CINCINNATI WATER WORKS.

REPORT

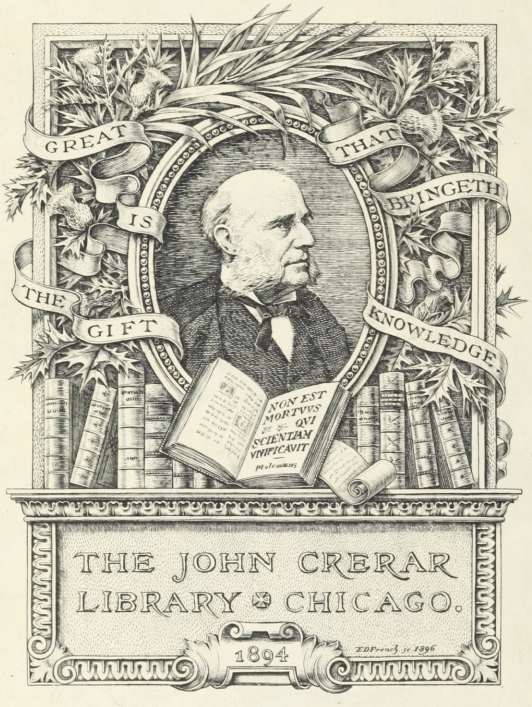
OF THE

BOARD OF EXPERTS

ON THE

Warden Compound Pumping Engine

MARCH, 1879.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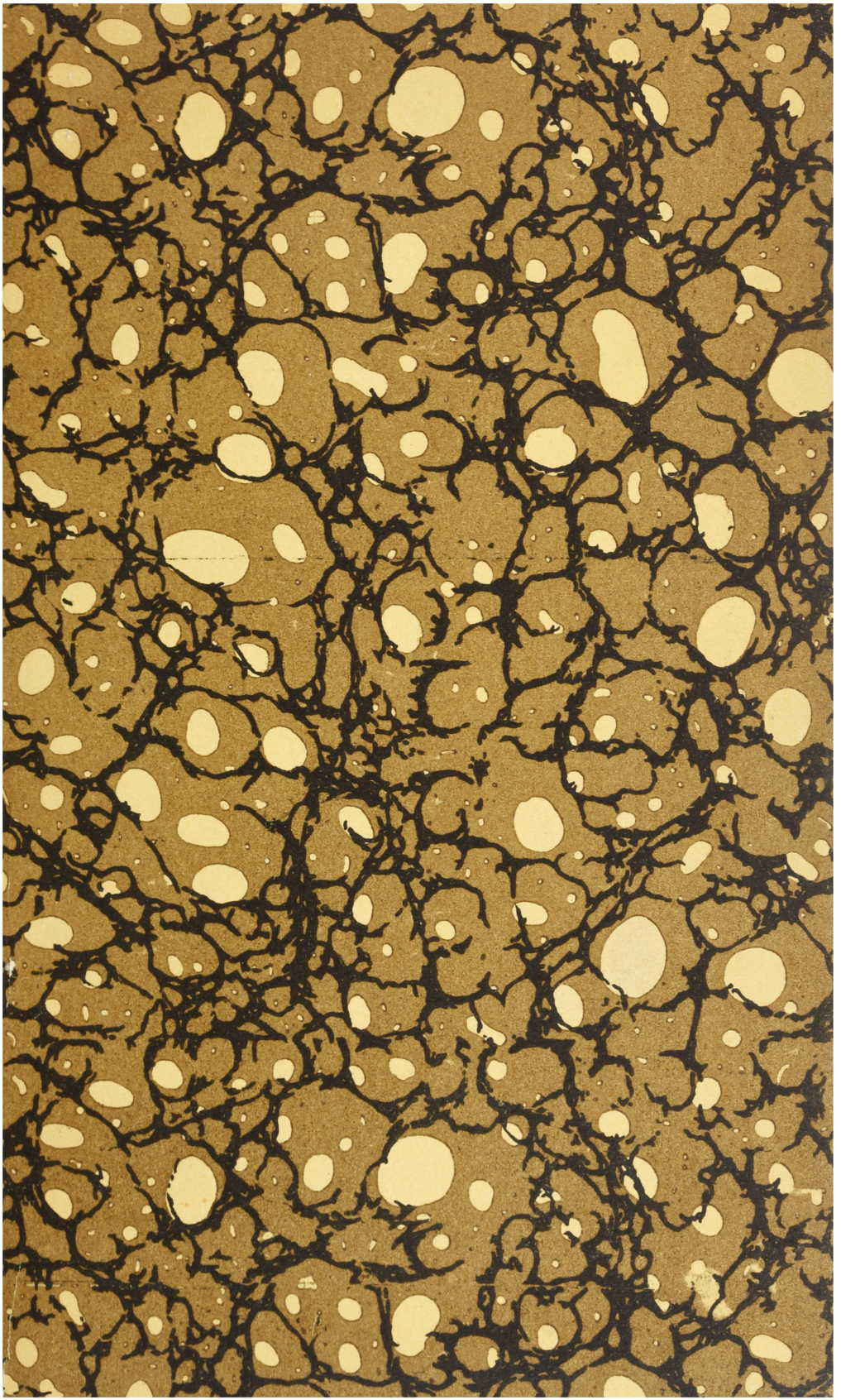

CINCINNATI WATER WORKS.

REPORT

OF THE

BOARD OF EXPERTS

ON THE

TEST TRIAL

OF THE

Warden Compound Pumping Engine

AT THE

HUNT STREET STATION,

TO THE

BOARD OF CITY COMMISSIONERS.

CINCINNATI: MARCH, 1879.

F. O. CARNAHAN & CO.
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REPORT

OF THE

BOARD OF EXPERTS

ON THE

TEST TRIAL OF THE WARDEN COMPOUND PUMPING ENGINE.

AT THE

HUNT STREET STATION,

TO THE

Board of City Commissioners.

CINCINNATI.

To the Honorable the Board of City Commissioners,

NATHANIEL C. CALDWELL,
CHARLES W. ROWLAND,
SIMON WOLFSTEIN,
GEORGE K. DUCKWORTH, and
ROBERT H. WEATHERHEAD,

GENTLEMEN:

Pursuant to a resolution of the Board of Public Works, passed December 28th, 1878, we were appointed a Board of Experts to test and report on the new engine at the Hunt Street Pumping House, built by Americus Warden, Esq., Engineer of the City Water Works, under the direction of the Board of Public Works.

RESOLUTION.

"*Resolved*, That a committee of three be appointed by this Board, of competent men, well skilled in the use of steam as a motive power, whose duty it shall be to examine the new pumping engine built in the Hunt Street Pumping House by Engineer Americus Warden, and report to this Board the adaptation and economy of said engine for the purpose for which it is now used. Also, the propriety of adopting similar engines for the pumping department for Western Reservoir at Considine Place."

The engine was built as an auxiliary to the old horizontal engines at this station, and, according to the engineer's statement, calculated for a daily capacity of 2,000,000 gallons delivered in the Mt. Auburn tanks.

The steam end of the engine was designed and built by Mr. Warden, and fitted with a cataract gear to govern the motion of the pistons.

The pumps and water connections were designed and built several years ago by Mr. George Shield, the engineer of the Water Works, and were used in this engine to reduce the cost of construction.

The original design of the engine embraced three steam cylinders: the first receiving steam at boiler pressure, and exhausting into a receiver; the second receiving steam from the first receiver, and exhausting into a second receiver; and the third receiving steam from the second receiver, and exhausting into a surface condenser—the condensing water for which would be obtained from the force main by branch pipe, and returned to the force main and delivered to the Mt. Auburn tanks.

The trial was made with the first two cylinders; the third cylinder and condensing apparatus remain to be added.

The water is delivered to the pumps under the head of 64–67

feet from the Eden reservoir, and pumped into the Mt. Auburn tanks against a natural head of 326 feet

Several novel features are presented in the combination of parts, the merit of which has been freely discussed during the limited period the engine has been in operation.

To determine the precise value of the arrangement of steam and water cylinders and valve motion, and the propriety of reproducing this type of pumping engine for city service, has been the object of our examination, the results of which are fully presented in this report.

Upon his request, Mr. Ahrens was relieved from active participation in the trials, but was present at the pumping house during the thirty-six hour run, and assisted in making the leakage observations.

The trials were run in six-hour watches, with two full sets of observers—one set under the direction of Mr. Hill and the other under the direction of Mr. Moore. At all times during the trials, two of the experts were present at the pumping house.

At the close of the trial, the indicator diagrams and observers' note books were turned over to Mr. Hill, who has developed the data and drawn the report, which is believed to cover all material points affecting the engine.

JOHN W. HILL,
ARTHUR G. MOORE,
C. AHRENS.

Description of the Engine.

The engine is simply a compound, vertical, direct-acting steam pump, of large dimensions, with double-acting piston pumps—the steam cylinders being elevated a convenient distance above the level of the engine room floor, and the pumps set below in the pit.

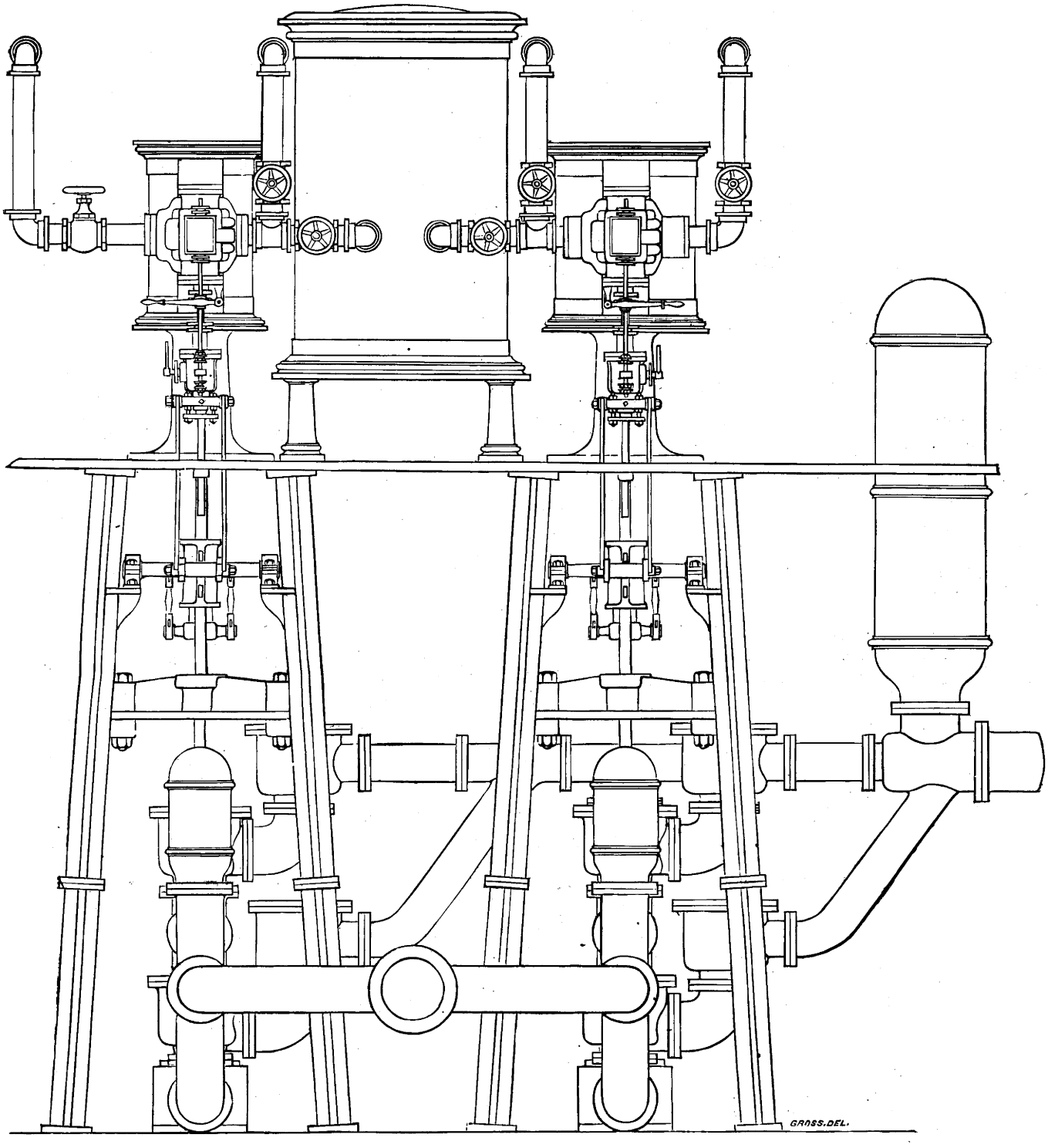
The high pressure cylinder takes steam direct from the boiler, and exhausts into the receiver placed between the two cylinders.

The low pressure cylinder takes steam from the receiver, and exhausts into a heater, through which the feed water is forced to the boilers.

The cylinders are provided with three ports, one to each end, and a central exhaust passage, after the manner of the ordinary three-port slide-valve engine. The valves are simple D slides, with central cavities for connection of steam to exhaust passages during exhaust strokes of pistons. The slide-valves were originally provided with steam and exhaust lap; but upon both ends of the slide-valve for the low pressure engine, and on the lower end of the slide-valve for high pressure engine, the lap was partially removed by notching to the edges of the steam ports.

The valve motion for each engine is effected by the Cope & Maxwell isochronal cataract gear, the object of which is to automatically regulate the motion of the slide-valves to the production of uniform strokes of the engine pistons in equal periods of time.

To avoid serious injury to the engine, in the event of failure upon the part of the cataract gear to arrest the motion of the



Cincinnati Water Works.

WARDEN COMPOUND ENGINE.

pistons at the ends of the nominal strokes, buffer beams, with heavy rubber buffers, are provided above and below the cross heads or bosses, joining the steam and water piston rods, against which the impact of the reciprocating parts is expended for over strokes of the pistons. The slide-valves are of the steam throwing type, the "cataract" regulating the time and velocity of motion of the auxiliary pistons by means of an independent steam chest and slide-valve. Steam direct from the boiler is taken to work the auxiliary pistons—the exhaust from the auxiliary cylinder of the high pressure engine being connected to the receiver, and the exhaust from the auxiliary cylinder of the low pressure engine being connected to the exhaust heater by means of the main exhaust pipe. Each engine is fitted with steam and exhaust pipes, to be worked independently "high pressure" in the event of accident to the opposite engine.

The steam cylinders, receiver, and all connecting pipes, are clothed with non-conducting cement and Russia iron covers. The cylinder heads have polished "false" covers to diminish the loss of heat by radiation. The steam-pipe from boiler to high pressure engine, exhaust pipe from low pressure engine to heater, and feed pipe from heater to boiler, are well felted to avoid loss of heat by radiation. The condensation occurring in the receiver is removed by an automatic steam trap, and an excess of steam pressure in the receiver is removed by an ordinary gravity relief valve placed on the top.

The pumps are double-acting, having same strokes as steam pistons, with a single suction and delivery valve at each end of the water cylinder. The valve seats are of brass, with twelve sectoral openings, presenting an aggregate clear area of 40.64." The valves are single, heavy hemispherical rubber discs, held in position by a central stud in the valve seat.

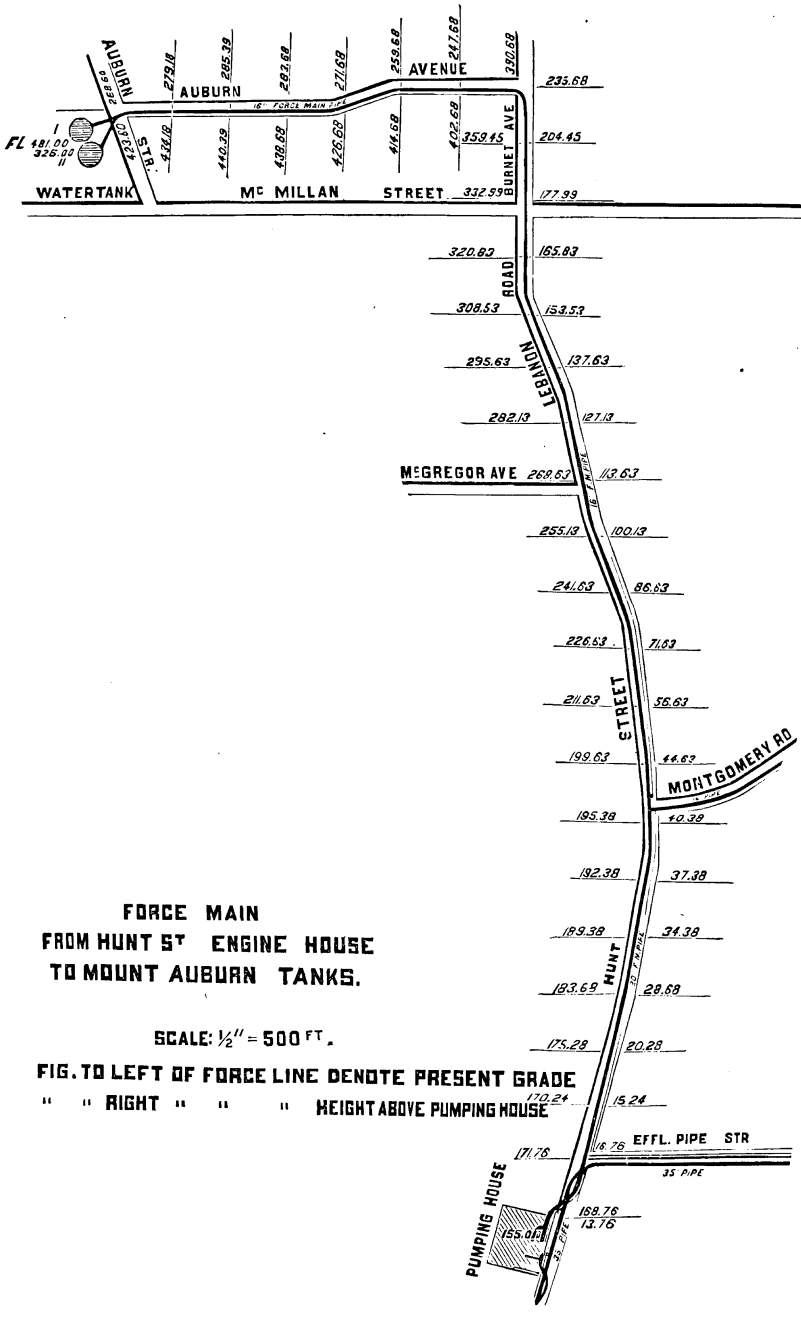
The Water Pipes.

The suction pipe bringing water to the pumps is 20″ diameter, 22′ long, and connected in front of the pumping house to 35″ distribution line from Eden reservoir.

The force pipe from the pumping house to the Mt. Auburn tanks is 20″ diameter for a length of 2705′, and 16″ diameter for a length of 4501′. The force pipe is also a distribution pipe. At Effluent Pipe Street, two lines of 10″ pipes are connected to supply water to Mt. Adams. At the intersection of Montgomery Road and Hunt Street, a 16″ line of pipe leads off to supply West Walnut Hills.

Between the valve in the line of pipe up the Montgomery Road and the force line, a 4″ line of pipe is connected, running down the east side of Hunt Street from the intersection with the Montgomery Road; and to the 16″ portion of the force pipe, are made two connections to supply a line of 4″ pipe running up the Lebanon Road parallel with the force line.

At the Mt. Auburn tanks, a connection is made with the force pipe, to supply a 16″ distributing line running down Vine Street Hill. The force main branches at the base of the tanks, one 16″ branch connecting with the North tank and one 16″ branch connecting with the South tank.



FORCE MAIN
FROM HUNT ST ENGINE HOUSE
TO MOUNT AUBURN TANKS.

SCALE: ½" = 500 FT.

FIG. TO LEFT OF FORCE LINE DENOTE PRESENT GRADE
" " RIGHT " " " HEIGHT ABOVE PUMPING HOUSE

The Boilers.

Steam is furnished the engine from a battery of two return flue boilers, each 48″ diameter and 24′ long, with two 10″ and four 8″ flues each. These are set in brick work, well protected from loss of heat by radiation. The furnace is continuous, as is the ash pit. A sheet iron breeching at the forward end, common to both boilers, conveys the hot gas into a sheet iron stack, 50″ diameter and 61.6′ high from center of grate. The feed water from the boilers is taken from the force main, the head upon which is sufficient to feed the boilers without the aid of the pump.

The steam-pipe from the boilers was disconnected from the main pipe to the engine room, and an independent connection made from the steam drum of boilers, used during the trial to the high pressure cylinder of the engine. All steam made during the trial except the small quantity condensed in the calorimeter, was delivered to the engine.

DIMENSIONS OF ENGINES.

DIAMETERS OF CYLINDERS.

H. P. Engine—Steam	14.0625″
" " Water	10.03125″
L. P. " Steam	22.5625″
" " Water	10.03125″
Piston and Pump-rods, both Engines	2.5625″

STROKES.

H. P. Engine—Nominal	30.375″
" " During trial by first method	29.550″
" " " " Second "	29.240″
L. P. " Nominal	30.000″
" " During trial by first method	29.030″
" " " " Second "	28.805″

CLEARANCES.

{ In fraction of piston displacement and equalized for both ends. Stroke = 1.0000. }

H. P. Cylinder, one end—Nominal	.07345
" " " " During trial by first method	.08934
" " " " " " Second "	.09564
L. P. " " " Nominal	.02662
" " " " During trial by first method	.04421
" " " " " " Second "	.04846

STEAM PIPES.

H. P. Engine—Supply	3.00″
" " Exhaust	4.00″
L. P. " Supply	4.00″
" " Exhaust	4.00″

SLIDE VALVES AND PORTS.

H. P. Engine—Steam Ports	1.1567″ x 3.00″
" " Exhaust "	1.9375″ x 3.00″
" " Nominal steam lap	.7177″
" " " Exhaust lap	.2505″

Lap partially removed by notching lower end of valve inside and outside.

L. P. Engine—Steam Ports	1.0937″ x 8.0625″
" " Exhaust "	1.9675″ x 8.0625″
" " Nominal steam lap	.7651″
" " " Exhaust lap	.3755″

Lap partially removed by notching both ends of valve inside and outside.

RECEIVER.

Diameter	41.00″
Height	72.00″
Volume, natural	55.0110 c. f.
" Connecting (4″) pipes	.6965 "
" L. P. Engine steam chest	.4489 "
" H. P. " exhaust chamber	.0725 "
" Total	56.2289 c.f.

RATIOS OF VOLUMES.

H. P. and L. P. cylinders to H. P. cylinder	3.3601
Receiver to H. P. cylinder	18,2638
" " L. P. "	7.7383
L. P. to H. P. "	2.3601

PUMP VALVES.

Area of opening inlet valves	40.64 s. i.
" " outlet "	40.64 "

DIMENSIONS OF BOILERS.

Number	2
Length	24.00′
Diameter	48.00″
Flues	2—10.00″ 4— 8.00″
Heating surface in shells	389.496 s. f.
" " " flues	654.528 "
" " " ends	38.954 "
" " total	1082.98 s.f.
Grate width	7.16′
" length	2.66′
" area	19.04 s.f.
Cross section of flues.	2.49
Ratio heating to grate surface	56.86
" grate surface to cross section of flues	7.65
Steam drum, diameter	24.00″
" " length	80.00″

WATER PIPES.

Suction, diameter	20″
Force, " 2705′	20″
" " 4501′	16″
" length	7206′

The Method of Trial.

Two methods were adopted for measurement of the water delivered by the pumps—the first method by cutting the connection between the pumps and force main, and turning the delivery into a weir box set in the engine house, the resistance being obtained by throttling in the discharge pipe. The second method was by closing all outlets from the force main, and pumping over a weir at the Mt. Auburn tanks.

In the test by delivery of water over the wier at the engine house, all leaks were carefully closed and all the water passed by the pumps was delivered over the weir.

In the test by pumping against the natural head up the line of force pipe to the weir set on top of the tanks, a certain unavoidable leakage occurred, which was measured and added to the quantity of water measured over the weir.

In the trial by throttle resistance, the only water credited to the pumps is that measured by the weir; but in the trial by natural resistance, three quantities of water are credited to the pumps. First, the delivery through the force pipe over the weir at the Mt. Auburn tanks. Second, the leakage in the force pipe as determined by a series of leakage trials. Third, the water pumped into the boilers: the feed being taken from the force pipe in the engine house.

The first method of trial began at 12 noon March 22nd, and continued to 9 P. M. same day, when the delivery of water was changed from the weir box in the engine house to the force line and over the weir at the tanks. The trial by the second method

began at 9 P. M. March 22nd, and terminated at 3 P. M. March 23rd, at which time the delivery of water was again directed into the weir box in the engine house, and continued until 12 midnight March 23rd. A thirty-six hour trial was made; the first and last nine hours of which the water delivered was measured over the weir at the engine house—the intervening eighteen hours being given to the delivery of water against the natural head over the weir at the Mt. Auburn tanks.

Previous to the regular trial commencing at 12 noon March 22nd, a preliminary trial of five hours was made, to skill the assistants in their duties and check errors in the apparatus. None of the data taken during the preliminary trial is considered in making up the record of performance.

COAL.

The coal fired was weighed in charges of 200 pounds, and dumped in front of the boilers ready for use. The scale used in weighing the coal was selected by Mr. Warden, and the men in charge of the coal were taken from the regular force.

An assistant was detailed to check the scale and weights and time of delivery of coal to the fireman, in addition to the log of coal charged by one of the Board of Experts in charge of the watch. The coal fired was Pittsburgh No. 2, of good quality. Previous to commencement of trials the ash pit was cleaned, and at the end of the thirty-six hour run the ash and clinker accumulated was weighed back dry. The use of the coal and working of the fires were entirely under the control of Mr. Warden and his assistants.

The only instruction given by the Board of Experts, was to maintain as nearly as possible the pressure subsisting in the boilers at 12 o'clock (noon) March 22nd.

In making up the record of coal burned, a copy of which is attached to the report, the following method was pursued:

At commencement of trial, the fires having been brought to a flush condition, the coal remaining in front of the boilers was removed, and the first charge of 200 pounds dumped and broken ready for use. The time of dumping the charge having been entered in the note books of two observers, the quantity was held to last until the next charge of 200 pounds was dumped —the second charge not being permitted on the floor of the boiler house until the previous charge was all on the grate.

The differences of time, therefore, in entering in the record successive charges of coal, represent the interval required to burn the previous charge. During the trial the fires were cleaned from time to time at the option of the fireman; the clinker being pushed back into the ash pit, and weighed as non-combustible at the end of the trial.

FEED WATER.

The water delivered to the boilers was measured in a divided tank, having a nominal capacity of 1550 pounds for each compartment. The partition between the two compartments of the tank was notched at the top, and the edge brought to a sharp angle in the center—this edge being kept well wetted to reduce adhesion of the particles of water lying close to it. The tanks were alternately filled from a supply pipe running over the top, with delivery pipes extending nearly to the bottom of the tanks, to avoid agitation of the surface of the water, whilst adjusting the level on the sharp edge of the partition. In filling the tanks or compartments of the tank, the observer adjusted the delivery of water whilst noting the rise of head on the edge of the partition from the opposite side.

No water was permitted to break over the partition during the trial. In emptying the compartments of the tank, the head was drawn down to a fixed gauge point on the glass water gauge in the side of each compartment, and the flow instantly checked by turning an open way stop cock. Directly the emptying tank was turned off, the previously filled tank was turned on, and the time of emptying the last tank entered in the observer's note book.

Under the usual conditions of operating the engines the gravity head on the force line to Mt. Auburn tanks is sufficient to feed the boilers.

But measurement of the feed water by the tank method during the trials, made it necessary to supply the boilers by an independent steam pump, taking steam from the battery of boilers connected with the old engine in the pump house.

The suction of the feed pump was connected by branch pipes to the bottom of each compartment of the measuring tank, and the water delivered through a large coil of pipe in the exhaust heater, thence to the stand pipe of the boilers.

Regularly every fifteen minutes during the trial, the temperature of water in the measuring tank was noted and entered in the observers' note book.

The temperature of feed water to the boilers was taken in the feed pipe near the check valve, by a screw joint thermometer with the bulb in the current of hot water. This was read regularly every fifteen minutes during the trial.

The pressure of the atmosphere was taken on a compensated Aneroid, and the temperature of air read on a low range thermometer, set in an open door way from engine room to boiler room. This was read regularly every fifteen minutes during the trial.

The water level in the boilers was taken upon a scale, set

alongside the glass water gauge, graduated to inches, the zero point of which coincided with the top of flues. The readings of water level are therefore in inches and decimals over flues.

A sliding index on the scale, which could be set at any desired point, enabled the observer to detect an increase or diminution of the water level and check his previous reading. This was read regularly every fifteen minutes during the trial.

To the steam drum of boilers near the steam-pipe, a calorimeter was connected to determine the quality of steam furnished. The calorimeter consisted of a coil of brass tube (.25″ diameter) set in a cylindrical, closed tin tank—the upper end of the coil connected by ¼″ steam-pipe to the drum, and the lower end carried through the side of the tank, and turned down into a measuring tank set on a small platform scale, into which the water of condensation was delivered from the coil.

The condensing water taken from the city mains, entered at the bottom of the tank and passed out at the top. The quantity of steam entering the coil was regulated by the orifice in the stop cock (about .0625″ diameter, chamfered on both sides of the key and set parallel with axis of connecting pipe).

The quantity of condensing water was regulated at the inflow to the tank by a stop cock. The condensing water was measured through a meter and passed to a barrel set to produce a low head on the tank, from which it was drawn as required. The barrel was filled to an overflow notch previous to the trial, and temperature noted. It was again filled at the end of trial, and temperature noted, and difference of meter readings corrected for temperatures held to represent the quantity of water passed the condenser during the trial.

Thermometers were inserted into the in-flow pipe for condensing water into the out-flow pipe for condensing water, and into

the lower end of the condensing coil for water of condensation. The water of condensation was weighed hourly. The temperatures of in-flow and out-flow condensing water, and of water of condensation from the coil, were taken regularly every fifteen minutes.

The meter was read each time the barrel was filled, as a check on the final record of meter measurement.

Indicators were attached to both high and low pressure cylinders, and steam diagrams were taken from each end of cylinders regularly every fifteen minutes during the trial. The pipes were arranged to use one indicator for both ends of the cylinder with an open way stop cock in each branch pipe, and a cock at the bottom to draw off condensation.

As the length of stroke made by the pistons was a very important factor in the trial of an engine of this peculiar type, wherein the strokes were of greater or less length, according to the regulation effected by the cataract, the indicators were moved by a positive gear, making a stroke proportional to that of the engine pistons, from which is deduced the length of stroke made by the piston for each diagram taken during the trial.

Thompson indicators, made by the Buckeye Engine Co., of Salem, Ohio, were used, with sixty (60) spring in indicator for high pressure engine, and twenty (20) spring in indicator for low pressure engine.

Two engine counters, one to the high pressure engine and one to the low pressure engine, recorded the double strokes of each; these were read regularly every fifteen minutes during the trial as a check upon the final record, and to observe the action of engines during given intervals of time.

The pressures in the boilers and on the water pipes were read from Asheroft gauges, constructed for the purpose, and found by

comparison with Post & Co.'s mercury column to be in error from one to three pounds.

The gauges were read regularly every fifteen minutes during the trial.

The gauge on the suction main was connected at the end of the pipe where it branched to the respective pumps; and to the corrected reading is added 12.5 feet, the vertical distance from the center of the pump to gauge. The gauge on the force pipe was connected to the first section of the force pipe, and to the corrected reading is added 12.5 feet, the vertical distance from center of pump to gauge.

The pressure in the receiver was read on the gauge previously used at this point. This gauge, by Kirkup & Co., was compared with the Post & Co. column, and found to be in error nearly three pounds. *The gauge readings are corrected in the summary of engine performance.*

The weir boxes at the engine house and at the Mt. Auburn tanks were each 14 feet long, 4 feet wide, and 3.5 feet deep. At the engine house the delivery pipe was turned down into the box near one end, and by means of baffle boards and screens a perfectly smooth surface of water approaching the weir was obtained. The last screen was placed about four feet from the weir. The weirs were made of cast iron, planed upon the up-stream side, and sunk flush into the bulk heads of the weir boxes; the notches were approximately 36″ long by 10″ deep, and the edges brought to an angle of 45 degrees on the down stream side. The edges of the weirs were carefully leveled before and after the trial.

The heads on the weir were taken 24″ up stream, and read independently on two hook gauges. The hook gauges and boxes were secured to the engine house walls to avoid the tremor of the weir box.

The heads on the weir were taken regularly every five minutes during the trial, except during the last five minutes of each hour, when the readings were taken every minute. The temperature of delivery over the weir was taken in the weir box.

The temperatures of water in the city mains, in the feed pipe, and in the weir box, were taken with Green's thermometers. The temperature of atmosphere was taken with a Tagliabue thermometer.

The signals for observations, except weir readings, were rung upon a large gong situated in one of the door ways from engine to boiler house. Two signals were rung to observers to hold themselves in readiness for an observation; the signal for which was given one minute later. The observers at the hook gauges took their time from a small gong placed convenient to the weir. Both gongs were tapped by an assistant, who read the time to seconds from the engine room clock.

In the following four tables are given the general data from the engine and boiler room for each method of trial. In tables I and IV, are given the data taken during the first and last nine hours of the trial; and in tables II and III are given the data taken during the second and third nine hours of the trial. At the foot of table IV are given the average readings for first method of trial, and at the foot of table III are given the averages for second method of trial.

Date.	Time.	Barometer.	Temperatures.				Gauges—Steam.	
			Air.	Water from City Mains.	Feed Water.	Elevation by Heater.	Boilers.	Receiver.
1	2	3	4	5	6	7	8	9
1879	M.							
March 22,	12.00	29.24	70.00	44.00	213.00	169.00	125.	38.50
	P. M.							
	12.15	29.25	69.00	44.00	214.00	170.00	125.	39.50
	12.30	29.25	68.75	44.00	213.00	169.00	125.	40.00
	12.45	29.25	73.00	43.50	214.25	170.75	125.	40.00
	1.00	29.25	71.00	44.00	214.00	170.00	125.	39.50
	1.15	29.26	76.00	43.50	214.25	170.75	124.	39.00
	1.30	29.27	76.75	44.00	214.50	170.50	124.	40.00
	1.45	29.27	75.00	43.50	214.25	170.75	124.	40.00
	2.00	29.28	77.00	44.00	214.00	170.00	118.	38.00
	2.15	29.28	74.70	44.00	213.50	169.50	126.	41.00
	2.30	29.28	76.00	44.00	214.75	170.75	125.	40.00
	2.45	29.29	76.00	43.50	214.50	171.00	125.	40.00
	3.00	29.30	70.00	43.50	214.50	171.00	125.	40.00
	3.15	29.30	76.00	44.00	214.25	170.25	125.	40.00
	3.30	29.30	75.00	43.50	214.25	170.75	125.	40.00
	3.45	29.30	75.20	44.00	214.75	170.75	124.	39.50
	4.00	29.30	76.20	43.50	214.50	171.00	125.	39.50
	4.15	29.31	76.50	43.50	214.75	171.25	125.	40.00
	4.30	29.31	76.70	44.00	215.00	171.00	125.	40.00
	4.45	29.32	75.00	43.50	214.75	171.25	125.	40.00
	5.00	29.32	74.50	44.00	214.75	170.75	125.	40.00
	5.15	29.33	75.00	44.00	214.90	170.90	125.	40.00
	5.30	29.33	74.00	43.50	214.50	171.00	125.	40.00
	5.45	29.34	74.00	46.00	214.90	168.90	125.	39.50
	6.00	29.35	72.00	44.00	215.00	171.00	125.	40.00
	6.15	29.36	65.00	44.00	214.00	170.00	124.	39.50
	6.30	29.36	70.00	44.00	214.80	170.80	124.	39.50
	6.45	29.37	73.00	43.50	214.90	171.40	125.	40.00
	7.00	29.37	73.00	43.50	214.00	170.50	125.	39.00
	7.15	29.39	75.00	43.50	216.00	172.50	124.	39.50
	7.30	29.39	74.00	43.50	214.90	171.40	125.	39.50
	7.45	29.40	74.50	43.50	214.60	171.10	125.	39.50
	8.00	29.40	75.50	43.50	215.00	171.50	125.	39.50
	8.15	29.41	75.00	43.50	215.00	171.50	124.	39.50
	8.30	29.41	75.40	43.50	214.90	171.40	125.	39.50
March 22,	8.45	29.41	76.00	43.50	214.90	171.40	125.	39.50

Water Level.	Gauges–Water.		Counters.		Calorimeter.			
	Suction Pipe.	Rising Pipe.	H. P. Engine.	L. P. Engine.	Temp. Steam.	Temp. Condensation.	Temp. Injection.	Temp. of Condensing Water
10	11	12	13	14	15	16	17	18
3.25	44.00	324.00	15,650	94,585	352.76	78.50	76.50	134.00
3.23	45.00	321.00	16,260	95,241	352.76	79.00	77.50	136.00
3.20	51.00	317.00	16,887	95,917	352.76	79.00	78.00	143.00
3.14	50.00	316.00	17,545	96,618	352.76	80.00	79.00	138.00
3.14	47.00	314.00	18,187	97,298	352.76	82.25	80.00	146.00
3.16	47.00	310.00	18,859	98,021	352.21	81.50	80.50	152.00
3.30	47.00	315.00	19,505	98,711	352.21	82.00	81.50	141.00
3.20	47.00	307.50	20,156	99,399	352.21	82.00	81.00	145.00
3.30	46.00	312.00	20,787	100,076	348.80	84.00	83.00	154.00
3.10	47.50	314.00	21,418	100,747	353.32	83.50	83.00	143.00
3.10	46.00	314.00	22,042	101,406	352.76	84.00	83.00	153.00
3.32	46.00	314.00	22,689	102,079	352.76	84.50	83.50	159.50
3.20	47.00	313.00	23,333	102,742	352.76	84.00	82.50	152.00
3.14	46.00	312.50	23,993	103,413	352.76	85.50	83.50	158.00
3.22	44.00	317.00	24,642	104,074	352.76	85.00	84.00	163.00
3.34	46.00	315.00	25,391	104,740	352.21	86.00	84.00	152.50
3.24	46.00	313.00	25,931	105,402	352.76	85 00	82.00	169.50
3.30	49.00	314.00	26,580	106,068	352.76	83.00	82.00	171.00
3.30	47.00	317.00	27,233	106,735	352.76	86.00	84.00	165.00
3.28	48.00	311.00	27,895	107,414	352.76	86.00	84.00	184.00
3.36	49.00	312.00	28,544	108,080	352.76	85.00	84.00	190.00
3.28	49.00	313.00	29,196	108,746	352.76	87.50	87.00	187.00
3.32	50.00	315.00	29,834	109,387	352.76	88.50	88.00	192.00
3.36	50.00	315.00	30,479	110,032	352.76	83.00	77.00	90.00
3.34	45.00	313.00	31,123	110,676	352.76	73.75	70.00	107.00
3.34	50.00	315.00	31,757	111,310	352.21	74.25	68.75	92.00
3.33	50.00	316.00	32,384	111,941	352.21	73.00	72.00	107.00
3.36	47.50	315.00	33,031	112,583	352.76	74.00	73.00	139.00
3.10	48.00	315.00	33,674	113,227	352.76	76.00	72.50	176.00
3.34	52.00	307.00	34,312	113,866	352.21	79.00	67.25	83.00
3.34	53.00	318.00	34,957	114,512	352.76	66.50	64.50	114.50
3.34	51.00	314.00	35,604	115,164	352.76	68.25	66.50	107.50
3.33	54.00	314.00	36,265	115,822	352.76	69.50	67.75	117 00
3.54	54.00	314.00	36,923	116,485	352.21	70.75	69.50	121.75
3.50	54.00	316.00	37,580	117,150	352.76	70.75	67.75	108.75
3.25	50.00	314.00	38,251	117,825	352.76	70.75	69.50	120.00

Date.	Time.	Barometer.	Temperatures.				Gauges—Steam.	
			Air.	Water from City Mains.	Feed Water.	Elevation by Heater.	Boilers.	Receiver.
1	2	3	4	5	6	7	8	9
1879	P. M.							
March 22,	9.00	29.45	74.75	43.50	214.00	170.50	126.	20.00
	9.15	29.45	76.25	43.50	214.50	171.00	124.	37.00
	9.30	29.46	75.00	43.50	215.25	171.75	125.	40.00
	9.45	29.47	74.50	43.50	215.00	171.50	125.	39.50
	10.00	29.48	74.50	43.50	215.00	171.50	125.	40.00
	10.15	29.48	75.00	43.50	215.00	171.50	125.	40.00
	10.30	29.49	74.00	43.50	215.00	171.50	125.	39.50
	10.45	29.49	77.90	43.50	215.00	171.50	125.	40.00
	11.00	29.49	72.50	43.50	214.80	171.30	125.	40.50
	11.15	29.50	75.00	43.50	215.70	172.20	125.	40.00
	11.30	29.51	74.50	44.00	216.00	172.00	125.	40.00
	11.45	29.52	74.00	44.00	216.00	172.00	125.	40.00
March 23,	A. M.							
	12.00	29.53	75.00	43.00	215.00	172.00	125.	40.00
	12.15	29.53	74.20	44.00	215.00	171.00	125.	40.00
	12.30	29.55	74.70	44.00	215.25	171.25	125.	40.50
	12.45	29.56	74.20	43.50	215.25	171.75	125.	40.00
	1.00	29.56	74.00	44.00	215.50	171.50	124.	40.00
	1.15	29.56	73.00	43.00	215.00	172.00	124.	40.00
	1.30	29.57	73.50	43.00	215.50	172.50	125.	40.50
	1.45	29.58	73.75	43.50	215.25	171.75	125.	40.50
	2.00	29.58	76.00	43.00	215.00	172.00	125.	40.50
	2.15	29.58	75.00	43.00	215.25	172.25	125.	40.50
	2.30	29.58	74.00	43.00	215.75	172.75	125.	40.00
	2.45	29.58	74.00	43.00	215.50	172.50	125.	40.50
	3.00	29.58	74.00	43.00	215.50	172.50	126.	41.00
	3.15	29.58	74.10	43.00	215.00	172.00	126.	40.50
	3.30	29.59	74.20	43.00	215.50	172.50	125.	40.50
	3.45	29.59	75.00	43.00	215.00	172.00	125.	40.00
	4.00	29.60	74.50	43.00	215.50	172.50	125.	40.50
	4.15	29.60	74.00	43.00	215.00	172.00	125.	40.00
	4.30	29.60	74.25	43.00	215.00	172.00	125.	40.50
	4.45	29.60	74.00	43.00	215.25	172.25	126.	40.50
	5.00	29.60	74.90	43.00	215.00	172.00	125.	41.50
	5.15	29.61	74.50	43.00	215 75	172.75	125.	40.50
	5.30	29.62	73.00	43.00	215.25	172.25	124.	40.50
	5.45	29.63	74.25	43.00	215.50	172.50	125.	40.00

