TESTS TO DETERMINE THE DISTRIBUTION OF POWER IN THE SHOPS OF THE MECHANICAL ENGINEERING DEPARTMENT K. S. A. C.

By

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The object of these tests was to determine the distribution of power through the different shops of the mechanical engineering department. The line shafting of these shops is driven by means of electrical motors and the individual machines by belt drives. In order to determine the distribution, the output of the motors at different shop loads had to be obtained. For this purpose, two sets of tests were carried on. In the first set the relation between the input in the motors, or the electrical horse-power, and the output, or the brake horse-power, was determined. In this set of tests readings were taken of the voltmeter, ammeter, and of the scales simultaneously. A zero reading was taken while the motor was standing still. A certain weight was then placed on the scales and the prony brake was tightened till the scales balanced and two or three readings were taken about a half minute apart, at the close of every five minutes. An average of these readings was taken so as to avoid any error which might arise from just one reading. The weight on the scale beam was then increased about one pound and the procedure was repeated. This was continued till the motor was at its maximum test load.

By multiplying the volts by the amperes, watts were obtained, (as shown in tables 1, 2 & 3 etc.) which divided by 746 gave the electrical horse-power of the motor or the input into the motor. The output in brake horse-power was obtained by subtracting the weight of the prony brake or the zero reading from the actual reading, which was taken when the motor was running with a certain weight on the scales, and multiplying the remainder by the R. P. M. and by the brake constant. By dividing the brake horse-power by the electrical horse-power the efficiency of the motor was obtained.

The brake constant was equal to .0005, this being obtained from the formula $\frac{2\pi L}{33000}$, where L = 31.5" is the length of the brake arm. This value being reduced to feet before substituting in above formula.

The second set of tests was carried on to determine how much power it took to drive the line shafting in the machine shop, and wood turning shop, also the power necessary to run each machine with and without load. Readings were taken while classes were using the machines in the machine shop and wood turning shop, to find out how much power was ordinarily used. During the tests machines were started and stopped, one at a time, in order to determine the power which would be required to run the individual machines.

The apparatus used in the tests consisted of a syphon, Weston voltmeter and ammeter, prony brake, and a speed counter. The results of the tests were put in tabular form; the volts, amperes, watts, R. P. M., weight, brake horse-power, and electrical horse-power being placed in separate columns. The tables in the machine shop were numbered 1; those of the wood turning shop 2; and those of the carpenter shop 3. Each curve sheet was numbered in a way to correspond to these tables.

The data which was obtained from these tests could never be used in engineering work to more than two significant figures. The power required from day to day by any one machine varies, since the material, the size of cut, the shape and conditions of the tool are not constant. The power supplied to the shops comes in the form of a 220 volt direct circuit. The method for stating the distribution of power in electrical horse-power would have

been objectionable on account of the loss of energy in the motor, the efficiency of which was unknown. It was decided that (1) the total electrical input of each motor should be obtained under actual working conditions, this data showing the names of the machines in use and whether under load or empty. These results can be found by consulting the tables. (2) The motors were loaded by using friction dynamometers in order to obtain conditions similar to (1) with respect to the voltage, speed, and load. In each case the input was obtained by placing the voltmeter and ammeter at the most accessible point in the line as shown in figure. Thus in the machine shop, the prony brake apparatus was all supported high up on the roof truss but the electrical instruments were placed in the circuit at a convenient place near the starting box and switch. This was allowable since the instruments were in the same position during tests 1 and 2, so that the line drop being a constant, was not counted.

During the tests some of the following things were observed. Water must be used constantly in order to remove the heat as fast as it is generated, otherwise the fluctuating temperature will effect the reading. When water is allowed to get to the rubbing surfaces it acts as a lubricant. If the quantity is small the heat from the brake is liable to dry the surface. When the lubricant is thus taken from the two rubbing surfaces the friction increases very rapidly, causing the brake to grip the pulley, to a dangerous point. Machine oil will help keep out water besides lubricating the surface, but a constant mixture is desirable. By using a sufficient quantity of water upon the inner surface of the pulley, the outside rubbing surface cannot get warm enough to dry off.

An attempt was made to design and construct a friction brake which would possess the following advantages over the common form.

1. Adjustable for pulleys between 6" and 10" diameter
2. No tendency to chatter from grip on the pulley
3. Large amount of rubbing surface well distributed over the pulley face
4. Spring balance reading actual force resisted
5. Ability to be loaded, by one screw, without producing errors in the reading

For want of time this brake was hastily put together and tried on the 20 H. P. motor. No oil could be used as the pulley face was pierced by numerous holes 1/8" in diameter and water from the inside of the pulley passed through these to rubbing surfaces. This brake acted fairly well during the test as the spring balance did not vibrate. The gripping effect which makes a common prony brake chatter, was absent. The brake was somewhat unhandy to place upon the pulley until experience was obtained.

LOAD ON NOMINAL 8 H.P. MOTOR IN

WOOD TURNING SHOP
All Machines Loaded.

