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FACULTY OF ENGINEERING & TECHNOLOGY

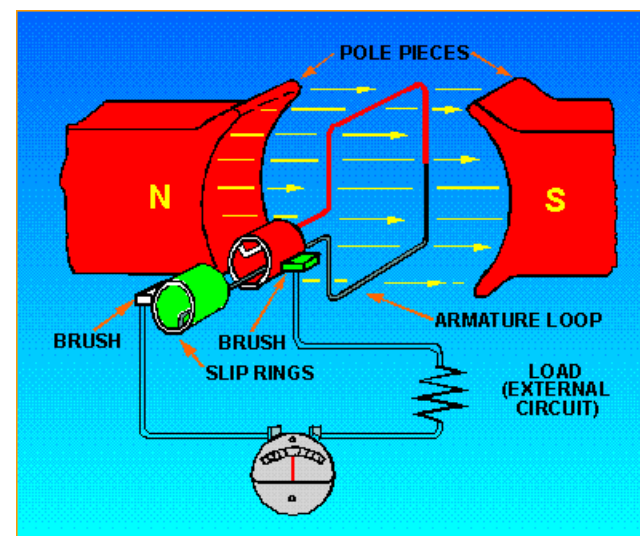
Electrical Machine-1

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# DC MACHINE

## Elementary concept of an electrical machine

- ❖ The simplest elementary generator that can be built is an ac generator. Basic generating principles are most easily explained through the use of the elementary ac generator. For this reason, the ac generator will be discussed first. The dc generator will be discussed later.
- ❖ An elementary generator consists of a wire loop mounted on the shaft, so that it can be rotated in a stationary magnetic field. This will produce an induced emf in the loop. Sliding contacts (brushes) connect the loop to an external circuit load in order to pick up or use the induced emf.
- ❖ The pole pieces (marked N and S) provide the magnetic field. The pole pieces are shaped and positioned as shown to concentrate the magnetic field as close as possible to the wire loop.
- ❖ The loop of wire that rotates through the field is called the **ARMATURE LOOP**. The ends of the armature loop are connected to rings called **SLIP RINGS**. They rotate with the armature.
- ❖ The brushes, usually made of carbon, with wires attached to them, ride against the rings. The generated voltage appears across these brushes.