Water Level.	Gauges–Water.		Counters.		Calorimeter.			
	Suction Pipe.	*Rising Pipe.*	*H. P. Engine.*	*L. P. Engine.*	*Temp. Steam.*	*Temp. Condensation.*	*Temp. Injection.*	*Temp. of Condensing Water*
10	11	12	13	14	15	16	17	18
3.30	56.00	305.00	38,912	118,493	353.32	72.00	70.25	115.00
3.40	55.00	335.00	39,390	118,932	352.21			
3.48	55.00	338.00	39,963	119,530	352.76			
3.36	55.00	338.00	40,567	120,165	352.76			
3.32	54.00	337.00	41,172	120,808	352.76	54.00	52.50	96.00
3.26	55.00	337.00	41,779	121,461	352.76	54.50	52.50	122.00
3.41	55.00	336.00	42,367	122,091	352.76	54.50	53.00	120.75
3.19	55.00	337.00	42,977	122,736	352.76	54.50	53.50	125.50
3.28	55.00	335.00	43,578	123,372	352.76	54.50	53.50	131.00
3.21	55.00	337.00	44,178	123,003	352.76	56.50	56.50	136.50
3.26	55.00	335.00	44,778	124,635	352.76	56.00	54.50	99.00
3.26	55.00	336.00	45,387	125,274	352.76	56.50	55.50	117.00
3.14	54.00	337.00	45,988	125,906	352.76	56.50	56.00	120.00
3.14	53.00	337.00	46,587	126,539	352.76	57.00	56.50	129.50
3.34	54.00	336.00	47,184	127,170	352.76	58.00	57.50	132.00
3.18	54.00	337.50	47,795	127,816	352.76	57.00	55.50	102.00
3.32	54.00	332.50	48,395	128,450	352.21	57.00	55.50	92.00
3.24	53.00	336.00	48,996	129,086	352.21	58.00	56.50	110.00
3.22	54.00	334.00	49,602	129,725	352.76	58.50	57.50	110.00
3.23	54.00	335.00	50,214	130,372	352.76	59.00	58.00	114.00
3.23	55.00	334.50	50,820	131,013	352.76	60.50	59.00	118.00
3.40	55.00	336.00	51,424	131,653	352.76	61.00	60.00	123.50
3.40	54.00	333.00	52,023	132,287	352.76	61.00	60.50	127.00
3.40	55.00	335.50	52,640	132,939	352.76	61.50	61.00	134.00
3.50	55.00	335.00	53,247	133,582	353.32	62.00	61.50	109.00
3.30	55.00	335.00	53,858	134,229	353.32	62.00	61.50	114.00
3.30	54.00	332.50	54,466	134,872	352.76	63.00	62.00	124.00
3.24	54.00	334.00	55,085	135,528	352.76	63.50	63.00	126.00
3.24	55.00	335.00	55,697	136,176	352.76	65.00	64.00	145.00
3.48	54.00	336.00	56,306	136,823	352.76	61.50	58.00	150.00
3.26	55.00	337.00	56,911	137,468	352.76	59.00	58.00	150.00
3.26	54.00	334.00	57,533	138,133	353.32	58.50	56.50	125.00
3.26	54.00	337.50	58,135	138,776	352.76	58.50	57.00	133.00
3.30	54.00	335.00	58,744	139,427	352.76	58.50	57.00	112.00
3.26	55.00	337.00	59,351	140,076	352.21	58.50	57.50	114.00
3.26	55.00	336.00	59,972	140,742	352.76	59.50	58.00	118.00

Date.	Time	Barometer.	Temperatures.				Gauges—Steam.	
			Air.	Water from City Mains.	Feed Water.	Elevation by Heater.	Boilers.	Receiver.
1	2	3	4	5	6	7	8	9
	A. M.							
March 23,	6.00	29.63	73.50	43.00	215.90	172.90	125.	40.50
	6.15	29.64	68.50	43.00	215.00	172.00	124.	40.50
	6.30	29.64	69.50	43.00	216.00	173.00	125.	40.50
	6.45	29.65	68.25	43.00	215.50	172.50	125.	40.50
	7.00	29.65	67.00	43.00	215.70	172.70	125.	40.00
	7.15	29.65	69.75	43.00	215.00	172.00	124.	40.00
	7.30	29.65	71.50	43.00	215.50	172.50	126.	40.50
	7.45	29.66	71.00	43.00	215.50	172.50	124.	40.00
	8.00	29.66	72.75	43.00	215.00	172.00	125.	40.50
	8.15	29.66	69.50	43.00	215.00	172.00	125.	40.50
	8.30	29.66	71.75	43.00	215.00	172.00	125.	40.50
	8.45	29.68	71.50	43.00	215.00	172.00	125.	40.00
	9.00	29.69	72.25	43.00	214.90	171.90	126.	40.50
	9.15	29.70	72.75	43.00	215.90	172.90	125.	40.50
	9.30	29.70	72.50	43.00	215.90	172.90	125.	40.50
	9.45	29.70	72.00	43.00	215.50	172.90	124.	40.00
	10.00	29.71	72.75	43.00	215.50	172.50	126.	40.50
	10.15	29.71	72.00	43.00	216.00	173.00	125.	40.00
	10.30	29.70	75.00	43.00	216.00	173.00	125.	40.00
	10.45	29.70	69.50	43.00	215.90	172.90	125.	40.50
	11.00	29.70	69.50	43.00	216.10	173.10	125.	40.50
	11.15	29.70	70.00	43.00	216.20	173.20	125.	40.50
	11.30	29.70	70.00	43.00	215.90	172.90	125.	40.50
	11.45	29.70	72.50	43.00	216.00	173.00	124.	40.00
	12.00	29.71	71.00	42.50	215.50	173.00	125.	40.50
	P. M.							
	12.15	29.71	70.00	42.50	216.00	173.50	125.	40.50
	12.30	29.71	71.00	43.00	216.00	173.00	125.	40.00
	12.45	29.71	72.50	43.00	215.50	172.50	125.	40.50
	1.00	29.71	73.00	43.00	215.75	172.75	125.	40.50
	1.15	29.71	72.00	43.50	216.00	172.50	125.	40.00
	1.30	29.70	73.75	43.00	215.75	172.75	125.	40.00
	1.45	29.70	73.50	43.00	215.00	172.00	125.	40.50
	2.00	29.70	73.90	43.00	215.50	172.50	125.	40.00
	2.15	29.69	72.00	43.50	215.75	172.25	124.	40.00
	2.30	29.68	72.50	43.00	215.50	172.50	126.	40.50
March 23,	2.45	29.67	71.90	43.00	215.50	172.50	125.	40.50
Averages,		29.62	72.95	43.15	215.41	172.26	125.	40.00

Water Level.	Gauges—Water.		Counters.		Calorimeter.			
	Suction Pipe.	Rising Pipe.	H. P. Engine.	L. P. Engine.	Temp. Steam.	Temp. Condensation.	Temp. Injection.	Temp. of Condensing Water.
10	11	12	13	14	15	16	17	18
3.26	54.00	334.00	60,583	141,397	352.76	60.00	59.00	120.00
3.26	55.00	334.00	61,185	142,043	352.21	60.25	59.00	121.00
3.58	54.00	334.00	61,783	142,684	352.76	60.00	59.75	123.00
3.58	55.00	334.00	62,388	143,336	352.76	60.75	59.75	122.50
3.36	55.00	334.00	62,991	143,983	352.76	60.00	60.00	113.00
3.22	53.00	333.00	63,597	144,633	352.21	61.00	60.50	117.50
3.22	53.00	335.00	64,193	145,277	353.32	61.50	61.50	121.00
3.22	53.00	334.00	64,800	145,932	352.21	62.00	61.50	122.00
3.22	53.00	333.00	65,400	146,579	352.76	62.25	62.00	125.50
3.22	53.00	334.00	65,992	147,220	352.76	63.25	63.00	124.00
3.22	52.00	334.00	66,584	147,864	352.76	64.25	63.25	113.50
3.22	52.00	333.00	67,188	148,519	352.76	64.50	64.00	113.00
3.12	51.00	333.00	67,778	149,164	353.32	65.50	65.00	119.00
3.20	53.00	334.00	68,367	149,808	352.76	61.00	57.00	105.00
3.24	53.00	333.00	68,958	150,449	352.76	57.50	56.00	112.00
3.24	53.00	334.00	69,561	151,098	352.21	57.50	56.50	114.50
3.24	53.00	334.00	70,162	151,743	353.32	57.50	57.00	118.00
3.24	52.50	333.00	70,773	152,398	352.76	57.75	57.75	120.00
3.24	51.00	333.00	71,369	153,038	352.76	57.75	57.75	125.00
3.24	52.50	334.00	71,974	153,688	352.76	57.75	57.75	127.50
3.22	50.00	332.00	72,567	154,335	352.76	58.00	58.00	124.00
5.25	54.00	334.00	73,167	154,986	352.76	58.50	58.50	124.00
3.44	53.00	334.00	73,759	155,616	352.76	60.00	60.00	124.00
3.44	52.50	333.00	74,369	156,276	352.21	60.50	60.50	133.00
3.20	53.00	334.50	74,960	156,922	352.76	60.00	59.50	91.00
3.18	52.00	334.00	75,557	157,567	352.76	58.75	58.00	94.00
3.20	52.50	334.00	76,155	158,216	352.76	60.00	60.00	102.00
3.34	52.50	334.00	76,759	158,872	352.76	61.50	61.50	107.00
3.26	54.00	332.50	77,360	159,524	352.76	62.50	62.00	115.00
3.30	53.00	333.00	77,957	160,169	352.76	63.00	63.00	134.00
3.30	53.00	335.00	78,555	160,815	352.76	63.00	58.00	114.00
3.30	54.00	334.00	79,168	161,475	352.76	64.00	63.00	128.00
3.30	52.50	335.00	79,766	162,120	352.76	65.50	65.00	132.00
3.30	55.00	331.00	80,341	162,771	352.21	58.00	54.00	98.00
3.30	54.00	334.00	80,980	163,427	353.32	56.00	53.50	98.00
3.30	52.00	332.50	81,598	164,094	352.76	56.00	54.00	103.00
3.28	53.80	334.24			352.74	57.29	56.33	113.79

Date.	Time.	Barometer.	Temperatures.				Gauges—Steam.	
			Air.	Water from City Mains.	Feed Water.	Elevation by Heater.	Boilers.	Receiver.
1	2	3	4	5	6	7	8	9
1879	P. M.							
March 23,	3.00	29.67	71.30	43.00	215.75	172.75	125.	38.50
	3.15	29.67	72.10	43.50	216.00	172.50	125.	39.50
	3.30	29 67	72.10	43.50	215.00	171.50	125.	40.00
	3.45	29.65	71.00	45.00	215.00	170.00	125.	39.50
	4.00	29.65	73.00	44.00	216.00	172.00	125.	40.50
	4.15	29.65	72.00	44.00	216.00	172.00	126.	40.50
	4.30	29.63	71.30	44.00	216.00	172.00	126.	40.50
	4.45	29.63	71.20	43.50	215.50	172.00	125.	40.00
	5.00	29.64	72.50	44.00	215.75	171.75	125.	40.00
	5.15	29.64	73.00	44.00	216.00	172.00	125.	40.00
	5.30	29.63	72.50	44.00	215 50	171.50	125.	40.00
	5.45	29.63	73.00	44.00	215.50	171.50	125.	40.50
	6.00	29.62	74.00	44.00	215.90	171.90	125.	39.50
	6.15	29.62	74.00	44.00	215.75	171.75	124.	39.50
	6.30	29.62	74.00	44.00	215.90	171.90	124.	40.00
	6.45	29.62	74.00	44.00	215.75	171.75	124.	39.50
	7.00	29.62	74.00	44.00	215.00	171.00	124.	39.00
	7.15	29.62	75 00	44.00	216.00	172.00	126.	39.50
	7.30	29.61	76.00	44.00	216.00	172.00	127.	40.00
	7.45	29.61	75.00	43.50	215.80	172.30	125.	39.50
	8.00	29.61	74.50	43.50	216.00	172.50	125.	39.00
	8.15	29.61	74.75	44.00	216.25	172.25	125.	39.50
	8.30	29.61	75.00	44.00	215.90	171.90	125.	39.50
	8.45	29.62	73.25	43.50	215.25	171.75	125.	39.50
	9.00	29.62	71.00	43.50	216.20	172.70	125.	39.50
	9.15	29.62	74.00	43.50	216.50	173.00	125.	39.50
	9.30	29.61	73.75	43.50	216.00	172.50	125.	39.50
	9.45	29.60	72.75	43.50	215.90	172.40	125.	39.50
	10.00	29.60	75.00	44.00	215.75	171.75	127.	40.00
	10.15	29.61	74.75	44.00	215.00	171.00	125.	39.50
	10.30	29.59	73.00	44.00	216.50	172.50	125.	40.00
	10.45	29.59	76.00	43.50	215.00	171.50	125.	40.00
	11.00	29.60	73.50	43.50	215.90	172.40	125.	40.50
	11.15	29.59	74.00	43.50	216.00	172.50	125.	40.00
	11.30	29.59	73.00	43.50	214.80	171.30	125.	40.00
	11.45	29.57	73.00	43.50	214.90	171.40	125.	40.00
March 23,	12.00	29.55	73.00	43.50	215.00	171.50	124.	40.00
		29.47	73.63	43.79	215.11	171.32	125.	39.71

	Gauges—Water.		Counters.		Calorimeter.			
Water Level.	*Suction Pipe.*	*Rising Pipe.*	*H. P. Engine.*	*L. P. Engine.*	*Temp. Steam.*	*Temp. Condensation.*	*Temp. Injection.*	*Temp. of Condensing Water.*
10	11	12	13	14	15	16	17	18
3.22	54.00	330.00	82,213	164,757	352.76	57.00	55.00	107.00
3.60	54.00	334.00	82,779	165,370	352.76	57.00	55.00	111.00
3.42	54.00	335.50	83,383	166,023	352.76	57.00	56.00	111.00
3.34	55.00	332.50	83,998	166,687	352.76	57.50	57.00	112.00
3.24	50.00	331.00	84,607	167,345	352.76	58.00	57.00	118.00
3.24	53.00	332.00	85,214	168,006	353.32	58.50	57.00	120.00
3.24	51.00	335.00	85,814	168,657	353.32	58.50	57.50	120.00
3.30	53.00	335.00	86,422	169,325	352.76	58.50	57.50	124.00
3.30	53.00	332.50	87,027	169,962	352.76	60.00	58.00	124.00
3.30	54.00	336.00	87,636	170,610	352.76	61.00	58.50	127.00
3.32	54.00	331.00	88,245	171,256	352.76	61.00	59.00	129.00
3.32	53.00	332.50	88,862	171,912	352.76	61.50	60.00	127.00
3.34	54.00	336.00	89,467	172,556	352.76	62.50	61.50	131.00
3.20	53.00	330.00	90,074	173,201	352.21	64.50	64.00	132.00
3.20	53.00	329.00	90,677	173,843	352.21	63.25	63.00	129.00
3.24	52.00	317.00	91,332	174,539	352.21	64.00	63.50	115.00
3.24	52.00	313.00	91,992	175,245	352.21	64.50	64.00	114.00
3.36	51.00	316.00	92,644	175,942	353.32	58.50	55.00	95.00
3.36	50.00	316.00	93,295	176,644	353.87	57.25	57.00	106.00
3.36	52.00	310.00	93,970	177,363	352.76	57.50	57.50	113.00
3.36	52.50	314.00	94,635	178,077	352.76	57.50	57.50	116.00
3.18	53.00	312.00	95,292	178,780	352.76	57.50	57.50	116.50
3.30	53.00	314.00	95,948	179,484	352.76	57.50	57.50	117.50
3.50	52.50	312.00	96,618	180,196	352.76	58.00	58.00	119.00
3.36	52.50	313.00	97,286	180,895	352.76	59.00	59.00	119.50
3.36	53.00	311.00	97,948	181,591	352.76	59.00	59.00	120.00
3.36	55.00	315.00	98,600	182,279	352.76	59.75	59.75	122.00
3.35	52.00	310.00	99,259	182,973	352.76	59.50	59.50	124.00
3.36	52.50	316.00	99,914	183,666	353.87	59.75	59.75	129.00
3.36	52.00	312.00	100,581	184,366	352.76	61.25	61.00	130.00
3.12	52.00	314.00	101,236	185,035	352.76	62.00	61.75	129.00
3.35	54.00	315.00	101,890	185,745	352.76	62.00	61.50	120.00
3.26	52.00	314.00	102,548	186,447	352.76	62.50	62.00	120.00
3.34	52.50	312.00	103,204	187,147	352.76	63.00	62.50	114.00
3.34	52.00	312.00	103,862	187,846	352.76	63.50	63.00	116.00
3.20	53.00	314.00	104,527	188,549	352.76	64.00	63.50	119.50
3.12	53.00	310.00	105,189	189,245	352.21	65.00	64.50	125.00
3.29	50.61	317.82			352.70	69.86	68.46	130.47

First Method of Trial. **Second Method of Trial.**

Date.	Time.	Weight. Tank No. 1.	Tank No. 2.	Aggregate.	Rate per hour.	Date.	Time.	Weight. Tank No. 1.	Tank No. 2.	Aggregate.	Rate per hour.
1	2	3	4	5	6	1	2	3	4	5	6
March 22,	P. M.					March 23,	P. M.				
	12.24	1547		1,547			9.22	1547		1,547	
	12.40		1537	3,084			9.48		1537	3,084	
	1.08	1547		4,631			10.12	1547		4,631	
	1.27		1537	6,168			10.33		1537	6,168	
	1.48	1547		7,715			10.57	1547		7,715	
	2.15		1537	9,252			11.22		1537	9,252	
	2.38	1547		10,799			11.45	1547		10,799	
	2.59		1537	12,336							
	3.21	1547		13,883		March 23,	A.M.				
	3.43		1537	15,420							
	4.05	1547		16,967			12.10		1537	12,336	
	4.27		1537	18,504			12.30	1547		13,883	
	4.49	1547		20,051			12.53		1537	15,420	
	5.11		1537	21,588			1.18	1547		16,967	
	5.33	1547		23,135			1.40		1537	18,504	
	5.55		1537	24,672			2.04	1547		20,051	
	6.17	1547		26,219			2.28		1537	21,588	
	6.39		1537	27,756			2.49	1547		23,135	
	7.03	1547		29,303			3.13		1537	24,672	
	7.24		1537	30,840			3.38	1547		26,219	
	7.46	1547		32,387			4.02		1537	27,756	
	8.08		1537	33,924			4.21	1547		29,303	
	8.32	1547		35,471			4.46		1537	30,840	
	8.57		1537	37,008	4112.0		5.11	1547		32,387	
							5.34		1537	33,924	
March 23,	P. M.						5.58	1547		35,471	3941.2
							6.20		1537	37,008	
	3.09	1547		38,555			6.40	1547		38,555	
	3.31		1537	40,092			7.08		1537	40,092	
	3.58	1547		41,639			7.33	1547		41,639	
	4.20		1537	43,176			7.55		1537	43,176	
	4.40	1547		44,723			8.17	1547		44,723	
	5.03		1537	46,260			8.42		1537	46,260	
	5.23	1547		47,807			9.06	1547		47,807	
	5.47		1537	49,344			9.28		1537	49,344	
	6.08	1547		50,891			9.52	1547		50,891	
	6.31		1537	52,428			10.13		1537	52,428	
	6.50	1547		53,975			10.35	1547		53,975	
	7.12		1537	55,512			10.59		1537	55,512	
	7.33	1547		57,059			11.20	1547		57,059	
	7.55		1537	58,596			11.41		1537	58,596	
	8.16	1547		60,143							
	8.32		1537	61,680			P. M.				
	8.57	1547		63,227							
	9.18		1537	64,764			12.08	1547		60,143	
	9.40	1547		66,311			12.31		1537	61,680	
	10.01		1537	67,848			13.52	1547		63,227	
	10.24	1547		69,395			1.14		1537	64,764	
	10.44		1537	70,932			1.35	1547		66,311	
	11.03	1547		72,479			1.59		1537	67,848	
	11.25		1537	74,016			2.27	1547		69,395	
	11.53	604		74,620	4179.0		2.47		1537	72,479	4112.0
Average,					4145.5	Average,					4026.6

Indicator Diagrams.

In the following sixteen tables are given all the important data from the indicator diagrams. As will be observed by the engraved diagrams accompanying this report, the form of the indicator card is rather peculiar; the initial pressure in the high pressure cylinder not being realized until the piston has made from five to ten per cent. of the stroke.

The uniformity of the diagram, however, is well shown by the ordinate measurements. By the action of the cataract a cut-off takes place very late in the stroke of both engines; but as it is too late in the low pressure engine to materially affect the ratio of expansion, the cut-off measurements are omitted in the tables of diagrams. In estimating the lengths of piston strokes from the diagrams, it is assumed that since certain diagrams must have been taken at intervals, when the cross-heads of the engines were beating both upper and lower buffers, that the longest cards coincide with the maximum piston strokes. By careful measurement of both engines, it is found that the maximum stroke of high pressure engine is 30.375″, and of low pressure engine 30.00″, and of the entire number of diagrams taken (290 to each engine), the longest have been held to represent the maximum strokes, and the other strokes have been taken in the ratio of the length of indicator cards.

The diagrams were carefully divided and measured by ordinates for maximum and counter pressures, and by a D., B. & S. steel scale, graduated to hundredths (inches) for lengths. By the aid of a hand-glass, the readings of lengths were readily made to the nearest, .005 of an inch.

The mean effective pressure for the purpose of estimating the power developed, has been taken with a planimeter.

The mean readings, by ten ordinates, from the peculiar form of the cards, is necessarily greater than the planimeter readings, and the latter is taken as representing the true mean effective pressure.

Date.	Time.	No. of Diagram.	Strokes.		Initial Pressure.	At .05.		At .15.		At .25.		At .35.		At .45.	
			Length, Ins.	Double, per minute.		Maximum Pres.	Counter Pres.	Maximum Pres.	Counter Pres.	Maximum Pres.	Counter Pres.	Maximum Pres.	Counter Pres.	Maximum Pres.	Counter Pres.
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
March 22,	M.														
	12.00 P M	1	28.57	40.67	123.5	123.5	43.0	116.5	43.5	114.0	44.0	114.0	44.0	108.5	43.5
	12.15	2	29.76	41.80	124.0	120.0	43.0	117.0	43.0	113.0	43.0	113.5	44.5	110.5	44.0
	12.30	3	29.46	43.87	123.5	115.5	43.0	117.5	43.0	114.0	43.5	111.0	43.5	110.0	43.5
	12.45	4	29.72	45.47	125.0	122.0	42.0	117.5	41.5	114.5	41.5	114.0	42.5	113.5	42.5
	1.00	5	30.00	44.80	122.0	115.0	43.5	118.5	43.0	116.5	43.0	113.0	43.5	113.0	44.0
	1.15	6	29.39	43.07	121.0	116.5	41.5	115.5	41.5	113.0	42.5	109.5	43.0	107.0	43.0
	1.30	7	28.91	43.40	122.0	121.5	42.5	119.0	42.5	112.5	42.5	109.0	42.5	108.0	42.5
	1.45	8	28.94	42.07	121.5	117.0	42.5	118.5	42.5	116.5	42.5	112.0	42.5	110.0	42.5
	2.00	9	29.88	42.07	111.0	110.5	39.5	111.0	39.0	108.0	39.0	106.5	40.5	105.0	41.0
	2.15	10	29.46	41.60	123.0	120.0	45.0	120.5	45.0	114.5	44.0	111.5	43.0	110.0	45.0
	2.30	11	28.75	43.13	124.5	118.5	43.5	117.0	43.5	112.0	43.5	109.5	43.5	108.0	43.5
	2.45	12	29.42	42.93	122.5	119.5	45.5	116.5	46.0	114.0	46.5	110.5	46.5	108.5	46.5
	3.00	13	28.66	44.00	124.5	115.5	40.5	115.5	42.0	111.0	41.5	108.0	42.0	105.5	42.0
	3.15	14	29.68	43.27	119.5	116.0	43.0	118.5	43.0	113.0	42.5	112.5	44.5	110.0	44.5
	3.30	15	30.19	43.27	119.0	115.5	45.0	120.0	44.0	115.5	45.5	114.0	45.0	110.5	45.0
	3.45	16	29.21	42.67	121.5	118.5	44.5	117.0	44.5	113.0	44.0	110.0	44.0	109.0	44.5
	4.00	17	29.15	43.27	123.0	121.5	43.0	116.0	43.0	111.5	43.0	109.0	43.5	108.0	43.5
	4.15	18	30.10	43.53	120.5	121.0	45.0	118.5	43.0	112.0	42.5	111.0	44.0	110.0	43.0
	4.30	19	29.06	44.13	122.5	121.0	43.5	115.5	43.5	111.0	44.0	108.5	43.0	108.0	43.5
	4.45	20	29.88	43.27	120.5	120.0	46.0	117.0	45.5	113.5	45.5	112.0	45.5	110.0	45.5
	5.00	21	29.12	43.47	124.5	120.5	45.0	119.0	45.0	115.0	45.0	113.0	45.0	110.0	45.0
	5.15	22	28.97	42.53	123.5	122.0	42.5	117.5	42.0	114.0	42.0	110.5	42.5	108.5	43.5
	5.30	23	30.13	43.00	120.0	114.0	45.0	119.0	45.0	115.0	45.0	114.5	45.5	113.5	45.5
	5.45	24	29.95	42.93	120.0	113.5	45.0	119.0	44.5	116.0	45.0	113.5	44.5	113.0	44.5
	6.00	25	29.95	42.27	117.5	112.0	45.0	117.0	42.5	113.0	43.0	110.0	42.5	110.0	42.5
	6.15	26	29.88	41.80	120.0	113.0	46.0	117.0	42.5	113.0	43.0	113.0	43.0	113.0	43.0
	6.30	27	30.28	43.13	119.0	114.0	46.0	118.5	43.0	114.5	43.0	113.5	43.0	111.5	43.0
	6.45	28	30.07	42.87	120.0	108.0	47.0	118.0	42.5	112.5	42.5	112.0	42.5	112.0	42.5
	7.00	29	30.16	42.40	120.0	113.0	46.5	117.5	43.0	114.0	43.0	112.0	43.5	111.5	43.5
	7.15	30	29.70	43.00	121.0	117.5	42.5	116.5	40.5	113.0	41.5	110.0	41.5	109.0	41.5
	7.30	31	29.79	43.13	123.5	116.0	45.5	117.5	42.0	113.5	41.5	112.5	42.0	110.5	42.0
	7.45	32	30.19	44.07	119.5	113.5	47.0	116.5	42.5	111.5	42.5	110.0	42.5	109.5	42.5
	8.00	33	29.55	43.87	118.0	112.0	41.0	116.0	41.5	112.0	41.5	110.0	42.0	108.0	42.0
	8.15	34	29.73	43.80	120.5	114.0	43.5	117.0	41.0	113.0	42.0	111.5	42.0	109.0	42.0
	8.30	35	30.10	44.73	120.0	112.5	47.0	117.5	41.5	112.5	42.0	110.0	41.5	109.0	41.5
	8.45	36	29.36		118.0	113.0	44.0	117.0	44.0	115.0	44.0	111.0	44.0	109.5	44.0

At .55.		At .65.		At .75.		At .85.		At .95.		Terminal Pres.	Mean Pressure.		Effective Pressure.	
Maximum Pres.	Counter Pres.	Maximum Pres.	Counter Pres.	Maximum Pres.	Counter Pres.	Maximum Pres.	Counter Pres.	Maximum Pres.	Counter Pres.		Maximum.	Counter.	By Ordinates.	By Planimeter
17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
108.0	43.5	108.5	44.5	108.5	46.0	108.5	45.5	105.0	49.5	80.0	111.55	44.70	66.80	65.76
110.5	44.5	110.5	44.5	110.5	45.0	110.0	45.0	103.0	71.5	96.0	111.85	46.80	65.05	64.49
108.5	43.0	107.5	43.0	107.5	43.5	107.0	44.0	101.0	59.0	98.0	109.95	44.90	65.05	64.35
112.0	43.5	110.5	44.0	109.5	44.0	109.5	44.0	101.0	57.5	96.0	113.40	44.30	69.10	66.65
113.0	44.5	113.0	45.0	111.0	45.0	111.0	45.5	102.0	72.5	98.0	112.60	46.95	65.65	65.50
107.5	43.5	106.5	43.5	106.0	43.5	105.5	45.5	101.0	58.0	97.0	108.80	44.55	64.25	63.37
107.0	43.0	107.0	43.5	107.0	43.5	107.5	44.5	102.5	59.0	98.0	110.10	44.60	65.50	64.62
109.5	43.5	108.0	44.5	108.0	44.5	107.5	45.0	102.0	56.0	96.0	110.90	44.60	66.30	64.68
104.5	41.0	104.5	40.5	104.5	40.5	104.5	41.0	96.5	55.5	92.0	105.55	41.75	63.80	62.63
108.5	45.5	107.5	45.0	108.0	45.5	109.0	45.0	104.0	70.0	99.0	111.35	47.50	63.85	62.92
106.5	43.0	107.0	44.0	106.5	44.0	107.0	44.5	102.0	64.5	98.0	109.40	45.75	63.65	63.69
107.5	47.0	106.0	46.5	106.0	46.5	106.0	47.0	99.5	59.5	93.0	109.40	47.75	61.65	59.65
105.5	42.5	105.5	43.5	105.0	42.5	105.5	43.0	99.5	53.0	95.0	107.65	43.25	64.40	63.13
109.0	44.5	108.0	44.5	108.0	44.5	107.5	45.5	98.5	71.0	94.0	110.10	46.75	63.35	62.96
111.0	45.0	111.0	45.0	110.5	44.5	110.5	44.5	103.0	58.0	97.0	112.15	46.15	66.00	64.67
108.5	44.0	107.0	44.0	108.0	45.0	109.5	44.5	105.0	56.5	99.0	110.55	45.55	65.00	63.57
107.0	43.0	107.0	43.0	106.5	43.5	106.5	43.0	103.0	54.5	97.0	109.60	44.30	65.30	63.58
110.0	43.5	109.5	43.0	110.0	44.0	110.5	43.5	101.0	71.0	96.0	111.35	46.25	65.15	64.02
107.0	43.5	106.5	43.5	106.0	44.0	107.0	44.0	103.0	57.5	98.0	109.35	45.00	64.35	63.40
108.0	46.0	107.5	47.0	108.0	47.0	107.5	47.5	105.0	61.0	98.0	111.85	47.65	64.20	61.77
108.0	46.0	107.5	47.0	107.5	47.0	107.0	47.0	100.5	57.0	96.0	110.80	46.90	63.90	61.88
106.0	44.0	106.0	45.0	106.0	45.0	105.5	44.5	99.5	68.5	92.0	109.55	45.95	63.60	62.84
113.0	45.5	113.0	45.0	113.0	45.5	110.5	46.0	102.5	75.0	97.0	112.80	48.30	64.50	63.70
110.5	44.5	110.5	44.5	110.5	44.5	111.0	45.5	103.0	62.5	98.0	112.05	46.50	65.55	63.73
109.5	42.5	110.0	42.5	109.5	42.5	109.5	43.0	100.0	71.5	94.0	110.05	45.75	64.30	63.73
110.5	43.0	110.5	43.0	110.5	43.0	108.5	43.5	99.0	55.5	95.0	110.80	44.55	66.25	64.12
111.5	43.5	111.5	43.0	111.0	43.0	110.5	44.5	100.5	73.5	96.0	111.70	46.55	65.15	64.35
112.0	42.5	112.5	43.0	112.0	43.0	112.0	43.0	101.0	71.0	96.0	111.20	45.95	65.25	64.93
111.5	44.0	110.0	44.0	110.5	43.5	110.0	44.5	99.5	74.5	94.0	110.95	47.00	63.95	63.28
108.0	41.5	107.0	41.0	106.0	41.5	104.0	42.0	95.5	54.5	80.0	108.65	42.80	65.85	64.38
110.5	42.5	111.0	43.0	110.5	42.5	107.5	42.5	100.0	55.0	94.0	110.95	43.85	67.10	66.27
109.0	42.5	109.0	43.0	109.0	43.0	108.0	43.5	99.0	72.0	94.0	109.60	46.10	63.50	63.52
108.0	42.0	106.5	42.5	106.5	42.5	104.0	42.0	96.5	66.5	91.0	107.85	44.35	63.50	63.72
109.0	42.0	107.5	41.5	106.5	42.0	105.0	42.0	96.0	70.0	92.0	108.85	44.80	64.05	64.80
109.0	41.5	109.5	42.0	109.0	41.5	109.0	42.0	99.0	73.0	93.0	109.70	45.35	64.35	64.26
108.5	44.0	107.0	44.0	106.5	44.5	105.0	44.5	98.5	70.0	93.0	109.10	46.70	62.40	62.49

Date.	Time.	No. of Diagrams.	Strokes.		Initial Pressure.	At .05.		At .15.		At .25.		At .35.		At .45.	
			Length, Ins.	Double, per Minute.		Maximum Press.	Counter Press.	Maximum Press.	Counter Press.	Maximum Press.	Counter Press.	Maximum Press.	Counter Press.	Maximum Press.	Counter Press.
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
March 22,	P. M.														
	9.00	37	28.39	44.07	74.0	74.0	20.5	67.5	20.5	59.5	20.5	54.5	20.5	51.5	20.5
	9.15	38	29.21	31.87	120.0	119.5	40.0	119.5	40.0	116.5	40.0	114.0	40.0	111.5	40.0
	9.30	39	28.85	38.20	126.0	126.0	41.0	117.0	40.5	114.5	40.5	112.0	40.5	111.0	40.5
	9.45	40	28.82	40.27	127.0	127.0	41.0	118.5	41.0	115.0	41.0	112.5	41.0	111.5	41.5
	10.00	41	28.82	40.33	119.0	119.5	42.0	118.5	42.0	115.5	42.0	112.5	42.5	111.0	42.5
	10.15	42	29.12	40.47	123.0	123.0	43.0	120.0	42.0	116.0	42.0	114.0	42.5	113.0	42.0
	10.30	43	29.00	39.20	127.5	127.5	42.0	120.0	42.0	116.5	43.0	115.0	43.5	114.0	43.5
	10.45	44	29.00	40.67	127.0	126.0	42.5	119.0	42.0	116.0	42.5	113.5	42.0	112.5	42.5
	11.00	45	28.82	40.07	127.0	127.0	43.0	119.0	43.0	116.0	43.0	113.5	43.0	112.5	43.5
	11.15	46	29.06	40.00	126.5	126.5	42.5	119.0	43.0	117.0	43.0	114.0	43.0	112.5	42.5
	11.30	47	29.03	40.00	125.0	125.0	42.5	120.0	43.0	115.0	42.0	112.5	42.5	111.0	42.0
	11.45	48	29.61	40.40	127.0	127.0	43.5	120.0	43.0	116.0	43.0	115.5	44.5	114.0	44.5
March 23,	A. M.														
	12.00	49	29.70	40.07	126.0	126.0	43.0	119.5	42.5	117.0	42.5	115.5	43.0	114.5	43.5
	12.15	50	29.85	39.93	127.0	121.0	45.0	119.5	42.0	117.5	42.0	114.0	42.5	114.0	44.5
	12.30	51	29.18	39.80	123.0	122.0	43.5	116.5	43.5	115.5	43.5	113.0	43.5	112.0	43.0
	12.45	52	28.94	40.73	123.0	123.0	43.0	117.5	42.5	113.5	42.5	112.5	42.5	112.0	42.5
	1.00	53	29.64	40.00	126.0	126.0	43.0	118.0	42.0	116.0	42.0	114.0	42.0	113.5	43.0
	1.15	54	29.79	40.07	125.5	114.0	45.0	118.5	42.0	117.0	41.5	115.0	42.5	114.5	42.5
	1.30	55	28.78	40.40	128.0	126.0	43.0	120.0	43.0	115.0	43.0	113.0	43.0	112.0	43.0
	1.45	56	29.00	40.80	128.0	128.0	43.0	119.0	43.5	116.0	43.5	113.5	44.0	112.0	43.5
	2.00	57	29.21	40.40	127.5	124.5	44.0	120.0	43.0	116.5	43.0	115.0	43.0	114.0	43.0
	2.15	58	29.42	40.27	124.0	124.0	43.0	119.0	43.0	116.0	43.0	114.5	44.5	114.0	44.5
	2.30	59	29.58	39.93	126.0	120.0	45.0	119.0	42.0	117.0	43.0	115.0	43.0	114.0	43.0
	2.45	60	29.15	42.47	127.0	127.0	43.0	119.0	43.0	116.0	43.5	113.0	43.5	112.5	43.0
	3.00	61	29.67	40.47	125.0	122.0	44.5	120.0	42.5	117.5	43.0	115.0	43.0	113.5	43.0
	3.15	62	29.79	40.73	124.0	124.0	46.5	120.0	43.0	118.0	43.0	115.0	43.0	114.0	43.0
	3.30	63	29.03	40.53	127.0	127.0	43.0	119.5	43.0	117.0	43.0	114.0	43.5	113.0	43.5
	3.45	64	29.00	41.20	127.0	127.0	44.0	120.0	42.5	117.0	43.0	114.0	43.0	113.0	43.5
	4.00	65	29.30	40.80	126.5	126.5	43.5	119.5	43.5	117.0	44.0	114.0	43.5	113.0	43.5
	4.15	66	28.97	40.60	127.0	127.0	43.0	119.0	43.5	115.0	43.5	112.0	43.5	111.0	43.5
	4.30	67	29.33	40.33	120.0	120.0	44.0	119.0	41.5	116.0	42.0	114.5	43.0	114.0	44.0
	4.45	68	29.61	41.47	120.0	120.0	45.0	120.0	43.0	117.0	43.0	114.0	43.0	114.0	43.0
	5.00	69	28.88	40.13	126.0	123.0	43.5	120.0	40.0	118.0	43.0	114.5	43.0	113.0	42.0
	5.15	70	29.45	40.60	125.5	121.0	45.0	120.0	42.0	118.0	43.5	116.0	44.0	114.0	44.0
	5.30	71	29.24	40.47	126.0	126.0	45.0	120.0	42.5	117.0	42.0	115.0	42.5	112.5	42.5
	5.45	72	29.55	41.40	118.0	118.0	43.5	121.0	43.0	117.0	44.0	114.0	43.5	113.0	44.0

At .55.		At .65.		At .75.		At .85.		At .95.			Mean Pressure.		Effective Pressure.	
Maximum Press.	*Counter Press.*	*Maximum Press.*	*Counter Press.*	*Maximum Press.*	*Counter Press.*	*Maximum Press.*	*Counter Press.*	*Maximum Press.*	*Counter Press.*	*Terminal Pressure.*	*Maximum.*	*Counter.*	*By Ordinates.*	*By Planimeter*
17	18	19	20	21	22	23	.24	25	26	27	28	29	30	31
51.0	21.0	51.0	21.0	51.0	21.5	51.0	22.5	51.5	27.5	44.5	56.25	21.60	34.65	34.06
111.0	40.0	111.0	41.0	109.0	41.5	108.0	42.5	99.5	48.0	94.5	111.95	41.30	70.65	68.59
110.5	40.5	108.5	41.0	108.5	41.0	108.5	41.5	101.0	66.0	96.0	111.75	43.30	68.45	66.79
111.5	41.5	110.5	41.5	110.0	41.0	109.5	42.0	101.5	72.0	96.5	112.75	44.35	68.40	68.00
111.0	43.0	110.5	43.0	110.0	42.5	111.0	43.5	105.0	69.5	99.5	112.45	45.25	67.20	67.24
112.0	42.5	111.5	42.0	111.5	42.5	109.0	43.0	101.0	70.5	96.5	113.10	45.20	67.90	67.29
112.5	43.5	112.5	43.5	112.0	44.0	109.5	44.5	102.5	67.5	96.0	114.20	45.10	69.10	66.95
112.0	43.0	110.0	43.0	110.0	43.0	110.0	44.5	102.0	67.0	97.5	113.10	45.20	67.90	66.31
110.0	43.0	110.0	44.0	110.0	44.0	111.0	45.0	103.5	67.0	98.0	113.25	45.85	67.40	66.22
112.0	43.0	112.5	43.5	110.0	44.0	109.5	44.5	101.5	68.5	96.0	113.45	45.75	67.70	66.55
109.5	42.0	109.0	43.0	108.5	43.0	109.0	44.5	101.0	67.0	96.0	112.05	45.15	66.90	65.74
114.0	44.0	114.0	45.0	114.0	45.5	104.0	46.0	103.5	69.0	98.0	114.20	46.80	67.40	66.55
114.0	45.0	114.0	45.0	114.0	45.0	111.0	45.0	102.5	70.0	97.5	114.80	46.45	68.35	66.72
114.0	44.0	114.0	44.5	114.0	44.0	112.5	44.5	102.5	70.0	97.5	114.30	46.30	68.00	66.62
112.0	43.5	112.0	43.5	112.5	43.5	113.5	44.0	104.5	67.0	99.0	113.35	45.85	67.50	66.78
111.5	42.5	111.5	42.5	111.0	42.5	111.0	43.0	104.5	58.5	99.0	113.10	44.20	68.90	67.47
114.0	43.0	113.0	44.0	112.5	44.5	110.5	44.5	101.0	71.5	95.5	113.85	45.95	67.90	66.73
114.0	43.0	114.0	43.5	112.5	45.0	111.0	45.0	102.0	69.5	97.0	113.65	45.95	67.70	67.13
110.5	43.5	109.0	43.0	110.0	44.0	110.0	44.5	102.0	67.5	98.0	112.75	45.75	67.00	65.79
109.5	43.5	109.0	44.0	109.5	43.5	109.5	44.0	102.0	67.0	97.5	112.80	45.95	66.85	65.43
113.0	43.5	113.0	44.0	112.0	44.5	109.0	46.0	100.0	68.5	95.5	113.70	46.25	67.45	66.76
113.0	45.0	113.0	45.0	112.5	45.5	112.5	46.0	102.5	68.5	99.0	114.10	46.80	67.90	65.73
114.0	44.0	113.5	44.0	113.5	46.0	111.0	46.0	102.0	70.0	97.5	113.90	46.60	67.30	66.50
111.5	43.0	111.0	44.0	109.0	44.5	108.0	45.0	99.5	78.0	95.5	112.65	47.05	65.60	64.96
113.0	43.5	113.0	44.0	111.5	45.0	108.0	45.0	99.0	68.0	96.0	113.25	46.15	67.10	66.79
113.0	43.5	112.0	44.5	112.0	45.0	109.0	46.0	100.0	69.0	95.5	113.70	46.65	67.05	65.40
111.5	43.5	110.0	43.0	110.0	44.0	109.5	45.0	101.0	69.0	97.0	113.25	46.05	67.20	65.61
111.0	44.0	109.5	43.5	109.5	44.0	110.0	45.0	101.0	67.0	97.0	113.40	45.95	67.45	65.94
112.0	43.5	110.0	44.0	110.0	45.0	109.0	45.5	100.5	68.0	95.0	113.15	46.40	66.75	64.75
109.0	44.0	109.0	43.5	109.5	44.5	110.0	45.0	102.0	68.0	98.0	112.35	46.20	66.15	64.74
113.0	43.0	113.0	44.5	113.0	45.0	111.5	45.0	103.0	69.0	98.0	113.70	46.10	67.60	67.43
114.0	43.5	111.5	44.0	112.0	45.0	110.0	45.0	101.0	68.5	96.0	113.35	46.30	67.05	65.32
111.0	42.0	109.5	42.5	110.0	44.0	110.0	44.0	101.0	67.0	96.5	112.90	45.40	67.50	66.34
114.0	44.0	112.5	44.5	111.0	45.0	109.0	46.0	100.0	70.0	96.0	113.55	46.80	66.75	65.41
112.0	43.0	111.0	43.0	111.0	44.5	108.0	44.5	100.0	66.0	96.0	113.15	45.75	67.40	65.63
113.0	45.0	113.0	45.0	112.5	46.0	111.5	46.0	104.0	71.0	98.5	113.70	47.40	66.30	65.58

