The Mechanical Efficiency of a Sweep Horse Power.

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The Mechanical efficiency of any machine or power is the useful work obtained, or in other words it is the work left after the friction of the machine parts has been over come, It has become important at this day and age to know the efficiency of machines and powers, because those that are called for are the ones that will do the greatest amount of work with the least friction possible.

The object of determining the efficiency of a sweep horse power was to find what per cent of the work put into the power was lost by the gearing and bearings of the power.

A one horse sweep power was secured and a series of tests made, The power selected was simple in construction, consisting of a master wheel or large bevel gear, which drove a small bevel gear or pinion to which a tumbling rod was attached. The object of the tumbling rod was to transmit the energy to some suitable place where it could be used. A dynamometer was attached to the sweep or lever arm of the power, and

The horse allowed to pull on the dynamometer.
A dynamometer is a device for measuring the power or force of any motor. The horse being the motor in this case, the dynamometer registered the force exerted by the horse at that point i.e. the point where he was hitched. The tumbling rod was connected to a shaft carrying a pulley on which a Prony or friction brake was clamped, the upper part of the brake serving as a lever, and resting upon a scale platform, (For detail construction of brake see plate I.) by such a device any amount of friction could be applied to the pulley in the brake, and the scales would register the amount. The friction produced by tightening the brake on the pulley would be the same as if some machine, such as a grinding mill attached to the pulley by a belt. The weight registered by the scales would be useful force. (which is explained below by an example)

Twenty two test were made, and a general average taken, which showed that 20.68% of the force exerted by the horse was lost by the friction of the mechanism of

the power. The average efficiency of the power was 79.82%. It was found that when a light load was applied a lower per cent of efficiency resulted than when a heavier load was applied. The reason being that a certain amount of friction remains constant in the mechanism of the power.

The only improvment in sweep powers that I can suggest, is that the efficiency could be greatly increased by the introduction of roller and ball bearings, which would greatly overcome the friction.

The table given below shows the results of each test, and the factors used in obtaining the results, and also shows a solution of one test with a card used in the test, taken from the indicator of the dynamometer.

Factors used in tests of the power.
Speed of power eight to one, i.e. one revolution of horse makes eight revolutions of brake pulley. Diameter of track trodden by horse 26 Ft. Circumference of track equals π 26 Ft. or 81.68 Ft. The spring of dynamometer 30 pounds. Area of dynamometer piston head 5 sq. inches. Spring times 5 sq. in. or 5 x 30 = 150 a constant used as a multiplier of av. pull on indicator card. Average height in inches on indicator card multiplied by 150 = average pull. Revolutions per minute of pulley in brake divided by speed of power times circumference of track equals speed per minute of horse. Av. pull times speed per minute of horse equals foot pounds of work exerted by the horse per minute.

Factors of brake used in tests.
Lever arm of brake 3'. 10.3", circumference of circle scribed by lever arm of brake 24.24'. Circumference of lever arm times revolutions per minute of friction pulley times weight registered on scale beam equals useful work. The useful work divided by foot lbs. exerted by horse equals efficiency of the power.

Solution of test.

Average height on indicator card .75".

Revolution per min. of brake pulley 25.

Weight on scale beam 35 lbs.

(1) Dynamometer on sweep.