NO	TIME	VOLTS	AMP	WATTS	E. H. P.	
1	1:04	216	16	3460	4.64	2,4,5,6,7
2	1:10	217	15	3260	4.37	2,5,8,7,9,11,14
3	1:15	218	16	3490	4.68	4,6,8,10,11
4	1:20	216	20	4320	5.79	4,6,9,11,12,15
5	1:23	216	18	3890	5.20	2,7,8,9,10,11,13,15
6	1:25	218	21	4570	6.13	6,7,8,9,10,11,13,16
7	1:27	218	21	4570	6.13	6,7,8,9,10,11,13,16
8	1:30	215	18	3880	5.20	2,4,5,7,8,10,11,12,13,15,16
9	1:35	218	18	3920	5.25	2,4,5,7,8,10,11,12,13,15,16
10	1:37	212	22	4660	6.25	4,6,7,8,9,10,11,14,15,16
11	1:40	220	22	4850	6.50	2,4,7,8,10,11,14,15,16
12	1:45	222	21	4670	6.25	4,6,8,9,11,16
13	1:51	221	21	4650	6.22	2,4,6,11,9,16
14	1:55	220	23	5050	6.77	2,4,8,9,7,11,15,16
15	1:59	220	30	6600	8.85	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16
16	1:59	222	25	5550	7.44	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16
17	2:02	221	23	5090	6.81	2,4,5,7,8,10,11,12,13,14,15,16
18	2:05	222	20	4440	5.95	2,4,5,6,7,9,10,11,13,14,15,16
19	2:10	222	18	4000	5.36	2,4,5,7,9,11,15,16
20	2:15	222	21	4660	6.25	2,4,5,6,7,8,9,11,12,14,15,16
21	2:22	221	16	3540	4.75	2,11,13,16
22	2:25	222	18	4000	5.36	2,5,6,7,9,10,11,13,15,16
23	2:30	221	18	3980	5.34	2,3,5,7,9,10,13,15,16
24	2:31	221	27	5970	8.00	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16
25	2:33	220	30	6600	8.85	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16
26	2:36	222	15	3320	4.45	1,4,6,7,9,11,13,16

NO	VOLTS	AMP	WATTS	E. H. P.	LOAD ON 8 H. P. MOTOR WOOD TURNING SHOP
27	224	18	4030	5.40	1,2,3,4,5,7,16
28	224	26	5820	7.80	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16
29	222	25	5550	7.44	1,2,3,4,5,6,7,8,10,11,12,13,14,15,16
30	222	24	5330	7.14	1,2,3,4,5,6,7,10,11,12,13,14,15,16
31	224	23	5150	6.90	1,2,3,4,5,6,7,11,12,13,14,15,16
32	222	22	4890	6.55	1,2,3,4,5,6,7,12,13,14,15,16
33	222	20	4440	5.95	1,2,3,4,5,6,7,12,14,15,16
34	222	19	4220	5.65	1,2,3,4,5,6,7,12,14,16
35	224	18	4030	5.40	1,2,3,4,5,6,7,12,16
36	222	18	4000	5.36	1,2,3,4,5,6,7,16
37	225	17	2830	3.79	1,2,3,4,5,6,7
38	224	17	3810	5.10	1,2,3,4,5,6,7
39	225	16	3600	4.82	1,2,3,4,6
40	226	15	3390	4.54	1,2,3,4
41	223	13	2900	3.89	1,2,3
42	224	14	3130	4.19	1,2
43	224	13	2910	3.90	2
44	224	12	2690	3.60	All Machines Off
45	224	9	2020	2.71	Line Shaft Only

PRONY BRAKE DATA
8 H.P.

NO	VOLTS	AMP	WATTS	E.H.P.	WEIGHT	FORCE	RPM	B.H.P.	WOOD TURNING SHOP
1	223	8	1780	2.38	10-2	0.87	1440	0.63	May 17
2	223	9	2020	2.70	11-0	1.75	1280	1.12	
3	224	10	2240	3.00	10-12	1.50	1430	1.07	
4	223	12	2680	3.60	12-0	2.75	1425	1.95	
5	224	15	3360	4.50	13-0	3.75	1220	2.29	
6	234	15	3510	4.70	14-0	4.75	1425	3.39	
7	242	18	4350	5.83	15-0	5.75	1425	4.10	
8	228	5	1140	1.53	0	0	1440	0	
1	220	6	1320	1.77	2-10	0.62	1100	0.34	May 20
2	218	8	1740	2.33	3-8	1.50	1100	0.83	
3	218	10	2180	2.92	3-8	1.50	1100	0.83	
4	216	11	2380	3.19	4-8	2.50	1050	1.31	
5	218	11	2400	3.22	4-8	2.50	1050	1.31	
6	218	10	2180	2.92	5-0	3.00	1100	1.65	
7	218	15	3270	3.62	5-0	3.00	1075	1.61	
8	218	15	3270	3.62	6-0	4.00	1100	2.20	
9	218	15	3270	3.62	7-0	5.00	1100	2.75	
10	216	19	4100	5.50	8-0	6.00	1100	3.30	
1	218	14	3050	4.08	5-0	3.00	1025	1.54	May 20
2	222	17	3770	5.05	7-0	5.00	1025	2.56	
3	218	20	4360	5.85	8-5	6.31	1050	3.32	
4	216	22	4750	6.37	9-4	7.25	1020	3.70	
5	218	22	4800	6.44	9-4	7.25	1050	3.80	
6	216	22	4750	6.37	9-12	7.75	1025	3.97	
7	216	22	4750	6.37	9-12	7.75	1050	4.06	

