T H E S I S

THE SPHERE SPARK GAP VOLTMETER

For the Degree of

BACHELOR OF SCIENCE IN ELECTRICAL ENGINEERING

By

R. C. McCalla

Under

Dr. C. A. Perkins.

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Note.

The Spark-gap voltmeter here described was constructed by

W.E. Saylor - Class of 1913. except the spheres which were turned up from the castings, as here described, by

R.C. McCalla - Class of 1914.

Chas. A. Perkins.

This instrument is designed to take the place of the needle point spark gap in the measurement of high voltages.

It is recommended as giving more consistent results than the needle point spark gap and being adapted to a greater range of voltages.

The instrument constructed as herein described is discussed in a paper published in the "Proceedings of the American Institute of Electrical Engineers", Volume XXXII, page 299, February 1913.

Two sphered of brass, each 25 centimeters in diameters, were constructed. These were mounted in a vertical position on a strong frame of wood. (See Plate I). The upper sphere was attached to a wooden rod fixed to the frame and the lower sphere was mounted on a vertical threaded brass rod turning in a threaded brass bushing. To the screw is attached a circular brass disk divided to tenths of one turn which moves by a vertical scale. This disk is attached by a set screw and is adjustable for zero position.

As the scale is divided into inches and tenths, one tenth corresponding to one turn of the screw, and the disk is divided into tenths of one turn or one hundredth of one inch on the scale, there is a micrometric adjustment of the distance between the spheres.

The spheres were made of hollow cast brass hemispheres. For convenience in mounting on the chuck the inside portions of these castings were made cylindrical for a short distance from

their rear sides. (See Plate II). The castings were mounted on a chuck as shown and turned to a true hemispherical form, using templates as guides, the rear parts were cut off smooth and they were joined as follows. The edges were tinned and the hemispheres placed in their proper relative position, tinned edges in contact. The joint was then heated by means of blow torches until the tinned edges united and the sphere was complete.

The templates used were made by turning out the center of a disk of sheet iron, 35 centimeters in diameter, and one eighth inch thick, to an inside diameter of 25 centimeters, the diameter of the spheres. The inside edge was beveled and the ring cut into three parts, a semicircle being one portion and approximately one eighth and three eighths of a circle being the other segments.

In turning the hemisphere it was found that the jaws of the chuck distorted the rear parts from the circular form. This was remedied by loosening the jaws somewhat when the hemisphere was nearly down to size and finishing with a light cut.

In mounting the spheres on the frame the instrument was leveled so that the screw stood in a vertical position, this being determined by suspending a plumb bob near the screw and obtaining a constant distance between the plumb line and the screw at different elevations.

The lower sphere was then attached to the screw and the upper one mounted over it in the same vertical plane, this being accomplished by suspending a plumb bob from the maximum

horizontal diameter of the upper sphere and causing it to touch the lower sphere on its maximum horizontal diameter.

The 25 cm. sphere spark gap is recommended for use in measuring voltages within the range of from 50,000 to 275,000 volts. From the calibration curve for this instrument it is seen that an e.m.f. of 275,000 volts will give a spark 12 cms. in length.

When in use one of the spheres of this instrument is to be grounded.

The data for this calibration curve was obtained from the "Proceedings of the A. I. E. E." for February 1913. Section II, page 635. The calibration curve of the A. I. E. E. for the needle gap voltmeter is also given.

For sphere gaps using spheres of greater diameter than 25 centimeters the calibration curves diverge above 150 kilovolts, the distance the spark will jump being greater for a given e. m. f. the larger the sphere.

Data for Calibration of 25 Centimeter Sphere Spark Gap.

