TORQUE ON A RESISTIVE ROTOR
IN A QUASI ELECTROSTATIC ROTATING FIELD
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Summary
The torque generated by a quasi electrostatic rotating field on a dielectric rotor with a resistance coating is determined theoretically. The magnitude of the torque appears to have a maximum in dependence on the surface resistance of the coating.

The value of the surface resistance for which this maximum occurs and the height of the torque itself decrease for increasing values of the permittivity of the rotor core.

§ 1. Introduction
The idea of creating a mechanical torque by placing a resistive rotor in a quasi electrostatic rotating field is not new. As early as 1906 Lampa [1] derived an expression for the torque on a conducting sphere in such a rotating field. Lampa's method however is based on Laplace's equation and the equation of continuity, neglecting inductive effects from the outset.

In 1913 Schaffit [2] in his dissertation used a similar procedure to explain the behaviour of an electrostatic rotating field voltmeter.

In later years the interest in the principle seems lost, anyhow to the author's knowledge notable contributions to the subject did not appear in literature.

Recently Bollee [3] investigated experimentally the applicability of this principle to the construction of very small 'electrostatic' motors. The results of some of his experiments stimulated a reconsideration of the theoretical background for the behaviour of one of his basic structures.

The device in question consists of a dielectric cylinder with a
thin coating with finite resistance. By a number of electrodes placed closely around the cylinder a quasi electrostatic rotating field is excited that gives rise to a torque exerted upon the cylinder.

This torque will be estimated theoretically applying a more general method than the one used in [1, 2]. The dependence of this torque on the permittivity of the rotor, the surface resistance of the rotor coating, and the frequency is investigated.

§ 2. Analysis

Let us consider a cylindrical rotating layer of charge as a representative source for the rotating field, as shown in Fig. 1. It is allowed to use such a model if the number of electrodes around the rotor is large.

The system is considered to be a part of one with infinite axial length and of which all quantities are independent of the axial coordinate. This implies that perturbing end effects are neglected. The subsequent analysis refers to unity axial length.

The distance $h$ between the source layer and the rotor surface is very small relative to the radius of the rotor. Furthermore the cir-

Fig. 1. The rotating charge layer representing the rotating field. Field lines are indicated.