ELECTRIC MOTOR AND ITS WORK QUALITY

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Abstract- In normal motoring mode, most electric motors operate through the interaction between an electric motor's magnetic field and winding currents to generate force within the motor. In certain applications, such as in the transportation industry with traction motors, electric motors can operate in both motoring and generating or braking modes to also produce electrical energy from mechanical energy. Found in applications as diverse as industrial fans, blowers and pumps, machine tools, household appliances, power tools, and disk drives, electric motors can be powered by direct current (DC) sources, such as from batteries, motor vehicles or rectifiers, or by alternating current (AC) sources, such as from the power grid, inverters or generators. Small motors may be found in electric watches. General-purpose motors with highly standardized dimensions and characteristics provide convenient mechanical power for industrial use. The largest of electric motors are used for ship propulsion, pipeline compression and pumped-storage applications with ratings reaching 100 megawatts. Electric motors may be classified by electric power source type, internal construction, application, type of motion output, and so on. Electric motors effect on a factory operation, why they are a basic and fundamental tools there. In this paper, we investigate the application and usefulness well**.**

Keywords- Operation, Electric motors, Quality control, Magnetic field

I. INTRODUCTION

Electric motors are so much a part of everyday life that we seldom give them a second thought. When we switch on an electric drill, for example, we confidently expect it to run rapidly up to the correct speed, and we do not question how it knows what speed to run at, or how it is that once enough energy has been drawn from the supply to bring it up to speed, the power drawn falls to a very low level. When we put the drill to work it draws more power, and when we wish the power

drawn from the mains reduces automatically, without intervention on our part. The humble motor, consisting of nothing more than an arrangement of copper coils and steel laminations, is clearly rather a clever energy converter, which warrants serious consideration.

By gaining a basic understanding of how the motor works, we will be able to appreciate its potential and its limitations, and (in later chapters) see how its already remarkable performance can be further enhanced by the addition of external electronic controls.

II. MAGNETIC CIRCUITS

So far we have assumed that the source of the magnetic Weld is a permanent magnet. This is a convenient starting point as all of us are familiar with magnets, even if only of the fridge-door variety.

But in the majority of motors, the working magnetic Weld is produced by coils of wire carrying current, so it is appropriate that we spend some time looking at how we arrange the coils and their associated iron 'magnetic circuit' so as to produce high magnetic Welds which then interact with other current-carrying conductors to produce force, and hence rotation.

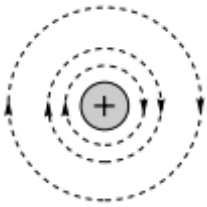


Figure 1 Magnetic flux lines produced by a straight, current-carrying wire

First, we look at the simplest possible case of the magnetic Weld surrounding an isolated long straight wire carrying a steady current (Figure 1). (In the figure, the þ sign indicates that current is showing into the paper, while a dot is used to signify current out of the paper: these symbols can perhaps be remembered by picturing an arrow or dart, with the cross being the rear view of the sketch, and the dot being the approaching point.) The flux lines form circles concentric with the wire, the Weld strength being greatest close to the wire. As might be expected, the Weld strength at any point is directly proportional to the current. The convention for determining the direction of the Weld is that the positive direction is taken to be the direction that a right-handed corkscrew must be rotated to move in the direction of the current.

III. MAGNETOMOTIVE FORCE (MM)

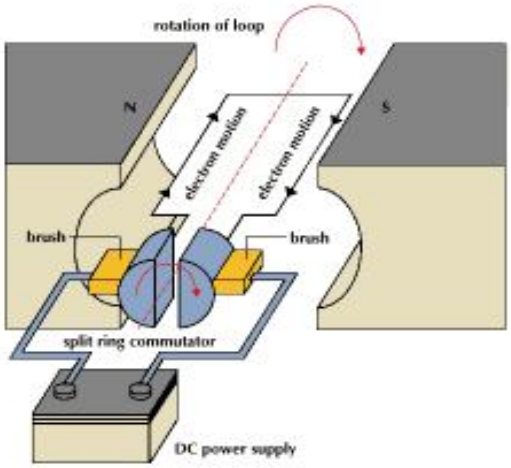
One obvious way to increase the flux density is to increase the current in the coil, or to add more turns. We find that if we double the current, or the number of turns, we double the total flux, thereby doubling the flux density everywhere. We quantify the ability of the coil to produce flux in terms of its magneto motive force (MMF). The MMF of the coil is simply the product of the number of turns (N) and the current (I), and is thus expressed in ampere-turns. A given

MMF can be obtained with a large number of turns of thin wire carrying a low current, or a few turns of thick wire carrying a high current: as long as the product NI is constant, the MMF is the same.

IV. BRUSHED DC MOTORS

The simplest (and cheapest) DC motor is the brushed DC motor. A brushed DC motor is like the simple loop generators we've seen in cartoons (or the Jensen generator used with the steam engine), only run backwards: the magnet is stationary and the DC-current-carrying coil (or coils), connected
to a shaft, rotates through the fixed magnetic field. Loop generators we've seen use "slip rings" to make electrical contact between fixed current-carrying wires and the rotor. But remember, in the simple loop generators, steady rotation in one direction with a slip ring produced alternating current. And a motor is the converse of a generator. So if you drove the slip-ringed generator as a motor with alternating current, you could get steady rotation. If drive it with direct current, though, the loop would just move to a place where force was zero and would stay there. To keep the loop moving and produce rotation in one direction requires not slip rings but some kind of "commutator" that essentially switches the diretion of the current, putting it first on one side of the loop and then on the other, mimicking alternating current.

