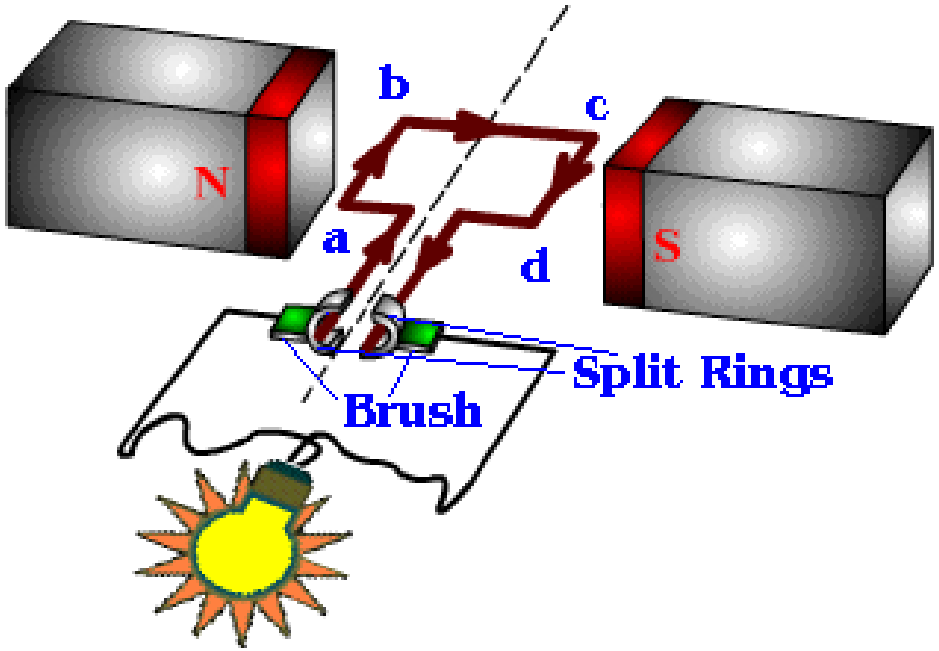
Electrical Machines

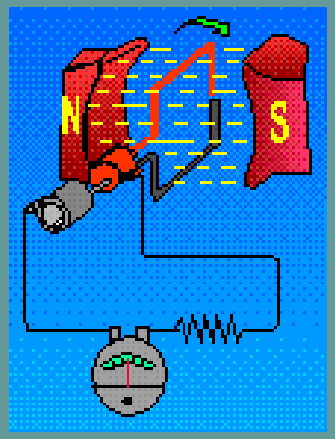
EEE 363

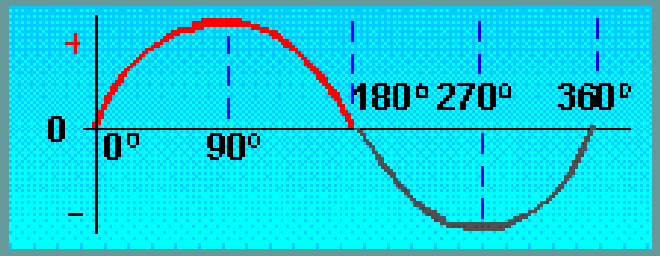
DC Generator

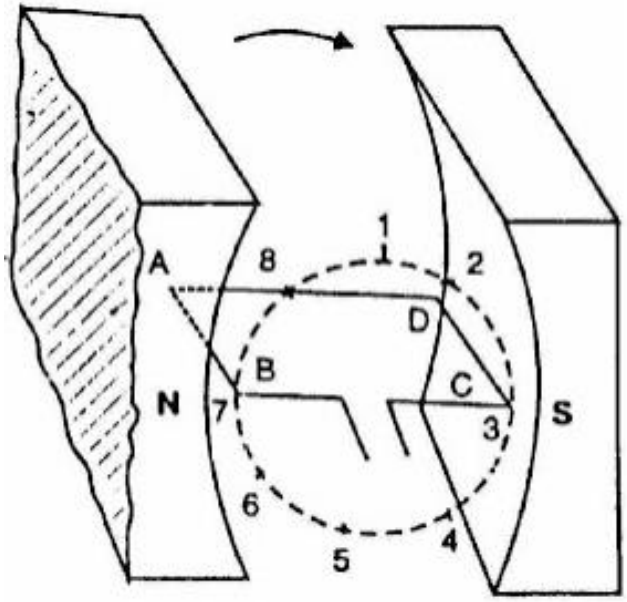
Whenever a conductor cuts magnetic flux, dynamically induced e.m.f. is produced in it according to Faraday's Laws of Electromagnetic Induction. This e.m.f. causes a current to flow if the conductor circuit is closed.

