various Degrees of Saturation
Vacuum 6" Hg.
Value of U
B.t.u. per Square Foot per degree Difference in Temperature per Hour
0
5
10
15
20
25
30

of the amount absorbed could be obtained. For the curve A no spray water was used and the saturation of the air was from 32% to 42% as may be seen in the table. Figure 13 shows the results for a vacuum of 6"hg.

Figure 14 was plotted with the same coordinates as Figure 13 for a vacuum of about 20" hg. It will be seen tha the curves follow the same law after the first point. Something must have caused an error in the results there for there is no reason why the value of U should decrease first and then increase. It may be seen from the curves that a change in the velocity of the air through the tubes of 1000 feet per minute gave a change of about fifteen for the value of U on all degrees of saturation. At 4000 feet per minute the value of U ranged from about 33 to 45. The degree of saturation of the air was not known after the spray water was introduced and therefore the variation of the value of U with a change in the relative humidity could not be determined.

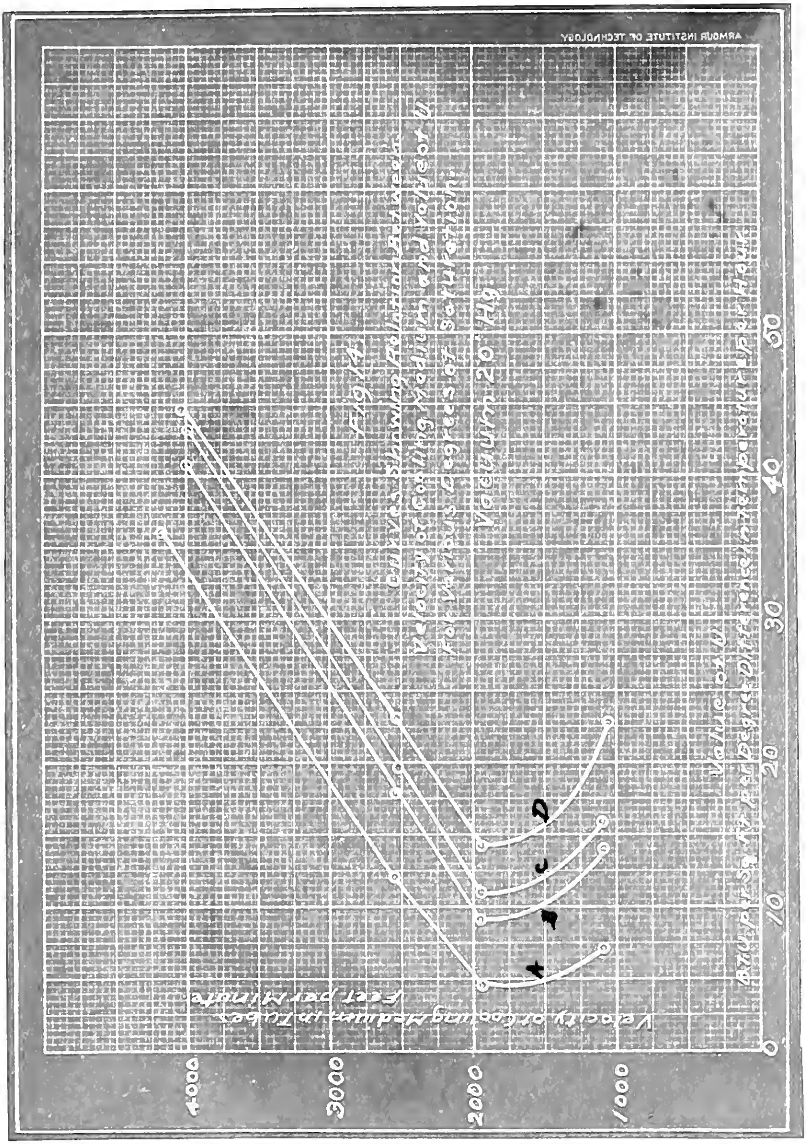

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Fig 14
Curves Showing Relation Between
Velocity of Cooling Medium and Value of U
For Various Degrees of Saturation.
Vacuum 20" Hg
Value of U
B.T.U. per Sq. Ft. per Degree Difference in Temperature per Hour
Velocity of Cooling Medium in Tubes
Feet per Minute
A
B
C
D
0
10
20
30
40
50
1000
2000
3000
4000

In Figure 13 the change of 1000 feet per minute made a change of about 7 in the value of U. This shows that the higher the vacuum the greater will be the change in the value of the coefficient of heat transmission for the same change in the velocity of the cooling medium in the tubes.

Figure 15 shows the beginning of many curves to show the relation of the Spray water to the condensed steam. The ration of the spray water to the condensed steam was plotted as the abscissae and the weight of condensed steam per 1000 cubic feet of the cooling medium was plotted as the ordinate.

As the degree of saturation could not be determined for the various runs with any degree of accuracy the results are of little value and merely go to show that the method of obtaining them was not satisfactory. From the figure of the curves it may be seen that the general tendency of the curves is to run up in a curve increasing as the ratio of the water to the steam increased. Curves of this nature have been obtained for water cooled condensers and run in this way.

