STUDY OF AN ELECTRIC DEMAND METER WHICH HAS BEEN CHANGED TO READ DEMAND OF GAS.

by

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TABLE OF CONTENTS.

PURPOSE

Before a gas meter can be installed it is necessary to know what size to put in. In restaurants, cooking houses, bakeries and other places where a good deal of gas is used and the demand is variable for different hours of the day, it is necessary to know what the maximum demand will be so that a meter with the right capacity can be used without being over taxed or over sized. For this purpose a gas demand meter is installed and let run for one week so as to get the maximum demand for seven days. It probably would not give the maximum demand if let run for any length of time less than that as any one day in the week might contain the maximum demand, and this one particular day is not known until the demand meter has been set for one week.

GENERAL PLAN OF ACTION

This demand meter can be connected to a 30 light or a 10 light meter. It was first connected to a 30 light meter anc was placed at Peter Kern Co. to get their demand for one week. As this meter was formerly an electric meter now geared to read the demand of gas it was found that its readings were not correct.

It was then decided to run accurate tests on the meter and see how it checked with the actual number of cubic feet passed. After it was removed from Peter Kern Co. it was reset at the shop and the tests recorded on the chart (Chart I, Page 18) were then taken.

This thesis covers the making of a chart both for a 30 light and a 10 light meter, keeping an accurate account of the njmber of cubic feet which passed through each meter, and plotting a curve between the reading of the chart and the actual number of cubic feet passed. As the demand meter and chart were made to read the demand of electricity instead of gas, it was found that the chart did not read the actual amount of gas passed, but to get the number of cubic feet it would be necessary to refer to the graph.

GENERAL THEORY OF THE APPARATUS

The Type G demand meter is a graphic type, providing a graphic record of the demand for each time interval. This type has a metal stylus and wax-coated chart with zero at the center.

The definition of a demand meter as taken from the Standard Handbood for Electrical Engineers (5th Edition) is: " A demand meter is a device which indicates or records the maximum demand."

There is a mechanical connection between the regular meter and the demand meter. As gas flows through the regular meter it turns a worm gear which engates a rod at right angles to it. As this rod revolves it raises and lowers a lever. This lever moves about a quarter of an inch up and down, raising and lowering a vertical rod which is connected in the demand meter. As this rod moves down and up one time it turns one notch of a gear which is also geared to an arm on which is the stylus. Then this stylus moves up a definite amount each time the rod is pushed down and released.

There is a seven day clock which moves the chart around, making one complete revolution each week. Also connected to the clock is an arm which drops every half an hour and disconnects the gear moving the arm on which is connected the stylus. The stylus therefore returns to zero every half an hour. The time when it drops does not have to be exact to the fraction of a second as the consumer does not pay for the amount of gas shown here, but the amount read on the regular meter.

DESCRIPTION OF HOW APPARATUS WORKS.

Demand meters measure a quantity which is composed of a gas factor and a time factor. Each demand meter must contain a gas element and a timing element which is structurally combined. These two elements with a suitable recording element make up the demand meter.

Referring to Fig. 2, as the gas passes through the meter the worm gear as shown at A revolves the rod B. As B rotates it moves the arm C up and down. Each time that C goes down it pushes on the end of rod D. When D (Fig. 3) is pushed down it moves the gear at E one notch and this gear in turn moves the lever arm F on which is placed the stylus which records a definite amount on the chart which is placed at the side of it. An arm G is connected to the lever arm F by gears and also connected to the clock. The arm G pushes on a wheel which makes one revolution every half hour. At one place on the wheel there is a depressed place which causes a drop to be made by the lever arm and releases the gears so that the point F drops to the zero line every half hour.

The chart upon which the stylus works has a black background and carries a thin coating of a special preparation givint the appearance of an almost white surface. On this the graduations are printed in an orange ink. The stylus in tracing its record removes the preparation, exposing the black background. In this way, very sharp, clear-cut records are obtained, sharper than an ink chart. One complete turn of the chart records the amount of gas used every half hour for seven days. The highest one of these peaks will be the maximum demand for that week.

THE PROVER

The Prover is an apparatus made for calibration of a meter. The Prover is a tank which holds exactly five cubic feet of air. The top of this tank is closed and the bottom immersed in a larger tank of oil. On one side of the tank which holds the air is a scale showing the cubic feet which the tank contains. From the top of the tank is a chain which runs over a pulley on the other end of which is a weight to help balance the tank. The tank is filled by pulling down on the chain which has the weights on it, and opening a valve to allow air to get in. When the tank is raised to the top the valve is closed and the air is brought to zero on the scale by opening the valve a little and letting a little of the air out. When the pointer reaches the zero point the valve is closed tight. Another valve is opened and the contents ot the tank allowed to flow thru the meter. This revolves the arm around on the meter the same as if gas was going thru it. The only difference is that a known definite amount of air goes thru instead of an unknown amount of gas.

For the 30 light meter the tank was filled up twice because the arm on this meter in making one revolution recorded IO cubic feet passed. The position of the pointer on the IO foot dial was ~~was~~ noted, and the valve closed when it reached this point again having made one complete revolution. The reading on the tank was then taken. When the tank was filled ~~up~~ twice and the valve closed as the hand on the dial came to the initial position, the difference in the reading on the tank and the point five, was the percent that the meter was off. To make this clear, let the hand on the dial be at zero and the tank filled with air with the pointer at zero. The air is let out of the tank thru the meter until the pointer on the tank reads 5, then the valve is closed to the meter and the tank again filled with air, the pointer again being at zero. This time the hand on the dial is watched and when it comes to the initial position at zero, the valve is closed. The pointer on the tank is then read and finding that it does not point exactly at 5, but reads 5.I, the meter is out of adjustment, plus one per cent. If the pointer read 4.9,the meter is out minus one per cent.

The difference in running a test on the IO light meter, was that the tank did not have to be filled up but once, for the first dial on this meter reads 5 cubic feet, per revolution, instead of IO.

DETAIL PLAN OF ACTION

The 30 light meter on which the demand meter was connected, was first calibrated by means of the prover, and adjustment was made until it read within one per cent, when the valve was open,and less than one per cent with the valve partly closed. The meter was then connected to the regular pressure line, with a valve between the meter and the line. The gas from the meter was run thru a pipe out the window, and burned at atmospheric pressure, as in the case of an ordinary consumer.

Accurate count was kept from the dial of the meter, of every time that the arm went around. On this meter, each revolution of the hand, meant that IO cubic feet of gas had passed thru. This count was placed in a table along with the reading on the chart which corresponded to it for that particular half hour. After running three or four tests of from two to five hours, the final graph plotted, was with the reading of the chart as abscissa, and the number of cubic feet passed as ordinate. After calibrating the demand meter, it was set up at a customer's establishment and allowed to run for a week. It was then brought back to the laboratory and a test again made upon it. The meter was found to be very near the same, as when it was calibrated. The reason that there was a little difference, was, because there had been no drip placed in the line, and some water was found in the meter. This is one of the sources of error which has to be guarded against.

The same process was used with the IO light meter, the demand meter being taken off and connected to this meter. This meter was also calibrated for both, the open flow demand, and for the slow demand, within one percent.