Only if you manage to continue to kick the loop around will it keep turning. The simplest commutator is a "split ring" that makes contact with two separate brushes. In the simple AC loop generator, the rotating and fixed conductors are connected with two slip rings, each of which maintains a



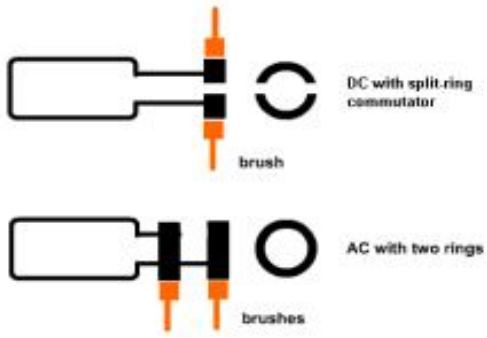


Figure 1: DC motor with rotating commentator split) rings for DC generation/motors

Figure 2: Slip rings for AC generators/motor (bottom and loop, brushes and split-ring (Encyclopedia Brittanica)

continuous connection between one end of the rotating loop and a fixed wire. The split ring commentators joins both ends of the loop to fixed wires, and every half-rotation, the contacts are switched. In a generator, the simple split ring commentator on a single loop generator would produce a voltage (and current) around the loop that is a single rectified sine wave, varying between zero and maximum every quarter revolution. In a DC motor with a simple split ring commentator, the torque provide by the motor is similarly irregular, varying from zero to maximum every quarter revolution. The motor doesn't provide steady even rotational force but a jerky force, which is obviously not ideal for industrial applications. This is termed "torque ripple." To minimize torque ripple, DC motors use the same strategies that DC generators use to minimize voltage ripple: increasing the number of windings on the rotor or magnetic poles on the state). The windings on the rotor are also called the "armature"). By producing many out-of-sync rectified sine waves superimposed on each other, adding windings or poles begins to approximate a constant torque. Brushed DC motors seem like a relatively practical solution, but there are drawbacks. The brushes themselves wear out fairly fast, and it is not wise to put big amounts of current through brushes that make sliding contacts, as they will spark as contacts are made and then broken. If the rotor turns too quickly, the sparking can damage or destroy the commentator.

V. BRUSHLESS DC MOTORS

Before the age of electronics, all DC motors had to have brushes or some other type of mechanical commentator. The electronic age offers other options. It is now possible to electronically switch current directions, in effect making AC power from a DC power source. A brushless DC motor is essentially a synchronous AC motor (discussed below) with electronic commutation. Like an AC motor, the magnet is on the rotor and the drive current on the stator rather than the other way around of brushed DC

motors. The electronic commutation switches the current back and forth to mimic AC current and keep the motor turning.

In brushless DC motors the user can actually do better than just mimic an AC motor from a DC power source. Electronic commutation gives you total control over the effective frequency of the "faux AC" you're producing, and
therefore lets you build an AC-like motor that can rotate at different speeds -you now have total electronic control over motor speed. (The advantage of this will be more clear when you read about AC limitations below). This controllability means that servo motors for complicated mechanical systems involving controls and electronic feedbacks (e.g. robotics) are now exclusively brushless DC.

VI. AC MOTORS

In modern AC motors, as in modern AC generators, the current is applied to the stationary part of the motor and the magnet is on the rotor. The varying current in the stator generates a rotating magnetic field (via Ampere's law) which interacts with the rotor magnetic field, pushing the rotor around. AC motors in use now come have several options for generating the rotor magnetic field. In some the rotor has permanent magnets; in others the rotor carries an electromagnets driven by an external DC power source; in still others (induction motors) the rotor merely picks up induced magnetic fields from the magnetic field of the stator.

VII. SYNCHRONOUS AC MOTORS

A synchronous AC motor really is essentially the same as the AC generators described in a previous reading. As before, the rotor speed and the frequency of the alternating current are irrevocably tied together. The motor must turn at the exact frequency of the alternating current that drives it (modulated only by the number of magnetic poles.(What are the benefits of a synchronous AC motor? One very large benefit is that you can avoid brushes, with their short lifetimes. You will need either a permanent magnet in the motor or slip rings to pass current to an electromagnet, but those currents are smaller than the drive current, and slip rings don't spark like brushes and so are longer-lived in general.

In practice, most small AC synchronous motors just use permanent magnets. That produces a sturdy, reliable, if not readily controllable motor. But if you just want to turn something, and you're OK with letting our 60 Hz grid system constrain that turning rate (think: household fans), an AC motor is just fine.

CONCLUSIONS

So far we have highlighted the benefits of closed-loop systems, but not surprisingly there is a potential negative side that we need to be aware of. This is that if the dc loop gain is too high, some closed loop systems exhibit self-sustaining oscillations, i.e. the output 'rings– ' generally at a high frequency – even when there is no input to the system. When a system behaves in this way it is said to be unstable, and clearly the consequences can be extremely serious, particularly
if large mechanical elements are involved. (It is worth mentioning that whereas in control systems instability is always undesirable, if we were in the business of designing electronic oscillators we would have an entirely different perspective, and we would deliberately arrange our feedback and loop gain so as to promote oscillation at the desired frequency.

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