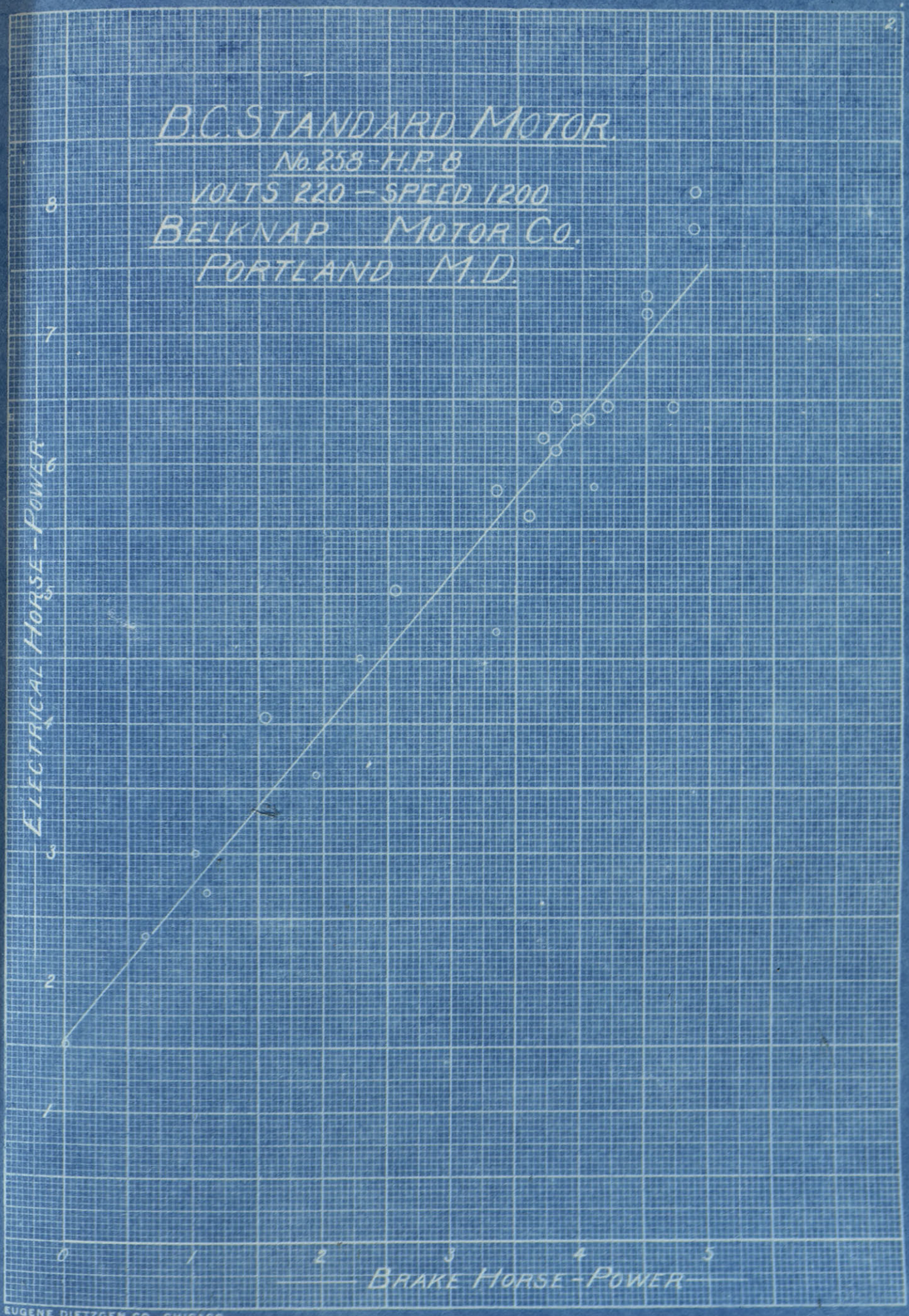
B.C. STANDARD MOTOR

No. 258 - H.P. 8

VOLTS 220 – SPEED 1200

BELKNAP MOTOR CO.

PORTLAND M.D.



EUGENE DIETZGEN CO., CHICAGO.

NO	TIME	VOLTS	AMP	WATTS	E.H.P.	LOAD ON NOMINAL 20 H.P. MOTOR IN WOOD TURNING SHOP
	May 15					
1	3:46	216	14	3020	4.05	A Line represents a Load
2	3:55	216	15	3240	4.34	$\overline{9}$
3	3:58	216	13	2810	3.76	All Line-shafting in Motion
4	3:58	216	14	3020	4.05	"
5	3:59	216	14	3020	4.05	6, 9
6	3:59	216	10	3460	4.64	$\overline{6}$, $\overline{9}$
7	4:00	216	19	4100	5.50	2, 6, 9
8	4:01	214	22	4710	6.32	2, 6, 7, 9
9	4:02	214	22	4710	6.32	2, 4, 6, 7, 9
10	4:02	216	34	7350	9.85	1, 2, 4, 6, 7, 9
11	4:03	210	40	8400	11.3	1, 2, 3, 4, 6, 7, 9
12	4:05	210	42	8810	11.8	1, 2, 3, 4, 6, 7, $\overline{8}$, 9
13	5:00	214	13	2780	3.73	1
14	5:02	214	24	5140	6.88	$\overline{1}$
15	5:02	215	24	5170	6.92	$\overline{1}$
16	5:06	216	14	3020	4.05	3
17	5:06	214	25	5360	7.17	$\overline{3}$
18	5:08	216	16	3460	4.64	$\overline{8}$
19	5:08	216	16	3460	4.64	$\overline{8}$
1	June 6	214	12	2570	3.45	0
2		214	14	3000	4.02	$\overline{3}$
3		214	15	3210	4.30	$\overline{4}$
4		214	18	3850	5.16	$\overline{4}$
5		214	21	4500	6.04	$\overline{2}$
6		214	26	5560	7.46	$\overline{1}$
7		214	21	4500	6.04	1
8		212	39	8260	11.1	$\overline{1}$, $\overline{2}$