Graphs were plotted for this meter as for the other one. This meter was also run on the prover to see if there had been any change after it had been set. The change was very small.

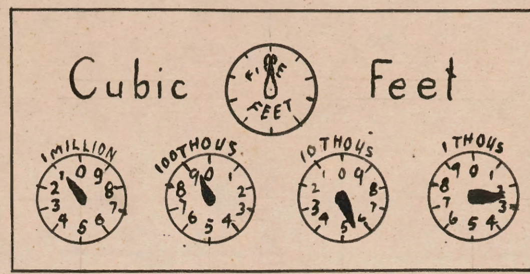
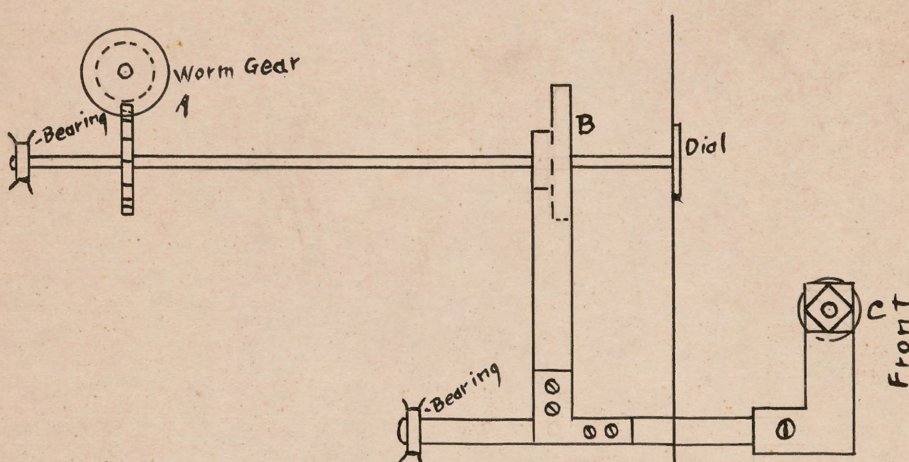


fig. 1



Top View fig. 2

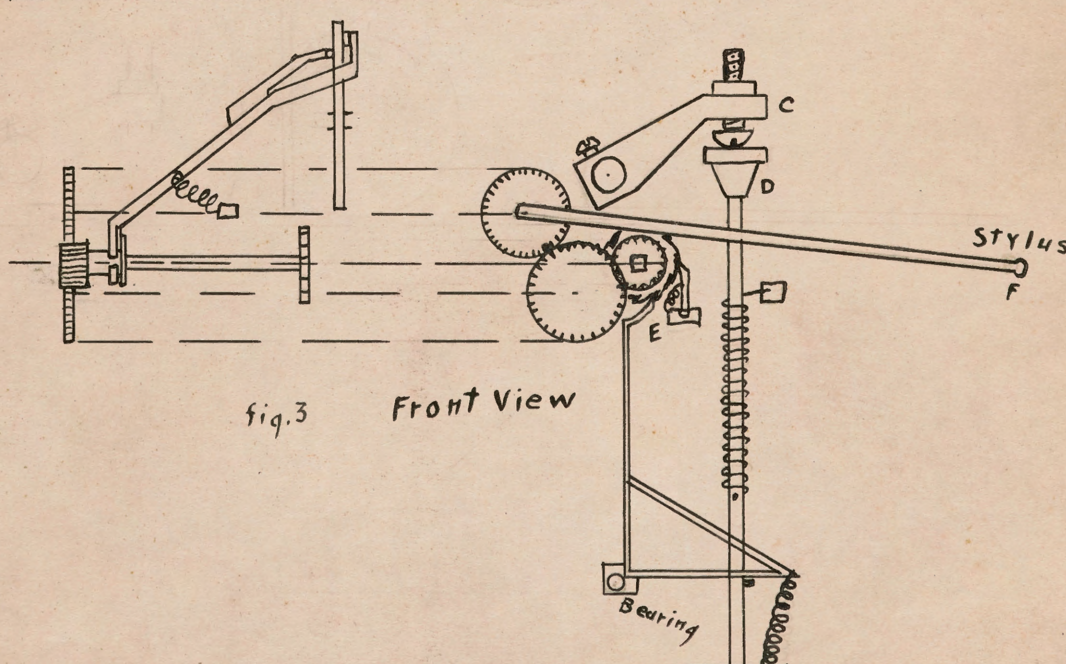
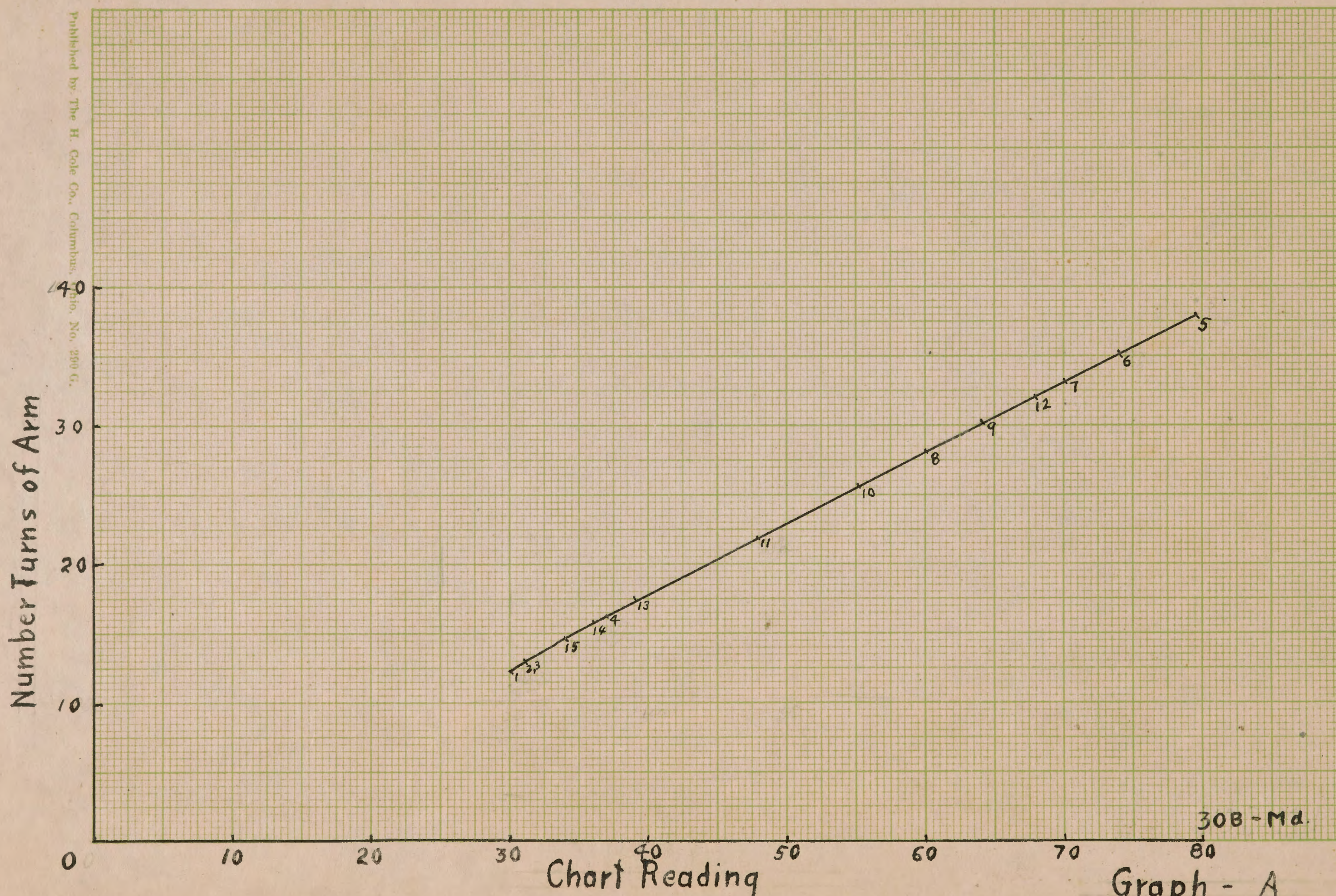


