



Walchand College Of Engineering, Sangli.

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EXPERIMENT - OS

Title : Speed control of DC shunt motor

objective: To study the speed control of DC shunt motor using

- 1) Armature voltage control
- 2) Field current control.

Apparatus

Gr.No	Item	Rating	Quantity
1)	Voltmeter	0-250V	1
2)	Ammeter	0-1000mA	1
3)	Resistor	800Ω, 360Ω, 20Ω	3
4)	DC motor		1
5)	Rheostat		1
6)	Tachometer		1



Theory:

The equation governing the speed of a dc shunt motor is

$$N = \frac{V - I_a R_a}{z\phi} A$$

where,

N = Speed of the motor

V = armature voltage

I_a = armature current

R_a = armature resistance

ϕ = Field flux

In above eqⁿ R_a is constant. so we can control the speed of motor in two ways. Firstly by changing the field flux ϕ and secondly by changing the armature voltage. In the both case we vary the speed of motor by introducing a rheostat in the field circuit and armature circuit respectively

Armature voltage control:

This method is based on the fact that by varying the voltage available across the armature, the back EMF and hence the speed of motor can be changed. This is done by inserting a variable resistance R_c (known as controller resistance) in series with armature.

$$E_b = V - I_a R_a$$

$$E_b \propto I_a R_a$$

$$E_b \propto N$$



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Advantages of armature control method:

- 1) Armature controlled motors offer nearly unmatched accuracy and control, along with a wide speed variation range.
- 2) constant field current and torque: with the armature control method, the field current and torque level remain constant throughout the application.
- 3) fast and simple speed variation: Armature controlled DC motor are known for their exceptional speed control, which allows operators to vary the speed as necessary in both directions.

Disadvantages of armature control method:

- 1) A large amount of power is wasted in the controller resistance since it carries full armature current I_a .
- 2) The speed varies widely with load since the speed depends upon voltage drop in controller resistance and hence on the armature current demanded by load.
- 3) The output and efficiency of the motor are reduced.
- 4) This method results in poor speed regulation.



Field current control:

It is based on the fact that by varying the field flux ϕ , the motor speed ($N \propto 1/\phi$) can be changed and hence the name flux control method

$$E_b = P\phi N z / 60A$$

$$E_b = N - I_a R_a$$

$$N = E_b / (60A/P\phi z)$$

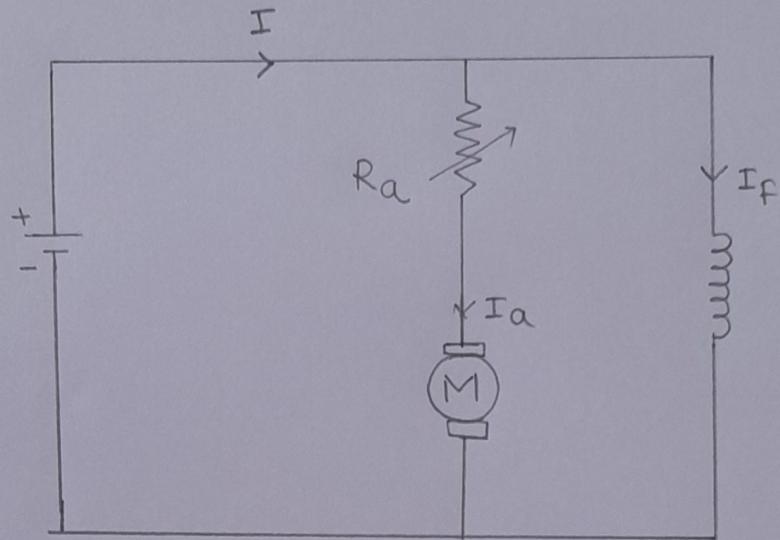
but, for a DC motor A, P and z are constants
Therefore, $N = k E_b / \phi$ (where, $k = \text{constant}$)

Advantages of field current control method:

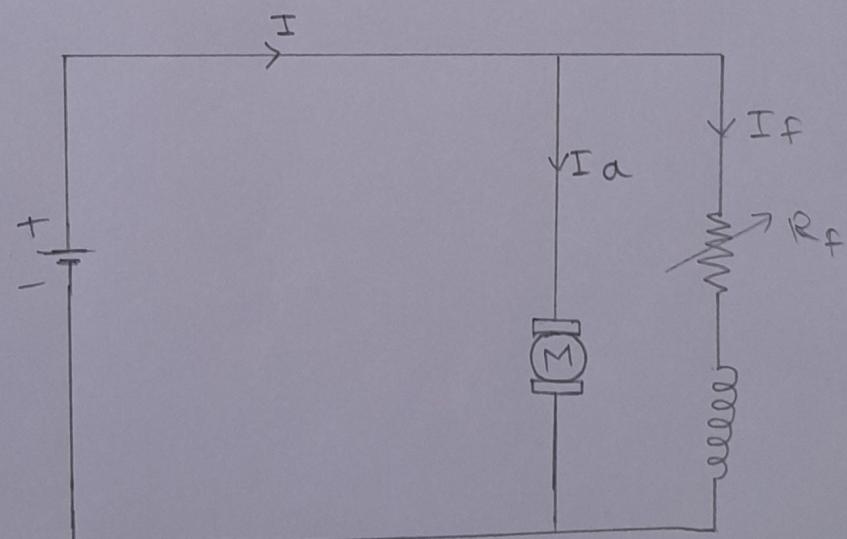
- ① This is an easy and conventional method.
- ② It is inexpensive method since very little power is wasted in the shunt field rheostat due to relatively small value of I_{sh} .
- ③ The speed control exercised by this method is independent of load on the machine.

Disadvantages of field current control:

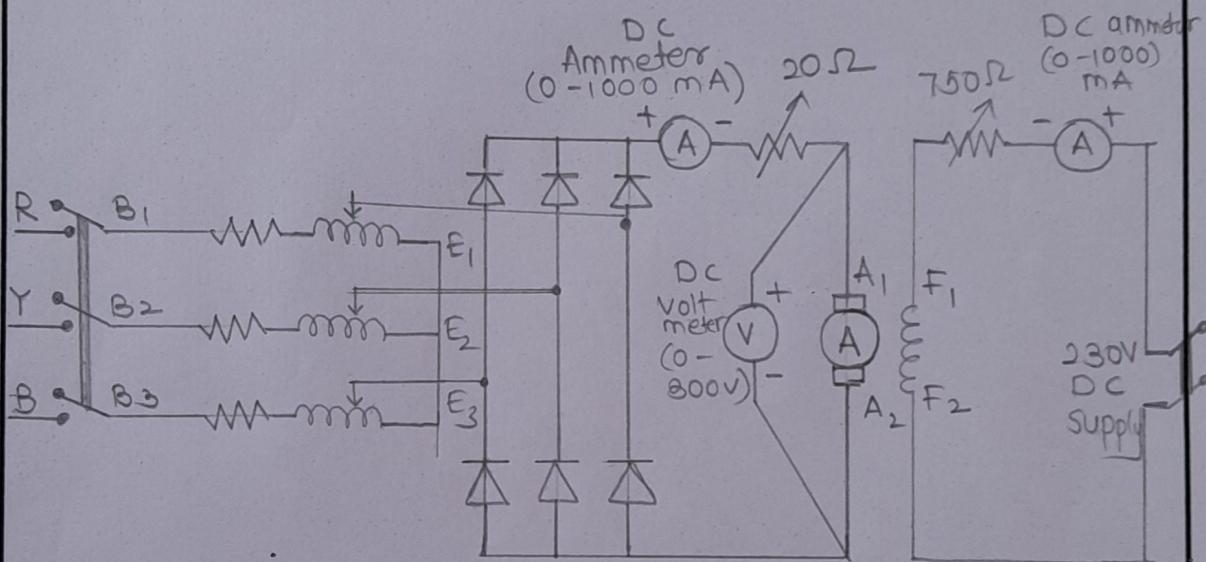
- ① Limits on speed: If your application requires you to adjust the motor below the normal speed, you may be better off choosing an armature controlled method. Field controlled DC motors can only operate above the normal speed. Higher speeds can also result in less torque.
- ② Reduced stability: The field control method allows operators to obtain higher speeds than the norm. Yet its overall range can be lowered due to a lack of stability. With a weaker field, you may only be able to safely exceed certain speeds.



Armature voltage control



field current control



speed control of DC shunt motor



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Procedure:

- 1) connect all components as per the circuit diagram
- 2) connect three phase 440V supply to Armature circuit.
- 3) connect 230V DC supply to field circuit.
- 4) For armature voltage control, change the rheostat resistance connected in series with armature circuit , such that speed of motor changes.
- 5) Next, for field current control , change the resistance of rheostat connected in series with field circuit such that speed can controlled.
- 6) Measure the motor speed using Tachometer for different voltages by varing the resistance.

Observation Table:

A] Armature voltage control:

Sr. No	Armature voltage(v)	speed (rpm)
1.	100	590.7
2.	120	786.0
3.	140	870.7
4.	160	1016.0
5.	180	1128.0