NO	TIME	VOLTS	AMP	WATTS	E. H. P.	LOAD ON NOMINAL 20 H.P.MOTOR IN WOOD TURNING SHOP
9		214	25	5350	7.17	1, 2, $\overline{4}$
10		214	30	6420	8.61	1, 2, $\overline{4}$
11		212	42	8900	11.9	$\overline{1}$, $\overline{2}$, $\overline{4}$
12		214	30	6420	8.61	$\overline{1}$, $\overline{2}$, $\overline{3}$, $\overline{4}$,
13		214	29	6200	8.31	$\overline{1}$, $\overline{2}$, $\overline{3}$, 4, 6
14		212	50	10600	14.2	$\overline{1}$, $\overline{2}$, $\overline{4}$, $\overline{6}$, $\overline{8}$

PRONY BRAKE TEST
20 H. P.

NO	VOLTS	AMP	WATTS	E. H. P.	FORCE	RPM	B. H. P.
1	218	9	1960	2.62	2	996	1.61
2	216	14	3020	4.06	4	964	3.11
3	216	17	3670	4.92	6	980	4.75
4	216	22	4750	6.36	7	958	5.41
5	216	22	4750	6.36	7	968	5.45
6	216	30	6480	8.68	8	958	6.19
7	214	29	6210	8.32	8	958	6.19
8	214	32	6850	9.19	9	956	6.95
9	214	32	6850	9.19	9	956	6.95
10	214	34	7280	9.75	10	960	7.75
11	214	34	7280	9.75	10	970	7.84
12	214	37	7920	10.6	11	948	8.42
13	214	38	8130	10.9	11	948	8.42
14	214	42	9000	12.1	11.5	950	8.82
15	214	40	8560	11.5	11.5	950	8.82
16	212	44	9320	12.5	12	944	9.14
17	212	45	9540	12.8	12	940	9.88
18	212	47	9960	13.3	14	958	10.8
19	212	52	11000	14.8	15	912	11.05
20	218	6	1310	1.75	0	990	0

