THESIS

TESTS OF MOTORS IN GRAIN ELEVATORS AND FEED MILLS

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TESTS OF MOTORS IN GRAIN ELEVATORS AND FEED MILLS

A Thesis Submitted to

The Faculty of

The Michigan Agricultural College

By

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Candidates for the Degree of

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June 1, 1921.

THESIS

INTRODUCTION.

This thesis is for the purpose of determining the amount of power required to drive the various types of feed-mill and elevator machinery.

Little attention has been paid to motors used for this purpose. Such motors while small in size are often large in importance, for each one constitutes a fire hazard. Elevators and feed-mills are necessarily very dusty, and a spark or an overheated motor may cause an explosion or a fire. For this reason it is essential that no motor should be overloaded enough to cause it to overheat.

Tests were made under actual running conditions, but in some cases it was impossible to obtain very accurate or satisfactory results, due to the fact that certain machines are usually run in connection with other equipment, such as short elevators, line shafts, etc.

However, we trust that our efforts will prove of some value in determining the power required to drive various elevator and feed- mill machines.

SAGINAW MILLING COMPANY, SANDUSKY, MICH.

On April 14, 1921 the electric motors in the "Greeley" and "Bickle" elevators of the Saginaw Milling Company at Sandusky, Michigan were tested by R.A. Backus and R. M. Maitland for the purpose of determining why the specified fuses were not sufficient to carry the load. Found that several of the motors were heavily overloaded.

Conditions were investigated at the Gleaner's Elevator, a printing shop, and two meat markets, which comprise the total power load of the village. The lighting load is very small during the day.

At the Gleaner's Elevator fuses were replaced with fuse-wire or copper wire thruout, except at relays on 10 H.P. motor circuit. The motors in the printing shop and the two meat-markets, which are all 5 H.P., were started with single throw triple pole switches, and fused with 60 amp. fuses, except where copper wire was used.

The Power Plant, which is owned by the Village, is located about 100 feet from the Bickle Elevator, and is equipped with two generators of 30 Kw. and 85 Kw. capacity.

Character of service: 440 volt, 60 cycles, 3 phase.

The following tabulated data shows the results of the tests.

GREELEY ELEVATOR.

MOTOR #1.

2 H.P. Robbins and Myers 1150 r.p.m., 32 amps. 3.2 amp

Driving one elevator leg empty, 45'- 5 x 9" cups.

Volts	Av. amps.	Start. amps.	Watts	H.P.	P.F.
472	2.5	15.5	1250	1.66	.612

Remarks:

The high starting current was instantaneous only.

MOTOR #2.

7.5 H.P.Robbins and Myers Type K 1150 r.p.m., 10 amps.

Driving one short elevator leg empty, and idler pulley on one #7 Monitor wheat cleaner.

Volts	Av. amps.	Start. amps.	Watts	H.P.	P.F.
464	10.4	26.5	2400	3.16	.285

Running the elevator and wheat cleaner loaded.

Volts	Av. amps.	Start. amps.	Watts	H.P.	P.F.
464	11.75		5100	6.8	.54

MOTOR #3.

7.5 H.P.Robbins and Myers type K 1150 r.p.m., 10 amps.

Driving one short elevator leg and #5 Monitor Grain Separator empty.

Volts	Av. amps.	Start. amps.	Watts	H.P.	P.F.
458	9.0	24.25	3800	5.06	.534

Remarks:

We were unable to run this machinery loaded.

MOTOR #4.

1 H.P.Robbins and Myers type K 1150 r.p.m., 1.6 amps.

Driving one short elevator leg empty.

Volts	Av.amps.	Start.amps.	Watts	H.P.	P.F.
476	2.5	7.5	550	.73	.267

Remarks:

This motor would undoubtedly be overloaded when

elevating grain.

MOTOR #5.

20 H.P. General Electric Type KT 1750 r.p.m., 24.5 amps.

Driving a Dreadnaught 20" Feed grinder empty.

Volts	Av. amps.	Start. amps.	Watts	H.P.	P.F.
442	7.5		3030	4.04	.525

Running the above machine while grinding oats.

Volts	Av. amps.	Start. amps.	Watts	H.P.	P.F.
438	13.21		9200	12.22	.92

Remarks:

This motor, together with the following 1 H.P. motor is on a separate circuit.

The exact starting current could not be determined as it was above 50 amperes and meters used were not of sufficient capacity.

MOTOR #6.

1 H.P. Fort Wayne Type MA, 1.75 amps. per phase, 1800 R.P.M.

Driving two short elevator legs and a shaker loaded with oats.

Volts	Av. amps.	Start. amps.	Watts	H.P.	P.F.
442	1.0	6.0	487	.647	.683

BICKLE ELEVATOR.

MOTOR#1.

3 H.P. Robbins and Meyers Type K, 4.2 amps. per phase, 1150 R.P.M.

Driving two short elevators and #10 Clipper Seed Cleaner empty.

Volts	Av. amps.	Start. amps.	Watts	H.P.	P.F.
478	2.5	21.75	1350	1.79	.510

Driving the above elevators and cleaner and idler pulley on Invincible bean picker.

Volts	Av. amps.	Start. amps.	Watts	H.P.	P.F.
478	4.0		1400	1.86	.424

Driving elevators, seed cleaner, and bean picker all empty.

Volts	Av. amps.	Start. amps.	Watts	H.P.	P.F.
478	4.5	22.0	1650	2.19	.444

MOTOR #2.

7.5 H.P. Robbins and Meyers Type K, 10 amps. per phase, 1150 R.P.M.

Driving fan on bean drier.

Volts	Av. amps.	Start. amps.	Watts	H.P.	P.F.
448	13.0	21.5	7180	9.6	.733

Driving idler pulley on fan.

Volts	Av. amps.	Start. amps.	Watts	H.P.	P.F.
452	9.0		2575	3.47	.365

Remarks:-

It is quite evident that this motor is overloaded while running fan.

MOTOR #3.

2 H.P. Robbins and Meyers, Type K, 1150 R.P.M. 3.2 amps. per phase.

Driving one elevator leg empty, 55' - 7 x 4½" cups.

Volts	Av. amps.	Start. amps.	Watts	H.P.	P.F.
466	2.7	13.75	1200	1.6	.550

Remarks:

This motor is undoubtedly overloaded while elevating grain.

MOTOR #4.

2 H.P.Robbins and Meyers, Type K, 1150 R.P.M. 3.2 amps. per phase.

Driving one elevator leg empty, 55' - 4½ x 7".

Volts	Av. amps.	Start. amps.	Watts	H.P.	P.F.
472	2.5	14.75	800	1.06	.333

Driving the above elevator loaded with beans.

Volts	Av. amps.	Start. amps.	Watts	H.P.	P.F.
472	5.0		3000	4.0	.735

Remarks:

This motor is heavily overloaded when elevating beans.

This motor blew 6 amp. starting fuses, but started on 10 amp. fuses.

MOTOR # 5.

10 H.P.Robbins and Meyers, Type K, 1150 R.P.M. 14 amps. per phase.

Driving three short elevator legs empty, and idler pulley on #6 Monitor bean separator.

Volts	Av. amps.	Start. Amps.	Watts	H.P.	P.F.
456	11.75	40.75	3100	4.12	.335

Driving above elevators and #6 Monitor bean separator all empty.

Volts	Av. amps.	Start. amps.	Watts	H.P.	P.F.
452	17.0		10300	13.7	.763

SUMMARY.

Tests show that several of the motors are heavily overloaded. They also show that several of these motors draw a very high starting current, due, no doubt, to the inertia of the machines which they start. Numerous readings of the voltage were taken and found to be 480 when no machines were running. There was a considerable drop when the various motors were started, but at no time did it drop more than 2 volts below normal, which is 440. This would show that the difficulty is not due to low voltage, but to overload.

On the 7.5 H.P. motor driving the coal conveyor there was no protection except the 150 amp. fuses at the entrance and located in the Bickle elevator.

