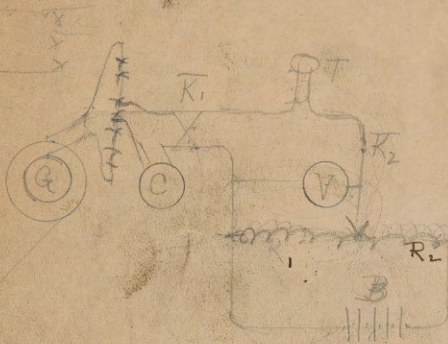


Determination of Wave Form of an Alternating Electromotive force

See Franklin and City Vol II § 10 for general description of method

A synchronous contact maker is attached to the shaft of the generator by which a circuit can be closed at a certain point in each revolution. If the emf of the alternator at the instant of contact is just equal and opposite to the emf of a battery in the same circuit, then there will be no flow of current at this instant. A telephone receiver in the circuit will indicate whether a current passes.



The connections may be as here shown.

G is the generator, C the contact maker, A reversing key K, changes the connections when the emf of the generator reverses sign.

T is the telephone receiver and V a voltmeter. When the resistance of R_1 is decreased and that of R_2 is increased, the emf as shown by

the voltmeter will decrease. The maximum emf to be measured which can be measured is the emf of the battery, obtained by making R_2 zero and R_1 as great as convenient.

First adjust the emf to zero ^{by using the maximum resistance in R_2 and then making $R_1 = 0$.} Turn the contact maker to a point that will give no sound in the telephone. This is the position of 0 emf. Record the reading and note carefully the position of the armature with respect to the poles. Turn the contact maker through about degrees, and increase R_1 until approximate silence is found. ~~By~~ Better silence can be had by now moving the contact maker. Read the angle and the emf.

Proceed in this way until one positive and one negative loop is found for the curve.

Plot your curve as you proceed. You can then judge whether you are taking the points with sufficient frequency.

It is frequently necessary to ~~measure~~ ^{that of} determine an emf higher than any available battery. Place two or more lamps in series across the terminals of the machine and find the emf between the terminals of one of the lamps. A voltmeter will give the ratio of this drop to the total drop between the machine terminals -



THESIS

Howard B. Freeman.

University of Tennessee.

A contact maker to be used in determining the wave form of alternating electro-motive force and current.

Before beginning the design I looked up several different designs of similar machines. The final decision was to design a machine which would be bolted to the dynamo of which the wave characteristics were to be determined as then there would be no variations in the contact. The machine may be attached to any dynamo in the laboratory if the dynamo is provided with a suitable support.

The contact maker is intended to make a momentary contact once during each revolution of the armature, but instead of a single brush touching a metal bar, two brushes are provided which rest for a small part of the revolution on a brass conductor carried on the circumference of an insulated iron ring. While the two brushes are placed in series in the circuit, so that the duration of the contact may be adjusted by varying the angular distance between the brush holders. The brush holders are carried by brass plates, which are bolted to a graduated iron ring. When the bolt is loosened the plates may be relatively displaced to vary the time of contact as above stated. When the bolt is tightened, the plates, brush holders and graduating ring may be shifted by rotation about the axis of the machine, for the purpose of making contact at different points in the wave of E.M.F.

The enclosed drawings show the general construction

of the machine. From these drawings I made patterns, three in number; the rotating ring, the bushing and the attachment piece. All castings were made of iron and made in the University of Tennessee Foundry. The brass brush stud supports were to be of one-eighth inch sheet brass but as I could not obtain brass of the required thickness I used two one-sixteenth inch thick.

The ring was bored and placed on a suitable mandril and turned all over. Graduations were made by the milling machine.

The degrees were stamped by hand. I believe it would have been better to have made the ring of cast brass as then the graduations and degrees would have shown much better and would have been easier to make. The bushing was bored and put on a mandril, turned all over and threaded on the front as is shown in the tracing. The nut which fits on the bushing was bored and threaded while in the chuck then taken out and put on a mandril and turned all over. A hole was put through the rim and tapped to fit a one quarter inch stud bolt inserted to prevent the nut turning off.

