



LXXVII. Rotating earth-inductor without sliding contacts

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in assuming that the distribution of velocity determined by the experiments is the same as that which would hold in the steady state. Strictly speaking, this conclusion is true; but when the matter is looked at quantitatively it will be seen that for all practical purposes it is false. The number of electrons which strike the bounding surface from the inside is enormous compared with the number which escape, and the number which escape must be approximately the same, whether the state is steady or otherwise, since the electric fields are too small to be appreciable within the surface layer. It follows that, even in the steady state, but an insignificant proportion of the electrons which escape from the metal will be made up of those returned to it and which do not undergo a considerable number of encounters within the metal. The number, and distribution of velocity, of the electrons emitted by the metal must therefore be the same, for all practical purposes, under the conditions of these experiments as in the steady state. We may therefore claim to have proved by direct experiment the truth of Maxwell's classical theorems relating to the distribution of velocity among a collection of material particles in statistical equilibrium.

Several of the preceding statements are true only within the limitation imposed by a considerable experimental error. There appears to be no obvious reason why the limit of error should not be materially reduced. Experiments with this object and in other directions suggested by the results of these researches are being instituted.

Princeton, N. J.,
July 6, 1908.

LXXVII. *Rotating Earth-inductor without Sliding Contacts.*
By J. J. TAUDIN CHABOT.*

[Plate XXVII.]

AS shown in a former article† it is possible—in spite of all constructions which previously apparently demonstrated the contrary—to connect together the stationary part of a circuit and the rotating coil (the rotation being continuously in one direction) by means of an unbroken conducting connexion—*i. e.* without any sliding contacts.

I have recently had an earth-inductor made according to the principle then explained, but which as constructed has

* Communicated by the Author.

† Phil. Mag. October 1902.

certain differences from the model previously described, which I consider to be advantageous. Hence I shall now describe the instrument in its present form with the help of figs. 1, 2, and 3 (Pl. XXVII.).

The conducting coil a is placed so as to turn around an axis y in a wooden arched-frame b , which is rotatable round an axis x normal to y in a fixed wooden frame c , which carries the driving mechanism d ; for these axes bronze ball-bearings are employed throughout. Fig. 1 shows the instrument with a horizontal axis x , adapted for induction by the total magnetic field of the earth, or by the vertical component alone, according as the x -component runs along it transversely or longitudinally; fig. 2 shows the same with vertical axis x arranged for induction by the earth's horizontal component; fig. 3 shows the arrangement of the unbroken conducting path between the fixed and rotating parts of the circuit.

The brass shaft to the conducting coil a is hollow and terminates at the one end with a bevel-wheel gearing in the particular model, with the nearest end of another hollow shaft (which, however, is of plaited bronze wire and is therefore flexible) whose other end is fixed rigidly in the framework c . At each rotation of the frame b round the axis of x there occurs therefore an equal rotation of the coil a round the axis of y in such a manner that the conducting windings of the coil can now without further ado be connected with the stationary current circuit by a flexible cable led through the two hollow shafts. This is a concentric double cable of very fine twisted copper wire of $\cdot 0123$ cm.² conducting cross section for each of the two current paths. The coil is wound in a square groove of 2.1 cms. side, and has 290 turns (N) with a mean diameter of 25 cms. (D). It is made of insulated round copper wire of $\cdot 0113$ cm.² conducting section and 3.2 ohms total resistance (W). Accordingly there results a mean electromotive force $e = \pi 10^{-8} N D^2 n F = 5698 \cdot 10^{-6} n F$ volts, where n denotes the number of rotations per second and F the strength of the magnetic field—which must be taken as the total, vertical, or horizontal, component according to the experimental arrangement.

The constructed model allows, when worked by hand, the value $n = 5$ to be attained with which a throttling by the self-inductance of the moderately wide wound induction-coil attains no appreciable value. The distance of the windings being .15 cm. (d), the self-inductance,

$$L_s = 2\pi D N^2 (\log \text{nat } 4d^{-1} \cdot D - 2),$$

is about 858 kilom. (or $350^{-1}v$), so that the impedance

$W_1 = [W^2 + (2\pi n L_s)^2]^{\frac{1}{2}}$, surpasses by about 25 per cent. at the most the simple resistance, W .