Elementary Generator

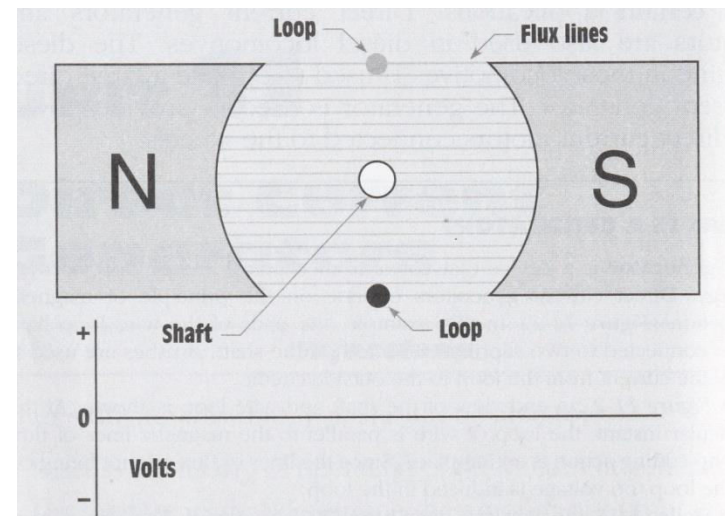
# DC MACHINE

## The Elementary Generator (A)

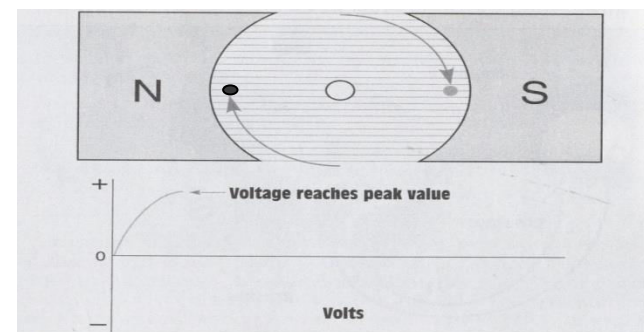
- An end view of the shaft and wire loop is shown. At this particular instant, the loop of wire (the black and white conductors of the loop) is parallel to the magnetic lines of flux, and no cutting action is taking place. Since the lines of flux are not being cut by the loop, no emf is induced in the conductors, and the meter at this position indicates zero.
- This position is called the **NEUTRAL PLANE**.

## The Elementary Generator (B)

- The shaft has been turned  $90^\circ$  clockwise, the conductors cut through more and more lines of flux, and voltage is induced in the conductor. at a continually increasing angle, the induced emf in the conductors builds up from zero to a maximum value or peak value.
- Observe that from  $0^\circ$  to  $90^\circ$ , the black conductor cuts DOWN through the field. At the same time the white conductor cuts UP through the field. The induced emf in the conductors are series-adding. This means the resultant voltage across the brushes (the terminal voltage) is the sum of the two induced voltages. The meter at position B reads maximum value.



$0^\circ$  Position (Neutral Plane)



$90^\circ$  Position

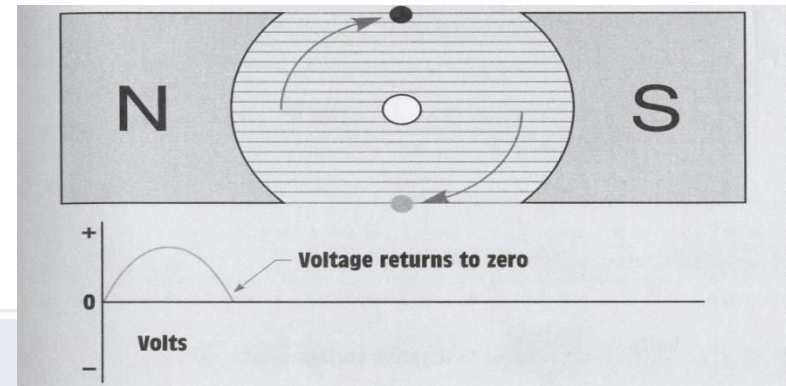
# DC MACHINE

## The Elementary Generator (C)

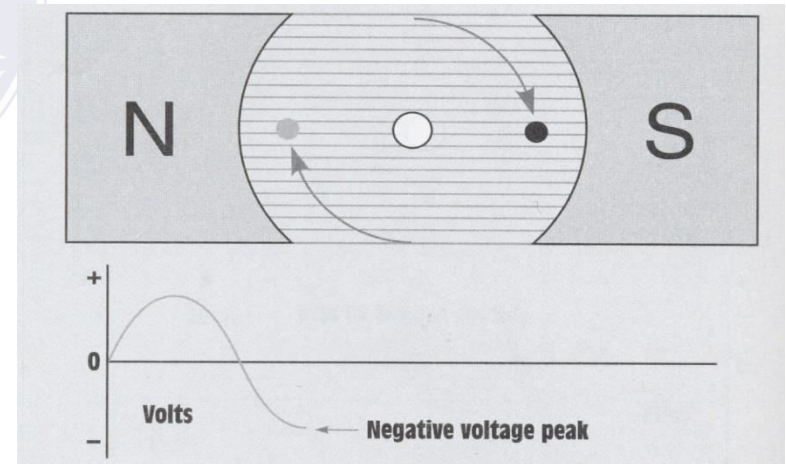
- After another  $90^\circ$  of rotation, the loop has completed  $180^\circ$  of rotation and is again parallel to the lines of flux. As the loop was turned, the voltage decreased until it again reached zero.
- Note that : From  $0^\circ$  to  $180^\circ$  the conductors of the armature loop have been moving in the same direction through the magnetic field. Therefore, the polarity of the induced voltage has remained the same

## The Elementary Generator (D)

- As the loop continues to turn, the conductors again cut the lines of magnetic flux.
- This time, however, the conductor that previously cut through the flux lines of the south magnetic field is cutting the lines of the north magnetic field, and vice-versa.
- Since the conductors are cutting the flux lines of opposite magnetic polarity, the polarity of the induced voltage reverses. After  $270^\circ$  of rotation, the loop has rotated to the position shown, and the maximum terminal voltage will be the same as it was from A to C except that the polarity is reversed.