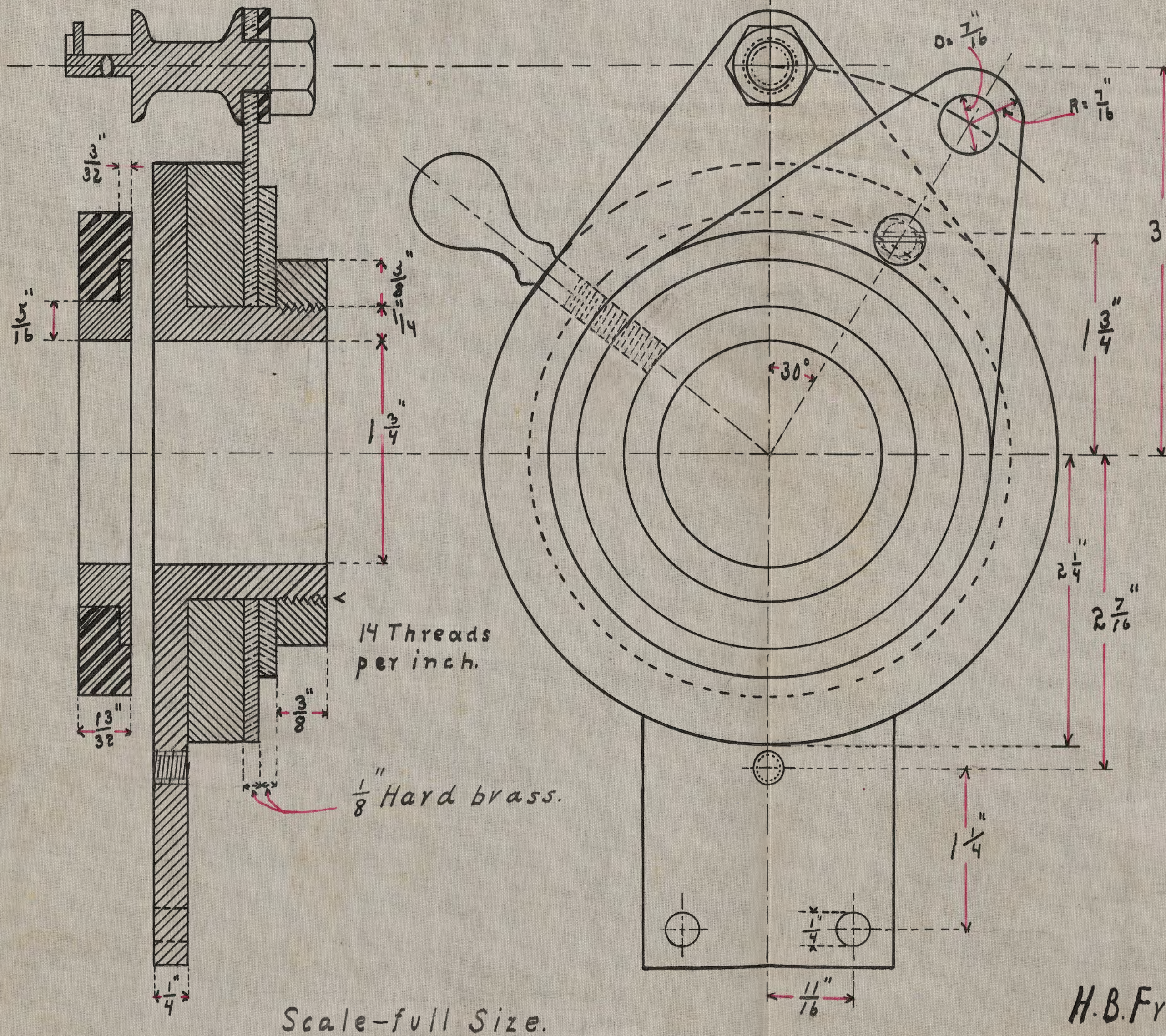
The brass brush stud holders were made of sheet brass bolted to a wooden face plate and bored to the required diameter. The two brass rings were placed on the bushing and turned to the proper size.