CARPENTER SHOP

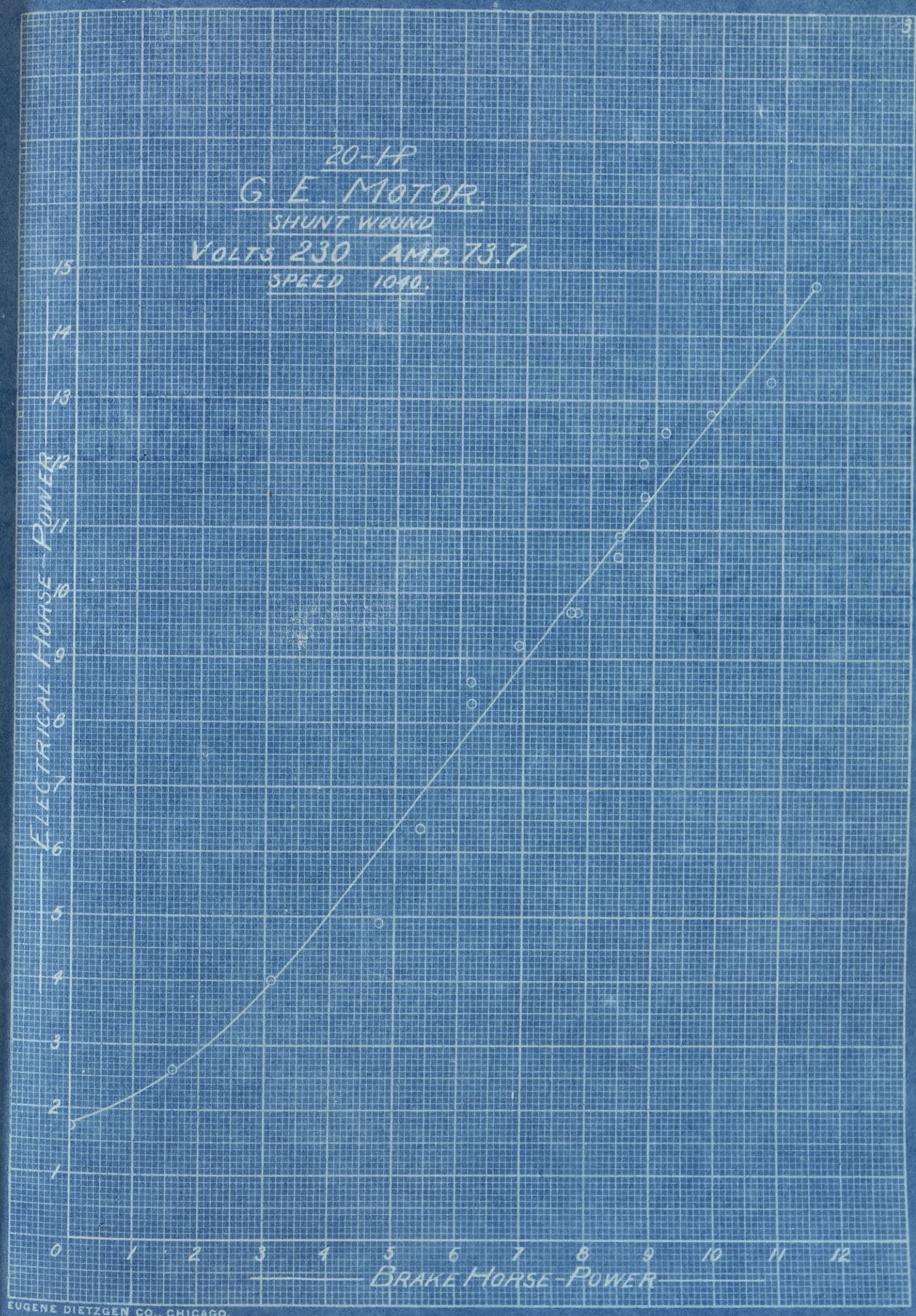
51" = ARM of COUPLE

$$H.P. = \frac{2\pi DNF}{33000}$$

------- C O D E -------

1	Planer	4	Shaper	7	Jig Saw
2	Band Saw	5	Polisher	8	Mortising Machine
3	Circular Saw	6	Wood Lathe - 12'	9	Drill Press

20-HP
G. E. MOTOR.
SHUNT WOUND
VOLTS 230 AMP. 73.7
SPEED 1040.



NO	TIME	VOLTS	AMP	WATTS	E.H.P.	LOAD ON 10 H. P. MOTOR MACHINE SHOP A Line represents a load.
	May 15					
1	1:01	229	16	3670	4.92	Line shafting as a load
2	1:06	220	17	3740	5.00	"
3	1:17	220	16	3520	4.72	$\overline{14},\overline{15},\overline{17}$
4	1:21	220	19	4180	5.60	$15,\overline{17}$
5						
5	1:30	220	20	4400	5.80	$\overline{3},\overline{14},\overline{15},\overline{17}$
6	1:35	218	25	5450	7.30	$\overline{1},\overline{3},\overline{15},\overline{17},\overline{19},\overline{25}$
7	1:48	220	20	4400	5.80	$\overline{1},\overline{2},\overline{15},\overline{17},\overline{25}$
8	1:50	220	20	4400	5.80	$\overline{2},\overline{15},\overline{17}$
9	1:55	219	20	4380	5.87	$\overline{5},\overline{14},\overline{15},\overline{17}$
10	2:03	218	18	3920	5.25	$\overline{1},\overline{5},\overline{18},\overline{19},23$
11	2:08	220	20	4400	5.90	$\overline{5},\overline{15},\overline{18}$
12	2:15	220	19	4180	5.60	$\overline{1},\overline{2},\overline{15},\overline{18},23$
13	2:20	220	20	4400	5.90	$\overline{2},\overline{15},\overline{18},\overline{20},\overline{23}$
14	2:25	220	16	3520	4.72	$\overline{2},\overline{18},\overline{20}$
15	2:30	219	19	4160	5.58	$\overline{1},\overline{2},\overline{3},\overline{4},\overline{16},\overline{18},\overline{20}$
16	2:33	219	20	4380	5.88	$\overline{3},\overline{4},\overline{16},\overline{18},\overline{20}$
17	2:35	220	21	4620	6.20	$\overline{1},\overline{2},\overline{4},\overline{5},\overline{15},\overline{16}$
18	2:40	218	21	4570	6.13	$\overline{1},\overline{3},\overline{4},\overline{15},\overline{18}$
19	2:45	220	16	3520	4.72	$\overline{2},\overline{4},\overline{5},14$
20	2:50	220	19	4175	5.60	$\overline{1},\overline{2},\overline{5},15,\overline{18}$
21	2:55	218	27	5900	7.90	$\overline{1},\overline{2},\overline{3},\overline{5},6,8,14,\overline{15},16,17,\overline{28},\overline{29},30,31$
22	2:56	218	24	5230	7.00	$\overline{1},\overline{2},\overline{3},\overline{5},6,8,\overline{12},14,\overline{15},16,17,\overline{18},23,\overline{28},$ 29,30,31
23	2:57	218	30	6540	8.76	$\overline{1},\overline{2},\overline{3},6,8,\overline{12},14,\overline{15},16,17,\overline{18},23,\overline{24},\overline{28},$ 29,30,31
24	2:58	220	27	5940	7.96	All Machines On, Unloaded.
25	2:59	220	30	6600	8.85	" - 5.
26	2:59	220	25	5500	7.48	" - 2 - 5.

LOAD ON 10 H. P. MOTOR
MACHINE SHOP

A Line represents a load.