5 X 30 = 150. 150 X 75 = 112.5 ap. Pull.

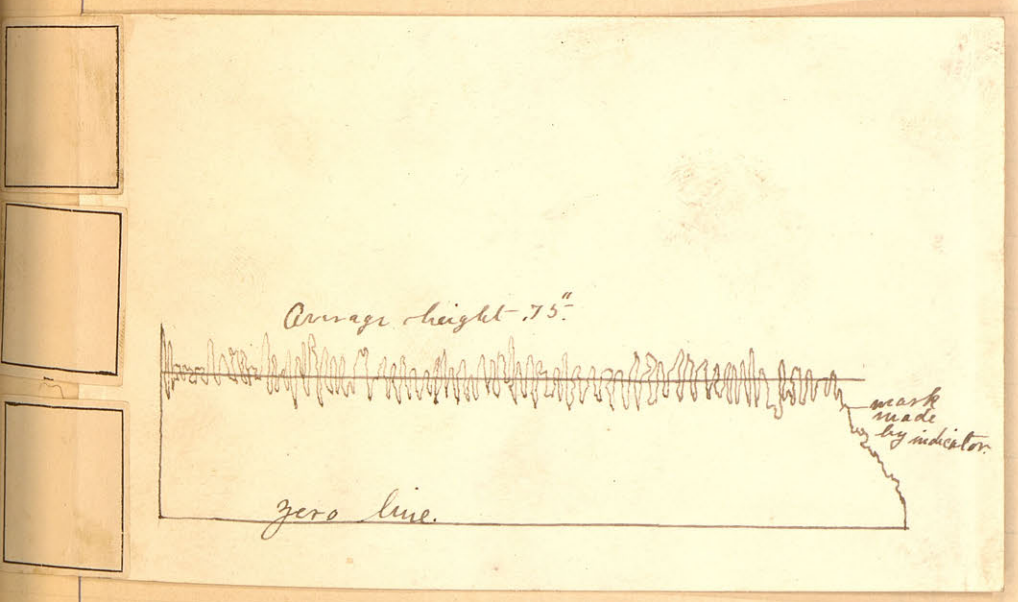
25 ÷ 8.5 = 2.92, 2.92 X 81.68 = 238.50 Speed of horse per min.

238.50 X 112.5 = 26821 ft. lbs. exerted by horse per min.

(2) Friction Brake.

24.24' X 25 X 35 = useful work per min.

22210 ÷ 26821 = Efficiency or 82.8 %.



The card taken from drum of indicator of dynamometer of which the solution above is derived.

Solution

average height o

Revolution per m

weight on scale

(1) Dynamomete

5 × 30 = 150, 150

25 ÷ 8.5 = 2.92, 292

238.50 × 112.5 = 268

(2) Friction Bra

24.24' × 25 × 35

22210 ÷ 26821

The card take

mometer of whic

Name .		No. 7
Speed 25 in 60	Spring 30	Stroke
Pounds Discharge	Total Lift	Suction
Area of Diagram		Length
Av. Height 75	Av. P. 112.5	Work per ~~Stroke~~ min 26821

wt. net 35

Ft. per min of load = 238.50

Useful work per min 22210

Efficiency 82.8%

PLATE I.

Plate showing The method
of applying friction brake
to platform scales.