Several of the low-voltage releases were repaired as they were not in working order.

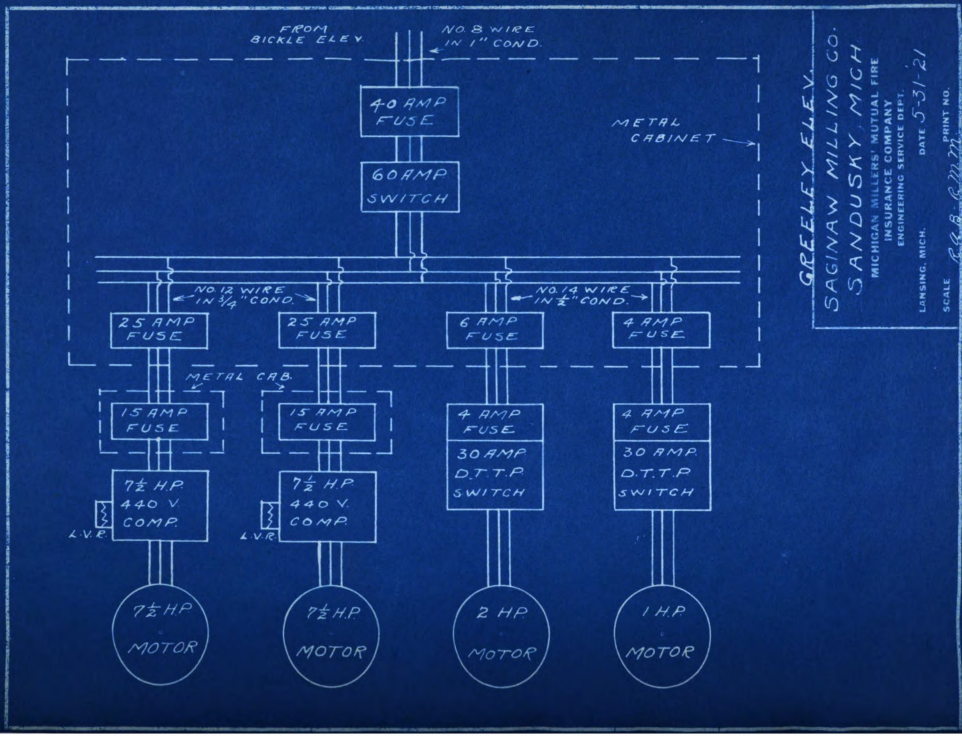
The following data gives the fuse sizes being used on the motors at the present time.

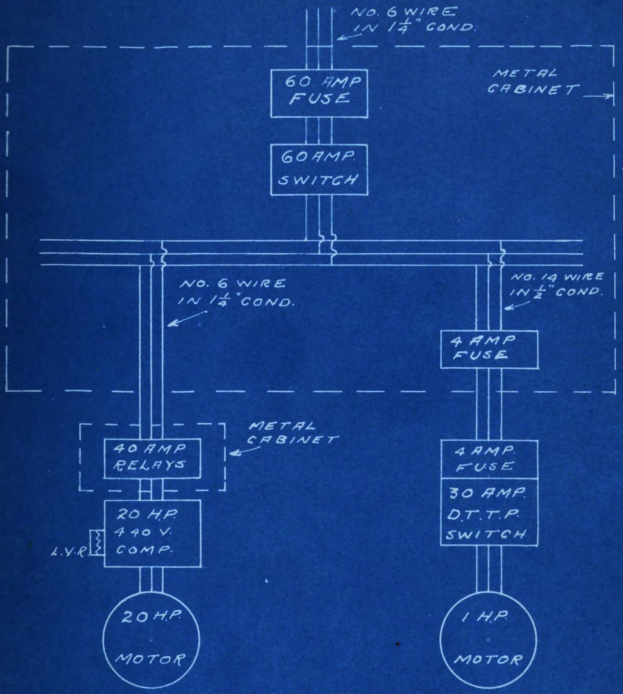
GREELEY ELEVATOR.

Motor size	Starting Fuse	Running Fuse
7.5 H.P.	Fuse Wire	30 amp.
2	Fuse Wire	60 amp.
1	Fuse Wire	15 amp.
7.5	30 amp.	30 amp.
20	60 amp.	30 amp. Relays
1	5 amp.	10 amp.

BICKLE ELEVATOR.

Motor Size	Starting Fuse	Running Fuse
10 H.P.	30 amp.	25 amp.
7.5	25 amp.	30 amp.
2	25 amp.	10 amp.
2	Fuse Wire	10 amp.
3	Copper Wire	15 amp.
7.5	No Fuses except the 150 amp. entrance fuses.	


FROM BICKLE ELEV.
NO. 8 WIRE IN 1" COND.
40 AMP FUSE
60 AMP SWITCH
METAL CABINET
NO. 12 WIRE IN 3/4" COND.
NO. 14 WIRE IN 1/2" COND.
25 AMP FUSE
25 AMP FUSE
6 AMP FUSE
4 AMP FUSE
METAL CAB.
15 AMP FUSE
15 AMP FUSE
4 AMP FUSE
30 AMP D.T.T.P. SWITCH
4 AMP FUSE
30 AMP D.T.T.P. SWITCH
7 1/2 H.P. 440 V. COMP.
L.V.R.
7 1/2 H.P. 440 V. COMP.
L.V.R.
7 1/2 H.P. MOTOR
7 1/2 H.P. MOTOR
2 H.P. MOTOR
1 H.P. MOTOR
GREELEY ELEV.
SAGINAW MILLING CO.
SANDUSKY, MICH
MICHIGAN MILLERS MUTUAL FIRE INSURANCE COMPANY
ENGINEERING SERVICE DEPT.
LANSING, MICH.
DATE 5-31-21
SCALE
PRINT NO.



GREELEY ELEV.

SAGINAW MILLING CO.

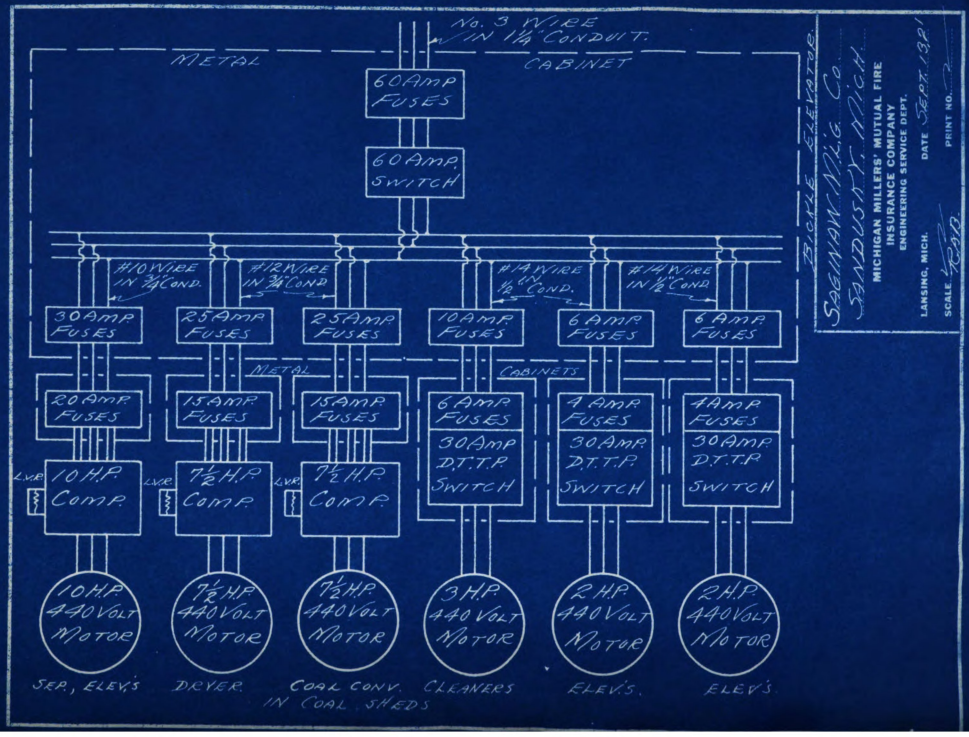
SANDUSKY, MICH.