Date.	Time.	No. of Diagram.	Strokes. Length, Ins.	Strokes. Double, per minute.	Initial Pressure.	At .05. Maximum Pres.	At .05. Counter Pres.	At .15. Maximum Pres.	At .15. Counter Pres.	At .25. Maximum Pres.	At .25. Counter Pres.	At .35. Maximum Pres.	At .35. Counter Pres.	At .45. Maximum Pres.	At .45. Counter Pres.
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
March 23,	A M 6.00	73	29.36	40.73	123.5	123.5	44.0	117.5	43.5	117.0	44.0	115.0	45.0	114.0	45.5
	6.15	74	29.39	40.13	125.0	125.5	42.0	119.0	42.0	116.5	43.0	113.0	43.5	113.0	43.0
	6.30	75	28.73	39.87	125.5	126.0	42.0	118.5	43.0	115.5	42.5	112.0	42.5	111.0	42.5
	6.45	76	28.79	40.33	115.0	115.0	42.0	118.0	42.5	115.5	43.0	114.0	42.5	111.0	43.0
	7.00	77	29.24	40.20	120.0	120.0	43.5	119.0	43.0	112.0	43.0	112.0	44.0	111.5	43.5
	7.15	78	29.67	40.40	124.5	115.0	45.0	120.0	42.5	116.0	43.0	114.0	44.0	113.5	44.0
	7.30	79	29.18	39.73	127.0	127.0	44.0	121.0	43.5	119.0	44.0	116.0	44.0	113.5	43.5
	7.45	80	28.76	40.47	126.0	126.0	42.0	118.5	42.5	115.0	42.0	114.5	43.0	112.0	43.0
	8.00	81	29.42	40.00	125.5	115.0	44.0	121.0	43.0	118.0	43.5	116.0	44.0	115.0	44.0
	8.15	82	29.43	39.47	119.0	119.0	45.0	119.5	43.0	119.0	43.0	115.0	42.0	114.0	42.5
	8.30	83	28.76	39.47	121.0	121.0	42.5	119.0	42.5	115.0	43.0	113.0	43.5	112.0	44.0
	8.45	84	29.06	40.27	130.0	130.0	44.0	119.5	42.0	116.0	43.0	114.0	43.0	113.0	42.0
	9.00	85	29.73	39.33	121.5	121.5	44.0	121.5	43.0	119.0	43.0	117.0	43.0	117.0	44.0
	9.15	86	29.12	39.27	120.5	120.5	43.0	118.5	43.5	117.5	43.5	115.5	44.0	114.0	45.5
	9.30	87	29.79	39.40	126.0	116.0	45.0	121.0	42.0	119.0	43.0	117.0	43.0	115.0	43.0
	9.45	88	29.00	40.20	125.0	122.5	42.0	119.5	43.0	114.0	43.0	113.0	42.0	113.0	42.5
	10.00	89	29.79	40.07	127.5	119.0	46.0	121.5	43.0	119.5	43.0	117.5	44.0	115.5	43.5
	10.15	90	29.52	40.73	120.0	116.0	44.5	119.0	42.0	117.0	42.0	114.5	43.0	113.5	43.5
	10.30	91	28.88	41.07	129.0	129.0	42.0	117.0	42.0	115.0	42.0	112.0	42.0	111.0	42.5
	10.45	92	29.33	40.33	114.0	118.0	44.0	120.0	42.5	117.0	43.0	115.0	43.0	114.0	43.0
	11.00	93	28.88	40.20	128.0	128.0	43.5	120.0	42.5	117.0	42.0	114.0	42.0	113.0	42.0
	11.15	94	29.61	40.00	127.0	127.0	45.0	121.5	41.5	118.0	42.0	116.5	42.5	116.0	43.0
	11.30	95	29.21	39.47	125.0	123.0	44.0	121.0	42.0	118.0	42.5	115.0	42.5	114.0	42.5
	11.45	96	28.82	40.67	125.0	125.0	43.0	119.0	43.0	116.0	43.0	114.5	43.0	113.0	43.0
	12.00	97	29.30	39.40	124.0	124.0	45.0	121.0	42.0	118.5	42.0	116.0	42.5	115.0	43.0
	P M 12.15	98	29.85	39.80	125.0	120.5	47.5	121.0	42.0	119.0	42.5	118.0	43.5	115.0	44.0
	12.30	99	29.67	39.87	122.5	116.0	45.0	121.5	41.0	118.0	41.5	116.0	43.0	114.0	43.0
	12.45	100	29.30	40.27	125.0	122.0	44.0	121.5	43.0	118.0	43.0	115.5	43.0	114.5	43.0
	1.00	101	29.39	40.07	125.0	109.5	43.0	117.0	42.0	116.0	43.0	114.5	44.0	113.0	45.0
	1.15	102	28.85	39.80	123.0	120.5	42.5	118.5	43.0	114.0	43.0	112.0	43.0	109.5	43.0
	1.30	103	28.82	39.87	125.0	125.0	43.0	117.0	42.0	115.0	43.0	112.0	43.5	112.0	43.0
	1.45	104	29.24	40.87	125.5	118.0	43.0	118.0	41.5	114.0	43.0	112.0	44.0	111.5	44.0
	2.00	105	28.97	39.87	125.0	124.0	44.0	119.0	42.0	117.0	42.0	114.0	42.0	112.0	42.0
	2.15	106	29.73	38.33	121.0	108.0	45.0	121.0	42.0	116.0	42.0	114.0	43.0	113.0	43.5
	2.30	107	29.85	42.60	120.0	106.0	49.0	121.0	42.0	111.0	43.0	114.0	43.0	113.0	43.5
	2.45	108	29.85	41.20	125.0	116.0	48.0	119.0	42.5	118.0	42.0	115.0	43.0	114.0	43.0
Averages,			29.25	40.26	123.7										

At .55.		At .65.		At .75.		At .85.		At .95.			Mean Pressure.		Effective Pressure.	
Maximum Pres.	*Counter Pres.*	*Maximum Pres.*	*Counter Pres.*	*Maximum Pres.*	*Counter Pres.*	*Maximum Pres.*	*Counter Pres.*	*Maximum Pres.*	*Counter Pres.*	*Terminal Pres.*	*Maximum.*	*Counter.*	*By Ordinates.*	*By Planimeter*
17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
114.0	45.0	113.5	45.0	112.5	45.0	113.0	45.0	105.0	70.0	123.5	114.50	47.20	67.30	66.48
113.0	44.0	112.5	44.5	112.5	45.0	112.0	45.5	103.0	71.0	98.0	114.00	46.35	67.35	65.57
109.5	42.5	108.0	42.5	108.0	43.0	108.5	44.5	101.0	67.0	97.0	111.80	45.20	66.60	65.29
109.0	42.5	109.0	42.5	109.0	43.5	109.5	44.0	101.5	67.0	97.0	111.15	45.25	65.90	64.90
109.0	43.0	109.0	43.0	109.0	43.0	109.0	44.0	99.5	68.0	99.0	111.85	45.80	66.05	66.01
112.5	43.5	113.0	45.0	113.0	45.0	113.0	45.0	104.0	69.0	98.5	113.40	46.60	66.80	65.43
113.0	44.0	112.0	44.5	110.5	44.5	110.0	46.0	102.0	69.0	96.5	114.40	46.70	67.70	66.02
110.5	42.5	109.0	43.0	109.5	44.0	110.0	45.0	102.0	68.5	97.5	112.70	45.55	67.15	66.49
114.0	44.5	114.0	43.5	113.0	45.0	110.5	46.0	102.5	71.0	97.0	113.90	46.85	67.05	66.84
113.0	43.0	113.0	44.0	112.0	44.5	109.5	45.0	100.0	69.5	96.5	113.40	46.15	67.25	66.84
112.5	44.0	112.5	43.5	113.0	44.0	112.5	44.0	105.0	73.0	99.5	113.55	46.40	67.15	66.49
112.0	43.0	112.0	43.0	110.0	44.0	109.0	44.0	102.0	68.0	96.5	113.75	45.60	68.15	65.67
115.5	44.0	115.0	45.0	115.0	45.0	113.0	47.0	104.5	70.0	99.5	115.90	46.80	69.10	67.88
114.0	45.5	113.5	45.0	114.0	45.5	114.0	46.0	107.0	70.0	101.0	114.85	47.15	67.70	66.79
114.0	43.0	114.0	43.0	112.0	44.0	110.0	45.5	103.0	71.5	97.0	114.10	46.30	67.80	66.27
112.0	42.0	112.0	43.5	112.0	44.0	112.5	44.0	104.5	68.0	100.0	113.50	45.40	68.10	66.75
115.5	44.5	114.5	45.0	113.5	44.5	111.0	46.5	101.5	72.5	96.5	114.85	47.35	67.50	66.39
113.0	44.5	113.0	45.0	113.0	45.0	113.0	46.0	104.5	70.0	99.0	114.05	46.55	67.50	65.77
111.0	42.0	111.0	43.0	110.5	43.0	110.5	43.0	105.0	65.5	99.0	113.20	44.70	68.50	66.85
113.5	44.0	112.0	44.0	110.5	44.5	110.0	45.0	101.0	68.0	96.5	113.10	46.10	67.00	65.68
110.5	42.0	110.5	42.5	111.0	43.5	110.6	44.0	104.0	67.0	99.0	114.00	45.10	68.90	67.35
115.0	43.0	114.0	44.0	113.5	45.0	111.0	45.5	101.0	70.0	96.0	115.35	46.15	69.20	67.17
113.0	43.0	112.0	43.0	110.5	43.0	108.0	45.0	100.0	66.0	95.0	113.45	45.35	68.10	66.20
113.5	43.0	113.5	44.0	113.0	44.5	113.0	44.5	106.5	68.5	101.0	114.70	45.95	68.75	67.75
114.0	42.0	113.5	43.0	113.0	44.0	110.5	45.0	102.0	68.5	96.5	114.75	45.70	69.05	67.37
114.5	44.5	114.5	45.5	114.5	45.5	114.5	46.0	104.0	69.0	99.0	115.55	47.00	68.55	67.10
114.0	44.5	114.0	44.5	114.0	45.0	114.0	45.0	105.0	68.0	100.0	114.65	46.05	68.60	66.66
113.0	43.5	112.0	43.5	111.0	44.5	109.0	46.0	99.0	69.0	96.5	113.55	46.25	67.30	64.36
112.5	45.0	112.5	45.0	112.5	45.5	112.5	45.0	105.0	66.5	100.5	112.50	46.40	66.10	64.55
108.5	43.0	109.0	43.0	109.0	43.5	110.5	44.0	105.0	65.5	98.5	111.65	45.35	66.30	64.95
110.5	43.0	111.5	43.5	111.0	44.0	111.0	44.0	104.0	66.0	99.0	112.90	45.50	67.40	65.08
111.0	44.0	111.0	44.5	111.0	44.5	111.0	45.0	104.5	66.0	99.0	112.20	45.95	66.25	65.13
111.0	42.0	110.0	43.5	108.5	43.5	109.0	44.5	101.0	66.5	96.0	112.55	45.20	67.35	65.25
113.0	44.5	113.0	45.0	112.0	45.0	111.5	45.5	103.0	69.0	97.0	112.45	46.45	66.00	64.93
112.5	44.5	112.0	45.0	112.5	45.0	112.0	46.0	104.0	68.0	99.0	118.80	46.90	64.90	64.03
113.0	43.5	112.0	43.5	112.0	44.5	109.0	45.0	100.5	70.0	94.5	112.85	46.50	66.35	65.03
										97.1		45.59	67.02	65.74

Date.	Time.	No. of Diagrams.	Strokes.		Initial Pressure.	At .05.		At .15.		At .25.		At .35.		At .45.	
			Length, Ins.	Double, per Minute.		Maximum Press.	Counter Press.	Maximum Press.	Counter Press.	Maximum Press.	Counter Press.	Maximum Press.	Counter Press.	Maximum Press.	Counter Press.
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
March 23,	P. M.														
	3.00	109	28.82	41.00	121.0	121.0	43.0	106.0	43.0	109.0	43.0	107.0	43.0	106.5	43.0
	3.15	110	29.61	37.73	123.5	116.0	43.0	119.0	40.0	114.0	41.0	114.0	42.0	112.0	42.5
	3.30	111	29.79	40.27	124.0	118.5	45.0	120.5	41.0	118.0	41.5	115.0	42.0	114.0	43.0
	3.45	112	28.69	41.00	124.0	122.5	43.0	119.5	42.0	117.0	42.5	113.0	42.0	111.5	42.5
	4.00	113	29.09	40.60	128.0	120.0	44.0	118.5	41.0	116.5	41.5	113.0	42.5	112.0	42.5
	4.15	114	29.42	40.47	126.0	114.5	44.5	120.0	42.0	116.5	42.5	115.5	43.0	113.0	43.5
	4.30	115	29.95	40.00	124.5	119.0	44.5	119.0	42.0	115.0	42.0	112.5	43.0	112.0	43.0
	4.45	116	29.42	40.53	126.0	119.5	44.0	121.5	41.0	118.0	41.5	115.0	41.5	113.5	42.5
	5.00	117	29.55	40.33	118.5	118.5	44.0	120.0	42.0	118.0	42.0	115.5	43.0	113.5	43.0
	5.15	118	29.00	40.60	121.0	121.0	43.5	118.0	41.5	115.5	42.0	112.5	42.0	111.0	42.0
	5.30	119	29.43	40.60	125.5	120.5	43.5	121.5	42.0	118.5	42.5	116.0	42.5	116.0	43.5
	5.45	120	29.91	41.13	124.5	116.5	47.0	121.0	42.0	118.0	42.5	116.5	43.0	115.0	43.5
	6.00	121	28.69	40.33	126.0	122.0	43.0	120.0	41.0	117.0	41.0	114.0	42.0	112.0	42.0
	6.15	122	29.30	40.47	124.5	117.5	46.0	117.5	41.0	114.0	41.5	111.0	41.5	110.5	41.5
	6.30	123	29.61	40.20	124.0	112.0	44.5	119.0	41.0	116.5	41.5	114.0	42.5	112.0	42.0
	6.45	124	29.85	43.70	120.5	120.5	45.0	117.0	41.5	112.0	42.0	109.5	42.0	107.0	42.5
	7.00	125	29.09	44.00	123.0	122.0	42.0	114.5	41.0	110.5	41.0	108.0	41.5	106.5	41.5
	7.15	126	30.10	43.47	124.0	120.0	44.5	117.0	41.0	113.5	42.0	112.0	43.0	110.0	43.0
	7.30	127	29.06	43.40	124.0	124.0	43.0	116.0	42.0	112.0	43.0	109.0	43.5	108.0	43.5
	7.45	128	29.06	45.00	120.0	120.0	43.0	116.0	42.0	113.0	42.0	110.0	42.5	108.0	43.0
	8.00	129	29.30	44.33	118.5	118.5	42.5	116.0	42.5	112.0	42.5	108.0	42.5	106.0	43.0
	8.15	130	30.10	43.80	118.0	118.0	45.0	116.5	41.0	111.5	41.5	110.5	41.5	109.0	42.0
	8.30	131	29.43	43.73	123.0	119.0	42.0	115.0	41.5	112.0	41.5	109.0	41.5	107.0	42.0
	8.45	132	29.18	44.67	122.0	118.5	42.0	114.0	42.0	110.5	42.5	108.5	41.5	105.5	42.5
	9.00	133	29.49	44.53	117.5	117.5	42.5	117.0	43.0	112.0	42.5	110.0	44.0	109.0	44.5
	9.15	134	30.08	44.13	114.5	114.5	46.5	117.0	43.0	112.0	43.0	111.0	43.0	108.0	43.0
	9.30	135	30.16	43.47	121.0	116.0	44.0	118.0	41.5	114.0	42.5	112.5	43.0	111.0	43.0
	9.45	136	29.70	43.93	121.0	117.5	45.0	116.5	42.0	112.0	42.5	110.0	42.5	108.5	43.0
	10.00	137	29.88	43.67	122.5	119.5	47.0	118.0	43.5	114.0	43.5	112.5	44.0	109.5	44.0
	10.15	138	30.25	44.47	115.5	115.5	49.5	118.0	41.5	113.5	42.0	110.0	43.0	109.0	43.0
	10.30	139	29.61	43.67	115.5	115.5	48.5	119.5	44.0	113.5	44.0	111.5	44.5	111.0	44.5
	10.45	140	29.50	43.60	117.0	117.0	45.0	117.0	43.0	112.5	43.5	109.0	44.0	108.0	43.0
	11.00	141	30.07	43.87	108.5	108.5	46.0	118.0	43.0	115.0	43.5	112.5	44.0	111.0	45.0
	11.15	142	29.98	43.73	117.0	117.0	44.5	117.0	42.5	112.5	43.0	109.0	43.5	109.0	43.5
	11.30	143	29.98	43.87	116.0	116.0	47.0	118.0	42.0	112.0	43.0	109.0	43.0	108.5	43.0
	11.45	144	29.97	44.33	117.0	118.0	45.5	117.0	42.0	112.0	43.0	110.5	43.0	109.5	43.5
	12.00	145	29.97	44.13	114.0	114.0	44.5	116.0	41.0	111.0	43.0	108.0	43.0	108.0	43.0
Averages			29.58	42.22	121.1										

At .55.		At .65.		At .75.		At .85.		At .95.		Terminal Pressure.	Mean Pressure.		Effective Pressure.	
Maximum Press.	Counter Press.	Maximum Press.	Counter Press.	Maximum Press.	Counter Press.	Maximum Press.	Counter Press.	Maximum Press.	Counter Press.		Maximum.	Counter.	By Ordinates.	By Planimeter
17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
106.0	42.5	106.0	42.5	107.0	43.0	108.5	44.0	103.5	61.5	96.5	108.05	44.85	63.20	62.16
113.0	43.5	112.0	43.5	111.0	43.0	111.0	44.0	103.0	69.0	98.0	112.50	45.15	67.35	66.55
113.5	43.5	114.0	43.5	113.5	43.0	113.0	44.0	104.0	70.0	99.0	114.30	45.65	68.65	67.48
111.0	43.0	111.0	43.0	111.0	43.5	110.5	44.0	106.5	66.0	101.0	113.35	45.15	68.20	67.15
111.0	43.0	111.5	44.0	111.0	45.0	111.5	45.5	105.5	66.0	100.0	113.05	45.50	67.55	66.23
113.0	43.5	112.5	44.5	112.0	44.5	112.0	45.0	104.5	68.0	99.5	113.35	46.10	67.25	67.34
113.5	43.5	114.0	43.0	116.0	43.0	116.5	43.5	106.0	70.0	101.0	114.35	45.75	68.60	68.27
113.0	43.0	112.5	43.0	112.5	43.5	111.5	44.0	104.0	69.0	99.0	114.10	45.30	68.80	68.09
113.0	43.0	113.0	43.5	113.0	44.0	112.5	44.5	104.0	69.5	99.0	114.30	45.85	68.45	66.94
111.0	43.0	110.5	43.0	111.5	43.0	113.5	43.5	108.5	69.5	103.5	113.30	45.25	68.05	66.82
114.0	43.5	114.0	44.0	112.5	44.0	112.0	44.5	104.0	70.5	99.5	114.90	46.05	68.85	66.72
115.0	43.5	115.0	43.5	114.0	43.0	114.5	44.5	106.0	72.0	100.0	115.15	46.45	68.70	67.22
111.5	43.0	111.0	43.0	111.0	43.5	112.0	44.0	106.0	67.0	102.0	113.65	44.95	68.70	66.38
110.5	43.0	110.5	43.0	110.0	43.0	111.5	43.5	106.5	66.5	100.0	111.95	45.05	66.90	65.75
111.5	43.0	111.5	43.0	111.0	43.0	110.5	44.0	101.5	67.5	97.0	111.95	45.20	66.75	65.32
106.5	42.0	107.5	42.5	109.5	42.0	110.0	43.5	103.0	69.0	98.0	110.25	45.20	65.05	63.43
106.0	42.5	106.0	43.0	106.0	43.0	106.0	44.0	99.0	64.5	94.5	108.45	44.40	64.05	61.45
110.0	44.0	109.0	44.0	109.0	44.0	103.0	44.5	100.0	69.0	94.5	110.35	45.90	64.45	63.28
107.0	43.0	105.0	44.0	106.5	44.0	106.5	44.5	100.0	65.0	95.0	109.40	45.55	63.85	62.52
107.0	43.5	106.0	44.0	106.0	43.5	106.0	44.0	100.0	67.0	93.5	109.20	45.45	63.75	62.01
106.0	43.0	106.0	43.0	106.0	43.5	106.0	45.0	99.5	65.0	94.5	108.40	45.25	63.15	61.25
108.5	43.0	108.5	43.0	108.5	43.0	108.5	43.0	99.0	70.0	94.5	109.85	45.30	64.55	62.55
106.0	42.5	105.5	43.0	105.0	43.5	105.5	44.0	98.0	66.0	94.5	108.20	44.75	63.45	61.99
105.5	43.0	105.0	44.0	105.0	44.0	105.0	44.5	99.0	67.0	90.5	107.65	45.30	62.35	61.00
108.0	45.0	108.0	45.0	107.0	44.5	107.0	45.0	100.0	69.0	94.0	109.55	46.50	63.05	61.12
108.0	43.5	107.5	43.5	108.0	44.0	107.5	44.0	101.0	70.5	97.0	109.45	46.40	63.05	61.16
110.5	43.0	110.0	43.0	109.5	43.0	107.5	43.5	98.0	70.5	93.0	110.70	45.70	65.00	63.40
107.5	43.0	107.5	43.0	107.5	43.5	108.5	44.0	103.0	69.5	97.0	109.85	45.50	64.35	62.53
109.0	44.0	109.0	44.0	111.0	44.0	112.0	45.0	102.5	71.5	98.0	111.70	47.05	64.65	62.14
107.0	43.0	107.0	43.0	108.0	43.0	108.0	43.5	100.5	71.0	97.0	109.65	46.25	63.10	61.39
110.0	44.5	110.0	44.5	111.5	45.0	112.5	46.0	106.0	70.5	100.0	112.10	47.60	64.50	63.34
108.5	43.5	109.0	44.0	109.5	43.0	108.0	44.5	103.0	68.5	97.5	110.15	46.20	63.95	62.36
110.0	45.0	110.0	45.5	109.0	45.5	108.0	45.5	100.0	73.0	95.0	110.20	47.60	62.60	61.16
109.0	43.5	109.0	44.0	109.0	44.0	110.0	44.0	103.0	72.0	99.0	110.45	46.45	64.00	62.93
108.0	43.0	108.5	43.5	108.0	43.0	108.0	43.0	101.0	69.0	95.5	109.70	45.95	63.75	61.83
109.0	43.0	109.5	43.5	109.0	43.0	110.0	44.0	101.5	71.0	96.5	110.50	46.15	64.35	62.81
106.0	43.0	106.0	44.0	107.0	43.0	108.0	44.0	100.0	60.5	86.0	108.40	44.90	63.50	61.22
										95.9		45.65	65.10	63.87

Date.	Time.	No. of Diagram.	Strokes.		Initial Pressure.	At .05.		At .15.		At .25.		At .35.		At .45.	
			Length, Ins.	Double, per minute.		Maximum Pres.	Counter Pres.	Maximum Pres.	Counter Pres.	Maximum Pres.	Counter Pres.	Maximum Pres.	Counter Pres.	Maximum Pres.	Counter Pres.
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
March 22,	M														
	12.00	1	28.57	40.67	126.5	122.5	42.5	118.0	43.5	113.0	43.0	112.0	42.5	112.0	43.0
	P M														
	12.15	2	29.00	41.80	123.5	104.5	46.5	118.5	44.5	104.5	44.5	113.0	45.0	112.5	45.0
	12.30	3	29.49	43.87	121.5	110.5	47.5	117.5	46.0	114.0	45.5	111.0	46.0	111.0	46.0
	12.45	4	29.91	45.47	124.0	110.5	59.5	119.0	44.5	116.0	44.5	115.5	45.5	114.5	46.5
	1.00	5	29.18	44.80	123.0	111.0	48.5	118.0	44.5	114.5	44.5	112.0	44.5	111.0	46.0
	1.15	6	30.28	43.07	122.0	108.5	53.5	117.5	45.0	115.5	44.5	114.5	46.5	113.0	46.0
	1.30	7	29.12	43.40	121.5	110.5	46.5	117.5	46.5	114.0	46.5	112.0	46.5	110.5	46.5
	1.45	8	29.21	42.07	120.0	114.0	48.0	117.0	44.5	113.5	45.5	111.0	45.5	109.5	45.5
	2.00	9	29.00	42.07	122.0	105.5	42.0	112.0	41.5	109.0	41.0	107.0	41.5	106.5	42.5
	2.15	10	29.09	41.60	122.0	109.0	51.5	120.0	44.5	116.0	45.5	114.5	45.5	113.5	47.0
	2.30	11	29.21	43.13	123.5	122.5	51.5	119.5	45.5	116.0	45.5	114.0	47.0	113.0	46.5
	2.45	12	28.81	42.93	124.5	124.5	47.0	118.0	44.5	115.0	44.0	112.5	44.5	111.0	45.0
	3.00	13	29.18	44.00	122.0	110.0	49.5	117.0	46.5	113.0	46.5	111.5	47.0	112.0	47.0
	3.15	14	29.24	43.27	125.5	125.5	50.0	119.0	44.0	115.5	45.0	114.0	46.0	113.0	46.5
	3.30	15	28.76	43.27	125.0	122.0	47.5	118.5	45.0	115.5	45.0	112.5	45.0	112.0	47.0
	3.45	16	29.61	42.67	124.0	122.5	48.0	116.5	44.5	113.0	44.5	111.5	45.5	110.5	45.5
	4.00	17	28.88	43.27	125.0	124.0	44.5	112.0	45.0	113.5	45.5	111.0	45.0	110.5	45.5
	4.15	18	29.15	43.53	122.5	111.5	50.5	118.5	44.5	114.5	45.0	112.0	45.0	111.0	46.0
	4.30	19	28.85	44.13	120.0	114.5	46.0	116.5	45.5	113.5	46.0	111.0	45.5	111.0	46.0
	4.45	20	29.61	43.27	123.0	112.0	50.0	120.0	45.0	117.0	45.5	115.0	46.5	113.5	47.0
	5.00	21	29.69	43.47	122.0	111.0	48.0	119.0	46.0	114.5	46.5	112.5	47.5	111.5	47.0
	5.15	22	30.40	42.53	121.5	108.5	54.0	117.5	45.0	116.0	45.0	115.5	45.5	115.5	45.5
	5.30	23	30.46	43.00	123.0	108.0	56.0	119.0	46.0	115.5	46.0	114.0	46.5	114.0	47.0
	5.45	24	30.01	42.93	122.0	108.5	54.5	119.0	45.5	115.0	46.0	114.5	46.0	114.5	46.0
	6.00	25	29.91	42.27	122.0	110.0	54.5	119.0	45.0	114.5	45.5	114.5	45.5	114.5	47.0
	6.15	26	29.97	41.80	121.5	108.0	54.0	117.5	44.5	114.0	45.0	109.0	45.5	113.5	46.0
	6.30	27	30.16	43.13	123.0	108.5	55.0	118.0	45.0	115.0	45.5	112.5	45.5	113.0	45.5
	6.45	28	30.37	42.87	120.5	106.5	54.5	116.5	44.0	112.0	43.5	111.0	44.0	111.0	43.5
	7.00	29	30.13	42.40	123.0	108.5	57.0	118.5	45.5	114.5	45.5	112.5	45.5	111.5	45.5
	7.15	30	30.01	43.00	123.0	108.0	55.5	118.5	45.0	114.5	44.5	113.0	44.5	113.0	45.0
	7.30	31	28.85	43.13	125.0	112.5	45.0	121.5	43.5	118.0	44.5	115.5	44.5	114.0	45.0
	7.45	32	29.97	44.07	123.0	107.0	54.0	118.0	45.0	114.0	45.0	113.5	45.0	113.0	45.0
	8.00	33	30.40	43.87	123.0	108.0	57.0	118.0	44.5	114.0	45.0	112.0	44.5	112.0	44.5
	8.15	34	28.76	43.80	121.0	108.5	54.0	117.0	45.0	116.0	45.0	114.0	44.5	114.0	45.0
	8.30	35	29.21	44.73	121.5	109.0	50.0	117.5	44.0	114.5	45.0	111.5	45.5	110.5	45.5
	8.45	36	30.40		122.0	105.5	57.0	118.0	44.5	113.0	45.0	111.0	44.5	111.5	45.0

At .55.		At .65.		At .75.		At .85.		At .95.		Terminal Pres.	Mean Pressure.		Effective Pressure.	
Maximum Pres.	Counter Pres.	Maximum Pres.	Counter Pres.	Maximum Pres.	Counter Press.	Maximum Pres.	Counter Pres	Maximum Pres.	Counter Pres.		Maximum.	Counter.	By Ordinates.	By Planimeter
17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
112.5	45.0	112.0	45.0	113.5	45.0	114.0	46.5	110.0	56.0	103.0	113.95	45.20	68.75	66.41
112.5	45.0	112.5	45.0	114.0	46.0	115.0	48.5	109.5	66.0	102.5	111.65	47.60	64.05	65.93
112.5	46.5	114.0	47.0	114.0	46.5	114.5	49.5	106.0	80.5	101.0	112.50	50.10	62.40	63.48
114.5	47.0	113.5	46.5	113.5	47.0	112.5	50.0	103.5	70.0	99.5	113.30	50.10	63.20	63.67
111.0	46.0	110.5	46.0	111.0	46.5	112.5	48.5	107.5	66.5	102.0	111.90	48.15	63.75	63.01
114.0	46.0	113.0	46.0	113.0	46.5	113.0	50.0	104.0	69.5	100.0	112.60	49.35	63.25	63.02
111.0	46.5	110.5	46.0	110.5	48.5	112.5	51.5	109.0	70.0	101.0	111.80	49.50	62.30	61.51
110.0	45.5	111.0	46.0	112.5	46.0	114.0	49.0	107.0	65.5	102.0	111.95	48.10	63.85	62.70
106.5	42.0	106.0	43.0	107.5	44.5	109.0	45.5	104.0	62.5	98.5	107.30	44.60	62.70	62.15
114.0	47.0	114.0	47.5	113.5	47.5	113.5	49.5	105.5	68.0	100.0	113.35	49.35	64.00	63.21
113.0	47.0	112.5	47.0	112.5	47.0	113.0	49.5	107.0	67.0	100.0	114.30	49.35	64.95	63.07
111.5	46.0	113.0	46.0	111.0	46.5	112.0	48.5	106.0	66.0	99.0	113.45	47.80	65.65	63.99
113.0	47.0	115.0	47.5	114.5	47.0	114.0	53.0	105.5	72.0	100.0	112.55	50.30	62.25	61.84
113.0	46.5	112.5	47.5	112.0	47.5	110.5	50.0	102.0	69.5	96.0	113.65	49.25	64.40	62.21
111.5	47.0	111.5	47.0	111.5	47.0	112.0	50.0	108.0	67.5	103.0	113.50	48.80	64.70	63.69
111.0	45.5	113.5	45.5	115.0	46.5	116.0	50.0	107.0	71.0	101.5	113.65	48.65	65.00	63.34
110.5	46.5	110.0	46.5	110.5	47.0	112.0	49.0	106.0	65.0	100.0	112.00	47.90	64.10	62.41
111.0	46.5	111.0	46.5	111.0	47.0	111.0	48.0	105.0	67.5	100.0	111.65	48.65	63.00	61.82
110.5	45.5	110.5	46.5	112.5	47.5	114.0	51.0	108.5	68.0	100.5	112.25	48.75	63.50	62.35
112.5	47.0	112.0	47.0	112.0	47.5	111.5	49.5	103.0	80.0	98.0	112.85	50.50	62.35	62.35
111.5	47.0	112.5	47.5	113.5	48.0	114.0	52.0	107.5	71.0	100.5	112.75	50.05	62.70	58.65
115.5	46.5	115.0	46.5	113.5	47.5	110.5	50.0	101.5	73.0	97.0	112.90	49.85	63.05	62.31
114.0	47.0	114.5	47.0	114.5	47.5	112.0	50.0	102.5	74.0	100.0	112.80	50.76	62.10	61.46
114.5	46.0	115.0	47.0	114.0	47.0	111.5	50.0	101.5	74.0	97.5	112.80	55.20	62.60	62.51
114.5	47.0	115.0	47.0	114.5	47.5	112.0	52.0	102.0	74.5	98.0	113.50	50.55	62.50	61.96
114.0	46.5	113.5	47.0	112.5	47.0	110.0	49.5	101.0	70.5	95.5	111.30	49.55	61.75	61.47
114.5	45.5	114.0	45.5	114.5	46.0	111.5	49.0	102.5	73.5	98.0	112.40	49.60	62.80	62.06
111.5	44.0	111.5	43.5	111.5	45.0	109.0	46.5	100.0	73.5	96.0	110.05	48.20	61.85	61.75
113.0	46.0	113.5	46.5	113.0	47.0	110.5	49.5	102.0	77.0	96.5	111.75	50.50	61.25	61.52
113.5	45.5	113.5	45.0	113.0	45.5	110.5	47.0	102.5	69.0	96.5	111.70	48.65	63.05	62.87
113.0	44.5	112.0	44.5	111.5	45.0	111.0	46.0	105.0	65.5	100.0	113.50	46.80	66.70	66.67
113.5	45.0	112.0	45.5	111.0	46.0	109.5	48.0	100.5	70.0	96.0	111.20	48.85	62.35	62.57
112 5	45.0	112.0	45.0	112.0	45.0	110.0	47.5	101.5	69.0	95.5	111.20	48.70	62.50	62.19
113.0	44.5	111.5	44.5	111.0	44.5	100.5	46.0	105.5	56.0	96.0	111.10	46.90	64.20	63.01
109.5	45.5	109.0	46.0	109.0	46.0	109.0	47.5	113.5	65.0	97.5	110.30	48.00	62.30	62.50
111.0	45.0	111.0	45.5	111.0	46.0	109.0	58.5	100.0	73.0	94.5	110.10	50.40	59.70	61.03

Date.	Time.	No. of Diagram.	Strokes.		Initial Pressure.	At .05.		At .15.		At .25.		At .35.		At .45.	
			Length, Ins.	Double, per minute.		Maximum Pres.	Counter Pres.	Maximum Pres.	Counter Pres.	Maximum Pres.	Counter Pres.	Maximum Pres.	Counter Pres.	Maximum Pres.	Counter Pres.
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
March 22,	P M.														
	9.00	37	28.76	44.07	63.0	63.0	17.5	59.5	18.0	53.5	18.0	50.5	18.5	50.0	19.5
	9.15	38	29.52	31.87	125.5	104.5	51.5	121.0	42.0	121.0	43.0	118.0	43.5	116.5	43.0
	9.30	39	29.24	38.20	126.0	113.5	56.0	122.5	44.0	120.5	44.0	118.5	44.5	117.0	44.0
	9.45	40	28.82	40.27	125.5	112.5	51.5	122.0	43.0	118.0	43.0	115.5	44.0	112.5	44.0
	10.00	41	28.97	40.33	125.0	112.0	52.0	121.0	45.0	120.0	44.5	117.5	45.0	116.5	45.0
	10.15	42	28.97	40.47	126.0	112.0	52.5	122.0	44.5	119.5	44.5	117.0	44.5	116.5	45.0
	10.30	43	29.18	39.20	127.5	114.0	54.0	123.0	46.0	120.0	45.0	118.5	45.5	117.0	47.0
	10.45	44	28.76	40.67	126.0	116.0	50.0	121.0	44.5	119.0	45.0	117.5	45.0	116.0	45.0
	11.00	45	28.93	40.07	125.0	113.0	51.0	120.0	45.0	119.0	46.0	117.0	46.0	116.0	45.5
	11.15	46	29.90	40.00	125.0	114.0	53.0	120.5	45.5	119.0	45.5	118.0	45.0	118.5	45.5
	11.30	47	28.73	40.00	124.5	116.0	49.5	120.5	44.5	118.0	44.0	116.0	44.0	114.0	44.0
	11.45	48	28.97	40.40	125.0	111.0	51.5	121.0	45.0	120.0	45.0	117.0	45.0	114.0	45.0
	12.00	49	29.49	40.07	124.5	116.0	52.0	120.0	46.0	118.5	46.0	118.0	46.0	118.0	46.0
March 23,	A M.														
	12.15	50	29.79	39.93	123.0	112.0	58.0	119.0	45.0	119.0	45.0	119.0	45.0	118.5	45.0
	12.30	51	29.67	39.80	124.0	112.5	58.0	120.5	43.5	119.5	45.0	118.5	45.0	117.0	45.0
	12.45	52	29.21	40.73	123.5	116.5	50.0	119.0	45.0	109.5	46.0	114.5	46.5	114.5	47.0
	1.00	53	29.64	40.00	126.0	113.0	54.5	121.0	44.5	119.5	45.0	119.0	45.0	117.5	45.0
	1.15	54	29.30	40.07	122.5	115.0	50.5	117.5	45.0	116.0	46.0	116.0	46.0	115.5	46.0
	1.30	55	29.30	40.40	126.0	114.0	51.0	122.0	45.0	121.0	45.0	119.5	45.0	119.0	45.5
	1.45	56	29.73	40.80	126.0	111.5	57.0	122.0	45.0	120.5	45.5	119.0	46.0	119.0	46.0
	2.00	57	29.06	40.40	125.0	114.5	56.0	121.5	46.0	118.0	46.0	114.0	46.0	114.0	46.0
	2.15	58	29.43	40.27	124.0	114.0	51.0	121.0	46.5	119.0	47.0	118.5	47.0	119.0	47.0
	2.30	59	29.30	39.93	125.0	113.0	54.0	122.5	45.5	119.0	45.0	118.0	45.5	117.0	45.5
	2.45	60	29.06	42.47	123.0	114.0	53.0	122.0	45.0	119.0	45.0	118.0	45.5	116.5	45.5
	3.00	61	29.18	40.47	123.0	111.0	47.0	119.5	45.0	117.5	45.0	115.0	44.5	113.0	44.5
	3.15	62	29.12	40.73	127.0	115.0	50.0	122.0	46.0	119.0	46.0	115.0	46.0	116.0	46.0
	3.30	63	29.61	40.53	124.0	116.5	51.5	119.0	46.0	118.0	46.5	117.0	46.0	117.0	47.5
	3.45	64	29.42	41.20	124.5	115.0	52.0	119.5	45.0	116.5	45.0	116.5	46.5	116.0	46.5
	4.00	65	29.61	40.80	126.0	110.0	55.0	122.0	45.0	120.0	45.0	119.5	45.5	118.0	45.5
	4.15	66	29.00	40.60	126.0	114.0	56.0	122.0	45.0	120.0	45.0	117.5	45.0	116.0	45.0
	4.30	67	29.24	40.33	124.0	112.5	54.0	122.0	45.0	120.0	45.0	119.0	45.0	118.0	45.0
	4.45	68	29.00	41.47	122.0	114.0	49.0	120.0	44.0	117.0	44.0	114.5	44.0	114.0	44.0
	5.00	69	29.73	40.13	122.0	114.5	53.0	120.0	45.0	119.0	45.0	118.0	45.5	118.0	45.5
	5.15	70	29.43	40.60	120.0	114.0	51.0	118.0	46.0	118.0	47.0	117.5	47.0	117.0	46.0
	5.30	71	29.55	40.47	123.0	110.0	58.0	121.5	45.0	120.0	45.0	119.0	45.0	118.0	45.0
	5.45	72	28.91	41.40	123.0	114.0	51.5	121.0	44.0	119.0	44.0	116.0	44.0	114.0	44.0