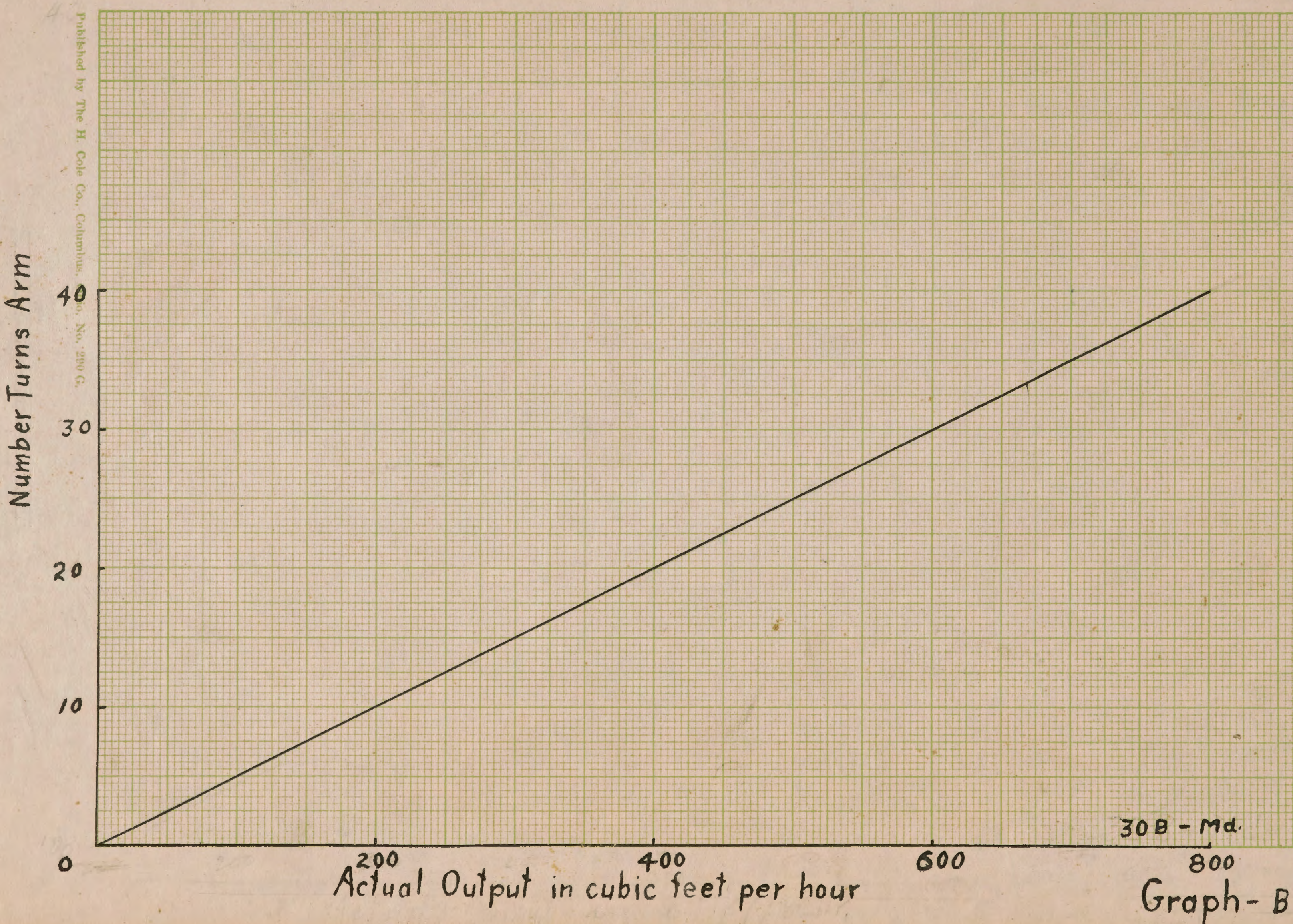
fig. 3 Front View

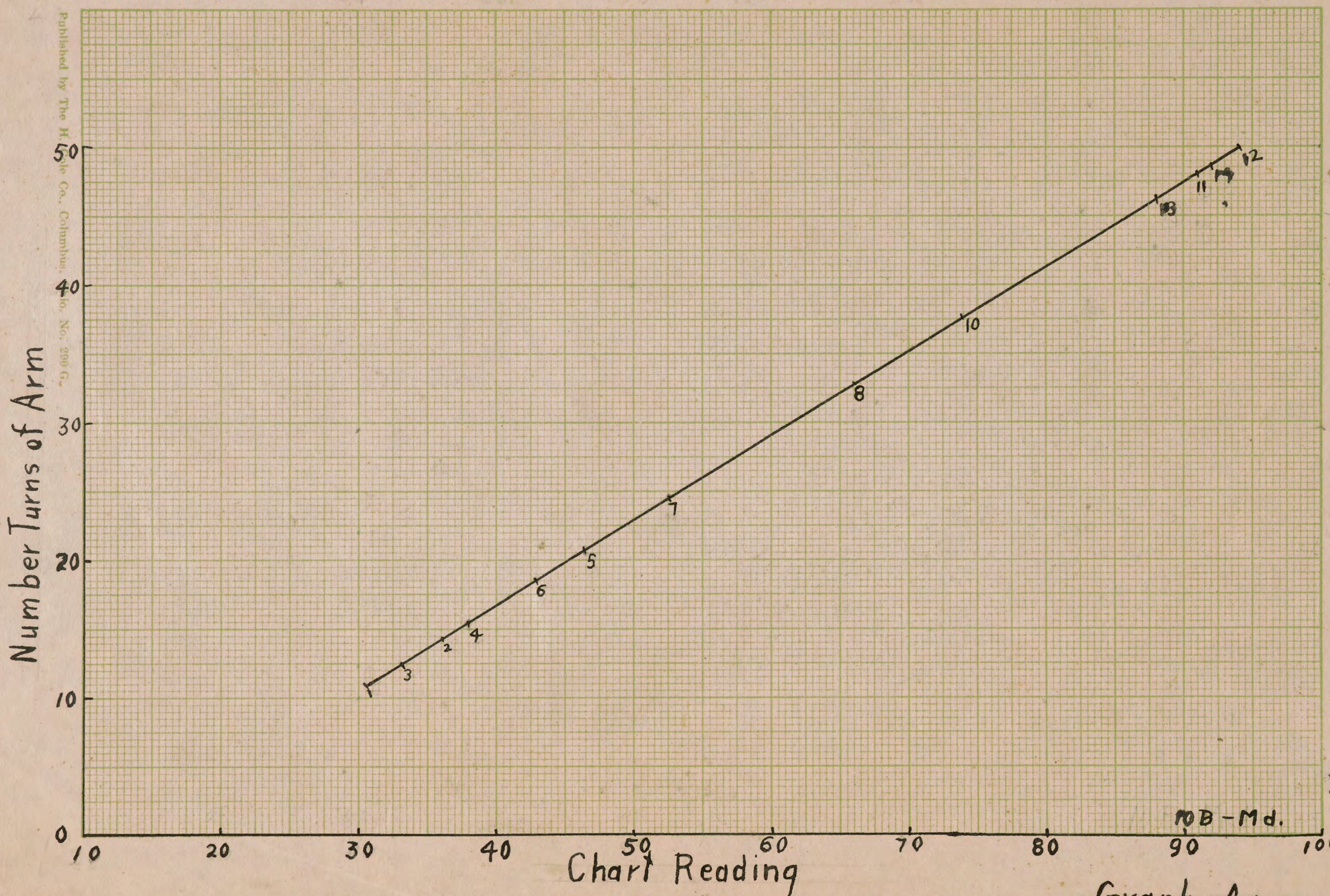


Published by The H. Cole Co., Columbus, Ohio. No. 200 G.
Number Turns of Arm
40
30
20
10
0
10
20
30
40
50
60
70
80
Chart Reading
1
2,3
15
14
4
13
11
10
8
9
12
7
6
5
30B-Md.

Graph - A

12.


Number Turns Arm
40
30
20
10
0
200
400
600
800
Actual Output in cubic feet per hour
30 B - Md.
Graph - B
Published by The H. Cole Co. Columbus, O. No. 200 G.


