On a Phase-Turning Apparatus for use with Electrostatic Voltmeters

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the time, occurs in my paper "On the Vapour-Pressure of Liquid Mixtures" (Phil. Mag. [5] xlv. p. 61, 1898), where the relation

$$x \frac{d \log p_1}{dx} + (1-x) \frac{d \log p_2}{dx} = 0$$

was to be verified: here x is the molecular fractional composition of a binary liquid mixture, p_1, p_2 the vapour-pressures of the two components. It is sometimes much easier to measure one of the vapour-pressures than the other. Suppose p_1 to be measured, then

$$\log p_2 = - \int \frac{x}{1-x} \frac{d \log p_1}{dx} dx.$$

Hence

$$\log p_2 = \left[\frac{-x}{1-x} \log p_1 \right] + \int \frac{\log p_1}{(1-x)^2} dx,$$

and the numerical solution becomes practicable.

XXXVIII. *On a Phase-Turning Apparatus for use with Electrostatic Voltmeters.* By ALBERT CAMPBELL, B.A.*

[Abstract.]

ELECTROSTATIC voltmeters are particularly insensitive at the lower parts of their ranges, the divisions closing in very much towards the zero point. When measurements of small direct-current potential-differences have to be made it is an easy matter to add to the voltage to be measured a constant voltage large enough to bring the deflexion to an open part of the scale. If the small voltage to be measured is an alternating one it is necessary that the auxiliary voltage should alternate with the same frequency and be in phase with it. The apparatus described enables the phase of the auxiliary voltage to be turned until it agrees with the one to be measured. The phase-difference referred to is not the time lag, but the angle whose cosine is the power-factor, and

* Read November 9, 1900.

may be called the power lag. The method is to get two independent voltages, U_1 and U_2 , differing in power phase by $\pi/2$ and to add together suitable fractions of these, such as $U_1 \sin \phi$, $U_2 \cos \phi$. The resultant is equal to U_1 , but with the power phase turned through ϕ . The unknown small voltage is connected in series with an auxiliary voltage and a voltmeter, and the phase of the latter voltage is turned until the maximum deflexion is obtained.

XXXIX. *On a Method of Measuring Power in Alternating Current Circuits.* By ALBERT CAMPBELL, B.A.*

[Abstract.]

THE circuit in which the power is to be measured is connected across the supply circuit in series with a small non-inductive resistance. By means of a transformer the small voltage on this resistance may be transformed into one whose power phase is π behind the voltage on the resistance. This is added to the voltage on the circuit to be measured, and then reversed and added again. The difference of the squares of these effective resultants is shown to be equal to a constant into the power to be measured. If there is any direct current it must be measured separately by a Weston voltmeter or other suitable instrument.

XL. *Note on obtaining Alternating Currents and Voltages in the same Phase for Fictitious Loads.* By ALBERT CAMPBELL, B.A.*

[Abstract.]

WHEN testing instruments for the measurement of large amounts of electrical power or energy, it is usually desirable to do so by means of fictitious loads, *i. e.*, by applying to the instrument under test current and potential-difference representing the required load. In order to obtain a fictitious

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