Combination of several of these inductors with variously directed axes is evidently possible in the simplest manner; thence also the determination of the ratio of the magnetic components to the total field, the inclination, &c.

A special case arises, if the middle plane of the windings of the inductor-coil is placed parallel to the axis of y instead of normal to it.

In all measurements with the earth inductor by a null method (adjusting for the vanishing of the induced current) it is most effective to employ as indicator a resonance-instrument (string galvanometer or the like), whose own frequency lies within the range of the frequency of the inductor (after paying due regard to the electromagnetic constants of the entire circuit) because it means such a very great increase in the sharpness of the observations. A resonance galvanometer, *f. i.*, indicating currents of 10^{-12} ampere (I) in a circuit of 10^4 ohm total resistance (W) shows at 105 rotations per minute ($60n$) the presence of a magnetic field $F = 5638^{-1} \cdot 10^6 I n^{-1} W = 10^{-6}$ gauss rising already at such a small variation of the earth-inductor's axis x from the axis of the geomagnetic field, that the angle will never be larger than that caused by a very small play of the rotating axis in its bearings.

Degerloch, Wuerttemberg, May 28, 1908.

LXXVIII. *An Experimental Investigation of the Nature of γ Rays.*—No. 2. By W. H. BRAGG, M.A., F.R.S., Elder Professor of Mathematics and Physics in the University of Adelaide; and J. P. V. MADSEN, D.Sc., Lecturer on Electrical Engineering*.

IN a previous paper (Trans. Roy. Soc. of S.A. 1908, p. 1) we have given a preliminary account of an investigation of the properties of the secondary radiation due to γ rays, and discussed the evidence thus afforded as to the nature of the rays. The first section of the present paper contains an account of further experiments, and the second a list of the properties of the secondary radiation, derived in part from the work of other observers, and in part from our own. In the third we have tried to show that the properties are

* Communicated by the Authors. From 'Transactions of the Royal Society of South Australia,' vol. xxxii. (1908).

FIG. 1.

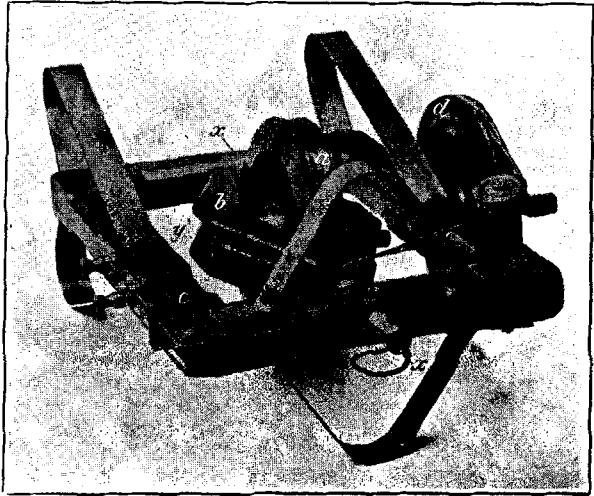


FIG. 2.

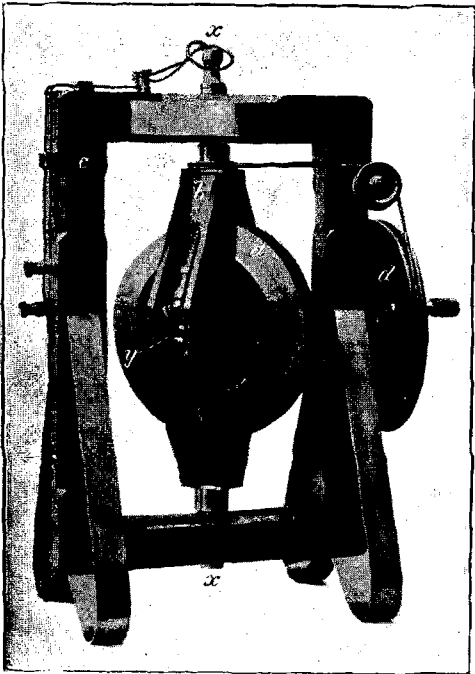


FIG. 3.