MICHIGAN MILLERS' MUTUAL FIRE INSURANCE COMPANY
ENGINEERING SERVICE DEPT.

LANSING, MICH. DATE 5-31-21

SCALE R.R.B.-R.M.M. PRINT NO.

100


No. 3 WIRE
IN 1 1/4" CONDUIT.
METAL
CABINET
60 AMP FUSES
60 AMP SWITCH
#10 WIRE IN 3/4" COND.
#12 WIRE IN 3/4" COND.
#14 WIRE IN 1/2" COND.
#14 WIRE IN 1/2" COND.
30 AMP FUSES
25 AMP FUSES
25 AMP FUSES
10 AMP FUSES
6 AMP FUSES
6 AMP FUSES
METAL
CABINETS
20 AMP FUSES
15 AMP FUSES
15 AMP FUSES
6 AMP FUSES
30 AMP D.T.T.R. SWITCH
4 AMP FUSES
30 AMP D.T.T.R. SWITCH
4 AMP FUSES
30 AMP D.T.T.R. SWITCH
L.V.R.
10 H.P. COMP.
L.V.R.
7 1/2 H.P. COMP.
L.V.R.
7 1/2 H.P. COMP.
10 H.P. 440 VOLT MOTOR
7 1/2 H.P. 440 VOLT MOTOR
7 1/2 H.P. 440 VOLT MOTOR
3 H.P. 440 VOLT MOTOR
2 H.P. 440 VOLT MOTOR
2 H.P. 440 VOLT MOTOR
SER., ELEV'S
DRYER
COAL CONV. IN COAL SHEDS
CLEANERS
ELEV'S.
ELEV'S.
PICKLE ELEVATOR.
SAGINAW M.R.G. CO.
SANDUSKY, MICH.
MICHIGAN MILLERS' MUTUAL FIRE INSURANCE COMPANY
ENGINEERING SERVICE DEPT.
LANSING, MICH.
DATE SEPT. 1921
SCALE
PRINT NO.

The following results were obtained at the Portland Farmer's Elevator Co., Portland, Michigan on April 23,1921.

Character of service: 220 volt, 60 cycle, 2 phase current, supplied by the Municipal Power Plant.

MOTOR #1.

No nameplate, supposed to be 10 H.P.

Driving Clipper Cleaner #99-D loaded with oats, 3 short elevators loaded with oats, 1 elevator, 46'4" long, 30" head pulley, 5" x9" cups, 9" canvas belt, known as #1, empty, and 1 elevator, 46'4" long, 20" head pulley, 4½" x 7" cups, 8" canvas belt, known as #2, loaded with oats.

Volts	Av. amps.	Start. amps.	Watts	H.P.	P.F.
218	12.9		3500	4.7	.63

Driving 3 short elevators empty, and #1 empty, and #2 loaded with oats.

Volts	Av. amps.	Start. amps.	Watts	H.P.	P.F.
224	12.5		2700	3.6	.48

Driving 3 short elevators empty, and #1 empty and #2 loaded with oats.

Volts	Av. amps.	Start. amps.	Watts	H.P.	P.F.
224	12.3		2340	3.12	.41

Remarks:

Starting current very high due to the use of Fairbanks-Morse Induction Motor resistance starter.

MOTOR #2.

7.5 H.P., Fairbanks-Morse Type B, 17 amps., figures not discernible for speed.

Driving line shaft and 1 short elevator empty.

Volts	Av. amps.	Start. amps.	Watts	H.P.	P.F.
218	7.0		1300	1.7	.41

Driving Clipper Clover-seed Cleaner #132 B, and 1 short elevator both empty.

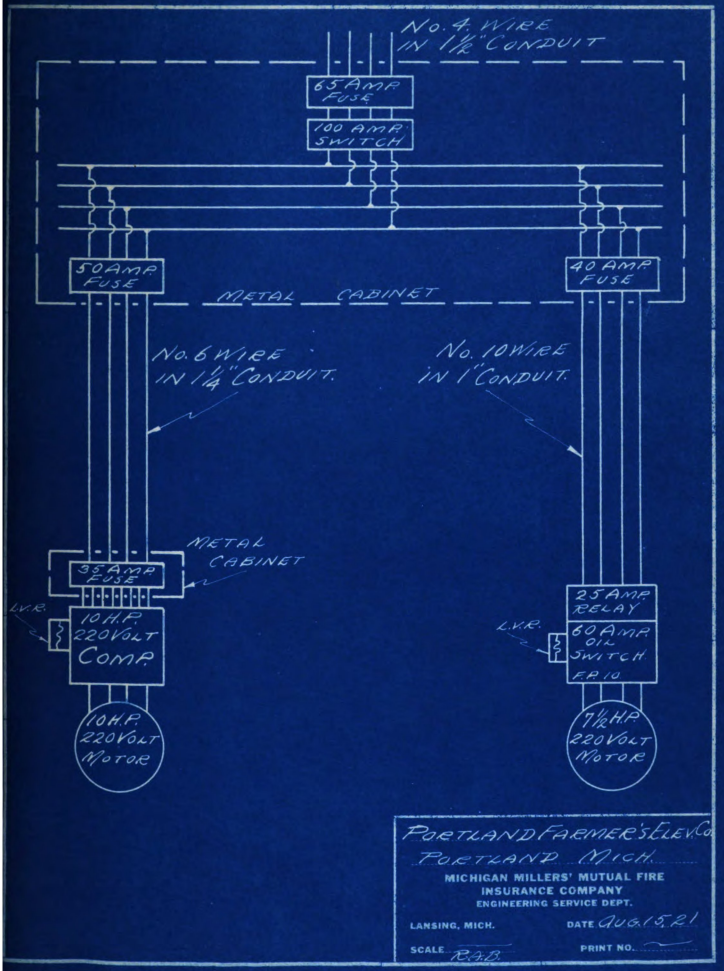
Volts	Av. amps.	Start. amps.	Watts	H.P.	P.F.
216	8.0		1540	2.04	.43

Driving 20 hand bean pickers empty.

Volts	Av. amps.	Start. amps.	Watts	H.P.	P.F.
216	8.0		1340	1.8	.39

Remarks:

Starting current very high due to the use of Fairbanks-Morse Induction Motor resistance starter.


No. 4 WIRE
IN 1½" CONDUIT
65 AMP. FUSE
100 AMP. SWITCH
50 AMP. FUSE
40 AMP. FUSE
METAL CABINET
No. 6 WIRE
IN 1¼" CONDUIT.
No. 10 WIRE
IN 1" CONDUIT.
METAL CABINET
35 AMP. FUSE
L.V.R.
10 H.P. 220 VOLT COMP.
10 H.P. 220 VOLT MOTOR
25 AMP. RELAY
L.V.R.
60 AMP. OIL SWITCH FP 10
7½ HP 220 VOLT MOTOR
PORTLAND FARMER'S ELEV. CO.
PORTLAND MICH.
MICHIGAN MILLERS' MUTUAL FIRE
INSURANCE COMPANY
ENGINEERING SERVICE DEPT.
LANSING, MICH.
DATE AUG. 15. 21
SCALE R.A.B.
PRINT NO.

The following results were obtained at the Portland Elevator Co., Portland, Michigan on April 23, 1921.

Character of service: 440 volt, 60 cycle, 3 phase current which is transformed, by means of the Scott connection, from the 2 phase current, supplied by the Municipal Power Plant.

MOTOR #1.

7.5 H.P. Western Electric, Type KT, 1200 R.P.M. 9.45 amps. per phase.

Driving 6 short elevator legs empty.

Volts	Av. amps.	Start. amps.	Watts	H.P.	P.F.
436	5.5	25.5	1850	2.46	.45

Driving the above elevators and #19 Clipper cleaner all empty.