Number Turns of Arm
Chart Reading
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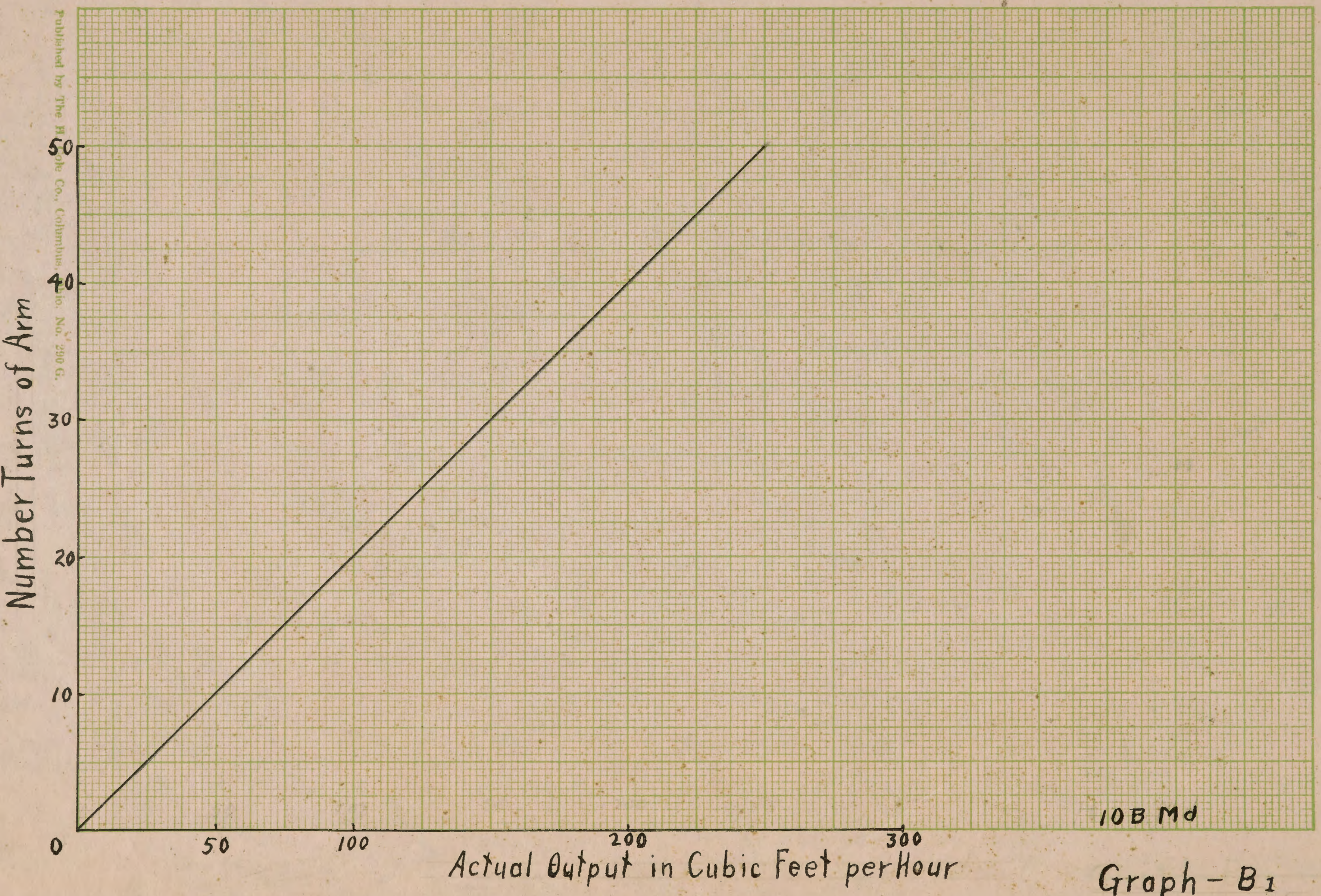
10
20
30
40
50
60
70
80
90
100
1
2
3
4
5
6
7
8
10
11
12
13
14
10B-Md.
Published by The H... Co., Columbus, ...o. No. 290 G.

Graph-A 1

14.


Published by The H... Co., Columbus, Ohio. No. 290 G.
Number Turns of Arm
50
40
30
20
10
0
50
100
200
300
10 B Md
Actual Output in Cubic Feet per Hour

Graph - B 1

15.

