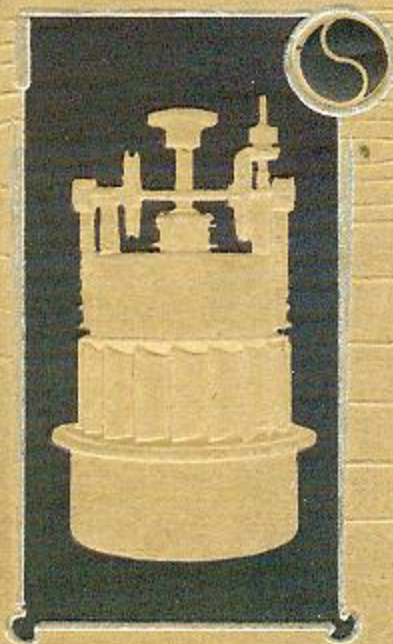


J. & W. JOLLY

Manufacturers of the
MCCORMICK HOLYOKE TURBINES



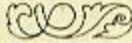
HOLYOKE, MASS. U.S.A.

ESTABLISHED 1821

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J. & W. JOLLY
INCORPORATED

Manufacturers of the
McCormick Holyoke

TURBINES 



HOLYOKE, MASS., U. S. A.
E S T A B L I S H E D 1 8 8 1

I N T R O D U C T I O N

TO Hydraulic Engineers and users of Water Power we present this catalog, hoping the information contained therein will be found useful in designing and installing hydraulic plants.

In the year 1888 the firm of J. & W. Jolly took up the manufacture of Turbine Water Wheels with John B. McCormick, who has been aptly designated "the man who revolutionized the turbine wheel business of the world," and is today recognized among water wheel builders as understanding the action of water in passing through the wheel better than any living man, holding the same position in regard to the designing of water wheels that Nat Hereschoff does to the designing of yachts. During the period from 1888 to 1894 John B. McCormick made for us a complete set of master patterns ranging from 9 inches to 66 inches in diameter, (the only set in existence), which were his final triumph, being from 10 to 25 per cent. greater in power as to diameter than his previous effort and stand today the peer of all other water wheels for efficiency, no wheel being put on the market until it had exceeded 80 per cent. efficiency in the Holyoke Water Power Co.'s testing flume, some attaining an efficiency as high as 85 and 86 per cent.

The highest compliment paid to Mr. McCormick is contained in the fact that the leading water wheel builders of today are copying his designs as closely as possible, but

I N T R O D U C T I O N

none have been able to reproduce those curves in which the true secret of their high efficiency lies.

In the following pages we reproduce copies of original tests made from our wheels in the Holyoke Water Power Co.'s testing flume, and we would draw attention to the fact that these tests in every case exceed the tabled power of the wheel. Whereas we have replaced wheels of all the other leading builders with the McCormick Wheel of the same or smaller diameter, in every instance delivering a greater power with economy of water, we have yet to hear of the McCormick Wheel being replaced in the same manner by any other.

To meet the demand for direct connection to electric generators we have designed a number of special wheels of high speed and power, and in the following pages we reproduce copies of official tests showing what we have already done along these lines. From these tests it will be seen we are in a particularly favorable position to design wheels to meet special requirements for modern electric plants where high speed and power, combined with economy of space, are matters of vital importance.

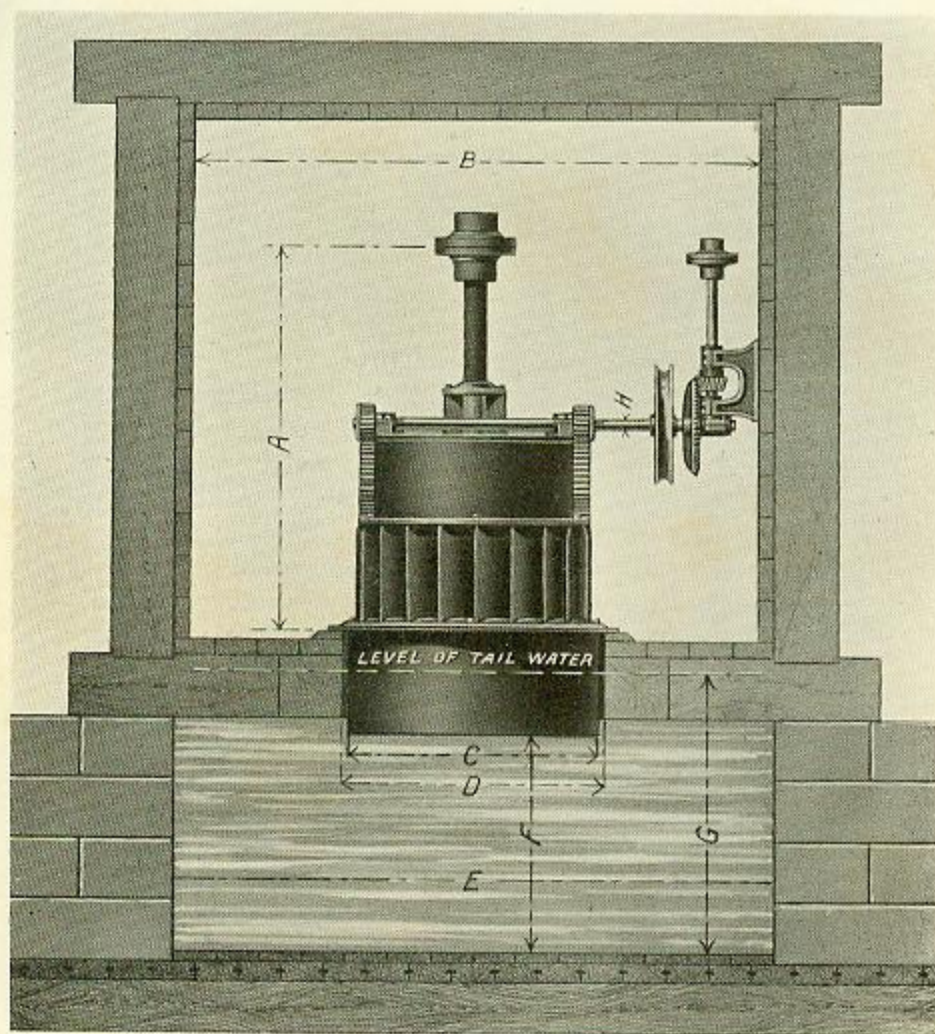


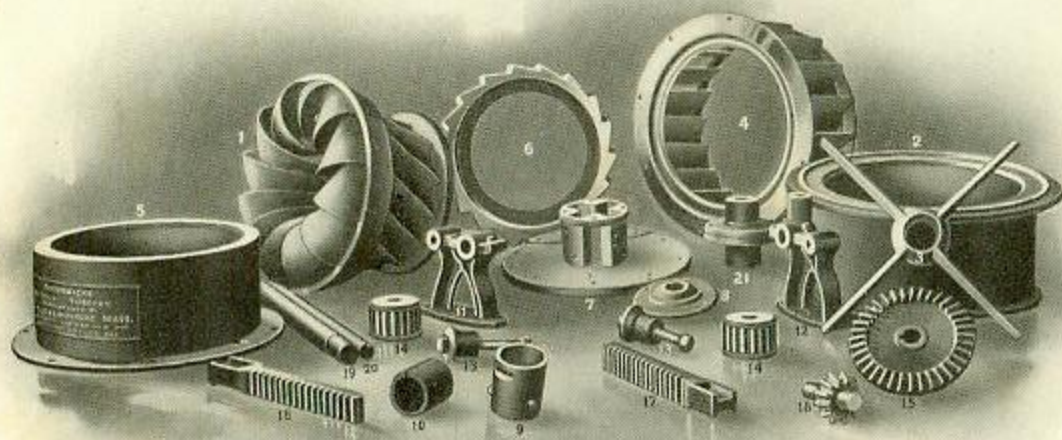
Plate 1

TABLE OF DIMENSIONS

These dimensions are for a 20 foot head and may be varied for a greater or less head.

DIA. OF WHEEL IN INCHES	DIA. OF SHAFT IN INCHES	A	B	C	D	E	F	G
		FT. INS.	FT. INS.	FT. INS.	FT. INS.	FT. INS.	FT. INS.	FT. INS.
9"	1 $\frac{9}{16}$ "	2 - 4	2 - 6	1 - 2 $\frac{3}{4}$	1 - 4 $\frac{1}{4}$	3 - 0	1 - 0	1 - 5
12	2 $\frac{3}{8}$ "	2 - 11 $\frac{5}{8}$	3 - 0	1 - 6 $\frac{1}{4}$	1 - 8 $\frac{1}{4}$	4 - 0	1 - 3	1 - 9
15	2 $\frac{1}{2}$ "	3 - 5 $\frac{5}{8}$	4 - 0	1 - 11 $\frac{1}{8}$	2 - 0 $\frac{5}{8}$	5 - 0	1 - 6	2 - 0
18	2 $\frac{9}{16}$ "	3 - 8 $\frac{7}{8}$	4 - 6	2 - 2 $\frac{3}{8}$	2 - 3 $\frac{7}{8}$	6 - 0	1 - 9	2 - 3
21	3 $\frac{3}{8}$ "	4 - 2 $\frac{1}{8}$	5 - 3	2 - 6 $\frac{3}{4}$	2 - 8 $\frac{1}{4}$	7 - 0	2 - 0	2 - 8
24	3 $\frac{1}{2}$ "	4 - 7 $\frac{1}{8}$	6 - 0	2 - 10 $\frac{7}{8}$	3 - 0 $\frac{1}{2}$	8 - 0	2 - 5	3 - 1
27	3 $\frac{13}{16}$ "	4 - 10 $\frac{3}{8}$	6 - 6	3 - 3 $\frac{1}{2}$	3 - 5 $\frac{1}{2}$	9 - 0	2 - 8	3 - 5
30	3 $\frac{9}{8}$ "	5 - 3 $\frac{5}{8}$	7 - 6	3 - 7 $\frac{5}{8}$	3 - 9 $\frac{5}{8}$	10 - 0	3 - 0	3 - 9
33	4 $\frac{3}{16}$ "	6 - 1 $\frac{1}{4}$	8 - 0	4 - 0 $\frac{1}{4}$	4 - 2 $\frac{1}{4}$	11 - 0	3 - 4	4 - 2
36	4 $\frac{9}{16}$ "	6 - 6	9 - 3	4 - 4	4 - 6	12 - 0	3 - 8	4 - 9
39	5 $\frac{1}{8}$ "	6 - 10	9 - 9	4 - 8 $\frac{5}{8}$	4 - 10 $\frac{5}{8}$	13 - 0	4 - 0	5 - 0
42	5 $\frac{5}{16}$ "	7 - 1 $\frac{5}{8}$	10 - 6	5 - 1 $\frac{5}{8}$	5 - 3 $\frac{5}{8}$	14 - 0	4 - 4	5 - 6
45	6 $\frac{3}{8}$ "	7 - 6 $\frac{1}{8}$	11 - 3	5 - 5 $\frac{3}{8}$	5 - 7 $\frac{3}{8}$	15 - 0	4 - 8	5 - 10
48	6 $\frac{1}{2}$ "	8 - 0 $\frac{7}{8}$	12 - 0	5 - 9 $\frac{1}{4}$	5 - 11 $\frac{1}{4}$	16 - 0	5 - 0	6 - 3
51	7 $\frac{1}{2}$ "	8 - 9 $\frac{1}{8}$	12 - 9	6 - 1 $\frac{1}{4}$	6 - 3 $\frac{1}{4}$	17 - 0	5 - 5	6 - 11
54	7 $\frac{1}{2}$ "	9 - 3 $\frac{1}{8}$	13 - 6	6 - 6	6 - 8	18 - 0	5 - 9	7 - 3
57	7 $\frac{9}{16}$ "	9 - 6	14 - 3	6 - 10 $\frac{5}{8}$	7 - 0 $\frac{5}{8}$	19 - 0	6 - 0	7 - 7
60	8 $\frac{3}{8}$ "	9 - 11 $\frac{3}{8}$	15 - 0	7 - 1 $\frac{5}{8}$	7 - 4	20 - 0	6 - 3	7 - 11

DETAIL OF WHEEL PARTS



- | | | |
|--------------|---------------------|-------------------------|
| 1 Runner | 8 Follow Box Cover | 15 Large Bevel Gear |
| 2 Draft Tube | 9 Shoe | 16 Gate Bevel Pinion |
| 3 Spider | 10 Step Pot | 17 Right Hand Rack |
| 4 Guide Rim | 11 Gate Stand | 18 Left Hand Rack |
| 5 Dome | 12 " " with step | 19 Wheel Shaft |
| 6 Gate | 13 Roll and Stud | 20 Gate Shaft |
| 7 Dome Cover | 14 Spur Gate Pinion | 21 Gate Shaft Couplings |



Plate 3

Plate 3 represents one of our standard runners, the buckets of which are cast separately, thus insuring the opportunity of getting a bucket casting free from all imperfections, true to pattern, and also enabling every part to be properly finished, which is very essential to reduce the friction of water as it passes through the bucket, which cannot be done with runners cast in one piece. The hub and band are cast on to the buckets, thus doing away with the objectional feature of bolting these together, and the liability of the buckets working loose.

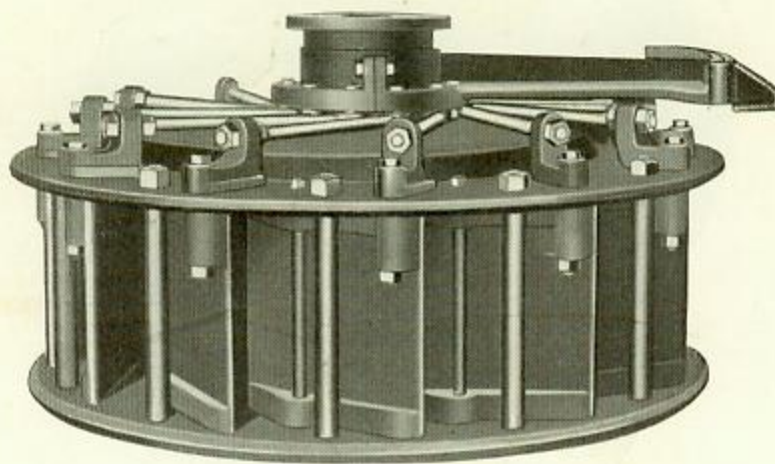


Plate 4

BALANCE GATE CASE

Plate 4 is an engraving of "Jolly's Improved Balance Gate," which, together with its great rigidity and ease of action combined with the best possible delivery of water to the wheel, at all parts of gate opening insuring the highest efficiency at part gates, has earned for itself the title of the best gate of its type on the market.

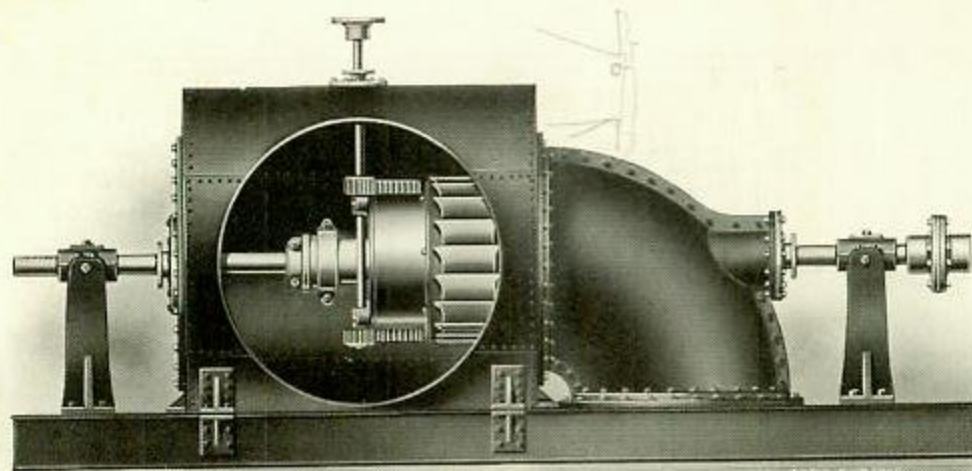


Plate 4A

McCormick Cylinder Gate Turbine, Horizontal Type, in Steel Flume.

McCORMICK'S HOLYOKE TURBINE.

9-INCH WHEEL.			
Head.	Revolutions per Minute.	Discharge. Cubic feet per Minute.	Horse Power.
5	311	201	1.5
6	340	221	2.0
7	367	238	2.5
8	393	255	3.1
9	417	270	3.7
10	439	285	4.3
11	461	299	5.0
12	481	312	5.7
13	501	325	6.4
14	520	337	7.1
15	538	349	7.9
16	556	360	8.7
17	573	371	9.5
18	589	382	10.4
19	605	393	11.3
20	621	403	12.2
21	636	413	13.1
22	651	423	14.0
23	666	432	15.0
24	680	441	16.0
25	694	450	17.0
26	708	459	18.0
27	722	468	19.1
28	735	477	20.2
29	748	485	21.3
30	761	493	22.4
31	773	502	23.5
32	786	510	24.6
33	798	518	25.8
34	810	525	27.0
35	822	533	28.2
36	833	541	29.4
37	845	548	30.6
38	856	555	31.9
39	867	563	33.2
40	878	570	34.4

"JOLLY" GUARANTEES AT LEAST 80 PER CENT. EFFICIENCY

TESTING FLUME OF THE HOLYOKE WATER POWER CO.

HOLYOKE MASS

Report of tests of a 12" R. H. McCORMICK'S HOLYOKE - - turbine wheel

No 466 . made January 17th, 1890.

Number of the experiment	Pressure applied		Head in feet	Revolutions per minute	Quantity of water discharged in cu. ft. per sec.	Power developed in the wheel	Efficiency of the wheel
	the full opening of the nozzle	the full opening of the nozzle, the jet being kept in contact with the bucket	in feet	per minute	in cu. ft. per sec.	H. P.	in per cent.
8	1.000	1.010	17.85	5	395.0	11.29	80.31
7	"	1.009	17.80	4	406.7	11.27	80.34
6	"	1.000	18.00	4	424.7	11.25	80.44
5	"	0.995	18.01	4	437.7	11.18	80.30
20	0.799	0.682	17.87	3	407.0	8.87	82.14
19	"	0.675	17.85	3	421.3	9.79	82.58
18	"	0.670	17.86	4	435.7	9.73	82.52
17	"	0.664	17.89	5	451.8	9.67	82.44
16	"	0.660	17.91	3	476.0	9.63	81.59
27	0.651	0.794	17.93	6	421.0	8.90	81.51
26	"	0.788	17.94	4	440.2	8.83	82.13
25	"	0.781	17.98	3	460.0	8.77	82.29
24	"	0.778	18.05	3	477.3	8.75	81.19
32	0.488	0.662	18.08	3	392.0	7.45	72.35
31	"	0.660	18.02	4	415.0	7.42	72.96
30	"	0.656	18.04	4	439.5	7.38	73.17
34	"	0.651	18.07	4	462.0	7.32	72.73
14	0.369	0.539	18.12	4	366.0	6.07	64.82
13	"	0.537	18.12	4	392.2	6.05	64.88
12	"	0.531	18.10	4	417.5	5.98	64.77

During the above experiments, the weight of the dynamometer, and of that portion of the shaft which was above the lowest coupling was 622 lbs.