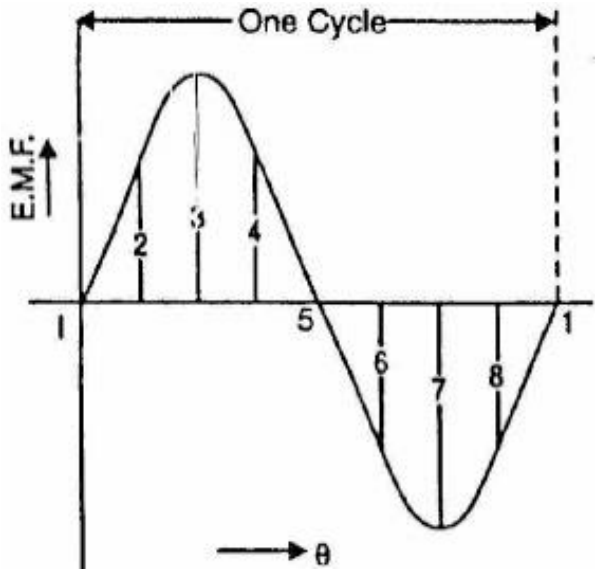


Fleming's Right Hand Rule

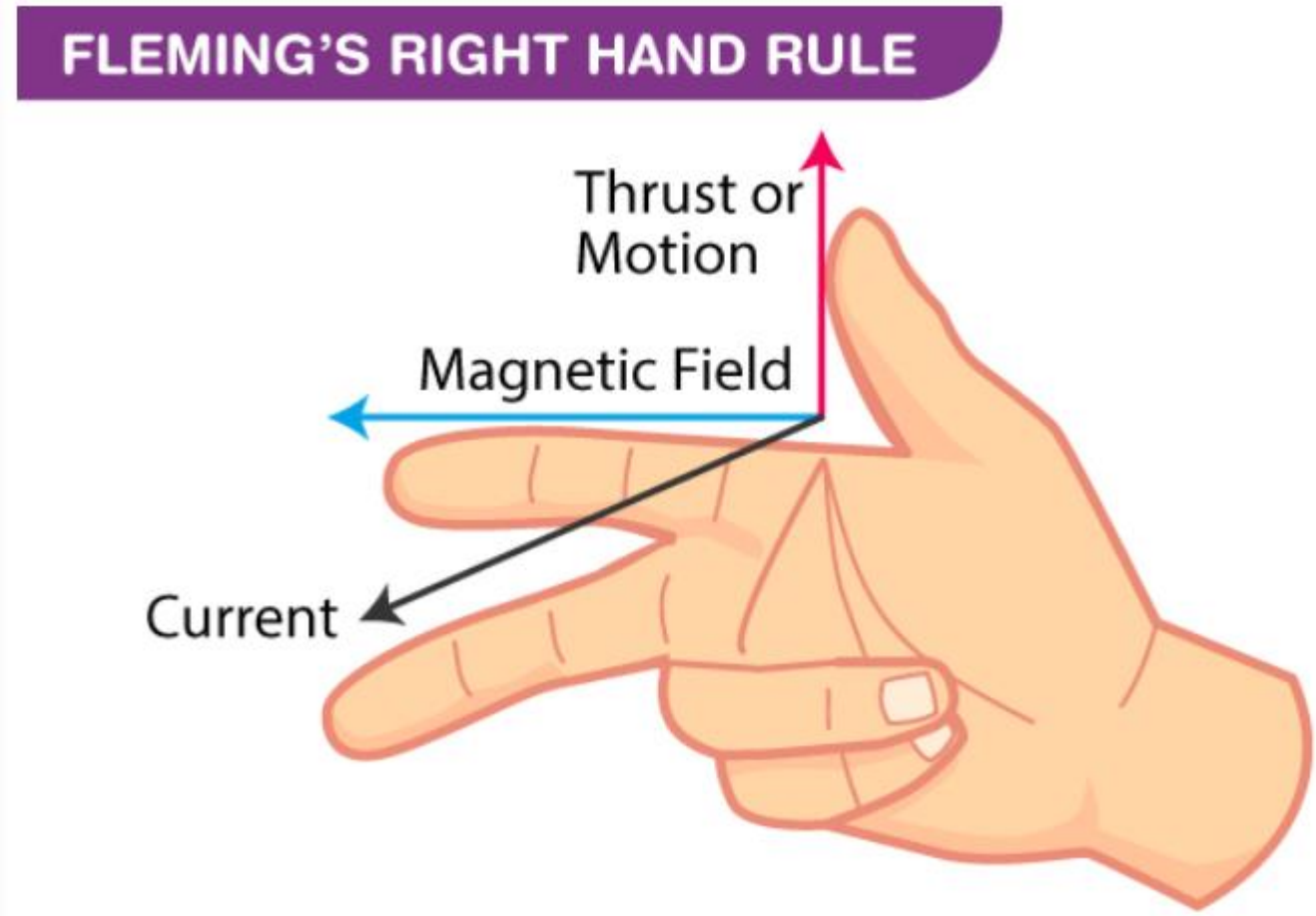

N
S


+
0
–
0°
90°
180°
270°
360°

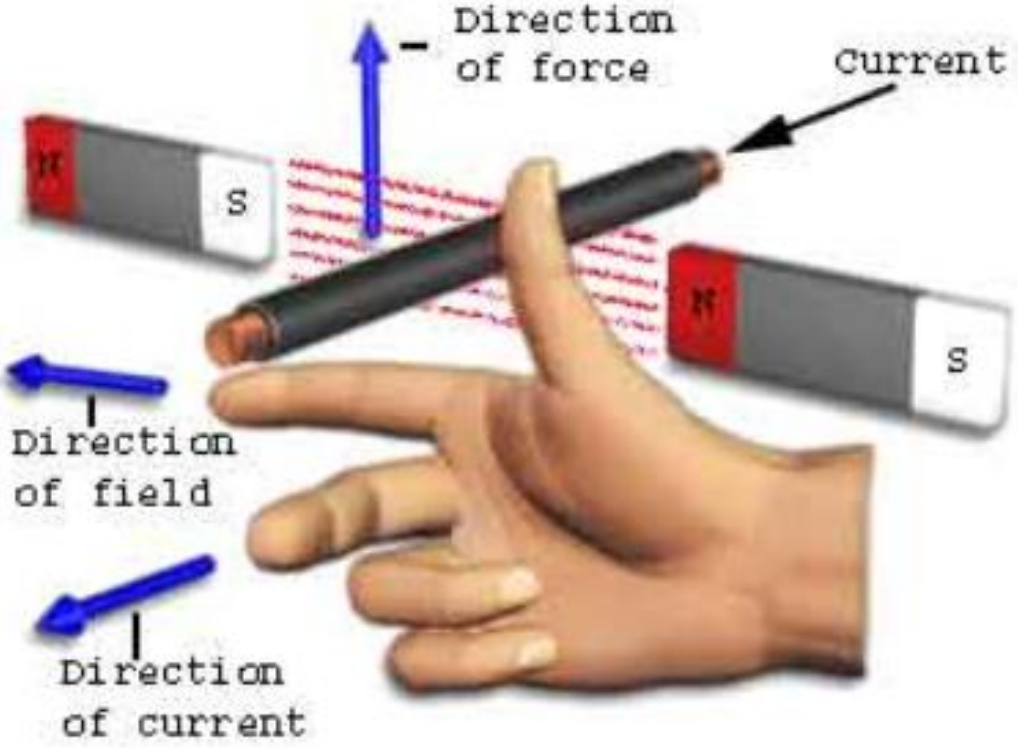

A
8
1
2
D
B
C
N
7
3
S
6
5
4


One Cycle
E.M.F.
2
3
4
1
5
6
7
8
1
θ

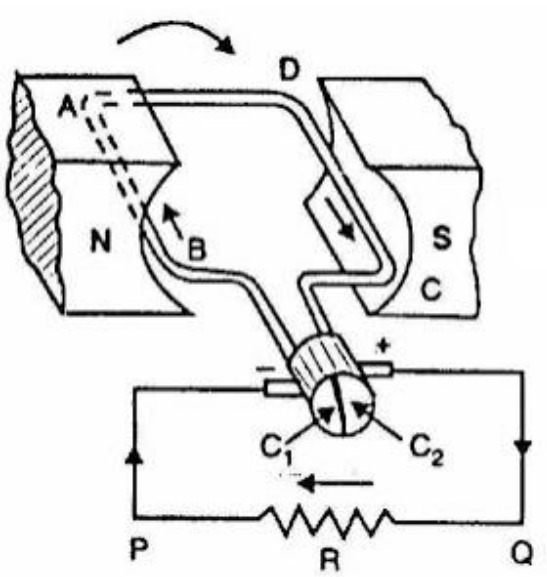