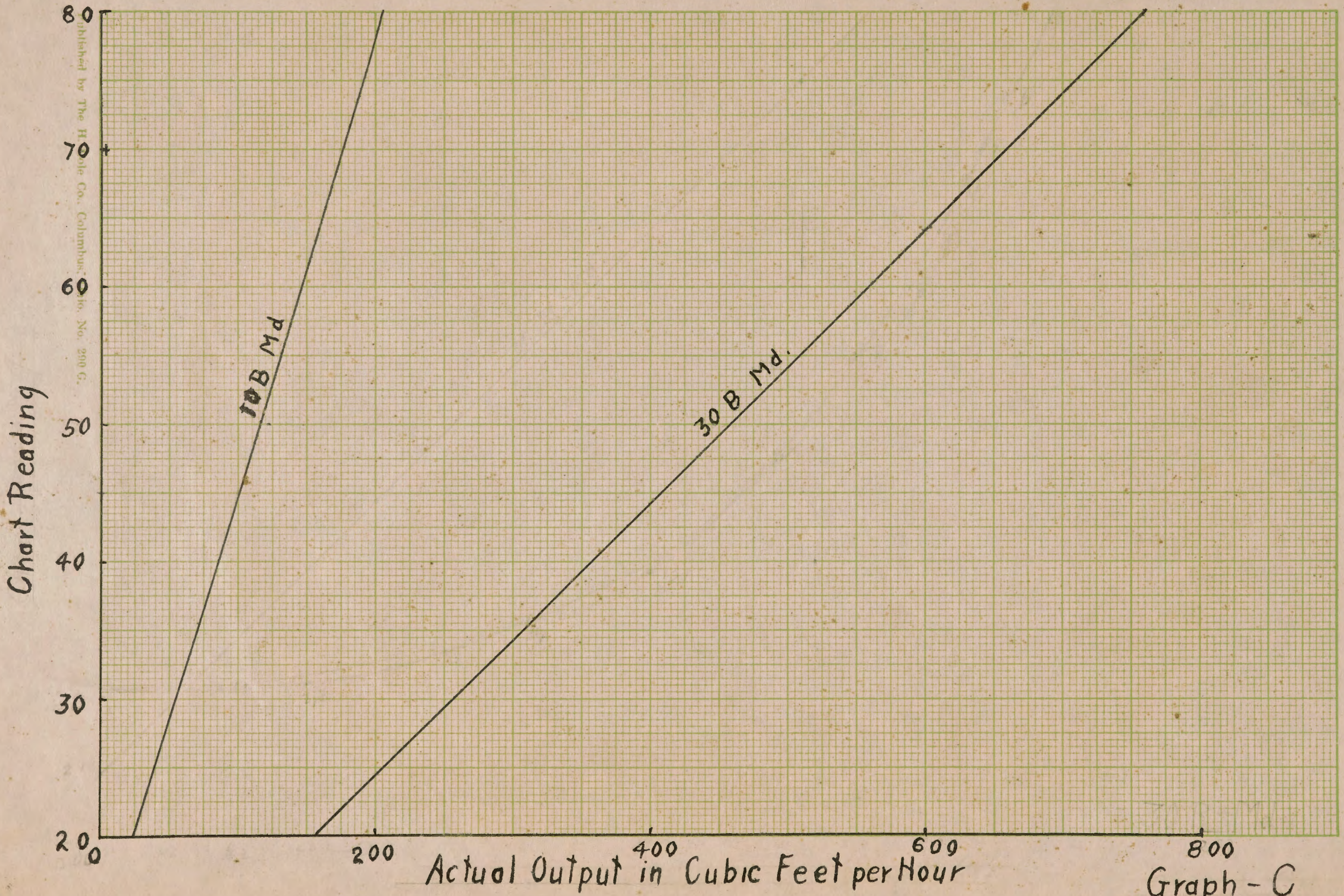
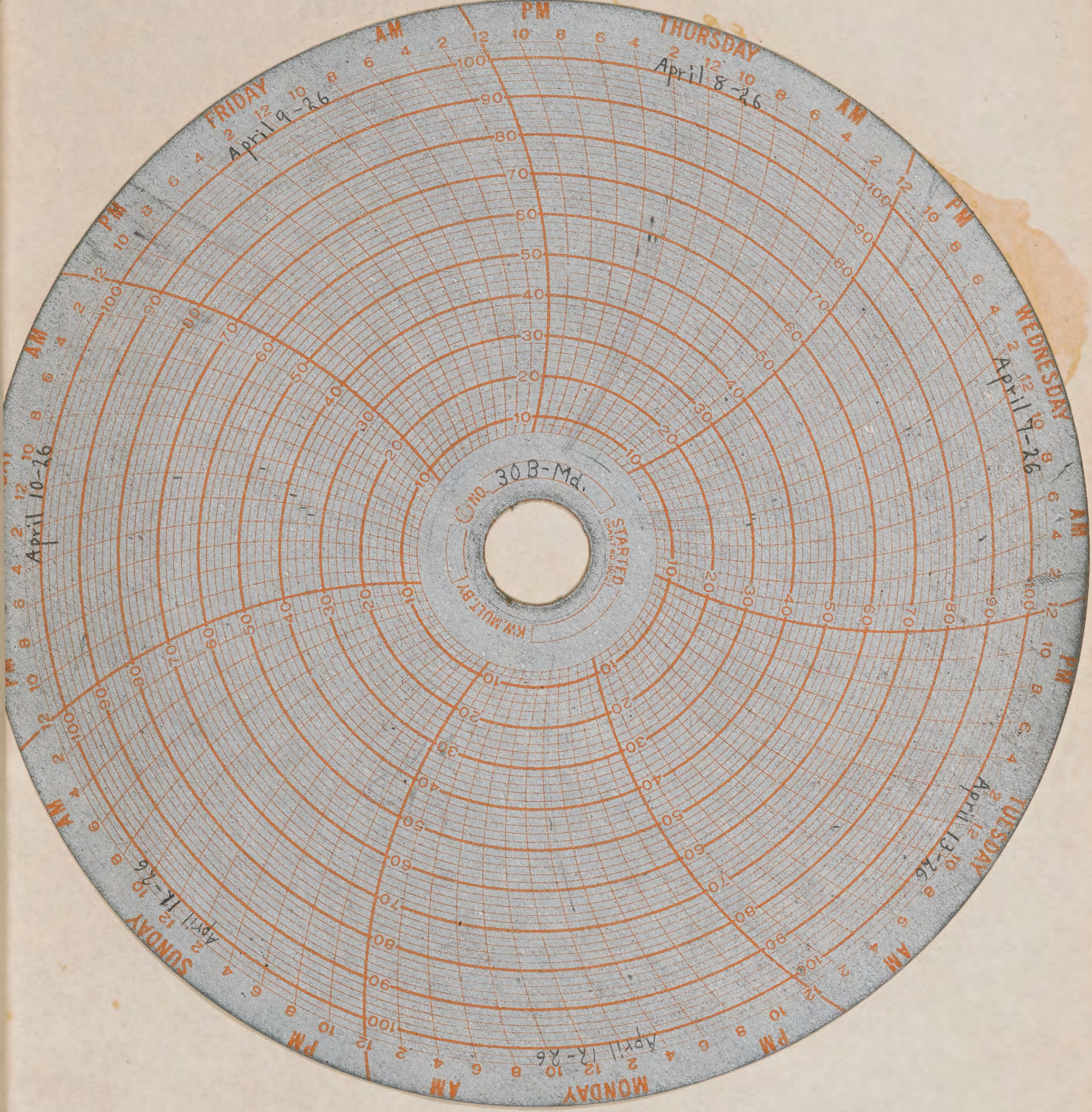