With the flume empty, a strain of 2 lbs. applied at a distance of 1.6 ft. from the center of the shaft, sufficed to start the wheel.

HOLYOKE WATER POWER CO.
By *A. E. Dickinson* Engineer in charge of Experiments By *E. S. Walters* Hall's Engineer

"JOLLY" GUARANTEES AT LEAST 80 PER CENT. EFFICIENCY

MCCORMICK'S HOLYOKE TURBINE.

15-INCH WHEEL.			
Head.	Revolutions per Minute.	Discharge. Cubic feet per Minute.	Horse Power.
5	196	627	4.7
6	215	687	6.2
7	232	742	7.8
8	248	793	9.6
9	263	841	11.4
10	277	887	13.4
11	291	930	15.5
12	304	972	17.6
13	316	1011	19.9
14	328	1050	22.2
15	340	1086	24.6
16	351	1122	27.1
17	362	1157	29.7
18	372	1190	32.4
19	382	1223	35.1
20	392	1254	37.9
21	402	1285	40.8
22	412	1316	43.7
23	421	1345	46.8
24	430	1374	49.8
25	439	1403	53.0
26	447	1430	56.2
27	456	1458	59.5
28	464	1484	62.8
29	472	1511	66.2
30	481	1536	69.6
31	489	1562	73.2
32	496	1587	76.7
33	504	1611	80.3
34	512	1636	84.0
35	519	1659	87.8
36	526	1683	91.6
37	534	1706	95.4
38	541	1729	99.3
39	548	1752	103.2
40	555	1774	107.2

"JOLLY" GUARANTEES AT LEAST 80 PER CENT. EFFICIENCY

TESTING FLUME
OF THE
HOLYOKE WATER POWER CO.,
HOLYOKE, MASS.

Report of tests of a 15" LEFT HAND McCORMICK'S HOLYOKE turbine wheel.
No. 056, made November 9th & 10th, 1896.

Tested with Special Draft-tube.				Tested for J. & W. Jolly.			
Number of experiments	Proportional part of		Head acting on the wheel	Revolutions per minute	Quantity of water discharged by the wheel	Power developed by the wheel	Efficiency of the wheel
	the full opening of the spiral gate	the full discharge of the wheel					
	in percent	in feet	in feet	per minute	cubic ft. per sec.	H. P.	in percent
30	1.000	1.008	15.28	4	315.0	18.40	82.44
29	"	1.004	15.28	4	327.0	18.34	82.74
28	"	1.002	15.29	5	341.2	18.30	83.20
27	"	0.998	15.30	4	332.2	18.24	83.36
26	"	0.987	15.32	4	378.5	18.05	82.41
25	0.776	0.868	15.46	3	309.7	15.93	81.65
22	"	0.861	15.47	4	328.0	15.82	82.48
21	"	0.851	15.48	4	342.5	15.83	82.38
20	"	0.837	15.49	4	355.2	15.39	81.73
14	0.597	0.705	15.67	4	326.0	13.04	76.84
13	"	0.693	15.67	4	338.0	12.81	76.82
12	"	0.680	15.70	5	353.8	12.69	76.59
11	"	0.674	15.71	4	369.0	12.48	75.54
6	0.468	0.538	15.82	4	306.0	10.82	68.72
5	"	0.573	15.85	4	323.7	10.66	70.46
4	"	0.559	15.87	3	340.0	10.40	71.06
3	"	0.557	15.86	4	363.2	10.37	70.61
36	0.340	0.439	15.82	4	304.5	8.16	61.54
35	"	0.432	15.84	6	329.8	8.04	62.36
34	"	0.428	15.85	4	351.0	7.96	59.63

During the above experiments, the weight of the dynamometer, and of the portion of the shaft which was above the lowest coupling was 622 lbs.

With the flume empty, a strain of $\frac{1}{2}$ lbs., applied at a distance of 1.6 ft. from the centre of the shaft, sufficed to start the wheel.

HOLYOKE WATER POWER CO.
L. J. Waters Hydraulic Engineer.
A. F. Lickman Engineer in charge of Experiments.

"JOLLY" GUARANTEES AT LEAST 80 PER CENT. EFFICIENCY

MCCORMICK'S HOLYOKE TURBINE.

18-INCH WHEEL.			
Head.	Revolutions per Minute.	Discharge. Cubic feet per minute.	Horse Power.
5	144	828	6.3
6	158	908	8.2
7	170	980	10.4
8	182	1048	12.7
9	193	1111	15.1
10	203	1172	17.7
11	213	1229	20.4
12	223	1283	23.3
13	232	1336	26.2
14	241	1386	29.3
15	249	1435	32.5
16	257	1482	35.8
17	265	1528	39.2
18	273	1572	42.8
19	280	1615	46.4
20	288	1657	50.1
21	295	1698	53.9
22	302	1738	57.8
23	309	1777	61.8
24	315	1815	65.8
25	322	1852	70.0
26	328	1889	74.2
27	334	1925	78.5
28	340	1960	82.9
29	346	1995	87.4
30	352	2029	92.0
31	358	2063	96.6
32	364	2096	101.3
33	370	2128	106.1
34	375	2160	111.0
35	381	2192	115.9
36	386	2223	120.9
37	391	2254	126.0
38	397	2284	131.1
39	402	2314	136.4
40	407	2343	141.6

"JOLLY" GUARANTEES AT LEAST 80 PER CENT. EFFICIENCY

TESTING FLUME OF THE HOLYOKE WATER POWER CO., HOLYOKE, MASS.

Report of tests of a 18" RIGHT HAND McCORMICK'S HOLYOKE turbine wheel.

No. 1155 made October 28th, 1896.

Tested on Special Draft-tube.

Tested for J. & W. Jolly.

Number of the experiment	Proportions of		Head		Revolutions		Quantity of water		Power	
	or full opening of the speed gate	discharge of the wheel	at the wheel	at the draft tube	at the wheel	at the draft tube	by the wheel	by the wheel	at the wheel	at the draft tube
	in per cent.	in cu. ft.	in ft.	in ft.	per minute	per minute	in cu. ft. per sec.	H. P.	in per cent.	in per cent.
10	1.000	1.011	17.48	4	276.5	26.64	42.22	80.27		
12	"	1.006	17.44	4	284.5	26.36	42.14	80.86		
11	"	1.002	17.42	4	293.2	26.24	42.06	81.23		
10	"	0.998	17.40	4	305.2	26.13	41.73	80.98		
9	"	0.992	17.38	4	315.2	25.96	41.07	80.30		
19	0.813	0.934	17.57	4	281.5	24.57	40.41	82.58		
18	"	0.931	17.56	4	291.7	24.49	40.55	83.17		
17	"	0.927	17.57	4	307.2	24.39	40.60	83.58		
16	"	0.925	17.59	4	321.5	24.34	40.29	83.02		
26	0.712	0.878	17.58	4	285.2	23.12	38.35	83.22		
25	"	0.875	17.57	4	295.5	23.03	38.38	83.67		
24	"	0.870	17.60	4	305.7	22.91	38.32	83.82		
23	"	0.868	17.60	4	315.0	22.85	37.80	82.62		
33	0.545	0.753	17.43	4	269.5	19.74	31.32	80.30		
32	"	0.751	17.47	4	283.0	19.71	31.30	80.95		
31	"	0.748	17.48	4	293.0	19.62	31.70	81.54		
30	"	0.742	17.57	4	306.7	19.63	31.45	80.95		
39	0.404	0.614	17.59	4	279.7	16.17	24.22	75.12		
38	"	0.611	17.65	4	293.7	16.10	24.09	74.79		
37	"	0.608	17.65	4	305.0	16.99	23.63	73.86		

During the above experiments, the weight of the dynamometer, and of that portion of the shaft which was above the lowest coupling was 1400 lbs.

With the flume empty, a strain of 2 lbs., applied at a distance of 2.4 ft. from the centre of the shaft, sufficed to start the wheel.

A. F. Sickman, Engineer in charge of Experiments.

HOLYOKE WATER POWER CO.
E. J. Watson, Hydraulic Engineer.

"JOLLY" GUARANTEES AT LEAST 80 PER CENT. EFFICIENCY

McCORMICK'S HOLYOKE TURBINE.

21-INCH WHEEL.			
Head.	Revolutions per Minute.	Discharge. Cubic feet per Minute.	Horse Power.
5	137	1172	8.9
6	150	1283	11.6
7	162	1386	14.7
8	173	1482	17.9
9	184	1572	21.4
10	194	1657	25.0
11	203	1738	28.9
12	212	1815	32.9
13	221	1889	37.1
14	229	1960	41.5
15	237	2029	46.0
16	245	2096	50.7
17	253	2160	55.5
18	260	2223	60.5
19	267	2284	65.6
20	274	2343	70.8
21	281	2401	76.2
22	287	2457	81.7
23	294	2513	87.3
24	300	2567	93.1
25	306	2620	99.0
26	312	2672	105.0
27	318	2722	111.1
28	324	2772	117.3
29	330	2821	123.6
30	336	2870	130.1
31	341	2917	136.6
32	347	2964	143.3
33	352	3010	150.1
34	357	3055	157.0
35	362	3100	163.9
36	368	3144	171.0
37	373	3187	178.2
38	378	3230	185.5
39	383	3272	192.8
40	387	3314	200.3

"JOLLY" GUARANTEES AT LEAST 80 PER CENT. EFFICIENCY

TESTING FLUME OF THE HOLYOKE WATER POWER CO.

HOLYOKE, MASS.

Report of tests of a 21" L. H. McCORMICK'S HOLYOKE - - - turbine wheel.

No. 701 made August 17th, 1893.
Tested for J. & W. Jolly.

Number of the experiment	Pressure of water		Head in ft.	Diameter of wheel in ft.	Revolutions per minute	Quantity of water discharged cu. ft. per sec.	Power developed by the wheel H. P.	Efficiency of the wheel per cent.
	at the opening of the flume	at the discharge of the flume						
	in ft.	in ft.	in ft.	in ft.	per minute	cu. ft. per sec.	H. P.	per cent.
6	1.000	1.013	15.62	4	224.0	34.95	49.07	79.42
5	"	1.006	15.65	4	234.2	34.76	49.16	79.86
4	"	1.000	15.66	4	244.0	34.55	48.99	80.02
3	"	0.993	15.68	4	253.7	34.32	49.63	79.84
13	0.790	0.904	15.62	4	222.0	31.30	45.59	81.12
12	"	0.899	15.63	4	233.2	31.22	45.76	81.82
11	"	0.895	15.65	4	244.0	31.03	45.66	82.02
10	"	0.890	15.80	4	255.5	30.85	45.47	81.97
9	"	0.874	15.90	4	271.5	30.45	44.60	81.41
18	0.628	0.772	15.67	4	237.5	26.67	37.93	80.21
17	"	0.768	15.71	4	246.0	26.57	37.91	80.26
16	"	0.763	15.73	5	258.4	26.43	37.73	80.20
22	"	0.756	15.68	4	265.0	26.15	36.88	79.49
27	0.499	0.656	15.77	4	223.0	22.75	29.51	72.68
26	"	0.654	15.76	4	230.6	22.67	29.47	72.68
25	"	0.653	15.76	4	239.7	22.64	29.53	73.14
24	"	0.646	15.81	4	252.2	22.49	29.55	72.93
35	0.374	0.535	15.70	4	205.7	18.50	21.12	64.26
34	"	0.533	15.70	4	217.2	18.44	21.31	65.04
33	"	0.531	15.74	4	227.0	18.41	21.24	64.76

During the above experiments, the weight of the dynamometer, and of that portion of the shaft which was above the lowest coupling was 1,396 lbs.

With the flume empty a strain of 24 lbs. applied at a distance of 2.4 ft. from the center of the shaft, sufficed to start the wheel.

A. F. Sickman

Engineer in charge of experiments.

HOLYOKE WATER POWER CO.
By E. W. Water Hydraulic Engineer.

"JOLLY" GUARANTEES AT LEAST 80 PER CENT. EFFICIENCY

McCORMICK'S HOLYOKE TURBINE.

24-INCH WHEEL.			
Head.	Revolutions per Minute.	Discharge. Cubic feet per Minute.	Horse Power.
5	113	1547	11.7
6	124	1695	15.4
7	134	1831	19.4
8	143	1957	23.7
9	152	2076	28.2
10	160	2188	33.4
11	168	2295	38.4
12	175	2397	43.5
13	182	2495	49.0
14	189	2589	54.8
15	196	2680	60.7
16	202	2768	66.9
17	208	2853	73.3
18	214	2936	79.8
19	220	3016	86.6
20	226	3095	93.5
21	232	3171	100.6
22	237	3246	107.9
23	242	3318	115.3
24	248	3390	122.9
25	253	3460	130.7
26	258	3528	138.6
27	263	3595	146.7
28	267	3661	154.9
29	272	3726	163.3
30	277	3790	171.8
31	281	3853	180.5
32	286	3914	189.3
33	290	3975	198.2
34	295	4035	207.3
35	299	4094	216.5
36	303	4152	225.8
37	307	4209	235.3
38	312	4265	244.9
39	316	4321	254.7
40	320	4376	264.5

"JOLLY" GUARANTEES AT LEAST 80 PER CENT. EFFICIENCY

TESTING FLUME

OF THE

HOLYOKE WATER POWER CO.,

HOLYOKE, MASS.

Report of tests of a 24" LEFT HAND McCORMICK - - - - - turbine wheel.

No. 675, made April 18th, 1893.

Tested for J. & W. Jolly.

Number of the experiment	Proportional part of		Head using	Revolutions	Revolutions	Quantity of	Power	Efficiency
	the full opening of the spiral gate.	the full discharge of the wheel, the full discharge of the gate when giving best effi- ciency.	in feet wheel.	of the gate. percent.	of the wheel.	water discharged by the wheel.	developed by the wheel.	of the wheel.
	in percent.		in feet.	in feet.	per minute.	in cubic feet per sec.	H. P.	in percent.
37	1.000	1.005	16.83	4	105.25	47.55	72.06	79.39
36	"	1.002	16.82	4	205.50	47.41	72.30	79.84
35	"	0.999	16.84	4	210.00	47.27	72.20	79.97
34	"	0.995	16.86	4	216.50	47.13	71.96	79.84
30	0.771	0.891	17.14	4	189.20	42.55	66.81	80.76
29	"	0.887	17.25	4	199.75	42.47	67.76	81.55
28	"	0.882	17.24	4	207.75	42.25	67.62	81.85
27	"	0.878	17.29	4	215.00	42.16	67.52	81.66
26	"	0.875	17.30	4	221.50	41.95	67.02	81.42
22	0.804	0.781	17.49	4	191.75	36.68	57.14	78.53
21	"	0.756	17.49	5	202.00	36.46	57.42	79.38
20	"	0.750	17.47	4	209.75	36.16	56.73	79.18
19	"	0.744	17.47	5	218.00	35.86	55.97	78.76
15	0.471	0.639	17.44	4	186.00	30.77	44.77	73.55
14	"	0.635	17.47	4	195.00	30.81	44.70	73.89
13	"	0.630	17.45	4	202.75	30.58	44.15	73.48
12	"	0.625	17.47	4	211.50	30.12	43.63	73.11
7	0.358	0.518	17.54	4	179.00	25.01	32.41	65.15
6	"	0.513	17.54	4	181.25	24.80	32.44	65.75
5	"	0.507	17.51	4	200.75	24.48	31.75	65.28

During the above experiments, the weight of the dynamometer, and of that portion of the shaft which was above the lowest coupling was 2,074 lbs.

With the flume empty, a strain of 10 lbs., applied at a distance of 2.4 ft. from the center of the shaft, sufficed to start the wheel.

HOLYOKE WATER POWER CO.

A. A. Dickman Engr in charge of Experiments By E. P. Watson Hydr. Engr.

"JOLLY" GUARANTEES AT LEAST 80 PER CENT. EFFICIENCY

MCCORMICK'S HOLYOKE TURBINE.

27-INCH WHEEL.			
Head.	Revolutions per Minute.	Discharge. Cubic feet per Minute.	Horse Power.
5	106	1960	14.8
6	116	2147	19.5
7	125	2319	24.5
8	134	2479	30.0
9	142	2629	35.8
10	149	2771	41.9
11	157	2906	48.3
12	164	3036	55.0
13	170	3160	62.1
14	177	3279	69.4
15	183	3394	76.9
16	189	3505	84.7
17	195	3613	92.8
18	200	3718	101.1
19	206	3820	109.7
20	211	3919	118.4
21	217	4016	127.4
22	222	4110	136.6
23	227	4203	146.1
24	231	4293	155.7
25	236	4382	165.5
26	241	4468	175.6
27	245	4554	185.8
28	250	4637	196.2
29	254	4719	206.8
30	259	4800	217.6
31	263	4879	228.6
32	267	4957	239.7
33	271	5034	251.0
34	275	5110	262.5
35	280	5184	274.2
36	283	5258	286.0
37	287	5331	298.0
38	291	5402	310.2
39	295	5473	322.5
40	299	5542	335.0

"JOLLY" GUARANTEES AT LEAST 80 PER CENT. EFFICIENCY

TESTING FLUME

NO. 100

HOLYOKE WATER POWER CO.

HOLYOKE, MASS.

Report of tests of a 27" L. H. McCORMICK'S HOLYOKE turbine wheel
No. 487, made October 6th, 1890.

Number of the experiment	Flow and pressure		Head water	Discharge	Revolutions	Quantity of water discharged	Power	Efficiency
	the fall pressure of the turbine	the fall pressure of the turbine, for the purpose of the test, the fall pressure being the difference between the head water and the tail water	in feet	in cu. ft. per minute	per minute	in cu. ft. per minute	in ft. lbs. per minute	in per cent.
8	1.000	1.000	16.72	4	174.50	60.26	92.07	60.64
10	"	1.000	16.66	4	182.25	59.95	91.98	81.26
7	"	1.001	16.78	4	194.00	59.90	93.46	82.05
11	"	0.886	16.61	5	190.00	59.26	90.85	81.44
9	"	0.888	16.82	4	209.25	59.16	91.21	80.86
16	0.768	0.877	16.80	4	164.75	52.64	80.13	79.52
15	"	0.871	16.93	4	178.25	52.35	81.79	81.43
14	"	0.859	16.94	4	188.50	51.64	81.30	82.01
13	"	0.851	16.96	3	199.33	51.18	79.56	80.68
21	0.599	0.732	17.10	4	170.50	44.23	64.93	75.75
23	"	0.751	17.07	3	179.67	44.10	65.86	77.30
20	"	0.728	17.12	3	185.00	43.97	66.21	77.61
19	"	0.721	17.11	4	191.25	43.58	64.93	76.84
28	0.472	0.608	17.30	3	163.00	36.60	50.11	69.85
27	"	0.604	17.27	4	173.75	36.64	51.02	71.15
26	"	0.601	17.29	4	185.00	36.50	50.93	71.21
25	"	0.594	17.34	4	188.25	36.12	50.05	70.48
5	0.372	0.496	17.64	4	154.25	30.40	38.93	64.05
4	"	0.496	17.64	3	166.00	30.45	38.61	65.06
3	"	0.488	17.65	4	181.50	30.53	39.97	65.46

During the above experiments, the weight of the dynamometer, and of that portion of the shaft which was above the lowest coupling was 2,026 lbs.