NO	TIME	VOLTS	AMP	WATTS	E. H. P.	
9	1:47	230	34	7820	10.5	1,$\overline{3}$,4,9,13,14,16,18,19,20,21,28,30,31
10	1:48	230	28	6440	8.63	1,$\overline{4}$,$\overline{9}$,13,14,$\overline{16}$,18,19,20,21,28,30,31
11	1:50	234	16	3740	5.01	$\overline{3}$,$\overline{4}$,21,31
12	1:55	232	15	3480	4.66	$\overline{2}$,$\overline{3}$,$\overline{4}$,$\overline{16}$,21
13	2:00	234	20	4680	6.28	$\overline{2}$,$\overline{3}$,$\overline{16}$,21
14	2:05	236	16	3780	5.06	$\overline{4}$,$\overline{15}$,21,$\overline{23}$
15	2:10	246	20	4920	6.59	$\overline{1}$,$\overline{2}$,$\overline{4}$,$\overline{15}$,$\overline{16}$,21
16	2:15	200	16	3200	4.29	$\overline{2}$,$\overline{4}$,$\overline{15}$,$\overline{16}$,21
17	2:20	216	16	3460	4.64	$\overline{1}$,$\overline{4}$,$\overline{16}$,21
18	2:25	220	14	3080	4.13	21
19	2:30	220	22	4840	6.48	$\overline{3}$,$\overline{4}$,$\overline{15}$
20	2:35	220	18	3960	5.30	$\overline{4}$,$\overline{15}$,$\overline{16}$
21	2:40	219	17	3720	4.98	$\overline{3}$,$\overline{15}$,$\overline{16}$
22	2:45	218	18	3920	5.25	$\overline{4}$,$\overline{15}$
23	2:50	218	14	3050	4.08	$\overline{4}$
24	2:55	216	13	3020	4.05	$\overline{14}$
25	3:00	217	14	3040	4.07	0
26	3:05	215	13	2790	3.74	$\overline{2}$
27	3:10	218	14	3050	4.08	$\overline{14}$,$\overline{16}$