Volts	Av. amps.	Start. amps.	Watts	H.P.	P.F.
432	6.5	27.5	3100	4.13	.64

Driving six elevators and #89 Clipper Cleaner, empty.

Volts	Av. amps.	Start. amps.	Watts	H.P.	P.F.
432	7.0	28.5	3710	4.93	.71

Driving six elevators and #16 Clipper Cleaner, empty.

Volts	Av. amps.	Start. amps.	Watts	H.P.	P.F.
430	6.0	27.5	2150	2.86	.48

MOTOR #2.

5 H.P.Westinghouse, Type CS, 850 R.P.M., 6.5 amps. Driving 1 elevator leg 47'7" long, head pulley diam. 30" 7" canvas belt, 7" x 3½" cups, known as elevator #1, and

1 elevator leg 47'7" long, head pulley diam. 30", 10" canvas belt, 5 x 9" cups, known as elevator #2, both empty.

Volts	Av. amps.	Start. amps.	Watts	H.P.	P.F.
420	4.0	27.0	600	.8	.20

Driving elevators #1 empty and #2 loaded with oats.

Volts	Av. amps.	Start. amps.	Watts	H.P.	P.F.
430	3.75		1040	1.4	.373

Driving #1 loaded with beans and #2 laoded with oats.

Volts	Av. amps.	Start. amps.	Watts	H.P.	P.F.
432	4.0		1200	1.6	.41

MOTOR #3.

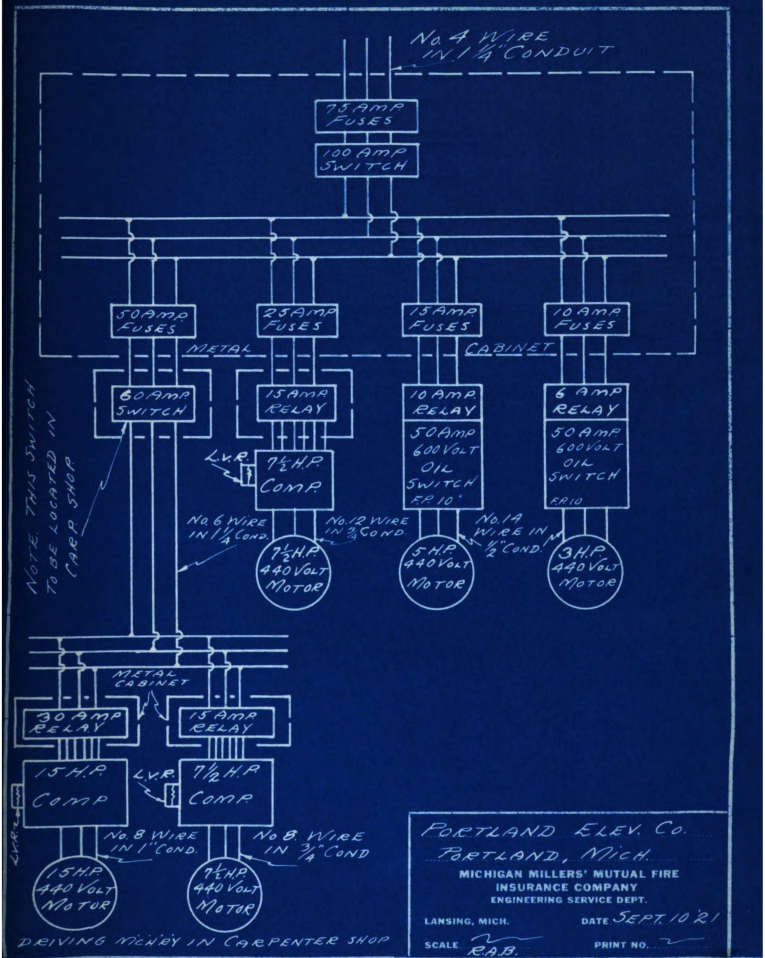
3 H.P., Western Electric, Type KT, 1200 R.P.M., 4.4 amps.

Driving 1 short elevator leg and one two-decker Invincible bean cleaner #16862 both empty.

Volts	Av. amps.	Start. amps.	Watts	H.P.	P.F.
424	2.75	12.0	330	.44	.16

Driving the above elevator empty and cleaner loaded.

Volts	Av. amps.	Start. amps.	Watts	H.P.	P.F.
430	2.7	12.5	410	.55	.20


No. 4 WIRE IN 1 1/4" CONDUIT
75 AMP FUSES
100 AMP SWITCH
50 AMP FUSES
25 AMP FUSES
15 AMP FUSES
10 AMP FUSES
METAL CABINET
60 AMP SWITCH
15 AMP RELAY
10 AMP RELAY
6 AMP RELAY
50 AMP 600 VOLT OIL SWITCH FR 10"
50 AMP 600 VOLT OIL SWITCH FR 10
L.V.R.
7 1/2 H.P. COMP.
NOTE. THIS SWITCH TO BE LOCATED IN CARP. SHOP
No. 6 WIRE IN 1 1/4" COND.
No. 12 WIRE IN 3/4" COND.
No. 14 WIRE IN 1/2" COND.
7 1/2 H.P. 440 VOLT MOTOR
5 H.P. 440 VOLT MOTOR
3 H.P. 440 VOLT MOTOR
METAL CABINET
30 AMP RELAY
15 AMP RELAY
15 H.P. COMP
7 1/2 H.P. COMP
L.V.R.
No. 8 WIRE IN 1" COND.
No. 8 WIRE IN 3/4" COND
15 H.P. 440 VOLT MOTOR
7 1/2 H.P. 440 VOLT MOTOR
DRIVING MCHRY IN CARPENTER SHOP
PORTLAND ELEV. CO.
PORTLAND, MICH.
MICHIGAN MILLERS' MUTUAL FIRE INSURANCE COMPANY
ENGINEERING SERVICE DEPT.
LANSING, MICH.
DATE SEPT. 10 '21
SCALE
R.A.B.
PRINT NO.

The following results were obtained at the Owosso Elevator & Lumber Co's. Elevator, Owosso, Michigan, April 30th, 1921.

Character of service: 440 volt, 60 cycle, 3 phase, alternating current, supplied by the Consumers Power Co., Owosso, Mich.

MOTOR #1.

15 H.P., Western Electric, Type KT, 1715 R.P.M., 18.5 amps. per phase.

Driving elevator leg 34 feet long, 24" head pulley, 7" canvas belt, 4 x 7" cups, empty, known as Elevator #1 and one elevator leg 41 feet long, 24" head pulley, 8" canvas belt, 5 x 8" cups, empty, known as elevator #2, also two short elevator legs empty, and line shaft.

Volts	Av. amps.	Start. amps.	Watts	H.P.	P.F.
474	7.5		3200	4.27	.52

Driving elevators #1 and #2 empty, two short elevator legs empty and Clipper Cleaner #8 D, empty.

Volts	Av. amps.	Start. amps.	Watts	H.P.	P.F.
488	975		4790	6.37	.58

Driving elevator legs #1 and #2 empty, two short elevator legs empty and 30" blower fan for loading cars.

Volts	Av. amps.	Start. amps.	Watts	H.P.	P.F.
486	15.1		10500	14.14	.86

Driving elevator #1 empty and elevator #2 loaded, two short elevator legs empty and line shaft.

Volts	Av.amps.	Start. amps.	Watts	H.P.	P.F.
489	8.5		3600	4.8	.51

Driving elevator #1 loaded, #2 empty, Clipper cleaner #8 D loaded, 2 short elevator legs empty.

Volts	Av.amps.	Start. amps.	Watts	H.P.	P.F.
488	10.25		4900	6.4	.58

MOTOR #2.

10 H.P. Fairbanks-Morse, Type B, 1800 R.P.M., 13 amps. per phase.

Driving elevator 35 feet long, 24" head pulley, 6" canvas belt 3½ x 6 " cups, empty, known as elevator #1, and one elevator 40 feet long, 24" head pulley, 5½" canvas belt, 3½ x 5" cups, empty, known as elevator #2, and two short elevator legs empty.