With the above engine, a strain of 6 lbs. applied at a distance of 2.4 ft. from the center of the shaft, sufficed to start the wheel.

A. F. Lickman

Eng'g in charge of Expt's

By

E. S. Water

Hyd'g Engr.

"JOLLY" GUARANTEES AT LEAST 80 PER CENT. EFFICIENCY

McCORMICK'S HOLYOKE TURBINE.

30-INCH WHEEL.			
Head.	Revolutions per Minute.	Discharge. Cubic feet per Minute.	Horse Power.
5	93	2361	17.8
6	102	2586	23.4
7	110	2793	29.5
8	118	2986	36.1
9	125	3167	43.1
10	132	3338	50.4
11	138	3501	58.2
12	144	3657	66.3
13	150	3806	74.8
14	156	3950	83.6
15	161	4089	92.7
16	167	4223	102.1
17	172	4353	111.8
18	177	4479	121.8
19	182	4602	132.1
20	186	4721	142.7
21	191	4838	153.5
22	195	4952	164.6
23	200	5063	176.0
24	204	5172	187.6
25	208	5278	199.4
26	212	5383	211.5
27	216	5486	223.8
28	220	5586	236.3
29	224	5683	249.1
30	228	5782	262.1
31	232	5878	275.3
32	236	5972	288.8
33	239	6064	302.4
34	243	6156	316.3
35	246	6246	330.3
36	250	6334	344.6
37	253	6421	359.0
38	257	6508	373.7
39	260	6593	388.5
40	263	6677	403.6

"JOLLY" GUARANTEES AT LEAST 80 PER CENT. EFFICIENCY

TESTING FLUME

OF THE

◁ HOLYOKE WATER POWER CO., ▷

HOLYOKE, MASS.

Report of tests of a 30" LEFT HAND McCORMICK turbine wheel.

No. 1368, made September 25th & 26th, 1901.

Tested on Conical Draft-tube.

Tested for J. & W. Jolly.

Number of the experiment	Diameter and part of the full opening of the aperture		Head water in the wheel		Discharge of the wheel		Quantity of water used in the wheel		Power developed by the wheel		Efficiency of the wheel	
	in feet	in inches	in feet	in inches	in feet	in inches	in feet	in inches	in feet	in inches	in per cent.	in per cent.
12	1.000	1.007	16.62	4	174.75	75.25	112.61	81.80				
11	"	1.002	16.62	4	182.25	72.96	113.22	82.43				
10	"	1.000	16.60	4	191.75	72.73	113.28	82.83				
9	"	0.993	16.60	4	202.50	72.24	111.00	81.71				
19	0.763	0.870	16.77	4	108.00	63.61	99.25	82.13				
18	"	0.863	16.82	4	175.50	63.20	99.40	82.55				
17	"	0.857	16.83	4	181.25	62.74	98.24	82.13				
16	"	0.851	16.82	4	186.00	62.28	96.29	81.14				
25	0.903	0.734	16.95	4	170.25	53.64	80.88	79.09				
24	"	0.728	16.98	4	175.10	53.57	80.16	77.80				
23	"	0.723	16.99	4	181.00	53.18	79.37	77.55				
22	"	0.711	17.02	4	189.75	52.36	77.43	76.67				
32	0.472	0.612	17.09	4	169.00	45.14	61.76	70.67				
31	"	0.603	17.11	4	175.25	44.78	60.94	70.09				
30	"	0.599	17.14	4	184.75	44.26	59.63	69.39				
29	"	0.593	17.16	4	193.75	43.60	57.82	67.64				
6	0.342	0.516	15.35	4	152.00	35.00	39.51	63.69				
5	"	0.512	15.40	5	159.00	35.90	39.00	63.23				
4	"	0.506	15.45	4	164.50	35.71	39.07	62.62				
3	"	0.504	15.48	5	172.60	35.41	37.84	60.94				

During the above experiments, the weight of the dynamometer, and of that portion of the shaft which was above the lowest coupling was 2500 lbs.

With the three empty, a strain of 5 lbs. applied at a distance of 3.2 ft. from the centre of the shaft, sufficed to start the wheel.

HOLYOKE WATER POWER CO.

S. J. Wain Hydraulic Engineer.

A. F. Sickman Engineer in charge of Experiments.

"JOLLY" GUARANTEES AT LEAST 80 PER CENT. EFFICIENCY

TESTING FLUME

OF THE

HOLYOKE WATER POWER CO.

HOLYOKE, MASS.

Report of tests of a 33" R. H. McCORMICK'S HOLYOKE turbine wheel.

No. 485, made June 13th 1890.

Number of the experiment	Proper and part of		Head using in the wheel	Diameter of the penstock	Revolutions of the wheel	Quantity of water discharged by the wheel	Power developed by the wheel	Efficiency of the wheel
	the full opening of the penstock	the full discharge of the wheel, the full discharge of the penstock, the full discharge of the penstock, the full discharge of the penstock						
	in per cent.	in feet	in feet	in inches	per minute	cubic ft. per sec.	H. P.	in percent.
12	1.000	1.006	14.54	4	127.50	75.11	100.85	81.49
11	"	1.002	14.55	3	133.33	74.83	101.40	82.19
10	"	0.999	14.57	3	140.00	74.60	101.36	82.30
9	"	1.000	14.59	3	147.00	74.75	101.06	81.78
8	"	0.986	14.64	4	157.25	73.83	98.54	80.46
34	0.808	0.806	14.66	3	137.17	68.35	95.14	82.67
33	"	0.801	14.87	2	144.50	67.99	95.83	83.65
32	"	0.894	14.89	4	151.25	67.50	94.78	83.23
31	"	0.886	15.14	4	156.75	67.50	95.37	82.36
18	0.640	0.797	14.86	4	130.00	60.33	81.47	79.66
17	"	0.791	14.98	4	138.50	59.91	82.58	81.21
16	"	0.784	15.01	4	146.25	59.47	81.86	80.93
15	"	0.776	15.03	4	154.00	58.86	80.68	80.38
24	0.510	0.675	15.03	4	129.50	51.20	65.40	75.00
23	"	0.672	15.05	4	137.00	50.99	65.85	75.73
22	"	0.665	15.06	3	145.33	50.48	65.43	75.08
21	"	0.656	15.11	4	155.75	49.87	63.49	74.36
5	0.366	0.523	15.35	4	125.75	40.11	46.67	60.90
4	"	0.521	15.35	4	134.50	39.94	47.46	68.32
3	"	0.513	15.40	3	143.67	38.39	46.33	67.40

During the above experiments, the weight of the dynamometer and of that portion of the shaft which was above the

lowest coupling was 3,300 lbs.

With the above couple, a strain of 4 lbs. applied at a distance of 3.2 ft. from the center of the shaft, sufficed to turn the wheel.

A. F. Sickman

Eng'r in charge of Expts.

By

E. V. Water

Hydr. Eng'r.

HOLYOKE WATER POWER CO.

"JOLLY" GUARANTEES AT LEAST 80 PER CENT. EFFICIENCY

McCORMICK'S HOLYOKE TURBINE.

33-INCH WHEEL.			
Head.	Revolutions per Minute.	Discharge. Cubic feet per Minute.	Horse Power.
5	81	2626	19.8
6	89	2876	26.1
7	96	3107	32.9
8	102	3321	40.2
9	109	3523	47.9
10	114	3713	56.1
11	120	3895	64.7
12	125	4068	73.8
13	131	4234	83.2
14	135	4394	92.9
15	140	4548	103.1
16	145	4697	113.6
17	149	4842	124.4
18	154	4982	135.5
19	158	5119	147.0
20	162	5252	158.7
21	166	5381	170.8
22	170	5508	183.1
23	174	5632	195.7
24	177	5753	208.6
25	181	5871	221.8
26	185	5988	235.2
27	188	6102	248.9
28	192	6214	262.9
29	195	6324	277.1
30	198	6432	291.6
31	202	6538	306.3
32	205	6643	321.2
33	208	6746	336.4
34	211	6847	351.8
35	214	6947	367.4
36	217	7046	383.3
37	220	7143	399.4
38	223	7239	415.7
39	226	7333	432.2
40	229	7427	448.9

"JOLLY" GUARANTEES AT LEAST 80 PER CENT. EFFICIENCY

McCORMICK'S HOLYOKE TURBINE.

36-INCH WHEEL.			
Head.	Revolutions per Minute.	Discharge, Cubic feet per Minute.	Horse Power.
5	79	3316	25.1
6	87	3632	32.9
7	94	3923	41.5
8	100	4194	50.7
9	106	4449	60.5
10	112	4689	70.9
11	118	4918	81.7
12	123	5137	93.1
13	128	5347	105.0
14	133	5548	117.4
15	137	5743	130.2
16	142	5931	143.4
17	146	6114	157.1
18	150	6291	171.1
19	154	6464	185.6
20	158	6632	200.4
21	162	6795	215.6
22	166	6955	231.2
23	170	7112	247.2
24	174	7265	263.4
25	177	7414	280.1
26	181	7561	297.1
27	184	7705	314.4
28	187	7847	332.0
29	191	7985	349.9
30	194	8122	368.2
31	197	8256	386.7
32	200	8388	405.6
33	204	8518	424.8
34	207	8646	444.2
35	210	8773	464.0
36	213	8897	484.0
37	216	9020	504.3
38	218	9141	524.9
39	221	9260	545.7
40	224	9378	566.9

"JOLLY" GUARANTEES AT LEAST 80 PER CENT. EFFICIENCY

TESTING FLUME
OF THE
HOLYOKE WATER POWER CO.,
HOLYOKE, MASS.

Report of tests of a 36" LEFT HAND McCORMICK'S HOLYOKE turbine wheel.
No. 855, made June 29th, 1895.

Number of the experiment	Proportional part of		Head acting	Duration	Revolutions	Quantity of wa- ter discharged	Power	Efficiency
	the full opening of the speed gate.	the full discharge of the wheel.	on the wheel.	of the ex- periment.	of the wheel.	by the wheel.	developed by the wheel.	of the wheel.
	in per cent.		in feet.	in min.	per minute.	cubic ft. per sec.	H. P.	in per cent.
6	1.000	1.004	16.70	4	139.37	102.76	158.64	81.69
5	"	1.001	16.71	4	146.00	102.53	159.60	82.47
4	"	1.000	16.68	4	154.00	102.30	159.18	82.43
3	"	0.985	16.67	4	166.25	100.75	153.43	80.73
15	0.761	0.887	17.05	4	137.50	91.72	143.82	81.27
14	"	0.881	17.07	4	143.37	91.18	143.78	81.53
13	"	0.877	17.04	4	149.50	90.72	142.57	81.50
12	"	0.871	17.08	4	155.75	90.16	140.87	80.83
25	0.810	0.774	17.22	4	133.75	80.48	121.79	77.66
24	"	0.768	17.29	4	139.50	80.05	121.89	77.81
23	"	0.784	17.33	4	145.25	79.73	121.54	77.73
22	"	0.757	17.40	4	151.25	79.07	120.05	77.10
21	"	0.749	17.39	4	155.75	78.23	116.91	75.94
32	0.471	0.642	17.42	4	137.00	67.15	95.25	71.65
31	"	0.639	17.45	4	142.75	66.85	94.86	71.85
30	"	0.633	17.42	4	149.12	66.24	93.58	71.67
29	"	0.627	17.47	4	155.75	65.64	91.04	70.15
48	0.364	0.529	17.78	4	139.00	55.87	72.69	64.66
47	"	0.524	17.79	4	148.25	55.39	71.15	63.80
46	"	0.519	17.79	4	155.75	54.83	69.04	61.64

During the above experiments, the weight of the dynamometer, and of that portion of the shaft which was above the lowest coupling was

With the flume empty, a strain of 15 lbs., applied at a distance of 5.2 ft. from the centre of the shaft, sufficed to start the wheel.

HOLYOKE WATER POWER CO.
By *E. S. Waters* Hydraulic Engineer.
A. F. Lickman Engineer in charge of Experiments.

"JOLLY" GUARANTEES AT LEAST 80 PER CENT. EFFICIENCY

McCORMICK'S HOLYOKE TURBINE.

39-INCH WHEEL.			
Head.	Revolutions per Minute.	Discharge. Cubic feet per Minute.	Horse Power.
5	69	3898	29.4
6	76	4270	38.7
7	82	4612	48.8
8	87	4930	59.6
9	93	5229	71.1
10	98	5512	83.3
11	103	5781	96.1
12	107	6038	109.5
13	111	6285	123.5
14	116	6522	138.0
15	120	6751	153.0
16	124	6972	168.6
17	127	7187	184.6
18	131	7395	201.1
19	135	7598	218.1
20	138	7795	235.6
21	142	7988	253.5
22	145	8176	271.8
23	148	8359	290.5
24	151	8539	309.7
25	155	8715	329.2
26	158	8888	349.2
27	161	9057	369.5
28	164	9223	390.2
29	166	9387	411.3
30	169	9547	432.8
31	172	9705	454.6
32	175	9860	476.8
33	178	10013	499.3
34	180	10164	522.2
35	183	10312	545.4
36	186	10459	568.9
37	188	10603	592.8
38	191	10745	617.0
39	193	10885	641.5
40	196	11024	666.3

"JOLLY" GUARANTEES AT LEAST 80 PER CENT. EFFICIENCY

TESTING FLUME
OF THE
HOLYOKE WATER POWER CO.,
HOLYOKE, MASS.

Report of tests of a 39" R. H. McCORMICK turbine wheel.

No. 1267, made July 16th, 1902.

Tested on Special Draft-tube, Geo. H. Gilbert M'f'g. Co.

Number of the experiment	Proportional part of		Head acting on the wheel,	Revolutions of the wheel, per minute.	Quantity of water discharged by the wheel,	Power developed by the wheel,	Efficiency of the wheel.
	the full opening of the spiral gate,	the full discharge of the wheel,					
	in per cent.	in feet.	in feet.	in min.	in cu. ft. per sec.	H. P.	in per cent.
5	1.000	1.010	16.88	4	129.25	116.53	81.94
4	"	1.005	16.88	4	134.25	115.72	82.37
3	"	0.997	16.90	4	140.25	114.88	82.50
2	"	0.991	16.92	4	146.25	114.29	81.70
49	0.750	0.875	17.08	4	126.25	101.36	82.60
48	"	0.870	17.11	4	132.00	100.80	83.78
47	"	0.867	17.13	4	137.00	100.56	83.27
46	"	0.863	17.13	4	142.75	100.10	83.64
21	0.605	0.772	17.43	4	132.25	90.31	82.11
20	"	0.767	17.44	4	136.50	89.86	82.44
19	"	0.762	17.48	4	144.50	89.29	82.87
18	"	0.754	17.50	4	152.50	88.40	82.15
26	0.469	0.646	17.66	4	127.00	76.16	77.23
28	"	0.641	17.69	4	133.00	75.62	77.74
27	"	0.637	17.68	4	138.50	75.09	77.81
25	"	0.629	17.68	4	145.00	74.12	76.04
14	0.350	0.532	17.96	4	124.75	63.15	71.44
13	"	0.529	17.92	4	130.75	62.75	71.18
12	"	0.523	17.90	4	136.00	62.05	70.54
11	"	0.518	17.92	4	141.50	61.46	69.39

* During the above experiments, the weight of the dynamometer, and of that portion of the shaft which was above the lowest coupling was suspended by ball bearing.

With the flume empty, a strain of 12 lbs., applied at a distance of 3.1 ft. from the centre of the shaft, sufficed to start the wheel.

HOLYOKE WATER POWER CO.
By *E. J. Watson* Hydraulic Engineer.
A. F. Lockman Engineer in charge of Experiments.

"JOLLY" GUARANTEES AT LEAST 80 PER CENT. EFFICIENCY

TESTING FLUME OF THE HOLYOKE WATER POWER CO., HOLYOKE, MASS.

Report of tests of a 42" LEFT HAND Mc Cormick's HOLYOKE -- turbine wheel.

No. 732, made December 23d. 1893.

Tested for J. & W. Jolly.

Number of the experiment	Dependent part of the full opening of the spiral gate.	Discharge of the wheel, in cu. ft. per second.	Head, in feet.	Revolutions of the wheel, per minute.	Quantity of the water, in cu. ft. per second.	Power, developed by the wheel, in H.P.	Efficiency of the wheel, in per cent.
38	1.000	1.007	13.25	4	102.00	130.78	79.26
34	"	1.006	13.18	4	103.00	130.27	79.79
33	"	1.000	13.14	4	109.00	129.30	79.83
37	"	0.998	13.41	5	112.80	130.50	79.50
29	0.800	0.808	16.58	4	108.75	131.65	79.67
28	"	0.803	16.52	3	113.00	130.85	80.13
27	"	0.899	16.45	4	118.00	130.07	80.56
26	"	0.882	16.38	4	123.00	128.75	80.59
25	"	0.888	16.36	4	127.00	127.85	79.57
22	0.656	0.797	16.55	3	107.00	115.87	77.28
21	"	0.794	16.55	4	112.00	115.17	77.71
20	"	0.790	16.51	4	116.75	114.45	78.00
19	"	0.785	16.51	4	121.00	113.63	77.41
14	0.518	0.674	16.74	4	108.25	98.43	72.88
13	"	0.670	16.76	4	111.75	97.88	73.32
12	"	0.664	16.81	4	116.75	97.17	72.61
11	"	0.657	16.81	4	122.00	96.04	71.77
7	0.398	0.546	16.97	4	102.00	80.20	66.78
6	"	0.544	16.88	3	108.00	79.77	66.02
5	"	0.540	16.90	5	114.20	79.23	65.83

During the above experiments, the weight of the dynamometer, and of that portion of the shaft which was above the lowest coupling was 0 lbs. (Weight carried on a ball bearing.)

With the flume empty, a strain of 25 lbs., applied at a distance of 3.6 ft. from the centre of the shaft, sufficed to start the wheel.

A. F. Slickman

Engineer in charge of Experiments.

HOLYOKE WATER POWER CO.

E. H. Walker Hydraulic Engineer.

"JOLLY" GUARANTEES AT LEAST 80 PER CENT. EFFICIENCY

McCORMICK'S HOLYOKE TURBINE.

42-INCH WHEEL.			
Head.	Revolutions per Minute.	Discharge, Cubic feet per Minute.	Horse Power.
5	67	4786	36.2
6	74	5242	47.5
7	80	5662	59.9
8	85	6053	73.2
9	90	6421	87.3
10	95	6768	102.3
11	100	7098	118.0
12	104	7414	134.4
13	108	7717	151.6
14	112	8008	169.4
15	116	8289	187.9
16	120	8561	207.0
17	124	8824	226.7
18	128	9080	247.0
19	131	9329	267.8
20	134	9571	289.3
21	138	9808	311.2
22	141	10038	333.7
23	144	10264	356.7
24	147	10485	380.2
25	150	10701	404.2
26	153	10913	428.7
27	156	11121	453.7
28	159	11325	479.1
29	162	11525	505.0
30	165	11722	531.4
31	167	11916	558.2
32	170	12107	585.4
33	173	12294	613.1
34	175	12479	641.1
35	178	12661	669.6
36	180	12841	698.5
37	183	13018	727.8
38	185	13193	757.5
39	188	13365	787.6
40	190	13536	818.1

"JOLLY" GUARANTEES AT LEAST 80 PER CENT. EFFICIENCY

McCORMICK'S HOLYOKE TURBINE.