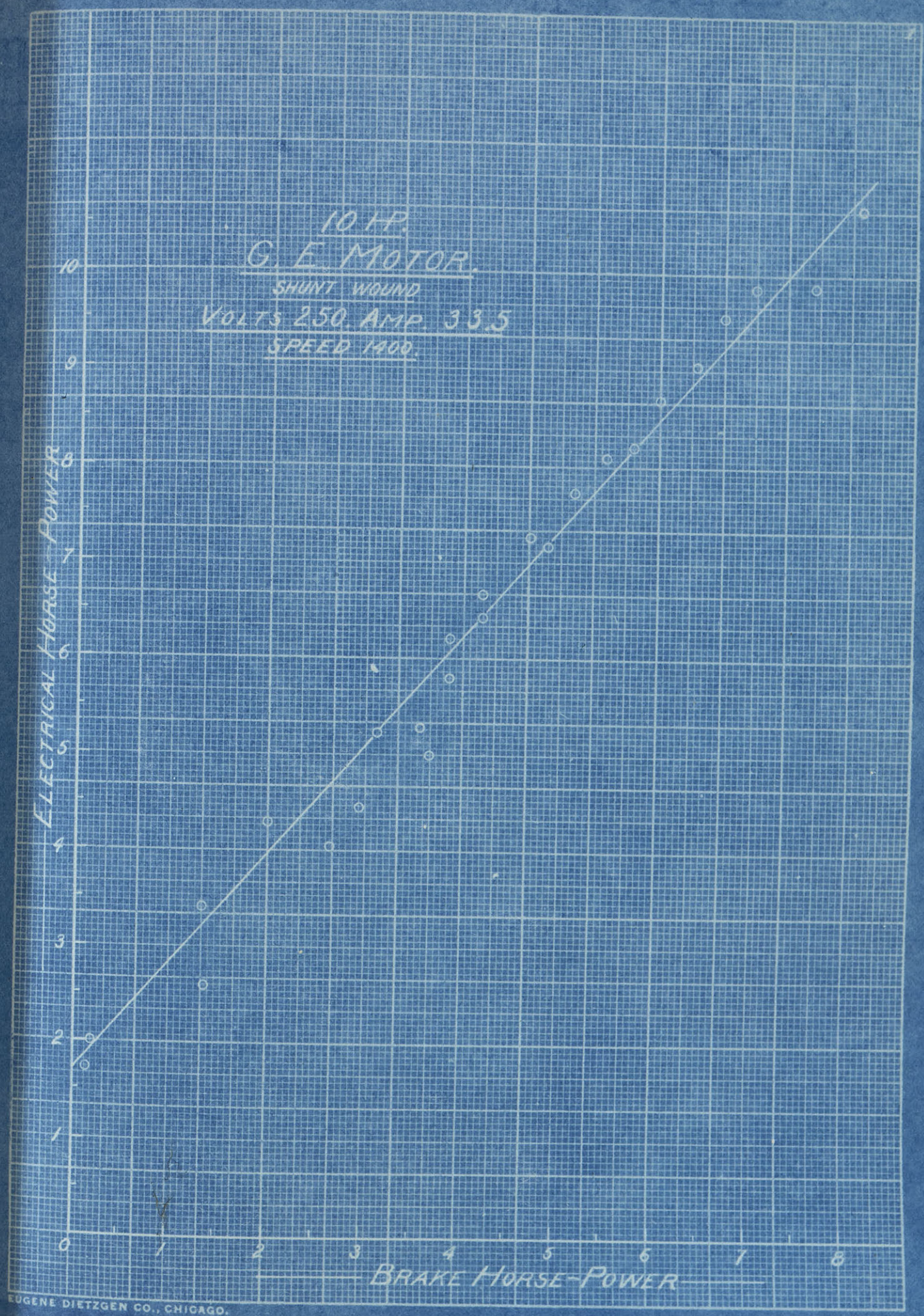
------- C O D E -------

1-12	14" Lathes	18	Miller	24	Pipe Machine
13	Tool Room Lathe	19	Emery Wheel	25	Speed Lathe
14	28"x20' Lathe	20	Polisher	26	Drill Grinder
15	Planer	21	Grindstone	27	Universal Grinder
16	Shaper	22	Hack-Saw	28,29,30	Sensitive Drill Press
17	Boring Mill	23	Drill Press	31	Slotter

PRONY BRAKE DATA
10 H.P.

NO	VOLTS	AMP	WATTS	E.H.P.	Wt.	FORCE	RPM	B.H.P.	MACHINE SHOP
1	212	6	1270	1.70	2 - 9	0.31	1195	0.185	31.5"= ARM of COUPLE
2	214	7	1500	2.01	2 - 9	0.31	1245	0.193	
3	212	9	1910	2.56	3 - 8	1.25	1245	0.78	
4	214	9	1930	2.59	4 - 8	2.25	1220	1.37	
5	214	12	2570	3.44	4 - 8	2.25	1195	1.34	
6	214	15	3210	4.30	5 - 8	3.25	1245	2.02	
7	216	14	3020	4.05	6 - 6	4.30	1245	2.68	
8	214	16	3420	2.58	7 - 0	4.75	1245	2.96	
9	218	18	3920	5.25	7 - 4	5.00	1245	3.11	
10	220	17	3740	5.00	8 - 0	5.75	1270	3.66	
11	220	18	3960	5.30	8 - 0	5.75	1245	3.58	
12	216	20	4320	5.80	8 - 8	6.25	1245	3.89	
13	220	21	4620	6.20	8 - 8	6.25	1245	3.89	
14	218	22	4800	6.44	9 - 0	6.75	1245	4.22	
15	216	23	4970	6.66	9 - 0	6.75	1245	4.69	
16	216	25	5400	7.25	9 - 8	7.25	1295	4.69	
17	214	25	5350	7.17	10- 0	7.75	1255	4.87	
18	214	27	5780	7.75	10-8	8.25	1245	5.14	
19	216	28	6050	8.10	11-0	8.75	1245	5.45	
20	218	28	6100	8.19	11-8	9.25	1245	5.75	
21	216	30	6480	8.69	12-0	9.75	1245	6.06	
22	218	31	6750	9.05	12-8	10.25	1245	6.38	
23	216	33	7130	9.55	13-12	10.75	1245	6.70	
24	216	34	7350	9.85	14-8	11.5	1220	7.00	

10 H.P.
G. E. MOTOR.
SHUNT WOUND
VOLTS 250. AMP. 33.5
SPEED 1400.



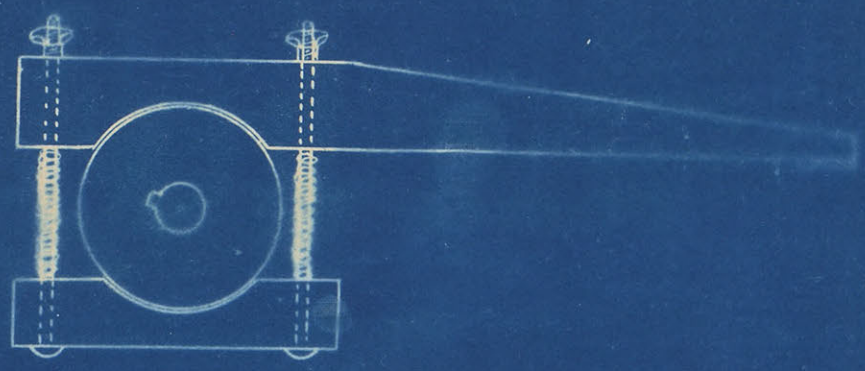
EUGENE DIETZGEN CO., CHICAGO.