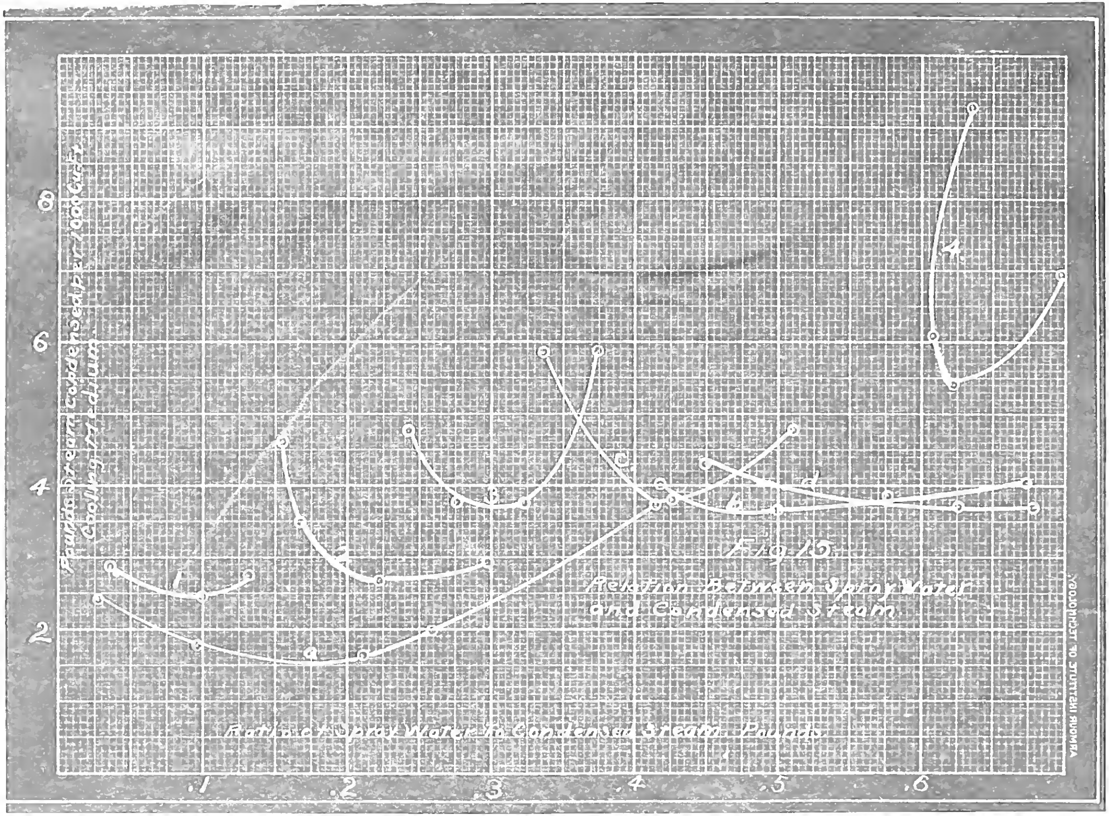

Fig 15
Relation Between Spray Water
and Condensed Steam

The results shown in figure 15 are for a vacuum of about 6" hg. and those in Figure 16 are for a 20" vacuum. The ration in the higher vacuum is higher but the amount of steam condensed was approximately the same.

Figure 17 shows the horse power necessary to move the cooling medium through the tubes and discharge it through the pipe. As both the inlet pipe and the outlet pipe han several bends there is some friction in them but this probably did not amount to a great deal, and could be neglected. The curves on the whole show that the horse power increased with the ratio of the water to the condensed steam. Wherever the saturation of the air makes any difference in the results, a marked irregularity occurs and therefore there should have been some method of controlling the saturation of the entering air and mixing the water with the air in some positive way before the air came to the condenser. One method that could be employed for this would be to have a large chamber for the air to pass through and to have

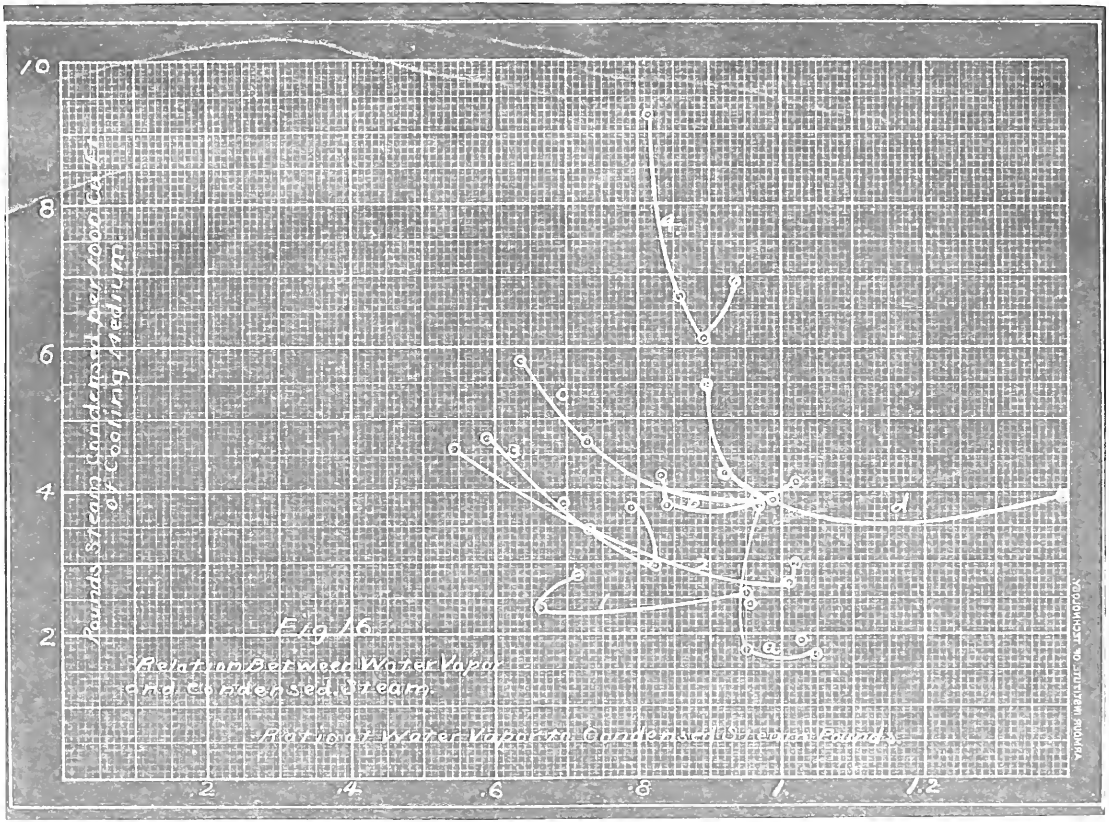

Fig 16.
Relation Between Water Vapor and Condensed Steam.