45-INCH WHEEL.			
Head.	Revolutions per Minute.	Discharge. Cubic feet per Minute.	Horse Power.
5	61	5096	38.5
6	67	5582	50.6
7	72	6030	63.8
8	77	6446	77.9
9	82	6837	93.0
10	87	7207	108.9
11	91	7558	125.6
12	95	7894	143.1
13	99	8217	161.4
14	102	8527	180.4
15	106	8826	200.1
16	109	9116	220.4
17	113	9396	241.4
18	116	9669	263.0
19	119	9934	285.2
20	122	10192	308.0
21	125	10443	331.4
22	128	10689	355.3
23	131	10929	379.8
24	134	11164	404.9
25	137	11395	430.5
26	139	11620	456.5
27	142	11842	483.1
28	145	12059	510.2
29	147	12272	537.8
30	150	12482	565.8
31	152	12689	594.4
32	155	12892	623.4
33	157	13091	652.8
34	160	13288	682.7
35	162	13482	713.0
36	164	13674	743.8
37	166	13862	775.2
38	169	14048	806.7
39	171	14232	838.7
40	173	14413	871.2

"JOLLY" GUARANTEES AT LEAST 80 PER CENT. EFFICIENCY

MCCORMICK'S HOLYOKE TURBINE.

48-INCH WHEEL.			
Head.	Revolutions per Minute.	Discharge. Cubic feet per Minute.	Horse Power.
5	55	5749	43.4
6	60	6298	57.1
7	65	6802	72.0
8	70	7272	87.9
9	74	7713	104.9
10	78	8130	122.9
11	82	8527	141.7
12	85	8906	161.5
13	89	9270	182.1
14	92	9620	203.5
15	95	9958	225.7
16	98	10284	248.6
17	101	10601	272.4
18	104	10908	296.7
19	107	11207	321.8
20	110	11498	347.5
21	113	11782	373.9
22	115	12059	400.9
23	118	12330	428.5
24	121	12595	456.8
25	123	12855	485.6
26	126	13110	515.0
27	128	13360	545.0
28	130	13605	575.6
29	133	13845	606.7
30	135	14082	638.4
31	137	14315	670.6
32	139	14544	703.3
33	141	14769	736.5
34	144	14992	770.2
35	146	15210	804.4
36	148	15426	839.2
37	150	15639	874.4
38	152	15849	910.0
39	154	16056	946.2
40	156	16261	982.8

"JOLLY" GUARANTEES AT LEAST 80 PER CENT. EFFICIENCY

TESTING FLUME

OF THE

HOLYOKE WATER POWER CO.,

HOLYOKE, MASS.

Report of tests of a 48" RIGHT HAND McCORMICK turbine wheel.

No. 1268, made July 18th & 19th, 1900.

Tested on Special Draft-tube.

G. H. Gilbert M'f'g. Co.

No. of test.	Proportional parts of		Head acting on the wheel.	Revolutions per minute.	Quantity of water discharged by the wheel.	Power developed by the wheel.	Efficiency of the wheel.
	the full opening of the draft pipe.	the full discharge of the wheel.					
in percent.			in feet.	in rpm.	in cubic feet per sec.	H. P.	in percent.
34	1.000	1.012	15.83	4	168.00	180.58	82.37
33	"	1.008	15.82	4	102.50	179.74	83.37
32	"	1.001	15.82	4	108.25	178.58	83.59
31	"	0.996	15.84	4	110.37	177.75	83.69
30	"	0.998	15.88	2	114.50	176.59	82.66
36	0.879	0.846	15.75	4	102.00	168.69	84.02
38	"	0.844	15.79	4	105.75	168.29	83.91
37	"	0.838	15.86	4	110.75	167.45	83.42
46	0.750	0.870	16.17	4	102.60	156.80	82.51
45	"	0.866	16.07	4	105.75	155.65	83.05
44	"	0.861	16.07	4	108.75	154.75	82.48
43	"	0.851	16.13	4	112.75	153.37	81.59
7	0.633	0.775	16.27	4	101.12	140.24	80.63
6	"	0.770	16.29	4	105.50	139.30	80.99
5	"	0.762	16.32	4	109.12	138.02	80.47
4	"	0.752	16.37	4	113.00	136.46	79.51
14	0.485	0.637	16.83	4	100.25	117.15	76.36
13	"	0.631	16.82	4	104.75	116.06	76.39
12	"	0.624	16.89	4	110.00	115.08	75.47
11	"	0.620	16.91	4	113.25	114.36	73.17

During the above experiments, the weight of the dynamometer, and of that portion of the shaft which was above the lowest coupling was suspended by ball bearing.

With the flume empty, a strain of 16 lbs., applied at a distance of 3.6 ft. from the center of the shaft, sufficed to start the wheel.

HOLYOKE WATER POWER CO.
E. J. Waters Hydraulic Engineer.

A. F. Lickman Engineer in charge of Experiments.

"JOLLY" GUARANTEES AT LEAST 80 PER CENT. EFFICIENCY

MCCORMICK'S HOLYOKE TURBINE.

51-INCH WHEEL.			
Head.	Revolutions per Minute.	Discharge. Cubic feet per Minute.	Horse Power.
5	56	6545	49.5
6	61	7170	65.0
7	66	7745	81.9
8	70	8279	100.1
9	75	8782	119.4
10	79	9257	139.9
11	82	9708	161.4
12	86	10140	183.9
13	90	10554	207.3
14	93	10952	231.7
15	96	11337	257.0
16	99	11709	283.1
17	103	12069	310.0
18	106	12419	337.8
19	108	12759	366.3
20	111	13091	395.6
21	114	13414	425.7
22	117	13730	456.4
23	119	14038	487.9
24	122	14340	520.0
25	124	14636	552.9
26	127	14926	586.4
27	129	15210	620.5
28	132	15489	655.3
29	134	15763	690.8
30	136	16033	726.8
31	138	16298	763.4
32	141	16559	800.7
33	143	16815	838.5
34	145	17068	876.9
35	147	17317	915.9
36	149	17563	955.4
37	151	17805	995.5
38	153	18044	1036.1
39	155	18280	1077.3
40	157	18513	1119.0

"JOLLY" GUARANTEES AT LEAST 80 PER CENT. EFFICIENCY

TESTING FLUME OF THE HOLYOKE WATER POWER CO. HOLYOKE, MASS.

Report of tests of a 51" L. H. McCOMBICK'S HOLYOKE - turbine wheel
No. 489, made June 28th, 1890.

Number of the experiments	Proportional gate of		Head water	Duration	Revolutions	Quantity of water discharged	Power	Efficiency
	the full opening of the gate	the full discharge of the wheel, being the discharge at full gate when gating, and when gating	in the wheel	in minutes	of the wheel	by the wheel	developed by the wheel	of the wheel
	in per cent		in feet	in min.	per minute	cubic ft. per sec.	H P.	in per cent
33	1.000	1.016	11.53	4	76.50	169.35	185.47	83.51
32	"	1.009	11.58	8	80.50	167.50	184.73	84.15
31	"	1.001	11.62	3	84.50	166.50	185.17	84.56
30	"	0.889	11.68	4	88.62	164.95	183.40	84.11
29	"	0.979	11.74	3	92.17	165.60	179.53	82.59
8	0.818	0.802	12.96	3	83.17	158.40	197.44	84.98
5	"	0.895	12.99	4	87.62	157.32	197.34	85.32
4	"	0.887	13.02	4	92.00	156.10	196.00	85.21
3	"	0.880	12.84	4	94.00	155.89	188.62	84.43
27	0.685	0.803	13.11	4	77.75	141.78	170.37	80.99
26	"	0.797	13.09	4	83.00	140.72	171.77	82.39
25	"	0.790	13.10	4	87.25	139.42	169.95	82.21
24	"	0.782	13.10	4	92.00	138.01	168.00	82.10
18	0.554	0.677	13.17	4	88.00	119.80	159.27	77.99
20	"	0.688	13.26	4	76.75	122.30	140.15	76.36
19	"	0.684	13.14	5	82.00	120.92	139.76	77.72
17	"	0.688	13.25	4	93.00	118.28	135.86	76.59
13	0.414	0.546	13.91	4	78.75	99.30	110.25	70.52
12	"	0.542	13.95	4	84.25	98.72	110.26	70.64
11	"	0.537	13.91	4	89.50	97.70	108.96	70.84

During the above experiments, the weight of the dynamometer, and of that portion of the shaft which lay above the lowest coupling was 5,700 lbs.

With the flume empty, a strain of 40 lbs., applied at a distance of 3.2 ft. from the center of the shaft, sufficed to start the wheel.

HOLYOKE WATER POWER CO.
A. F. Sickman Eng'r in charge of Expts. By E. P. Waters Bldg. Eng'r.

"JOLLY" GUARANTEES AT LEAST 80 PER CENT. EFFICIENCY

TESTING FLUME
OF THE
HOLYOKE WATER POWER CO.,
HOLYOKE, MASS.

Report of tests of a 54" LEFT HAND McCORMICK turbine wheel
No. 1288, made October 9th, 1900.

Tested on Conical Draft-tube.

Tested for J. & W. Jolly.

Number of the experiments	Proportional part of		Head acting on the wheel	Revolutions of the per minute	Revolutions of the wheel	Quantity of wa- ter discharged by the wheel	Power developed by the wheel	Efficiency of the wheel
	The full opening of the spiral gate	The full discharge of the wheel	in feet	in min.	per minute	in cu. ft. per sec.	H. P.	in per cent.
21	1.000	1.005	13.28	4	88.37	216.31	272.48	85.90
20	"	1.001	13.33	4	84.75	215.72	270.61	84.92
24	"	1.000	13.20	4	96.62	214.48	272.25	84.89
19	"	0.993	13.39	3	100.67	214.60	275.58	83.99
16	0.800	0.903	13.95	4	84.75	199.15	266.40	84.66
15	"	0.899	13.96	4	89.12	198.25	268.22	84.62
14	"	0.887	14.04	4	94.62	196.30	263.58	84.37
13	"	0.872	14.21	5	99.30	194.11	256.18	82.00
11	0.649	0.776	14.74	4	83.25	175.81	231.73	78.65
10	"	0.774	14.78	4	89.33	175.81	239.56	81.39
9	"	0.767	14.87	4	93.37	174.56	237.71	80.55
8	"	0.755	14.93	4	97.50	172.32	231.68	79.50
5	0.466	0.638	15.55	5	86.80	148.51	192.70	73.67
4	"	0.639	15.57	4	90.62	148.80	193.80	73.80
3	"	0.629	15.60	4	95.25	146.75	194.00	74.81
2	"	0.623	15.65	4	100.50	145.57	191.05	74.04
37	0.577	0.614	16.18	4	88.75	122.17	150.63	67.28
36	"	0.509	16.19	4	95.00	120.91	148.34	66.90
38	"	0.508	16.17	4	100.25	120.05	142.83	65.00
35	"	0.501	16.19	4	105.50	118.63	136.09	62.40

During the above experiments, the weight of the dynamometer, and of that portion of the shaft which was above the lowest coupling was suspended by ball bearing.

With the flume empty, a strain of 30 lbs., applied at a distance of 3.6 ft. from the centre of the shaft, sufficed to start the wheel.

HOLYOKE WATER POWER CO.
By *E. J. Waters* Hydraulic Engineer.
A. F. Sickman Engineer in charge of Experiments.

"JOLLY" GUARANTEES AT LEAST 80 PER CENT. EFFICIENCY

MCCORMICK'S HOLYOKE TURBINE.

57-INCH WHEEL.			
Head.	Revolutions per Minute.	Discharge. Cubic feet per Minute.	Horse Power.
5	50	8646	65.3
6	55	9472	85.9
7	59	10231	108.2
8	63	10937	132.2
9	67	11601	157.8
10	70	12228	184.8
11	74	12825	213.2
12	77	13395	242.9
13	80	13942	273.9
14	83	14468	306.1
15	86	14976	339.4
16	89	15467	374.0
17	92	15943	409.6
18	94	16406	446.2
19	97	16855	483.9
20	100	17293	522.6
21	102	17720	562.3
22	104	18137	602.9
23	107	18545	644.5
24	109	18944	687.0
25	111	19334	730.4
26	113	19717	774.6
27	116	20093	819.7
28	118	20461	865.7
29	120	20824	912.5
30	122	21179	960.1
31	124	21530	1008.5
32	126	21874	1057.7
33	128	22213	1107.6
34	130	22547	1158.4
35	132	22876	1209.9
36	134	23201	1262.1
37	135	23521	1315.0
38	137	23837	1368.7
39	139	24148	1423.1
40	141	24456	1478.2

"JOLLY" GUARANTEES AT LEAST 80 PER CENT. EFFICIENCY

TESTING FLUME
OF THE
HOLYOKE WATER POWER CO.
HOLYOKE, MASS.

Report of tests of a 57" RIGHT HAND McCORMICK'S HOLYOKE turbine wheel.

No. 1140, made September 13th, 1898.

Tested on Conical Cylinder.				Tested for J. & W. Jolly.				
Number of the experiment	Proportional part of		Head water on the wheel.	Diameter of the ex- periment.	Revolutions of the wheel.	Quantity of wa- ter discharged by the wheel.	Power	
	the opening of the aperture.	the full discharge of the wheel.					developed by the wheel.	of the wheel.
	in per cent.		in feet.	in inches.	per minute.	cubic ft. per sec.	H. P.	in per cent.
53	1.000	1.006	13.78	4	82.37	244.72	308.48	80.70
52	"	1.002	13.79	5	85.90	243.92	311.19	81.70
51	"	0.998	13.81	4	89.00	245.12	310.32	81.83
50	"	0.994	13.83	4	91.75	242.32	306.68	81.35
43	0.756	0.869	14.50	4	83.37	217.60	295.79	82.29
42	"	0.865	14.60	"	86.75	216.67	295.99	82.64
41	"	0.861	14.62	4	90.00	215.77	294.84	82.55
40	"	0.856	14.58	4	92.62	214.26	290.84	82.23
33	0.597	0.740	15.28	4	83.25	189.69	259.72	79.14
32	"	0.737	15.26	4	86.75	188.67	256.84	79.40
31	"	0.731	15.30	4	90.12	187.34	256.03	78.89
30	"	0.724	15.35	4	93.75	185.92	252.33	78.06
23	0.477	0.623	15.80	4	84.75	162.22	214.28	75.84
22	"	0.610	15.75	4	87.25	161.13	211.71	75.68
21	"	0.614	15.77	4	90.50	159.92	209.14	75.24
20	"	0.610	15.83	4	94.62	159.10	205.79	72.17
14	0.356	0.495	16.34	4	87.12	131.07	161.05	66.42
13	"	0.492	16.38	5	91.00	130.54	158.96	65.66
12	"	0.489	16.39	4	95.25	129.90	155.37	64.46
11	"	0.486	16.56	4	100.25	129.54	149.90	61.72

During the above experiments, the weight of the dynamometer, and of that portion of the shaft which was above the lowest coupling was suspended by ball bearing.

With the flume empty, a strain of 18 lbs., applied at a distance of 3.6 ft. from the centre of the shaft, sufficed to start the wheel.

HOLYOKE WATER POWER CO.
By *E. J. Water* Hydraulic Engineer.
A. F. Sickman Engineer in charge of Experiments.

"JOLLY" GUARANTEES AT LEAST 80 PER CENT. EFFICIENCY

McCORMICK'S HOLYOKE TURBINE.

60-INCH WHEEL.			
Head.	Revolutions per Minute.	Discharge, Cubic feet per Minute.	Horse Power.
5	46	9059	68.4
6	50	9924	90.0
7	54	10719	113.4
8	58	11459	138.5
9	62	12154	165.3
10	65	12812	193.6
11	68	13437	223.3
12	71	14035	254.5
13	74	14608	286.9
14	77	15159	320.7
15	79	15691	355.7
16	82	16206	391.8
17	85	16704	429.1
18	87	17189	467.5
19	89	17660	507.0
20	92	18119	547.6
21	94	18566	589.1
22	96	19003	631.7
23	98	19430	675.3
24	101	19848	719.8
25	103	20257	765.2
26	105	20658	811.6
27	107	21052	858.9
28	109	21438	907.0
29	111	21818	956.1
30	112	22191	1005.9
31	114	22557	1056.7
32	116	22918	1108.2
33	118	23274	1160.5
34	120	23624	1213.7
35	121	23969	1267.6
36	123	24309	1322.3
37	125	24644	1377.8
38	127	24975	1434.1
39	128	25301	1491.0
40	130	25624	1548.7

This wheel is too large to be tested in the Holyoke Water Power Co.'s Testing Flume, therefore we cannot produce test of this excellent wheel.

Following are a few Official Tests
made to meet special conditions of
Speed and Power.

Send us your requirements.

We make a specialty of low speed
wheels for factories and high speed
wheels for direct connected Electric
Light and Power installation.

TESTING FLUME
OF THE
HOLYOKE WATER POWER CO.,
HOLYOKE, MASS.

Report of tests of a 21" L. H. SPECIAL McCORMICK'S HOLYOKE turbine wheel.

No. 978, made January 22d, 1897.

Tested for J. & W. Jolly.

Tested on Special Draft-tube.

Number of the experiment	Dimensions of part of		Head acting on the wheel.	Diameter of the jet.	Revolutions of the wheel.	Quantity of water discharged by the wheel.	Power developed by the wheel.	Efficiency of the wheel.
	the full opening of the spiral gate.	the full discharge of the wheel.						
	in feet.		in feet.	in inches.	per minute.	cubic ft. per sec.	H. P.	in per cent.
5	1.000	1.011	16.65	4	246.50	27.29	43.37	84.17
6	"	1.006	16.64	4	257.25	27.13	43.50	84.96
7	"	1.000	16.65	4	268.25	27.00	43.62	85.36
8	"	0.996	16.65	4	262.50	26.89	43.25	85.19
34	0.743	0.877	16.50	4	246.00	23.55	36.84	83.59
33	"	0.872	16.54	4	262.50	23.46	37.19	84.51
32	"	0.866	16.54	4	273.50	23.29	36.87	84.40
31	"	0.859	16.57	3	283.07	23.12	36.30	83.55
17	0.645	0.803	16.75	4	241.00	21.73	33.04	80.05
16	"	0.800	16.85	4	253.75	21.73	33.63	80.99
15	"	0.795	16.84	4	268.50	21.59	33.74	81.84
14	"	0.786	16.83	4	278.50	21.34	33.09	81.24
22	0.497	0.670	16.80	4	241.75	18.17	25.41	73.40
21	"	0.665	16.82	4	255.50	18.05	25.69	74.61
20	"	0.659	16.87	4	269.00	17.91	25.42	75.34
19	"	0.654	16.86	4	279.50	17.77	25.55	75.19
28	0.363	0.529	16.92	4	245.75	14.40	19.09	69.10
27	"	0.524	16.96	4	257.25	14.28	19.81	69.49
26	"	0.519	17.01	4	268.50	14.15	19.41	67.43
25	"	0.514	16.99	4	277.00	14.01	17.72	65.65

During the above experiments, the weight of the dynamometer, and of that portion of the shaft which was above the lowest coupling was 1296 lbs.

With the flume empty, a strain of 1 lb., applied at a distance of 2.4 ft. from the centre of the shaft, sufficed to start the wheel.

HOLYOKE WATER POWER CO.
E. J. Waters, Hydraulic Engineer.

