THE ELECTROLYTIC WAVE DETECTOR.¹

BY L. W. AUSTIN.

THE electrolytic wave detector first described by Fessenden and later independently by Schlömilch consists essentially of a cell having as one electrode a point of fine platinum wire and containing an electrolyte the decomposition products of which are gaseous. When an E.M.F. is applied to such a cell powerful polarization ensues so that practically no current passes unless the E.M.F. exceeds a certain value. When electrical oscillations pass through the cell this resistance is for the time decreased but returns to its former value as soon as the waves cease.

This work was undertaken with the purpose of gaining some quantitative data regarding the detector and with the hope of settling some of the disputed points regarding its action. Experiments were made with the cell excited by alternating currents of low frequency and also by true electrical waves supplied for the most part from a station seven miles away. The action in the two cases seems to be in general the same.

The following are the principal results:

When the polarization is complete enough so that a sensitive galvanometer can be used, a few thousandths volts alternating E.M.F. can be detected.

The decrease in the resistance of the cell is approximately proportional to the square of the applied alternating E.M.F.

With increasing polarizing E.M.F. the sensitiveness increases to a maximum after which it remains constant or decreases.

Under favorable conditions the cell is found to be about equally sensitive with positive (oxygen) or negative (hydrogen) polarization on the point thus supporting the results of Fessenden and Rothmund and Lessing in opposition to those of DeForrest and Schlömilch. At times however the action with negative polarization is irregular, the resistance occasionally increasing instead of decreasing.

The resistance of the cell is very variable depending on the polarizing E.M.F. When the polarizing E.M.F. is low it may be 50,000 ohms or more while at the point where the polarization is beginning to break down it is sometimes less than 1,000 ohms. In the case of rapid oscillations the effective resistance is modified by the fact that the cell acts as a condenser.

For slow alternations the cell is equally sensitive whether the small electrode is minute or of considerable size. For oscillations of the period usually used in wireless telegraphy the area should not exceed 0.0003 mm. This difference in action is probably due to the capacity effect of the point.

¹ Abstract of a paper presented at the meeting of the Physical Society held April 20-21, 1906.

In order to test the hypothesis that heat is a prominent factor in breaking down the polarization resistance at the small electrode, this electrode was made in the form of a loop of wire through which an alternating heating current could be passed. It is found that the heating of the electrode produces a marked diminution in the resistance of the cell, which indicates that heat is at least one of the factors in the phenomenon.

ON THE INFLUENCE OF FREQUENCY UPON THE SELF-INDUCTANCE
OF CYLINDRICAL COILS OF ANY NUMBER OF LAYERS.¹

BY J. G. COFFIN.

CALCULATIONS on a marble standard of self-inductance, constructed for the Bureau of Standards, showed that a change in the self-inductance with the frequency, of over 0.25 per cent., was possible.

In accurate work, this is a very large variation and it is necessary to derive a method for assigning the correction to be applied to any given coil at any given frequency.

Such a method is given in this paper, which is an extension of one for the corrections to a coil of a single layer, shortly to be published in the Bulletin of the Bureau of Standards.

Starting from Maxwell's equations, a differential equation is derived for the variation in the magnetic field as a function of the distance from the central axis of the coil, with any frequency.

The solutions of this equation are the Bessels functions of the zeroth order. Following A. Sommerfeld, these solutions are replaced by approximation formulæ, thus reducing the problem to one in simple functions alone.

An equation is then derived which gives the law according to which the variable part of the self-inductance of a coil of m -layers changes with the frequency.

Curves are drawn which render the calculations for any given coil very easy. Approximation formulæ for the case of low and high frequencies are also derived.

This paper will appear in a future number of the PHYSICAL REVIEW.

¹ Abstract of a paper presented at the meeting of the Physical Society held April 20-21, 1906.