At .55.		At .65.		At .75.		At .85.		At .95.		Terminal Pres.	Mean Pressure.		Effective Pressure.	
Maximum Pres.	Counter Pres.	Maximum Pres.	Counter Pres.	Maximum Pres.	Counter Pres.	Maximum Pres.	Counter Pres.	Maximum Pres.	Counter Pres.		Maximum.	Counter.	By Ordinates.	By Planimeter
17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
50.5	20.0	50.5	20.0	50.0	20.5	50.0	21.0	50.5	28.0	47.0	52.80	20.10	32.70	32.36
116.0	43.5	115.0	43.0	115.0	45.0	113.5	45.0	105.5	57.0	99.5	114.60	45.65	68.95	69.24
116.5	44.5	116.0	45.0	116.0	45.0	114.5	46.0	107.5	62.0	103.0	116.25	47.50	68.75	66.51
113.0	44.0	113.0	44.0	114.0	44.0	115.5	45.5	110.5	67.0	105.0	114.65	47.00	67.65	66.61
113.0	45.5	113.5	45.5	113.5	45.0	114.0	46.5	109.0	59.5	103.0	115.00	47.35	67.65	65.37
113.5	44.5	112.5	44.5	113.0	45.0	114.0	46.0	108.0	59.0	103.5	114.80	47.00	67.80	66.51
116.0	46.5	114.0	46.5	113.5	46.5	114.5	47.5	108.5	56.5	103.5	115.90	48.10	67.80	65.65
114.0	44.5	115.0	44.5	116.0	44.5	116.0	45.0	110.0	54.0	104.5	116.05	46.20	69.85	68.28
114.0	46.0	114.0	46.0	114.0	45.5	114.5	46.0	108.0	58.0	103.5	114.95	47.50	67.45	65.82
118.5	46.5	118.0	47.0	117.0	47.0	115.0	48.0	106.0	75.0	101.0	116.45	49.80	66.65	65.26
113.5	44.5	113.5	44.0	114.0	44.0	115.5	44.5	109.0	56.5	103.5	115.20	45.95	69.25	67.19
101.0	67.0	114.0	45.0	113.5	45.0	113.5	45.0	109.0	56.0	103.0	113.40	48.95	64.45	65.75
118.0	46.0	117.0	46.0	117.5	46.0	116.0	47.5	107.0	75.0	102.5	116.60	49.65	66.95	67.08
118.5	45.0	116.5	45.0	116.0	45.5	114.0	46.0	105.0	75.5	100.0	115.75	49.50	66.25	66.39
116.0	45.0	114.5	45.0	113.0	45.5	113.0	45.0	105.5	69.0	100.5	115.00	48.60	66.40	66.17
115.0	46.5	116.0	47.0	116.5	46.5	116.5	47.5	109.0	72.0	103.0	114.70	49.30	65.40	65.83
116.0	45.5	115.0	46.0	113.0	46.0	113.0	46.0	105.0	71.5	100.5	115.20	48.90	66.30	65.62
116.0	46.0	116.5	46.0	117.0	46.0	116.5	48.0	109.0	71.0	102.5	115.50	49.05	66.45	65.25
117.5	46.5	116.5	46.5	115.0	46.5	113.0	46.5	106.0	63.5	99.5	116.45	47.10	69.35	66.50
118.0	46.0	117.0	46.5	116.0	46.5	114.0	47.0	105.0	57.5	100.5	116.20	48.30	67.90	65.17
114.0	46.0	114.5	46.0	114.5	46.0	115.0	46.0	109.0	61.0	104.0	114.90	48.55	66.35	65.17
118.5	46.5	118.0	46.0	117.0	46.0	117.0	49.0	108.0	77.5	102.5	117.00	50.35	66.65	65.18
116.0	45.5	115.5	45.5	114.0	46.0	113.0	46.5	106.0	64.0	102.0	115.40	48.30	67.10	65.87
114.0	46.0	114.0	46.0	113.5	46.0	114.0	46.0	107.5	58.0	102.5	115.25	47.60	67.65	65.80
114.0	45.0	113.5	45.0	113.5	45.0	114.0	46.0	109.0	70.0	103.0	114.00	47.70	66.30	65.38
115.5	46.0	116.0	46.0	117.0	46.0	117.0	46.5	109.0	74.5	104.0	116.15	49.35	66.80	65.66
117.0	47.0	117.0	47.0	117.0	47.0	117.0	49.0	107.0	76.5	102.0	116.25	50.40	65.85	65.07
116.0	47.0	116.5	46.5	117.0	47.0	117.0	48.0	109.0	72.0	103.0	115.90	49.55	66.35	65.10
117.0	46.0	116.0	46.5	114.0	47.0	113.0	47.0	105.5	60.0	100.0	115.50	48.25	67.25	65.57
114.0	46.0	114.0	46.0	114.0	46.0	114.0	46.0	109.0	57.0	103.5	115.45	47.70	67.75	65.56
116.0	45.0	114.5	45.0	113.0	45.0	113.0	46.0	106.0	70.0	100.5	115.40	48.50	66.90	65.88
114.0	44.5	115.0	44.5	115.0	44.5	115.5	45.0	99.0	80.0	103.0	113.80	48.35	65.45	66.31
117.5	45.5	118.0	46.0	117.0	46.0	115.0	47.0	106.0	72.5	100.5	116.30	49.10	67.20	66.52
117.0	47.0	117.0	47.0	118.0	47.0	117.0	47.5	108.0	73.0	102.0	116.15	49.85	66.30	65.48
116.0	45.0	114.0	46.0	113.5	46.0	113.0	46.0	106.0	72.5	99.5	115.10	49.35	65.75	64.46
114.0	44.0	114.5	44.0	115.5	45.5	116.0	45.5	109.5	60.0	104.0	115.35	46.65	68.70	66.27

Date.	Time.	No. of Diagram.	Strokes.		Initial Pressure.	At .05.		At .15.		At .25.		At .35.		At .45.	
			Length, Ins.	Double, per Minute.		Maximum Press.	Counter Press.	Maximum Press.	Counter Press.	Maximum Press.	Counter Press.	Maximum Press.	Counter Press.	Maximum Press.	Counter Press.
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
M'ch 23,	A. M.														
	6.00	73	29.73	40.73	124.0	112.0	53.0	122.0	46.0	118.0	46.0	117.0	46.0	117.0	46.0
	6.15	74	28.88	40.13	123.0	113.5	50.5	120.0	44.5	117.0	44.0	113.5	44.0	113.0	45.0
	6.30	75	29.43	39.87	121.5	111.5	51.0	119.5	45.0	118.0	45.0	116.5	45.0	117.0	45.0
	6.45	76	29.30	40.33	120.0	114.5	50.0	117.0	45.0	116.0	45.5	116.0	45.0	116.0	45.5
	7.00	77	28.82	40.20	123.0	115.5	50.0	121.0	45.0	118.5	45.0	113.5	44.5	114.0	45.0
	7.15	78	29.43	40.40	122.5	112.5	51.0	120.0	44.5	119.5	45.5	118.0	44.5	118.0	45.0
	7.30	79	29.50	39.73	123.0	114.0	50.0	121.0	45.0	116.0	45.5	116.0	47.0	116.0	47.0
	7.45	80	29.06	40.47	122.0	115.5	49.0	117.5	45.0	115.5	45.0	115.0	45.0	116.0	47.0
	8.00	81	29.09	40.00	125.0	112.0	56.0	122.0	44.5	121.0	44.5	119.5	44.5	118.0	44.0
	8.15	82	28.93	39.47	124.5	115.5	53.0	122.0	45.0	119.0	45.0	117.0	45.0	116.0	45.0
	8.30	83	29.49	39.47	124.5	113.5	54.0	122.0	46.0	120.5	46.0	120.0	45.5	120.5	45.5
	8.45	84	29.37	40.27	127.0	113.0	53.0	126.5	44.0	121.0	44.0	119.5	44.5	118.0	44.0
	9.00	85	29.61	39.33	124.5	114.5	58.0	121.5	45.0	121.0	45.0	120.0	45.0	119.5	45.0
	9.15	86	29.24	39.27	123.0	114.0	49.5	119.5	45.0	119.5	46.0	119.0	45.0	120.0	46.0
	9.30	87	29.42	39.40	122.5	114.0	52.0	119.0	44.0	119.5	44.5	119.5	45.0	119.0	45.0
	9.45	88	29.12	40.20	124.5	113.0	52.0	122.0	44.0	121.0	45.0	118.5	44.0	118.5	45.0
	10.00	89	29.67	40.07	124.0	114.0	55.0	121.5	46.0	120.0	46.0	119.0	46.0	119.5	46.0
	10.15	90	28.88	40.73	123.5	114.5	50.0	121.0	44.5	118.0	44.5	114.5	44.5	114.5	44.5
	10.30	91	28.93	41.07	122.5	114.0	51.0	121.0	44.5	117.5	44.5	113.5	44.5	113.5	45.0
	10.45	92	29.73	40.33	122.0	115.0	52.0	120.5	45.5	120.0	45.0	117.5	46.0	117.0	46.0
	11.00	93	29.15	46.20	122.0	113.0	50.0	121.0	44.0	116.0	45.0	114.5	41.5	114.5	46.0
	11.15	94	28.91	40.00	124.0	115.0	51.0	121.5	45.0	120.5	46.0	117.0	44.5	116.0	45.0
	11.30	95	28.70	39.47	124.0	114.0	52.0	121.0	44.0	119.0	44.5	116.0	44.5	115.0	45.0
	11.45	96	29.24	40.67	124.0	113.0	50.0	122.0	45.0	117.5	45.0	116.5	45.0	117.0	45.5
	12.00	97	28.91	39.40	125.0	114.0	57.5	121.0	44.5	118.5	45.5	115.0	45.0	115.0	45.0
	P. M.														
	12.15	98	29.30	39.80	125.0	113.5	57.0	123.0	46.0	121.5	44.5	120.5	45.0	119.5	45.0
	12.30	99	29.79	39.87	123.5	112.5	61.0	121.5	44.5	121.0	45.0	120.5	44.5	118.5	44.0
	12.45	100	29.50	40.27	122.0	114.0	50.0	119.0	46.0	116.0	44.5	116.0	46.0	116.0	46.5
	1.00	101	28.88	40.07	122.5	114.0	51.0	121.0	44.0	118.0	46.0	114.0	44.5	114.0	44.5
	1.15	102	29.33	39.80	125.0	115.0	51.5	122.0	45.0	117.0	44.0	116.5	45.5	116.0	45.5
	1.30	103	29.12	39.87	124.5	113.0	53.0	121.0	44.5	121.0	45.5	120.0	45.0	118.5	44.5
	1.45	104	28.88	40.87	124.0	114.0	51.0	120.0	44.5	118.0	45.0	116.0	44.5	113.5	44.0
	2.00	105	28.82	39.87	123.0	113.5	49.0	120.0	44.0	117.0	44.0	114.5	45.0	112.5	45.0
	2.15	106	29.00	38.33	124.0	113.0	53.0	121.0	44.5	120.0	44.0	118.0	44.5	117.0	45.0
	2.30	107	28.85	42.60	124.0	114.0	52.0	121.0	44.5	119.0	44.5	116.0	44.5	114.0	44.5
	2.45	108	29.00	41.20	124.0	113.0	52.5	121.0	44.5	119.0	44.5	117.0	44.0	114.5	44.5
Average			29.23	40.26	123.4										

At .55.		At .65.		At .75.		At .85.		At .95.			Mean Pressure.		Effective Pressure.	
Maximum Press.	*Counter Press*	*Maximum Press.*	*Counter Press.*	*Maximum Press.*	*Counter Press.*	*Maximum Press.*	*Counter Press.*	*Maximum Press.*	*Counter Press.*	*Terminal Pressure.*	*Maximum.*	*Counter.*	*By Ordinates.*	*By Planimeter*
17	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**31**
117.0	46.5	117.0	46.0	117.0	47.0	115.5	48.5	107.0	75.0	99.0	116.00	50.10	65.90	64.19
114.0	45.0	114.5	46.0	114.5	45.0	115.5	46.0	110.0	71.0	102.5	114.55	48.10	66.45	65.45
117.0	45.0	115.5	46.0	115.0	46.0	114.0	47.5	105.0	75.0	100.0	114.90	49.05	65.85	65.10
115.0	45.0	116.0	46.0	116.0	47.0	116.0	49.5	108.0	73.0	101.0	115.05	49.15	65.90	65.00
114.0	44.0	115.0	45.0	115.0	45.0	115.5	46.0	110.0	70.0	103.5	115.20	47.95	67.25	66.22
117.0	45.5	116.0	46.0	115.5	46.0	113.0	47.5	105.0	73.0	99.5	115.45	48.85	66.60	65.73
115.5	47.0	116.5	47.0	117.0	47.0	117.0	50.0	109.0	83.0	103.5	115.80	50.85	64.95	64.35
116.0	46.5	117.0	46.0	117.0	47.0	117.0	49.5	109.0	71.0	104.0	115.55	49.10	66.45	65.42
117.0	45.0	115.5	44.0	114.0	44.5	114.0	45.0	107.0	70.0	100.0	116.00	48.20	67.80	67.74
114.0	45.0	114.0	45.0	115.0	44.5	110.0	45.0	110.0	58.0	103.0	115.80	47.05	68.75	67.34
120.0	46.0	119.0	46.5	118.0	46.5	115.5	47.0	107.0	73.5	102.0	117.60	49.65	67.95	67.33
117.0	44.5	116.0	45.0	114.5	45.0	113.5	45.5	107.0	64.0	102.0	116.10	47.35	68.75	67.48
118.0	46.0	117.0	45.5	115.0	45.5	114.5	46.0	107.5	59.0	101.5	116.85	48.00	68.85	67.54
120.0	46.5	120.0	48.0	119.5	47.0	120.0	49.0	110.0	76.0	104.5	118.15	49.80	68.35	67.76
118.0	45.0	117.0	45.0	116.0	45.0	113.5	46.0	106.0	73.0	100.0	116.15	48.45	67.70	66.72
117.0	45.0	114.5	45.0	114.0	45.0	114.0	46.0	106.0	71.0	102.0	115.85	48.20	67.65	67.42
119.0	47.0	119.0	47.0	118.0	46.5	114.5	48.0	106.0	74.5	101.5	117.05	50.20	66.85	66.29
114.5	44.0	115.5	45.0	116.0	46.0	117.0	47.0	110.0	73.0	104.5	115.55	48.30	67.25	64.94
114.0	44.0	114.5	43.5	115.0	44.0	116.0	45.0	110.0	59.5	103.5	114.90	46.60	68.30	65.95
118.0	46.0	118.5	46.5	118.0	47.0	117.0	48.0	109.0	75.0	103.0	117.05	49.70	67.35	66.28
114.0	45.5	114.5	46.0	115.0	46.0	116.5	48.0	109.0	71.0	103.0	114.80	48.40	66.40	64.45
115.5	46.0	115.0	46.0	116.0	46.5	116.0	46.0	110.0	57.0	105.0	116.25	47.05	69.25	66.50
114.5	44.0	114.5	44.0	115.0	44.0	114.5	44.5	108.5	58.0	103.0	115.20	46.50	68.70	67.27
117.0	45.5	117.0	45.0	117.0	46.0	117.0	48.0	109.5	79.0	102.0	116.35	49.45	66.90	66.39
115.5	44.0	115.5	45.0	115.5	45.0	117.5	45.5	110.5	67.0	104.0	115.80	47.70	68.10	66.02
118.0	45.0	115.5	45.0	115.0	45.0	114.5	45.5	106.5	79.0	101.0	116.75	49.75	67.00	66.00
118.0	44.0	116.0	45.0	115.5	45.0	114.0	45.0	105.5	62.5	101.0	116.30	48.00	68.30	65.16
116.0	46.5	117.0	47.0	117.0	47.0	116.5	48.0	108.5	81.5	102.0	115.00	50.45	64.55	64.47
114.0	44.5	114.0	44.5	114.0	45.0	115.0	46.0	109.0	68.0	103.0	114.70	47.60	67.10	65.96
116.5	46.0	115.5	45.5	116.0	45.5	116.5	47.0	109.5	79.0	103.0	116.05	49.55	66.50	65.68
117.5	45.0	116.0	45.0	114.5	44.5	114.0	44.5	106.0	60.0	100.0	116.15	47.10	69.05	67.55
114.5	44.5	113.0	44.0	114.0	44.5	114.0	44.0	109.0	60.0	102.5	114.60	46.20	68.40	65.32
112.5	45.0	113.0	45.5	114.0	45.0	115.0	45.5	109.0	67.0	102.0	114.10	47.50	66.60	65.21
114.0	45.0	114.0	45.0	114.0	45.0	114.0	45.0	108.0	66.0	102.0	115.30	47.75	67.55	66.44
114.0	44.5	114.5	44.5	115.0	44.5	115.5	46.0	109.0	69.0	103.0	115.20	47.85	67.35	65.39
114.0	44.0	114.0	44.0	114.5	44.0	115.0	45.0	108.0	66.5	102.0	115.00	47.35	67.65	65.80
										101.4		47.97	66.76	65.56

Date.	Time.	No. of Diagram.	Strokes		Initial Pressure.	At .05.		At .15.		At .25.		At .35.		At .45.	
			Length, Ins.	Double, per Minute.		Maximum Press.	Counter Press.	Maximum Press.	Counter Press.	Maximum Press.	Counter Press.	Maximum Press.	Counter Press.	Maximum Press.	Counter Press.
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
M'ch 23,	P. M.														
	3.00	109	28.36	41.00	112.0	103.0	38.0	111.0	35.0	108.0	36.0	106.5	36.0	105.0	36.0
	3.15	110	29.79	37.73	121.0	112.0	47.0	119.0	44.0	116.0	44.5	114.0	45.0	115.0	45.5
	3.30	111	28.51	40.27	121.0	116.5	46.0	119.0	43.5	116.5	44.0	115.0	44.5	114.0	44.5
	3.45	112	29.88	41.00	122.5	114.0	50.0	120.0	44.5	117.5	45.0	115.5	45.5	117.5	46.5
	4.00	113	28.93	40.60	123.0	114.0	49.0	120.5	44.0	118.0	44.0	118.5	44.0	115.5	45.0
	4.15	114	28.51	40.47	122.5	115.0	46.0	120.0	44.0	117.0	44.0	116.0	44.0	115.0	45.0
	4.30	115	29.49	40.00	122.5	113.0	50.0	120.0	43.0	119.5	45.0	117.0	45.0	116.0	45.0
	4.45	116	29.36	40.53	124.0	111.5	51.5	121.0	44.5	119.5	44.5	118.5	45.0	117.5	45.0
	5.00	117	29.79	40.33	123.6	112.5	50.5	119.0	44.0	117.5	44.0	115.5	45.5	115.5	45.5
	5.15	118	29.12	40.60	123.0	113.0	45.5	119.0	44.0	116.0	44.5	114.5	44.5	114.0	44.5
	5.30	119	29.67	40.60	123.0	113.0	48.5	119.0	43.0	116.5	43.0	116.0	44.0	115.0	44.0
	5.45	120	29.79	41.13	124.0	110.0	53.0	120.0	44.0	119.5	45.0	119.0	45.0	119.0	45.0
	6.00	121	28.51	40.33	121.5	113.5	44.5	119.5	44.5	117.0	44.0	115.0	44.5	114.5	45.0
	6.15	122	28.73	40.47	120.0	113.0	46.0	118.5	43.0	115.5	44.0	114.0	44.5	113.0	44.0
	6.30	123	28.85	40.20	122.0	108.5	52.0	118.0	43.5	118.0	43.5	117.5	43.5	117.0	44.0
	6.45	124	29.97	43.70	122.5	109.0	52.0	119.0	43.0	116.0	44.0	114.0	44.0	114.0	45.0
	7.00	125	29.12	44.00	121.5	110.0	47.5	118.0	43.0	112.0	43.0	110.5	43.5	110.0	44.0
	7.15	126	28.85	43.47	121.5	111.0	47.5	118.0	44.0	114.0	45.0	111.0	44.0	110.0	45.0
	7.30	127	29.36	43.40	121.0	114.0	47.5	118.5	44.5	113.5	45.0	111.5	45.0	111.0	45.0
	7.45	128	30.22	45.00	122.5	107.5	53.0	118.0	44.0	114.5	44.5	113.0	45.0	112.5	46.0
	8.00	129	29.43	44.33	123.0	109.0	50.0	119.0	44.0	115.5	44.0	112.5	44.5	111.5	44.5
	8.15	130	30.09	43.80	122.0	107.0	55.0	120.0	43.0	115.0	43.5	114.0	44.5	113.5	44.5
	8.30	131	29.67	43.73	120.0	109.5	49.0	118.0	44.0	113.6	45.0	110.5	45.5	110.5	45.0
	8.45	132	29.85	44.67	121.0	109.0	49.0	118.0	44.5	113.5	45.0	110.5	45.0	110.5	45.0
	9.00	133	30.22	44.53	121.0	107.5	55.0	119.0	44.5	115.0	45.0	111.5	45.5	111.5	46.0
	9.15	134	29.76	44.13	122.0	110.0	51.0	119.5	43.5	116.5	44.0	114.0	45.0	112.5	45.5
	9.30	135	29.52	43.47	122.0	109.5	50.5	120.5	43.5	116.0	44.0	113.0	45.0	112.0	45.5
	9.45	136	30.22	43.93	120.0	107.0	56.5	118.0	44.5	115.0	44.5	114.0	45.0	114.0	45.5
	10.00	137	28.93	43.67	121.5	113.5	46.5	119.0	45.0	114.5	45.0	113.0	45.5	112.0	46.0
	10.15	138	29.67	44.47	122.0	110.0	49.0	120.5	43.0	116.5	43.5	113.0	44.5	112.0	45.0
	10.30	139	30.03	43.67	122.5	108.5	57.0	119.0	46.0	117.0	46.0	115.5	46.5	115.5	47.5
	10.45	140	30.16	43.60	122.0	108.5	51.5	119.0	45.0	114.5	46.0	112.0	46.0	112.0	46.0
	11.00	141	29.67	43.87	123.0	107.5	51.5	119.0	43.5	116.0	44.5	113.5	45.0	112.5	46.0
	11.15	142	30.19	43.73	122.0	109.0	55.0	118.5	45.5	113.0	45.5	111.0	46.0	111.0	47.0
	11.30	143	30.10	43.87	122.0	108.0	52.0	118.0	44.0	113.5	45.0	111.5	45.5	110.0	46.5
	11.45	144	30.04	44.33	122.0	108.0	54.0	119.0	45.0	116.0	45.0	115.0	45.5	115.0	46.0
	12.00	145	29.96	44.13	120.5	107.0	53.0	117.0	44.0	103.5	44.5	111.0	45.0	110.0	45.5
Average			29.52	42.22	122.2										

At .55.		At .65.		At .75.		At .85.		At .95.		Terminal Pressure.	Mean Pressure.		Effective Pressure.	
Maximum Press.	Counter Press.	Maximum Press.	Counter Press.	Maximum Press.	Counter Press.	Maximum Press.	Counter Press.	Maximum Press.	Counter Press.		Maximum.	Counter.	By Ordinates.	By Planimeter
17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
103.5	37.0	103.0	37.0	103.0	38.0	102.0	38.0	100.0	49.0	96.0	104.50	38.00	66.50	64.06
117.5	46.0	118.0	46.0	118.0	46.0	117.0	50.0	106.5	84.0	102.0	115.30	49.80	65.50	65.40
113.5	44.5	114.0	45.0	114.5	45.5	116.5	47.5	110.0	66.5	103.5	114.95	47.15	67.80	66.81
119.5	47.0	119.5	46.5	119.5	48.0	117.5	50.5	108.0	80.0	90.5	116.85	50.35	66.50	65.70
114.0	45.0	114.5	45.0	115.5	45.0	116.0	46.0	109.0	63.5	104.0	115.55	47.05	68.50	66.70
114.5	45.0	114.5	45.0	116.0	45.5	116.0	47.0	110.5	66.0	105.0	115.45	47.15	68.30	66.81
115.5	45.0	115.0	45.0	115.0	45.0	115.0	46.0	107.0	68.5	101.5	115.30	47.75	67.55	66.33
117.0	45.5	116.5	45.5	116.5	45.5	116.0	46.5	108.0	66.0	103.0	116.20	47.95	68.25	66.73
118.0	45.5	119.0	46.5	118.5	46.5	117.0	49.0	108.0	78.0	100.5	116.05	49.50	66.55	65.53
115.0	45.0	115.0	45.0	117.5	46.0	118.5	49.5	110.0	79.5	104.0	115.25	48.80	66.45	66.90
116.0	44.0	119.0	45.0	118.5	45.5	117.0	48.5	108.0	80.5	102.5	115.80	48.60	67.20	67.78
118.5	45.0	117.0	45.0	115.5	46.0	114.5	48.0	106.0	79.0	99.5	115.90	49.50	66.40	67.13
114.5	46.0	114.5	45.5	115.0	46.0	115.5	47.5	110.0	63.0	105.0	114.85	47.05	67.80	66.80
113.0	45.0	114.0	45.0	115.0	46.0	117.0	48.0	110.0	68.0	105.0	114.30	47.35	66.95	66.05
116.5	44.5	114.5	44.5	114.0	45.5	112.0	47.5	104.0	71.0	98.5	113.65	47.95	65.70	65.40
114.5	45.5	113.5	45.0	112.5	46.5	111.5	49.5	104.0	71.5	98.0	112.80	48.60	64.20	62.32
110.0	44.5	109.0	45.0	110.0	45.0	112.0	48.0	106.5	62.0	98.5	110.80	46.55	64.25	61.26
110.0	45.0	110.0	45.0	110.5	46.0	111.0	48.0	106.5	64.5	100.0	111.20	47.40	63.80	61.58
110.5	45.0	112.0	45.0	114.0	46.5	115.0	50.0	108.0	69.0	102.5	112.80	48.25	64.55	62.87
113.0	46.0	113.5	46.5	114.0	48.0	112.0	52.0	103.0	71.0	97.0	112.10	49.60	62.50	60.60
111.5	45.0	111.5	45.0	111.5	46.0	111.0	48.0	107.5	77.0	100.0	112.05	48.80	63.25	62.24
113.5	45.0	113.5	45.0	114.0	45.5	111.5	47.5	103.0	72.0	97.0	112.50	48.55	63.95	61.94
110.0	45.5	110.0	45.5	113.0	46.5	113.5	54.0	107.5	74.0	100.5	111.55	49.40	62.15	60.99
110.5	45.5	111.0	45.5	113.0	47.0	114.0	51.0	106.0	80.5	99.0	111.60	49.80	61.80	60.61
113.0	46.0	113.5	47.0	113.0	47.0	112.0	49.5	103.5	74.0	98.0	111.95	49.95	62.00	60.60
111.5	46.0	111.0	46.0	111.0	46.0	111.0	48.0	102.5	76.0	97.0	111.95	49.10	62.85	61.90
111.5	45.0	111.5	45.0	111.0	46.0	111.0	47.0	105.0	66.0	99.5	112.10	47.75	64.35	62.05
114.0	46.0	113.5	46.0	112.5	47.0	110.5	49.0	102.0	74.5	96.5	112.05	49.85	62.20	60.72
112.5	47.5	112.0	47.0	112.5	48.0	112.5	50.0	107.0	68.5	102.0	112.85	48.90	63.95	62.78
110.5	45.0	110.0	45.0	111.0	46.0	111.0	48.0	103.5	79.0	97.0	111.80	48.80	63.00	61.97
114.5	47.0	114.0	47.0	113.0	47.5	111.0	50.0	103.0	80.0	97.0	113.10	51.45	61.65	60.49
113.5	47.0	114.0	46.5	115.0	47.0	114.0	50.5	104.5	79.0	99.0	112.70	50.45	62.25	60.73
111.5	46.0	112.0	46.5	111.5	46.5	111.5	48.5	104.0	79.0	97.5	111.90	49.70	62.20	60.98
112.5	47.0	113.0	47.0	114.0	48.0	113.5	51.0	104.0	75.0	98.0	111.95	50.70	61.25	59.45
110.0	46.0	112.0	46.0	114.0	47.0	113.5	49.0	105.0	75.0	99.5	111.55	49.60	61.95	60.00
115.0	46.5	114.0	47.0	113.0	47.0	111.0	50.0	102.5	74.0	97.0	112.85	50.00	62.85	61.95
110.0	45.5	111.5	45.0	113.0	46.0	113.5	49.0	104.5	75.5	98.5	110.10	49.30	60.80	60.73
										99.3		48.71	63.93	63.01

Date.	Time.	No. of Diagram.	Strokes.		Initial Pressure.	At .05.		At .15.		At .25.		At .35.		At .45.	
			Length, Ins.	Double, per minute.		Maximum Pres.	Counter Pres.	Maximum Pres.	Counter Pres.	Maximum Pres.	Counter Pres.	Maximum Pres.	Counter Pres.	Maximum Pres.	Counter Pres.
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
March 22,	P M														
	12.00	1	30.00	43.73	36.5	36.0	6.0	36.0	3.0	35.0	3.5	33.5	3.5	34.0	3.5
	12.15	2	28.33	45.07	36.0	36.0	6.0	35.5	3.0	35.5	2.5	35.0	3.0	34.0	3.0
	12.30	3	28.93	46.73	36.0	36.0	7.0	35.5	2.5	35.0	3.0	34.5	3.5	33.5	3.5
	12.45	4	28.93	45.33	35.5	35.5	6.5	36.0	3.0	35.5	3.0	35.0	3.0	33.5	3.5
	1.00	5	28.81	48.20	35.5	35.5	4.5	35.5	3.0	34.5	3.5	33.5	4.0	32.0	4.0
	1.15	6	29.26	46.00	35.5	35.5	6.0	36.0	3.0	35.5	3.0	34.5	3.5	33.5	3.5
	1.30	7	28.75	45.87	36.0	36.0	5.0	36.0	3.0	35.0	3.0	34.0	3.5	33.0	4.0
	1.45	8	29.17	45.13	36.0	36.0	6.5	36.0	3.0	35.5	3.5	35.0	3.5	34.0	4.0
	2.00	9	28.78	44.73	36.0	36.0	4.0	34.5	2.0	32.5	2.0	31.5	2.5	30.5	2.5
	2.15	10	29.08	43.93	36.0	36.0	7.5	36.0	3.5	36.0	4.0	35.5	4.0	35.5	4.0
	2.30	11	29.05	44.87	35.5	35.5	6.0	36.5	3.5	35.5	3.5	35.0	3.5	34.0	4.0
	2.45	12	28.59	44.20	35.5	35.5	6.0	35.5	3.0	35.0	3.0	34.0	3.5	33.5	3.5
	3.00	13	28.29	44.73	36.0	36.0	5.0	36.0	3.0	35.5	3.5	33.5	4.0	32.5	4.5
	3.15	14	28.53	44.07	36.0	36.0	5.5	35.5	2.5	35.0	3.0	33.5	3.0	33.0	3.5
	3.30	15	28.75	44.40	36.0	36.0	5.5	36.0	2.5	35.5	2.5	34.0	2.5	33.0	3.0
	3.45	16	28.99	44.13	36.0	36.0	6.0	36.0	2.5	35.5	2.5	34.5	2.5	33.5	3.0
	4.00	17	28.20	44.40	36.0	36.0	3.0	36.0	2.5	35.0	3.0	33.5	3.5	32.5	3.5
	4.15	18	28.62	44.47	35.5	35.5	6.0	36.0	2.5	35.5	3.0	34.0	3.0	33.0	3.5
	4.30	19	28.62	45.27	36.0	36.0	5.5	36.0	3.0	35.0	3.0	34.5	3.5	34.0	4.0
	4.45	20	28.72	44.40	35.5	35.5	4.0	35.5	2.0	34.5	3.0	33.5	3.5	32.5	4.0
	5.00	21	28.81	44.40	36.0	36.0	5.0	35.5	2.0	35.0	3.0	34.0	3.0	33.5	4.0
	5.15	22	29.02	42.74	35.5	35.5	6.0	35.5	2.0	35.0	2.5	33.5	3.0	32.5	3.5
	5.30	23	29.20	43.00	35.5	35.5	8.0	35.5	2.0	35.0	1.5	34.0	2.0	34.0	3.0
	5.45	24	29.26	42.93	35.5	35.5	7.5	35.5	1.5	35.0	1.5	35.0	2.0	34.5	2.5
	6.00	25	29.14	42.27	36.0	36.0	7.5	35.5	2.0	35.5	2.0	35.0	2.0	35.0	3.0
	6.15	26	29.36	42.07	35.5	35.5	8.5	35.5	2.5	35.5	2.0	35.0	2.0	35.0	2.5
	6.30	27	29.26	42.80	35.5	35.5	8.5	35.5	2.5	35.0	2.0	34.0	2.0	34.0	2.0
	6.45	28	29.26	42.93	35.5	35.5	8.5	35.0	2.5	34.0	2.0	33.5	2.0	33.5	2.5
	7.00	29	29.23	42.60	35.5	35.5	8.5	35.5	3.0	34.5	2.0	34.0	2.0	33.5	2.5
	7.15	30	29.20	43.07	35.5	35.5	8.5	35.5	2.5	35.0	2.0	34.5	2.0	34.5	2.5
	7.30	31	28.23	43.47	35.5	35.5	2.5	35.5	1.5	35.0	2.0	34.0	2.5	33.5	2.5
	7.45	32	29.17	43.73	35.5	35.5	8.5	35.5	2.5	35.5	2.0	35.5	2.5	35.5	3.0
	8.00	33	29.26	44.22	35.5	35.5	10.0	35.0	3.0	35.0	2.0	34.0	2.0	34.5	2.5
	8.15	34	29.02	44.33	35.5	35.5	9.5	35.5	2.5	35.0	2.0	34.5	2.5	34.0	3.5
	8.30	35	29.20	45.00	35.5	35.5	10.5	35.5	3.0	35.5	2.0	34.5	2.0	34.5	2.5
	8.45	36	29.56		35.5	35.5	10.0	35.5	3.0	35.5	2.5	34.5	2.0	35.0	2.5

At .55.		At .65.		At .75.		At .85.		At .95.		Terminal Pres.	Mean Pressure.		Effective Pressure.	
Maximum Pres.	Counter Pres.	Maximum Pres.	Counter Pres.	Maximum Pres.	Counter Pres.	Maximum Pres.	Counter Pres.	Maximum Pres.	Counter Pres.		Maximum.	Counter.	By Ordinates.	By Planimeter
17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
34.0	4.0	33.5	4.0	33.0	5.5	32.0	7.0	27.0	17.0	24.5	33.40	5.70	27.70	27.96
33.5	3.0	33.0	3.5	33.0	4.5	31.5	6.0	28.0	10.0	25.5	33.50	4.45	29.05	28.69
33.5	3.5	33.0	4.0	33.0	4.5	32.5	6.0	28.0	10.5	26.0	33.45	4.80	28.65	28.24
32.5	4.0	32.0	4.0	31.5	5.0	31.0	6.5	27.5	12.0	24.5	33.00	5.05	27.95	27.86
31.5	4.5	31.0	5.0	31.0	6.0	30.5	7.0	27.0	13.0	25.0	32.20	5.45	26.75	26.71
33.0	4.0	33.0	4.0	32.5	5.0	31.0	6.0	27.0	16.5	25.0	33.15	5.45	27.70	25.71
32.5	4.5	32.0	5.0	32.0	6.0	31.0	7.5	27.0	13.5	25.5	32.85	5.50	27.35	27.15
33.5	4.0	33.0	4.5	32.5	5.0	32.0	6.0	27.5	11.0	25.5	33.50	5.10	28.40	27.92
30.5	3.0	30.0	3.0	29.5	3.0	29.5	4.5	25.5	5.5	24.0	31.00	3.20	27.80	26.50
34.5	5.0	34.0	5.0	33.5	6.0	32.5	7.5	28.5	12.5	27.0	34.20	5.90	28.30	28.00
33.5	4.0	33.0	4.0	33.0	4.5	32.0	5.5	27.0	8.5	26.0	33.60	4.10	29.50	27.95
33.0	4.0	33.0	4.0	33.0	4.5	32.0	5.5	27.5	9.0	26.5	33.20	4.60	28.60	28.31
32.0	5.0	32.0	5.5	32.0	6.0	32.0	7.5	28.0	11.0	26.0	32.95	5.50	27.45	27.28
32.5	4.0	32.0	4.0	32.0	4.5	31.5	6.0	27.5	9.0	26.0	32.85	4.50	28.35	27.60
33.0	3.5	32.5	3.5	32.0	4.5	31.0	5.5	27.5	9.5	25.5	33.05	4.25	28.80	28.54
33.0	3.5	33.0	4.0	32.5	4.5	32.0	6.0	27.5	10.0	25.0	33.35	4.45	28.90	28.26
32.0	4.5	32.0	5.0	32.0	5.5	31.0	6.5	27.5	12.5	25.5	32.75	4.95	27.80	27.67
33.0	4.0	32.5	4.5	32.0	5.0	32.0	6.0	28.0	10.5	25.5	33.15	4.80	28.35	27.86
33.0	4.5	33.0	4.5	32.5	5.0	32.0	6.5	28.0	11.0	26.0	33.40	5.05	28.35	27.60
32.0	4.5	32.5	5.5	32.5	7.0	31.5	8.0	28.0	13.0	26.0	32.80	5.45	27.35	27.17
33.0	4.0	32.5	4.5	32.5	5.0	31.5	6.5	27.5	9.5	26.0	33.10	4.65	28.45	27.93
32.5	4.0	32.5	5.0	33.0	5.5	32.5	7.0	28.5	12.0	26.0	33.10	5.05	28.05	28.06
32.5	4.0	34.0	5.5	33.5	7.0	32.5	9.0	28.0	14.5	26.0	33.55	5.65	27.90	27.97
34.0	4.0	35.0	5.5	34.5	6.5	33.0	9.0	33.0	15.0	27.0	34.50	4.10	30.40	28.29
35.0	4.5	35.5	5.5	35.0	6.5	34.0	9.0	29.5	14.5	27.0	34.60	5.65	28.95	28.53
35.0	4.0	35.0	5.0	35.0	7.0	33.5	9.0	28.5	13.0	27.0	34.35	5.52	28.83	28.49
34.0	3.0	33.5	4.0	33.0	5.0	32.5	7.0	28.0	13.0	26.0	33.50	4.90	28.60	28.37
33.5	3.5	33.5	5.0	33.0	6.5	32.0	9.0	28.0	14.5	25.0	33.15	5.60	27.55	27.18
33.5	3.5	32.5	5.0	33.5	6.5	32.5	9.5	28.0	15.0	26.0	33.60	5.75	27.85	27.57
34.5	3.5	33.5	4.5	33.0	6.5	32.0	9.0	27.5	15.0	25.0	33.55	5.60	27.95	27.98
33.0	3.0	33.0	3.0	32.5	3.0	32.0	3.5	28.0	6.5	25.5	33.20	3.00	30.20	29.80
35.0	4.0	34.5	5.5	34.0	8.0	32.5	11.0	28.0	17.5	25.5	34.15	6.45	27.70	27.63
34.0	3.5	34.0	5.5	33.0	7.0	32.5	9.5	27.5	16.0	25.5	33.50	6.10	27.40	27.33
34.0	4.5	34.0	6.0	33.0	7.0	32.5	10.0	28.0	16.0	25.5	33.60	6.35	27.25	27.56
34.5	4.0	34.0	5.5	33.5	7.5	33.0	9.5	28.0	15.0	26.5	33.85	6.15	27.70	27.24
35.0	4.5	34.5	6.0	33.5	8.0	32.0	10.5	28.0	17.5	25.0	33.90	5.75	28.15	27.18

