(4) An active e.m.f. existing between the turns of the field coils which may be termed the counter e.m.f. of the field coils.

With an alternating magnetic field there are two distinct e.m.f.'s generated in the armature coils, first by the movement of the coil through the field with a maximum value when the coil is parallel to the lines of force and a zero value when the coil is at right angles to these lines — and the second by the alternating magnetism, with the maximum value occurring when the coil is at right angles to the lines of force and a zero value when the coil is parallel to these lines. The first, or mechanically generated e.m.f. is proportional to the speed; the second, or electrically generated e.m.f. is proportional to the current frequency. While these two e.m.f.'s exist in the armature winding, only one, the mechanically generated e.m.f. appears at the terminals of the motor. So far as the external circuit is concerned, the electrically generated e.m.f. neutralizes itself and plays no part in determining the current taken by the motor, but at each brush there is a local circuit in which the electrically generated e.m.f. is not neutralized; a current results, which, if not prevented, affects commutation and increases motor loss; this, however, has been taken care of in the design of the motors so that the operation is quite satisfactory.

The external appearance of the single phase motor in general is similar to that of direct current motors; the construction, however, is slightly different in that the entire magnetic part of the field is laminated, the field being built up of annular punchings with poles projecting radically inward. The punchings are held together in a steel frame, the armature being put in or taken out through the ends. The armature is also similar in appearance to the armatures of direct current railway motors.

There is very little tendency to flash across between brushes or from the brushes to the frame of the motor and the commutation is very satisfactory, the sparking being so slight as to be barely noticable.

The operation of direct current railway systems has been very satisfactory for two main reasons: first, because the direct current series motor, owing to its variable field, has speed torque characteristics which make it particularly suitable for traction work and, secondly, because only a single trolley is necessary. The direct current railway system has, however, some disadvantages, the most serious of which, perhaps, is the comparatively low trolley voltage which is necessary. This feature has hampered, to a considerable extent the development of such roads. Owing to the ease and economy of voltage transformation with alternating current, the use of alternating current motors permits of a high trolley voltage