A cast iron ring was made having a flange which was used ^{as} ~~for~~ the support ~~of~~ for a fiber ring. The fiber was bolted to a wooden face plate and turned to fit the flange ring as shown in the tracing. After the fiber was fitted to the ring the whole was turned into shape.

Holes were drilled in the flange and screws inserted into the fiber to prevent its slipping on its support. The fiber ring was then placed in the milling machine and a thirty degree slot cut in its outer rim three sixty-fourths of an inch deep. In this slot was placed a piece of brass which was ^xheld in by brass screws. The fiber ring and support were then placed on a mandril and turned all over.

A tracing is given of the data for the inclosed curve and for the connections to be used in obtaining such curves. E. B is some source of constant direct current voltage, R is an adjustable resistance, V is a direct current voltmeter, S is a shunt, C is contact machine, r is a resistance to prevent excessive currents in a telephone receiver T, A is the alternating current dynamo whose curve is under investigation. To obtain a voltage curve the switch is closed at H and adjustment is made the contact maker till practically no sound is heard in the telephone receiver. The voltmeter readings and angles of the contact machine are recorded. To obtain the current wave form switches F and G are closed, and suitable voltmeter is placed at V which goes with the shunt, usually a different resistance and ~~xxx~~ battery are required, manipulated as before and record the points of silence. The curve as shown is not 0 volts at 0 degrees but is 0 at somewhat less. The armature was turned in the opposite direction and 0 obtained at a point about as great above 0 as it was below in the first case showing that pole flux was distorted.

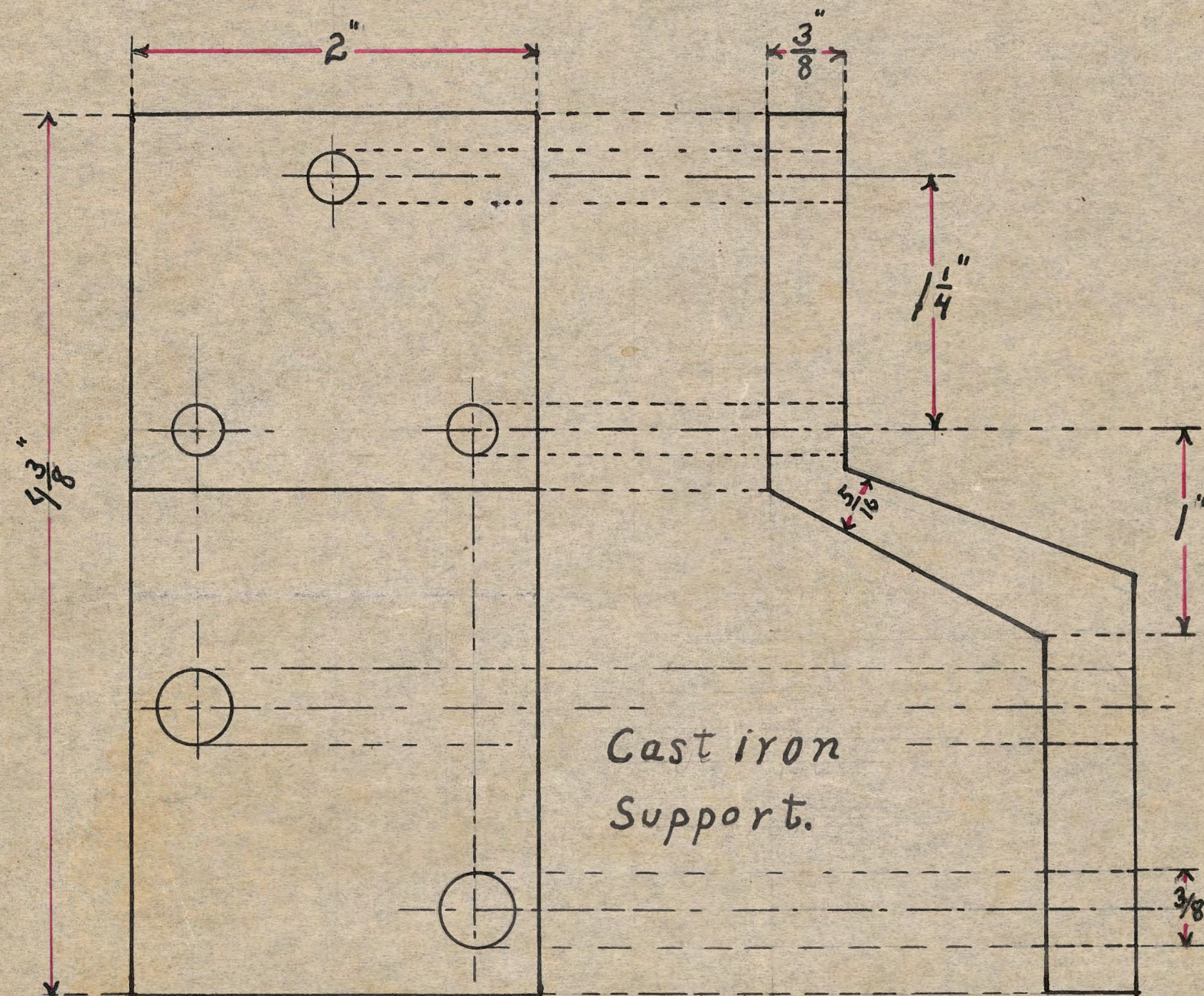
ELECTRICAL CONTACT MACHINE.