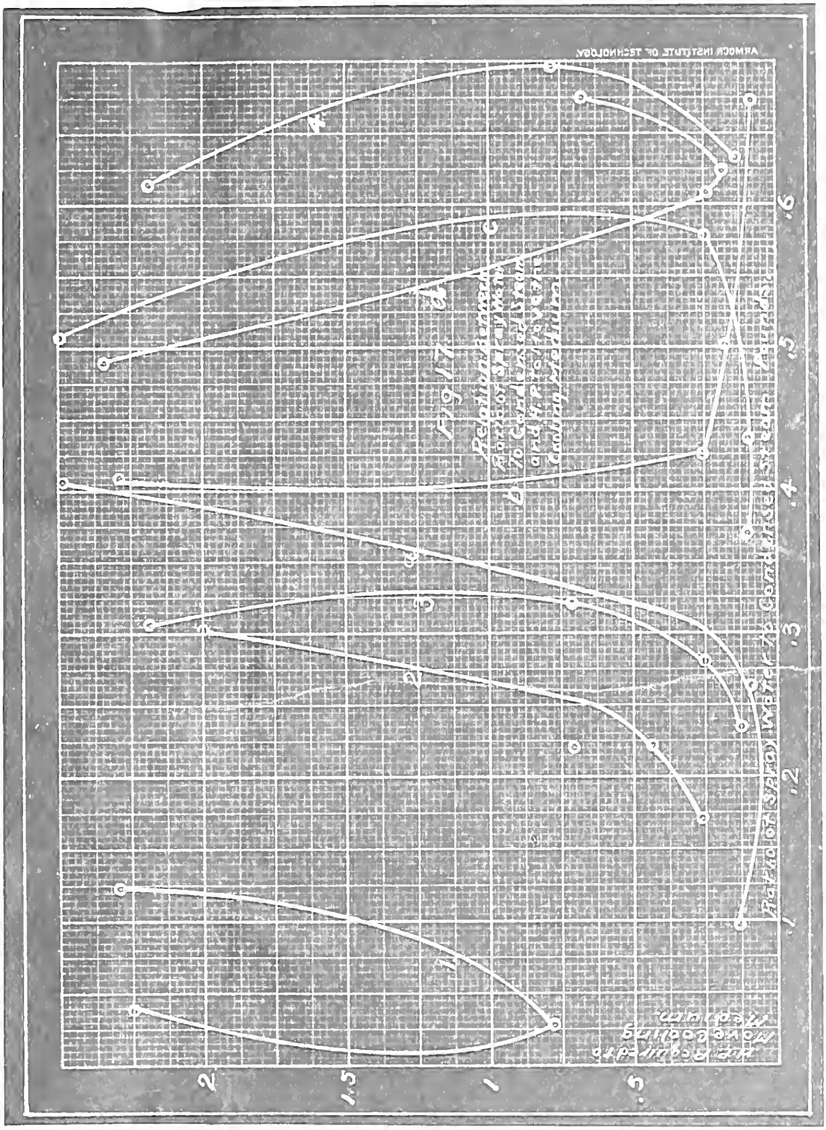
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Fig 17
Relation between
Ratio of Spray Water
To Condensed Steam
and H.P. to overcome
Cooling medium
Ratio of Spray Water To Condensed Steam
.1
.2
.3
.4
.5
.6
.5
1
1.5
2

the water spread over a large surface in this chamber so that the air would absorb it there. The humidity of the air could then be controlled and more satisfactory results obtained.

If the water is to be sprayed into the pipe it was found that it would mix much more satisfactorily if the nozzle was turned up the current of air. Ih this series of tests this could not be done as the water then came in contact with the pitot tube and effected the readings of this.

The changes in the apparatus then for a test of this nature would be to have a mixing chamber for the air aid water and if this was not available to place the pitot tube so that the nozzle could be pointed up the stream of air.

Data For Meam Radius of Duct.

Distance From Bottom	Velocity Head	Velocity. See Fig 8	Static Head	Temperatures. Dry Bulb	Temperatures. Wet Bulb
0	1.85		1.3	75	58
.25	4.20		1.3	75	58
.5	4.35		1.3	75	58
.75	4.50		1.3	75	58
1.	4.60		1.3	75	58
1.5	4.75		1.3	75	58
2.	4.85		1.3	75	58
3.	4.95		1.3	75	58
4.	5.00		1.3	75	58
4.5	5.00		1.3	75	58
5.	5.00		1.3	75	58
6.	4.95		1.3	75	58
7.	4.55		1.3	75	58
7.5	4.25		1.3	75	58
8.	3.90		1.3	75	58
8.25	3.55		1.3	75	58
8.5	3.22		1.3	75	58
8.75	2.45		1.3	75	58
9.	0.95		1.3	75	58

No. 1.

Without Spray Water.

Time	I	R.P.M.	Calorimeter Temp.	Calorimeter Pressure	Temp. Cond St	Pitot Stat	Pitot Vel	Hygrom Wet	Hygrom Dry	Disch Air Temp	Vacuum " hg.
[illegible]	17	2200	219	3.0	199	1.05	5.5	65	85	186	6.00
[illegible]	17	2200	219	3.1	200	1.00	5.5	65	85	186	5.90
[illegible]	17	2200	219	3.0	200	1.00	5.5	65	85	186	5.90
[illegible]	17	2200	219	3.0	200	1.00	5.5	65	85	186	6.00
[illegible]	17	2200	220	3.0	200	1.00	5.5	65	85	186	6.00
[illegible]	17	2200	219	3.2	200	1.00	5.5	65	86	186	5.90
[illegible]	17	2200	219	3.0	200	1.00	5.5	65	85	186	6.00
[illegible]	17	2200	219	3.0	200	1.00	5.5	65	85	186	6.05
[illegible]	17	2200	219	3.0	200	1.00	5.5	64	84	186	6.20
[illegible]	17	2200	219	3.0	200	1.00	5.5	64	84	186	6.20
[illegible]	17	2200	219	3.0	200	1.00	5.5	65	85	186	6.25
[illegible]	17	2200	219	3.0	200	1.00	5.5	65	85	186	6.20
[illegible]	17	2200	219	3.0	200	1.00	5.5	65	85	186	6.20