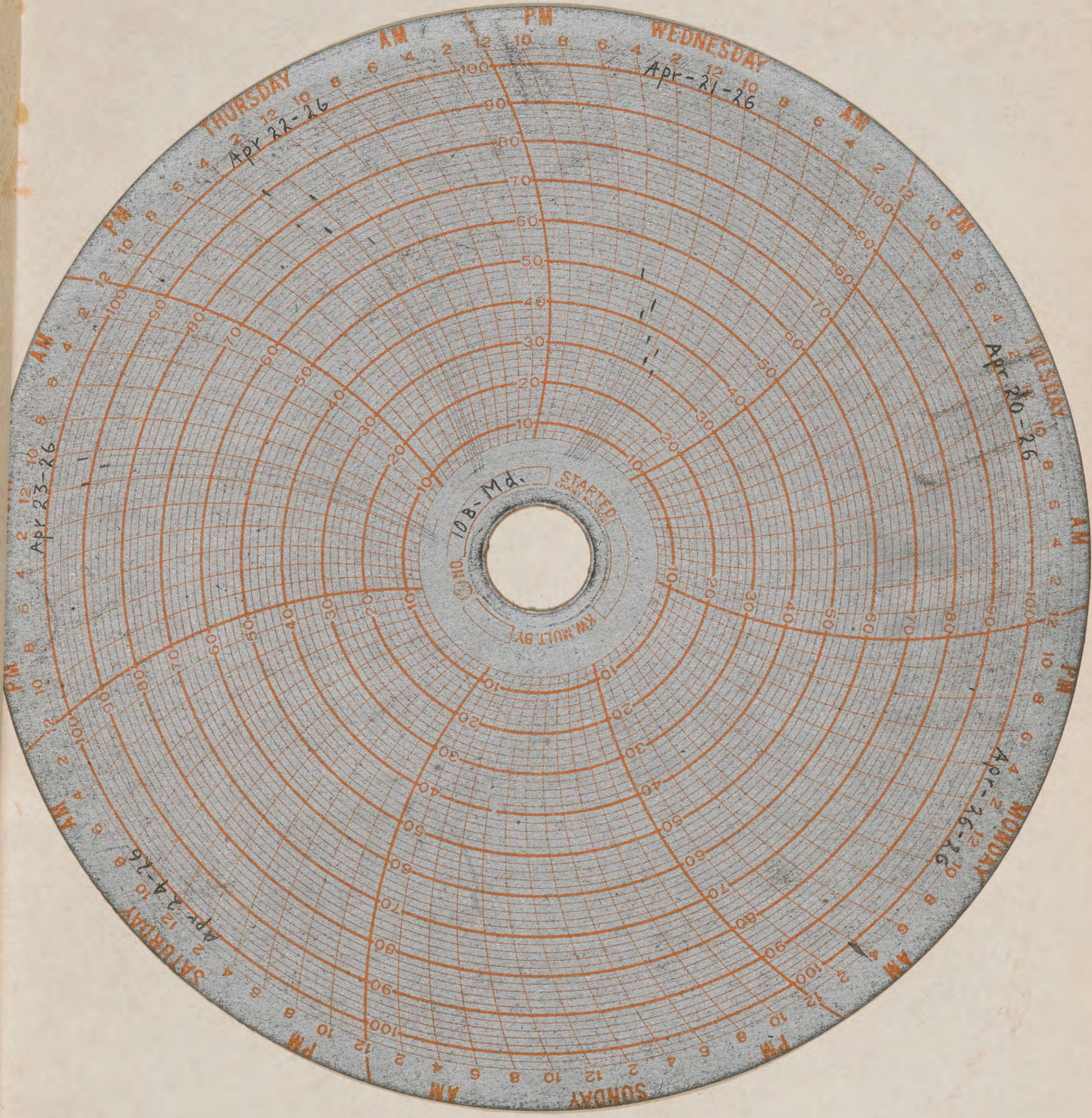
Chart Reading
80
70
60
50
40
30
20
0
200
400
600
800
Actual Output in Cubic Feet per Hour
10 B Md
30 B Md.

Graph - C

17


No. 30B-Md.
STARTED
KW. MULT. BY
THURSDAY
April 8-26
FRIDAY
April 9-26
April 10-26
SUNDAY
April 11-26
MONDAY
April 12-26
TUESDAY
April 13-26
WEDNESDAY
April 7-26
AM
PM

WEDNESDAY
THURSDAY
FRIDAY
10 B-Md.
Chart # 2.


WEDNESDAY
Apr-21-26
THURSDAY
Apr 22-26
TUESDAY
Apr 20-26
Apr 23-26
MONDAY
Apr-26-26
SATURDAY
Apr 24-26
SUNDAY
10B-Md.
STARTED
KW MULT. BY
NO.

Test.

30 B Md. Capacity in cubic feet per hour (max. rated) 280

IO B Md. " " " " " " (max. rated) 609

Adjustment Test by <u>Prover</u>

Light	Wide Open Demand	Slow Demand (Cap. Test)
30	-5 %	-4 %
30	-3 %	-2 %
30	+I %	0
IO	-4 %	-3
IO	+2	-I
IO	+I	0

30 B Md. Date of Test - Apr. - 7 - 26

No. of point on curve	I	2	3	4	5	6
Time Start	I0:I9	I0:49	II:I9	II:49	I2:I9	I2:49
Time Stop	I0:49	II:I9	II:49	I2:I9	I2:49	I:I9
No. Turns Arm *	I2.3	I3.2	I3.2	I6.4	38.	35.2
Reading Chart	30	3I	3I	37	79.5	74.

* To get actual output multiply by I0

30 B Md. Date of Test - Apr. - 8 - 26

No. of point on curve	7	8	9	I0
Time Start	2:06	2:36	3:36	4:06
Time Stop	2:36	3:06	4:06	4:36
No. Turns Arm	33.2	28.I	30.2	25.6
Reading Chart	70	60	64	55

30 B Md. Date of Test - Apr. - I0 - 26

No. of point on curve	II	I2	I3	I4	I5
Time Start	II:I0	I2:40	I:I0	I:40	3:I0
Time Stop	II:40	I:I0	I:40	2:I0	3:40
Turns of arm	22.0	32.I	I7.5	I5.9	I4.8
Reading Chart	48	68	39	36	34

Test on Prover

30 B Md.	open demand	+ 2 ½ %	(Slow)
30 B Md.	Cap Test	+ I ½ %	(Slow)

IO B Md.	Date of Test		-	Apr. - 2I - 26
No. of point on curve	I	2	3	4
Time Start	IO:30	II:00	II:30	I2:00
Time Stop	II:00	II:30	I2:00	I2:30
Turns of Arm *	II	I4.3	I2.5	I5.5
Reading Chart	30.5	36	33	38