Right hand rule

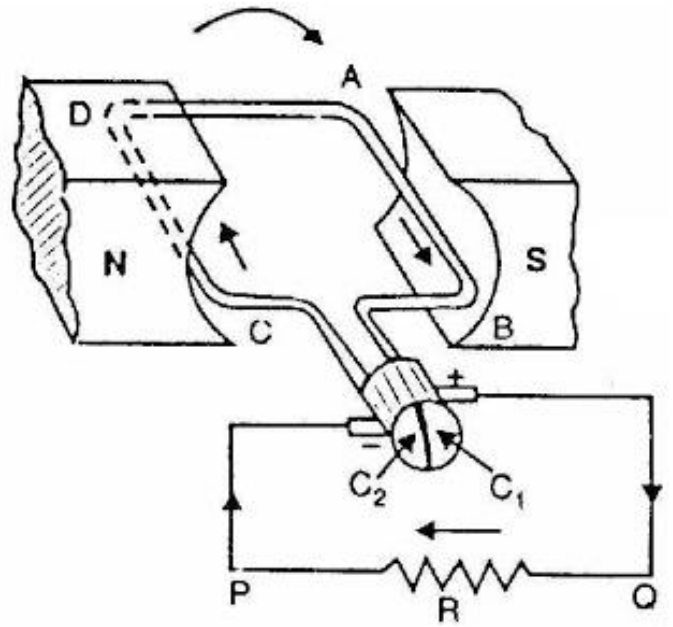


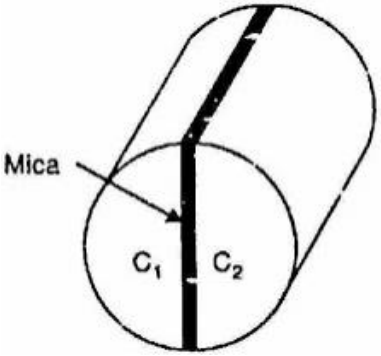
Fleming's Right Hand Rule

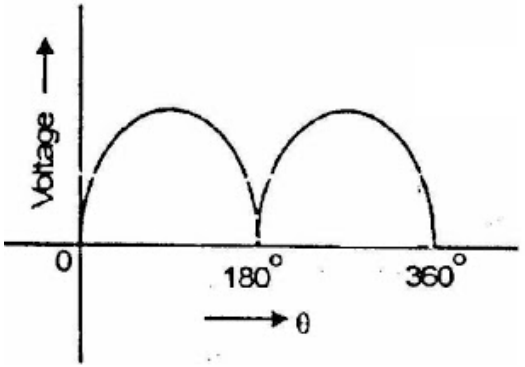


Commutator

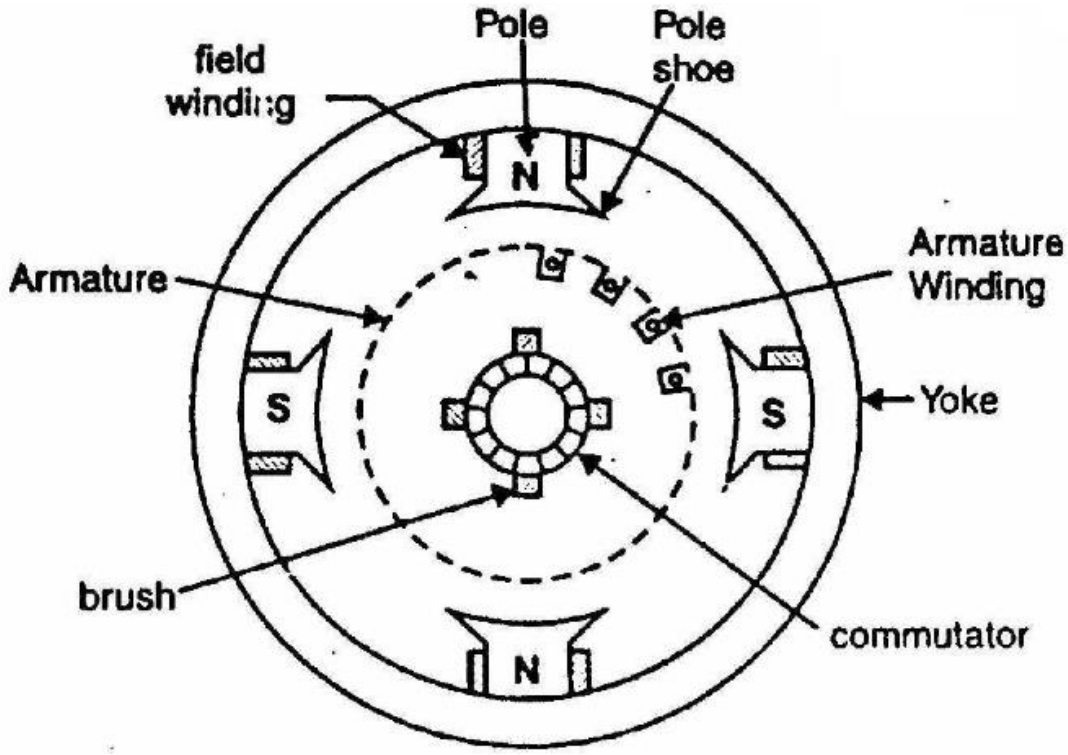




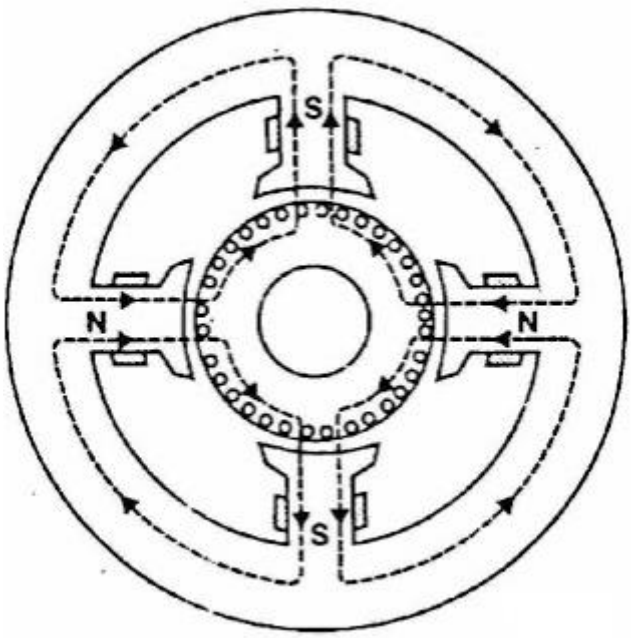