Thermometer No. 1 in Calorimeter. No. 2 in Discharge Air and No. 3 in Condensed Steam Pipe.
(0 - 150) Voltmeter No. 4830 (0 - 50) Ammeter No. 2185
Steam Gauge Reads 5# High. Pitot Tube in Center of Pipe.
Barometer 29.48" hg. Tare Water = 1053.5# Full Water = [illegible]
Zero Reading of Draft Gauge = 2.15"

No. 2 Without Spray Water.											
E	I	R.P.M.	Calorim		Cond St	Pitot		Hygrom		Discharge	Vacuum
			Temp	Pr.	Temp	Stat	Vel	Wet	Dry	Air Temp	
113	10	1700	219	3.	200	.5	4.1	60	75	186	6.15
114	10	1700	219	3.	200	.5	4.1	60	75	186	6.3
114	10	1700	219	3.	200	.5	4.1	60	75	186	6.2
113	11	1700	219	3.	200	.5	4.1	60	75	186	6.25
113	11	1700	219	3.	200	.5	4.1	60	75	186	6.3
113	11	1700	219	3.	200	.5	4.1	60	75	186	6.2
113	11	1700	219	3.	200	.5	4.1	60	75	186	6.2
113	11	1700	219	3.	200	.5	4.1	60	75	186	6.2
113	11	1700	219	3.	200	.5	4.1	60	75	186	6.1
113	11	1700	219	3.	200	.5	4.1	60	75	186	6.15
113	11	1700	218	3.	200	.5	4.1	60	75	186	6.3
113	11	1700	218	3.	200	.5	4.1	60	75	186	6.1
113	11	1700	218	3.	200	5	4.1	60	75	186	6.1

Zero Reading of Draft Gauge = 2.15 Barometer = 29.4" Hg.
Pitot in center of pipe. Tare Water 1185# Full Water 1297#
April 16th 1909

No. 8

Without Spray Water

E	I	R.P.M.	Outlet Temp	[illegible]	Cond St Temp	Pitot Stat	Pitot Vel	Hygrom Wet	Hygrom Dry	Discharge Air Temp	Vacuum In Hg
[illegible]	7	[illegible]	214	[illegible]	[illegible]	.15	2.55	65	83	188 6	6.[illegible]
[illegible]	[illegible]	990	214	[illegible]	189	.15	2.55	65	84	188	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	189	.15	2.55	65	84	188	[illegible]
[illegible]	[illegible]	[illegible]	214	[illegible]	189	.15	2.55	65	84	188	[illegible]
[illegible]	[illegible]	[illegible]	214	[illegible]	189	.15	2.55	65	84	188	[illegible]
[illegible]	7	[illegible]	214	[illegible]	189	.15	2.55	65	84	188	[illegible]
[illegible]	[illegible]	1000	215	[illegible]	189	.15	2.[illegible]	65	84	188	6.25

Zero reading of draft gauge = 2.[illegible] Pitot in center of pipe

Barometer = 29.[illegible] in Hg Wave Height = [illegible] Temp = [illegible]

April [illegible] 1908

No. 5.
With Spray Water. Orifice .013" diam.

E	I	R.P.M.	Calorim Temp	Calorim Pr	Cond St Temp	Pitot Stat	Pitot Vel	Hygrom Wet	Hygrom Dry	Discharge Air Temp	Vacuum in Hg.
111	24	2400	219	3.	200	1.05	6.8	56	70	184	6.2
111	24	2400	219	3.	200	1.05	6.8	56	70	184	6.3
111	24	2400	219	3.	200	1.05	6.75	56	70	184	6.2
111	24	2400	219	3.	200	1.05	6.75	58	70 72	184	6.2

Barometer = 29.27
Zero Draft Gauge Reading = 2.5 Pitot in center of pipe.
Start Water = 417.3 Finish = 416.5 Tare Steam 1420# Full 1470#
April 19th 1909.

No. 6.
With Spray Water. Orifice = .013" diam.

E	I	R.P.M.	Calorim Temp	Calorim Pr	Cond St Temp	Pitot Stat	Pitot Vel	Hygrom Wet	Hygrom Dry	Discharge Air Temp	Vacuum in Hg.
111	12	1700	216	[illegible]	[illegible]	.5	[illegible]	58	74	186	6.2
111	12	1700	216	3	[illegible]	.5	4.55	58	74	186	6.2
111	12	1700	216	[illegible]	[illegible]	.5	[illegible]	58	74	185	6.2
111	12	1700	216	[illegible]	[illegible]	[illegible]	4.55	58	74	186	6.2
111	12	1700	216	[illegible]	198	.5	4.55	58	74	186	6.2
111	12	1700	[illegible]	[illegible]	[illegible]	.5	4.55	58	74	188	6.2

Zero Draft Gauge Reading = 2.5 Barometer = 28.67" Hg
Start Water 409.[illegible] Finish Water = 407.3 Tare Steam 1380 Full 1430#
April 19th 1909.

No.7
With Spray Water.