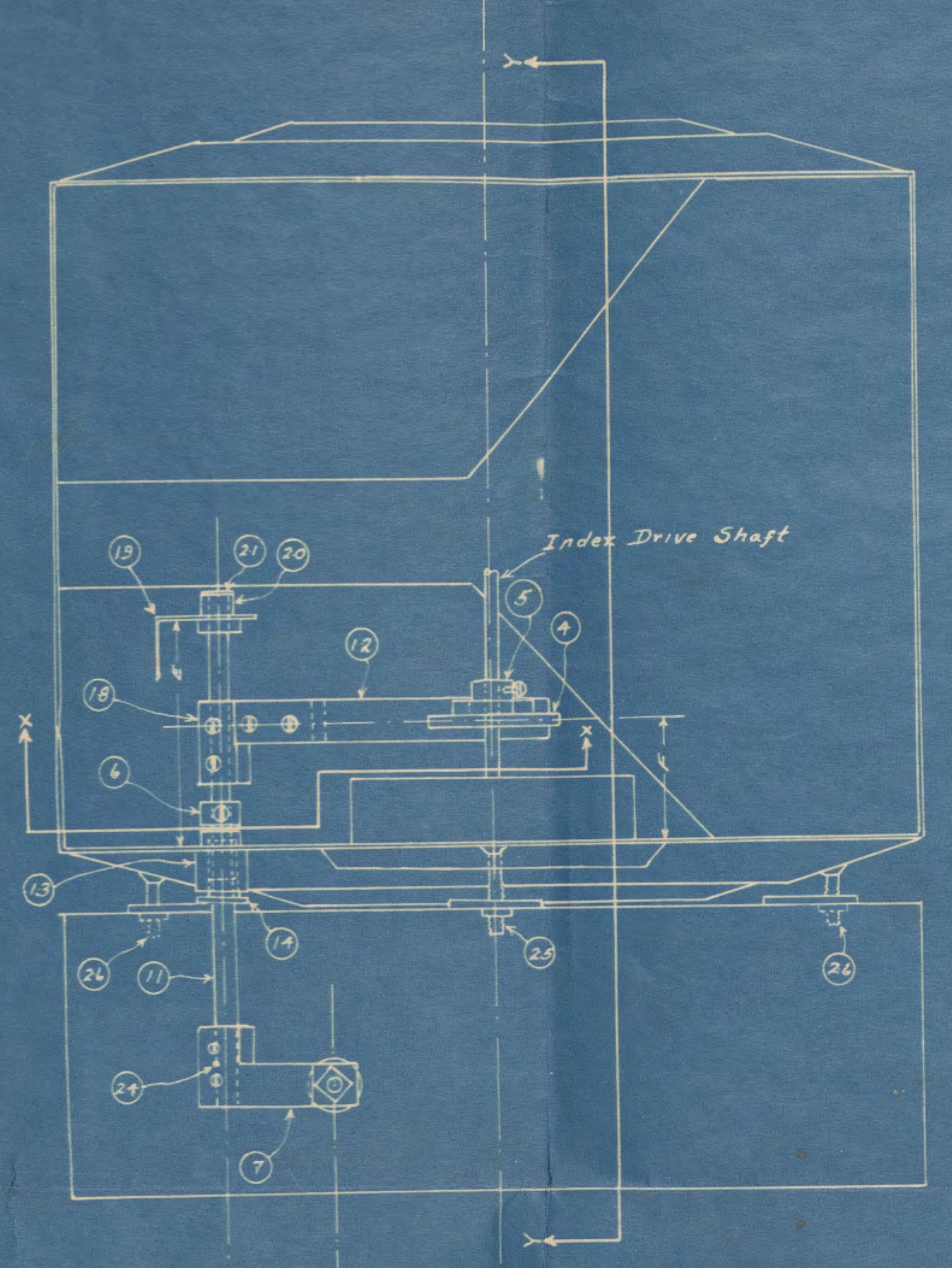
* To get actual no. of cubic feet passed multiply by 5

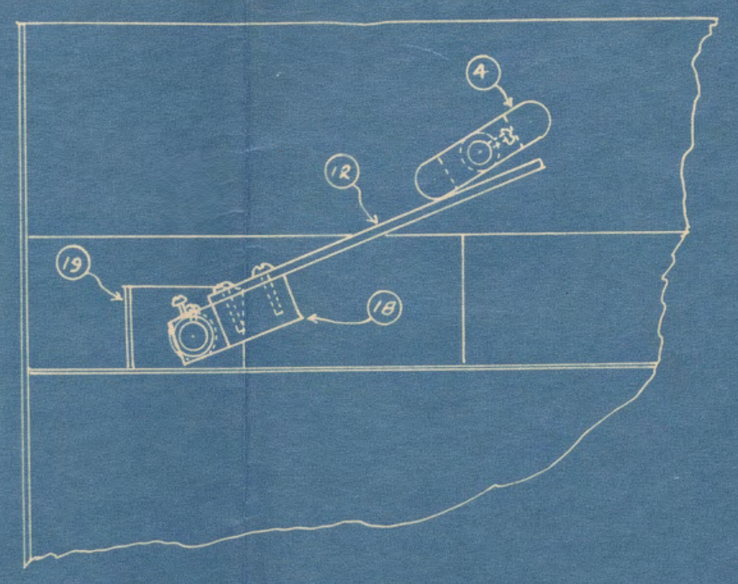
IO B Md.	Date of Test		- Apr. - 2I - 26
No. of point on curve	5	6	7
Time Start	I:30	2:30	3:30
Time Stop	2:00	3:00	4:00
Turns of Arm	20.3	I8.5	24.5
Reading Chart	46.5	43	52.5

ASSEMBLY
OF
APPLICATION OF GENERAL ELECTRIC CO'S.
TYPE G-2 DEMAND METER
TO
5A & 10A GAS METERS
GEORGIA RAILWAY & POWER CO.
GAS SERVICE DEPT.