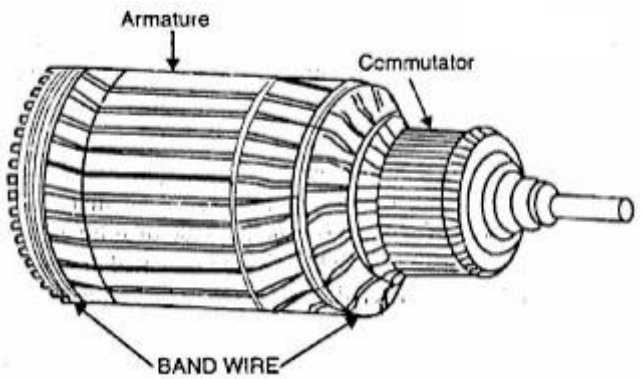


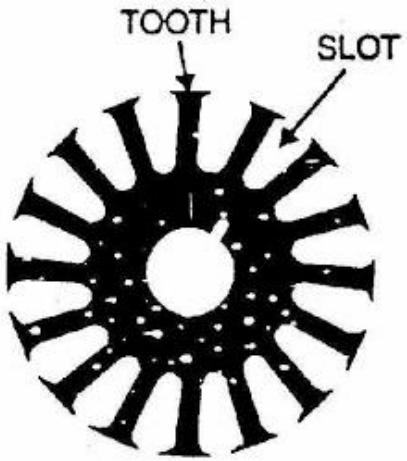
Constructions



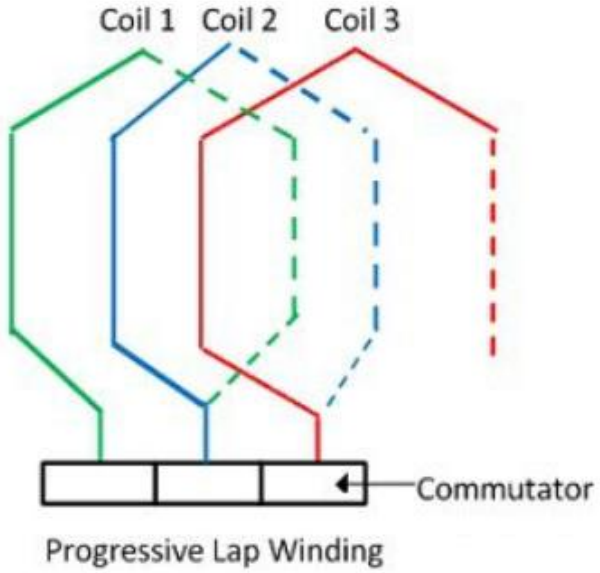
Pole pitch and Coil pitch

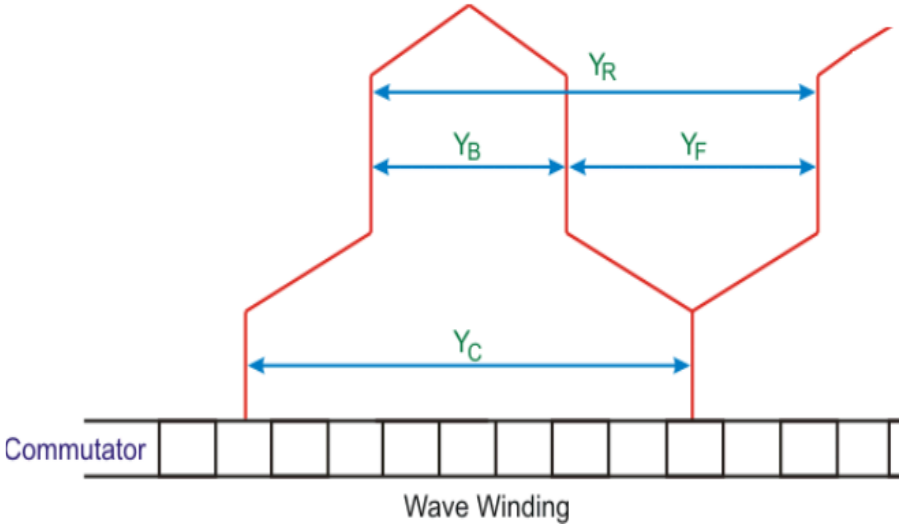

S
N
N
S


Armature
Commutator
BAND WIRE


TOOTH
SLOT