Date.	Time.	No. of Diagram.	Strokes		Initial Pressure.	At .05.		At .15.		At .25.		At .35.		At .45.	
			Length, Ins.	Double, per Minute.		Maximum Press.	Counter Press.	Maximum Press.	Counter Press.	Maximum Press.	Counter Press.	Maximum Press.	Counter Press.	Maximum Press.	Counter Press.
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
M'ch 22,	P.M.														
	9.00	37	28.11	44.53	23.5	23.5	1.0	22.5	0.5	21.5	1.0	21.0	1.0	20.0	1.0
	9.15	38	28.44	29.27	35.5	35.5	5.5	35.5	2.0	34.5	2.5	33.5	2.5	33.0	2.5
	9.30	39	28.41	39.87	36.0	36.0	5.5	35.5	3.0	35.0	3.0	35.0	3.0	34.5	3.0
	9.45	40	28.75	42.33	36.0	36.0	7.5	35.5	3.0	35.5	3.5	34.5	3.0	34.5	3.5
	10.00	41	28.72	42.87	36.0	36.0	7.0	35.5	2.5	35.5	3.0	35.5	3.0	34.5	3.0
	10.15	42	29.20	43.53	36.0	36.0	6.0	35.5	2.5	35.0	3.0	34.0	3.0	33.0	3.0
	10.30	43	28.53	42.00	35.5	35.5	8.0	36.0	3.0	35.5	3.0	35.0	3.0	34.0	3.0
	10.45	44	28.87	43.00	36.0	36.0	6.5	36.0	3.0	35.5	3.0	35.0	2.0	34.0	3.0
	11.00	45	29.20	42 40	35.5	35.5	7.5	36.0	3.0	35.5	3.0	34.5	3.0	34.0	3.0
	11.15	46	28.53	42.07	35.5	35.5	7.0	35.5	3.0	35.5	3.0	35.5	3.0	35.0	3.0
	11.30	47	28.50	42.13	35.5	35.5	7.0	35.5	3.0	35.0	2.5	35.5	3.0	34.5	2.5
	11.45	48	28.47	42.60	36.0	36.0	7.0	36.0	3.0	36.0	3.0	35.5	3.0	35.0	3.0
	12.00	49	29.08	42.13	35.5	35.5	7.0	36.0	3.0	35.5	3.0	35.0	3.0	34.0	3.0
M'ch 23,	A.M.														
	12.15	50	28.59	42.20	35.5	35.5	6.5	35.5	3.0	35.0	3.0	34.0	3.0	34.0	3.0
	12.30	51	28.72	42.07	36.0	36.0	6.5	35.5	3.0	35.5	3.0	35.5	3.0	34.5	3.0
	12.45	52	28.62	43.07	35.5	35 5	7.5	35.5	3.0	35.5	3.0	34.0	3.0	33.5	3.0
	1.00	53	28.99	42.27	36.0	36.0	7.0	35.5	3.0	35.5	3.0	35.5	3.0	34.5	3.0
	1.15	54	28.56	42.40	35.5	35.5	7.5	36.0	3.0	35.5	3.0	35.5	3.0	35.0	3.0
	1.30	55	28.56	42.60	35.5	35.5	7.0	36.0	3.0	35.5	3.0	35.5	3.0	35.0	3.0
	1.45	56	28.47	43.13	35.5	35.5	8.0	36.0	3.0	36.0	3.0	35.5	3.0	35.0	3.0
	2.00	57	28.65	42.73	36.0	36.0	7.0	36.0	3.0	35.5	3.0	35.5	3.0	35.0	3.0
	2.15	58	28.59	42.67	35.5	35.5	7.5	36.0	3.5	35.5	3.0	35.5	3.0	35.5	3.0
	2.30	59	28.72	42.27	36.0	36.0	7.5	35.5	3.0	35.5	3.5	35.5	3.5	35.0	3.5
	2.45	60	28.84	43.47	35.5	35.5	7.0	36.0	3.0	35.5	3.0	35.5	3.0	34.5	3.0
	3.00	61	28.78	42.87	35.5	35.5	7.0	35.5	3.0	35.5	3.0	35.0	2.5	35.0	3.0
	3.15	62	28.81	43.13	36.0	36.0	8.0	36.0	3.5	36.0	3.0	35.5	3.5	35.0	3.0
	3.30	63	28.53	42.87	36.0	36.0	7.0	36.0	3.5	35.5	3.5	35.5	3.5	35.0	3.5
	3.45	64	28.72	43.73	36.0	36.0	7.5	36.0	3.0	36.0	3.0	36.0	3.0	35.5	3.0
	4.00	65	28.65	43.20	35.5	35.5	7.0	36.0	3.0	35.5	3.0	34.5	3.0	34.5	3.0
	4.15	66	28.38	43.13	36.0	36.0	7.0	36.0	3.0	35.5	3.0	34.5	3.0	34.0	3.5
	4.30	67	28.47	43.00	35.5	35.5	7.5	36.0	3.5	35.5	3.5	35.5	3.5	34.5	3.5
	4.45	68	28.72	44.33	36.0	36.0	8.5	36.0	3.0	36.0	3.0	35.0	3.0	34.0	3.0
	5.00	69	28.84	42.87	36.0	36.0	8.0	36.0	3.0	35.5	3.0	34.5	3.0	34.5	3.0
	5.15	70	29.17	43.40	36.0	36.0	8.0	36.0	3.5	36.0	3.5	35.5	3.5	34.5	3.5
	5.30	71	28.93	43.27	35.5	35.5	7.0	36.0	3.5	35.5	3.5	35.5	3.5	34.0	3.0
	5.45	72	29.11	44.40	35.5	35.5	7.5	36.0	3.5	35.5	3.5	35.0	3.5	34.0	3.5

At .55.		At .65.		At .75.		At .85.		At .95.		Terminal Pressure.	Mean Pressure.		Effective Pressure.	
Maximum Press	Counter Press.	Maximum Press.	Counter Press.	Maximum Press.	Counter Press.	Maximum Press.	Counter Press.	Maximum Press.	Counter Press.		Maximum.	Counter.	By Ordinates.	By Planimeter
17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
20.0	1.5	20.0	1.5	20.0	1.0	20.0	1.0	18.0	1.5	16.0	20.65	1.10	19.55	18.74
33.0	2.5	33.0	2.5	33.0	3.0	32.0	4.0	28.0	6.5	25.5	33.10	3.35	29.75	29.67
34.0	3.5	33.5	3.5	33.0	3.5	32.0	5.0	28.0	7.5	27.0	33.65	4.05	29.60	29.61
34.0	3.5	34.0	3.5	34.0	4.0	32.5	5.0	28.5	8.0	26.0	33.90	4.45	29.45	28.88
34.0	3.0	33.5	3.0	33.0	3.5	31.5	4.5	28.0	8.0	25.5	33.70	4.05	29.65	29.13
32.5	3.0	32.5	3.0	32.5	4.0	31.0	5.5	26.5	11.0	25.5	32.85	4.45	28.40	27.60
33.5	3.0	33.0	3.0	33.0	3.5	32.0	4.5	28.0	7.0	26.0	33.55	4.10	29.45	29.21
33.0	3.0	32.5	3.0	32.5	3.5	32.0	5.0	27.5	9.0	26.0	33.40	4.20	29.20	28.38
34.0	3.0	33.5	3.5	33.5	4.0	32.0	5.0	27.5	9.5	26.0	33.60	4.45	29.15	28.43
34.0	3.0	33.5	3.5	33.0	4.0	37.0	5.5	28.0	11.5	26.0	34.25	4.65	29.60	28.72
34.0	3.0	34.0	3.5	33.0	4.0	32.5	5.0	28.0	8.5	23.0	33.75	4.20	29.55	28.92
34.0	3.0	33.5	3.5	33.0	4.0	32.0	5.5	28.5	9.5	26.0	33.95	4.05	29.90	29.20
33.5	3.0	33.0	3.5	32.5	4.0	31.0	6.0	27.0	12.0	25.0	33.30	4.75	28.55	28.13
33.0	3.0	32.5	3.0	32.5	4.0	31.5	5.5	27.5	9.0	25.5	33.10	4.30	28.80	28.40
34.0	3.0	33.0	3.0	32.5	4.0	31.0	4.5	32.0	8.5	25.5	33.95	4.15	29.80	28.91
33.5	3.0	33.0	3.0	33.0	4.0	32.0	5.0	27.5	8.0	26.0	33.30	4.25	29.05	28.62
34.0	3.0	33.5	3.5	33.0	4.5	31.5	5.0	27.5	8.5	25.5	33.65	4.35	29.30	28.60
34.0	3.0	33.0	3.0	32.5	3.5	32.0	5.0	28.0	7.5	26.0	33.70	4.15	29.55	29.11
35.0	3.0	34.5	3.5	34.0	4.0	33.0	5.0	34.0	8.0	26.5	34.80	4.25	30.55	29.88
34.0	3.0	33.5	3.5	32.5	4.0	32.0	5.0	28.0	8.0	25.5	33.80	4.35	29.45	29.42
34.5	3.5	34.0	4.0	33.5	4.5	32.5	5.5	28.5	9.0	26.0	34.10	4.55	29.55	29.27
35.0	3.5	34.5	3.5	34.0	4.0	33.0	5.0	28.5	8.0	24.5	34.30	4.40	29.90	29.72
34.0	3.5	33.5	3.5	33.0	4.0	32.0	5.0	27.5	7.5	26.0	33.75	4.45	29.30	28.83
34.0	3.0	33.5	3.5	33.0	4.0	31.5	5.5	28.0	11.0	25.5	33.70	4.60	29.10	28.83
34.5	3.0	34.0	3.0	33.0	3.0	32.0	4.5	28.5	8.0	26.0	33.85	4.00	29.85	29.40
35.5	3.5	34.0	4.0	33.5	5.5	32.5	6.0	28.5	9.0	26.0	34.25	4.90	29.35	29.07
34.5	3.5	34.0	4.0	33.5	4.0	32.5	5.0	28.5	9.5	26.5	34.10	4.70	29.40	29.10
34.5	3.5	34.5	3.5	33.5	4.5	33.0	6.5	28.5	9.5	26.0	34.35	4.70	29.65	29.21
34.5	3.5	34.0	3.5	33.5	4.0	32.5	5.5	28.5	9.0	26.5	33.90	4.05	29.85	29.18
33.5	3.5	34.0	4.0	34.0	4.5	33.0	6.0	29.0	8.0	26.5	33.95	4.55	29.50	29.21
34.5	3.5	33.5	4.0	33.0	5.0	31.5	5.5	27.5	9.0	26.0	33.70	4.85	28.85	28.65
33.5	3.0	33.0	3.5	33.0	4.0	31.5	5.5	27.5	7.0	25.5	33.55	4.35	29.20	28.91
34.0	3.5	34.0	3.5	33.0	4.0	31.5	5.5	27.5	11.0	26.5	33.65	4.75	28.80	28.75
33.5	3.5	33.5	4.0	33.5	5.0	32.0	6.0	28.5	11.0	26.0	34.00	5.15	28.85	28.38
33.5	3.5	33.0	4.0	32.5	4.0	31.5	6.0	27.5	11.0	25.0	34.45	4.90	29.55	28.15
33.5	3.5	33.5	4.0	33.5	4.5	32.0	6.5	27.5	13.0	26.0	33.60	5.30	28.30	28.06

Date.	Time.	No. of Diagram.	Strokes.		Initial Pressure.	At .05.		At .15.		At .25.		At .35.		At .45.	
			Length, Ins.	Double, per minute.		Maximum Pres.	Counter Pres.	Maximum Pres.	Counter Pres.	Maximum Pres.	Counter Pres.	Maximum Pres.	Counter Pre	Maximum Pres.	Counter Pres.
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
March 23,	A M														
	6.00	73	28.84	43.67	35.5	35.5	7.5	35.5	3.0	35.0	2.0	35.0	3.0	34.5	3.5
	6.15	74	28.50	43.07	35.5	35.5	7.0	35.5	3.0	35.5	3.0	35.5	3.5	34.0	3.5
	6.30	75	28.62	42.73	36.0	36.0	7.5	35.5	3.5	35.5	3.0	35.5	3.0	35.0	3.0
	6.45	76	28.59	43.47	35.5	35.5	7.0	35.5	3.0	36.0	3.5	35.5	3.0	35.0	3.0
	7.00	77	28.72	43.13	36.0	36.0	8.0	36.0	3.5	35.5	3.0	34.5	3.0	34.5	3.0
	7.15	78	28.65	43.33	36.0	36.0	7.5	36.0	3.0	36.0	3.0	35.5	3.0	35.0	3.0
	7.30	79	28.65	42.93	35.0	35.0	7.0	36.0	3.0	35.5	3.0	35.0	3.0	35.0	3.0
	7.45	80	28.72	43.33	36.0	36.0	7.5	36.0	3.0	35.5	3.0	35.5	3.0	35.0	3.0
	8.00	81	28.72	43.13	35.5	35.5	7.5	36.0	3.0	36.0	3.0	35.5	3.0	34.5	3.0
	8.15	82	28.53	42.73	35.5	35.5	7.5	35.5	3.0	35.5	3.0	35.5	3.0	35.5	3.0
	8.30	83	28.53	42.93	35.5	35.5	7.0	36.0	3.0	35.5	3.0	35.5	3.5	35.0	3.5
	8.45	84	28.53	43.67	35.5	35.5	6.5	35.5	3.0	35.5	3.0	35.0	3.0	34.0	3.0
	9.00	85	28.59	43.00	35.5	35.5	7.5	35.5	3.0	35.5	3.0	35.0	3.0	34.0	3.0
	9.15	86	28.90	42.93	36.0	36.0	7.5	36.0	3.5	36.0	3.5	35.5	3.5	35.0	3.5
	9.30	87	28.47	42.75	35.5	35.5	6.5	35.5	3.0	35.5	3.0	35.5	3.5	35.5	3.5
	9.45	88	28.59	43.27	35.5	35.5	7.0	36.0	3.0	35.5	3.0	35.5	3.0	35.0	3.0
	10.00	89	28.47	43.00	35.5	35.5	7.0	36.0	3.5	35.5	3.5	35.5	3.5	35.0	3.5
	10.15	90	28.65	43.67	36.0	36.0	7.0	36.0	3.5	35.5	3.0	34.5	3.0	33.5	3.0
	10.30	91	28.62	42.67	36.0	36.0	7.0	36.0	3.0	35.5	3.0	35.5	3.0	35.0	3.0
	10.45	92	28.69	43.33	35.5	35.0	7.5	36.0	3.5	36.0	3.0	35.5	3.0	35.0	3.0
	11.00	93	28.53	43.13	35.5	35.5	7.0	35.5	3.0	35.5	3.0	35.0	3.0	34.5	3.0
	11.15	94	28.78	43.00	35.5	35.5	8.5	36.0	3.5	35.5	3.0	35.5	3.0	35.0	3.5
	11.30	95	28.65	42.40	35.5	35.5	8.0	35.5	3.5	35.5	3.0	35.5	3.0	35.5	3.5
	11.45	96	28.59	44.00	36.0	36.0	7.5	36.0	3.0	35.5	3.0	35.0	3.0	34.0	3.0
	12.00	97	28.65	43.07	35.5	35.5	6.5	35.5	3.5	35.5	3.0	35.5	3.5	35.0	3.5
	P M														
	12.15	98	28.90	43.00	36.0	36.0	7.5	36.0	3.5	35.5	3.5	35.5	3.0	35.0	3.0
	12.30	99	28.65	43.27	35.5	35.5	7.0	36.0	3.0	35.5	3.0	35.5	3.0	35.0	3.0
	12.45	100	28.90	43.73	36.0	36.0	8.0	36.0	3.0	35.5	3.0	35.5	3.0	35.5	3.0
	1.00	101	29.08	43.47	35.5	35.5	7.5	36.0	3.5	36.0	3.5	35.5	3.5	34.5	3.5
	1.15	102	29.11	43.00	36.0	36.0	8.0	36.0	3.5	36.0	3.5	35.5	3.5	34.5	3.5
	1.30	103	28.75	43.07	35.5	35.5	7.0	35.5	3.0	36.0	3.0	35.5	3.0	35.0	3.0
	1.45	104	28.78	44.00	36.0	36.0	7.0	36.0	3.0	36.0	3.0	35.5	3.0	35.0	3.0
	2.00	105	28.81	43.00	35.5	35.5	6.0	35.5	3.0	35.5	3.0	35.5	3.0	34.5	3.0
	2.15	106	28.84	43.40	35.5	35.5	6.0	36.0	3.0	36.0	3.0	35.5	3.0	35.0	3.0
	2.30	107	28.75	43.73	36.0	36.0	6.5	36.0	3.0	35.5	3.5	35.0	3.5	34.0	3.5
	2.45	108	28.99	44.47	35.5	35.5	7.0	35.5	3.0	35.5	3.0	35.5	3.5	35.0	3.5
Averages,			28.70	42.84	35.5										

At .55.		At .65.		At .75.		At .85.		At .95.		Terminal Pres.	Mean Pressure.		Effective Pressure.	
Maximum Pres.	Counter Pres.	Maximum Pres.	Counter Pres.	Maximum Pres.	Counter Pres.	Maximum Pres.	Counter Pres.	Maximum Pres.	Counter Pres.		Maximum.	Counter.	By Ordinates.	By Planimeter
17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
33.5	3.5	33.0	3.5	32.5	4.0	31.5	5.5	27.5	10.0	25.5	33.35	4.65	29.70	28.37
33.5	3.5	33.5	3.5	33.5	4.0	33.5	5.0	29.0	8.5	26.5	33.85	4.45	29.40	29.00
34.0	3.0	33.5	3.5	33.5	3.5	32.0	5.0	28.0	7.5	26.5	33.85	4.25	29.60	29.05
34.5	3.5	34.5	4.0	33.5	4.5	32.5	5.5	28.5	10.0	26.0	34.30	4.70	29.60	29.04
34.5	3.0	34.5	3.5	34.0	4.5	33.5	6.0	29.0	11.0	26.5	34.20	4.85	29.35	29.04
34.0	3.5	33.5	3.5	33.0	4.5	31.5	5.5	28.0	9.5	26.0	33.85	4.60	29.25	28.51
34.0	3.0	33.5	3.5	33.5	4.0	32.5	5.5	28.0	9.5	26.0	33.80	4.45	29.35	28.89
34.5	3.0	34.0	3.0	33.5	4.0	32.0	5.0	28.0	9.0	26.0	34.00	4.35	29·65	28.87
33.5	3.0	33.0	3.5	32.0	4.0	31.5	5.0	28.0	9.0	25.5	33.55	4.40	29.15	28.19
34.5	3.0	34.0	3.5	33.5	4.5	32.5	4.5	28.5	8.0	26.5	34.05	4.30	29.75	28.93
34.0	3.5	34.0	4.0	34.0	4.0	33.0	5.5	29.0	8.5	26.5	34.15	4.55	29.60	28.97
33.0	3.0	33.0	3.5	33.5	4.0	32.5	4.5	28.5	8.0	26.5	35.60	4.15	31.45	28.72
33.5	3.0	33.0	3.5	32.0	4.0	31.0	6.0	27.5	8.0	25.5	33.25	4.40	29.85	27.84
34.5	3.5	34.0	3.5	33.5	4.0	32.5	5.0	28.5	9.5	26.0	34.15	4.70	29.45	28.65
34.5	3.5	34.0	3.5	33.5	4.0	32.5	5.0	29.0	9.0	26.5	34.10	4.45	29.65	29.12
34.0	3.0	33.5	4.0	33.0	4.5	32.0	5.5	28.0	11.0	25.5	33.80	4.70	29.10	26.57
34.5	3.5	34.5	3.5	34.5	4.5	34.0	6.0	29.5	9.0	27.0	34.45	4.75	29.70	28.33
33.5	3.5	34.0	4.0	33.5	4.0	32.5	5.5	28.0	10.5	26.5	33.70	4.70	29.00	28.56
34.5	3.0	34.0	3.0	33.5	4.0	32.0	5.5	28.0	8.0	26.5	34.00	4.25	29.75	29.30
34.0	3.0	33.5	3.5	33.0	4.0	32.0	5.5	28.0	9.0	26.0	33.85	4.50	29.35	28.78
34.5	3.0	34.0	3.5	34.0	4.0	33.0	5.5	28.5	9.0	26.5	34.00	4.40	29.60	29.06
34.0	3.5	33.5	3.5	33.0	3.5	32.0	5.5	28.0	8.0	26.0	33.80	4.55	29.25	28.85
34.5	3.5	34.0	4.0	33.5	4.5	32.5	6.0	28.5	12.0	26.5	34.05	5.10	28.95	28.55
34.0	3.0	34.0	3.5	34.0	3.5	33.0	5.0	28.5	8.0	27.0	34.00	4.25	29.75	29.44
34.5	3.5	34.0	3.5	33.5	4.0	32.5	5.5	28.5	10.0	26.0	34.00	4.65	29.35	28.85
34.0	3.5	34.0	3.5	33.5	4.5	32.0	5.0	28.0	9.5	26.0	34.00	4.65	29.35	28.53
34.5	3.0	33.5	3.5	33.0	4.0	31.5	5.5	28.0	12.0	25.5	33.75	4.70	29.05	28.85
35.0	3.5	34.5	4.0	34.5	4.5	33.0	6.0	29.0	14.0	26.5	34.45	5.20	29.25	29.11
33.5	3.5	33.0	4.0	32.5	4.5	31.0	6.0	27.0	11.0	25.0	33.45	5.05	28.40	28.00
34.0	3.5	33.5	4.0	33.0	4.5	32.0	5.5	28.0	11.5	25.5	33.85	5.10	28.75	28.18
34.5	3.0	34.0	3.5	33.5	4.0	32.5	4.5	28.5	9.0	26.0	34.05	4.30	29.65	29.56
34.0	3.0	34.0	3.5	33.5	3.5	32.0	4.5	28.5	9.0	26.0	34.05	4.25	29.80	29.15
34.0	3.0	33.5	3.0	33.0	3.5	32.0	5.0	28.0	9.5	26.0	33.70	4.20	29.50	29.12
35.0	3.0	35.5	3.0	36.0	3.0	36.0	3.0	35.5	6.0	26.5	34.30	4.60	29.70	28.94
34.0	4.0	33.5	4.0	33.5	4.5	32.5	5.0	28.0	9.5	26.5	33.80	4.70	29.10	28.88
34.5	3.5	34.0	4.0	33.5	4.0	32.5	5.5	23.5	10.5	26.0	33.50	4.75	28.75	28.60
										25.84		4.45	29.27	28.71

Date.	Time.	No. of Diagram.	Strokes.		Initial Pressure.	At .05.		At .15.		At .25.		At .35.		At .45.	
			Length, Ins.	Double, per minute.		Maximum Pres.	Counter Pres.	Maximum Pres.	Counter Pres.	Maximum Pres.	Counter Pres.	Maximum Pres.	Counter Pres.	Maximum Pres.	Counter Pres.
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
March 23,	P M														
	3.00	109	28.65	44.20	32.5	32.5	3.5	31.0	1.5	30.0	1.5	29.5	1.5	28.5	1.5
	3.15	110	28.84	40.87	36.0	36.0	5.5	35.5	2.5	35.0	2.5	34.5	3.0	34.5	3.0
	3.30	111	28.44	43.53	35.5	35.5	2.5	35.5	2.0	35.5	2.5	34.5	3.5	33.5	3.5
	3.45	112	28.69	44.27	36.0	36.0	5.5	36.0	2.5	36.0	3.0	35.5	3.0	34.5	3.5
	4.00	113	29.02	43.87	36.0	36.0	6.5	35.5	2.0	35.5	2.5	35.5	3.0	35.0	3.0
	4.15	114	28.35	44.07	36.0	36.0	4.0	36.0	2.5	35.5	3.0	34.5	3.5	34.0	4.0
	4.30	115	28.65	43.40	35.5	35.5	5.5	35.5	2.0	35.0	2.0	34.0	2.5	33.5	3.5
	4.45	116	28.56	44.53	35.5	35.5	5.5	35.5	2.5	35.5	3.0	34.0	3.0	33.5	3.5
	5.00	117	29.02	42.47	36.0	36.0	6.0	36.0	2.0	35.5	2.0	34.5	2.5	34.0	3.0
	5.15	118	28.53	43.20	35.5	35.5	4.5	35.5	2.0	35.5	3.0	35.5	3.5	34.5	3.5
	5.30	119	28.96	43.07	35.5	35.5	4.0	35.5	1.5	35.5	2.0	35.0	3.0	34.5	3.5
	5.45	120	28.69	43.73	35.5	35.5	4.0	35.5	2.0	36.0	2.5	35.0	3.0	34.5	4.0
	6.00	121	28.90	42.93	36.0	36.0	5.5	35.5	2.5	35.5	2.5	35.5	3.0	35.0	3.0
	6.15	122	28.75	43.00	36.0	36.0	4.5	35.5	2.5	35.5	2.5	34.5	3.0	34.0	3.5
	6.30	123	29.08	42.80	36.0	36.0	6.5	35.5	3.0	34.5	3.5	34.0	4.0	34.0	4.5
	6.45	124	29.08	46.40	34.5	34.5	5.0	36.0	3.0	35.5	3.5	34.5	3.5	33.5	4.0
	7.00	125	28.59	47.07	35.0	35.0	5.0	35.0	2.5	34.5	3.0	33.5	3.5	32.5	3.5
	7.15	126	28.87	46.47	35.5	35.5	5.0	35.5	3.0	34.5	3.5	34.0	4.0	33.0	5.0
	7.30	127	29.17	46.80	35.5	35.5	5.0	35.5	2.5	35.0	3.5	34.0	4.5	33.0	4.5
	7.45	128	28.75	47.93	35.5	35.5	5.5	35.5	3.5	35.5	3.5	34.0	4.0	33.0	4.5
	8.00	129	28.99	47.60	35.5	35.5	6.5	35.5	3.0	35.0	3.0	34.0	3.5	34.0	4.0
	8.15	130	28.93	46.87	35.0	35.0	5.0	35.5	2.5	34.5	2.5	33.5	3.5	33.0	4.5
	8.30	131	28.90	46.93	36.0	36.0	6.0	36.0	3.0	35.5	3.5	34.5	3.5	33.5	4.0
	8.45	132	29.45	47.47	35.5	35.5	6.5	35.5	2.5	35.0	2.5	35.0	3.5	34.5	4.0
	9.00	133	29.02	46.60	34.5	34.5	6.5	35.5	2.5	35.0	3.5	33.5	4.0	33.0	5.0
	9.15	134	28.96	46.40	36.0	36.0	5.5	35.5	2.0	35.5	2.5	34.0	3.5	33.5	5.0
	9.30	135	29.11	45.87	35.5	35.5	6.0	35.5	2.0	35.0	2.5	34.5	3.5	33.5	4.0
	9.45	136	29.05	46.27	35.5	35.5	6.0	35.5	2.5	35.5	3.0	54.5	3.5	33.5	4.0
	10.00	137	29.23	46.20	35.5	35.5	6.5	35.5	2.5	35.5	3.0	35.5	3.5	35.0	4.0
	10.15	138	29.05	46.67	34.0	34.0	6.0	35.5	2.5	35.5	2.5	35.0	3.0	34.5	4.0
	10.30	139	29.39	44.60	35.5	35.5	8.5	35.5	2.5	35.5	3.0	35.5	3.5	35.5	5.0
	10.45	140	28.81	47.33	35.5	35.5	5.5	35.5	2.5	35.5	3.0	35.5	3.5	35.0	4.0
	11.00	141	28.56	46.80	36.0	36.0	5.0	35.5	3.0	35.5	3.5	34.5	4.0	33.5	5.0
	11.15	142	28.81	46.67	36.0	36.0	6.0	36.0	3.0	35.5	3.5	35.0	4.0	34.0	4.5
	11.30	143	29.02	46.60	35.5	35.5	7.0	35.5	3.0	35.5	3.0	35.0	4.0	34.5	4.0
	11.45	144	28.93	46.87	35.5	35.5	6.0	35.5	2.0	35.0	3.0	33.5	4.0	33.0	4.5
	12.00	145	Not	46.40 Taken.											
Averages,			28.92	44.80	35.6										

At .55.		At .65.		At .75.		At .85.		At .95.		Terminal Pres.	Mean Pressure.		Effective Pressure.	
Maximum Pres.	Counter Pres.	Maximum Pres.	Counter Pres.	Maximum Pres.	Counter Pres.	Maximum Pres.	Counter Pres.	Maximum Pres.	Counter Pres.		Maximum.	Counter.	By Ordinates.	By Planimeter.
17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
28.0	1.5	27.5	1.5	27.5	1.5	26.5	2.0	23.5	4.0	21.5	28.45	2.00	26.45	25.74
34.5	3.5	34.0	3.5	34.0	4.0	33.0	5.5	29.5	10.0	26.0	34.05	4.30	29.75	29.17
33.0	4.0	32.5	4.5	33.0	5.0	32.5	7.0	28.5	11.5	26.5	33.40	4.60	28.80	28.34
34.0	3.5	33.5	3.5	33.5	4.0	33.0	5.0	29.0	9.5	26.5	34.10	4.30	29.80	29.33
34.5	3.0	33.5	4.0	33.5	4.0	33.0	6.0	28.5	10.0	27.0	34.05	4.40	29.65	28.82
33.5	4.0	33.0	4.5	33.5	5.0	33.5	6.0	29.0	9.5	26.5	33.85	4.60	29.25	28.73
33.5	3.5	33.0	4.5	33.0	5.5	32.0	6.5	29.0	10.0	27.0	33.40	4.55	28.85	28.25
33.5	3.5	33.0	4.0	33.0	5.0	33.0	5.5	30.0	9.5	27.5	33.65	4.50	29.15	28.97
33.5	3.5	33.5	4.5	34.0	5.5	34.0	7.0	29.0	11.5	27.5	34.00	4.75	29.25	28.99
34.0	3.5	33.5	4.0	33.5	4.0	33.0	5.5	29.5	9.5	27.5	34.00	4.30	29.70	29.23
34.5	4.5	34.5	5.0	34.0	5.5	34.0	7.5	30.0	12.0	28.5	34.30	4.85	29.45	29.18
34.0	4.5	33.5	4.5	33.5	5.0	33.5	6.0	30.0	10.0	27.5	34.10	4.55	29.55	29.16
34.5	3.5	34.5	4.0	34.0	4.5	34.0	6.0	29.0	11.0	27.5	34.35	4.55	29.80	29.40
34.0	4.0	33.5	4.5	33.5	5.0	33.5	6.5	29.5	6.0	28.0	33.95	4.20	29.75	28.88
33.5	5.0	33.0	5.0	33.0	6.0	32.0	8.5	27.5	16.0	26.5	33.30	6.20	27.10	27.04
33.0	4.5	32.5	4.5	32.5	5.5	31.5	8.0	27.5	17.0	25.5	33.10	5.85	27.25	27.19
32.0	4.0	31.5	4.5	31.5	5.5	31.0	6.0	27.0	10.0	24.5	32.35	4.75	27.60	27.12
32.5	5.5	32.5	7.0	33.5	8.5	32.5	11.0	29.0	17.0	26.5	33.25	6.95	26.30	25.85
32.5	5.0	32.0	6.5	32.5	7.0	33.0	9.5	28.5	17.0	26.5	33.15	6.50	26.65	26.58
32.0	4.5	31.5	5.0	31.0	5.5	31.0	7.5	27.5	13.0	25.0	32.65	5.65	27.00	26.45
34.0	4.5	33.5	5.5	33.0	6.5	32.5	8.5	28.5	14.5	25.5	33.55	5.95	27.60	27.38
32.0	5.0	32.0	6.0	31.5	7.0	31.5	8.5	28.0	13.5	26.5	32.65	5.80	26.85	26.64
33.0	4.5	32.5	5.0	32.0	6.0	31.5	8.0	28.0	14.0	25.5	33.25	5.75	27.50	27.47
34.5	5.0	34.0	5.5	34.0	7.0	33.0	9.5	28.0	17.0	26.5	33.90	6.30	27.60	27.68
33.0	5.5	33.0	6.0	33.0	7.5	33.0	8.5	28.5	13.5	26.0	33.20	6.25	26.95	26.89
33.0	5.5	33.0	6.5	33.0	8.0	33.0	9.0	28.5	15.0	26.0	33.50	6.25	27.25	27.15
33.0	5.0	33.0	6.5	33.0	7.0	32.5	8.0	28.5	14.5	26.5	33.40	5.90	27.50	27.27
33.5	5.0	33.0	6.5	33.5	7.5	32.5	9.5	28.5	15.0	26.5	33.55	6.25	27.30	27.32
34.5	5.5	34.0	6.0	33.5	7.5	32.5	10.0	28.5	16.0	25.0	34.00	6.45	27.55	27.50
34.5	5.0	34.0	6.0	33.5	8.0	32.0	10.5	28.0	16.0	26.0	33.65	6.35	27.30	27.28
35.5	6.5	35.5	7.5	35.5	9.5	34.5	11.5	30.0	17.0	26.5	34.85	7.45	27.40	27.65
34.5	4.5	34.0	5.0	34.0	6.0	32.5	8.0	28.5	14.0	26.5	34.05	5.60	28.45	28.36
33.5	5.5	33.0	6.0	32.5	6.5	32.5	8.5	29.0	13.0	27.0	33.55	6.00	27.55	26.94
33.0	5.0	33.0	5.5	32.5	5.5	32.0	7.0	28.0	13.0	26.0	33.50	5.70	27.80	27.13
34.0	4.5	33.5	5.5	33.0	6.0	32.5	8.0	28.5	14.0	25.5	33.75	5.90	27.85	27.31
33.0	5.5	33.0	6.5	33.0	7.0	32.5	9.5	29.0	16.0	26.5	33.30	6.40	26.90	26.89
										26.0		5.27	28.14	27.76

Date.	Time.	No. of Diagram.	Strokes		Initial Pressure.	At .05.		At .15.		At .25.		At .35.		At. 45.	
			Length, Ins.	Double, per Minute.		Maximum Press.	Counter Press.	Maximum Press.	Counter Press.	Maximum Press.	Counter Press.	Maximum Press.	Counter Press.	Maximum Press.	Counter Press.
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
M'ch 22,	M.														
	12.00	1	28.69	43.73	36.5	36.5	7.0	36.0	4.0	35.0	4.5	34.0	5.0	33.5	5.5
	P.M.														
	12.15	2	28.65	45.07	36.0	36.0	7.5	36.0	5.0	35.0	5.5	34.0	6.0	33.5	6.5
	12.30	3	28.90	46.73	36.0	36.0	7.5	36.0	5.0	34.5	5.0	33.5	6.0	33.0	6.5
	12.45	4	29.20	45.33	36.0	36.0	10.5	36.0	5.0	35.5	5.5	34.0	6.0	33.0	6.5
	1.00	5	29.48	48.20	36.0	36.0	9.5	35.5	5.0	35.5	5.5	35.0	6.0	34.5	6.0
	1.15	6	29.39	46.00	36.0	36.0	8.5	36.0	5.5	35.0	6.0	34.0	6.0	33.0	6.5
	1.30	7	28.99	45.87	36.0	36.0	10.0	36.0	6.0	36.0	6.5	35.0	7.0	34.0	7.0
	1.45	8	28.75	45.13	36.0	36.0	6.0	35.5	4.0	34.0	5.0	33.0	6.0	32.5	7.0
	2.00	9	28.65	44.73	35.5	35.5	6.0	33.5	3.5	32.5	4.5	31.5	5.0	31.0	6.0
	2.15	10	29.14	43.93	36.5	36.5	9.5	36.0	5.5	36.0	6.5	35.5	7.0	35.0	7.0
	2.30	11	29.08	44.87	36.0	36.0	9.0	35.5	4.5	34.5	5.5	33.0	6.0	32.5	6.5
	2.45	12	28.84	44.20	36.0	36.0	7.5	36.0	4.0	35.0	5.0	34.0	6.0	33.0	6.5
	3.00	13	29.14	44.73	36.0	36.0	8.5	35.5	5.0	35.0	5.5	34.5	6.0	34.5	6.5
	3.15	14	28.65	44.07	36.0	36.0	6.5	35.5	5.0	35.0	6.0	34.0	6.5	33.5	7.5
	3.30	15	28.69	44.40	35.5	35.5	8.5	35.5	5.0	35.5	5.5	34.0	6.0	33.5	6.5
	3.45	16	28.96	44.13	35.5	35.5	8.5	35.5	4.0	35.5	5.0	35.0	5.5	34.0	6.0
	4.00	17	28.99	44.40	36.0	36.0	8.0	36.0	4.5	35.5	5.0	35.0	5.0	34.5	6.0
	4.15	18	29.02	44.47	36.0	36.0	8.0	35.5	3.0	34.0	4.5	33.0	5.0	32.5	6.5
	4.30	19	28.93	45.27	36.0	36.0	9.0	35.5	4.0	34.5	4.5	33.0	5.5	32.5	6.5
	4.45	20	28.99	44.40	35.5	35.5	8.5	35.5	4.5	35.5	5.5	35.0	6.0	34.0	6.5
	5.00	21	29.20	44.40	36.0	36.0	9.0	35.5	5.0	35.5	5.0	35.0	5.5	34.5	6.5
	5.15	22	29.14	42.74	36.0	36.0	7.0	35.5	3.5	35.0	4.5	34.5	5.5	33.5	6.5
	5.30	23	29.39	43.00	36.0	36.0	8.0	35.5	3.0	35.5	3.5	34.5	4.0	34.5	5.5
	5.45	24	29.69	42.93	35.5	35.5	11.0	35.5	4.0	34.5	3.0	34.0	3.0	34.0	5.0
	6.00	25	29.60	42.27	36.0	36.0	11.0	35.5	3.5	35.0	3.0	34.5	3.5	34.0	5.0
	6.15	26	29.39	42.07	35.5	35.5	9.5	35.5	3.0	35.0	3.0	34.0	3.5	34.0	4.5
	6.30	27	29.45	42.80	35.5	35.5	9.0	35.5	3.0	35.0	3.0	35.0	4.0	34.5	5.0
	6.45	28	29.57	42.93	35.5	35.5	9.5	35.0	3.0	34.5	3.5	34.5	4.0	34.5	5.0
	7.00	29	29.54	42.60	35.5	35.5	9.5	35.5	3.5	35.0	3.5	34.5	4.0	34.5	5.0
	7.15	30	29.39	43.07	35.5	35.5	10.5	35.5	4.0	35.5	3.5	35.5	4.0	35.5	5.0
	7.30	31	29.11	43.47	36.0	36.0	7.0	35.5	3.5	35.0	3.5	34.5	4.5	34.0	5.5
	7.45	32	29.45	43.73	35.0	35.0	11.5	35.5	4.0	35.0	3.0	34.5	3.0	34.5	4.0
	8.00	33	29.57	44.22	35.5	35.5	10.5	35.5	4.0	35.5	4.0	35.0	4.0	35.0	5.0
	8.15	34	29.45	44.33	35.5	35.5	10.5	35.5	3.5	35.0	3.0	35.0	4.0	35.0	5.5
	8.30	35	29.60	45.00	36.0	36.0	11.0	35.5	4.0	35.5	3.5	35.5	4.0	35.5	5.0
	8.45	36	29.57		35.5	35.5	11.0	35.5	3.5	35.5	3.5	35.5	4.0	35.0	5.0

At .55.		At .65.		At .75.		At .85.		At .95.		Terminal Pressure.	Mean Pressure.		Effective Pressure.	
Maximum Press.	Counter Press.	Maximum Press.	Counter Press.	Maximum Press.	Counter Press.	Maximum Press.	Counter Press.	Maximum Press.	Counter Press.		Maximum.	Counter.	By Ordinates.	By Planimeter
17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
33.0	5.5	32.5	6.0	33.0	7.0	32.5	8.0	28.5	13.5	27.0	33.45	6.60	26.85	26.60
33.0	7.0	33.0	8.0	33.0	8.0	33.0	10.0	29.0	17.0	26.5	33.55	7.90	26.65	25.79
32.0	6.5	32.0	7.0	32.0	8.5	31.0	10.0	27.5	19.0	25.5	32.75	8.10	24.65	24.51
32.5	6.5	32.0	7.5	32.0	9.5	32.0	12.0	27.5	19.5	25.5	33.05	8.85	24.20	23.80
34.0	6.5	34.0	7.5	33.5	9.0	32.5	11.5	28.5	20.5	26.0	33.90	8.75	25.15	24.98
32.5	7.5	32.5	8.5	32.0	9.5	31.5	12.0	27.5	19.5	22.5	33.00	8.95	23.05	24.06
33.5	7.5	33.0	8.0	32.5	9.0	32.5	11.0	29.0	19.0	26.5	33.75	9.10	24.65	24.22
32.0	7.0	32.0	8.0	32.5	9.5	32.5	11.0	29.0	17.0	27.0	32.90	8.05	24.85	24.52
31.0	6.5	31.0	7.0	31.5	7.5	32.0	9.0	28.5	14.5	26.5	31.80	6.95	24.85	24.51
34.5	8.0	34.0	8.5	34.0	9.5	33.0	10.5	29.0	20.0	27.0	34.35	9.20	25.15	25.02
32.0	7.0	32.5	8.0	33.0	9.0	33.0	11.0	29.0	17.5	27.0	33.10	8.40	24.70	24.65
33.0	7.5	33.5	8.0	34.0	9.5	34.5	11.5	30.0	18.0	28.0	33.90	8.35	25.55	25.45
34.0	7.0	34.0	8.5	34.0	9.5	33.5	11.5	29.5	20.0	27.5	34.05	8.80	25.25	25.10
33.5	8.0	33.0	8.5	33.5	9.5	33.5	11.0	30.0	16.5	28.0	33.75	8.50	25.25	24.75
33.0	6.5	33.5	7.0	33.5	8.0	33.0	9.0	28.5	14.5	27.0	33.55	76.5	25.90	25.14
33.5	6.5	33.5	7.0	33.5	8.5	33.0	10.0	28.5	16.5	26.5	33.75	7.75	26.00	25.60
34.0	6.5	33.5	7.0	33.5	8.0	33.0	10.0	29.0	15.5	26.5	34.00	7.55	26.45	25.70
32.5	7.0	32.0	8.0	33.0	9.0	33.5	11.0	29.5	17.0	27.0	33.15	7.90	25.25	24.96
33.0	7.5	33.5	8.0	34.0	9.5	33.5	11.0	29.5	17.5	27.0	33.50	8.30	25.20	24.86
33.5	7.0	33.5	8.0	33.5	9.0	33.0	11.0	28.0	17.5	26.5	33.70	8.35	25.85	24.21
33.5	7.5	33.5	8.0	33.5	9.0	33.5	11.0	28.0	18.5	27.0	33.70	8.90	24.80	24.80
33.5	7.5	33.5	8.5	33.5	9.5	33.0	11.5	29.0	17.0	26.5	33.70	8.10	25.60	24.85
34.5	7.0	34.5	9.0	34.5	10.5	34.0	12.5	29.5	18.5	27.5	34.30	8.15	26.15	25.81
34.0	6.5	34.0	8.0	34.5	10.0	33.5	12.0	29.0	17.5	27.0	33.85	8.00	25.85	25.34
34.0	6.5	34.0	8.5	34.0	10.0	34.0	12.5	29.0	19.5	27.0	34.00	8.20	25.80	25.17
34.0	6.5	34.0	8.5	33.5	10.0	32.5	12.0	28.5	17.0	26.5	33.65	7.75	25.90	25.02
34.5	6.5	35.0	8.0	35.0	9.5	34.0	12.0	29.5	17.5	27.0	34.35	7.75	26.60	25.84
34.0	6.5	34.0	8.0	34.0	9.5	33.5	12.0	29.0	18.5	26.5	33.85	7.95	25.90	25.23
34.5	6.5	35.0	8.0	34.5	9.5	33.5	11.5	29.0	17.5	26.5	34.15	7.85	26.30	25.67
35.0	6.5	35.0	8.0	34.5	10.0	33.5	12.5	29.0	18.0	27.0	34.45	8.20	26.25	25.64
34.0	7.0	34.0	8.5	34.0	9.5	34.0	11.5	29.5	18.0	27.5	34.05	7.85	26.20	25.97
34.5	5.5	34.0	7.0	33.0	9.5	32.5	12.0	28.5	18.5	26.0	33.70	7.80	25.90	25.50
35.0	6.5	34.5	9.0	34.5	10.5	33.5	13.5	28.5	19.5	27.0	34.25	8.35	25.90	25.23
35.0	7.0	34.5	8.5	35.0	10.0	34.0	12.0	29.5	18.0	27.0	34.40	8.20	26.20	25.60
35.0	6.5	35.0	8.5	35.0	10.0	33.5	12.5	29.0	20.5	27.0	34.55	8.50	26.05	25.46
35.0	6.5	35.0	8.5	35.0	10.0	34.0	12.5	29.0	20.0	27.0	34.50	6.65	27.90	25.56