E	I	R.P.M.	Calorim Temp	Calorim Pr.	Cond St Temp	Pitot Stat	Pitot Vel	Hygrom Wet	Hygrom Dry	Discharge Air Temp	Vacuum
112	23	2400	223	3	200	1.1	6.7	57	70	180	5.95
112	23	2400	224	3	200	1.1	6.7	57	70	182	6.35
112	23	2400	224	3	200	1.1	6.7	57	70	182	6.35
112	23	2400	224	3	200	1.1	6.7	57	70	182'	5.95
112	23	2400	224	3	200	1.1	6.7	57	70	182	5.95
112	23	2400	224	3	200	1.1	6.7	57	70	182	6.20
112	23	2400	224	3	200	1.1	6.7	57	70	182	5.95

Zero Reading of Draft Guage = 2.5 Barometer = 29.67" Hg.
Pitot in center of pipe. Tare Water 470.# Full Water 453.5#
Tare Steam 1331# Full Steam 1421# 44% Saturated.

No.8
With Spray Water.

E	I	R.P.M.	Calorim Temp	Calorim Pr.	Cond St Temp	Pitot Stat	Pitot Vel	Hygrom Wet	Hygrom Dry	Discharge Air Temp	Vacuum
111	22	2450	216	3	198	.95	6.75	64	76	180	6.0
111	22	2450	218	3	198	1.00	6.75	64	76	182	6.1
111	22	2450	220	3	198	1.00	6.85	64	76	182	6.2
112	22	2450	222	3	198	1.00	6.75	64	76	182	6.2
112	22	2450	221	3	198	.95	6.85	64	76	181	6.2
112	22	2450	224	3	198	1.00	6.85	64	76	181	6.3
122	22	2450	224	3	198	1.00	6.85	64	76	182	6.2

Zero Reading of Draft Gauge = 2.65 Barometer = 28.92" Hg.
Pitot in center of Pipe. Tare Water 287.5# Full Water 257.6#
Tare Steam 1094.# Full Steam 1195.# 52% Saturated.

No. 9

With Spray Water.

E	I	R.P.M.	Calorim Temp	Calorim Pr.	Cond St Temp	Pitot Stat	Pitot Vel	Hygrom Wet	Hygrom Dry	Discharge Air Temp	Vacuum
[illegible]	11	1700	220	3	198	.4	4.75	62	76	184	6.1
[illegible]	11	1700	220	5	198	.4	4.75	62	76	184	6.2
[illegible]	11	1700	220	3	198	.4	4.75	62	76	184	6.2
112	11	1700	220	3	198	.4	4.75	62	76	184	6.2
112	11	1700	220	3	198	.4	4.75	62	76	184	6.2
112	11	1700	220	3	198	.4	4.75	62	76	184	6.1
112	11	1700	220	[illegible]	198	.4	4.75	62	76	184	6.1

Zero Reading of Draft Gauge = 2.65 Barometer = 28.92

Pitot in center of pipe. Tare Water 385.3# Full Water 371.[illegible]#

Tare Steam 1332# Full Steam 1395# 45% Saturated.

No. 10

With Spray Water.

E	I	R.P.M.	Calorim Temp	Calorim Pr.	Cond St Temp	Pitot Stat	Pitot Vel	Hygrom Wet	Hygrom Dry	Discharge Air Temp	Vacuum
111	8	1300	216	[illegible]	200	.15	3.9	58	74	186	5.[illegible]
111	8	1300	216	[illegible]	200	.10	3.9	58	74	186	5.[illegible]
111	8	1300	216	3	200	.20	3.9	58	74	186	6.2
111	8	1300	216	3	200	.20	3.9	58	74	186	6.1
111	8	1300	216	3	200	.20	3.9	58	74	186	6.1
111	8	1300	216	3	200	.20	3.9	58	74	186	6.1
111	8	1300	216	3	200	.20	3.9	58	74	186	6.1

Zero Reading of Draft Gauge = 2.65 Barometer = 28.[illegible]

Pitot in center of pipe. Tare Water 349.5# Full Water = 3[illegible]#

Tare Steam 1230# Full Steam 1291# 58% Saturated.

No. 11
With Spray Water.

E	I	R.P.M.	Calorim Temp	Calorim Pr.	Cond St Temp	Pitot Stat	Pitot Vel	Hygrom Wet	Hygrom Dry	Discharge Air Temp	Vacuum
114	6	800	216	3	198	000	3.20	56	72	186	6.1
114	6	800	216	3	198	000	3.15	56	72	186	6.1
114	6	800	216	3	198	000	3.20	56	72	186	6.2
114	6	800	216	3	198	000	3.20	56	72	186	6.2
114	6	800	216	3	198	000	3.20	56	72	186	6.2
114	6	800	216	3	198	000	3.20	56	72	188	6.2
114	6	800	216	3	198	000	3.20	56	72	186	6.2

Zero Reading of Draft Gauge = 2.66 Barometer = 28.92
Pitot in center of pipe. Tare Water 307.# Full Water 399.#
Tare Steam 1048# Full Steam 1098# 34.5% Saturated.

No. 12
With Spray Water.

E	I	R.P.M	Calorim Temp	Calorim Pr	Cond St Temp	Pitot Stat	Pitot Vel	Hygrom Wet	Hygrom Dry	Discharge Air Temp	Vacuum
112	23	2450	220	3	200	0.95	7.1	56	73	178	6.2
112	23	2450	220	3	200	1.00	7.1	56	73	178	6.2
112	23	2450	220	3	200	1.00	7.0	56	74	178	6.0
112	23	2450	220	3	200	1.00	7.0	56	74	178	6.2
112	23	2450	220	3	200	1.00	7.0	56	74	178	6.1
112	23	2450	220	3	200	1.00	7.0	56	74	178	6.2
112	23	2450	220	3	200	1.00	7.0	56	74	178	6.3

Zero Reading of Draft Gauge = 2.75 Barometer = 29.28
Pitot in center of pipe. Tare Water 441.8# Full Water 411.6#
Tare Steam 1007# Full Steam 1108# 30.5% Saturated.