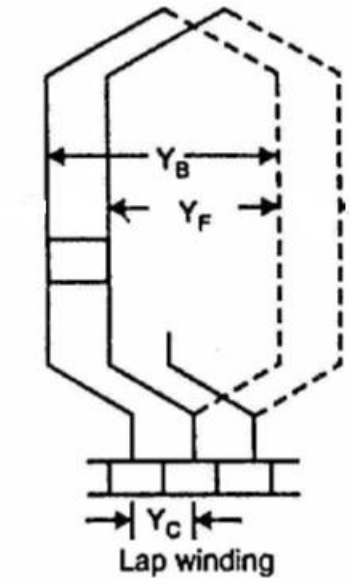
Types of winding



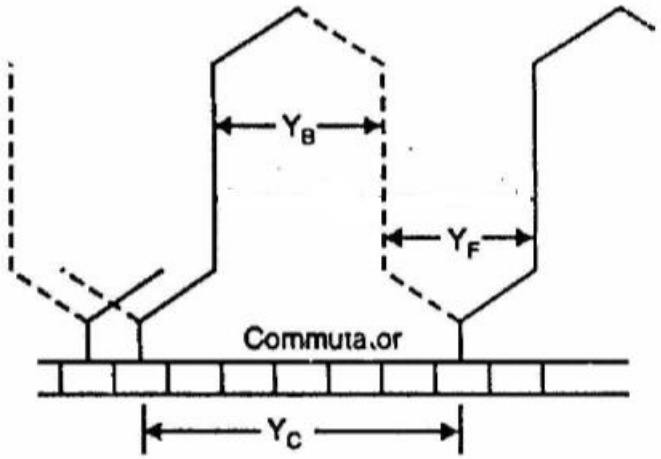


- Lap winding
- Wave winding

Back/Front Pitch

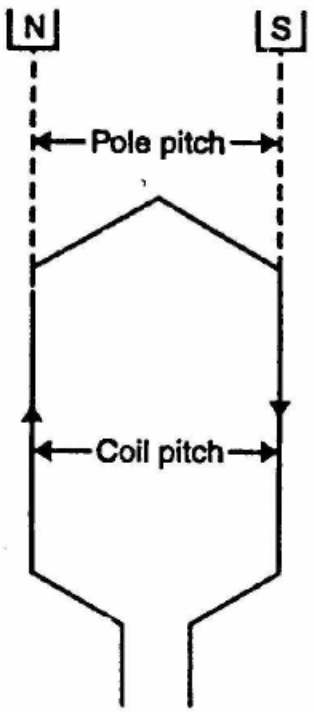


Lap winding

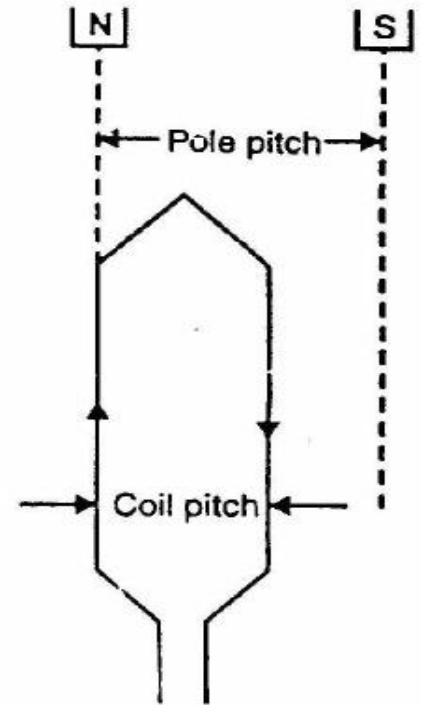


Wave winding

Types of coil



- Full-pitched coil



- Fractional-pitched coil

Example 26.1. *Draw a developed diagram of a simple 2-layer lap-winding for a 4-pole generator with 16 coils. Hence, point out the characteristics of a lap-winding.*

Solution. The number of commutator segments = 16

Number of conductors or coil sides $16 \times 2 = 32$; pole pitch = 32/4 = 8

Now remembering that (*i*) Y_B and Y_F have to be odd and (*ii*) have to differ by 2, we get for a progressive winding $Y_B = 9$; $Y_F = -7$ (retrogressive winding will result if $Y_B = 7$ and $Y_F = -9$). Obviously, commutator pitch $Y_C = -1$.

