ELECTROMAGNETIC FIELD MEASUREMENTS OF VERY SHORT RADIO WAVES NEAR THEIR SOURCE

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(Abstract)

Electromagnetic wave theory indicates that the electromagnetic field associated with the alternating current contains two components. One of these, the radiation component, varies inversely as the distance from the source: the other, the induction component, varies inversely with the square or the cube of the distance. Although the theory has been verified for distances which involve only the radiation component, measurements made at short distances have proved somewhat unreliable. Measurements at distances as short as 8 meters have been made by Ramsey and Dreisback (Proc. Inst. Rad. Eng., Vol XVI, pp. 1118-1132), using a wavelength of about 16 meters.

In order to extend the verification to shorter distances and wavelengths, a transmitter and a field intensity meter were designed and constructed for operation on a wavelength of 2.55 m. The meter was calibrated and field intensity measurements made using three different transmitting aerials. Two of these were coil aerials; the third a horizontal doublet antenna. Computations were made and comparisons established between observed and computed values of field intensity. The slight discrepancies occurring were accounted for.

The following conclusion was reached:

That portion of electromagnetic theory which apperfains to electromagnetic fields produced by antenna and coil aerials is reasonably well substantiated by experiment. Three serious weaknesses in this branch of radio theory are, however, evident.

First, in the development of radiation theory the practice has been to assume an ideal case which fails to approach the situation met in practice. For example, in the development of the expression representing the field produced by an antenna, it is assumed that the current is uniform along the length of an antenna; although current nodes and loops are definitely present.

Second, much of the development has been done by engineers whose knowledge and use of mathematics is practical rather than scholarly. This fact is evidenced by lack of generality and by awkward mathematical notation.

Third the terminology of radio is marked by looseness and lack of standardization. In several instances there occur actual inconsistencies in the significance of expressions as used in radio and as used in other scientific fields.

Future work should be devoted to remedying the defects mentioned. Much of radio theory should be redeveloped, and the notation and terminology of radio should be reconciled to that of other fields of physics. Finally, the actual current distribution in transmitting antennae should be made the basis for the development of transmission formulas intended to replace the empirical formulas now used by radio engineers.