No. 15
With Spray Water

E	I	R.P.M.	Chlorim Therm	Ft	Cond St Temp	Pitot Stat	Vel	Hygrom Wet	Dry	Discharge Air Temp	Vacuum
[illegible]	11	[illegible]	320	[illegible]	200	[illegible]	4.8	56	74	[illegible]	[illegible]
[illegible]	11	1700	320	[illegible]	200	.4	[illegible]	[illegible]	74	182	[illegible]
[illegible]	11	1700	320	[illegible]	200	[illegible]	[illegible]	[illegible]	74	182	[illegible]
[illegible]	11	1700	320	[illegible]	200	.4	[illegible]	[illegible]	74	[illegible]	[illegible]
[illegible]	11	1700	320	[illegible]	200	[illegible]	4.8	56	74	[illegible]	[illegible]
[illegible]	11	1700	300	[illegible]	200	.4	[illegible]	[illegible]	74	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	300	[illegible]	200	.4	4.8	[illegible]	74	182	[illegible]

[illegible] of orifice gauge = [illegible] Barometer = [illegible]
[illegible] [illegible] [illegible]
[illegible] [illegible] Steam [illegible] Superheated

No. 14
With Spray Water

E	I	R.P.M.	Calorim Therm	Ft	Cond St Temp	Pitot Stat	Vel	Hygrom Wet	Dry	Discharge Air Temp	Vacuum
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	74	[illegible]	[illegible]

[illegible] orifice gauge = [illegible] Barometer = [illegible]
[illegible]
[illegible] Steam [illegible] Superheated

No. 15
With Spray Water.

E	I	R.P.M	Calorim Temp	Calorim Pr.	Cond St Temp	Pitot Stat	Pitot Vel	Hygrom Wet	Hygrom Dry	Discharge Air Temp	Vacuum
112	7.5	750	216	3	199	00	3.15	[illegible]	74	185	6.2
112	7.5	750	216	3	199	00	3.15	56	74	185	6.2
112	7.5	750	216	3	199	00	3.15	56	74	185	[illegible]
112	7.5	750	216	3	199	00	3.15	56	74	185	[illegible]
112	7.5	750	216	[illegible]	199	00	3.15	56	74	185	[illegible]
112	7.5	750	216	[illegible]	199	00	[illegible]	56	74	185	[illegible]
112	7.5	750	216	[illegible]	199	00	3.15	56	74	185	[illegible]

Zero Reading of Draft Gauge = 2.75 Barometer = 29.22
Pitot in center of pipe. Tare Water 304.# Full Water [illegible] #
Tare Steam 1371.# Full Steam 1415.# 30.5% Saturated.

No. 16
With Spray Water.

E	I	R.P.M	Calorim Temp	Calorim Pr.	Cond St Temp	Pitot Stat	Pitot Vel	Hygrom Wet	Hygrom Dry	Discharge Air Temp	Vacuum
112	24	2450	224	3	200	[illegible]	6.75	58	76	162	6.1
112	23	2450	224	[illegible]	200	[illegible]	6.75	58	76	162	6.1
112	23	2450	224	[illegible]	200	.8	6.75	58	76	162	6.1
112	23	2450	224	3	200	[illegible]	6.75	58	76	162	6.1

Zero Reading of Draft Gauge 2.75 Barometer = 29.22
Pitot in center of pipe. Tare Water 387.# Full Water 550.1#
Tare Steam 834 # Full Steam 1012# 32% Saturated.

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No. 17
With Spray Water.

E	I	R.P.M.	Calorim Temp	Calorim Pr.	Cond St Temp	Pitot Stat	Pitot Vel	Hygrom Wet	Hygrom Dry	Discharge Air Temp	Vacuum
112	11	1700	224	3	200	.3	4.55	58	76	137	6.1
112	11	1700	224	3	200	.3	4.55	58	76	137	6.1
112	11	1700	224	3	200	.3	4.55	58	76	135	6.1
112	11	1700	224	3	200	.3	4.55	58	76	145	6.1

Zero Reading of Draft Gauge = 2.75 Barometer = 29.22
Pitot in center of pipe. Tare Water 397.2# Full Water 347.6#
Tare Steam 1062# Full Steam 1133# 32% Saturated.

No. 18
With Spray Water.

E	I	R.P.M.	Calorim Temp	Calorim Pr.	Cond St Temp	Pitot Stat	Pitot Vel	Hygrom Wet	Hygrom Dry	Discharge Air Temp	Vacuum
111	7.5	1300	232	3	200	.3	3.45	58	76	125	6.2
111	7.5	1300	232	3	200	.3	3.45	58	76	125	6.2
111	7.5	1300	232	3	200	.3	3.45	58	76	128	6.2
111	7.5	1300	232	3	200	.3	3.45	58	76	128	6.2

Zero Reading of Draft Gauge = 2.75 Barometer = 29.22
Pitot in center of pipe. Tare Water 481.6# Full Water 441.7#
Tare Steam 1207# Full Steam 1270# 32% Saturated.

No. 19
With Spray Water.

E	I	R.P.M.	Calorim Temp	Calorim Pr.	Cond St Temp	Pitot Stat	Pitot Vel	Hygrom Wet	Hygrom Dry	Discharge Air Temp	Vacuum
112	7.5	750	224	3	200	00	2.9	58	76	184	6.2
112	7.5	750	224	3	200	00	2.9	58	76	184	6.2
112	7.5	750	224	3	200	00	2.9	58	76	184	6.2
112	7.5	750	224	3	200	00	2.9	58	76	184	6.2

Zero Reading Reading of Draft Gauge = 2.75   Barometer = 29.82
Pitot in center of pipe.   Tare Water 308# Full Water 277#
Tare Steam 1208# Full Steam 1256#   52% Saturated.

No. 20
With Spray Water.

E	I	R.P.M.	Calorim Temp	Calorim Pr.	Cond St Temp	Pitot Stat	Pitot Vel	Hygrom Wet	Hygrom Dry	Discharge Air Temp	Vacuum
113	25	2500	219	3	156	1.25	7.9	53	65	158	20.1
113	25	2500	219	3	156	1.25	8.0	53	65	144	20.1
112	26	2500	219	3	156	1.25	7.9	53	65	142	20.1
112	26	2500	219	3	156	1.25	7.9	53	65	142	20.1

Zero Reading of Draft Gauge =2.8   Barometer = 29.27
Pitot in center of pipe.   Tare Water 388#Full Water 557.#
Tare Steam 1256# Full Steam 1326#   45% Saturated.