Gap cms.	Kilovolts	Gap cms.	Kilovolts.
1.31	39.6	5.71	151
1.19	39.6	6.78	151
3.10	90.9	7.29	191
3.10	90.9	7.32	192
3.86	114.	9.02	227
4.07	114.3	9.08	227
4.06	115.1	11.37	265
5.52	152.8	11.36	268
5.56	154.	11.17	306
4.92	137.8	14.67	306
4.38	122.6	14.43	307
3.79	107.2	17.80	343
3.76	106.8	18.02	345
2.34	69.	23.56	381
1.82	57.	24.73	381
		23.55	380
		27.85	404
		21.28	363
		27.58	402
		22.79	381
		14.88	303
		9.20	225
		5.56	154
		5.66	155

Data for Calibration Curve of Needle Point Spark Gap.

A. I. E. E. Standard.

Kilovolts Sq.root of Av.sq.	Kilovolts Max.	Gap Cms.	Kilovolts Sq.root of Av.sq.	Kilovolts Max.	Gap Cms.
5	7.06	0.57	210	297.	54.1
10	14.14	1.19	220	311.	56.8
20	28.28	2.54	230	325.	59.4
30	42.4	4.1	240	339.	62.1
40	56.5	6.2	250	353.5	64.7
50	70.6	9.	260	367.5	67.3
60	84.8	11.8	270	382.	69.8
70	99.	14.9	280	396.	72.4
80	113.	18.	290	410.	74.9
90	127.	21.2	300	424.	77.4
100	141.4	24.4			
110	155.5	27.3			
120	169.5	30.1			
130	184.	32.8			
140	198.	35.4			
150	212.	38.1			
160	226.	40.7			
170	240.4	43.4			
180	254.5	46.1			
190	268.5	48.8			
200	282.8	51.4			

(Kilovolts max. = sq.root of av. sq. $\times \sqrt{2}$.)

PLATE I.