Date.	Time.	No. of Diagram.	Strokes		Initial Pressure.	At .05.		At .15.		At .25.		At .35.		At. 45.	
			Length, Ins.	Double, per Minute.		Maximum Press.	Counter Press.	Maximum Press.	Counter Press.	Maximum Press.	Counter Press.	Maximum Press.	Counter Press.	Maximum Press.	Counter Press.
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
M'ch 22,	P. M.														
	9.00	37	28.01	44.53	24.0	24.0	3.5	24.0	2.0	23.0	2.5	23.0	2.5	22.5	3.0
	9.15	38	28.72	29.27	36.0	36.0	9.5	36.0	4.5	35.5	5.0	35.5	5.0	34.0	5.0
	9.30	39	28.99	39.87	36.0	36.0	9.5	35.5	5.0	35.5	5.5	35.5	5.5	34.0	5.5
	9.45	40	29.23	42.33	35.5	35.5	12.5	36.0	5.5	35.5	5.0	34.5	5.0	34.0	5.5
	10.00	41	28.90	42.87	35.5	35.5	11.5	36.0	5.0	35.5	5.0	35.0	5.0	34.0	5.5
	10.15	42	28.84	43.53	36.0	36.0	10.5	35.5	5.0	34.5	5.0	34.5	5.0	34.5	5.5
	10.30	43	29.14	42.00	36.0	36.0	11.5	35.5	5.0	35.5	5.0	35.5	5.0	35.0	5.5
	10.45	44	28.84	43.00	36.0	36.0	10.5	36.0	5.5	35.5	5.0	35.0	5.0	34.0	5.0
	11.00	45	28.78	42.40	36.0	36.0	11.0	36.0	5.0	36.0	5.0	35.5	5.0	34.5	5.5
	11.15	46	29.02	42.07	35.5	35.5	10.5	35.0	5.0	35.0	4.5	35.0	4.5	35.0	5.0
	11.30	47	28.84	42.13	36.0	36.0	10.5	35.5	5.0	35.0	5.0	35.0	5.0	35.0	5.0
	11.45	48	28.90	42.60	36.0	36.0	11.0	36.0	5.0	35.5	4.5	35.0	5.5	34.0	5.5
	12.00	49	28.96	42.13	36.0	36.0	7.0	35.5	4.5	35.5	4.5	35.5	5.0	35.0	5.0
M'ch 23,	A. M.														
	12.15	50	28.99	42.20	36.0	36.0	10.5	35.5	5.0	35.5	5.0	35.0	5.0	35.0	5.5
	12.30	51	29.05	42.07	36.0	36.0	11.0	36.0	5.0	35.5	5.0	35.0	5.5	34.5	5.0
	12.45	52	29.26	43.07	36.0	36.0	10.5	35.5	5.5	35.5	5.0	35.0	5.0	34.5	5.5
	1.00	53	29.17	42.27	36.0	36.0	11.5	36.0	5.0	35.5	5.5	34.5	5.5	33.5	6.0
	1.15	54	29.05	42.40	35.5	35.5	10.5	35.5	5.0	35.5	5.0	35.5	5.0	35.0	5.0
	1.30	55	29.02	42.60	36.0	36.0	10.5	36.0	5.0	35.5	5.0	35.5	5.5	35.0	5.5
	1.45	56	29.14	43.13	36.0	36.0	10.5	36.0	5.5	36.0	5.0	35.5	5.5	35.0	5.5
	2.00	57	28.81	42.73	36.0	36.0	10.5	36.0	5.5	35.0	5.0	35.0	5.5	34.5	5.5
	2.15	58	29.33	42.67	36.0	36.0	11.0	35.5	5.5	35.5	5.5	35.0	5.5	35.0	6.0
	2.30	59	29.05	42.27	36.0	36.0	11.0	36.0	5.0	35.5	5.5	35.0	5.5	34.5	6.0
	2.45	60	29.20	43.47	36.0	36.0	10.5	36.0	5.0	35.5	5.0	35.5	5.5	35.0	5.5
	3.00	61	28.99	42.87	36.0	36.0	11.0	36.0	5.0	35.5	5.0	35.5	5.0	35.0	5.5
	3.15	62	28.99	43.13	36.0	36.0	11.5	36.0	5.5	35.5	5.5	35.0	6.0	35.0	6.0
	3.30	63	28.96	42.87	35.5	35.5	11.0	36.0	5.0	35.5	5.5	35.5	5.5	35.5	6.0
	3.45	64	28.84	43.73	36.0	36.0	11.0	36.0	5.5	35.5	5.5	35.5	6.0	35.0	6.0
	4.00	65	28.93	43.20	36.0	36.0	10.5	36.0	5.5	36.0	5.5	35.5	5.5	35.5	6.0
	4.15	66	28.96	43.13	36.0	36.0	11.0	36.0	5.5	35.5	5.5	35.5	5.5	35.5	5.5
	4.30	67	28.72	43.00	36.0	36.0	10.5	36.0	5.5	35.5	6.0	35.0	6.0	35.0	6.0
	4.45	68	28.62	44.33	36.0	36.0	9.0	36.0	5.5	35.5	5.0	35.5	5.5	35.0	6.0
	5.00	69	28.96	42.87	36.0	36.0	10.5	36.0	5.5	35.5	5.5	35.5	5.5	35.0	6.0
	5.15	70	28.96	43.40	36.0	36.0	12.5	36.0	5.5	35.5	5.5	35.5	6.0	35.0	6.0
	5.30	71	28.90	43.27	36.0	36.0	11.0	36.0	5.0	35.5	5.5	35.5	5.5	35.0	6.0
	5.45	72	29.14	44.40	36.0	36.0	12.0	35.5	5.5	35.5	5.0	35.5	5.5	34.5	5.5

At .55.		At .65.		At .75.		At .85.		At .95.		Terminal ressure.	Mean Pressure.		Effective Pressure.	
Maximum Press.	*Counter Press.*	*Maximum Press.*	*Counter Press.*	*Maximum Press.*	*Counter Press.*	*Maximum Press.*	*Counter Press.*	*Maximum Press.*	*Counter Press.*		*Maximum.*	*Counter.*	*By Ordinates.*	*By Planimeter*
17	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**31**
22.0	3.0	22.0	3.0	22.0	3.0	22.0	3.5	20.5	4.5	19.0	22.50	3.05	19.45	18.28
33.5	6.0	32.5	6.0	32.0	7.0	31.5	8.0	27.5	14.0	26.0	33.40	7.00	26.40	25.73
34.0	6.0	34.0	6.5	33.0	7.0	32.5	8.5	29.0	16.5	26.5	33.85	7.55	26.30	25.74
33.5	6.0	33.0	6.0	33.0	7.0	32.0	8.5	28.5	14.5	26.0	33.45	7.55	25.90	25.10
34.0	6.0	33.5	6.0	33.0	7.0	33.0	8.5	29.0	16.0	27.0	33.90	7.55	26.35	25.40
34.0	6.0	33.5	6.5	33.5	7.5	33.0	9.0	28.5	15.5	27.0	33.75	7.55	26.20	25.28
34.5	5.5	34.0	6.0	34.0	7.0	33.0	9.0	29.0	19.0	27.0	34.20	7.85	26.35	26.02
34.0	5.5	33.0	6.5	33.0	7.0	32.0	9.0	28.5	16.0	26.5	33.70	7.50	26.20	25.54
34.0	6.0	34.0	6.0	33.5	7.0	33.0	9.0	29.0	14.5	27.0	34.15	7.40	26.75	25.76
34.0	5.0	34.0	6.0	33.5	6.5	32.5	8.5	29.0	19.0	26.5	33.85	7.45	26.40	25.80
34.5	5.5	34.0	6.0	34.0	7.0	33.0	9.0	29.0	16.5	26.5	34.10	7.45	26.65	26.04
34.0	6.0	33.0	6.0	32.5	6.5	32.0	9.0	28.5	18.0	26.5	33.65	7.70	25.95	25.14
34.5	5.5	34.0	5.5	35.5	6.5	32.5	8.0	28.5	16.5	26.5	34.05	6.80	27.25	26.14
34.5	5.5	34.5	6.0	34.0	6.5	32.5	8.0	29.0	15.0	27.0	34.15	7.20	26.95	25.90
34.0	6.5	33.5	6.0	33.0	6.5	32.5	8.5	28.5	18.5	26.0	34.85	7.75	27.10	25.68
34.0	5.5	34.0	6.0	33.5	7.0	32.0	8.5	28.0	19.0	26.0	34.80	7.70	27.10	25.41
33.5	6.5	33.5	6.5	33.0	7.0	33.0	9.5	29.0	19.5	26.5	34.75	8.25	26.50	29.17
34.0	5.5	34.5	6.0	34.0	6.5	33.0	9.0	29.0	18.5	26.0	34.15	7.40	26.75	26.02
34.0	6.0	34.0	6.5	34.0	7.5	33.0	9.5	29.0	17.5	26.5	34.20	7.85	26.35	25.67
34.5	6.0	34.5	6.5	34.0	7.0	33.0	9.0	28.5	19.0	26.5	34.30	7.95	26.35	25.81
35.0	6.0	35.0	6.5	34.5	7.0	33.5	9.5	29.0	19.0	27.0	34.35	8.00	26.35	26.13
35.0	6.0	34.5	7.0	34.0	8.0	32.5	10.0	29.0	19.5	26.5	34.20	8.40	25.80	25.03
34.0	6.0	34.0	6.5	33.5	7.0	32.0	9.5	28.0	17.0	26.0	33.85	7.95	25.90	25.26
35.0	6.0	34.5	6.5	34.0	7.0	33.5	9.5	29.0	19.5	26.5	34.40	8.00	26.40	25.55
34.0	6.0	34.0	6.5	34.0	7.5	32.5	9.5	28.5	18.5	26.5	34.10	7.95	26.15	25.40
35.0	6.5	34.5	7.0	34.0	7.5	33.5	9.0	29.5	15.5	27.0	34.40	8.00	26.40	25.53
35.5	6.5	35.0	6.5	34.5	7.0	33.5	8.5	29.5	15.5	27.5	34.60	7.70	26.90	26.02
35.0	6.5	35.0	7.0	34.5	7.5	33.5	9.5	29.5	16.0	27.0	34.55	8.05	26.50	25.83
35.0	6.0	34.5	6.0	34.0	7.0	33.5	9.0	29.5	18.5	27.0	34.55	7.95	26.60	26.05
35.5	6.0	35.5	6.5	35.0	8.0	34.0	9.5	30.0	19.5	27.5	34.85	8.25	26.60	25.89
35.0	6.0	35.0	6.5	34.5	7.0	33.5	9.5	29.5	16.0	27.0	34.50	7.90	26.60	25.86
34.0	6.0	33.5	6.5	34.0	7.5	33.5	9.5	29.5	18.5	27.0	34.25	7.90	26.35	25.43
34.5	6.0	34.0	6.5	33.5	7.0	32.5	8.5	29.0	15.5	26.5	34.15	7.65	26.50	25.60
34.5	6.5	34.0	7.0	33.5	8.0	33.0	10.0	29.5	18.5	27.0	34.25	8.55	25.70	25.00
34.5	6.0	34.0	6.5	34.0	7.5	33.0	9.5	29.0	16.5	26.5	34.25	7.90	26.35	25.31
34.5	6.0	34.0	6.5	33.5	7.0	32.5	8.5	28.5	16.5	26.0	34.00	7.75	26.25	25.23

Date.	Time.	No. of Diagram.	Strokes.		Initial Pressure.	At .05.		At .15.		At .25.		At .35.		At .45.	
			Length, Ins.	Double, per minute.		Maximum Pres.	Counter Pres.	Maximum Pres.	Counter Pres.	Maximum Pres.	Counter Pres.	Maximum Pres.	Counter Pres.	Maximum Pres.	Counter Pres.
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
March 23,	A M														
	6.00	73	28.84	43.67	36.0	36.0	11.0	35.5	5.0	35.5	5.5	34.5	5.5	34.5	6.0
	6.15	74	28.47	43.07	36.0	36.0	11.0	35.5	6.5	35.5	6.0	35.0	6.5	34.0	6.5
	6.30	75	29.14	42.73	36.0	36.0	13.0	36.0	5.5	35.5	5.0	35.5	5.5	34.5	5.5
	6.45	76	28.93	43.47	36.0	36.0	12.0	36.0	5.0	35.5	5.0	35.5	5.5	34.0	5.5
	7.00	77	28.78	43.13	36.0	36.0	11.0	36.0	5.0	36.0	5.5	35.0	5.5	34.5	6.0
	7.15	78	28.65	43.33	36.0	36.0	11.5	35.5	5.0	35.5	5.0	34.5	5.5	34.5	5.5
	7.30	79	28.56	42.93	36.0	36.0	11.5	36.0	5.5	36.0	5.5	35.5	5.5	35.0	5.5
	7.45	80	28.99	43.33	36.0	36.0	11.0	36.0	5.0	35.5	5.0	35.5	5.5	35.0	6.0
	8.00	81	28.69	43.13	36.0	36.0	10.5	35.5	5.0	35.5	5.0	35.5	5.0	35.0	5.5
	8.15	82	28.78	42.73	35.5	35.5	10.5	35.5	5.0	35.5	5.0	35.5	5.0	35.5	5.5
	8.30	83	28.69	42.93	36.0	36.0	10.5	35.5	5.5	35.5	5.5	35.5	6.0	35.5	5.5
	8.45	84	28.99	43.67	36.0	36.0	11.0	35.5	5.0	35.5	5.0	35.0	5.5	34.5	6.0
	9.00	85	28.72	43.00	36.0	36.0	11.0	36.0	5.5	36.0	5.5	35.0	5.5	34.0	5.5
	9.15	86	29.23	42.93	35.5	35.5	11.5	36.0	5.5	35.5	5.5	35.5	6.0	35.0	6.0
	9.30	87	28.59	42.73	36.0	36.0	10.0	35.5	5.5	35.5	5.5	34.5	5.5	34.0	5.5
	9.45	88	28.62	43.27	36.0	36.0	11.0	36.0	5.0	35.0	5.5	35.5	5.5	35.0	5.5
	10.00	89	29.11	43.00	36.0	36.0	13.0	36.0	5.5	36.0	5.5	36.0	6.0	35.5	6.0
	10.15	90	28.81	43.67	36.0	36.0	11.0	36.0	5.0	35.5	5.5	35.5	5.5	35.0	6.0
	10.30	91	28.65	42.67	36.0	36.0	10.5	36.0	5.0	35.5	5.5	35.5	5.5	35.0	6.0
	10.45	92	28.96	43.33	36.0	36.0	11.0	35.5	5.0	35.5	5.5	35.5	5.5	34.5	5.5
	11.00	93	28.69	43.13	35.5	35.5	11.0	35.5	5.0	35.5	5.0	35.5	5.0	35.5	5.5
	11.15	94	28.84	43.00	36.0	36.0	11.5	36.0	5.0	35.5	5.0	35.0	5.5	35.0	5.5
	11.30	95	28.90	42.40	36.0	36.0	11.5	36.0	5.5	35.5	5.5	35.5	5.5	35.5	6.0
	11.45	96	28.87	44.00	36.0	36.0	11.0	36.0	5.5	36.0	5.5	35.5	5.5	35.0	6.0
	12.00	97	28.96	43.07	36.0	36.0	10.5	36.0	5.5	36.0	5.5	35.5	5.5	35.5	6.0
	P M														
	12.15	98	28.96	43.00	36.0	36.0	11.5	36.0	5.0	35.5	5.0	35.0	5.0	34.5	5.5
	12.30	99	28.90	43.27	36.0	36.0	11.0	36.0	5.0	35.5	5.5	35.5	5.5	34.5	6.0
	12.45	100	29.08	43.73	36.0	36.0	11.0	35.5	5.5	35.5	5.5	35.5	6.0	35.0	6.0
	1.00	101	28.84	43.47	36.0	36.0	11.0	36.0	5.5	35.5	6.0	35.0	6.0	33.5	6.0
	1.15	102	28.96	43.00	36.0	36.0	11.0	36.0	5.0	35.5	5.5	35.0	5.5	34.5	6.0
	1.30	103	28.93	43.07	36.0	36.0	9.5	36.0	4.5	35.5	4.5	35.0	5.0	35.0	5.5
	1.45	104	28.90	44.00	35.5	35.5	10.5	36.0	5.5	35.5	5.5	35.5	5.5	35.5	6.0
	2.00	105	28.96	43.00	35.0	35.0	11.0	35.5	5.0	35.5	5.0	35.5	5.0	35.0	5.5
	2.15	106	29.45	43.40	36.0	36.0	12.5	36.0	5.5	35.5	5.5	35.5	5.5	35.5	6.0
	2.30	107	29.02	43.73	36.0	36.0	11.0	36.0	5.0	36.0	5.5	35.5	5.5	34.0	5.5
	2.45	108	29.05	44.47	36.0	36.0	11.0	35.5	5.5	35.5	5.5	34.5	5.5	33.5	5.5
Averages,			28.91	42.84	35.7										

At .55.		At .65.		At .75.		At .85.		At .95.		Terminal Pres.	Mean Pressure.		Effective Pressure.	
Maximum Pres.	Counter Pres.	Maximum Pres.	Counter Pres.	Maximum Pres.	Counter Pres.	Maximum Pres.	Counter Pres.	Maximum Pres.	Counter Pres.		Maximum.	Counter.	By Ordinates.	By Planimeter.
17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
34.5	6.0	34.5	6.5	34.0	7.0	33.5	9.0	29.5	15.5	27.0	34.20	7.70	26.50	25.37
33.5	6.5	33.5	7.0	33.0	7.5	32.0	9.5	28.5	16.0	26.5	33.65	8.30	25.35	24.50
34.0	6.0	34.0	6.5	33.5	7.0	32.5	9.0	28.5	18.5	26.5	34.00	7.65	26.35	25.02
34.0	6.0	34.0	6.5	34.0	7.5	33.5	10.0	29.0	19.5	27.0	34.15	8.25	25.90	25.12
34.0	6.5	34.0	6.5	34.0	7.5	33.0	9.0	29.0	16.0	27.0	34.15	7.85	26.30	25.42
34.0	5.5	34.0	6.0	34.5	7.5	33.5	9.0	29.0	18.5	27.0	34.10	7.90	26.20	25.49
34.5	6.5	34.0	6.5	33.5	7.5	32.5	9.5	29.0	17.5	27.0	34.20	8.10	26.10	25.44
34.5	6.0	34.0	6.5	34.0	7.5	33.0	9.0	29.0	15.5	27.0	34.25	7.70	26.55	25.65
34.5	5.5	34.0	6.0	33.5	9.0	33.0	9.0	29.0	12.0	27.0	34.15	7.55	26.60	25.80
34.5	6.0	34.0	6.0	34.0	7.0	33.0	8.5	29.5	15.0	27.0	34.25	7.35	26.90	25.76
35.0	6.0	34.5	6.0	34.0	7.0	33.5	8.5	29.5	15.0	27.5	34.45	7.55	26.90	26.23
34.0	6.0	33.5	6.5	33.5	7.0	32.5	9.5	29.0	18.5	26.0	33.90	8.00	25.90	25.23
34.0	6.0	34.0	6.5	34.0	7.0	33.5	9.0	29.5	16.5	27.5	34.20	7.80	26.40	25.52
34.0	6.5	34.0	7.0	33.5	7.5	32.5	9.0	28.5	17.5	26.5	34.00	8.20	25.80	25.02
34.0	6.0	34.0	6.5	34.0	7.0	34.0	9.5	30.0	16.5	27.5	34.15	7.75	26.40	25.28
34.5	5.5	34.0	6.0	34.0	6.5	33.0	8.5	29.0	15.5	26.5	34.20	7.45	26.75	25.39
35.5	6.5	34.5	6.5	34.5	7.5	33.0	9.0	29.0	16.0	26.5	34.60	8.15	26.45	25.30
34.5	6.0	34.0	6.5	34.0	7.5	33.0	9.0	29.0	15.0	26.5	34.25	7.70	26.55	25.61
34.5	6.0	34.0	6.5	34.0	7.0	33.0	9.0	29.0	15.5	26.5	34.25	7.65	26.60	25.62
34.0	6.0	34.0	6.5	33.5	7.0	32.5	8.5	28.5	18.5	26.5	33.95	7.90	26.05	24.94
35.5	5.5	35.0	6.5	34.5	7.0	33.5	9.0	30.0	16.0	27.5	34.60	7.55	27.05	26.27
34.0	6.5	33.5	6.5	33.5	7.5	33.0	9.5	29.5	15.5	27.0	34.10	7.80	26.30	25.57
35.0	6.0	34.5	7.0	34.0	7.5	33.0	9.0	29.0	16.0	27.0	34.40	7.95	26.45	25.61
34.5	6.0	34.0	6.5	34.0	7.5	33.0	9.0	29.0	16.5	26.5	34.30	7.90	26.40	25.69
35.0	6.0	34.5	6.5	34.0	7.5	33.0	9.5	29.5	18.0	27.0	34.50	8.05	26.45	25.77
34.0	5.5	34.0	6.0	33.5	6.5	33.0	8.0	29.0	13.5	27.0	34.05	7.15	26.90	26.61
34.0	6.0	33.0	6.5	33.0	7.5	32.5	9.5	29.5	16.0	27.0	33.95	7.85	26.10	25.23
34.5	6.0	34.0	6.5	34.0	7.5	33.0	9.5	29.5	19.0	27.0	34.25	8.25	26.00	25.47
33.5	6.5	33.5	7.0	33.5	8.0	33.0	9.5	30.0	18.0	27.0	33.95	8.35	25.60	25.32
34.0	6.0	33.5	6.0	33.5	7.0	32.5	9.0	28.5	15.5	26.5	33.90	7.65	26.25	25.60
35.0	6.0	35.0	6.0	34.5	7.0	33.5	9.0	29.5	16.0	27.5	34.50	7.30	27.20	26.22
34.5	6.0	34.5	6.5	34.0	7.5	33.0	8.5	29.5	14.5	27.0	34.35	7.60	26.75	25.82
35.0	5.5	34.0	5.5	34.0	7.0	33.0	8.5	29.0	14.5	27.0	34.15	7.25	26.90	25.72
34.5	6.0	34.0	7.0	34.0	8.0	33.0	10.5	29.0	19.0	26.5	34.30	8.55	25.75	25.05
33.5	6.0	33.5	6.5	33.5	7.0	33.5	8.5	29.5	15.0	27.0	34.10	7.55	26.55	25.59
33.0	6.0	33.0	7.0	33.0	7.5	33.0	9.0	29.5	16.5	27.0	33.65	7.90	25.75	25.52
										26.6		7.72	26.29	25.93

Date.	Time.	No. of Diagram.	Strokes.		Initial Pressure.	At .05.		At .15.		At .25.		At .35.		At .45.	
			Length, Ins.	Double, per minute.		Maximum Pres.	Counter Pres.	Maximum Pres.	Counter Pres.	Maximum Pres.	Counter Pres.	Maximum Pres.	Counter Pres.	Maximum Pres.	Counter Pres.
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
March 23,	P M														
	3.00	109	28.41	44.20	35.5	35.5	6.5	35.0	4.5	34.0	5.0	32.5	5.5	32.0	6.0
	3.15	110	28.90	40.87	36.0	36.0	7.5	36.0	4.5	35.5	5.0	35.5	5.5	35.0	6.0
	3.30	111	29·11	43.53	36.0	36.0	6.0	35.5	3.5	35.5	4.0	35.5	5.0	35.5	6.0
	3.45	112	28.87	44.27	36.0	36.0	8.0	36.0	4.5	35.5	5.0	35.0	5.5	34.0	6.0
	4.00	113	28.99	43.87	36.0	36.0	8.0	35.5	4.0	35.5	4.5	35.0	5.0	34.0	5.5
	4.15	114	28.53	44.07	36.0	36.0	5.5	35.5	3.5	36.0	4.5	35.0	5.5	34.0	6.5
	4.30	115	28.84	43.40	36.0	36.0	7.0	36.0	4.5	35.5	5.0	34.0	5.5	34.0	6.0
	4.45	116	28.62	44.53	36.0	36.0	5.5	35.5	3.5	35.5	4.5	34.5	5.5	34.0	6.0
	5.00	117	29.14	42.47	36.0	36.0	9.0	36.0	3.5	36.0	4.5	35.5	5.0	35.5	5.5
	5.15	118	29.33	43.20	36.0	36.0	7.5	35.5	3.5	35.5	4.0	35.5	4.5	35.5	5.5
	5.30	119	28.90	43.07	36.0	36.0	6.5	36.0	4.0	36.0	5.0	35.0	6.0	34.5	7.0
	5.45	120	28.62	43.73	36.0	36.0	6.5	35.5	3.5	35.5	4.5	34.5	5.5	34.5	6.0
	6.00	121	29.29	42.93	36.0	36.0	7.0	36.0	2.5	35.5	3.0	34.5	3.5	34.5	5.5
	6.15	122	29.60	43.00	36.0	36.0	7.5	35.5	3.0	35.5	3.5	35.5	4.0	35.5	5.5
	6.30	123	28.65	42.80	36.0	36.0	5.5	35.5	4.0	34.5	5.5	33.0	6.0	32.5	7.0
	6.45	124	29.14	46.40	35.5	35.5	6.5	35.5	4.0	34.5	4.5	33.5	5.5	33.0	7.0
	7.00	125	29.08	47.07	36.0	36.0	10.5	36.0	7.0	34.5	6.5	34.5	6.0	34.0	6.5
	7.15	126	28.81	46.47	36.0	36.0	8.5	35.5	5.0	35.5	6.0	34.5	7.0	33.5	7.5
	7.30	127	29.02	46.80	36.0	36.0	7.5	36.0	4.5	35.0	5.5	34.0	6.5	33.5	7.0
	7.45	128	29.17	47.93	35.5	35.5	8.5	35.5	5.0	35.0	5.5	34.5	6.0	33.5	6.5
	8.00	129	29.11	47.60	35.5	35.5	8.5	35.0	4.5	34.5	5.5	33.5	5.5	33.5	6.5
	8.15	130	29.11	46.87	36.0	36.0	7.5	36.0	5.0	34.0	6.0	33.5	7.0	33.0	7.5
	8.30	131	29.39	46.93	35.5	35.5	9.0	36.0	5.0	35.5	5.5	34.5	6.5	34.0	7.0
	8.45	132	28.90	47.47	36.0	36.0	7.5	36.0	4.5	35.0	5.5	33.5	6.5	33.5	7.5
	9.00	133	29.20	46.60	35.5	35.5	8.5	35.5	4.0	35.5	5.0	34.5	6.0	34.0	7.0
	9.15	134	29.23	46.40	35.5	35.5	8.0	35.5	4.0	35.5	5.0	35.0	6.0	34.5	7.0
	9.30	135	29.69	45.87	35.5	35.5	10.0	35.5	4.0	35.5	4.5	35.5	5.0	35.5	6.0
	9.45	136	29.51	46.27	35.5	35.5	9.5	35.5	3.0	35.0	3.0	34.0	4.0	34.0	6.0
	10.00	137	29.57	46.20	35.5	35.5	10.5	35.5	3.5	35.5	4.0	34.5	5.0	34.5	6.5
	10.15	138	29.60	46.67	35.5	35.5	10.0	35.5	3.5	35.5	4.0	34.0	4.5	34.5	6.0
	10.30	139	29.48	44.60	36.0	36.0	8.5	36.0	3.5	35.5	4.5	35.5	5.5	35.0	7.5
	10.45	140	29.23	47.33	35.5	35.5	10.0	35.5	5.0	35.5	5.5	35.0	6.0	34.5	6.5
	11.00	141	28.96	46.80	36.0	36.0	8.0	35.5	4.5	35.0	5.5	33.5	7.0	33.0	8.0
	11.15	142	29.23	46.67	36.0	36.0	10.0	36.0	5.0	35.5	5.5	34.5	6.0	34.0	6.5
	11.30	143	29.23	46.60	36.0	36.0	9.5	36.0	5.0	36.0	5.5	35.0	6.0	34.5	6.5
	11.45	144	29.14	46.87	36.0	36.0	9.5	35.5	4.5	35.5	5.0	35.0	6.0	34.0	7.0
	12.00		Not	46.40 Taken											
Averages,			29.14	44.80	35.8										

At .55.		At .65.		At .75.		At .85.		At .95.		Terminal Pres.	Mean Pressure.		Effective Pressure.	
Maximum Pres.	Counter Pres.	Maximum Pres.	Counter Pres.	Maximum Pres.	Counter Pres.	Maximum Pres.	Counter Pres.	Maximum Pres.	Counter Pres.		Maximum.	Counter.	By Ordinates.	By Planimeter.
17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
32.0	7.0	31.5	7.5	31.0	8.5	31.0	10.0	28.0	14.0	26.0	32.25	7.45	25.80	23.60
34.5	6.0	34.5	7.5	34.5	8.5	34.0	10.0	30.0	17.0	27.5	34.55	7.75	26.80	25.74
35.0	6.5	35.0	7.5	35.5	8.5	35.0	11.5	30.5	17.5	27.5	34.90	7.60	27.30	25.97
34.0	6.0	33.5	6.5	33.5	7.5	33.5	9.5	29.0	17.0	27.0	34.00	7.55	26.45	25.57
34.0	6.0	34.0	6.5	34.0	7.0	33.5	9.0	28.5	19.5	27.0	34.00	7.50	26.50	25.68
34.0	7.0	33.5	8.0	34.0	9.0	35.0	11.0	31.5	17.5	28.0	34.45	7.80	26.65	25.64
33.5	6.0	33.0	6.5	33.5	7.5	33.5	9.5	29.5	16.0	26.5	33.85	7.40	26.45	25.45
34.0	6.5	33.5	7.0	33.5	7.5	33.5	9.0	29.5	16.0	27.5	33.95	7.10	26.85	26.03
35.5	6.5	35.5	7.5	35.0	8.5	34.5	10.5	30.5	18.5	27.5	35.00	7.90	27.10	26.36
35.0	6.0	35.0	7.0	35.0	8.5	34.0	10.5	30.0	18.0	27.5	34.70	7.50	27.20	26.32
34.5	8.0	34.5	8.5	35.0	10.0	35.0	12.0	31.5	18.0	29.0	34.80	8.50	26.30	25.57
34.5	7.5	34.5	8.5	34.5	9.5	34.5	11.5	31.0	17.5	28.5	34.50	8.05	26.45	25.57
34.0	6.5	34.0	8.0	34.0	9.5	34.0	11.5	30.5	17.5	27.0	34.30	7.45	26.85	25.76
35.5	6.0	35.5	7.5	35.5	9.0	34.5	11.0	30.0	19.0	27.5	34.90	7.60	27.30	26.25
32.5	7.5	32.5	8.5	32.0	9.5	32.5	11.5	28.0	16.5	26.5	32.85	8.15	24.70	23.91
32.0	7.5	32.5	9.0	33.0	10.0	33.5	12.0	29.5	19.5	26.5	33.25	8.55	24.70	23.85
33.5	7.0	33.0	8.0	33.0	9.0	32.5	11.0	28.5	17.5	25.5	33.55	8.90	24.65	23.56
33.5	8.5	33.0	9.0	32.5	10.0	33.0	11.5	29.5	17.0	27.5	33.65	9.00	24.65	23.75
33.0	8.0	33.0	9.0	32.5	9.5	32.5	11.5	29.0	19.0	26.5	33.45	8.80	24.65	23.99
33.0	7.0	32.5	8.0	32.0	8.5	32.0	10.5	28.0	18.0	25.0	33.15	8.35	24.80	24.24
33.0	7.0	33.0	7.5	33.0	8.5	33.0	10.5	28.0	17.0	25.0	33.20	8.10	25.10	24.56
32.5	8.5	32.0	9.0	32.0	10.5	32.0	13.0	28.0	19.5	26.0	32.90	9.35	23.55	22.74
33.5	7.5	33.5	8.5	33.0	10.0	32.5	12.0	28.5	19.0	26.0	33.65	9.00	24.65	24.19
33.0	8.0	33.0	9.0	33.5	10.0	33.0	12.0	29.5	17.5	27.0	33.60	8.80	24.80	24.00
33.5	7.5	33.0	8.5	33.0	9.5	33.0	12.0	29.5	18.0	26.0	33.70	8.60	25.10	24.24
34.0	8.5	34.0	9.5	34.0	11.0	34.0	12.5	29.5	18.5	27.5	34.15	9.00	25.15	24.44
35.0	7.5	35.0	9.0	35.0	10.5	33.5	13.0	29.0	19.5	26.0	34.50	8.90	25.60	24.76
34.0	7.5	34.0	9.0	33.5	11.0	33.5	12.5	29.5	18.0	26.0	33.85	8.35	25.50	24.79
35.0	8.0	35.0	9.5	35.5	11.5	35.0	13.0	30.5	19.5	26.5	34.65	9.10	25.55	25.03
34.5	8.0	35.0	9.5	35.0	11.0	34.5	13.0	30.0	19.0	27.5	34.40	8.90	25.50	24.84
35.0	9.0	35.0	10.0	35.0	11.5	34.5	13.5	30.0	19.0	27.0	34.75	9.25	25.50	24.90
34.0	7.5	33.5	8.0	33.5	9.5	32.5	12.0	29.5	19.0	26.5	33.90	8.90	25.00	24.40
32.5	8.5	32.5	9.0	32.5	10.0	32.5	12.0	28.5	17.5	26.5	33.15	9.00	24.15	23.44
33.5	7.0	33.5	8.0	33.0	9.0	32.5	11.5	28.5	18.0	25.5	33.70	8.65	25.05	24.23
34.0	7.5	34.0	8.5	33.5	9.5	32.5	12.0	28.5	18.0	26.0	34.00	8.80	25.20	24.48
34.0	7.5	33.5	8.0	33.0	9.0	33.0	11.0	29.0	16.0	26.5	33.85	8.35	25.50	24.64
										26.7		8.23	25.63	24.96

First Method of Trial at Pumping House.

Date.	*Time.*	*No. of Readings.*	*Observed head in feet.*	*Discharge by formula,* $D = 3.33\,[l - .2H]\,H^{\frac{3}{2}}$	*Velocity head feet.*	*Corrected head.* $H' = [(H + h)^{\frac{3}{2}} - h^{\frac{3}{2}}]^{\frac{2}{3}}$	*Corrected discharge per second, cubic feet.*	*Temp. of Water.*	*Weight of delivery per second.*
		1	2	3	4	5	6	7	8
March 22,	P. M.								
	12.00 to 12.30	7	.4976	3.3856				42.0	
	12.30 to 1.00	10	.5178	3.5938				42.0	
	1.00 to 1.30	6	.5125	3.5388				42.0	
	1.30 to 2.00	10	.5022	3.4326				42.0	
	2.00 to 2.30	6	.5015	3.4254				42.0	
	2.30 to 3.00	10	.5051	3.4624				42.5	
	3.00 to 3.30	6	.5069	3.4809				42.5	
	3.30 to 4.00	10	.5024	3.4347				42.5	
	4.00 to 4.30	6	.5062	3.4787	.001167	.5079	3.4998	42.5	217.7596
	4.30 to 5.00	10	.5074	3.4861				42.5	
	5.00 to 5.30	6	.5062	3.4787				42.5	
	5.30 to 6.00	10	.5041	3.4521				42.5	
	6.00 to 6.30	6	.5003	3.4132				42.5	
	6.30 to 7.00	10	.5046	3.4573				42.5	
	7.00 to 7.30	6	.5027	3.4378				42.5	
	7.30 to 8.00	10	.5126	3.5398				42.0	
	8.00 to 8.30	6	.5133	3.5470				42.0	
	8.30 to 9.00	9	.5185	3.6011				42.0	
March 23,	P. M.								
	3.00 to 3.30	6	.4843	3.2508				42.0	
	3.30 to 4.00	10	.4921	3.3296				42.5	
	4.00 to 4.30	6	.4912	3.2976				42.5	
	4.30 to 5.00	10	.4890	3.2982				42.5	
	5.00 to 5.30	6	.4890	3.2982				42.5	
	5.30 to 6.00	10	.4909	3.3175				42.5	
	6.00 to 6.30	6	.4892	3.3002				42.5	
	6.30 to 7.00	10	.5146	3.5605				42.5	
	7.00 to 7.30	6	.5162	3.5771				42.5	
	7.30 to 8.00	10	.5197	3.6136	.001167	.5070	3.4817	42.5	217.1919
	8.00 to 8.30	6	.5177	3.5927				42.5	
	8.30 to 9.00	10	.5181	3.5970				42.5	
	9.00 to 9.30	6	.5153	3.5678				42.5	
	9.30 to 10.00	10	.5147	3.5616				42.5	
	10.00 to 10.30	6	.5188	3.6043				42.5	
	10.30 to 11.00	10	.5146	3.5605				42.5	
	11.00 to 11.30	6	.5156	3.5710				42.5	
	11.30 to 12.00	10	.5158	3.5730				42.5	
Averages,			.5050	3.4752			3.4862		217.4757

Second Method of Trial at Mount Auburn Tanks.

Date.	*Time.*	*No. of Readings.*	*Observed head in feet.*	*Discharge by formula.* $D = 3.33\,(l - .2H)\,H^{\frac{3}{2}}$	*Velocity head.*	*Corrected head.* $H' = [(H+h)^{\frac{3}{2}} - h^{\frac{3}{2}}]^{\frac{2}{3}}$.	*Corrected discharge per second, cubic feet.*	*Temp. of Water.*	*Weight of delivery per second.*
		1	2	3	4	5	6	7	8
March 22,	P. M.								
	9.00 to 9.30	3	.4460	2.8866				42.0	
	9.30 to 10.00	10	.4572	2.9960				42.0	
	10.00 to 10.30	6	.4557	2.9812				42.0	
	10.30 to 11.00	10	.4538	2.9626				42.0	
	11.00 to 11.30	6	.4561	2.9851				42.0	
	11.30 to 12.00	10	.4563	2.9871				42.0	
March 23,	A. M.								
	12.00 to 12.30	6	.4555	2.9793				42.0	
	12.30 to 1.00	10	.4523	2.9479				42.0	
	1.00 to 1.30	6	.4525	2.9499				42.0	
	1.30 to 2.00	10	.4560	2.9842				42.0	
	2.00 to 2.30	6	.4512	2.9372				42.0	
	2.30 to 3.00	10	.4547	2.9714				42.0	
	3.00 to 3.30	6	.4538	2.9626				42.0	
	3.30 to 4.00	10	.4590	3.0137				42.0	
	4.00 to 4.30	6	.4608	3.0314				42.0	
	4.30 to 5.00	10	.4638	3.0611				42.0	
	5.00 to 5.30	6	.4598	3.0216				42.0	
	5.30 to 6.00	10	.4564	2.9881	.000888	.4563	2.9871	42.0	186.3385
	6.00 to 6.30	6	.4520	2.9450				42.0	
	6.30 to 7.00	10	.4541	2.9656				42.0	
	7.00 to 7.30	6	.4526	2.9509				41.0	
	7.30 to 8.00	10	.4477	2.9031				41.0	
	8.00 to 8.30	6	.4493	2.9187				41.0	
	8.30 to 9.00	10	.4485	2.9109				41.0	
	9.00 to 9.30	6	.4478	2.9041				41.0	
	9.30 to 10.00	10	.4528	2.9529				41.5	
	10.00 to 10.30	6	.4583	3.0068				41.7	
	10.30 to 11.00	10	.4573	3.9970				41.8	
	11.00 to 11.30	6	.4579	3.0029				41.7	
	11.30 to 12.00	10	.4582	3.0058				41.8	
	12.00 to 12.30	6	.4590	3.0137				41.7	
	12.30 to 1.00	10	.4602	3.0255				41.8	
	1.00 to 1.30	6	.4585	3.0088				41.7	
	1.30 to 2.00	10	.4586	3.0098				41.8	
	2.00 to 2.30	6	.4573	2.9970				41.7	
	2.30 to 3.00	3	.4663	3.0859				41.8	
Averages,		278	.4549	2.9792					

First Method of Trial.

Date.	Time.	No. of Charge.	Weight. Charge.	Weight. Aggregate.	Rate per hour.
1	2	3	4	5	6
March 22,	M. 12.00	1	200	200	
	P. M. 12.45	2	200	400	
	1.13	3	200	600	
	1.42	4	200	800	
	2.02	5	200	1,000	
	2.34	6	200	1,200	
	3.02	7	200	1,400	
	3.32	8	200	1,600	
	4.03	9	200	1,800	
	4.30	10	200	2,000	
	5.02	11	200	2,200	
	5.28	12	200	2,400	
	5.58	13	200	2,600	
	6.25	14	200	2,800	
	7.00	15	200	3,000	
	7.27	16	200	3,200	
	7.57	17	200	3,400	
March 23,	8.30	18	200	3,600	400
	P. M. 3.19	55	200	3,800	
	3.52	56	200	4,000	
	4.25	57	200	4,200	
	5.02	58	200	4,400	
	5.35	59	200	4,600	
	6.07	60	200	4,800	
	6.33	61	200	5,000	
	7.00	62	200	5,200	
	7.28	63	200	5,400	
	7.59	64	200	5,600	
	8.26	65	200	5,800	
	8.55	66	200	6,000	
	9.31	67	200	6,200	
	10.01	68	200	6,400	
	10.33	69	200	6,600	
	11.03	70	200	6,800	
March 23,	11.31	71	200	7,000	378
Average,					389

Second Method of Trial.

Date.	Time.	No. of Charge.	Weight. Charge.	Weight. Aggregate.	Rate per hour.
1	2	3	4	5	6
March 22,	P. M. 9.08	19	200	200	
	9.40	20	200	400	
	10.07	21	200	600	
	10.36	22	200	800	
	11.05	23	200	1,000	
	11.40	24	200	1,200	
March 23,	A. M. 12.13	25	200	1,400	
	12.43	26	200	1,600	
	1.13	27	200	1,800	
	1.50	28	200	2,000	
	2.17	29	200	2,200	
	2.46	30	200	2,400	
	3.15	31	200	2,600	
	3.49	32	200	2,800	
	4.15	33	200	3,000	
	4.52	34	200	3,200	
	5.22	35	200	3,400	
	5.56	36	200	3,600	400
	6.26	37	200	3,800	
	6.57	38	200	4,000	
	7.27	39	200	4,200	
	7.58	40	200	4,400	
	8.28	41	200	4,600	
	8.59	42	200	4,800	
	9.31	43	200	5,000	
	9.59	44	200	5,200	
	10.31	45	200	5,400	
	11.03	46	200	5,600	
	11.35	47	200	5,800	
	P. M. 12.03	48	200	6,000	
	12.35	49	200	6,200	
	1.03	50	200	6,400	
	1.32	51	200	6,600	
	1.58	52	200	6,800	
	2.17	53	200	7,000	
	2.52	54	200	7,200	400
Average,					400

Duty by First Method of Trial.

