SINGLE-PHASE COMMUTATOR MOTORS

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BY

FRANKLIN PUNGA

TRANSLATED FROM THE GERMAN BY

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WITH EIGHTY-ONE ILLUSTRATIONS

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PREFACE

A TREATISE on single-phase motors is largely a treatise on the sparking problem, for a thorough knowledge of the phenomenon of commutation is of even more importance in connection with single-phase than in connection with continuous-current motors.

Electrical science is particularly indebted to Messrs Parshall and Hobart, the authors of *Electric Generators*, and to Prof. E. Arnold, the author of *Die Gleichstrommaschine*, for investigating and elucidating the problem of sparking. Whilst Messrs Parshall and Hobart have evolved a simple and eminently practical criterion for predetermining sparking, Prof. Arnold has overcome the difficulties connected with a close mathematical treatment on this difficult subject.

Amongst the other investigators who have contributed to our present knowledge, the names of Thornburne Reid, Pichelmayer, Rothert, Fischer-Hinnen, Prof. G. Kapp, and Niethammer may be mentioned.

The method of treating this subject, set forth in the pages of this book, was first outlined by the author in the *Zeitschrift für Elektrotechnik*, Vienna, 1902, Nos. 30, 31, and 32, and, although his con-

tribution can only be small compared with that of the other investigators referred to, yet he ventures to hope that some of the results obtained, which appear new, may interest and benefit the profession at large.

The present book is practically a translation of the German original, with the addition of a second appendix containing a discussion on some interesting oscillograph tests relating to the commutation of single-phase motors. The oscillograms in question, hitherto unpublished, were kindly placed at my disposal by Mr F. Creedy, to whom I also wish to express my thanks for valuable suggestions and for assistance in correcting the proofs.

In the opening chapters, the origin and nature of sparking are gone into in detail; the manner of calculating the reactance voltage is explained, and means of preventing or minimising sparking are discussed at length, particular attention being paid to the method of reducing sparking by inserting resistances in the commutator leads. A convenient method of computing the reaction of the commutating coils upon the field flux is given in Chapter VI. This reaction is by no means always insignificant—as is shown in an example—and has hitherto hardly received the attention it deserves.

It is not claimed that Chapters VIII., IX., and X., which deal with the general theory of single-phase commutator motors, are perfect theoretically; indeed, these chapters are merely intended to lead up to Chapters XII., XIII., and XIV., containing the final conclusions. In Chapter XV., a series motor, repulsion motor, and compensated repulsion motor are

calculated through, the calculations being based on equal manufacturing costs in each case.

The detailed theoretical investigation of the repulsion motor has been reserved for the appendix so as not to discourage those readers who are not mathematically inclined.

The design of the single-phase series motor has been more specifically dealt with by Messrs Lamme and Finzi, while Heubach was one of the foremost to expound its theory; Eichberg, Winter, Latour, Osnos, Danielson, Pichelmayer and Niethammer have been prominent in connection with the compensated repulsion motor, while C. P. Steinmetz has largely contributed to our knowledge of the repulsion motor. One of the most illuminating treatises on single-phase motors generally is that contributed by Prof. Görges to the *Elektrotechnische Zeitschrift*, 1903, No. 15.

The single-phase motor invented by Eichberg, Winter and Latour is often referred to as the compensated series motor, and thereby an impression is created that this motor is a series motor provided with a coil for compensating the self-induction. Danielson was, perhaps, the first to call it a compensated repulsion motor, and in this he was undoubtedly right. The reason for designating this motor a series motor with a compensating winding must be ascribed to an imperfect understanding of its nature.

In a future edition of this book, it is intended also to include those single-phase motors which do not possess a 'series' characteristic. Though of scarcely any importance in connection with traction