Chapter 7
DC Motor Functionality

ABSTRACT

This chapter deals with the core of direct current machines. In this chapter, the authors present a very detailed insight about the principle of operation of DC motor. They Discuss torque generated from motors. Then they discuss counter emf or back emf. Speed of rotation is then discussed. They then discuss power developed by motor, relation between torque and speed of a motor, speed-torque characteristics, torque-load characteristics, shunt motor, series motor, compound motor, speed-load characteristics, and cumulative compound motor. Differential compound motor is then discussed along with discussion of speed regulation. This chapter ends with starting of DC motor and a discussion over four point starting box.

This chapter is the core of this book. In this chapter, we will discuss the functionality of D.C. motor.

7.1 PRINCIPLES OF OPERATION OF A DC MOTOR

D.C. motor is a device which transforms electrical energy into mechanical energy. Its action is based on the principle that when a current carrying conductor is placed in magnetic field, it experiences a mechanical force whose direction is given by Fleming's left hand rule and whose magnitude is given by:Where F is force

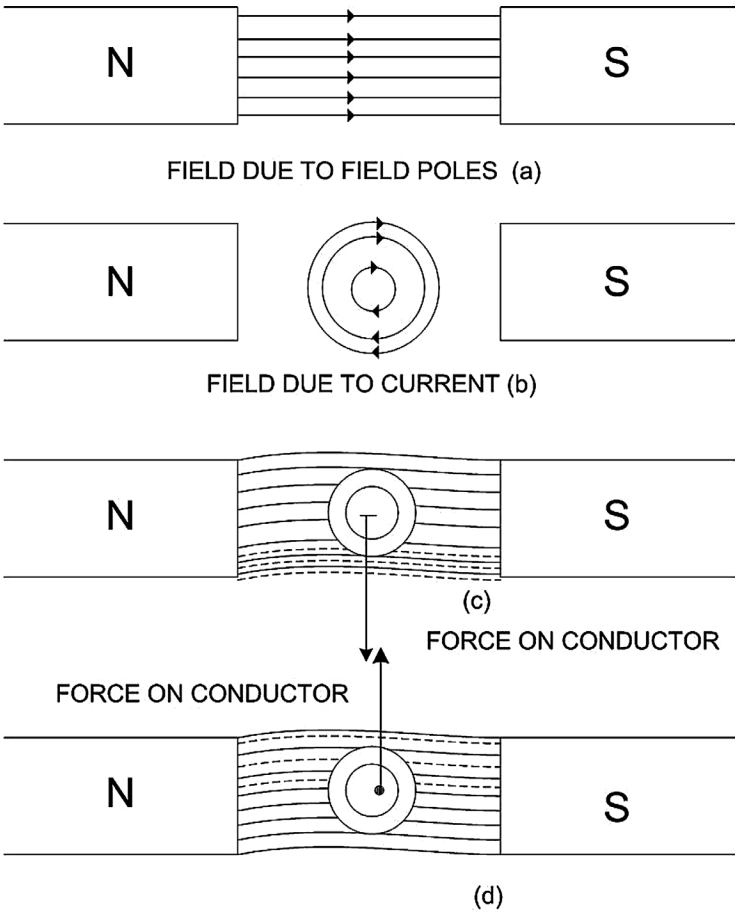
B is flux density
I is current
L is length of conductor

The motor principle may be explained with the help of Figure 1.

Figure 1 (a) shows the field due to main poles. The Figure 1 (b) shows the field due to current carrying conductor alone. The Figure 1 (c) shows the resultant field. The conductor field above the conductor opposes the main field and aids it below the conductor the result is the crowd of flux below the conductor and reductions of the flux above the conductor. It will be found that force acts on the conductor

DOI: 10.4018/978-1-4666-8441-6.ch007

Figure 1. Field due to current carrying conductor



downward as shown by arrows. The force on the conductor will reverse its direction if the direction of conductor current is reversed as shown in Figure 1 (d).

Now let us consider a two pole machine. The conductors under the influence of North Pole will carry current in positive direction while the conductors under the influence of south pole will carry current in negative direction, so the direction of force on conductors under north pole will be upward and the force on the conductors under south pole will be downward and hence a torque will be produced as shown in Figure 2

7.2 TORQUE DEVELOPED BY MOTOR

As shown earlier, each conductor lying under a pole face exerts a torque tending to turn armature. The sum of all these torques is called armature torque. If F is the sum of forces on each conductor then armature torque is