No. 21
With Spray Water.

E	I	R.P.M	Calorim Temp	Calorim Pr.	Cond St Temp	Pitot Stat	Pitot Vel	Hygrom Wet	Hygrom Dry	Discharge Air Temp	Vacuum
111	27	2500	219	3	162	1.2	7.5	53	65	146	18.9
111	27	2500	219	3	162	1.2	7.5	53	65	147	18.8
111	27	2500	219	3	162	1.2	7.5	53	65	147	18.8
111	27	2500	219	3	162	1.2	7.5	53	65	147	18.8

Zero Reading of Draft Gauge = 2.8 Barometer = 29.27
Pitot in center of pipe. Tare Water 328.3# Full Water 284.8#
Tare Steam 1367# Full Steam 1452# 45% Saturated.

No.22
With Spray Water.

E	I	R.P.M	Calorim Temp	Calorim Pr.	Cond St Temp	Pitot Stat	Pitot Vel	Hygrom Wet	Hygrom Dry	Discharge Air Temp	Vacuum
111	25	2500	220	3	156	1.25	7.8	53	65	137	20.1
111	25	2500	220	3	142	1.25	7.8	53	65	140	21.0
111	25	2500	220	3	158	1.25	7.8	53	65	142	20.0
111	25	2500	220	3	158	1.25	7.8	53	65	142	20.0

Zero Reading of Draft Gauge = 2.8 Barometer = 29.27
Pitot in center of pipe. Tare Water 499.2# Full Water 464.4#
Tare Steam 1103# Full Steam 1280# 45% Saturated.

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No. 23
With Spray Water

E	I	R.P.M	Calorim		Cond St	Pitot		Hygrom		Discharge	Vacuum
			Temp	Pr.	Temp	Stat	Vel	Wet	Dry	Air Temp	
112	24	2500	218	3	156	1.2	7.6	53	66	146	19.2
112	24	2500	219	3	154	1.2	7.6	53	66	145	19.6
112	24	2500	219	3	156	1.2	7.6	53	66	146	19.2
112	24	2500	219	3	156	1.2	7.6	53	66	146	19.2

Zero Reading of Draft Gauge = 2.8 Barometer = 29.27
Pitot in center of pipe. Tare Water 441#Full Water 410.6#
Tare Steam 1319.# Full Steam 1385.# 41% Saturated.

No. 24
With Spray Water.

E	I	R.P.M	Calorim		Cond St	Pitot		Hygrom		Discharge	Vacuum
			Temp	Pr.	Temp	Stat	Vel	Wet	Dry	Air Temp	
112	12	1700	219	3	158	.45	4.75	53	68	136	19.3
112	12	1700	219	3	158	.45	4.75	53	68	129	19.4
112	12	1700	219	3	158	.45	4.75	53	[illegible]8	118	19.6
112	12	1700	219	3	158	.45	4.75	53	68	118	19.7

Zero Reading of Draft Gauge = 2.8 Barometer = 29.27
Pitot in center of pipe. Tare Water 400.6# Full Water 375.8#
Tare Steam 1338.# Full Steam 1430.# 35% Saturated.

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No. 25
With Spray Water.

E	I	R.P.M	Calorim		Cond St	Pitot		Hygrom		Discharge	Vacuum
			Temp	Pr.	Temp	Stat	Vel	Wet	Dry	Air Temp	
112	12	1700	219	3	158	.45	4.7	54	72	122	19.4
112	12	1700	219	3	158	.45	4.7	54	72	128	19.2
112	12	1700	219	3	158	.45	4.7	54	72	130	18.7
112	12	1700	219	3	158	.45	4.7	54	72	129	18.7

Zero Reading of Draft Gauge = 2.75 Barometer = 29.27
Pitot in center of pipe. Tare Water 340# Full Water 309.#
Tare Steam 1154.# Full Steam 1200.# 28% Saturated.

No. 26
With Spray Water.

E	I	R.P.M	Calorim		Cond St	Pitot		Hygrom		Discharge	Vacuum
			Temp	Pr.	Temp	Stat	Vel	Wet	Dry	Air Temp	
112	10	1700	220	3	148	.5	4.9	54	72	119	20.0
112	10	1700	220	3	146	.5	4.9	54	72	119	20.8
112	10	1700	220	3	155	.5	4.9	54	72	124	20.2
112	10	1700	220	3	148	.5	4.9	54	72	125	20.5

Zero Reading of Draft Gauge = 2.8 Barometer = 29.27
Pitot in center of pipe. Tare Water 298.7# Full Water 268.7#
Tare Steam 1213.# Full Steam 1257.# 28% Saturated.

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No. 27
With Spray Water.

E	I	R.P.M.	Calorim Temp	Calorim Pr.	Cond St Temp	Pitot Stat	Pitot Vel	Hygrom Wet	Hygrom Dry	Discharge Air Temp	Vacuum
112	10	1700	219	3	160	.5	4.9	54	72	139	18.8
112	10	1700	219	3	160	.5	4.9	54	72	148	18.8
112	10	1700	219	3	160	.5	4.9	54	72	148	18.8
112	10	1700	219	3	160	.5	4.9	54	72	148	18.8

Zero Reading of Draft Gauge = 2.8   Barometer = 29.27
Pitot in center of pipe.   Tare Water 482.4# Full Water 478.#
Tare Steam 1265.# Full Steam 1285.#   28% Saturated.

No. 28
With Spray Water.