A. F. Lickman, Engineer in charge of Experiments.

"JOLLY" GUARANTEES AT LEAST 80 PER CENT. EFFICIENCY

TESTING FLUME OF THE HOLYOKE WATER POWER CO., HOLYOKE, MASS.

Report of tests of a 21" L. H. SPECIAL McCORMICK'S HOLYOKE turbine wheel.
No. 837, made April 8th, 1895.

Tested for J. & W. Jolly.

Revolutions of the engine.	Experimental period		Discharge in cu. ft. per sec.	Head in ft.	Horse power developed by the wheel.	Quantity of water discharged by the wheel.	Power developed by the wheel.	Efficiency in per cent.
	Beginning of the specimen	End of discharge of the specimen						
	in seconds		in ft.	in ft.	in horse power	in cubic feet per sec.	in ft.	in per cent.
6	1.000	1.005	16.63	5	206.00	55.80	57.62	83.10
5	"	1.006	16.62	4	215.25	55.80	88.03	83.56
4	"	1.005	16.61	4	224.00	55.85	88.47	84.08
3	"	0.997	16.61	4	233.75	55.41	88.06	84.35
2	"	0.992	16.63	4	245.25	55.15	83.43	83.09
13	0.792	0.898	16.76	4	219.00	50.15	79.17	82.95
12	"	0.893	16.76	4	226.50	49.69	78.44	82.57
11	"	0.889	16.80	4	231.75	49.70	77.45	81.78
10	"	0.884	16.82	5	237.20	49.43	76.38	81.00
21	0.649	0.803	17.04	4	214.75	45.21	70.46	80.64
20	"	0.801	17.04	4	222.75	45.06	70.38	80.82
19	"	0.797	17.04	5	230.00	44.84	69.87	80.63
18	"	0.792	17.03	4	240.50	44.55	68.68	79.81
27	0.500	0.669	17.16	4	216.00	37.81	64.47	74.01
26	"	0.666	17.15	4	224.50	37.83	64.53	74.54
25	"	0.664	17.15	4	233.00	37.50	63.80	73.75
24	"	0.659	17.17	4	240.75	37.23	62.66	72.63
35	0.378	0.547	17.42	4	216.50	31.13	41.44	67.37
34	"	0.544	17.45	4	225.00	30.97	41.01	66.91
33	"	0.542	17.44	4	230.00	30.84	39.83	65.26

During the above experiments, the weight of the dynamometer, and of that portion of the shaft which was above the lowest coupling was 2600 lbs.

With the flume empty, a strain of 23 lbs. applied at a distance of 3.2 ft. from the centre of the shaft, sufficed to start the wheel.

HOLYOKE WATER POWER CO.
By E. J. Waters Hydraulic Engineer.

A. F. Sickman Engineer in charge of Experiments.

"JOLLY" GUARANTEES AT LEAST 80 PER CENT. EFFICIENCY

TESTING FLUME OF THE HOLYOKE WATER POWER CO., HOLYOKE, MASS.

Report of tests of a 30" L. H. SPECIAL McCORMICK'S HOLYOKE turbine wheel.

No. 1070 made June 28th, 1898. Case #1118.

This wheel for Hampshire Paper Co. Tested on Special Draft-tube.

Number of the experiment	Proportional part of		Head water	Direction	Revolutions	Quantity of water	Power	Efficiency
	the full opening to the speed gate	the full discharge of the wheel	on the wheel	of the ex- periment	of the wheel	discharged by the wheel	developed by the wheel	of the wheel
	in per cent.		in feet	in min.	per minute	in cu. ft. per sec.	H. P.	in per cent.
9	1.000	1.015	16.43	4	127.25	92.81	148.96	84.56
8	"	1.007	16.48	4	132.75	92.20	148.66	85.21
7	"	1.000	16.51	4	137.75	91.66	146.17	85.33
6	"	0.993	16.54	4	142.75	91.05	145.36	85.28
5	"	0.985	16.58	4	148.00	90.42	144.34	85.06
17	0.840	0.933	16.59	5	127.20	85.73	136.54	84.81
16	"	0.926	16.59	4	132.37	85.04	136.40	85.41
15	"	0.920	16.59	4	137.50	84.52	135.78	85.55
14	"	0.914	16.61	5	142.60	83.98	134.70	85.31
25	0.680	0.817	16.76	4	130.25	75.38	119.04	83.24
24	"	0.811	16.78	4	135.26	74.86	118.63	83.40
23	"	0.803	16.80	4	140.60	74.23	117.20	83.03
22	"	0.794	16.82	4	146.75	73.40	115.21	82.44
34	0.520	0.690	17.08	4	127.75	64.29	97.18	78.17
33	"	0.684	17.08	4	133.26	63.73	96.44	78.27
32	"	0.677	17.05	4	138.00	63.07	94.80	77.88
31	"	0.670	17.08	4	143.50	62.48	93.30	77.24
42	0.360	0.527	17.32	4	128.00	49.41	67.24	69.41
41	"	0.521	17.32	4	131.50	48.90	66.14	68.86
40	"	0.515	17.36	4	137.50	48.41	64.64	68.27

During the above experiments, the weight of the dynamometer, and of that portion of the shaft which was above the lowest coupling was suspended by ball bearing.

With the flume empty, a strain of 5 lbs., applied at a distance of 3.2 ft. from the centre of the shaft, sufficed to start the wheel.

HOLYOKE WATER POWER CO.

By *E. J. Waters* Hydraulic Engineer.

A. F. Sickman Engineer in charge of Experiments.

"JOLLY" GUARANTEES AT LEAST 80 PER CENT. EFFICIENCY

TESTING FLUME OF THE HOLYOKE WATER POWER CO.,

HOLYOKE, MASS.

Report of tests of a 42" RIGHT HAND McCORMICK'S HOLYOKE turbine wheel.
No. 908, made April 18th. 1896.

Tested with Special Case.

Number of the experiment	Discharge per sec.		Head at inlet	Rotation	Revolutions	Quantity of water discharged	Power	Efficiency
	(the full opening of the spillage gate)	(the full discharge of the wheel)	on the wheel	of the ex- periment	of the wheel	by the wheel	developed by the wheel	(the wheel)
	cu. ft. per sec.	cu. ft.	ft.	rev. per min.	per sec.	cu. ft. per sec.	H. P.	per cent.
28	1.000	1.001	16.11	4	121.75	155.67	223.16	76.46
27	"	1.000	16.03	4	126.75	155.15	222.97	79.05
26	"	0.999	16.00	4	131.37	154.85	222.21	79.08
25	"	0.995	16.04	4	136.75	154.47	220.37	78.42
20	0.736	0.815	16.54	4	117.75	128.39	204.96	85.10
19	"	0.808	16.61	4	121.75	127.62	204.44	85.04
18	"	0.800	16.68	4	124.87	126.62	202.00	84.33
17	"	0.791	16.74	4	128.75	125.55	198.77	83.62
16	"	0.780	16.86	4	132.75	124.10	195.15	82.24
53	0.667	0.736	16.86	4	118.00	117.15	187.25	83.59
52	"	0.727	16.89	5	121.60	115.82	183.99	82.93
51	"	0.718	16.94	4	126.25	114.48	181.71	82.62
50	"	0.708	17.02	4	129.75	113.25	177.17	81.04
43	0.589	0.639	16.84	4	115.75	101.55	154.49	79.66
42	"	0.633	16.70	4	118.25	100.28	150.56	79.27
41	"	0.623	16.79	4	122.75	98.80	148.74	78.98
40	"	0.613	17.05	4	129.25	98.00	148.66	78.36
34	0.477	0.555	17.69	4	119.00	87.23	131.72	75.26
33	"	0.530	17.71	4	124.00	85.46	129.08	74.66
32	"	0.524	17.68	4	129.00	85.47	126.95	74.03

During the above experiments, the weight of the dynamometer, and of that portion of the shaft which was above the lowest coupling was **suspended by ball bearing.**

With the flume empty, a strain of 20 lbs., applied at a distance of 3.2 ft. from the centre of the shaft, sufficed to start the wheel.

HOLYOKE WATER POWER CO.
By *E. J. Water* Hydraulic Engineer.
A. F. Sickman Engineer in charge of Experiments.

"JOLLY" GUARANTEES AT LEAST 80 PER CENT. EFFICIENCY

TESTING FLUME
OF THE
HOLYOKE WATER POWER CO.,
HOLYOKE, MASS.

Report of tests of a 45° R. H. SPECIAL McCORMICK'S HOLYOKE turbine wheel.

No. 850, made June 10th, 1895.

Built by J. & W. Jolly.

Number of the experiment	Proportional part of the full opening of the spiral gate		Head water in the wheel	Duration of the run in seconds	Revolutions of the wheel	Quantity of water discharged by the wheel	Power developed by the wheel	Efficiency of the wheel
	in per cent.		in feet	in min.	per minute	cubic ft. per sec.	H. P.	in per cent.
7	1.000	1.013	16.50	5	114.00	111.35	176.22	84.72
8	"	1.007	16.23	4	116.00	109.78	172.16	85.35
5	"	1.000	16.23	4	120.37	109.05	171.24	85.45
4	"	0.994	16.23	4	124.50	108.45	169.45	85.04
15	0.783	0.894	16.68	4	111.50	98.85	155.87	85.52
14	"	0.888	16.67	4	115.50	98.14	154.55	85.34
13	"	0.882	16.67	4	120.00	97.46	152.97	85.17
12	"	0.875	16.65	4	125.50	96.67	150.71	82.71
23	0.612	0.765	17.18	4	109.75	85.85	131.84	79.02
22	"	0.758	17.17	4	113.75	85.08	131.00	79.21
21	"	0.751	17.14	4	118.75	84.21	128.71	78.77
20	"	0.746	16.97	4	122.75	83.22	124.73	78.02
31	0.503	0.665	17.31	4	107.00	74.88	109.39	74.55
30	"	0.658	17.34	4	113.50	74.13	109.04	74.93
29	"	0.651	17.36	4	118.50	73.40	107.28	74.37
28	"	0.643	17.38	4	123.75	72.66	104.41	73.13
38	0.373	0.535	17.59	4	109.75	60.75	82.46	68.16
37	"	0.531	17.53	4	115.25	60.18	81.62	68.34
36	"	0.526	17.54	4	120.00	59.69	79.81	67.34
35	"	0.520	17.55	4	125.00	59.00	76.98	65.67

During the above experiments, the weight of the dynamometer, and of the portion of the shaft which was above the lowest coupling was

With the flume empty, a strain of 20 lbs., applied at a distance of 3.2 ft. from the centre of the shaft, sufficed to start the wheel.

HOLYOKE WATER POWER CO.
By *E. S. Water* Hydraulic Engineer.
A. F. Sickman Engineer in charge of Experiments.

"JOLLY" GUARANTEES AT LEAST 80 PER CENT. EFFICIENCY

TESTING FLUME
OF THE
HOLYOKE WATER POWER CO.,
HOLYOKE, MASS.

Report of tests of a 57" LEFT HAND SPECIAL MCCORMICK turbine wheel.

No. 1703, made June 22-23, 1906.

Tested for J. & W. Jolly.

Swing-gate.

Conical draft-tube.

Number of the experiment	Proportional part of		Head acting on the wheel	Diameter of the ex- periment wheel	Revolutions of the wheel	Quantity of wa- ter discharged by the wheel	Power developed by the wheel	Efficiency of the wheel
	the full opening of the spill gate	the full discharge of the wheel						
	1 per cent.		in feet.	in ins.	per minute.	cubic ft. per sec.	H. P.	in per cent.
55	1.000	1.000	12.80	4	93.50	254.78	231.18	76.88
58	"	1.000	12.79	4	97.00	254.61	232.23	79.20
54	"	1.001	12.82	4	100.80	255.12	232.57	79.04
50	0.980	0.971	13.63	4	93.25	253.04	325.12	79.91
49	"	0.970	13.91	4	95.75	257.55	324.12	79.93
46	"	0.971	13.84	4	96.50	257.24	323.42	80.25
47	"	0.972	13.81	3	103.87	257.07	322.85	80.35
42	0.920	0.941	12.86	4	94.00	249.40	316.19	81.32
44	"	0.939	13.88	4	97.25	248.95	319.32	81.64
41	"	0.939	13.87	3	100.33	248.95	319.24	81.68
36	0.840	0.890	14.15	4	92.25	238.38	315.39	82.60
33	"	0.886	14.16	4	96.75	237.30	314.40	82.66
34	"	0.877	14.23	4	100.75	238.58	310.35	81.87
29	0.760	0.822	14.03	4	90.25	224.30	308.55	82.78
26	"	0.814	14.74	4	94.25	222.50	308.28	82.40
27	"	0.803	14.85	4	97.50	220.40	300.34	81.07
22	0.680	0.745	15.11	4	88.25	206.23	263.79	80.46
21	"	0.736	15.12	4	92.50	204.03	261.60	80.38
15	0.600	0.656	15.65	4	90.75	164.80	254.97	77.88
14	"	0.638	15.73	4	96.25	160.20	250.87	78.13

During the above experiments, the weight of the dynamometer, and of that portion of the shaft which was above the lowest coupling was suspended by ball bearing.

With the flume empty, a strain of lbs., applied at a distance of ft. from the centre of the shaft, sufficed to start the wheel.

HOLYOKE WATER POWER CO.

By A. F. Slickman Hydraulic Engineer.

H. C. Layford Engineer in charge of Experiments.

"JOLLY" GUARANTEES AT LEAST 80 PER CENT. EFFICIENCY

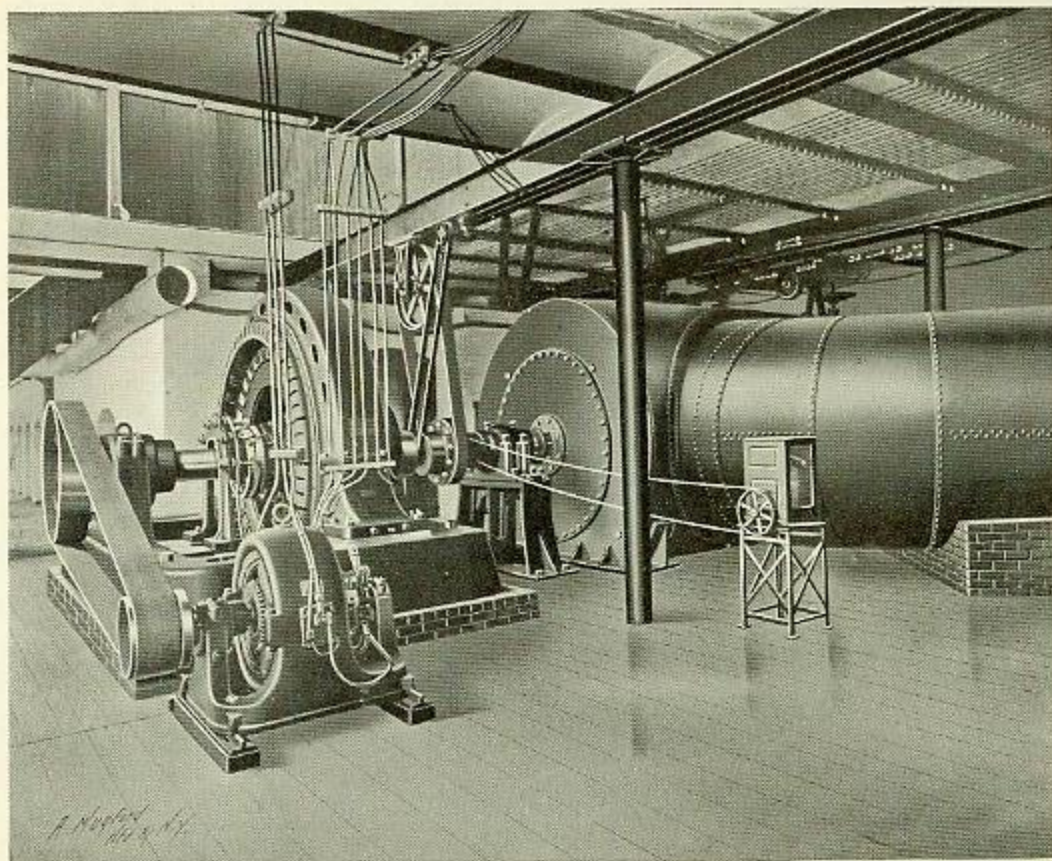


PLATE 5. Represents one of four pair 36 inch horizontal McCormick "Holyoke" Turbines installed at Indian Orchard for the United Electric Light Company of Springfield, Mass., developing 3712 H. P. under 35 foot head.

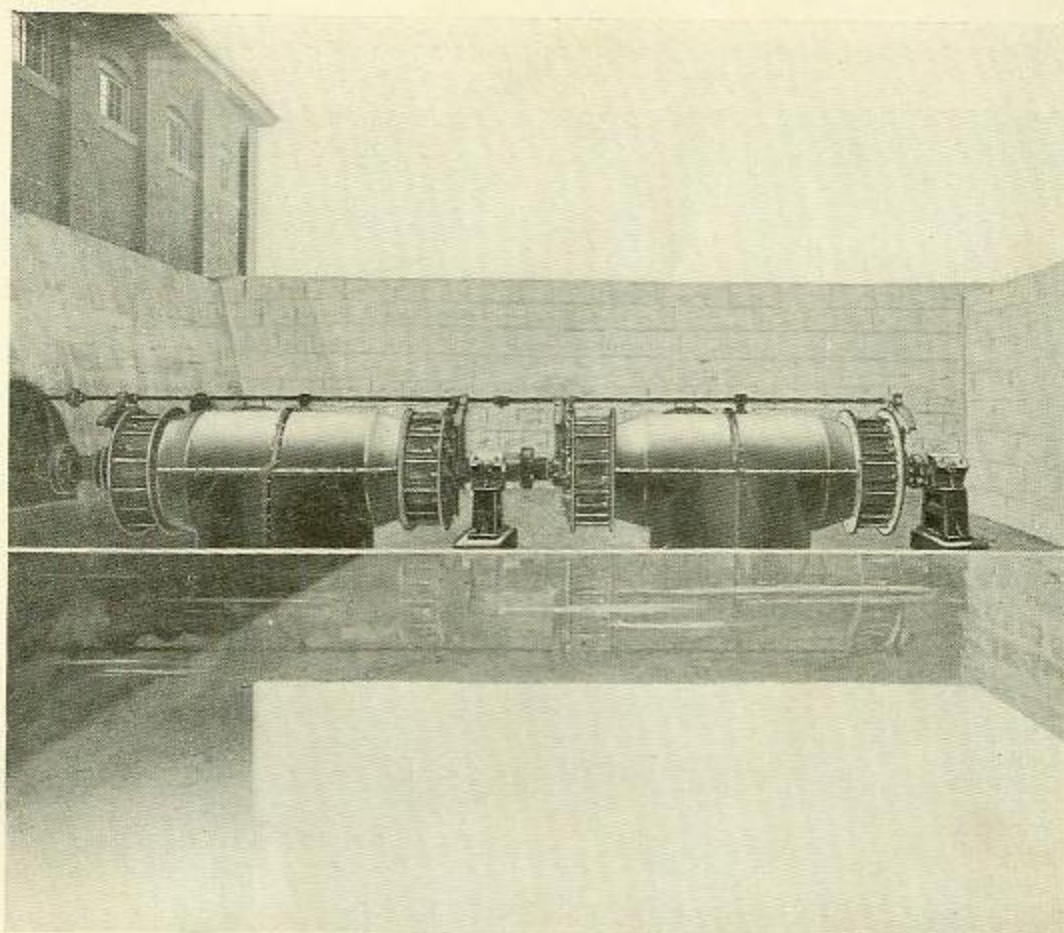


PLATE 6. This cut shows one unit consisting of four 39 inch McCormick "Holyoke" Turbines, two such units being installed at the Birchem Bend Plant of the United Electric Light Company, Springfield, Mass., and developing 1400 H. P. under 24 foot head.