[Otherwise, as shown in Art. 26.26, for progressive winding

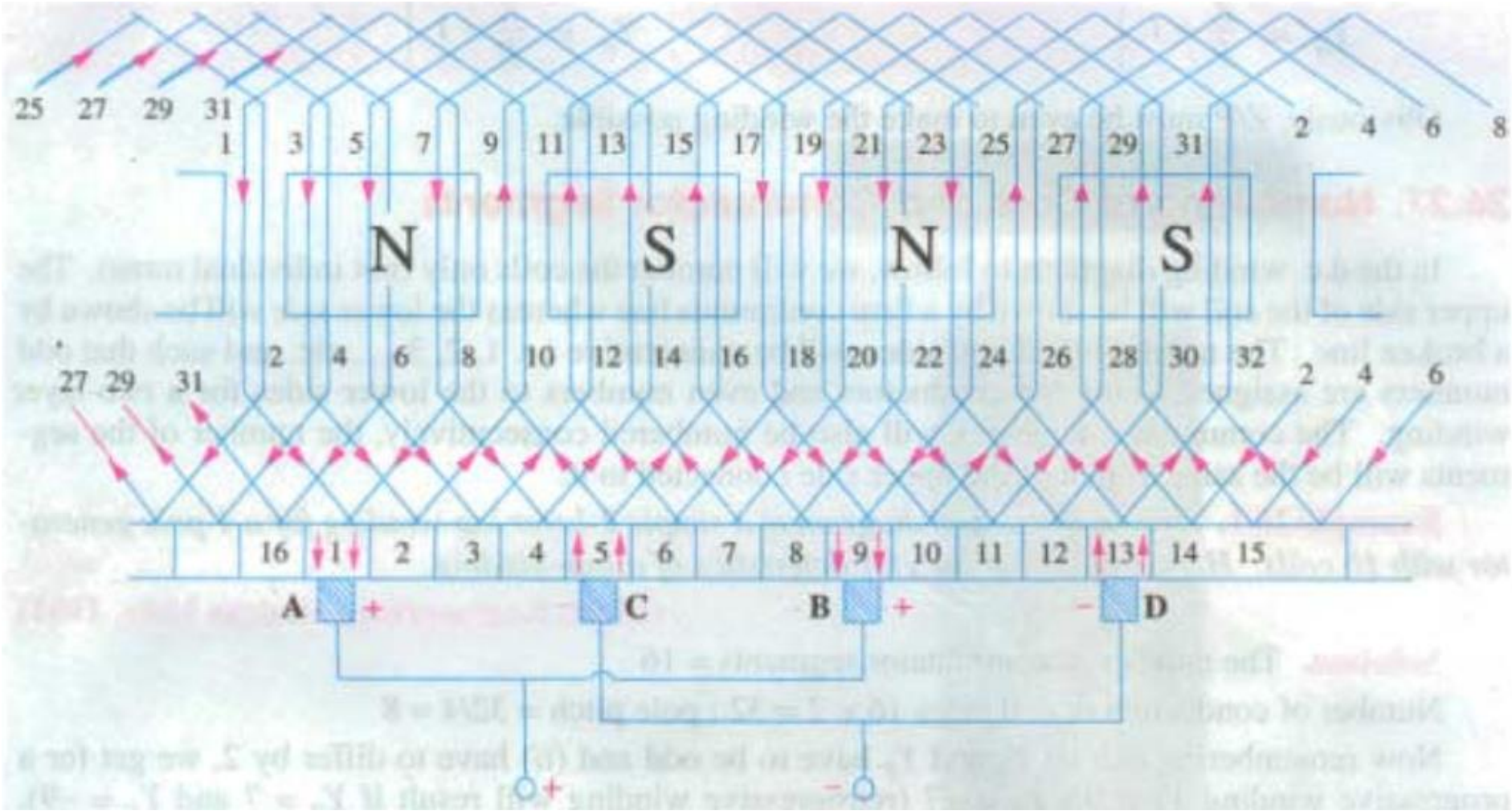
$$Y_F = \frac{Z}{P} - 1 = \frac{32}{4} - 1 = 7 \text{ and } Y_B = \frac{Z}{P} - 1 = \frac{32}{4} + 1 = 9]$$

The simple winding table is given as under :

Back Connections		*Front Connections*
1 to (1 + 9) = 10	⟶	10 to (10 – 7) = 3
3 to (3 + 9) = 12	⟶	12 to (12 – 7) = 5
5 to (5 + 9) = 14	⟶	14 to (14 – 7) = 7
7 to (7 + 9) = 16	⟶	16 to (16 – 7) = 9
9 to (9 + 9) = 18	⟶	18 to (18 – 7) = 11
11 to (11 + 9) = 20	⟶	20 to (20 – 7) = 13
13 to (13 + 9) = 22	⟶	22 to (22 – 7) = 15
15 to (15 + 9) = 24	⟶	24 to (24 – 7) = 17
17 to (17 + 9) = 26	⟶	26 to (26 – 7) = 19
19 to (19 + 9) = 28	⟶	28 to (28 – 7) = 21

21 to (21 + 9) = 30	⟶	30 to (20 – 7) = 23
23 to (23 + 9) = 32	⟶	32 to (32 – 7) = 25
25 to (25 + 9) = 34 = (34 – 32) = 2	⟶	2 to (34 – 7) = 27
27 to (27 + 9) = 36 = (36 – 32) = 4	⟶	4 to (36 – 7) = 29
29 to (29 + 9) = 38 = (38 – 32) = 6	⟶	6 to (38 – 7) = 31
31 to (31 + 9) = 40 = (40 – 32) = 8	⟶	8 to (40 – 7) = 33 = (33 – 32) = 1

The winding ends here because we come back to the conductor from where we started.


25 27 29 31
1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31
2 4 6 8
N S N S
2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32
27 29 31
2 4 6
16 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
A + C − B + D −
+
−