Thesis.

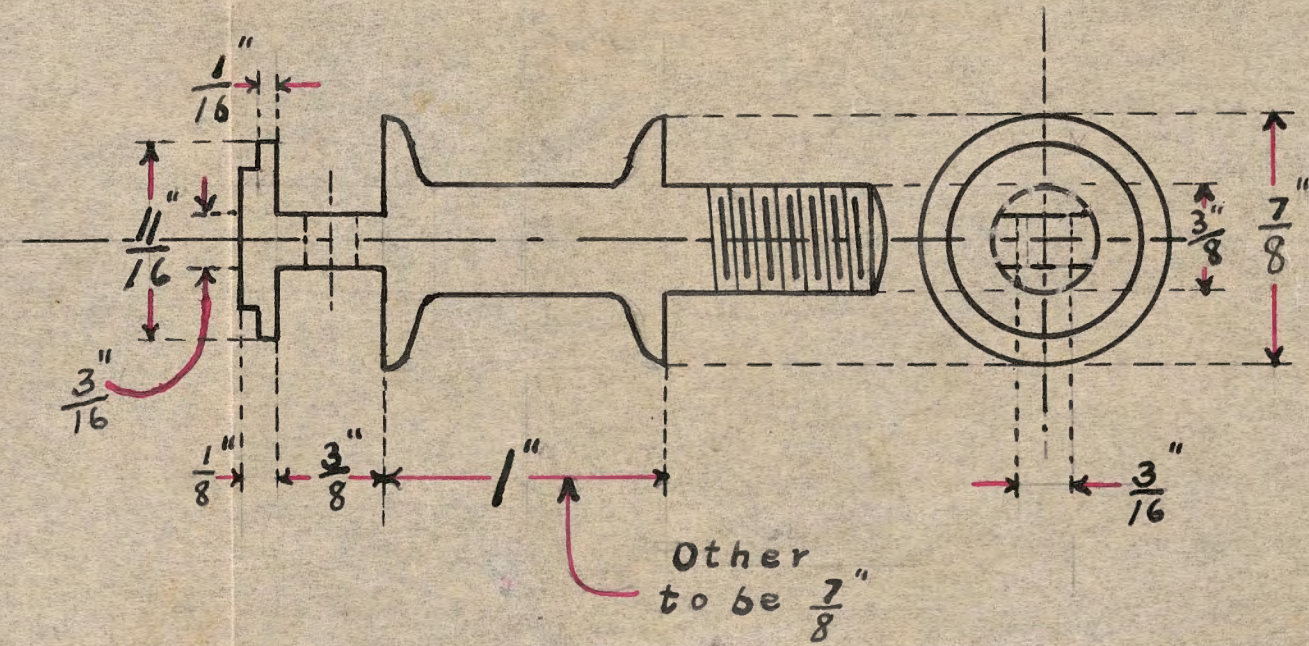
H. B. Freeman—3.—1914

ELECTRICAL CONTACT MACHINE

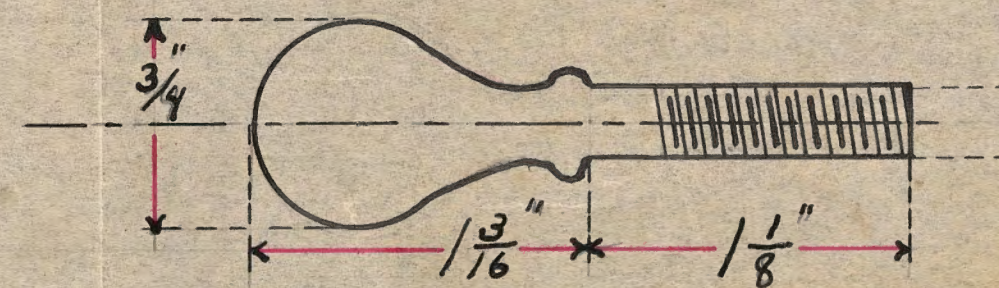


Scale-full size.

Brush Stud.



Adjusting Screw.