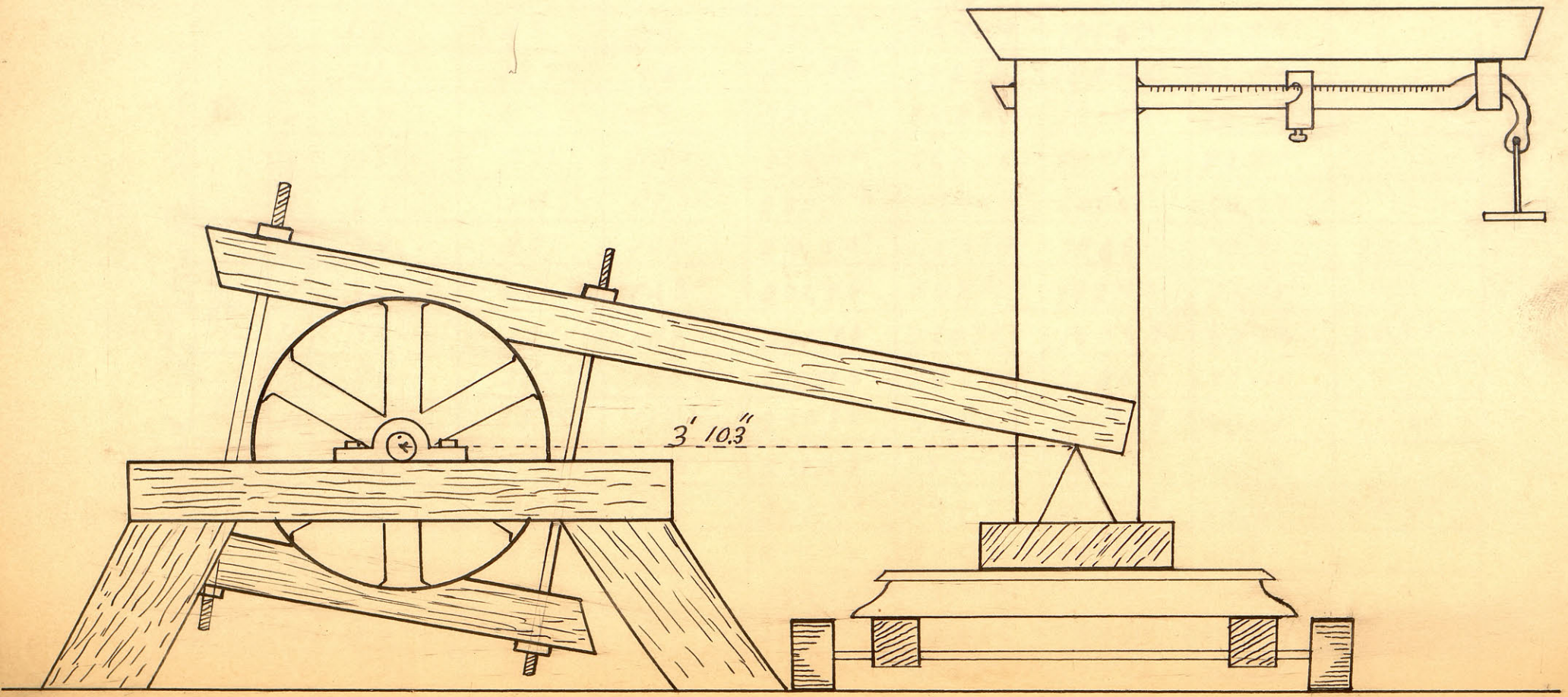


Table showing results of tests with a one horse sweep power. Speed of power 8 to 1.

Spring of Dynamometer 30 lbs. circumference of brake lever 24.24'

Weight applied to Scale beam.	no.	Av. height on indicator card in inches.	Revolution per min. of friction wheel.	Av. pull of horse in pounds.	Speed of horse per min.	Ft. lbs. exerted by horse per min.	useful work per min.	Efficiency per cent.	Av. Efficiency.
30	1	.71	24	106.5	230.33	245-34	1715-3	69.91	
	2	.66	24	99	230.33	22802	1745-3	76.5-4	73.22
35	3	.69	23	103.5	220.5-3	22825	19163	83.95	
	4	.68	23	102	220.5-3	22494	19163	85.35	
	5	.71	22.73	106.5	218.70	23292	19284	82.79	
	6	.78	23	117	220.5-3	25802	19163	70.39	
	7	.75	25	112.5	238.5-0	26821	22210	82.80	
	8	.65	24	97.5	230.34	22458	20361	90.77	
	9	.74	22	121	211.5-5	25597	18665	72.91	81.28
38	10	.82	21	123	201.75	24815	19843	77.95	
	11	.73	21	109.5	201.75	22091	19343	87.5-6	82.75
40	12	.87	22.5-5	130.5	216.45	28246	21864	77.40	
	13	.79	25.10	118.5	240.95	275-5-2	20387	73.81	75.60
43	14	.92	22	138	211.65	29207	22931	78.51	
	15	.92	21	138	201.75	27841	21888	78.62	78.56
46	16	.98	21	147	201.75	29657	28416	78.95	
	17	.97	19	145.5	182.15	26503	21185	79.94	
	18	.90	22	135	211.5-5	28559	24531	85.89	
	19	1.05	21	157.5	201.75	31775	23416	73.69	79.62
50	20	1.04	19	156	182.14	28414	23028	81.04	
	21	1.02	22	153	211.65	32382	26664	82.34	81.69
55	22	1.13	18.46	169.5	177.24	30042	24611	81.92	81.92