ALTERNATING CURRENT WIRING AND DISTRIBUTION

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BY

William Leroy
W. L. R. EMMET.

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INTRODUCTORY.

The object of this work is to point out the practical significance of some of the laws governing the distribution of alternating currents; also, to explain those laws in such a manner that their nature and relative importance may be realized by practical men without the expenditure of time necessary to the study of complete works on the subject. Tables are given and determinations worked out which show how calculations can be made, and which also serve as illustrations of the principles involved. Mathematical expressions and scientific terms have been avoided as much as possible, since their use would tend to make the work less suggestive to many readers for whom it is intended. In cases where no conventional names exist to express the meanings desired terms have been used which suggest corresponding terms that are generally familiar to persons engaged in electrical work.

To properly study a subject of this kind it is desirable that the mind should form a clear and correct general conception of the fundamental principles before it is burdened with a multiplicity of details. It is hoped that this book may help the reader to form certain ideas and conceptions which tend to make available to him the information obtainable from more thorough and comprehensive works.

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WIRING AND DISTRIBUTION.

1. Influences Affecting Alternating Distribution.— The different effects which influence alternating distribution are very commonly confused with each other by persons who have not carefully studied the subject. It will, therefore, be well to state what these different influences are. We will, therefore, name them in the order in which they are discussed.

Surface or Skin Effect. By this is meant the property possessed by alternating currents of a ttaining a greater density on and near the surface of conductors than in the interior portions, the result of which is that a certain proportion of the conducting metal is practically inoperative. *Inductive Effects*, by which are mean tthe counter E. M. F.'s which are induced in a circuit through the alternations of its own current. *The Inductive Influence of other Alternating Circuits*, which may give rise to periodic or continuous inequalities of distribution. *Capacity Effects*, which are due to the fact that lines and cables may act as electrical condensers, which alternately charge and discharge themselves with the fluctuations of E. M. F. in the circuit.

2. Surface or Skin Effect.—The nature of this phenomenon may be briefly explained as follows:

When a current is started in a wire each line or element of increasing current tends to induce counter E. M. F.'S or reverse currents in the metal in its neighborhood; thus all the metal in the wire is subjected to two opposing forces, one to create current flow and the other to retard it. The central portions of the wire are surrounded by these retarding influences while the outer surface of the wire can receive them from one side only. The result of this is that when a wire is suddenly subjected to an E. M. F. the current begins first to flow on its surface, and an appreciable time elapses before the full current density reaches the centre of the wire. Thus the current may be said to begin on the outside and soak into the wire. If the alternations are sufficiently frequent the central portions of the wire are practically never reached by the current, and the copper available for conducttivity is little greater than what it would be if the conductor were a tube of similar outside diameter. The thickness of the walls of the equivalent tube will be less as the frequency increases. It is easy to understand that this effect is relatively greater with large wires than with small; also, that it will be much greater with iron than with copper wires.

This surface effect is entirely confined to the wire itself, and has nothing to do with the magnetic field surrounding the wire; hence it practically amounts to an increase in resistance of the wire, and does not affect the inductance of the cir-