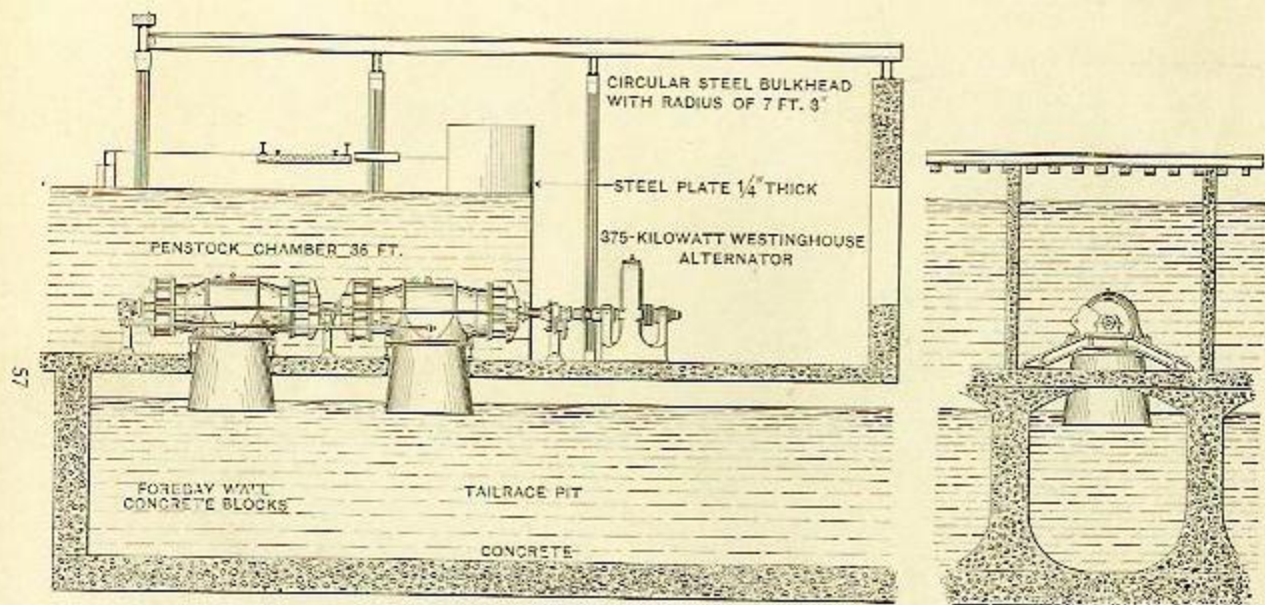


Plate 7

This shows a cross and longitudinal section of one unit, consisting of four 33 inch Special High Speed Horizontal McCormick "Holyoke" Turbines direct connected to generators, 40 units having been installed at the Sault St. Marie plant of the Michigan Lake Superior Power Company, developing 45120 H. P. under 16 foot head at 180 revolutions per minute.

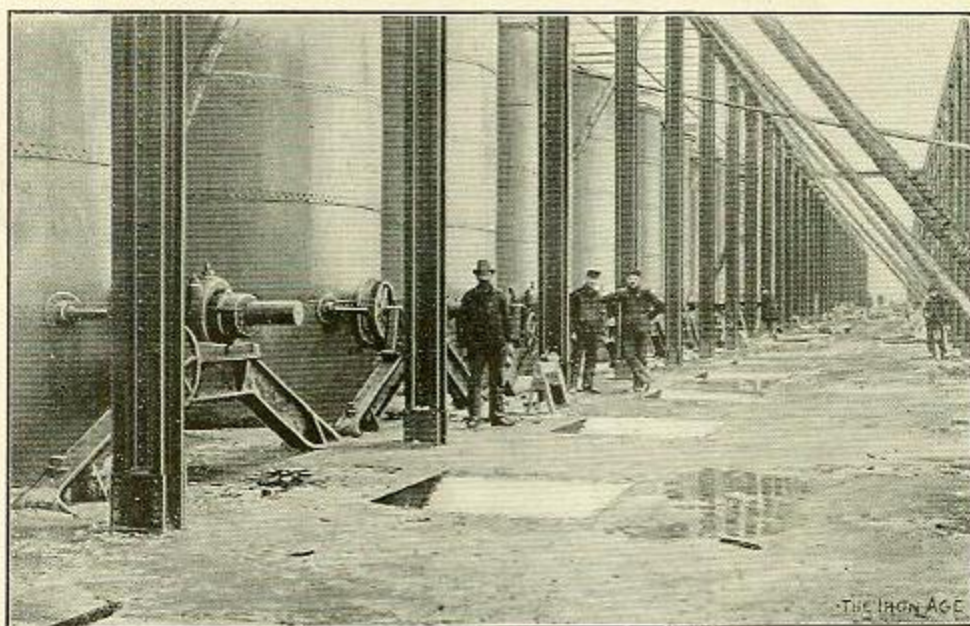


Plate 10

Another view of Sault St. Marie plant nearing completion.

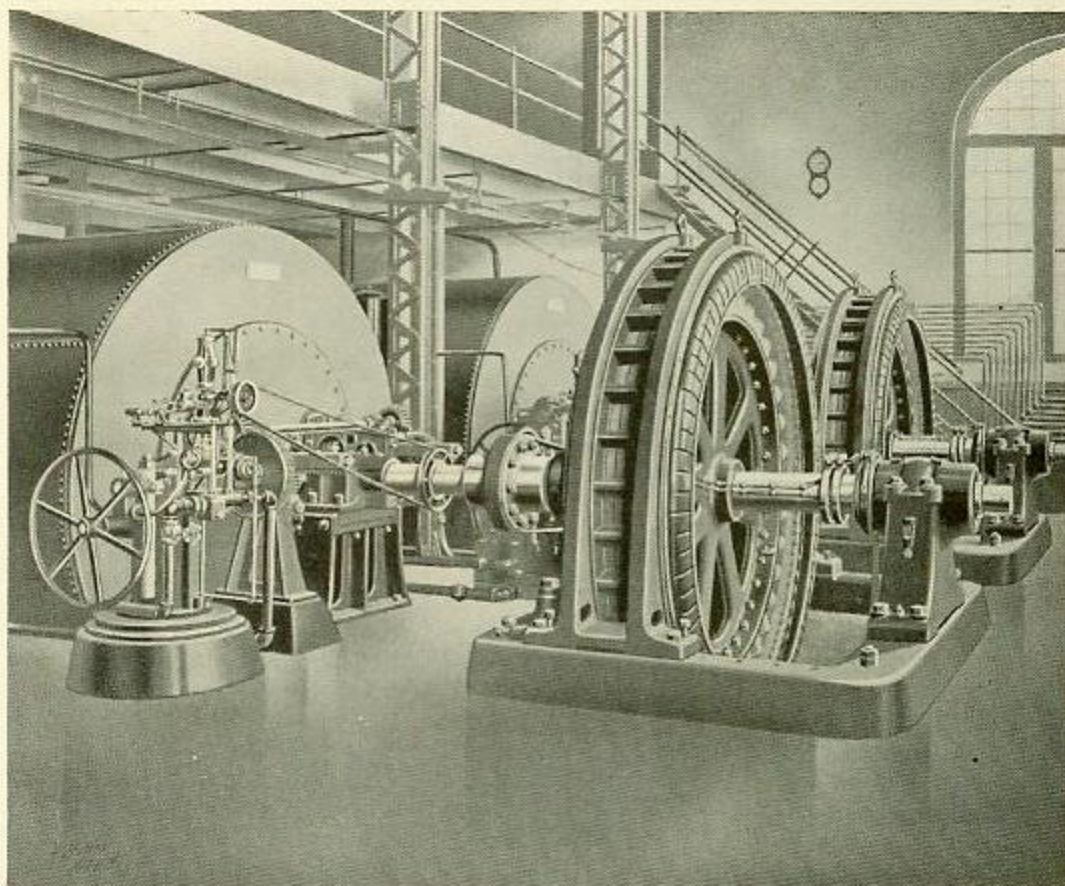


PLATE 11. Represents one of the finest direct connected installations in the country. It consists of two units, each unit consisting of two 39 inch Special High Speed Horizontal M. Cormick "Holyoke" Turbines, developing 2200 H. P. under 30 foot head, running at 220 revolutions per minute, with provision for a third unit to develop 3300 H. P., installed at the power station of the Holyoke Water Power Co., Holyoke, Mass.

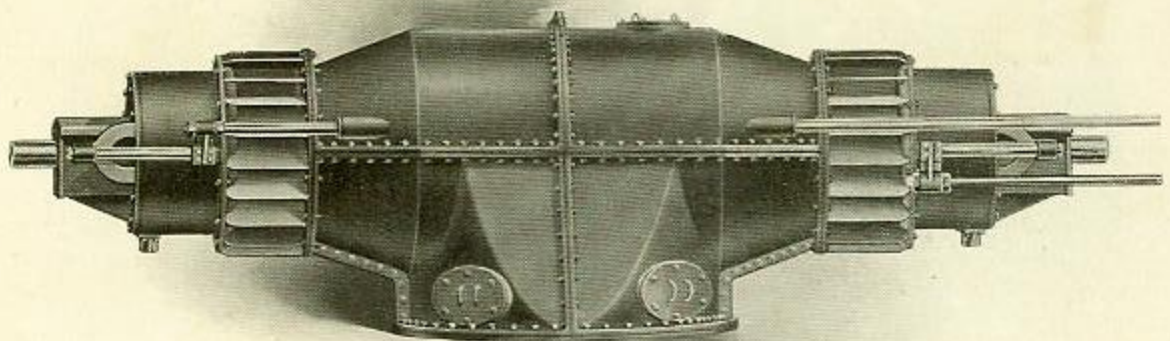


Plate 12

This is one unit of the Holyoke Water Power Co.'s plant illustrated on the previous page.

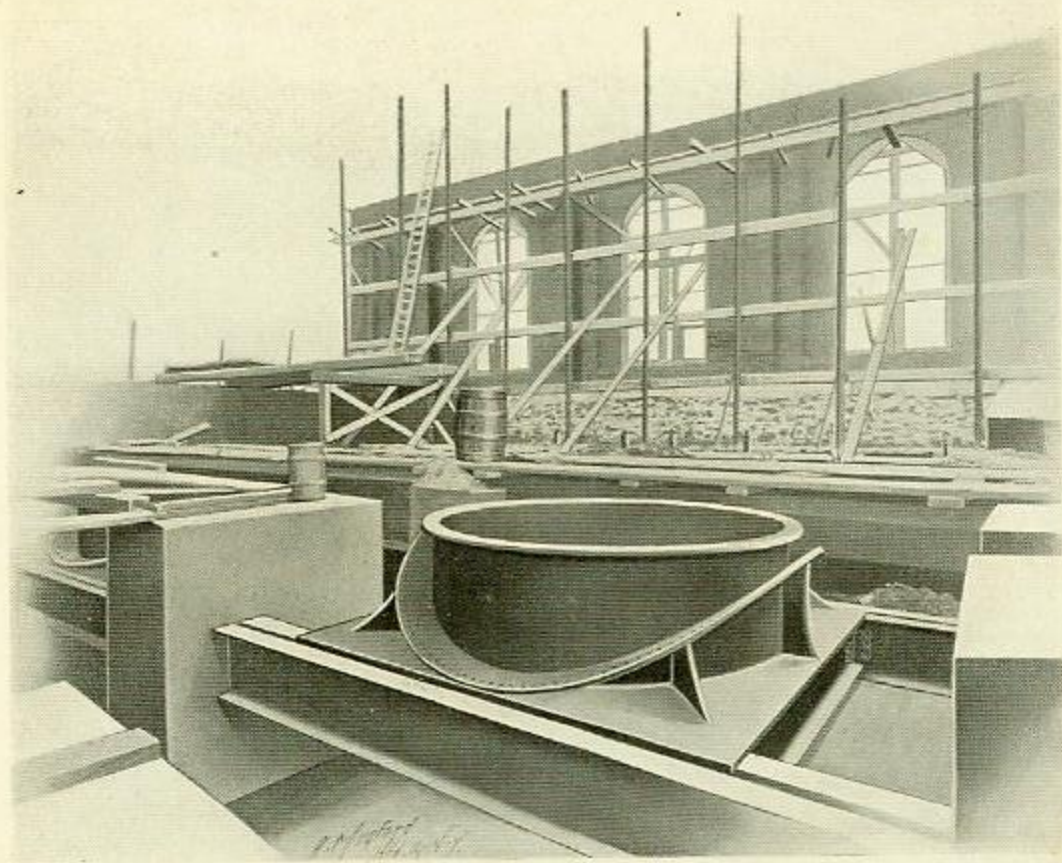


PLATE 13. Shows the power plant of the Holyoke Water Power Company in course of construction with draft tube for one unit in position on steel girders set in concrete.

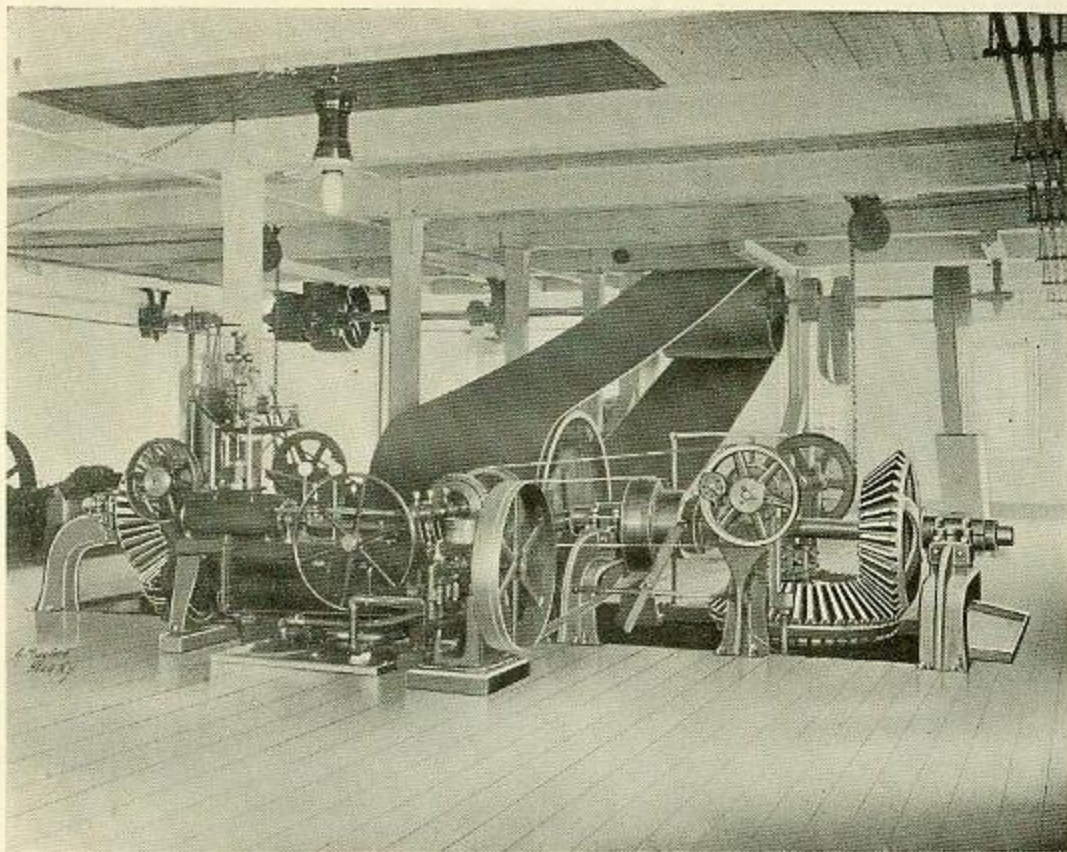


PLATE 14. This cut shows the gearing, harness work, pulleys and governor of two 45 inch Vertical McCormick "Holyoke" Turbines, installed by us at the plant of the J. Stevens Arms and Tool Co., Chicopee Falls, Mass., developing 286 H. P. under 12 foot head.

RULES FOR THE MEASUREMENT OF WATER

It is very important many times to ascertain the exact quantity of water that flows in a stream, and the head and fall, to determine accurately the amount of power and work the stream is capable of performing, before building a mill or factory. It is frequently the case that factories and mills are constructed before first finding the power of the stream, and upon trial is found to fall short of their calculations.

We will give a very plain rule which will enable any one to determine the amount of water in a stream, then by referring to our tables they can ascertain very nearly the power the stream will afford.

Place a wide board as a dam across the stream, called a weir, with a notch cut in it as shown in Plate 15, and make all the water pass through this notch freely without backing up from below. Care should be taken to have this board set level, so the water in the notch will be of uniform depth.

Give us the width of the notch and depth of the water as it pours through, (and the working head and fall) and we will make the estimate of power the stream will afford.

TABLES OF SPOUTING VELOCITY, ETC.