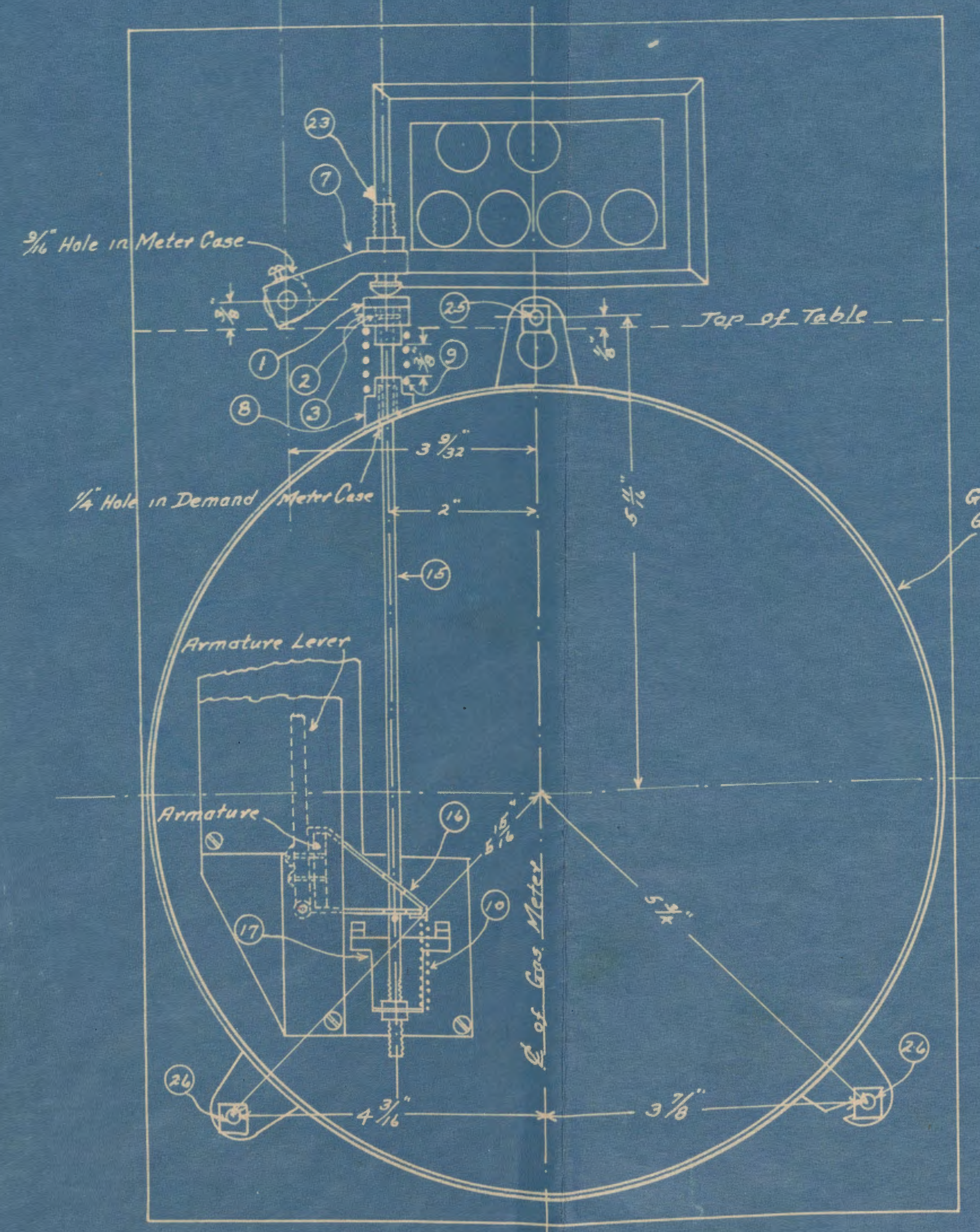
SCALE HALF SIZE SEPT. 10th 1924.

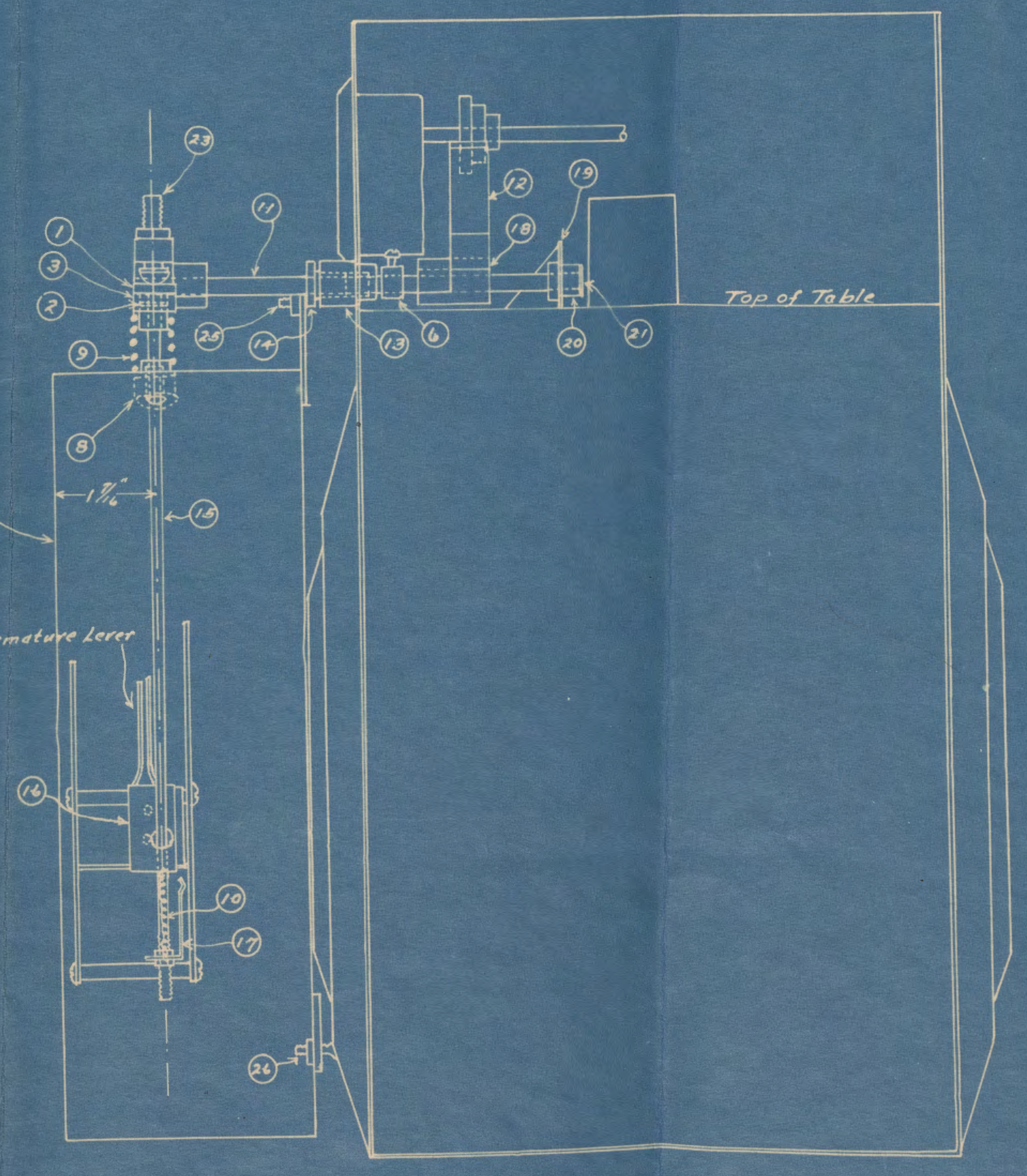
See Detail Sheet.





Section X X





Section Y Y

IO B Md. Date of Test - Apr. - 22 - 26

No. of point on curve	8	9	IO	II
Time Start	I:IO	I:40	2:IO	2:40
Time Stop	I:40	2:IO	2:40	3:IO
Turns of Arm	32.7	43.2	37.7	48
Reading Chart	66	83	74	9I

IO B Md. Date of Test - Apr. - 23 - 26

No. of point on curve	I2	I3	I4
Time Start	IO:I7	II:I7	I2:I7
Time Stop	IO:47	II:47	I2:47
Turns of Arm	50	46	48.6
Reading Chart	94	88	92

Test on Prover

IO B Md.	Open Demand	+ I % (Slow)
IO B Md.	Cap Test	+ ½ % (Slow)

APPROVAL

The foregoing thesis is hereby approved as a creditable study of an engineering subject, carried out and presented in a manner sufficiently satisfactory to warrant its acceptance as a prerequisite to the degree for which it has been submitted. It is to be understood that by this approval the undersigned does not necessarily endorse or approve any statement made, opinions expressed, or conclusions drawn therein, but approves the thesis only for the purpose for which it is submitted.

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Title Professor Electrical Engrg.