The delivery of water over the weir during the first and last nine hours of trial, has been estimated by averaging the heads for each half hour; the first half hour comprising six readings, and the last half in each hour comprising ten readings. The discharge has been calculated by the well known Francis formula.

$$D = 3.33\ (L - .2H)H^{\frac{3}{2}}$$

The discharges for the average heads are given in the table of water delivered by the pumps for each half hour of the trial. The velocity head has been established upon the average discharge for the first nine hours and the last nine hours of the trial, and the head on the weir corrected by the Francis formula.

$$H' = [(H + h)^{\frac{3}{2}} - h^{\frac{3}{2}}]^{\frac{2}{3}}$$

$$h = \frac{v^2}{2g} \text{ and } v = \frac{D}{A}$$

A representing the area of cross section of weir box to head on weir.

The corrected discharge is obtained by the substitution of H′ for H in the formula for observed discharge.

The length of notch in the weir plate at the pumping house was not exactly uniform for all heads, and to correct the error seven measurements of length were made, with the following results.

Length at edge of weir	(a)	2.99876′
" " height of 1″	(b)	2.99876′
" " " " 2″	(c)	2.99800′
" " " " 3″	(d)	2.99810′
" " " " 4″	(e)	2.99723′
" " " " 5″	(f)	2.99675′
" " " " 6″	(g)	2.99610′

from which is deduced the mean length as

$$\left(\frac{a}{2} + b + c + d + e + f + \frac{g}{2}\right) \div 6 = 2.99769'$$

The effective length of weir,

$$L' = L - .2\ H$$

has been determined upon the average heads for each series of observations, and discharges for low heads are less, and for high heads greater than the true discharge. The mean discharge for each method of trial is unaffected by the use of a constant effective length of weir. The mean discharge during the trial by first method was at the rate of 3.4862 cubic feet per second; or, at mean temperature of water in the weir box, 782,912.52 pounds per hour, and the net head pumped against

$$332.09 - 63.99 = 268.10\ \textit{feet.}$$

The mean rate of coal consumption per hour was 389 pounds, and the duty per hundred pounds of coal burned, becomes

$$100 \times \frac{782{,}912.52 \times 268.10}{389} = 53{,}957{,}957.5\ (a)$$

In contract trials of pumping engines, five per cent. is usually added to the measured delivery of water, to cover the loss of action in the pump, whence the duty becomes

$$53{,}957{,}957.5 + \frac{53{,}957{,}957.5}{20} = 56{,}655{,}855.37 \ (b)$$

The duty represented by the work done in the pumps, is obtained as follows: The mean pressure in both pumps from the water diagrams taken during the latter part of the trial, was equivalent to a water lift of 290.54 feet. Substituting in equation (*a*) this quantity for the head measured in the force pipe, the duty becomes

$$100 \times \frac{782{,}912.52 \times 290.54}{389} = 58{,}474{,}970 \ (c)$$

The indicated horse power of the engine has been determined as follows: The area of high pressure piston is 154.60 inches, and area of rod 5.1572 inches, mean area of piston

$$154.60 - \frac{5.1572}{2} = 152.02$$

The area of low pressure piston is 399.81 inches, and area of rod 5.1572 inches, mean area of piston

$$399.81 - \frac{5.1572}{2} = 397.23$$

During the trial by first method, the mean lengths of stroke, as measured on the diagrams, were

H. P. engine, down stroke	29.58″	29.55″
" " up "	29.52″	
L. P. " down stroke	28.92″	29.03″
" " up "	29.14″	

The total double strokes of high pressure piston for first method of trial were 46,238 for a period of eighteen hours, or 42.813 double strokes per minute. The total double strokes of low pressure piston for first method of trial were 48,396 for a period

of eighteen hours, or 44.611 double strokes per minute; hence, mean piston speed of high pressure engine in feet per minute,

$$\frac{29.55 \times 2 \times 42.813}{12} = 210.854$$

and for low pressure engine,

$$\frac{29.03 \times 2 \times 44.611}{12} = 215.843$$

The factor of horse power for the high pressure engine,

$$\frac{152.02 \times 210.854}{33000} = .9713$$

and for the low pressure engine,

$$\frac{397.23 \times 215.843}{33000} = 2.5981$$

The mean effective pressure by planimeter for high pressure engine, first method of trial, was 63.44 pounds, and indicated horse power,

$$.9713 \times 63.44 = 61.62$$

The mean effective pressure for low pressure engine, first method of trial, was 26.36 pounds, and indicated horse power,

$$2.5981 \times 26.36 = 68.486$$

and aggregate indicated horse power for first method of trial,

$$61.62 + 68.486 = 130.106$$

The rate per hour of coal consumption was 389 pounds, and coal per indicated horse power

$$\frac{389}{130.106} = 2.99 \text{ pounds}$$

The duty as represented by the work done in the steam cylinders of the engine, is estimated as follows:

The unit of horse power is 33000 foot pounds of work per minute or $33000 \times 60 = 1980000$ foot pounds per hour, and duty by this method of calculation,

$$\frac{1980000 \times 100}{2.99} = 66{,}220{,}736. \quad (d)$$

Duty by Second Method of Trial.

The delivery of water over the weir during the second and third nine hours of trial, has been estimated in the same manner as for the first method of trial.

The weir box at the Mt. Auburn tanks was erected on timbers spanning the space (about 8′) between the tanks. The notch in the weir plate was uniformly 3.0013 feet long.

The mean discharge over the weir at the tanks was 2.9871 cubic feet per second, or at the rate of 670,818.6 pounds per hour. Of the total water delivered to the force pipe, only a portion was measured over the weir, a portion leaking through the closed stop valves into the branch pipes, and possibly through the joints of the force main, and a final portion being diverted at the engine house to supply the boilers. The first quantity is known from the hook guage readings at the tanks, and the last quantity is known from the tank measurements to the boilers. The leakage, however, required special trials to determine its value.

The trial by second method terminated at 3 P. M. March 23, after which time, to the close of the trial, the water pumped was delivered over the weir at the engine house. From 3 P. M. to 6 P. M. March 23, leakage trials were made in the following manner:

The valves shutting off water to the distributing pipes connected to the force main remaining unaltered, the force line and weir box were filled by working the horizontal engines in the house—when the engines were stopped by signals from the tanks, and the time required for a given decline of head in the

vertical length of force pipe at the tanks, noted to the nearest half second.

The force pipe entered the south tank at Mt. Auburn, at the bottom near the north side; to the joint entering the tank, an 18″ wrought iron riveted pipe was connected, and by means of a horizontal length of pipe and two bends carried vertically up to the south end of the weir box, to which it was attached by an internal flange joint well leaded to avoid leakage. During this portion of the trial the south tank was empty of water, and no leaks were detected in the wrought iron pipe or in the connections.

From the bottom of the weir box the wrought iron pipe extended vertically downward 34 feet to the first bend. By means of a float and Chesterman tape, the decline of head in the force pipe could be accurately noted.

The weir box having been filled with water above the edge of weir plate, the horizontal engines were stopped; and an observer stationed at the weir noted the decline of level in the weir box, and directly the water ceased to flow over the weir, time was called. Two assistants, one to manage the float and the other to note the fall of head in the force pipe, regulated the depth to which the float was dropped, and gave the signals when the minimum head was reached. An observer with a stop watch noted the time to half seconds when the water ceased to flow over the weir, and when the float had reached the minimum level.

The index point from which the levels were read, was taken on one of the braces across the top of the weir box, the edge of which happened to be directly over the center of the force pipe. The dimensions of weir box and pipe were carefully taken by the writer and Mr. Boeckh of the water department, and the agreed measurements were as follows: Surface of weir box $14' \times 4'$.

From index point to lowest point reached by float 36.5842′. From index point to crest of weir 1.1146′. From crest of weir to top of force pipe 2.66′. From which is obtained the length of force pipe emptied 32.809′.

The volume of the weir box was

$$14 \times 4 \times 2.66 = 148.96$$

and the volume of the force pipe emptied

$$\frac{(.7854 \times 18^2) \times 32.809}{144} = 57.978 \text{ cubic feet}$$

and total volume of water discharged

$$148.96 + 57.9784 = 206.9384$$

The quantities of water discharged were uniform for all observations. In the following table are given the data obtained from the leakage trials:

Number of Observations	1	2	3	4	5	6
Quantity Discharged	206.9384	206.9384	206.9384	206.9384	206.9384	206.9384
Time in Discharging Quantity	12′:28.5″	12′:4″	12′:43″	13′:12″	12′:55″	12′:29″
Time in Seconds	748.5	724.0	763.0	792.0	775.0	749.0

From which is deduced the mean time required to discharge 206.9384 cubic feet of water, as 764.6 seconds and the rate of discharge

$$\frac{206.9384}{764.6} = .27065 \text{ cubic feet}$$

The observed leakage is less than the actual leakage in the ratio of the velocity due the efflux head taken from the mean head on the weir during the trial, to mean velocity of efflux during the decline of water in the weir box and rising pipe. The precise location of the leaks are unknown and no attempt is made to correct the observed leakage.

The mean temperature of the water discharged was 42.5 *F* and weight of discharge per second

$$.27065 \times 62.381 = 16.8834 \text{ pounds.}$$

The water to the boilers per hour by the measuring tank, was at the rate of 4026.6 pounds, or 1.1184 pounds per second, and the total water credited to the pumps for the second method of trial

By the weir	186.3385	pounds
" leakage	16.8834	"
" measuring by tanks to boilers	1.1184	"

The hourly delivery of water was 735,625.08 pounds, and the net head pumped against

$$348.81 - 67.82 = 280.99 \text{ feet.}$$

The mean rate of coal consumption per hour was 400 pounds and the duty

$$100 \times \frac{735625.08 \times 280.99}{400} = 51,675,822.8$$

In contract trials for duty of pumping engines, five per cent. is usually added to the measured delivery of water to cover the loss of action in the pumps. By this method the duty becomes

$$51,675,822.8 + \frac{51,675,822.8}{20} = 54,259,613.94$$

No water diagrams were taken during the trial by second method, and the duty upon the delivery and water head in the pump cannot be estimated.

The indicated horse power of engines during second method of trial, has been determined as follows:

Effective area of H. P. piston, 152.02 inches
" " L. P. " 397.23 "

The lengths of stroke as measured on the diagrams were

H. P. engine, down stroke,.....29.25" } 29.24"
" " up " .....29.23" }
L. P. " down stroke,.....28.70" } 28.805"
" " up " .....28.91" }

The total double strokes of high pressure piston for second method of trial were 43,301 for a period of eighteen hours, or 40.09 double strokes per minute.

The total double strokes of low pressure engine for second method of trial were 46,264 for a period of eighteen hours, or 42.837 double strokes per minute, and mean piston speed for high pressure engine in feet per minute,

$$\frac{29.24 \times 2 \times 40.09}{12} = 195.37$$

and for low pressure engine

$$\frac{28.805 \times 2 \times 42.837}{12} = 205.65$$

The factor of horse power for the high pressure engine

$$\frac{152.02 \times 195.37}{33000} = .9000$$

and for low pressure engine

$$\frac{397.23 \times 205.65}{33000} = 2.4754$$

The mean effective pressure by planimeter for high pressure engine second method of trial, was 65.65 pounds and indicated horse power,

$$.9 \times 65.65 = 59.085$$

The mean effective pressure for low pressure engine, second method of trial, was 27.32 pounds, and indicated horse power

$$2.4754 \times 27.32 = 67.628$$

and aggregate indicated horse power for second method of trial,

$$59.085 + 67.628 = 126.713$$

The rate per hour of coal consumption was 400 pounds and coal per indicated horse power,

$$\frac{400}{126.713} = 3.157 \text{ pounds}$$

and duty by the work done in the steam cylinders of the engine,

$$\frac{1980000 \times 100}{3.157} = 62,717,770$$

Capacity.

The daily delivery of water against the observed heads during the trial were for first method,

$$\frac{217.4757 \times 3600 \times 24}{8.34} = 2{,}252{,}985.67 \text{ gallons}$$

and for second method

$$\frac{204.3403 \times 3600 \times 24}{8.34} = 2{,}116{,}906.70 \text{ gallons}$$

LOSS OF ACTION IN THE PUMPS.

The area of each pump piston is 79.03146 inches, and mean strokes during the trial by first method

H. P. engine pump,..... .....29.55″
L. P. " " .....29.03″ } 29.29″

and nominal displacement in cubic inches per double stroke;

$$79.03146 \times 2 \times 29.29 = 4629.659$$

From this is deducted the volume in cubic inches of piston rod for one stroke

$$5.1592 \times 29.29 = 151.054$$

and net displacement of pump piston in gallons, per double stroke

$$\frac{4629.659 - 151.054}{231} = 19.3879$$

The double strokes per minute were

H. P. piston,.....42.813
L. P. " ..... 44.611 } 43.712

and gallons per hour due pump action

$$19.3879 \times 43.712 \times 60 = 50{,}849.03$$

for each pump; or, 101,698.06 gallons per hour, as the calculated delivery of both pumps.

The weight of water delivered over the weir per hour was 782,912.52 pounds, and delivery in gallons

$$\frac{782912.52}{8.34} = 93874.4$$

and loss of action in pumps in fraction of calculated delivery

$$1 - \frac{93{,}874.4}{101{,}698.06} = .07693$$

The mean strokes during trial by second method, were

H. P. engine pump..... 29.240″
L. P. " " .....28.805″ } 29.022″

and nominal piston displacement in cubic inches, per double stroke

$$79.03146 \times 2 \times 29.022 = 4587.3$$

from which is deducted the volume of piston rod (151.054 cubic inches), for one stroke; when net displacement of pump piston in gallons, per double stroke, is

$$\frac{4587.3 - 151.054}{231} = 19.2045$$

The double strokes per minute were

H. P. piston.....40.093
L. P. " .....42.837 } 41.465

and gallons per hour due pump action

$$19.2045 \times 41.465 \times 60 = 47778.87$$

for each pump; or 95,557.75 gallons per hour as the calculated delivery of both pumps.

The weight of water delivered to the force pipe per hour was 735,625.08 pounds, and delivery in gallons

$$\frac{735{,}625.08}{8.34} = 88{,}204.45$$

and loss of action in pumps in fraction of calculated delivery

$$1 - \frac{88{,}204.45}{95{,}557.75} = .07591$$

And the difference between slip by first method of trial and by second method of trial upon the known quantities of water delivered by the pumps

$$\begin{array}{r} .07693 \\ .07591 \\ \hline .00102 \end{array}$$

or, $\frac{1}{10}$ of one per cent., from which it it proper to infer that the larger portion of the leakage in the force main occurred near the foot of the pipe.

By way of justifying the observed loss of action in the pumps, attention is directed to the engraved diagrams accompanying this report, from which it appears that (especially in the high pressure engine) initial pressure is not obtained until a very large fraction of the stroke has been made; assuming that no loss of action existed in the pumps, the initial pressure would necessarily obtain at the beginning of the stroke; for the pressure in the steam cylinder, at any point in the stroke, is only greater than the pressure in the water cylinder at a corresponding point in the stroke, by the friction of engine and load, and the steam pistons could not be moved from the ends of cylinder except full initial pressures were first realized.

As a fact, however, the pistons do travel through a very material portion of the stroke before the water load is indicated on the steam diagrams; when the initial pressure is suddenly realized, and the stroke completed in conformity with the observed water load on the pump pistons.

Ratio of Expansion.

The ratio of expansion due cylinder volumes is given in the table of engine dimensions as

3.3601

The mean initial pressure during trial by first method, was by the diagrams 121.60, and pressure of atmosphere by barometer 14.467 pounds; hence, absolute pressure at which steam entered high pressure cylinder,

$$121.60 + 14.467 = 136.067$$

The terminal pressure in the low pressure cylinder, was by the diagrams 26.35 pounds, and absolute terminal pressure

$$26.35 + 14.467 = 40.817$$

and ratio of expansion by pressures

$$\frac{136.067}{40.817} = 3.3337$$

The mean initial pressure during trial by second method, was by the diagrams 123.35 pounds, and pressure of atmosphere by barometer 14.541 pounds; hence, absolute pressure at which steam entered high pressure cylinder,

$$123.35 + 14.541 = 137.891$$

The terminal pressure in the low pressure cylinder was by the diagrams 26.22 pounds, and absolute terminal pressure

$$26.22 + 14.541 = 40.761$$

and ratio of expansion by pressures

$$\frac{137.891}{40.761} = 3.3829$$

mean ratio of expansion by the pressures during the trial

$$\frac{3.3829 + 3.3337}{2} = 3.583$$

The close approximation of the grades of expansion by volumes and by pressures, is rarely obtained from unjacketed engines.

FRICTION IN THE FORCE PIPE.

The natural head to the flow line in Mt. Auburn tanks, as measured from the floor of the engine house, is

311. feet

From the floor of engine house to the center of pumps, the vertical distance is

8.2916 feet

and from the flow line at the Mt. Auburn tanks to the mean head on the weir, the vertical distance was

6.679 feet

and total static head pumped against during second method of trial,

325.9706 feet

The mean dynamic head during trial by second method, was

348.81 feet

from which is obtained the head required to overcome the friction and produce the flow through the force pipe

22.8394 feet

Friction of Water Passages in Pumps.

From a series of twenty-five diagrams from the upper end, and twenty-five diagrams from the lower end of pump driven by the high pressure engine, taken during the last four hours of the trial, it appears that the mean pressure upon the pump pistons was 123.32 pounds per superficial inch of exposed surface, corresponding to a water head of

$$123.32 \times 2.308 = 284.62 \text{ feet.}$$

During the intervals when water diagrams were taken, the pressure gauges on the suction and force pipes were read every minute, from which is deduced as a mean head on the force pipe

$$(136.5 \times 2.308) + 12.5 = 327.54 \text{ feet}$$

and on the suction pipe

$$(22.5 \times 2.308) + 12.5 = 64.43 \text{ feet}$$

and net head pumped against during the time high pressure (engine) water diagrams were taken, as measured in the force main to the center of pump cylinders,

$$327.54 - 64.43 = 263.11 \text{ feet}$$

and pressure per superficial inch of pump piston required to open the suction and delivery valves, in addition to frictional resistance of water passages into and out of the pump, becomes

$$\frac{284.62 - 263.11}{2.308} = 9.32 \text{ pounds}$$

Of this pressure

$$27.916 - 21.56 = 6.356 \text{ pounds}$$

was expended in lifting the suction valve and overcoming the friction of entry, and

$$144.88 - 141.916 = 2.964 \text{ pounds}$$

was expended in opening the delivery valve and overcoming the friction of exit.

Twenty-five diagrams were also taken from each end of the pump worked by the low pressure engine, during the last four hours of the trial, from which is obtained as the mean pressure per superficial inch of pump piston

$$128.45 \text{ pounds}$$

corresponding to a water head of

$$128.45 \times 2.308 = 296.46 \text{ feet}$$

The mean readings of pressure guages on the water main, during the interval of time, whilst low pressure (engine) water diagrams were taken; were for suction pipe 22 pounds, and for force pipe 137. pounds, from which is deduced as a mean head on the force pipe

$$(137 \times 2.308) + 12.5 = 328.69 \text{ feet}$$

and on the suction pipe

$$(22 \times 2.308) + 12.5 = 63.27 \text{ feet}$$

and net head against which water was pumped during the time water diagrams from low pressure (engine) pump were taken, as measured in the force main to center of pump cylinder, becomes

$$328.69 - 63.27 = 265.42 \text{ feet}$$

and pressure per superficial inch of pump piston required to open the suction and delivery valves, in addition to frictional resistance of water passages into and out of the pump, was

$$\frac{296.46 - 265.42}{2.308} = 13.45 \text{ pounds}$$

of this pressure

$$27.416 - 18.60 = 8.816 \text{ pounds}$$

was expended in lifting the inlet valve and overcoming the friction of entry, and

$$147.05 - 142.416 = 4.634 \text{ pounds}$$

was expended in lifting the outlet valve and overcoming the friction of exit. The usual allowance is one pound pressure per superficial inch of pump pistons for overcoming frictional resistances in the pump and valves, and in moving the valves; or about $\frac{9}{100}$ of the pressure required in the pumps of this engine.

The relative thickness of rubber valves in use in these pumps, made necessary by the head against which the pumps work, together with the cramped arrangement of inlet and outlet connections, are responsible for the serious loss of power in filling and discharging the pumps. The arrangement of inlet and outlet pipes is perhaps the best attainable within the small space between the foundation wall of old (horizontal) engines and natural rock foundation, under the west wall of engine house; and as suggested, the rubber valves are necessarily very thick to wear even a short time under the constant heavy pressure to which they are subjected.

Friction of Engine and Pump.

The mean pressure on the piston of high pressure pump was

$$123.32 \text{ pounds,}$$

and the mean area of piston

$$79.0314 - \frac{5.1572}{2} = 76.4528 \text{ inches}$$

and the moment of pump load by the water diagrams

$$76.4528 \times 123.32 = 9418.16$$

The mean pressure on the steam piston of high pressure engine was

$$63.44 \text{ pounds}$$

and mean area of piston

$$152.022 \text{ inches;}$$

and the moment of load by the steam diagrams

$$152.022 \times 63.44 = 9644.27$$

and fraction of total power absorbed by friction of engine and pump alone, exclusive of slide-valve friction,

$$1 - \frac{9418.16}{9644.27} = .02346$$

The mean pressure on the piston of the low pressure pump was

$$128.45 \text{ pounds}$$

and mean area of piston

$$76.4528 \text{ inches}$$

hence moment of load by the water diagrams

$$76.4528 \times 128.45 = 9820.36$$

The mean pressure on the steam piston of low pressure engine was

$$26.36 \text{ pounds}$$

and mean area of piston

$$397.2372 \text{ inches}$$

and the moment of load by the steam diagrams

$$397.2372 \times 26.36 = 10471.04$$

and fraction of total power absorbed by friction of engine and pump alone, exclusive of slide valve friction,

$$1 - \frac{9820.36}{10471.54} = .06216$$

The power required to move the slide valves does not appear on the steam diagrams, as these are connected to the boiler by independent pipes, and the friction shown is simply that of the engine, and pump pistons, and rods, and a rocker arm imparting motion to the cataract gear. The difference between the friction of high and low pressure engines, is partially accounted for by the relative steam pressures and areas of steam pistons. Thus the friction is composed: first, of the engine in all its parts; and second, the extra friction of those parts due to the load.

The first element is usually represented by a given pressure per superficial inch of piston, whence the actual friction varies directly as the areas of pistons, but with equal steam pressures. The percentage or fraction of friction would be the same for both engines. The ratio of steam pressure in the high pressure cylinder to the steam pressure in the low pressure cylinder, was

$$\frac{63.44}{26.36} = 2.33$$

and for equal amounts of work the relative friction should be inversely as the pressure ratio. That is, the fractional friction of the low pressure engine should be the greatest.

The extra friction due to the load, is usually taken as a certain percentage of the total indicated, less the friction load. The loads being alike, the extra friction due to the load would be relatively greatest in the high pressure engine. Conversely, the velocity of inflow and outflow for the low pressure pump was about *eight* per cent. in excess of the high pressure pump, and the frictional resistance of water passages would be as 1.00 for the high pressure pump, and 1.17 nearly for the low pressure pump. It is probable that the friction pressure per superficial inch of pistons for engine alone does not vary much between the two cylinders.

Gain by Exhaust Heater.

During trial by first method, the feed water was delivered to the coil in the heater at a mean temperature of 43.15, and elevation of temperature by heater 172.26, and fraction of total heat furnished the steam by exhaust from low pressure engine

$$\frac{172.26}{1221.53 - 43.15} = .1461$$

The temperature of steam as it entered the heater is taken at 223.5, and the temperature of the feed water from the heater 215.41, and difference of temperature of exhaust steam and feed water

$$223.5 - 215.41 = 8.09 \text{ degrees.}$$

During the trial by second method, the feed water was delivered to the coil in the heater at a mean temperature of 43.79, and the elevation of temperature by heater was 171.32, and fraction of total heat furnished the steam by exhaust from low pressure engine

$$\frac{171.32}{1221.53 - 43.79} = .1438$$

The temperature of steam as it entered the heater is taken at 221.8, and the temperature of feed water from the heater 215.11, and difference of temperature of exhaust steam and feed water

$$221.8 - 215.11 = 6.69 \text{ degrees.}$$

Reduction of Pressures.

The reduction of pressure by velocity of entry and friction in the supply pipe to the high pressure engine is for first method of trial,

$$128 - 121.60 = 6.40 \text{ pounds}$$

and for second method of trial,

$$128 - 123.35 = 4.65 \text{ pounds}$$

The mean counter pressure in high pressure cylinder, first method of trial, was 47.17 pounds, and mean pressure in receiver 42.71 pounds, and reduction of pressure to receiver by velocity of entry and friction in the exhaust pipe

$$47.17 - 42.71 = 4.46 \text{ pounds}$$

The mean initial pressure in low pressure cylinder, during trial by first method, was 35.7 pounds, and reduction of pressure by velocity of entry and friction in the supply pipe

$$42.71 - 35.70 = 7.01 \text{ pounds}$$

The mean counter pressure in high pressure cylinder, during trial by second method, was 46.78 pounds, and mean pressure in the receiver 43.0 pounds, and reduction of pressure by velocity of entry and friction in the exhaust pipe was

$$46.78 - 43. = 3.78 \text{ pounds}$$

The mean initial pressure in low pressure cylinder, during trial by second method, was 35.60 pounds, and reduction of pressure by velocity of entry and friction in the supply pipe

$$43. - 35.60 = 7.40 \text{ pounds.}$$

Performance of the Boilers.

During the trial by first method, covering a period of eighteen hours, 7000 pounds of coal was fired, and 74620 pounds of water at temperature of 43.79 Fahr. was pumped into the boilers; but the capacity of tanks was determined with water at 48 Fahr. and actual weight of water delivered

$$\frac{74620 \times 62.385}{62.377} = 74629 \text{ pounds}$$

and apparent evaporation per pound of coal from temperature of feed

$$\frac{74629}{7000} = 10.661 \text{ pounds}$$

The temperature of feed was 215.11, and neglecting the specific heat of water, each pound of steam was furnished with

$$1178 - 215.11 = 962.89 \text{ thermal units}$$

And equivalent evaporation from and at 212 Fahr. was

$$\frac{10.661 \times 962.89}{966} = 10.627 \text{ pounds}$$

The coal burned per square foot of grate per hour, during trial by first method, was

$$\frac{389}{19.04} = 20.43 \text{ pounds}$$

The apparent evaporation per square foot of heating surface per hour was

$$\frac{4145.4}{1082.98} = 3.828 \text{ pounds}$$

The coal fired for second method of trial, covering a period of eighteen hours, was 7200 pounds, and water delivered to boilers for same interval of time 72,479 pounds. Correcting for temperature the weight of water becomes

$$\frac{72479 \times 62.386}{62.377} = 72489 \text{ pounds}$$

And apparent evaporation per pound of coal,

$$\frac{72489}{7200} = 10.068 \text{ pounds}$$

The temperature of feed was 215.41, and thermal units furnished, per pound of steam, were

$$1178 - 215.41 = 962.59$$

and equivalent evaporation from and at 212 Fahr. was

$$\frac{10.068 \times 962.59}{966} = 10.032 \text{ pounds}$$

The coal burned per square foot of grate per hour during trial by second method was

$$\frac{400}{19.04} = 21.01 \text{ pounds}$$

The evaporation per square foot of heating surface per hour was

$$\frac{4026.6}{1082.98} = 3.718 \text{ pounds}$$

The boilers were set in the manner common to this type, (return flue) but the arch over the top instead of lying close to the shell was removed from it about *one* inch. The water line on the outside surfaces of shells was slightly above the fire line, but on the inside surfaces of shells slightly below the fire line.

Although it was not intended to provide superheating surfaces

to the boilers, it is extremely probable that a passage between the tiles was accidently left open, through which the hot gas could pass to the air spaces over the boilers and superheat the steam.

No thermometer was used in the steam drum, it not being supposed that a superheat could occur in return flue boilers set as these were; but from the calorimeter data, which were carefully taken, it appears that a very material superheat obtained.

The mean temperature of the injection to the calorimeter was 62.39, and the mean temperature of condensing water from the calorimeter was 122.13, and thermal units added per pound of condensing water

$$122.13 - 62.39 = 59.74$$

The condensing water passed the calorimeter at the rate of 61.00 pounds per hour, and the thermal units accounted for

$$59.74 \times 61.00 = 3644.14$$

The condensation from the worm was weighed and dumped at the rate of 3.00 pounds per hour, and thermal units accounted for per pound of steam condensed

$$1214.71$$

The condensed steam left the worm at a temperature of 63.57, and total thermal units per pound of steam at boiler pressure were

$$1222$$

But the units of heat resident in the condensed steam were 63.57, and thermal value of saturated steam

$$1222 - 63.57 = 1158.43$$

and excess of heat in the steam during trial

$$1214.71 - 1158.43 = 56.28$$

Estimating the evaporation from and at 212 Fahr. upon the total heat furnished per pound of steam from the temperature of feed,

then evaporation for first method of trial becomes

$$10.66 \times \frac{1063.17}{966} = 11.726 \text{ pounds}$$

and for the second method of trial

$$10.068 \times \frac{1062.87}{966} = 11.075 \text{ pounds}$$

The weight of steam condensed in the calorimeter was regularly weighed each hour; but the reading of the water meter was taken at commencement and at end of trial, and at random during the interval of thirty-six hours, to check the final record.

NON-COMBUSTIBLE IN COAL.

At the end of trials, the ash and clinker were weighed back dry, and amounted to 435 pounds; and fraction of non-combustible in the coal,

$$\frac{435}{14200} = .0306$$

Trial by First Method.

SUMMARY.

Duration	18 hour
Number of general observations	73
" " diagrams each engine	145
" " weir readings	288

TEMPERATURES.

Atmosphere	72.95 F.
Water from city mains	43.15 "
" " heater	215.41 "
Elevation by "	172.26 "
Steam at saturation (estimated)	352.74 "

PRESSURES.

Barometer	29.62 ins.
In the boilers by gauge	125.00 pds.
" " " " corrected gauge	128.00 "
" " receiver by gauge	39.71 "
" " " " corrected gauge	42.71 "
" " suction pipe by gauge	50.61 feet
" " " " " corrected gauge	51.49 "
Add vertical distance gauge to center of pump	12.50 "
Total head suction pipe	63.99 "
In the force pipe by gauge	317.82 "
" " " " " " corrected gauge	319.59 "
Add vertical distance gauge to center of pump	12.50 "
Total head force pipe	332.09 "
Net " " "	268.10 "

COUNTERS.

H. P. Engine, 12 M., March 22	15650
" " " 9 P. M., " "	38912
Double strokes during nine hours.	23262
H. P. Engine, 3 P. M., March 23	82213
" " " 12 " " " "	105189
Double strokes during nine hours	22976
" " " trial	46238
L. P. Engine, 12 M., March 22	94585
" " " 9 P. M., " 22	118493
Double strokes during nine hours	23908
L. P. Engine, 3 P. M., March 23	164757
" " " 12 " " "	189245
Double strokes during nine hours	24488
" " " trial	48396

PISTON SPEEDS.

H. P. Engine per minute	210.854
L. P. " " "	215.843

FACTOR OF H. P.

H. P. Engine per pound pressure	.9713
L. P. " " " "	2.5981

BY THE STEAM DIAGRAMS.

H. P. Engine, initial pressure	121.60
" " " terminal "	97.60
" " " counter "	47.17
" " " mean effective pressure by planimeter	63.44
" " " indicated horse power	61.62
L. P. " initial pressure	35.7
" " " terminal "	26.35
" " " counter "	6.74
" " " mean effective pressure by planimeter	26.36
" " " indicated horse power	68.486
Aggregate " " "	130.106

BY THE WATER DIAGRAMS.

H. P. Engine pump mean pressure.....	123.32 pds.
L. P. " " " "	128.45 "

FRICTION.

H. P. Engine, fraction of indicated power.....	.02346
L. P. " " " " "	.06216
H. P. " pump water passages.....	9.32 pds.
L. P. " " " "	13.45 "

DUTY.

By the pressure in the force pipe and water delivered	53,957,957.50
By the pressure in the force pipe and water delivered + five per cent.....	56,655,855.37
By the load on the water pistons and water delivered.....	58,474,970.00
By the indicated work in the steam cylinders.....	66,220,736.00

CAPACITY.

Gallons per day of 24 hours.....	2,252,985.67

RATIO OF EXPANSION.

Absolute initial to absolute terminal pressure.....	3.3337

ECONOMY OF ENGINES.

Coal per indicated horse power per hour.....	2.99 pds.

LOSS OF ACTION IN THE PUMPS.

In fraction of calculated delivery.....	.07693

Trial by Second Method.

SUMMARY.

Duration	18 hours
Number of general observations	72
" " diagrams each engine	144
" " weir readings	278

TEMPERATURES.

Atmosphere	73.63 F.
Water from city mains	43.79 "
" " heater	215.11 "
Elevation by "	171.32 "
Steam at saturation (estimated)	352.70 "

PRESSURES.

Barometer	29.47 ins.
In the boilers by gauge	125.00 pds.
" " " " corrected gauge	128.00 "
" " receiver by gauge	40.00 "
" " " " corrected gauge	43.00 "
" " suction pipe by gauge	53.80 feet
" " " " " corrected gauge	55.32 "
Add vertical distance gauge to center of pump	12.50 "
Total head suction pipe	67.82 "
In the force pipe by gauge	334.24 "
" " " " " " corrected gauge	336.31 "
Add vertical distance gauge to center of pump	12.50 "
Total head force pipe	348.81 "
Net " " "	280.99 "

COUNTERS.

H. P. Engine, 9 P. M., March 22	38,912
" " " 4 P. M., " 23	82,213
Double strokes during eighteen hours	43,301
L. P. Engine, 9 P. M., March 22	118,493
" " " 3 " " " 23	164,757
Double strokes during eighteen hours	46,264

PISTON SPEEDS.

H. P. Engine per minute	195.37
L. P. " " "	205.65

FACTOR OF H. P.

H. P. Engine	.9000
L. P. "	2.4754

BY THE STEAM DIAGRAMS.

H. P. Engine, initial pressure	123.35
" " " terminal "	99.25
" " " counter "	46.78
" " " mean effective pressure by planimeter	65.65
" " " indicated horse power	59.085
L. P. " initial pressure	35.60
" " " terminal "	26.22
" " " counter "	6.08
" " " mean effective pressure by planimeter	27.32
" " " indicated horse power	67.628
Aggregate " " "	126.713

DUTY.

By the pressure in the force pipe and water delivered	51,675,822.8
By the pressure in the force pipe and water delivered + five per cent	54,259,613.94
By the indicated work in the steam cylinders	62,717,770.00

CAPACITY.

Gallons per day of 24 hours	2,116,906,70

RATIO OF EXPANSION.

Absolute initial to absolute terminal pressure.....	3.3829

ECONOMY OF ENGINES.

Coal per indicated horse power per hour.....	3.157

LOSS OF ACTION IN THE PUMPS.

In fraction of calculated delivery.....	.07591

Adaptation.

In forming an opinion upon the adaptability of this engine to the purpose for which it is designed, we have been governed partly by the facts developed during the trial, partly by accepted knowledge upon pumping engines for public service, and partly by our personal information upon this class of machinery.

The duty developed during the trial stamps this as one of the best engines in point of economy the city possesses, and the duty by either method of calculation is all the more creditable when you consider the comparatively small cost of the machine. *The excellence of the duty, however, is due to the high steam pressure carried and the remarkable evaporation of the boilers, rather than to the engine.*

The pumps, valve chambers and valves, and the connections to the water mains, are exceedingly defective, as the large loss of action verifies.

The condition of water load on both sides of the pumps, is calculated, in our opinion, for a very small loss of action with modern pumps, valves, valve chambers and connections. The water end of the engine, or a material part of it, was designed and constructed by the late Geo. Shield, whilst in charge of the pumping department of the City Water Works, and to reduce the cost to the city of the engine under consideration, was used by Mr. Warden. The error in failing to furnish the engine with first class pumps and connections is shown in the loss of nearly ***nine millions in the duty*** between the net power delivered to the pumps and the work actually performed.

In other words, the large loss of action in the pumps, plus the enormous friction of water passages, and resistance of the pump valves, reduces the duty from 63,000,000, the theoretical work, to 54,000,000, the actual work, a or loss of more than ***fourteen per cent.*** of the work actually performed by the steam in the steam cylinders is chargeable to the inferior design of the pumps, valve chambers and arrangement of the connecting pipes.

It is, of course, impossible to avoid a certain loss in slip of pump and resistance of valves, and friction of water passages; but this, instead of fourteen per cent., should not be more than ***two and one-half to three per cent.*** of the work performed in the steam cylinders.

The cataract which forms a part of the steam end of the engine, is intended to automatically regulate the valve motion to the production of equal strokes in equal times. In crank and fly wheel engines, the strokes of piston are uniform in length, and the motion of the piston is gradually arrested toward the ends of stroke by the crank action. The cataract gear is intended to regulate the length of stroke, and arrest it toward the end by cushioning the steam in the exhaust end of the cylinder, as well as producing a practically uniform reciprocating motion of the piston.

These are the pronounced objects of the cataract valve gear, which, if successful, will go far toward revolutionizing the design and construction of large pumping engines, to which class of engines only the cataract is applicable. If we are to be governed in our opinion upon this device by the data obtained from the trial, and by our observation of its performance during the trial (and it would be manifestly improper to pass upon the merit of the engine, on the data obtained, and upon the cataract on data not obtained), then we are compelled to pronounce against it.

Whilst it may be possible that the cararact is capable of ac-

ceptable regulation of the length of piston strokes under certain conditions of speed and load, it certainly was incapable of doing this during the test trial; and in support of this statement reference is had to the columns of stroke in the tables of Indicator Diagrams.

The variability of the stroke is least objectionable in the high pressure engine, as all the steam expended in filling the clearance of this engine is utilized in the low pressure engine. But the variability of stroke in the low pressure engine is decidedly objectionable and cannot be justified by any process of reasoning known to your committee. The defect of the cataract, however, is not so much in the failure to comply with what are well recognized conditions of piston performance, as in the failure to promptly arrest the motion of the pistons at the ends of strokes. This during the test trial it did not do; and the persistency with which the cross heads of both engines hammered the buffers leads your committee to the opinion that the durability of the engine must certainly be less than that of a crank and fly wheel engine, otherwise equal to this.

The comparatively low cost, small space occupied for a given capacity, and facility of operating, are all elements in favor of the engine.

The performance of the boilers is excellent, and so far as your committee are aware, unprecedented for return flue boilers with natural draft.

The performance of the engine during the test trial, independent of the high steam pressure carried, and independent of the performance of the boilers, is not such as to warrant us in recommending its reproduction for the WESTERN RESERVOIR AT CONSADINE PLACE. A single cylinder crank and fly wheel engine—of same capacity—at the same piston speed—with the same ratio of ex-

pansion—same evaporation per unit of fuel burned, being capable of a higher duty than obtained from this engine during the test trial.

It is due Mr. Warden to remind you of a statement made early in this report, that according to his original plans the engine is at present incomplete; and that it was designed and constructed simply as an auxiliary to the old (horizontal) engines at this station.

In submitting our report upon the test trials of the Warden Compound Pumping Engine, we desire to express our thanks to Mr. Americus Warden, the Engineer, to Mr. James E. Bell, Superintendent of the Water Works, and to your predecessors the Board of Public Works, for the liberal spirit in which they met our desire to make these trials complete and creditable to the City.

(SIGNED,)

JOHN W. HILL,
ARTHUR G. MOORE,
C. AHRENS.

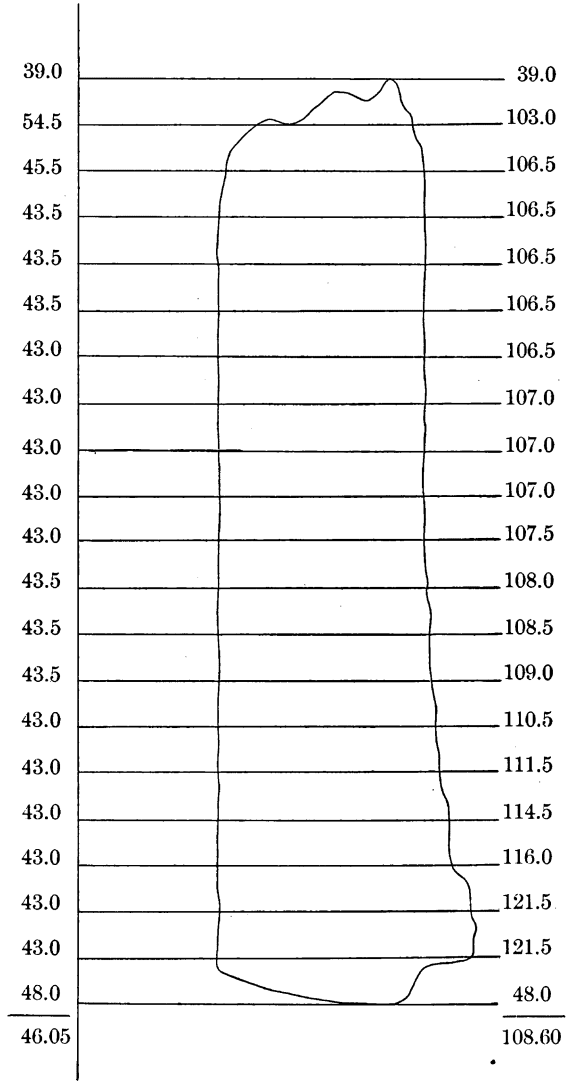
CINCINNATI, June 1, 1879.

EXPERT TRIAL

WARDEN COMPOUND ENGINE.

INDICATOR DIAGRAMS.