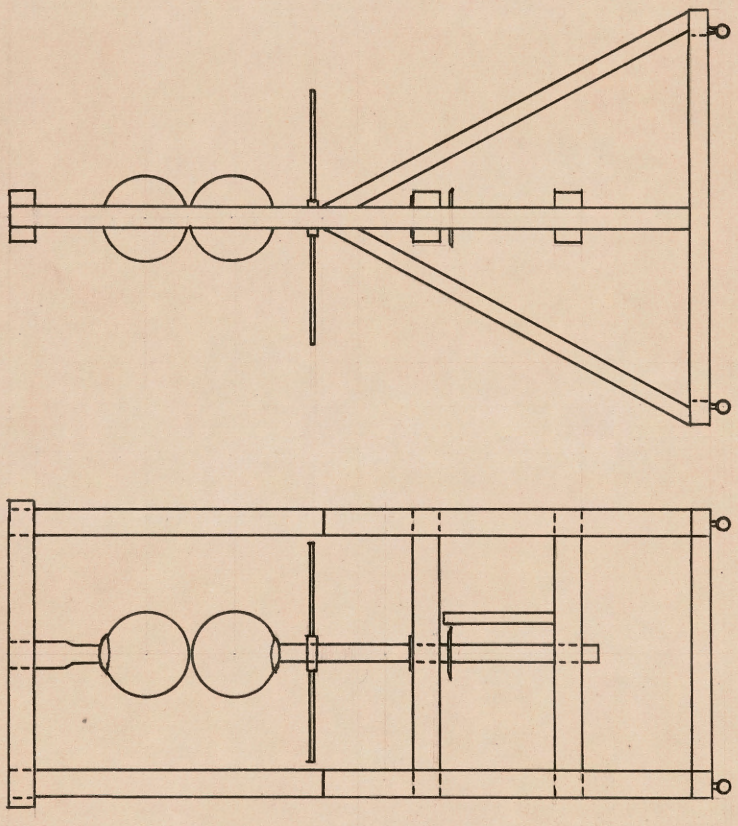
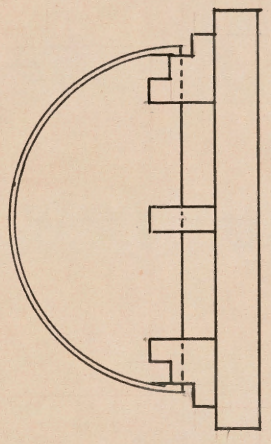
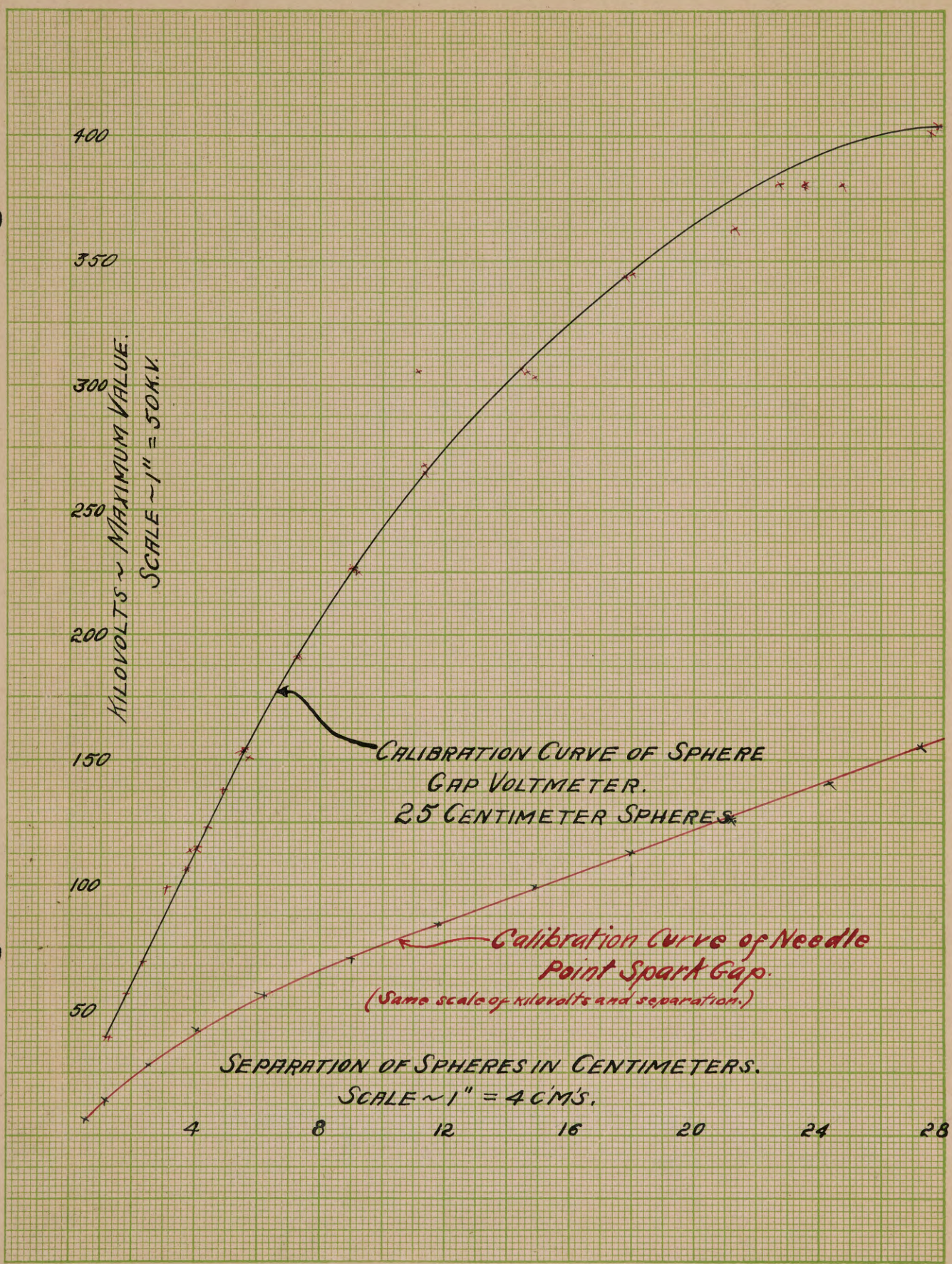


PLATE II.



Showing method of mounting hemisphere on chuck.



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