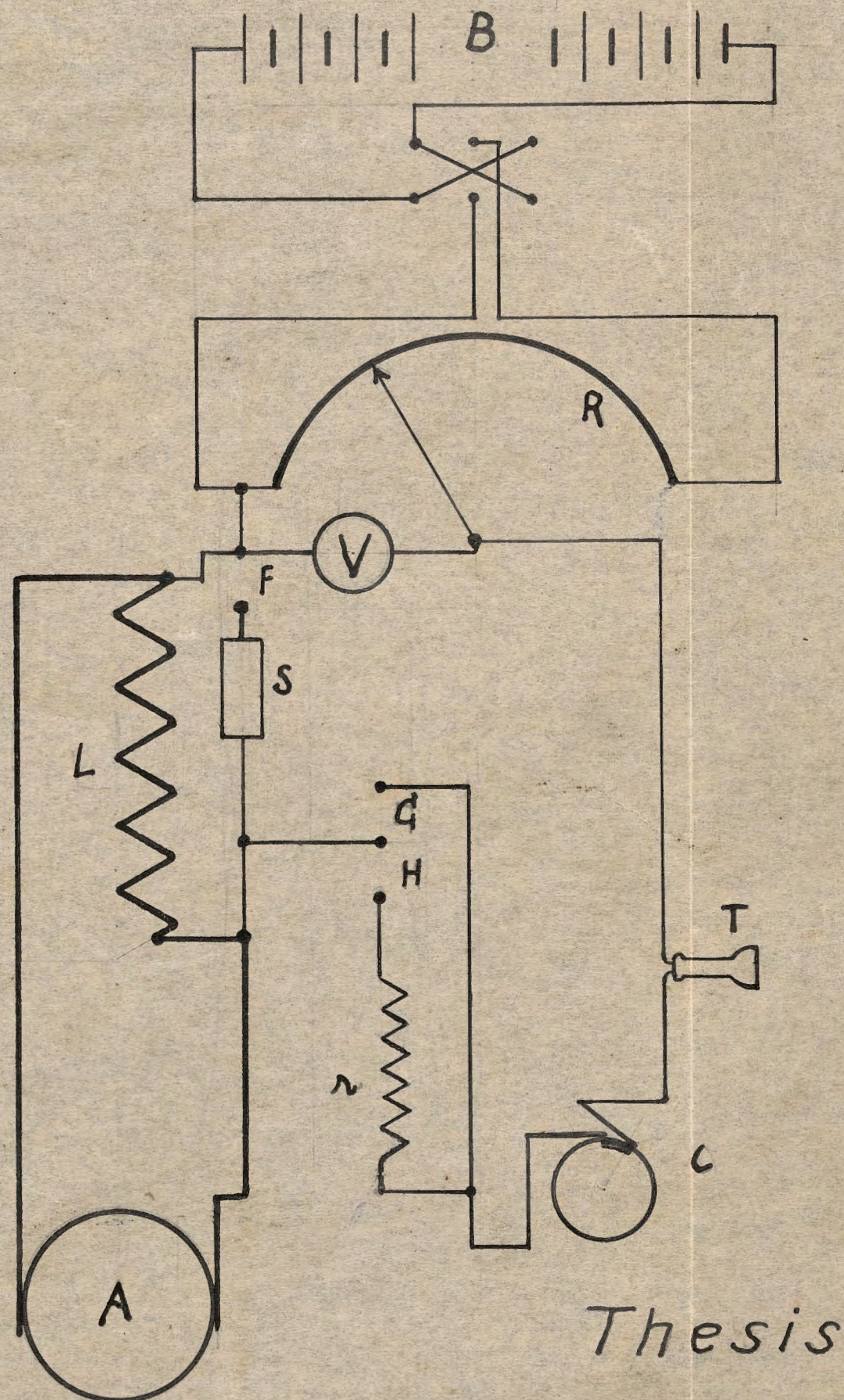
Thesis

Freeman-3-1914

Connections for Obtaining Wave Forms with Contact Machine.

Data for
Enclosed Curve

Degrees	Volts
0 0	1 5
1 0	4 0
2 0	5 7
3 0	6 7.5
4 0	7 6
5 0	7 3
6 0	5 4
7 0	3 5
8 0	8
9 0	1 3.5
10 0	3 8
11 0	5 5