$180^\circ$  Position

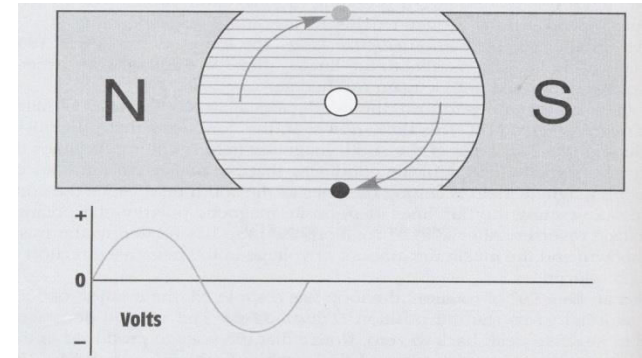


$270^\circ$  Position

# DC MACHINE

## The Elementary Generator (A)

- After another  $90^\circ$  of rotation, the loop has completed one rotation of  $360^\circ$  and returned to its starting position.
- The voltage decreased from its negative peak back to zero.
- Notice that the voltage produced in the armature is an alternating polarity. The voltage produced in all rotating armatures is alternating voltage.

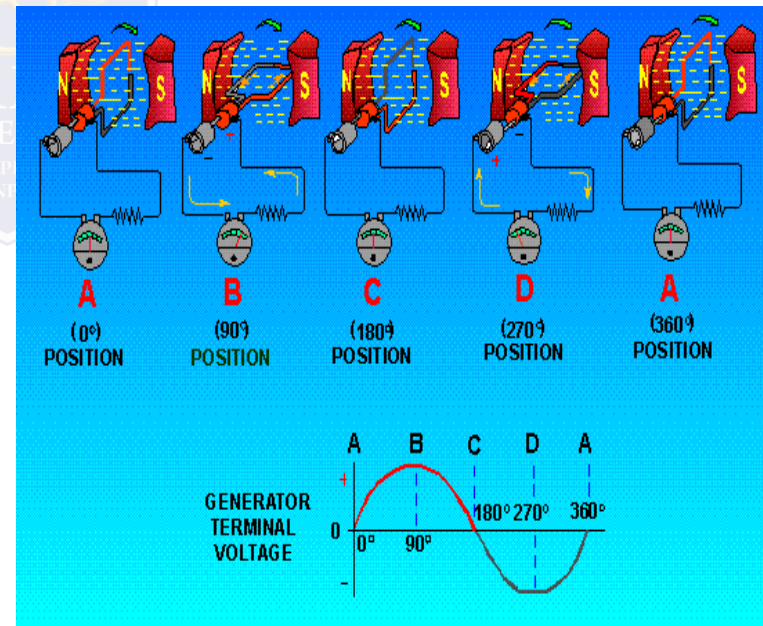


360° Position

## Elementary Generator (Conclusion)

Observes

- The meter direction
- The conductors of the armature loop
- Direction of the current flow



Output voltage of an elementary generator during one revolution

## Difference Between Motor And Generator

### **MOTOR**

- Motor converts electrical energy into mechanical energy.
- DC motor uses Fleming left hand rule .
- Efficiency of motor is ratio of mechanical power to Electrical power



### **GENERATOR**

- A generator converts mechanical energy in to electrical energy
- Generator uses Fleming right hand rule.
- Efficiency of generator is ratio of Electrical power to mechanical power.