LOAD ON 10 H.P. MOTOR
MACHINE SHOP

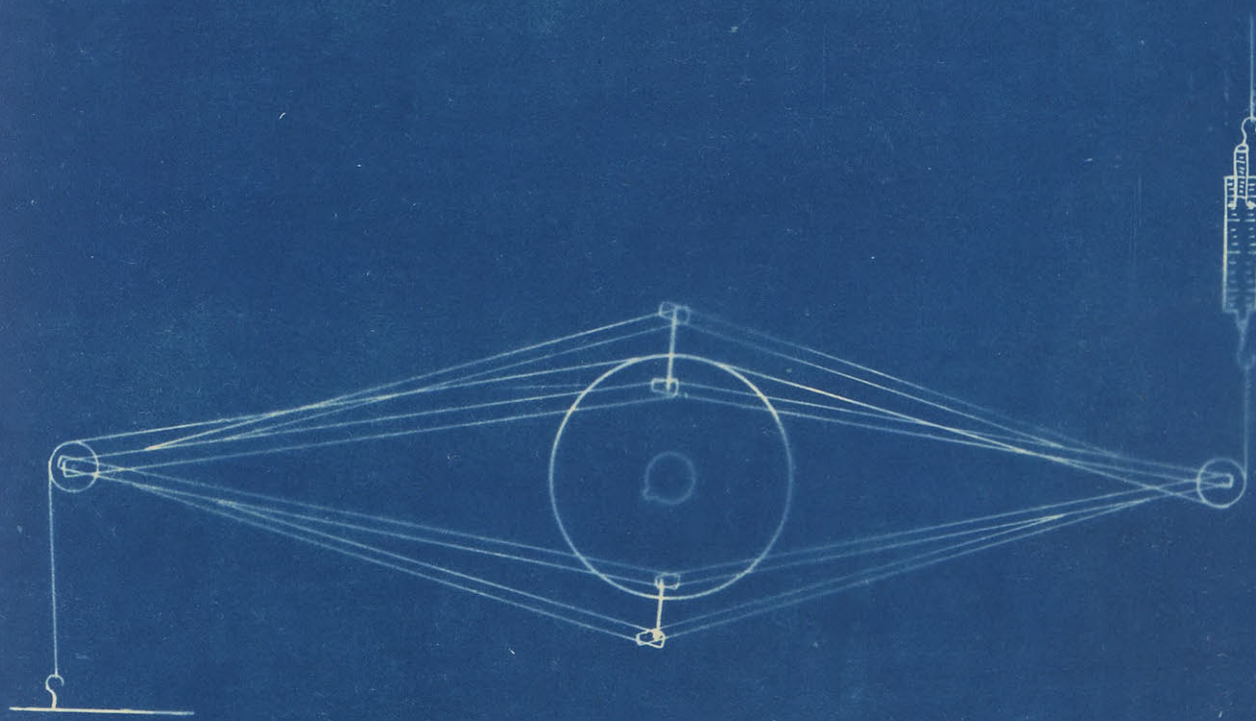
NO	TIME	VOLTS	AMP	WATTS	E. H. P.	A Line represents a load.
27	2:59	218	25	5450	7.30	All Machines running, except Numbers 1, 2, 5.
28	3:00	220	31	6820	9.30	1,2,5,6
29	3:01	218	22	4790	6.43	1,2,4,5,6
30	3:01	220	31	6820	9.15	1,2,3,4,5,6
31	3:02	220	22	4840	6.48	1,2,3,4,5,6,8
32	3:03	220	27	5950	7.98	1,2,3,4,5,6,8,10,12
33	3:03	220	22	4840	6.49	1,2,3,4,5,6,8,10,11,12
34	3:04	220	29	6380	8.55	1,2,3,4,5,6,8,9,10,11,12
35	3:05	220	24	5280	7.08	1,2,3,4,5,6,8,9,10,11,12,14,24
36		222	22	4840	6.48	1,2,3,4,5,6,8,9,10,11,12,14,23,24
37		222	24	5280	7.08	Machines Running 7,13,15,17,18,19,20,21,22,25,26,27,28,31
38		220	20	4400	5.91	7,13,15,17,18,19,20,21,22,25,26,27,28
39		221	20	4420	5.92	7,15,17,19,20,21,22,25,26,27,28
40	3:07	222	19	4220	5.65	7,15,17,20,21,22,25,26,27,28
41		220	20	4400	5.9	7,15,17,21,22,25,26,28
42		220	14	3080	4.13	7,15,17,21,22,25,26
43		220	13	2860	3.84	7,15,21,22,25,26
44		220	15	3300	4.42	7,21,22,25,26
May 14						
1	1:10	229	18	4120	5.42	$\overline{4}$,$\overline{9}$,$\overline{15}$,21
2	1:15	229	22	5040	6.75	$\overline{4}$,$\overline{9}$,$\overline{15}$,21
3	1:20	229	19	4350	5.78	$\overline{4}$,$\overline{9}$,$\overline{15}$,$\overline{16}$,21
4	1:25	228	17	3880	4.53	$\overline{3}$,$\overline{4}$,$\overline{9}$,$\overline{15}$,$\overline{16}$,21,$\overline{25}$
5	1:30	230	17	3910	5.24	$\overline{3}$,$\overline{4}$,$\overline{9}$,$\overline{16}$,21
6	1:35	231	15	6470	4.65	$\overline{3}$,$\overline{4}$,21
7	1:40	230	17	3910	5.24	$\overline{3}$,$\overline{4}$,9,$\overline{16}$,$\overline{21}$,$\overline{25}$
8	1:45	231	28	6470	8.67	1,$\overline{3}$,$\overline{4}$,$\overline{9}$,13,14,$\overline{16}$,18,19,20,21,28,30

SUMMARY OF RESULTS.

AVERAGE TOTAL POWER B. H.P.	KIND OF LOAD	CONDITION OF LOAD
4	Machine Shop	Normally loaded
2.8	" "	Running light
6.5	" "	Heavily loaded
5	Carpenter "	Normally loaded
3	" "	Lightly loaded
9	" "	Heavily loaded
3.75	Wood turning shop	Normally loaded
1.3	" "	Lightly loaded
5	" "	Heavily loaded



PRONY BRAKE USED IN MACHINE SHOP AND WOOD-TURNING SHOP



PRONY BRAKE USED IN CARPENTER SHOP