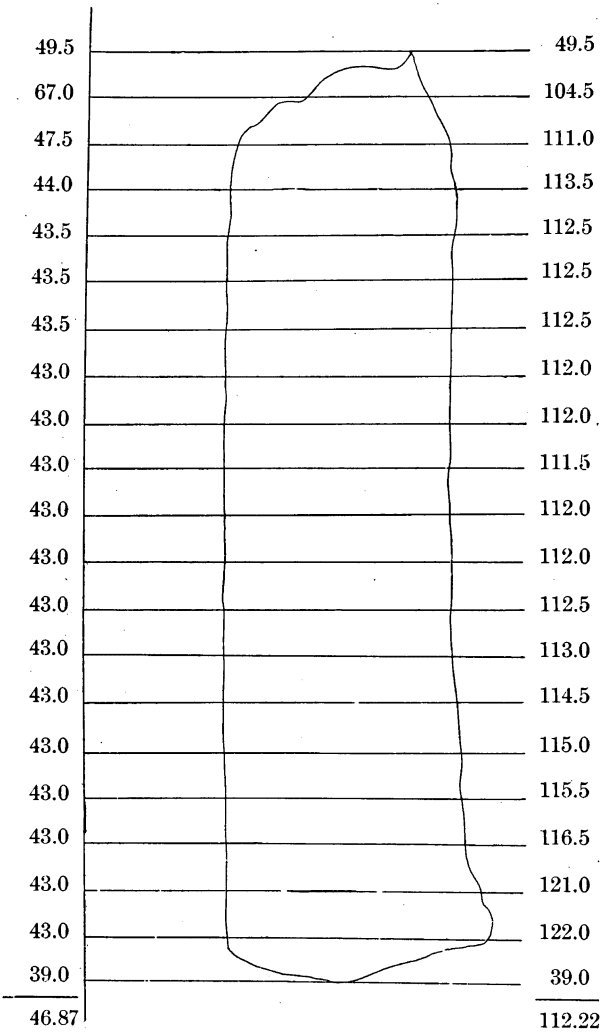
DIAGRAM No. 17.



39.0	39.0
54.5	103.0
45.5	106.5
43.5	106.5
43.5	106.5
43.5	106.5
43.0	106.5
43.0	107.0
43.0	107.0
43.0	107.0
43.0	107.5
43.5	108.0
43.5	108.5
43.5	109.0
43.0	110.5
43.0	111.5
43.0	114.5
43.0	116.0
43.0	121.5
43.0	121.5
48.0	48.0
46.05	108.60

Ordinates	62.55
Planimeter	63.58
Initial	121.50
Terminal.	97.
Stroke	29.15

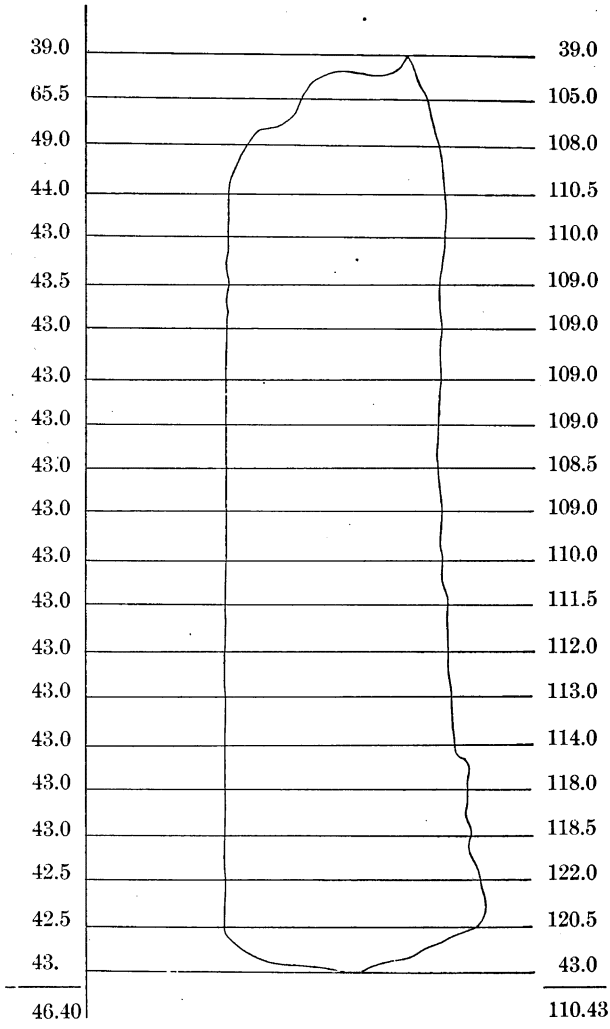
DIAGRAM No. 51.



49.5		49.5
67.0		104.5
47.5		111.0
44.0		113.5
43.5		112.5
43.5		112.5
43.5		112.5
43.0		112.0
43.0		112.0
43.0		111.5
43.0		112.0
43.0		112.0
43.0		112.5
43.0		113.0
43.0		114.5
43.0		115.0
43.0		115.5
43.0		116.5
43.0		121.0
43.0		122.0
39.0		39.0
46.87		112.22

Ordinates	65.35
Planimeter	66.78
Initial	123.
Terminal	99.
Stroke	29.18

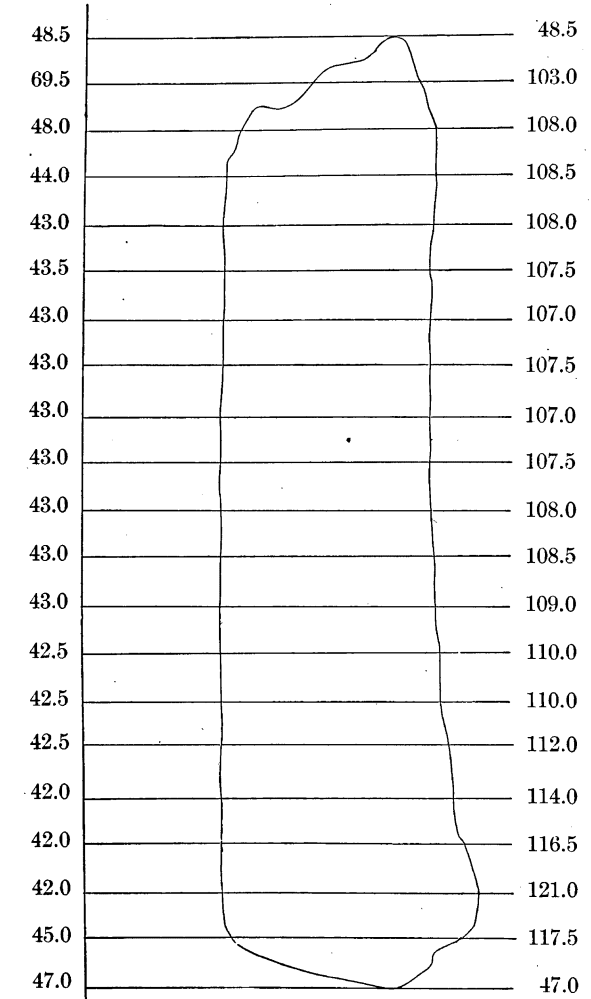
DIAGRAM No. 102.



39.0		39.0
65.5		105.0
49.0		108.0
44.0		110.5
43.0		110.0
43.5		109.0
43.0		109.0
43.0		109.0
43.0		109.0
43.0		108.5
43.0		109.0
43.0		110.0
43.0		111.5
43.0		112.0
43.0		113.0
43.0		114.0
43.0		118.0
43.0		118.5
42.5		122.0
42.5		120.5
43.		43.0
46.40		110.43

Ordinates	64.03
Planimeter	64.95
Initial	123.
Terminal	98.5
Stroke	28.88

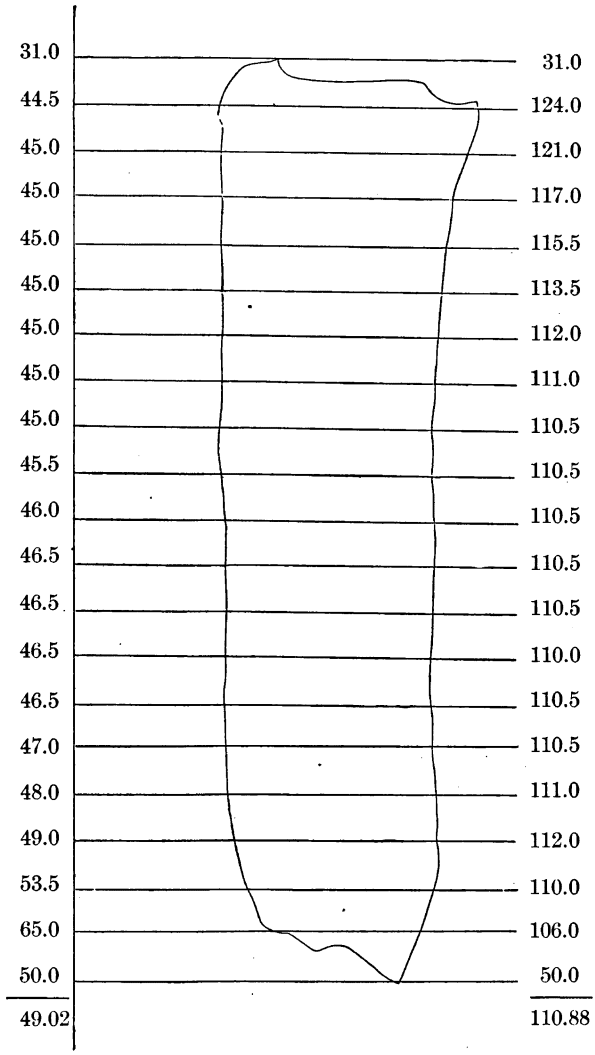
DIAGRAM No. 136.



48.5		48.5
69.5		103.0
48.0		108.0
44.0		108.5
43.0		108.0
43.5		107.5
43.0		107.0
43.0		107.5
43.0		107.0
43.0		107.5
43.0		108.0
43.0		108.5
43.0		109.0
42.5		110.0
42.5		110.0
42.5		112.0
42.0		114.0
42.0		116.5
42.0		121.0
45.0		117.5
47.0		47.0
47.12		109.45

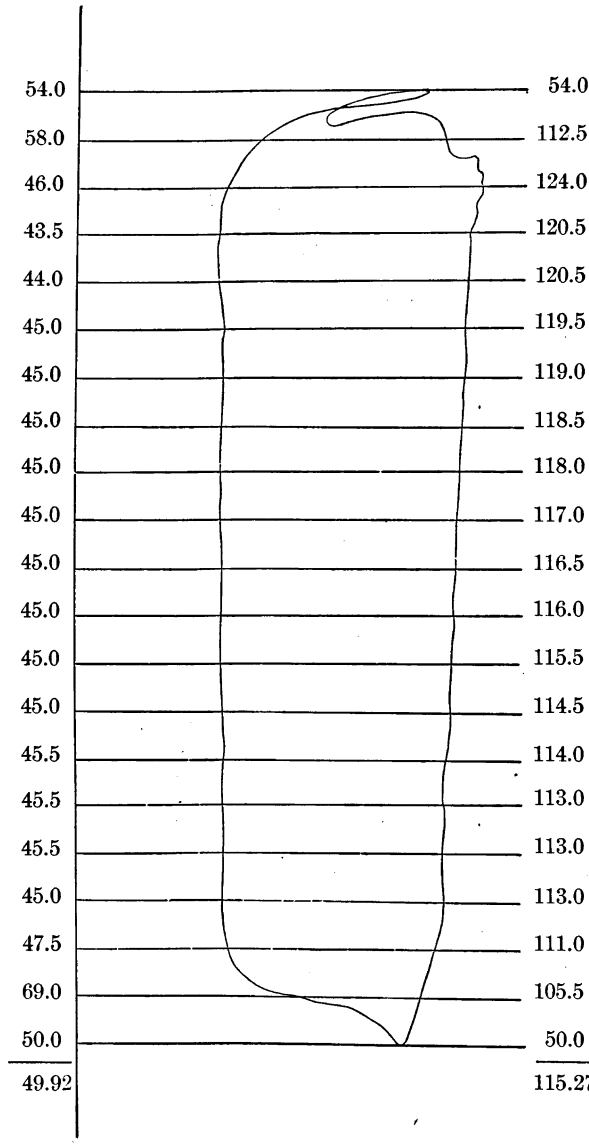
Ordinates	62.33
Planimeter	62.53
Initial	121.
Terminal	97.
Stroke	29.70

DIAGRAM No. 17.



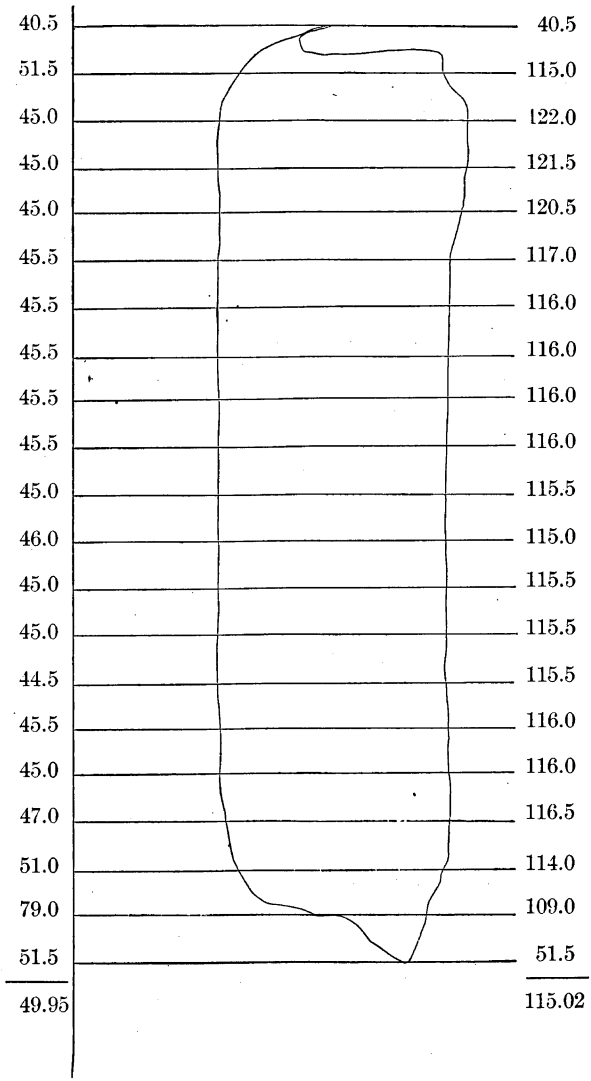
Ordinates	61.85
Planimeter	62.41
Initial	124.
Terminal	100.
Stroke	28.88

DIAGRAM No. 51.



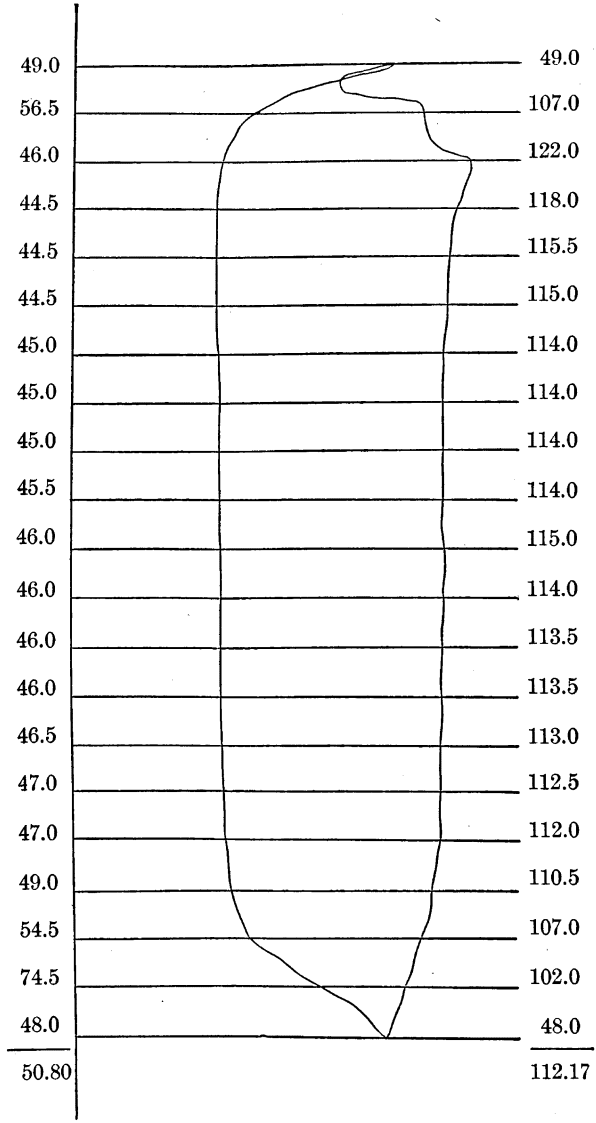
Ordinates	65.35
Planimeter	66.17
Initial	124.
Terminal	100.5
Stroke	29.67

DIAGRAM No. 102.



Ordinates	65.07
Planimeter	65.68
Initial	122.
Terminal	103.
Stroke	29.33

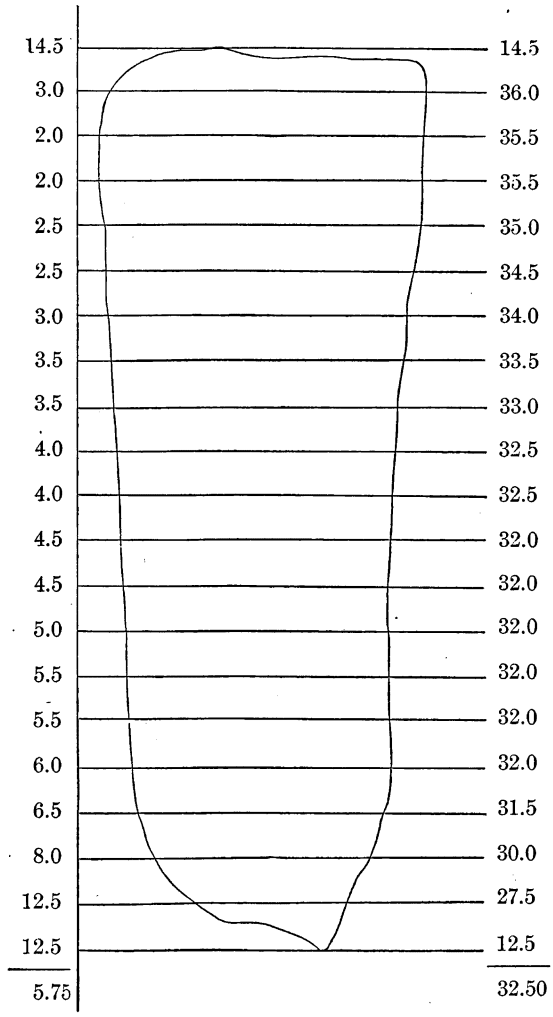
DIAGRAM No. 136.



49.0		49.0
56.5		107.0
46.0		122.0
44.5		118.0
44.5		115.5
44.5		115.0
45.0		114.0
45.0		114.0
45.0		114.0
45.5		114.0
46.0		115.0
46.0		114.0
46.0		113.5
46.0		113.5
46.5		113.0
47.0		112.5
47.0		112.0
49.0		110.5
54.5		107.0
74.5		102.0
48.0		48.0
50.80		112.17

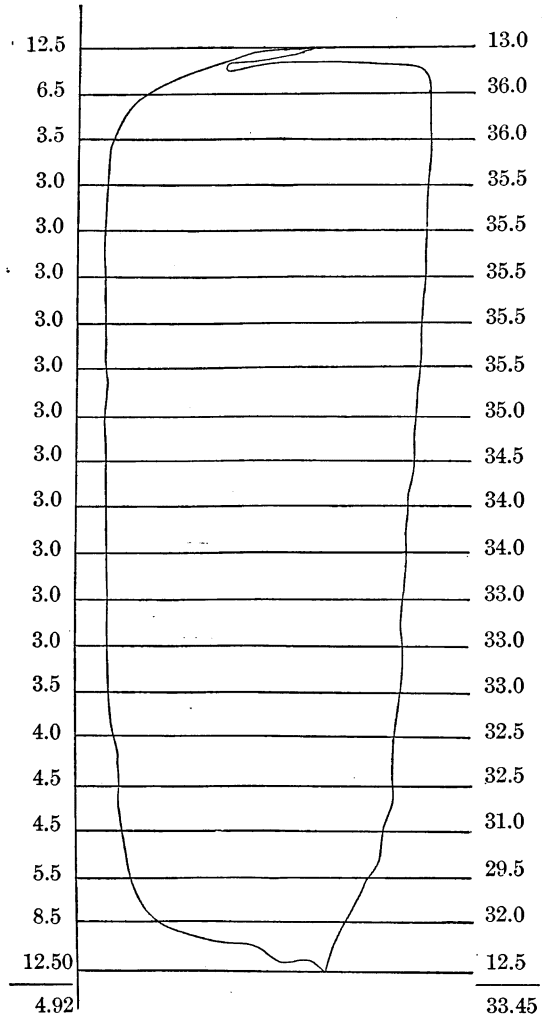
Ordinates	61.37
Planimeter	60.72
Initial	122.
Terminal	96.5
Stroke	30.22

DIAGRAM No. 17.



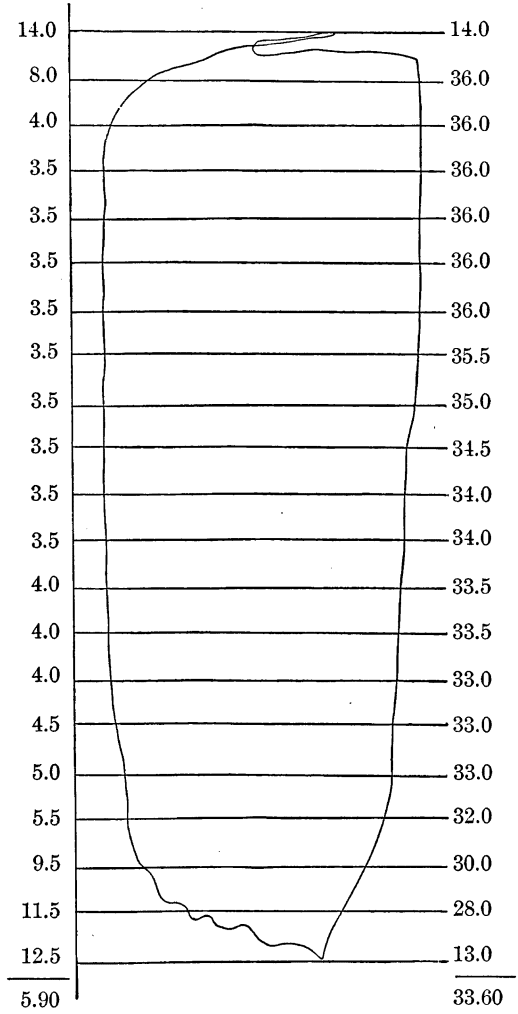
Ordinates	26.75
Planimeter	27.67
Initial	36.
Terminal	25.5
Stroke	28.20

DIAGRAM No. 51.



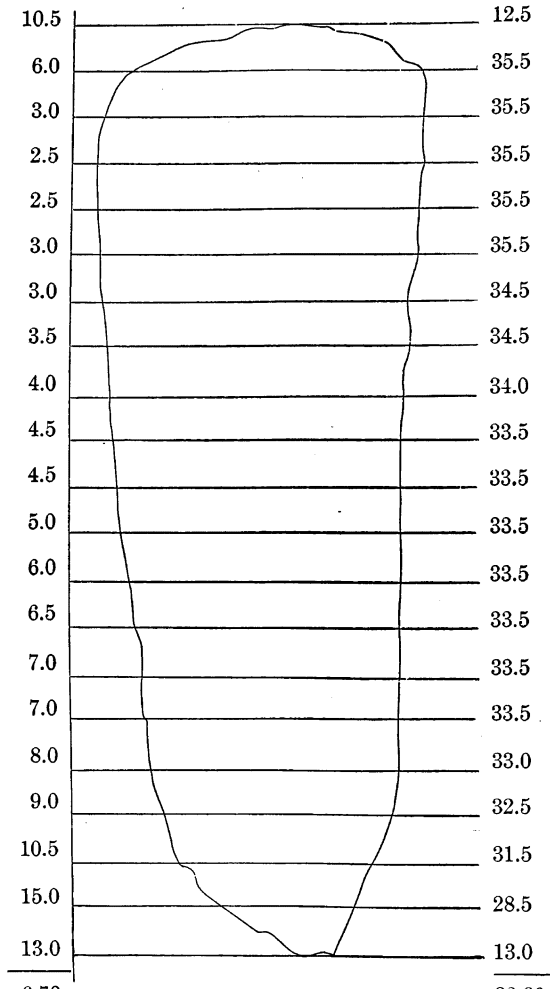
Ordinates	28.53
Planimeter	28.91
Initial	36.
Terminal	25.5
Stroke	28.72

DIAGRAM No. 102.



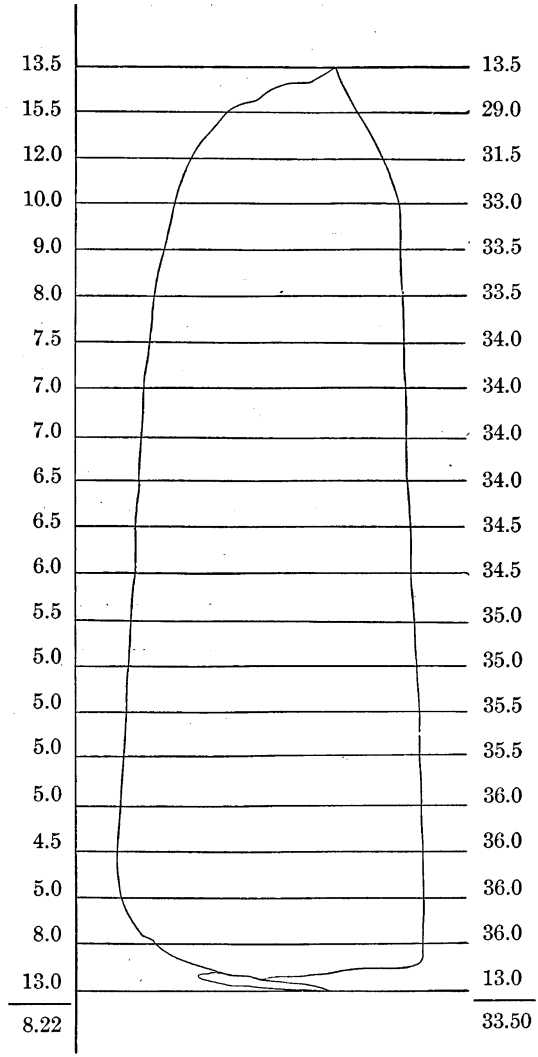
Ordinates	27.70
Planimeter	28.18
Initial	36.
Terminal	25.5
Stroke	29.11

DIAGRAM No. 136.



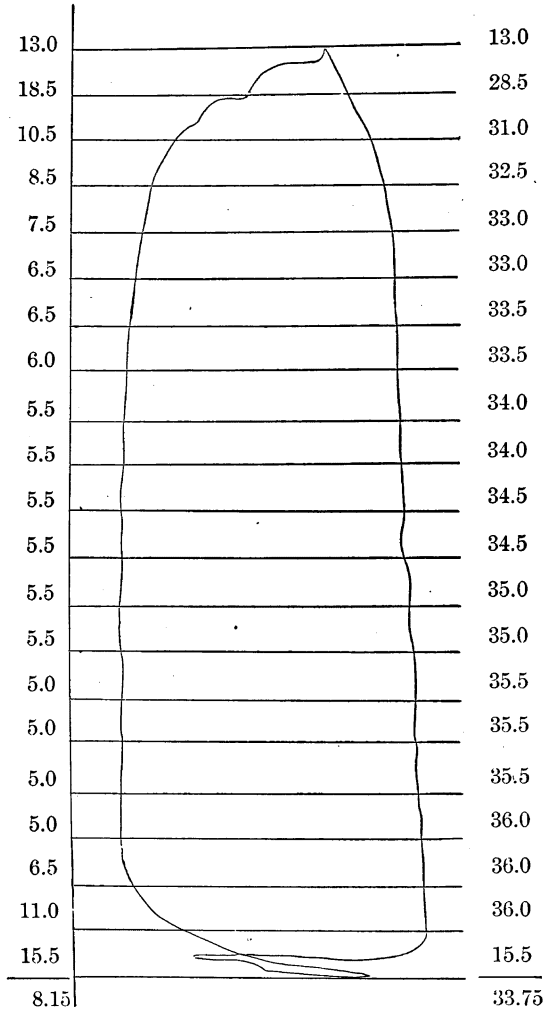
Ordinates	26.60
Planimeter	27.32
Initial	35.5
Terminal	26.5
Stroke	29.05

DIAGRAM No. 17.



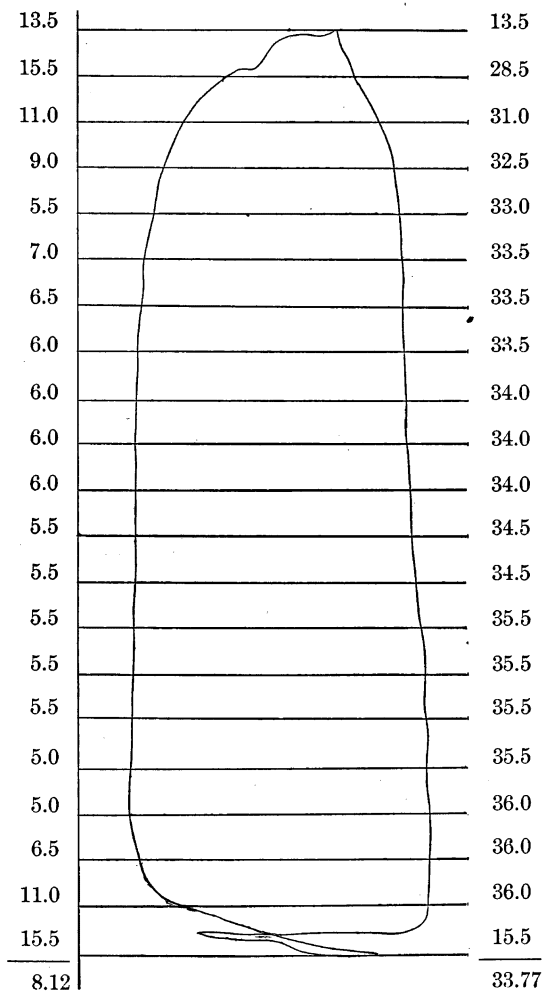
Ordinates	25.28
Planimeter	25.70
Initial	34.
Terminal	26.5
Stroke	28.99

DIAGRAM No. 51.



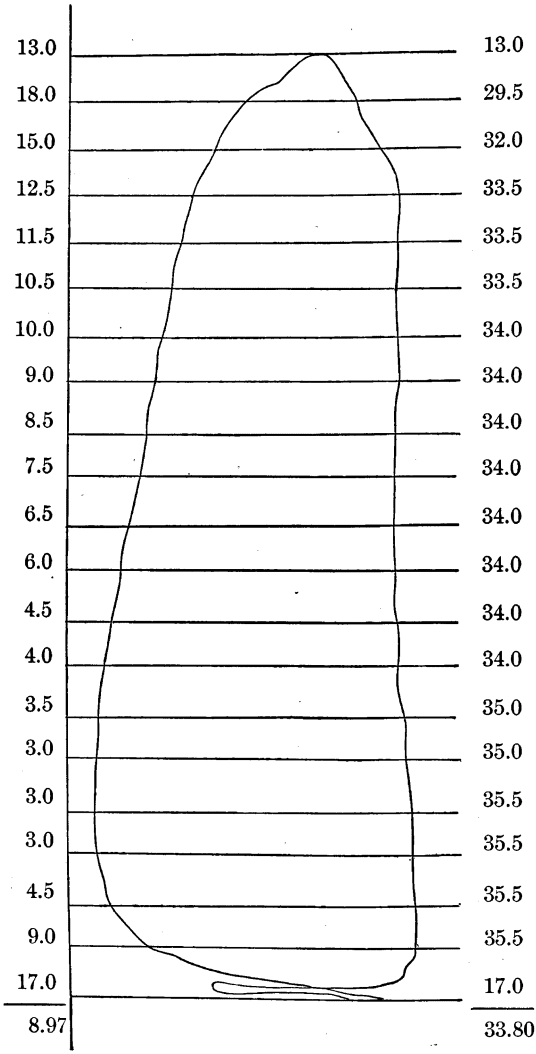
Ordinates	25.60
Planimeter	25.68
Initial	36.
Terminal	26.
Stroke	29.05

DIAGRAM No. 102.



Ordinates	25.65
Planimeter	25.60
Initial	36.
Terminal	26.5
Stroke	28.90

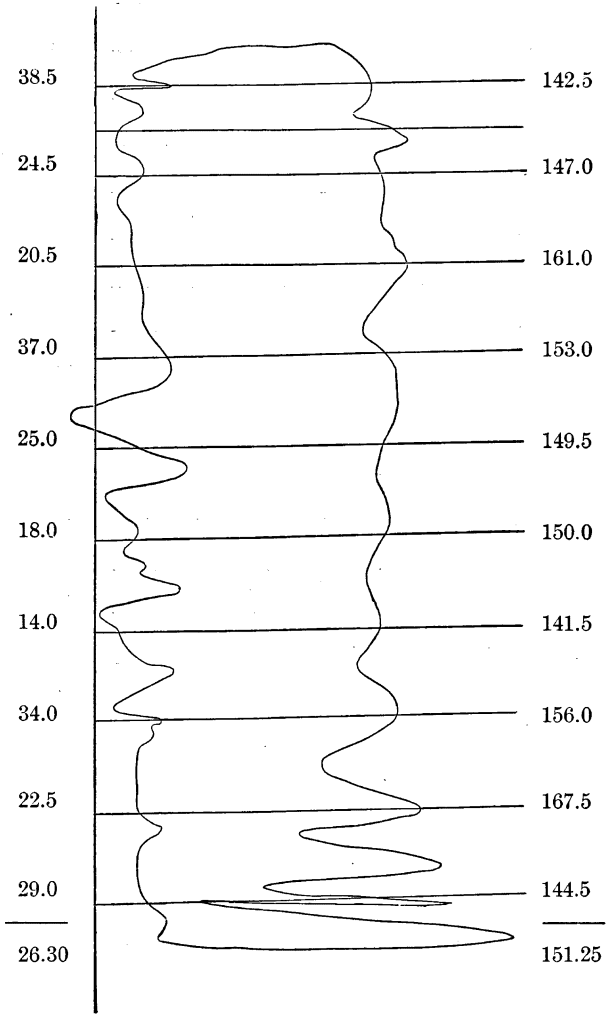
DIAGRAM No. 136.



13.0		13.0
18.0		29.5
15.0		32.0
12.5		33.5
11.5		33.5
10.5		33.5
10.0		34.0
9.0		34.0
8.5		34.0
7.5		34.0
6.5		34.0
6.0		34.0
4.5		34.0
4.0		34.0
3.5		35.0
3.0		35.0
3.0		35.5
3.0		35.5
4.5		35.5
9.0		35.5
17.0		17.0
8.97		33.80

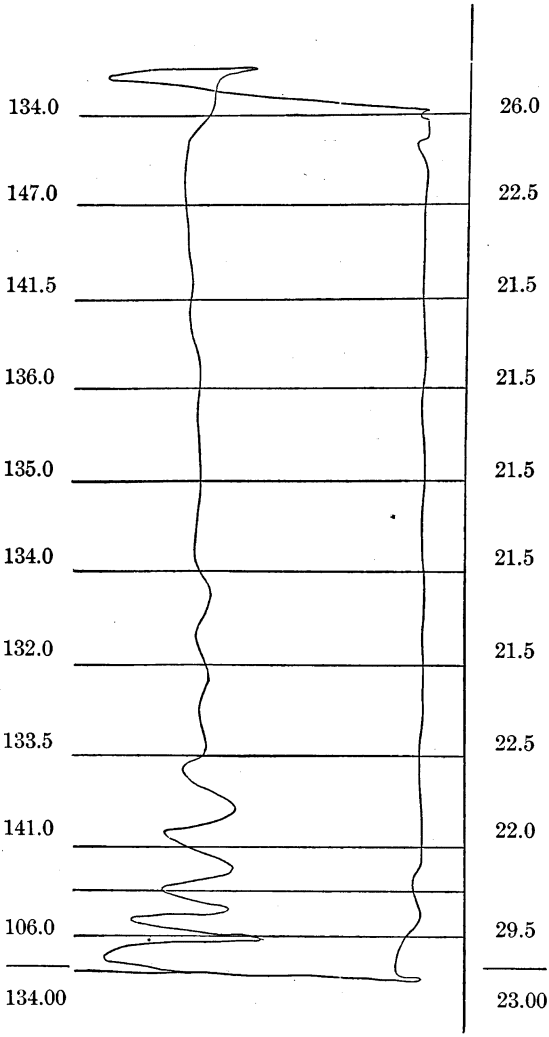
Ordinates	24.83
Planimeter	24.79
Initial	35.5
Terminal	26.
Stroke	29.51

DIAGRAM No. 8.



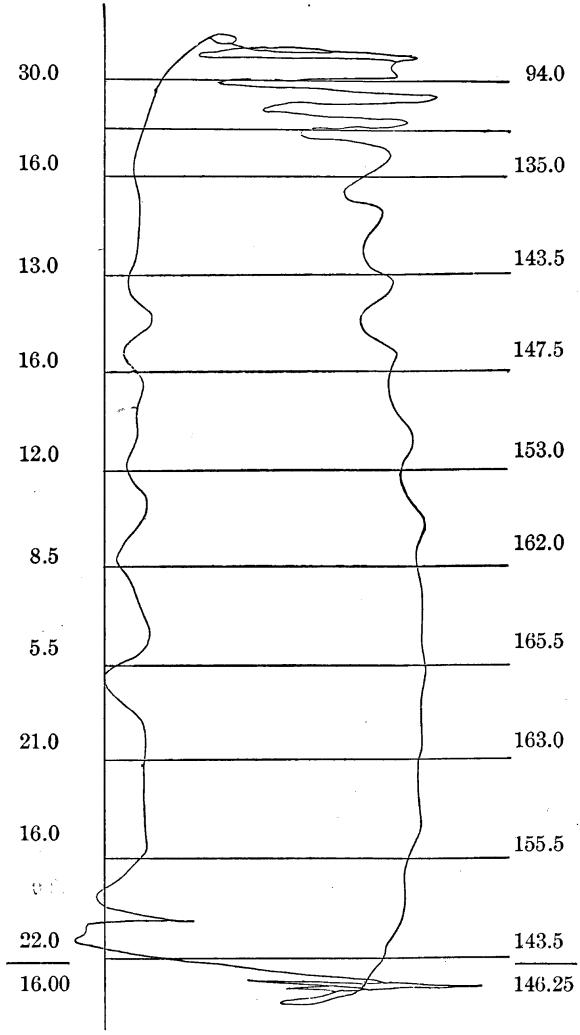
Ordinates..... .... 124.95

DIAGRAM No. 25.



Ordinates..... 111.00

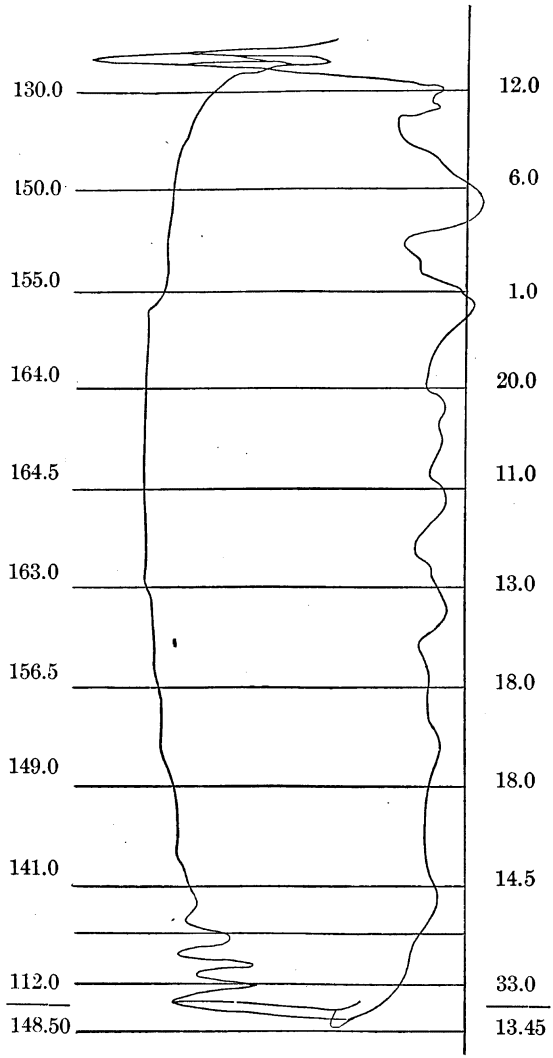
DIAGRAM No. 3.



30.0	94.0
16.0	135.0
13.0	143.5
16.0	147.5
12.0	153.0
8.5	162.0
5.5	165.5
21.0	163.0
16.0	155.5
22.0	143.5
16.00	146.25

Ordinates..... 130.25

DIAGRAM No. 8.



Ordinates..... 135.05

To the Honorable, the Board of City Commissioners:

GENTLEMEN:

Since submitting the report on the performance of the Hunt Street Pumping Engine, my attention has been directed to an error in the preliminary statement as also in the opinion, which in justice to the late GEO. SHIELD, ESQ., *I desire to correct.*

On pages 4 and 101 of the report, the statement is made that Mr. Shield designed and built the water end of the Warden Compound Engine. I am now informed by Mr. Warden that Mr. Shield did not design the water end as it is now used, but that the original design was for an eight inch (diam.) pump, and that he (Mr. Warden) increased the diameter of bore from an eight inch to a ten inch pump, preserving the valve chambers and water ways as originally designed for an eight inch pump by Mr. Shield; and the water end of the engine was constructed under the supervision of Mr. Warden, after the original patterns by Mr. Shield were altered, as noticed above.

Very obediently yours,

JOHN W. HILL.

CINCINNATI, JULY 17, 1879.