Volts	Av. amps.	Start. amps.	Watts	H.P.	P.F.
486	8.5		1650	2.2	.23

Driving elevators #1 and #2 empty and two short elevators empty and Clipper cleaner #99 D empty.

Volts	Av. amps.	Start. amps.	Watts	H.P.	P.F.
488	10		4900	6.5	.58

Driving elevators #1 and #2 empty, two short elevators empty and Gibbs bean picker empty.

Volts	Av. amps.	Start. amps.	Watts	H.P.	P.F.
484	8.4		2600	3.46	.37

Driving elevators #1 and #2 empty, two short elevators empty and one elevator 40 feet long, 24" head pulley, 4" x 7" cups, chain drive, known as elevator #3, empty.

Volts	Av. amps.	Start. Amps.	Watts	H.P.	P.F.
480	8.4		2550	3.39	.36

Driving elevators #1, 2 and 3 empty, two short elevators empty and an elevator 34 feet long, 24" head pulley, 6" canvas belt, 6 x 3½" cups, empty, known as elevator #4.

Volts	Av. amps.	Start. amps.	Watts	H.P.	P.F.
481	8.8		2730	3.63	.37

MOTOR #3.

7½ H.P. Fairbanks-Morse, Type B, 1800 R.P.M., 10 amps. per phase.

Driving Sprout & Waldron cob crusher empty.

Volts	Av. amps.	Start. amps.	Watts	H.P.	P.F.
493	6		2040	2.78	.4

Running above crusher loaded.

Volts	Av. amps.	Start. amps.	Watts	H.P.	P.F.
492	15		9800	13.2	.66

Remarks:

The load fluctuated considerably, consequently it was impossible to get very accurate results.

MOTOR #4.

7½ H.P. Fairbanks-Morse Type B, 1800 R.P.M., 10 amps. per phase.

Driving one long elevator loaded, one long elevator empty, one short elevator loaded, line shaft and corn sheller empty.

Volts	Av. amps.	Start. amps.	Watts	H.P.	P.F.
488	5		2800	3.72	.66

Driving two long elevators and one short elevator empty.

Volts	Av. amps.	Start amps.	Watts	H.P.	P.F.
480	5.5		2450	3.28	.54

Driving two long elevators loaded, one short elevator empty, corn sheller empty.

Volts	Av. amps.	Start. amps.	Watts	H.P.	P.F.
486	5.5		2600	3.48	.57

MOTORS #5 and #6.

Both motors alike, 10 H.P. Fairbanks-Morse, Type B, 1800 R.P.M. 13 amps. per phase.

Driving Hallstead 18" attrition mill empty.

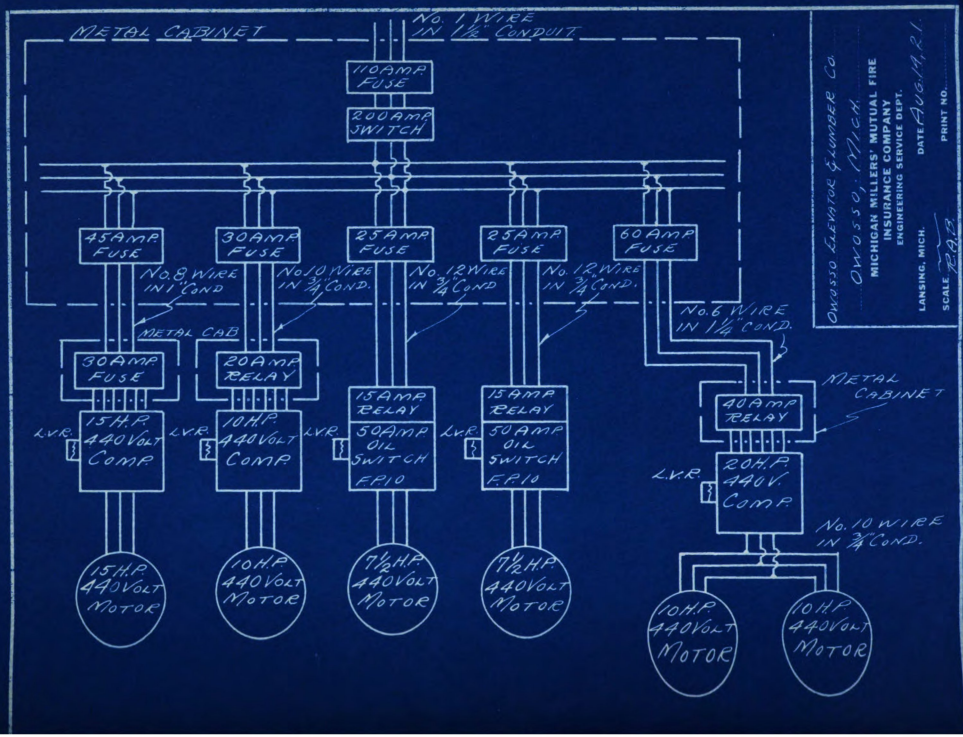
Volts	Av. amps.	Start.amps.	Watts	H.P.	P.F.
486	17.2		9100	12.1	.63

Driving the above mill loaded with corn and oats mixed.

Volts	Av.amps.	Start. amps.	Watts	H.P.	P.F.
480	27.6		17900	23.8	.78

Remarks:

Both motors were so hot that it was impossible to leave the bare hand on them.


METAL CABINET
No. 1 WIRE IN 1½" CONDUIT
110 AMP. FUSE
200 AMP. SWITCH
45 AMP. FUSE
30 AMP. FUSE
25 AMP. FUSE
25 AMP. FUSE
60 AMP. FUSE
No. 8 WIRE IN 1" COND.
No. 10 WIRE IN ¾" COND.
No. 12 WIRE IN ¾" COND.
No. 12 WIRE IN ¾" COND.
No. 6 WIRE IN 1½" COND.
METAL CAB.
30 AMP. FUSE
20 AMP. RELAY
15 AMP. RELAY
15 AMP. RELAY
40 AMP. RELAY
METAL CABINET
L.V.R.
15 H.P. 440 VOLT COMP.
10 H.P. 440 VOLT COMP.
50 AMP. OIL SWITCH EP10
50 AMP. OIL SWITCH EP10
20 H.P. 440 V. COMP.
No. 10 WIRE IN ¾" COND.
15 H.P. 440 VOLT MOTOR
10 H.P. 440 VOLT MOTOR
7½ H.P. 440 VOLT MOTOR
7½ H.P. 440 VOLT MOTOR
10 H.P. 440 VOLT MOTOR
10 H.P. 440 VOLT MOTOR
OWOSSO ELEVATOR & LUMBER CO.
OWOSSO, MICH.
MICHIGAN MILLERS' MUTUAL FIRE INSURANCE COMPANY
ENGINEERING SERVICE DEPT.
LANSING, MICH.
DATE AUG. 19, 21
PRINT NO.
SCALE RAZ

The following results were obtained at the Cass Bean and Grain Co's. elevator, Bay City, (Salzburg), Michigan, May 7th, 1921.

Character of service: 220 volt, 60 cycle, 3 phase, supplied by the Consumers Power Co., Bay City, Michigan.

MOTOR #1.

7.5 H.P. Westinghouse, Type CF. 9.8 amps. per phase, 1130 R.P.M.

Driving Clipper Cleaner #8d, empty.

Volts	Av. amps.	Start. amps.	Watts	H.B.	P.F.
229	14.8		4100	5.97	.743

MOTOR #2.

5 H.P. 1130 R.P.M., 13 amps. per phase, Type CF, Westinghouse.

Driving Clipper Cleaner #99-D, empty.

Volts	Av. amps.	Start. amps.	Watts	H.B.	P.F.
240	13.3		4900	6.5	.89

MOTOR #3.

15 H.P., Fairbanks-Morse, 1200 R.P.M., Type H, Full load amp. 38.

Driving fan on Ellis dryer.