E	I	R.P.M.	Calorim Temp	Calorim Pr.	Cond St Temp	Pitot Stat	Pitot Vel	Hygrom. Wet	Hygrom. Dry	Discharge Air Temp	Vacuum
112	7.5	1300	219	3	140	.25	4.00	56	75	145	20.0
112	7.5	1300	219	3	135	.25	3.95	56	75	145	20.4
112	7.5	1300	219	3	140	.25	3.95	56	75	147	19.9
112	7.5	1300	219	3	138	.25	3.95	56	75	150	19.7

Zero Reading of Draft Gauge = 2.8   Barometer = 29.27
Pitot in center of pipe.   Tar Water 477.5# Full Water 473.#
Tare Steam 1297.5# Full Steam 1313.#   28% Saturated.

No. 29
With Spray Water.

E	I	R.P.M.	Calorim Temp	Calorim Pr.	Cond St Temp	Pitot Stat	Pitot Vel	Hygrom Wet	Hygrom Dry	Discharge Air Temp	Vacuum
111	7	1300	219	3	160	.25	3.9	56	75	152	18.8
111	7	1300	219	3	160	.25	3.9	56	75	152	18.8
111	7	1300	219	3	160	.25	3.9	56	75	152	18.9
111	7	1300	219	3	160	.25	3.9	56	75	152	18.9

Zero Reading of Draft Gauge = 2.8 Barometer = 29.27
Pitot in center of pipe. Tare Water 468.8# Full Water 467.4#
Tare Steam 1320.# Full Steam 1335.# 26% Saturated.

No. 30
With Spray Water.

E	I	R.P.M.	Calorim Temp	Calorim Pr.	Cond St Temp	Pitot Stat	Pitot Vel	Hygrom Wet	Hygrom Dry	Discharge Air Temp	Vacuum
113	8	1300	219	3	158	.25	3.9	58	76	119	19.4
113	8	1300	219	3	158	.25	3.9	58	76	121	19.2
113	8	1300	219	3	158	.25	3.9	58	76	120	19.4
113	8	1300	219	3	158	.25	3.9	58	76	125	19.7

Zero Reading of Draft Gauge = 2.8 Barometer = 29.27
Pitot in center of pipe. Tare Water 424.8# Full Water 400.8#
Tare Steam 1348.# Full Steam 1380.# 32% Saturated.

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No. 31
With Spray Water.

E	I	R.P.M.	Calorim Temp	Calorim Pr.	Cond St Temp	Pitot Stat	Pitot Vel	Hygrom Wet	Hygrom Dry	Discharge Air Temp	Vacuum
113	8	1300	219	3	164	.25	3.9	58	76	113	18.3
113	8	1300	219	3	160	.25	3.9	58	76	112	18.8
113	8	1300	219	3	163	.25	3.9	58	76	112	18.5
113	8	1300	219	3	163	.25	3.9	58	76	112	18.3

Zero Reading of Draft Gauge = 2.8 Barometer = 29.27
Pitot in center of pipe. Tare Water 391.7# Full Water 475.6#
Tare Steam 1393.# Full Steam 1425.# 58% Saturated.

No. 32
With Spray Water.

E	I	R.P.M.	Calorim Temp	Calorim Pr.	Cond St Temp	Pitot Stat	Pitot Vel	Hygrom Wet	Hygrom Dry	Discharge Air Temp	Vacuum
114	8	800	219	3	148	.1	3.15	58	78	147	20.2
114	8	800	219	3	148	.1	3.15	58	78	146	20.6
114	8	800	219	3	148	.1	3.15	58	78	146	20.5
114	8	800	219	3	148	.1	3.15	58	78	148	20.0

Zero Reading of Draft Gauge = 2.8 Barometer = 29.27
Pitot in center of pipe. Tare Water 479.5# Full Water 468.5#
Tare Steam 1169# Full Steam 1185.# 98% Saturated.

No. 33
With Spray Water.

E	I	R.P.M.	Calorim Temp	Calorim Pr.	Cond St Temp	Pitot Stat	Pitot Vel	Hygrom Wet	Hygrom Dry	Discharge Air Temp	Vacuum
114	8	800	219	3	146	.1	3.15	58	78	147	20.6
114	8	800	219	3	152	.1	3.15	58	78	145	20.8
114	8	800	219	3	156	.1	3.15	58	78	145	20.1
114	8	800	219	3	158	.1	3.15	58	78	145	19.9

Zero Reading of Draft Gauge = 2.8 Barometer = 29.27
Pitot in center of pipe. Tare Water 463.3# Full Water 446.7#
Tare Steam 1198.# Full Steam 1217.# 28% Saturated.

No. 34
With Spray Water.

E	I	R.P.M.	Calorim Temp	Calorim Pr.	Cond St Temp	Pitot Stat	Pitot Vel	Hygrom Wet	Hygrom Dry	Discharge Air Temp	Vacuum
114	8	800	219	3	152	.1	3.15	58	78	147	19.7
114	8	800	219	3	156	.1	3.15	58	78	148	19.8
114	8	800	219	3	156	.1	3.15	58	78	151	19.6
114	8	800	219	3	156	.1	3.15	58	78	151	19.7

Zero Reading od Draft Gauge = 2.8 Barometer = 29.27
Pitot in center of pipe. Tare Water 442.6# Full Water 433.5#
Tare Steam 1226.# Full Steam 1245.# 28% Saturated.

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No. 35
With Spray Water.

E	I	R.P.M.	Calorim Temp	Calorim Pr.	Cond St Temp	Pitot Stat	Pitot Vel	Hygrom Wet	Hygrom Dry	Discharge AIR Temp	Vacuum
114	8	800	219	3	160	.1	3.15	58	80	152	18.8
114	8	800	219	3	160	.1	3.15	58	80	152	18.8
114	8	800	219	3	160	.1	3.15	58	80	158	18.8
114	8	800	219	3	160	.1	3.15	58	80	154	18.8

Zero Reading of Draft Gauge = 2.8 Barometer = 29.27
Pitot in center of pipe. Tare Water 428.6# Full Water [illegible]5.5#
Tare Steam 1257.# Full Steam 1259.# 99% Saturated.