HOME STUDY COURSE IN PRACTICAL ELECTRICITY: AN ELECTRICAL CATECHISM. IN THREE VOLUMES. VOLUME III. OPERATION AND MANAGEMENT OF ELECTRIC MOTORS, LAMPS AND POWER STATIONS

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W. H. RADCLIFFE

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Trieste

HOME STUDY COURSE

IN

Practical Electricity

AN ELECTRICAL CATECHISM

IN THREE VOLUMES

VOLUME III

OPERATION AND MANAGEMENT OF ELECTRIC MOTORS, LAMPS AND POWER STATIONS

BY

W. H. RADCLIFFE

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DIRECT-CURRENT MOTORS

PRINCIPLES GOVERNING THEIR ACTION

788. What is a direct-current motor?

A direct-current motor is a machine for converting energy in the form of direct-current electricity into energy in the form of mechanical motion.

789. How does this conversion take place?

Through the force of two magnetic fields mutually exerted upon each other within a small space between the stationary and movable members of the electric motor.

790. Does it make any difference how the two magnetic fields are formed?

Only a difference in degree. The two magnetic fields may be formed by currents flowing in two wires (straight or coiled, with or without cores), or by two permanent magnets, or the one field may be produced by a current in a wire and the other field by a permanent magnet.

791. Explain how the magnetic fields produce mechanical motion in an electric motor.

When the lines of force of two magnetic fields meet without coinciding in direction, each set exerts a pull upon the other which tends to draw them into agreement as to their direction in space; this pull is transmitted to the parts in which the magnetic lines of force originate, and will tend to draw them into such a position that the lines of force of the two fields will coincide to the greatest possible extent. The greater the strengths of the magnetic fields, the stronger will be the force thus acting, and if the fields be sufficiently strong mechanical motion will be given to that part which moves the more readily.

792. Describe a simple arrangement which illustrates the magnetic action referred to in Answer 791.

Fig. 304 illustrates such an arrangement. One magnetic field is produced between the poles *N* and *S* of a horseshoe magnet, and the other by a current flowing in the loop of wire suspended between the magnet poles with its plane parallel to the lines of force of the magnet. The lines of magnetic force set up by the current will be projected at right angles to those of the magnet, which are represented by the light lines, and if the magnet be held so it cannot move and the loop be freely suspended, the latter will turn through

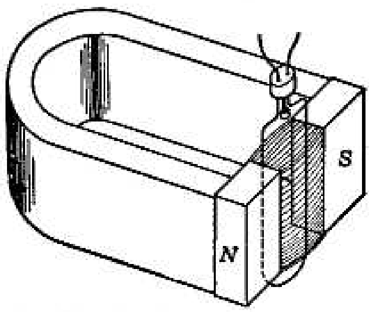

Fig. 304.—Loop Conductor in a Magnetic Field.

90 degrees to the position in which the lines of force of the magnet's field will thread through it in the same direction as its own lines. If the current through the loop be reversed in direction, the direction of the lines of force formed by it will be reversed, and the loop will tend to turn through 180 degrees or until the lines of force of both fields again coincide in direction.

793. How is magnetic action practically applied in an electric motor?

Suppose an armature with one coil connected to a two-bar commutator, as shown in Fig. 305, be placed in a magnetic field between the poles *N* and *S*. If brushes be pressed against the commutator *1-2*, as indicated in the sketch, and a current be sent through the coil in the direction indicated by the small arrowheads, this current will set up a magnetic field in the armature core *a* and the surrounding air, and the lines of magnetic force will have the direction of the arrow *A* through the core. The lines of force set up by the magnet have the direction shown by the arrows near the letters *N* and *S*, and the magnetic pull between these two fields will turn the armature over in a clockwise direction until the arrow *A* is parallel with the arrows on the magnet poles, as shown by Fig. 306. When this position is reached, the pull between the two magnetic fields ceases, because their lines of force coincide,

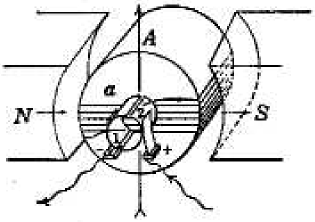

Fig. 305.—Position of Maximum Magnetic Pull.

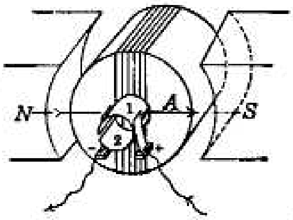

Fig. 306.—Position of Minimum Magnetic Pull.

and the armature would come to a stop in this position, so far as the pulling force is concerned, but for the commutator.

794. How does the commutator keep the armature revolving?

When the armature reaches the position shown in Fig. 306, its momentum carries it slightly past, so that the positive brush touches the half *1* of the commutator and the negative brush touches the half *2*; this reverses the current through the coil and the magnetic field set up by it is also reversed. Consequently, instead of agreeing with the main field set up by the magnet, the armature field is in opposition to it and the two react to pull the armature around in the same direction as before, one-half a revolution, to the position opposite that in Fig. 306. When the momentum of the armature car-