12 0	6 9
13 0	7 7.5
14 0	7 4
15 0	5 4
16 0	3 6
17 0	9
18 0	1 3
17 4	0
35 5	0

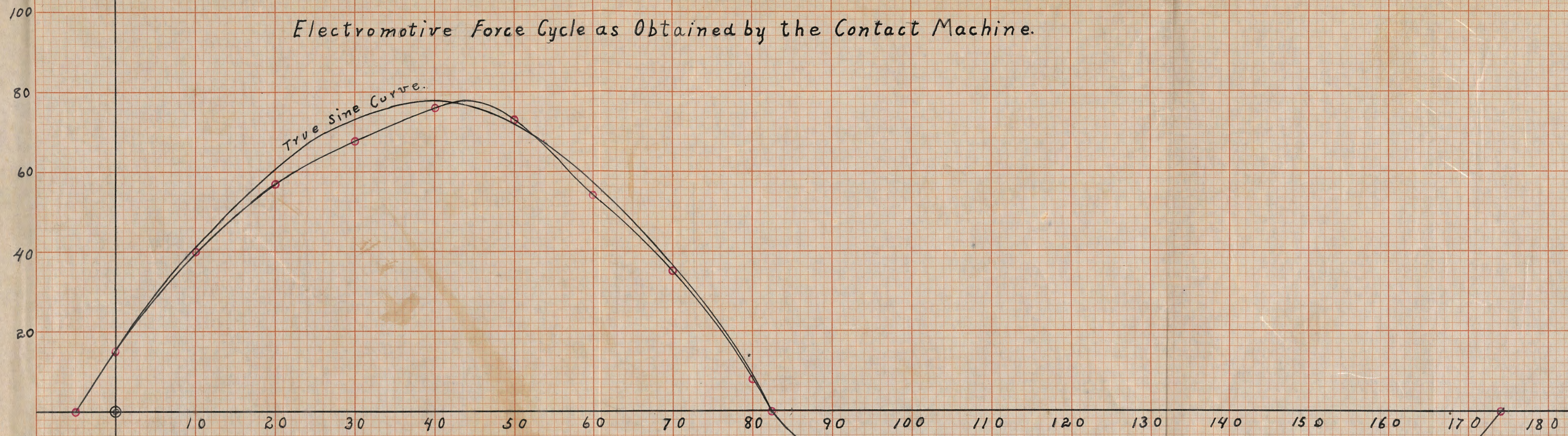


Thesis

Volts

Electromotive Force Cycle as Obtained by the Contact Machine.

True sine Curve.



Values of π

Volts

Thesis

Freeman- 5-1914