TABLE 1.					TABLE 2.				
THEORETICAL.			REAL.		THEORETICAL.			REAL.	
Head in Feet.	Velocity per Second in Ft.	Cubic Feet Discharged per Minute, Area of Orifice, 1 Inch.	Velocity per Second in Ft.	Cubic Feet Discharged per Minute, Area of Orifice, 1 Inch.	Head in Inches.	Velocity per Second in Inches and Decimals.	Cubic Feet Discharged per Minute, Area of Orifice, 1 Inch.	Velocity per Second in Inches and Decimals.	Cubic Feet Discharged per Minute, Area of Orifice, 1 Inch.
Feet.	Feet.	Cubic Ft.	Feet.	Cubic Ft.	Inch.	Inches.	Cubic Ft.	Inches.	Cubic Feet
1	8.02	8.84	5.09	2.12	1	27.78	0.95	17.64	0.61
2	11.34	4.78	7.20	3.00	2	39.29	1.37	24.95	1.86
3	13.89	5.79	8.82	3.68	3	48.12	1.67	30.55	1.16
4	16.04	6.68	10.19	4.24	4	55.56	1.93	35.28	1.22
5	17.93	7.47	11.39	4.71	5	61.62	2.16	39.45	1.37
6	19.64	8.18	12.47	5.19	6	68.05	2.36	43.21	1.50
7	21.22	8.84	13.47	5.61	7	73.50	2.55	46.68	1.62
8	22.68	9.45	14.40	6.00	8	78.58	2.73	49.90	1.73
9	24.00	10.02	15.28	6.36	9	83.35	2.89	52.92	1.84
10	25.36	10.57	16.10	6.71	10	87.80	3.03	55.79	1.94
11	26.66	11.08	16.89	7.04	11	92.14	3.20	58.51	2.03
12	27.78	11.57	17.64	7.35	12	96.24	3.34	61.11	2.12
13	28.91	12.05	18.36	7.65	13	100.17	3.48	63.61	2.21
14	30.04	12.50	19.05	7.94	14	103.95	3.61	66.01	2.29
15	31.06	12.94	19.72	8.22	15	107.60	3.74	68.33	2.37
16	32.08	13.37	20.37	8.50	16	111.13	3.87	70.57	2.45
17	33.07	13.78	21.00	8.75	17	114.58	3.98	72.74	2.53
18	34.03	14.18	21.61	9.00	18	117.87	4.09	74.85	2.60
19	34.96	14.57	22.20	9.25	19	121.10	4.20	76.90	2.67
20	35.87	14.95	22.78	9.49	20	124.25	4.31	78.90	2.75
21	36.75	15.31	23.34	9.72	21	127.34	4.42	80.84	2.82
22	37.61	15.67	23.88	9.95	22	130.34	4.53	82.75	2.93
23	38.46	16.02	24.42	10.17	23	133.24	4.63	84.61	3.00
24	39.29	16.37	24.96	10.39	24	136.10	4.73	86.43	3.06
25	40.10	16.71	25.46	10.61	25	138.91	4.82	88.21	3.12
26	40.89	17.04	25.97	10.82	26	141.68	4.92	89.96	3.18
27	41.67	17.36	26.46	11.02	27	144.36	5.01	91.67	3.24
28	42.43	17.68	26.94	11.21	28	147.01	5.11	93.35	3.30
29	43.18	17.99	27.42	11.42	29	149.61	5.20	95.00	3.35
30	43.93	18.29	27.90	11.62	30	152.17	5.29	96.63	3.41
31	44.65	18.59	28.35	11.81	31	154.68	5.37	98.22	3.46
32	45.37	18.89	28.81	12.00	32	157.19	5.46	99.80	3.52
33	46.07	19.19	29.25	12.19	33	159.62	5.54	101.34	3.57
34	46.77	19.49	29.70	12.38	34	162.00	5.62	102.87	3.63
35	47.46	19.77	30.14	12.55	35	164.35	5.71	104.37	3.67
36	48.12	20.05	30.56	12.73	36	166.68	5.79	105.85	3.72
37	48.78	20.33	30.98	12.91	37	168.99	5.87	107.31	3.77
38	49.44	20.60	31.39	13.08	38	171.26	5.95	108.75	3.82
39	50.08	20.87	31.80	13.25	39	173.50	6.02	110.17	3.87
40	50.72	21.13	32.21	13.42	40	175.71	6.10	111.55	3.93

HYDRAULIC FORMULAE

In the following Approximate Hydraulic Formulae, Head (H) is always expressed in feet. Pressure (P) in pounds per square inch. Diameter (D) in feet. Area (A) in square feet. Quantity (Q) in cubic feet per second. Time (T) in seconds.

$$\text{Pressure (P)} = .43 \times \text{Head.}$$

$$\text{Head (H)} = 2.3 \times \text{Pressure.}$$

SPOUTING VELOCITY = $8.02 \sqrt{H}$. Time (T₁) to acquire Spouting velocity in a vertical pipe, or (T₂) in a pipe on an angle (θ) from horizontal.

$$T_1 = \frac{8.02 \sqrt{H}}{32.17} \quad T_2 = \frac{8.02 \sqrt{H}}{32.17 \times \sin. \theta}$$

Head (H), or Pressure (P) which will vent any quantity (Q) through a round orifice of any diameter (D) or Area (A).

$$H = \frac{Q^2}{14.1 \times D^4} \quad H = \frac{Q^2}{23.75 \times A^2}$$

$$P = \frac{Q^2}{34.1 \times D^4} \quad P = \frac{Q^2}{55.3 \times A^2}$$

Quantity (Q) discharged through a round orifice of any diameter (D) or area (A) under any pressure (P) or under any head (H).

$$Q = \sqrt{P \times 55.3 \times A^2} \quad Q = \sqrt{P \times 34.1 \times D^4}$$

$$Q = \sqrt{H \times 23.75 \times A^2} \quad Q = \sqrt{H \times 14.71 \times D^4}$$

Diameter (D) or area (A) of a round orifice to vent any quantity (Q) under any head (H) or under any pressure (P).

$$D = \sqrt{\frac{Q}{3.84 \times \sqrt{H}}} \quad D = \sqrt{\frac{Q}{5.8 \times \sqrt{P}}}$$

$$A = \frac{Q}{4.89 \times \sqrt{H}} \quad A = \frac{Q}{7.35 \times \sqrt{P}}$$

Time (T) of emptying a vessel of any area (A) through an orifice of any area (A) anywhere in its side.

$$T = \frac{.416 \times A \times \sqrt{H}}{a}$$

Time (T) of lowering a water level from (H) to (h) in a tank through an orifice of any area (A) in its side. Area of tank is (A).

$$T = \frac{.416 \times A}{a} (\sqrt{H} - \sqrt{h})$$

LOSS OF HEAD IN ONE HUNDRED FEET LENGTH OF PIPE
AT DIFFERENT VELOCITIES

Diameter of Pipe	Cubic Feet per Minute at one ft. per second velocity	1 Foot Per Second	1½ Feet Per Second	2 Feet Per Second	3 Feet Per Second	4 Feet Per Second	5 Feet Per Second	6 Feet Per Second	7 Feet Per Second
3"	2.95	.186	.476	.700	1.507	2.600	3.937	5.598	7.472
6	11.75	.0855	.213	.324	.702	1.214	1.843	2.619	3.003
9	26.50	.0543	.1422	.2053	.4440	.7690	1.1770	1.6650	2.4500
12	47.10	.040	.0983	.1480	.3206	.5500	.8437	1.1925	1.5925
15	73.50	.0295	.0754	.1170	.2430	.4240	.6500	.9190	1.2250
18	106	.0237	.0600	.0900	.1944	.3400	.5208	.7425	.9975
21	144	.0193	.0492	.0729	.1607	.2800	.4286	.6043	.8150
24	188	.0166	.0413	.0625	.1350	.2350	.3641	.5175	.6891
27	238	.0139	.0341	.0533	.1175	.2044	.3125	.4460	.5990
30	294	.0123	.0310	.0470	.1013	.1760	.2725	.3870	.5230
36	424	.0096	.0243	.0367	.0787	.1383	.2135	.3038	.4073
42	577	.0075	.0189	.0286	.0630	.1114	.1571	.2443	.3280
48	752	.0062	.0158	.0240	.0529	.0925	.1438	.2042	.2756
54	954	.0052	.0133	.0202	.0449	.0778	.1198	.1700	.2300
60	1176	.0044	.0113	.0173	.0383	.0667	.1062	.1458	.1972
66	1425	.0039	.0100	.0153	.0338	.0591	.0909	.1309	.1755
72	1696	.0035	.0089	.0137	.0301	.0530	.0815	.1162	.1698
78	1991	.0031	.0079	.0122	.0263	.0476	.0731	.1038	.1382
84	2308	.0028	.0072	.0110	.0243	.0426	.0656	.0939	.1256
90	2650	.0025	.0063	.0098	.0218	.0382	.0590	.0840	.1139
96	3008	.0022	.0055	.0088	.0196	.0342	.0531	.0754	.1018
102	3406	.0021	.0046	.0083	.0183	.0334	.0511	.0731	.1000
108	3816	.0019	.0043	.0075	.0172	.0307	.0482	.0693	.0964
120	4704	.0018	.0040	.0070	.0160	.0285	.0446	.0643	.0876
132	5702	.0017	.0038	.0067	.0154	.0276	.0430	.0619	.0851
144	6784	.0015	.0032	.0060	.0131	.0241	.0374	.0523	.0735

AREAS AND CIRCUMFERENCES OF CIRCLES.

Dia. in inch.	Circ'm in ft. in.	Area in Square Inches.	Dia. in ft. in.	Circ'm in ft. in.	Area in Square Feet.	Dia. in ft. in.	Circ'm in ft. in.	Area in Square Feet.
1	3 $\frac{1}{4}$	.7854	1 2	3 7 $\frac{7}{8}$	1.0775	3 2	9 11 $\frac{1}{2}$	7.8081
1 $\frac{1}{4}$	3 $\frac{3}{4}$	1.227	1 2 $\frac{1}{2}$	3 9 $\frac{1}{4}$	1.1569	3 2 $\frac{1}{2}$	10 0 $\frac{1}{2}$	8.0846
1 $\frac{1}{2}$	4 $\frac{1}{8}$	1.767	1 3	3 11 $\frac{1}{8}$	1.2370	3 3	10 2 $\frac{1}{2}$	8.2951
1 $\frac{3}{4}$	5 $\frac{1}{4}$	2.405	1 3 $\frac{1}{2}$	4 0 $\frac{1}{8}$	1.3208	3 3 $\frac{1}{2}$	10 4	8.5091
2	6 $\frac{1}{2}$	3.141	1 4	4 2 $\frac{1}{4}$	1.4074	3 4	10 5 $\frac{1}{2}$	8.7260
2 $\frac{1}{4}$	7	3.976	1 4 $\frac{1}{2}$	4 3 $\frac{3}{4}$	1.4967	3 4 $\frac{1}{2}$	10 7 $\frac{1}{2}$	8.9462
2 $\frac{1}{2}$	7 $\frac{1}{2}$	4.908	1 5	4 5 $\frac{1}{2}$	1.5888	3 5	10 8 $\frac{1}{2}$	9.1686
2 $\frac{3}{4}$	8 $\frac{1}{8}$	5.939	1 5 $\frac{1}{2}$	4 6 $\frac{3}{4}$	1.6836	3 5 $\frac{1}{2}$	10 10 $\frac{1}{2}$	9.3936
3	9 $\frac{1}{4}$	7.068	1 6	4 8 $\frac{1}{2}$	1.7812	3 6	10 11 $\frac{1}{2}$	9.6212
3 $\frac{1}{4}$	10 $\frac{1}{2}$	8.295	1 6 $\frac{1}{2}$	4 10 $\frac{1}{4}$	1.8816	3 6 $\frac{1}{2}$	11 1 $\frac{1}{2}$	9.8518
3 $\frac{1}{2}$	11	9.621	1 7	4 11 $\frac{1}{2}$	1.9847	3 7	11 3	10.084
3 $\frac{3}{4}$	11 $\frac{1}{2}$	11.044	1 7 $\frac{1}{2}$	5 1 $\frac{1}{4}$	2.0904	3 7 $\frac{1}{2}$	11 4 $\frac{1}{2}$	10.320
4	1 0 $\frac{1}{4}$	12.566	1 8	5 2 $\frac{1}{2}$	2.1990	3 8	11 6 $\frac{1}{2}$	10.559
4 $\frac{1}{4}$	1 1 $\frac{1}{8}$	14.186	1 8 $\frac{1}{2}$	5 4 $\frac{1}{8}$	2.3103	3 8 $\frac{1}{2}$	11 7 $\frac{1}{2}$	10.800
4 $\frac{1}{2}$	1 1 $\frac{1}{4}$	15.904	1 9	5 5 $\frac{1}{4}$	2.4244	3 9	11 9 $\frac{1}{2}$	11.044
4 $\frac{3}{4}$	1 2 $\frac{1}{8}$	17.720	1 9 $\frac{1}{2}$	5 7 $\frac{1}{8}$	2.5412	3 9 $\frac{1}{2}$	11 10 $\frac{1}{2}$	11.291
5	1 3 $\frac{1}{8}$	19.635	1 10	5 9 $\frac{1}{4}$	2.6608	3 10	12 0 $\frac{1}{2}$	11.534
5 $\frac{1}{4}$	1 4 $\frac{1}{4}$	21.647	1 10 $\frac{1}{2}$	5 10 $\frac{3}{8}$	2.7832	3 10 $\frac{1}{2}$	12 2	11.793
5 $\frac{1}{2}$	1 5 $\frac{1}{4}$	23.758	1 11	6 0 $\frac{1}{2}$	2.8903	3 11	12 3 $\frac{1}{2}$	12.048
5 $\frac{3}{4}$	1 6 $\frac{1}{8}$	25.967	1 11 $\frac{1}{2}$	6 1 $\frac{1}{4}$	3.0129	3 11 $\frac{1}{2}$	12 5 $\frac{1}{2}$	12.305
6	1 6 $\frac{3}{4}$	28.274	2 0	6 3 $\frac{1}{8}$	3.1418	4 0	12 6 $\frac{1}{2}$	12.566
6 $\frac{1}{4}$	1 7 $\frac{1}{8}$	30.679	2 1	6 4 $\frac{1}{4}$	3.2731	4 0 $\frac{1}{4}$	12 8 $\frac{1}{4}$	12.829
6 $\frac{1}{2}$	1 8 $\frac{1}{4}$	33.183	2 1 $\frac{1}{2}$	6 6 $\frac{1}{4}$	3.4081	4 1	12 9 $\frac{1}{4}$	13.095
6 $\frac{3}{4}$	1 9 $\frac{1}{8}$	35.784	2 1 $\frac{3}{4}$	6 8 $\frac{1}{8}$	3.5468	4 1 $\frac{1}{4}$	12 11 $\frac{1}{4}$	13.364
7	1 10 $\frac{1}{4}$	38.484	2 2	6 9 $\frac{1}{4}$	3.6870	4 2	13 1	13.635
7 $\frac{1}{4}$	1 10 $\frac{3}{4}$	41.282	2 2 $\frac{1}{2}$	6 11 $\frac{1}{4}$	3.8302	4 2 $\frac{1}{4}$	13 2 $\frac{1}{4}$	13.909
7 $\frac{1}{2}$	1 11 $\frac{1}{4}$	44.178	2 3	7 0 $\frac{1}{4}$	3.9761	4 3	13 4 $\frac{1}{4}$	14.186
7 $\frac{3}{4}$	2 0 $\frac{1}{8}$	47.173	2 3 $\frac{1}{2}$	7 2 $\frac{1}{8}$	4.1241	4 3 $\frac{1}{4}$	13 5 $\frac{1}{4}$	14.465
8	2 1 $\frac{1}{4}$	50.265	2 4	7 3 $\frac{1}{4}$	4.2760	4 4	13 7 $\frac{1}{4}$	14.748
8 $\frac{1}{4}$	2 1 $\frac{3}{8}$	53.456	2 4 $\frac{1}{2}$	7 5 $\frac{1}{4}$	4.4302	4 4 $\frac{1}{4}$	13 8 $\frac{1}{4}$	15.033
8 $\frac{1}{2}$	2 2 $\frac{1}{8}$	56.745	2 5	7 7	4.5861	4 5	13 10 $\frac{1}{4}$	15.320
8 $\frac{3}{4}$	2 3 $\frac{1}{8}$	60.132	2 5 $\frac{1}{2}$	7 8 $\frac{1}{4}$	4.7467	4 5 $\frac{1}{4}$	14 0	15.611
9	2 4 $\frac{1}{4}$	63.617	2 6	7 10 $\frac{1}{4}$	4.9081	4 6	14 1 $\frac{1}{4}$	15.904
9 $\frac{1}{4}$	2 5	67.200	2 6 $\frac{1}{2}$	7 11 $\frac{1}{4}$	5.0731	4 6 $\frac{1}{4}$	14 3 $\frac{1}{4}$	16.200
9 $\frac{1}{2}$	2 5 $\frac{1}{4}$	70.882	2 7	8 1 $\frac{1}{4}$	5.2278	4 7	14 4 $\frac{1}{4}$	16.498
9 $\frac{3}{4}$	2 6 $\frac{1}{8}$	74.662	2 7 $\frac{1}{2}$	8 2 $\frac{1}{4}$	5.4112	4 7 $\frac{1}{4}$	14 6 $\frac{1}{4}$	16.800
10	2 7 $\frac{1}{4}$	78.540	2 8	8 4 $\frac{1}{4}$	5.5850	4 8	14 7 $\frac{1}{4}$	17.104
10 $\frac{1}{4}$	2 8 $\frac{1}{8}$	82.516	2 8 $\frac{1}{2}$	8 6 $\frac{1}{4}$	5.7601	4 8 $\frac{1}{4}$	14 9 $\frac{1}{4}$	17.411
10 $\frac{1}{2}$	2 8 $\frac{3}{4}$	86.590	2 9	8 7 $\frac{1}{4}$	5.9398	4 9	14 11	17.720
10 $\frac{3}{4}$	2 9 $\frac{1}{8}$	90.762	2 9 $\frac{1}{2}$	8 9 $\frac{1}{4}$	6.1201	4 9 $\frac{1}{4}$	15 0 $\frac{1}{4}$	18.033
11	2 10 $\frac{1}{4}$	95.789	2 10	8 10 $\frac{1}{4}$	6.3051	4 10	15 2 $\frac{1}{4}$	18.347
11 $\frac{1}{4}$	2 11 $\frac{1}{8}$	100.195	2 10 $\frac{1}{2}$	9 0 $\frac{1}{4}$	6.4911	4 10 $\frac{1}{4}$	15 3 $\frac{1}{4}$	18.665
11 $\frac{1}{2}$	3 0 $\frac{1}{4}$	104.688	2 11	9 1 $\frac{1}{4}$	6.6815	4 11	15 5 $\frac{1}{4}$	18.985
11 $\frac{3}{4}$	3 0 $\frac{3}{8}$	109.296	2 11 $\frac{1}{2}$	9 3 $\frac{1}{4}$	6.8738	4 11 $\frac{1}{4}$	15 6 $\frac{1}{4}$	19.309
12	3 1 $\frac{1}{4}$	113.990	3 0	9 5	7.0688	5 0	15 8 $\frac{1}{4}$	19.635
12 $\frac{1}{4}$	3 3 $\frac{1}{4}$	123.696	3 1	9 6 $\frac{1}{4}$	7.2664	5 0 $\frac{1}{4}$	15 10	19.963
13	3 4 $\frac{1}{4}$	133.790	3 1 $\frac{1}{2}$	9 8 $\frac{1}{4}$	7.4661	5 1	15 11 $\frac{1}{4}$	20.294
13 $\frac{1}{4}$	3 6 $\frac{1}{4}$	144.223	3 1 $\frac{3}{4}$	9 9 $\frac{1}{4}$	7.6691	5 1 $\frac{1}{4}$	16 1 $\frac{1}{4}$	20.629

AREAS AND CIRCUMFERENCES OF CIRCLES.