Volts	Av. amps.	Start. amps.	Watts	H.F.	P.F.
242	45		16450	21.6	.75

MOTOR #4.

3 H.P., Fairbanks-Morse Type H, 1130 R.P.M., 8.8 amps. per phase.

Driving Crippen blended action bean picker, empty.

Volts	Av. amps.	Start. amps.	Watts	H.P.	P.F.
252	5		650	.86	.29

Driving the above machine loaded.

Volts	Av. amps.	Start. amps.	Watts	H.P.	P.F.
248	5.2		730	.92	.33

MOTOR #5.

2 H.P. Westinhouse type CS, 1120 R.P.M. 5.8 amps.

Driving Oxford bean polisher #475, empty.

Volts	Av. amps.	Start. amps.	Watts	H.P.	P.F.
250	5		1100	1.46	.51

Driving the above machine loaded.

Volts	Av. amps.	Start. amps.	Watts	H.P.	P.F.
248	5		1300	1.73	.61

MOTOR #6.

1 H.P. Westinghouse, Type CSA, 1725 R.P.M., 2.5 amps.

Driving Giant bean picker loaded.

Volts	Av. amps.	Start. amps.	Watts	H.P.	P.F.
248	1.85		750	1	.945

MOTOR #7.

2 H.P. Westinghouse, Type CS, 1120 R.P.M, 5.8 amps.

Driving elevator 61.5 feet long, 36" head pulley, 8 x 5 cups, 9" rubberoid canvas belt, empty.

Volts	Av. amps.	Start. amps.	Watts	H.P.	P.F.
252	4.1	29	650	.87	.37

Driving the above elevator loaded with wheat.

Volts	Av. amps.	Start. amps.	Watts	H.P.	P.F.
252	4.85		1300	1.75	.63

MOTOR #8.

1/2 H.P. Westinghouse, Type CSA, 1140 R.P.M., 1.75 amps.

Driving 16 hand bean pickers, empty.

Volts	Av. amps.	Start. amps.	Watts	H.P.	P.F.
252	2.2	6	415	.55	.43

MOTOR #9.

30 H.P. Fairbanks-Morse Type B, 1200 R.P.M., 74 amps.

Driving Dreadnaught 24" Attrition Mill, Bryant Cob Crusher, corn sheller, and 3 short elevators, all empty.

Volts	Av. amps.	Start. amps.	Watts	H.P.	P.F.
236	49.8		6600	8.76	.33

Driving attrition mill and 3 short elevators loaded with oats, other machines empty.

Volts	Av. amps.	Start. amps.	Watts	H.P.	P.F.
236	64.5		17550	23.4	.67

Driving cob crusher loaded with cobs, other machines empty.

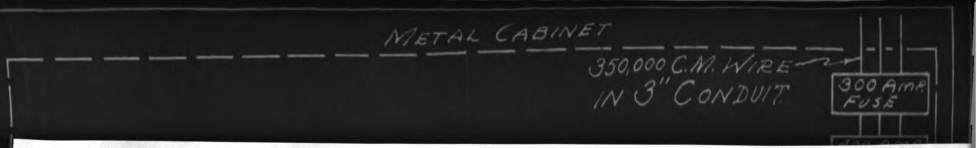
Volts	Av. amps.	Start. amps.	Watts	H.P.	P.F.
232	54		8550	11.35	.39

Driving cob crusher and sheller loaded with corn on cobs, other machines empty.

Volts	Av. amps.	Start. amps.	Watts	H.P.	P.F.
236	61.5		16050	21.3	.64

Driving attrition mill loaded with corn and crushed cobs all other machines empty.

Volts	Av. amps.	Start. amps.	Watts	H.P.	P.F.
238	66		20100	26.7	.74


METAL CABINET
350,000 C.M. WIRE
IN 3" CONDUIT
300 AMP
FUSE

The following results were obtained at the Stockbridge Elevator Co's. Elevator, Jackson Michigan on May 14th, 1921.

Character of service: 440 volt, 60 cycle, 3 phase, supplied by the Consumers Power Co., Jackson, Michigan.

MOTOR #1.

3 H.P. General Electric, Type KT, 1200 R.P.M., 4.2 amps.

Drives fan on Clarage #9, Type CI car loader.

Volts	Av. amps.	Start. amps.	Watts	H.P.	P.F.
482	6	25.5	4460	5.93	.89

MOTOR #2.

10 H.P. Wagner, Type 14 ZBW, 1730 R.P.M., 13 amps.

Driving Monarch #384 size 2 C Cracked Corn Separator and Sprout & Waldron #16 corn crusher, both machines empty.

Volts	Av. amps.	Start. amps.	Watts	H.P.	P.F.
468	5	45.5	2800	4.05	.69

Driving above machines loaded with corn.

Volts	Av. amps.	Start. amps.	Watts	H.P.	P.F.
460	4.5	45.5	1810	3.58	.51

Driving line shaft only.

Volts	Av. amps.	Start. amps.	Watts	H.P.	P.F.
458	4		1200	1.61	.38

Driving the above machines empty and Crippen bean picker empty.

Volts	Av. amps.	Start. amps.	Watts	H.P.	P.F.
460	5.5		2550	3.4	.58

MOTOR #3.

5 H.P. Western Electric Type KT, 1200 R.P.M., 6.6 amps.

Driving line shaft only.

Volts	Av. amps.	Start. amps.	Watts	H.P.	P.F.
469	4	40	450	.6	.14

Driving Invincible 3 Deck Cleaner empty.

Volts	Av. amps.	Start. amps.	Watts	H.P.	P.F.
464	4.5		600	.8	.17

Remarks:

This motor is also used to run freight elevator.

MOTOR #4.

3 H.P. Wagner, Type 11 PBP, 1750 R.P.M., 8 amps.

Driving an elevator leg 85'6", 33" head pulley, 11" canvas belt, 11 x 5½" cups, empty.

Volts	Av. amps.	Start. amps.	Watts	H.P.	P.F.
486	1.95	27.5	690	.92	.42

Driving above elevator loaded with cracked corn.

Volts	Av. amps.	Start. amps.	Watts	H.P.	P.F.
488	2.2		990	1.32	.54

MOTOR #5.

1 H.P. Robbins & Meyers Type K, 1750 R.P.M., 1.4 amps.

Driving Monarch aspirator #20, size 5 A, empty.

Volts	Av. amps.	Start. amps.	Watts	H.P.	P.F.
490	1.4	6.5	690	.92	.59

MOTOR #6.

7.5 H.P. General Electric Type KT, 1200 R.P.M., 9.5 amps.

Driving fan on Hess Ideal Pneumatic dryer.

Volts	Av. amps.	Start. amps.	Watts	H.P.	P.F.
488	9	31	6700	8.9	.99

MOTOR #7.

3 H.P. Western Electric, Type KT, 1800 R.P.M., 3.8 amps.

Driving elevator leg 79'6" long, 33" head pulley, 11" canvas belt, 5 x 11" cups. This elevator will be known as #1. Also elevator leg 85'6" long, 36" head pulley, 11" canvas belt, 5 x 11" cups. This elevator will be known as elevator #2.

Driving #1 and #2 empty.

Volts	Av. amps.	Start. amps.	Watts	H.P.	P.F.
480	2.1		610	.81	.35

Driving #1 loaded and #2 empty.

Volts	Av. amps.	Start. amps.	Watts	H.P.	P.F.
476	2.7		1350	1.8	.61

MOTOR #8.

