On a Method of Determining the Difference between the Phase of two Harmonic Currents of Electricity having the same Period

This content has been downloaded from IOPscience. Please scroll down to see the full text.

1887 Proc. Phys. Soc. London 9 165

(<http://iopscience.iop.org/1478-7814/9/1/323>)

View [the table of contents for this issue](#), or go to the [journal homepage](#) for more

Download details:

IP Address: 165.123.34.86

This content was downloaded on 02/10/2015 at 11:27

Please note that [terms and conditions apply](#).

conclusions:—That when gas is not evolved at an electrode, streaks are formed there. These are due either to a concentration or weakening of the electrolyte, as in the case of solutions of acids and alkalies and some salts (such as zinc sulphate); or, in the case of other salts (such as potassium sulphate), to a chemical change in the electrolyte, yielding at one pole alkali and at the other pole acid, producing solutions of different density to the electrolyte. When gas is not evolved at an electrode these changes are still produced, but their effect in producing streaks is destroyed by the evolution of the gas.

In our next paper we hope to describe some experiments in which these effects become of great importance in changing the resistance of the electrolyte.

XXIII. *On a Method of Determining the Difference between the Phase of two Harmonic Currents of Electricity having the same Period.* By THOMAS H. BLAKESLEY, M.A.*

It has been brought to my notice by both English and Foreign journals connected with science that a method of determining the difference in phase of two Harmonic Currents of Electricity having the same period, which I invented and published some years ago, forms an important part of the subject matter of a paper communicated to the Royal Academy of Sciences of Turin, second series, vol. xxxviii., by Signor Galileo Ferraris, in which that philosopher lays claim to the invention above mentioned, producing it as original, with no sign of acknowledgment that the method has before been made public.

The method consists in employing the two coils of an electric dynamometer in a peculiar way. When an harmonic current is sent through the coils of such a dynamometer in series, its reading will measure the quantity $\frac{I^2}{2}$, where I is the maximum value of such a current. In this way we may

* Read March 10, 1888.

successively determine $\frac{I_1^2}{2}$ and $\frac{I_2^2}{2}$, where the subscripts refer to two currents having the same period.

But if we place one of the coils in one circuit and the other in the second circuit, the reading of the instrument will measure $\frac{I_1 I_2}{2} \cos \theta$, where θ is the angle representing the phase-difference of the two currents, to which the name "*décalage*" has, I have no doubt with great propriety, been accorded by M. Hospitalier.

It is clear that from the three readings we can deduce the angle of phase-difference. Thus, $\alpha_1, \alpha_2, \alpha_3$ being the three readings, we have :—

$$\alpha_1 \propto \frac{I_1^2}{2},$$

$$\alpha_2 \propto \frac{I_2^2}{2},$$

$$\alpha_3 \propto \frac{I_1 I_2}{2} \cos \theta ;$$

$$\therefore \cos^2 \theta = \frac{\alpha_3^2}{\alpha_1 \alpha_2}.$$

Here I have supposed that the same instrument is used successively ; and it is hardly necessary to point out that if we have three exactly similar dynamometers, or if we have three dynamometers of which the relative values of the constants are known, we can deduce θ by means of three simultaneous observations.

The real importance of the determination of the *décalage* rests in the means it affords us of determining the causes of its existence ; among which I may here mention Coefficients of Induction (self or mutual), Capacity of Condensers, and hysteresis or the waste of energy involved in the reversal of electromagnetic momentum, all of which present useful fields for inquiry capable of investigation by means of this application of the dynamometer, a few of which I have myself traversed.

I wish to point out that this method and its importance (not yet fully appreciated) were published by me in the 'Electrician' newspaper of October 2, 1885 ; and the entire

series of papers, of which this formed one, was republished in book form at the end of the same year. This was before I had the honour of membership in the Physical Society, or doubtless I should have then brought the subject more immediately under your notice; but upon my being elected a member I lost no time in presenting a copy to this Society, and those who care to examine this question will find therein a chapter devoted to this very employment of the dynamometer to determine Coefficients of Self- and Mutual-Induction and the Capacity of Condensers.

March 1888.

XXIV. *On the Numerical Relation between the Index of Refraction and the Wave-length within a Refractive Medium, and on the Limit of Refraction.* By T. PELHAM DALE, M.A.*

THE following equation (see Sir Geo. Airy's Treatise on the Undulatory Theory, ed. 1877, p. 93) is proposed as expressing the relation between wave-length and velocity of propagation in an isotropic medium:—

$$v = \sqrt{\left(1 - \frac{1}{2^{\frac{3}{2}}}\right)^m} \cdot \frac{\sin \frac{\pi h}{\lambda}}{\frac{\pi h}{\lambda}} \dots \dots \dots (\alpha)$$

v is here the velocity of propagation, h the distance between the undulating particles, λ the wave-length, m the absolute force of attraction, supposed to follow the law of the inverse square.

For our purpose this may be put under the form

$$v = k \sin \frac{\pi h}{l} / \frac{\pi h}{l} \dots \dots \dots (\beta)$$

It is convenient to reserve λ to signify the wave-length in free æther, and to use l for the wave-length within the medium. The values of the wave-lengths in free æther are those given in the text-book of Glazebrook and the tables of Lupton.

Now, knowing the index of refraction for any fixed line by observation of the index μ , the corresponding value of l is given by the equation

$$l = \frac{\lambda}{\mu}.$$

* Read February 11, 1888.