Dia. in ft. in.	Circ'm in ft. in.	Area in Square Feet.	Dia. in ft. in.	Circ'm in ft. in.	Area in Square feet.	Dia. in ft. in.	Circ'm in ft. in.	Area in Square Feet.
5 2	16 2½	20.965	7 4	23 0½	42.2367	11 4	35 7½	100.8797
5 2½	16 4½	21.305	7 5	23 2½	43.2022	11 5	35 10½	102.3689
5 3	16 5½	21.647	7 6	23 4½	44.1787	11 6	36 1½	103.8691
5 3½	16 7½	21.992	7 7	23 6½	45.1656	11 7	36 4½	105.3794
5 4	16 9	22.333	7 8	24 1½	46.1638	11 8	36 7½	106.9013
5 4½	16 10½	22.621	7 9	24 4½	47.1730	11 9	36 10½	108.4342
5 5	17 0½	23.043	7 10	24 7½	48.1926	11 10	37 2½	109.9772
5 5½	17 1½	23.330	7 11	24 10½	49.2236	11 11	37 5½	111.5319
5 6	17 3½	23.758	8 0	25 1½	50.2656	12 0	37 8½	113.0976
5 6½	17 4½	24.119	8 1	25 4½	51.3178	12 1	37 11½	114.6732
5 7	17 6½	24.483	8 2	25 7½	52.3816	12 2	38 2½	116.2607
5 7½	17 8	24.850	8 3	25 11	53.4562	12 3	38 5½	117.8590
5 8	17 9½	25.220	8 4	26 2½	54.5412	12 4	38 8½	119.4674
5 8½	17 11½	25.592	8 5	26 5½	55.6377	12 5	39 0	121.0876
5 9	18 0½	25.964	8 6	26 8½	56.7451	12 6	39 3½	122.7187
5 9½	18 2½	26.344	8 7	26 11½	57.8628	12 7	39 6½	124.3598
5 10	18 3½	26.725	8 8	27 2½	58.9920	12 8	39 9½	126.0127
5 10½	18 5½	27.108	8 9	27 5½	60.1321	12 9	40 0½	127.6765
5 11	18 7	27.494	8 10	27 9	61.2826	12 10	40 3½	129.3504
5 11½	18 8½	27.883	8 11	28 0½	62.4445	12 11	40 6½	131.0360
6 0	18 10½	28.274	9 0	28 3½	63.6174	13 0	40 10	132.7326
6 0½	18 11½	28.663	9 1	28 6½	64.8006	13 1	41 1½	134.4391
6 1	19 1½	29.065	9 2	28 9½	65.9951	13 2	41 4½	136.1574
6 1½	19 2½	29.466	9 3	29 0½	67.2007	13 3	41 7½	137.8867
6 2	19 4½	29.867	9 4	29 3½	68.4166	13 4	41 10½	139.6260
6 2½	19 6	30.271	9 5	29 7	69.6440	13 5	42 1½	141.3771
6 3	19 7½	30.679	9 6	29 10½	70.8823	13 6	42 4½	143.1391
6 3½	19 9½	31.090	9 7	30 1½	72.1309	13 7	42 8	144.9111
6 4	19 10½	31.503	9 8	30 4½	73.3910	13 8	42 11½	146.6949
6 4½	20 0½	31.919	9 9	30 7½	74.6620	13 9	43 2½	148.4896
6 5	20 1½	32.337	9 10	30 11½	75.9433	13 10	43 5½	150.2943
6 5½	20 3½	32.759	9 11	31 1½	77.2362	13 11	43 8½	152.1109
6 6	20 5	33.183	10 0	31 5	78.5400	14 0	43 11½	153.9384
6 6½	20 6½	33.619	10 1	31 8½	79.8540	14 1	44 2½	155.7758
6 7	20 8½	34.039	10 2	31 11½	81.1795	14 2	44 6	157.6250
6 7½	20 9½	34.471	10 3	32 2½	82.5160	14 3	44 9½	159.4852
6 8	20 11½	34.906	10 4	32 5½	83.8627	14 4	45 0½	161.3553
6 8½	21 0½	35.344	10 5	32 8½	85.2000	14 5	45 3½	163.2373
6 9	21 2½	35.784	10 6	32 11½	86.5389	14 6	45 6½	165.1303
6 9½	21 4	36.227	10 7	33 2½	87.8897	14 7	45 9½	167.0331
6 10	21 5½	36.674	10 8	33 5½	89.2408	14 8	46 0½	168.9479
6 10½	21 7½	37.122	10 9	33 8½	90.5927	14 9	46 4	170.8735
6 11	21 8½	37.573	10 10	34 0½	92.1749	14 10	46 7½	172.8091
6 11½	21 10½	38.027	10 11	34 3½	93.5986	14 11	46 11½	174.7565
7 0	21 11½	38.4846	11 0	34 6½	95.0334	15 0	47 1½	176.7150
7 1	22 3	39.4060	11 1	34 9½	96.4783	15 1	47 4½	178.6832
7 2	22 6½	40.3388	11 2	35 0½	97.9347	15 2	47 7½	180.6634
7 3	22 9½	41.2825	11 3	35 4½	99.4021	15 3	47 10½	182.6545

WEIGHT PER FOOT OF ROUND AND SQUARE BAR IRON.

INCH.	ROUND.	SQUARE.	INCH.	ROUND.	SQUARE.
$\frac{1}{8}$	.165	.211	4	42.464	54.084
$\frac{1}{4}$	.373	.475	$4\frac{1}{2}$	47.952	61.055
$\frac{3}{8}$	.603	.845	$4\frac{3}{4}$	53.760	68.448
$\frac{1}{2}$	1.043	1.320	5	59.900	72.264
$\frac{5}{8}$	1.493	1.901	$5\frac{1}{4}$	66.350	84.480
$\frac{3}{4}$	2.032	2.588	$5\frac{1}{2}$	73.172	93.108
$1\frac{1}{8}$	2.654	3.380	$5\frac{3}{4}$	80.304	102.24
$1\frac{1}{4}$	3.360	4.278	6	87.776	111.75
$1\frac{1}{2}$	4.147	5.280	$6\frac{1}{4}$	95.552	121.66
$1\frac{3}{4}$	5.019	6.390	$6\frac{1}{2}$	103.70	132.04
$2\frac{1}{8}$	5.972	7.604	$6\frac{3}{4}$	112.16	142.81
$2\frac{1}{4}$	7.010	8.926	7	120.96	154.01
$2\frac{1}{2}$	8.128	10.352	$7\frac{1}{4}$	130.04	165.63
$2\frac{3}{4}$	9.333	11.883	$7\frac{1}{2}$	139.54	177.67
3	10.616	13.520	$7\frac{3}{4}$	149.32	190.13
$3\frac{1}{8}$	13.440	17.112	8	159.45	203.02
$3\frac{1}{4}$	16.588	21.120	$8\frac{1}{4}$	169.85	216.33
$3\frac{1}{2}$	20.076	25.560	$8\frac{1}{2}$	180.60	230.06
$3\frac{3}{4}$	23.888	30.416	$8\frac{3}{4}$	191.80	244.22
4	28.040	35.704	9	203.26	258.80
$4\frac{1}{8}$	32.512	41.408	$9\frac{1}{4}$	215.04	273.79
$4\frac{1}{4}$	37.332	47.534	$9\frac{1}{2}$	227.15	289.22

WEIGHT OF FLAT BAR IRON PER LINEAL FOOT.

Width	THICKNESS IN FRACTIONS OF INCHES.								
	1-4	5-16	3-8	7-16	1-2	5-8	3-4	7-8	1
1	.84	1.05	1.26	1.48	1.69	2.11	2.53	2.95	3.38
1 1-8	.95	1.18	1.42	1.66	1.90	2.37	2.85	3.32	3.80
1 1-4	1.05	1.32	1.58	1.85	2.11	2.64	3.17	3.69	4.22
1 3-8	1.16	1.45	1.74	2.03	2.32	2.90	3.48	4.06	4.64
1 1-2	1.26	1.58	1.90	2.22	2.53	3.17	3.80	4.43	5.07
1 5-8	1.37	1.71	2.06	2.40	2.74	3.43	4.12	4.80	5.49
1 3-4	1.48	1.85	2.22	2.59	2.95	3.69	4.43	5.17	5.91
1 7-8	1.58	1.98	2.37	2.77	3.17	3.96	4.75	5.54	6.33
2	1.69	2.11	2.53	2.96	3.38	4.22	5.07	5.91	6.76
2 1-4	1.90	2.37	2.85	3.33	3.80	4.75	5.70	6.65	7.60
2 1-2	2.11	2.64	3.17	3.69	4.22	5.28	6.33	7.39	8.45
2 3-4	2.32	2.90	3.48	4.07	4.65	5.81	6.97	8.13	9.29
3	2.53	3.17	3.80	4.43	5.07	6.34	7.60	8.87	10.14
3 1-4	2.74	3.43	4.12	4.80	5.49	6.86	8.24	9.61	10.98
3 1-2	2.96	3.69	4.43	5.17	5.91	7.39	8.87	10.35	11.83
3 3-4	3.17	3.96	4.75	5.54	6.33	7.92	9.50	11.09	12.67
4	3.38	4.22	5.07	5.91	6.76	8.45	10.14	11.83	13.52

SPECIFIC GRAVITY
AND
WEIGHTS OF VARIOUS SUBSTANCES.

Name of Substance.	WEIGHTS.			Specific Gravity.
	Per Cubic Foot.	Per Square Foot, 1 In. Thick.	Per Cubic Inch.	
Water, Pure	62.3	5.19	.036	1.000
Water, Sea	64.3	5.36	.037	1.028
Wrought Iron	490	40.30	.277	7.70
Cast Iron	450	37.50	.260	7.20
Steel	490	40.84	.283	7.84
Lead	710	59.16	.410	11.36
Copper, Rolled	548	45.66	.317	8.80
Brass, Rolled	524	43.66	.302	8.40
Sand	98	8.23	.057	1.57
Clay	120	10.00	.069	1.92
Brickwork, Common . . .	120	10.00	.069	1.92
Brickwork, Close Joints . .	140	11.66	.081	2.24
Limestone	168	18.00	.124	2.68
Glass	156	13.00	.090	2.49
Concrete	137.5	11.45	.079	2.20
Pine, White	30	2.50	.017	.48
Pine, Yellow	35	2.91	.019	.56
Hemlock	25	2.08	.015	.40
Maple	49	4.08	.028	.78
Oak, White	50	4.16	.030	.80
Walnut	41	3.41	.023	.65
Hickory	49.5	4.12	.028	.79
Lignum-Vita	83.3	6.94	.048	1.33
Locust	45.5	3.79	.026	.73

WEIGHTS AND MEASURES.

Avoirdupois or Commercial Weight.

16 drachms	1 ounce.
16 ounces	1 pound.
14 pounds	1 stone.
28 "	1 quarter.
4 quarters	1 cwt.
2240 pounds	1 ton.

Square Measure.

144 square inches	1 square foot.
9 " feet	1 " yard.
30½ " yards	1 " rod.
40 " rods	1 " rood.
4 " roods	1 " acre.
640 " acres	1 " mile.

Measure of Volume.

A cubic foot has	1728 cubic inches.
An ale gallon has	282 " "
A standard or wine gallon has	231 " "
A dry gallon has	268.8 " "
A bushel has	2150.4 " "
A cord of wood has	128 " feet.
A perch of stone has	24.75 " "
A ton of round timber has	40 " "
A " hewn " "	50 " "
A box 19½ x 19½ inches, 19½ inches deep, contains	1 barrel.
A " 12½ x 12½ " 12½ " " "	1 bushel.
A " 8½ x 8½ " 8½ " " "	1 peck.
A " 6½ x 6½ " 6½ " " "	½ " "
A " 4½ x 4½ " 4½ " " "	1 quart.
An acre contains	4840 square yards.
209 feet long by 209 feet broad is	1 acre.

Table of Distance.

A mile is	5280 feet or 1760 yards.
A knot is	6086 feet.
A league is	3 miles.
A fathom is	6 feet.
A metre is nearly	3 feet 3¼ inches.
A hand is	4 inches.
A palm is	3 " "
A span is	9 " "

Liquid Measure.

A barrel holds	31½ gallons.
A hogshhead holds	63 " "
A tierce "	42 " "
A puncheon "	84 " "
A tun "	252 " "

Barrel Measure.

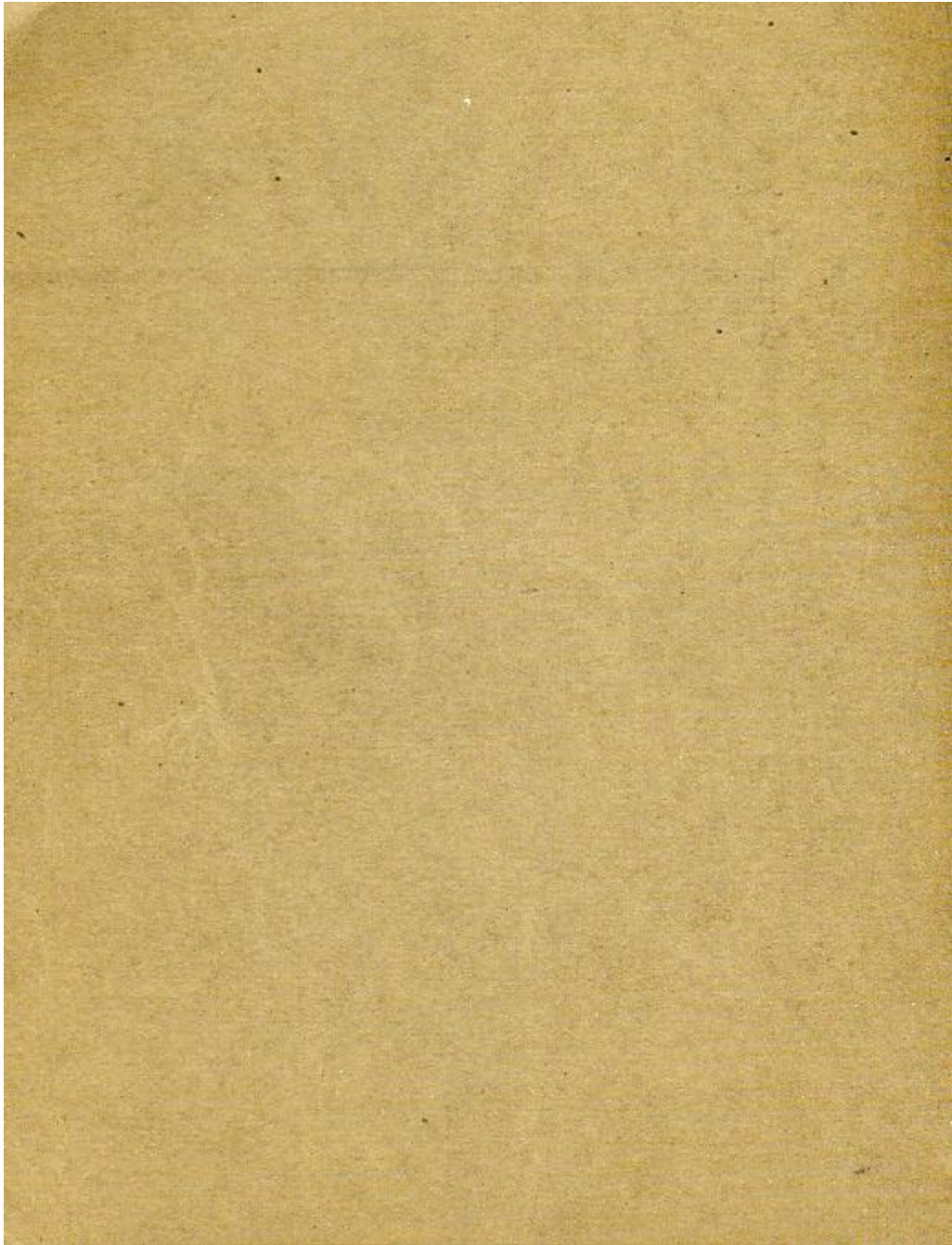
A barrel of flour is	196 pounds.
A " " pork "	200 " "
A " " rice "	600 " "
A firkin of butter "	56 " "
A tub of " "	84 " "

Measure of Length.

12 inches	1 foot.
3 feet	1 yard.
2 yards	1 fathom.
16½ feet	1 rod.
4 rods	1 chain.
10 chains	1 furlong.
8 furlongs	1 mile.
3 miles	1 league.

DECIMAL EQUIVALENTS OF INCHES AND FEET.

Fractions of an Inch.	Decimals of an Inch.		Decimals of a Foot.	Inches.		Feet.
$\frac{1}{16}$	.0625	Equals	.00521	1	Equals	.0833
$\frac{3}{32}$	.125	"	.01041	2	"	.1666
$\frac{1}{8}$	.1875	"	.01562	3	"	.25
$\frac{5}{32}$	.25	"	.02083	4	"	.3333
$\frac{3}{16}$	.3125	"	.02604	5	"	.4166
$\frac{1}{4}$	.375	"	.03125	6	"	.5
$\frac{7}{16}$	.4375	"	.03646	7	"	.5833
$\frac{1}{2}$	.5	"	.04166	8	"	.6666
$\frac{5}{8}$	.5625	"	.04687	9	"	.75
$\frac{3}{4}$	.625	"	.05208	10	"	.8333
$\frac{7}{8}$	.6875	"	.05729	11	"	.9166
$\frac{15}{16}$	.75	"	.06250	12	"	1.000
$\frac{1}{2}$	.8125	"	.06771			
$\frac{1}{4}$	.875	"	.07292			
$\frac{1}{8}$	.9375	"	.07812			
1	1.00	"	.0833			



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TESTING FLUME

OF THE

HOLYOKE WATER POWER CO.,

HOLYOKE, MASS.

Report of tests of a 45" LEFT HAND McCORMICK'S HOLYOKE - turbine wheel.

No. 1010, made April 26th, 1897.

Tested on Special Draft-Tube.

Tested for J. & W. Jolly.

Number of the experiment	Revolutions per min.		Discharge in cu. ft. per sec.	Duration of the ex- periment	Head in ft. at the wheel	Quantity of wa- ter discharged by the wheel	Power developed by the wheel	Efficiency of the wheel
	the full opening of the draft-tube	the full discharge of the wheel, in cu. ft. per sec. at the same head						
	in percent	in ft.	in min.	per minute	in cu. ft. per sec.	H. P.	percent	
38	1.000	1.006	16.15	4	110.25	153.68	234.74	83.41
37	"	1.001	16.16	4	114.50	153.00	235.22	83.90
36	"	0.999	16.16	4	118.25	152.61	234.08	83.71
35	"	0.995	16.14	4	122.12	151.94	232.60	83.65
34	"	0.991	16.12	4	125.50	151.27	229.65	83.06
30	0.779	0.898	16.35	4	106.50	138.07	212.99	83.21
29	"	0.896	16.35	4	111.50	137.69	215.41	84.38
28	"	0.891	16.38	4	116.12	137.15	214.85	84.34
27	"	0.885	16.38	4	120.50	126.23	213.12	84.23
26	"	0.881	16.38	4	124.50	135.60	210.88	83.73
20	0.625	0.778	16.64	4	111.12	120.65	185.19	81.35
19	"	0.774	16.65	4	115.50	120.14	184.64	81.40
18	"	0.768	16.67	4	120.00	119.28	183.67	81.46
17	"	0.765	16.70	4	124.50	118.79	182.08	80.85
12	0.489	0.660	17.03	4	106.50	103.48	155.04	77.59
11	"	0.656	17.07	4	111.25	102.90	154.39	77.51
10	"	0.651	17.08	4	116.50	102.30	153.74	77.60
5	0.380	0.552	17.28	4	99.50	87.28	122.51	71.64
4	"	0.549	17.29	4	105.75	86.82	123.01	72.27
3	"	0.546	17.30	4	111.50	86.29	122.10	72.14

During the above experiments, the weight of the dynamometer, and of that portion of the shaft which was above the lower coupling was suspended by ball bearing.

With the flume empty, a strain of 18 lbs. applied at a distance of 3.6 ft. from the centre of the shaft, sufficed to start the wheel.

HOLYOKE WATER POWER CO.

By E. C. Walter Hydraulic Engineer

A. F. Dickman Engineer in charge of Experiments

"JOLLY" GUARANTEES AT LEAST 80 PER CENT. EFFICIENCY