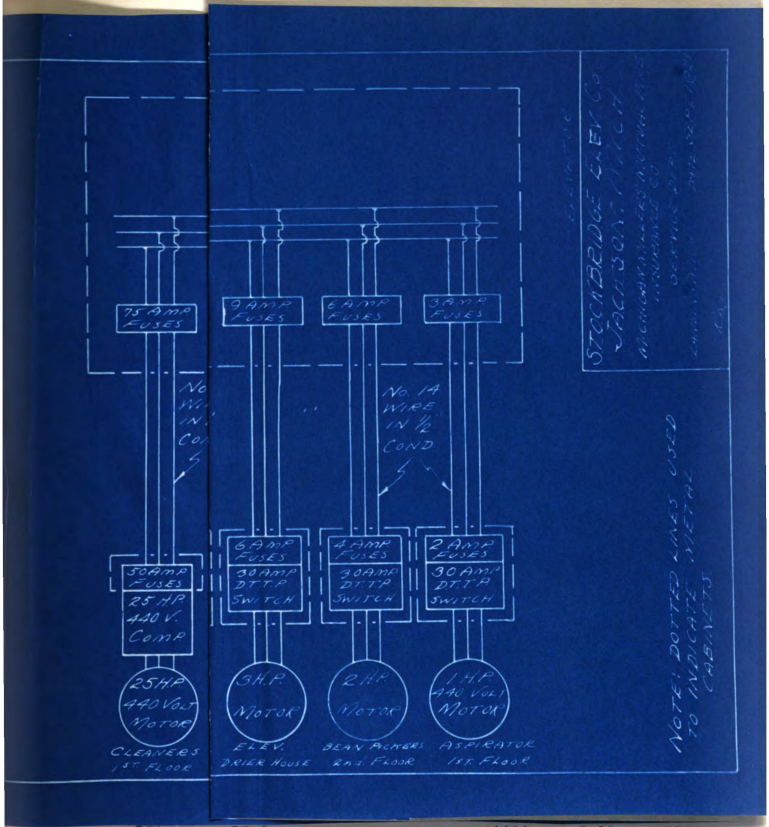
10 H.P. Fairbanks-Morse 1200 R.P.M., 14 amps. per phase.

Driving idler pulley only.

Volts	Av. amps.	Start. amps.	Watts	H.P.	P.F.
476	6		1400	1.86	.283

Driving Wolf-Dawson Wheat Washer, #W288 empty.

Volts	Av. amps.	Start. amps.	Watts	H.P.	P.F.
476	6.5		1800	2.4	.34



234	18.8	4400	5.85	.58

MOTOR #2.

5 H.P. Fairbanks-Morse Type B, 1800 R.P.M., 13 amps. per phase.

The following results were obtained at the George F. Dimond Elevator Co., St. Johns, Michigan June 9th, 1921.

Character of Service; 220 volt, 60 cycle, 3 phase furnished by the Municipal Power Plants.

MOTOR #1.

10 H.P. Fairbanks-Morse, Type B, 1800 R.P.M., 24.4 amps. per phase.

Driving Clipper Cleaner #149 D, loaded with barley, and one elevator leg 44' long, 24" head pulley, known as #2 Elevator, and one elevator 44' long, 12" head pulley, elevator known as #1, both empty.

Volts	Av. amps.	Start. amps.	Watts	H.P.	P.F.
230	18.2		4200	5.6	.58

Driving Elevator #1 empty and Elevator #2 loaded with barley.

Volts	Av. amps.	Start. amps.	Watts	H.P.	P.F.
234	17		1951	2.59	.28

Driving elevators #1 and #2 empty.

Volts	Av. amps.	Start. amps.	Watts	H.P.	P.F.
238	17.5		1700	2.26	.24

Driving cleaner and elevators both empty.

Volts	Av. amps.	Start. amps.	Watts	H.P.	P.F.
234	18.8		4400	5.85	.58

MOTOR #2.

5 H.P. Fairbanks-Morse Type B, 1800 R.P.M., 13 amps. per phase.

Driving elevator leg 37' long, 16" head pulley, 8½" leather belt, 8 x 5 cups, known as elevator #1 and elevator leg 46' long, 16" head pulley, 8½" leather belt, 8 x 5" cups, known as elevator #2, both empty, and a line shaft with two short elevators, both empty.

Volts	Av. amps.	Start. amps.	Watts	H.P.	P.F.
232	10		1800	2.4	.45

Driving the two long elevators, two short elevators and Clipper Cleaner #89, all empty.

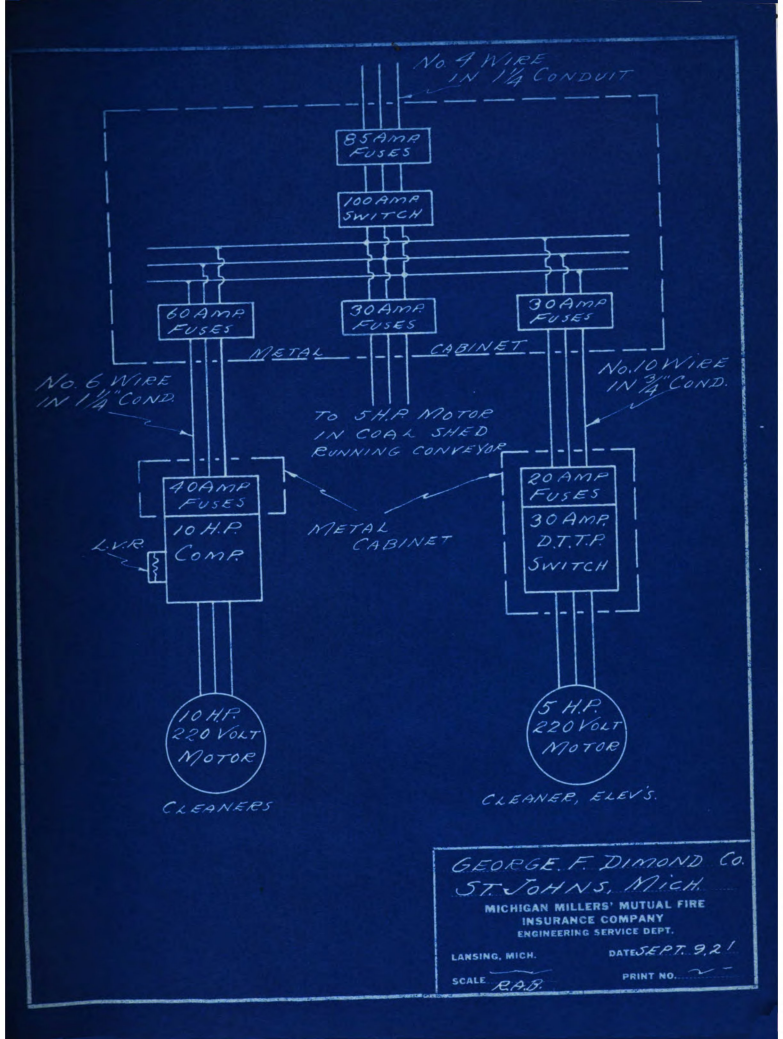
Volts	Av. amps.	Start. amps.	Watts	H.P.	P.F.
224	11		2650	3.52	.62

Driving Oxford Bean Polisher #1L, two short, and the two long elevators, all empty.

Volts	Av. amps.	Start. amps.	Watts	H.P.	P.F.
230	10.75		2500	3.33	.58

Driving Centrifugal Bean Picker, two short, and the two long elevators, all empty.

Volts	Av. amps.	Start. amps.	Watts	H.P.	P.F.
230	11.25		2750	3.65	.61


No 4 WIRE IN 1¼ CONDUIT
85 AMP FUSES
100 AMP SWITCH
60 AMP FUSES
30 AMP FUSES
30 AMP FUSES
METAL CABINET
No. 6 WIRE IN 1¼" COND.
No. 10 WIRE IN ¾" COND.
TO 5 H.P. MOTOR IN COAL SHED RUNNING CONVEYOR
40 AMP FUSES
10 H.P. COMP.
L.V.R.
METAL CABINET
20 AMP FUSES
30 AMP. D.T.T.P. SWITCH
10 H.P. 220 VOLT MOTOR
5 H.P. 220 VOLT MOTOR
CLEANERS
CLEANER, ELEV'S.
GEORGE F. DIMOND CO.
ST. JOHNS, MICH.
MICHIGAN MILLERS' MUTUAL FIRE INSURANCE COMPANY
ENGINEERING SERVICE DEPT.
LANSING, MICH.
DATE SEPT. 9, 21
SCALE R.A.B.
PRINT NO.

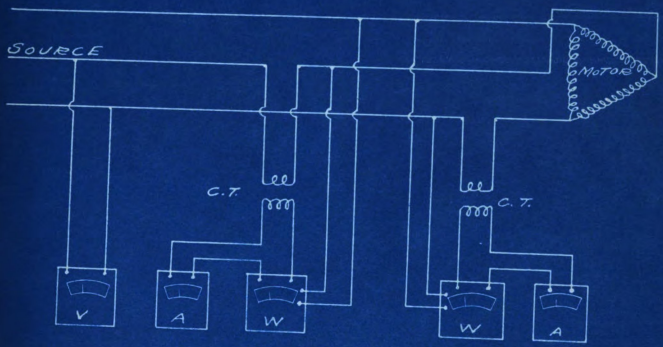
Grain Cleaners	Page	H.P. Empty	H.P. Loaded	Type Load	Other Machinery	Loaded
Clipper						
No. 8 D	16	5.97				
No. 8 D	12	6.37			34'-4x7" cups 41'-5x8" cups 2 Short Elev.	No
No. 10 Seed	3	1.79			2 Short Elev.	No
No. 16	10	2.86			6 Short Elev.	No
No. 19	10	4.13			6 Short Elev.	No
No. 89	10	4.93			6 Short Elev.	No
No. 89	23	3.52			37'-5x8" cups. 46'-5x8" cups. 2 Short Elev.	No
No. 99 D	8	3.12			46'-5x9" cups 46'-4½x7" cups 3 Short Elev.	No
No. 99 D	13	6.5			35'-3½x6" cups 40'-5½x5" cups 2 Short Elev.	No
No. 99 D	16	6.5				
No. 132 B Clover Seed	9	2.04			1 Short	No
No. 149 D	22	5.85	5.6	Barley	44'-4x6" cups 44'-4x6" cups	No

Grain Cleaners	Page	H.P. Empty	H.P. Loaded	Type Load	Other Machinery	Loaded
Monitor						
No. 5 Grain	2	5.06			1 Short	No
No. 7 Wheat	2		6.8	Wheat	1 Short Elev.	Yes
Invincible 3 Deck	20	.8				
Bean Machinery						
Invincible 2 Deck Cleaner	11	.44	,55		1 Short Elev.	No
Invincible Bean Picker	4	2.19			2 Short Elev. 1 #10 Clipper Seed Cleaner	No
Monitor Bean Sep. No. 6	5	13.7			3 Short Elev.	No
Gibbs Picker	13	3.46			35'-3½x6" cups 40'-3½x5" cups 2 Short Elev.	No
Crippen Blended Action	17	.86	.92			
Giant Picker	17		1.00			
Oxford Polisher 475	17	146	1.73			
Oxford Polisher I L	23	3.33			37'-5x8" cups 46'-5x8" cups 2 Short Elev.	No

Bean Machinery	Page	H.P. Empty	H.P. Loaded	Type Load	Other Machinery	Loaded
Centrifugal Picker	23	3.65			37'-5x8" cups 46'-5x8" cups 2 Short Elev.	No
20 Hand Bean Pickers	9	1.8				
16 Hand Bean Pickers	18	.55				
Grinders, Crushers, Shellers.						
Dreadnaught 20"	3	4.04	12.22	Oats		
Dreadnaught 24"	18	8.76	23.4		Bryant Crusher Corn Sheller 3 Short Elev.	No
Dreadnaught 24"	18	No	11.35	Crusher		Yes
Dreadnaught 24"	18	No	21.3	Corn on cobs	Crusher and Sheller	Yes
Dreadnaught 24"	18		26.7	Corn	Crusher and Sheller	No
Halstead 18"	15	12.1	23.8	Corn & Oats		
Sprout & Waldron	14	2.78	13.2	Cobs		
Sprout & Waldron No. 16	19	4.05	3.58	Corn	Mon. Corn Sep. 384-2C	No
Sprout & Waldron No. 16	19	3.04			Crippen	No

Fans	Page	H.P. Empty	H.P. Loaded	Type Load	Other Machinery	Loaded
30" Loader	12		14.14		34'-4x7" cups 41'-5x8" cups 2 Short Elev.	No
Ellis Drier Fan	16		21.6			
Clarage Car Loader No. 9	19		5.93			
Pneumatic Drier "Hess"	21	8.9				
Bean Drier Fan	4	9.6				
Monarch Aspirator No. 20-5A	20	.92				
Wheat Washer						
Wolf Dawson # 288	21	2.4				
Elevators						
45'-5x9" cups	2	1.66				
1 Short	2	3.16			Idler Pulley	
1 Short	2	.73				
2 Short	3		.647	Oats	Shaker	Yes
55'-4½x7" cups	4	1.6				
55'-4½x7" cups	5	1.06	40	Beans		

Elevators	Page	H.P. Empty	H.P. Loaded	Type Load	Other Machinery	Loaded
3 Short	5	4.12			Idler Pulley	
1 Short	9	1.7			Line shaft	
6 Short	10	2.46				
47'-3½x7", 47'-5x9"	10	.8	1.5	Oats		
34'-4x7", 41'-5x8", 2 Short	12	4.27			Line Shaft	
34'-4x7" cups	12	4.8			41'-5x8" cups 2 Short Elev.	Yes
35'-3½x6" cups, 40'-3½x5" cups	13	2.2			2 Short Elev.	No
35'-3½x6", 40'-3½x5", 40'x4x7"	13	3.39			2 Short Elev.	No
35'-3½x6", 40'-3½x5" 40'-4x7", 34'-3½x6"	14	3.63			2 Short Elev.	No
61'-5x8" cups	17	.87	1.73	Wheat		
85'-5½x11" cups	20	.92	1.32	Cr.Corn		
79'-5x11" cups	21	.81	1.82		85'-5x11" cups	No
45'-5x9" cups	22	2.26			44'-4x5" cups	No
45'-5x9" cups		2.59		Barley	44'-4x5" cups	No
37'-5x8" cups, 46'-5x8" cups	23	2.4			2 Short Elev. Line Shaft	No



CONNECTION DIAGRAM FOR

THREE-PHASE POWER MEASUREMENT

A. = AMMETER.
W. = WATTMETER
C.T. = CURRENT TRANS.
V. = VOLTMETER.

MICHIGAN MILLERS' MUTUAL FIRE
INSURANCE COMPANY
ENGINEERING SERVICE DEPT.

LANSING, MICH. DATE

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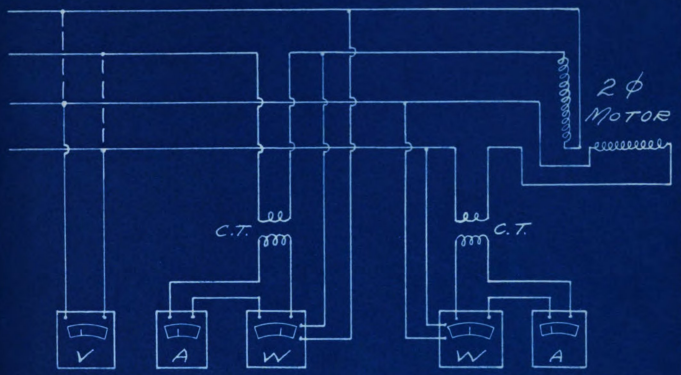

CONNECTION DIAGRAM FOR

TWO-PHASE POWER MEASUREMENT

A = AMMETER
W = WATTMETER
C.T. = CURRENT TRANS.
V = VOLTMETER.

MICHIGAN MILLERS' MUTUAL FIRE
INSURANCE COMPANY
ENGINEERING SERVICE DEPT.

LANSING, MICH. DATE

SCALE R.A.B. 2/MM PRINT NO.