S. B. JAIN INSTITUTE OF TECHNOLOGY, MANAGEMENT & RESEARCH, NAGPUR.

Practical No. 01

Aim: Analyze the speed control of a DC shunt motor by Armature voltage control method and Field flux control method.

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EXPERIMENT NO-01

AIM: Analyze the speed control of a DC shunt motor by Armature voltage control method and Field flux control method.

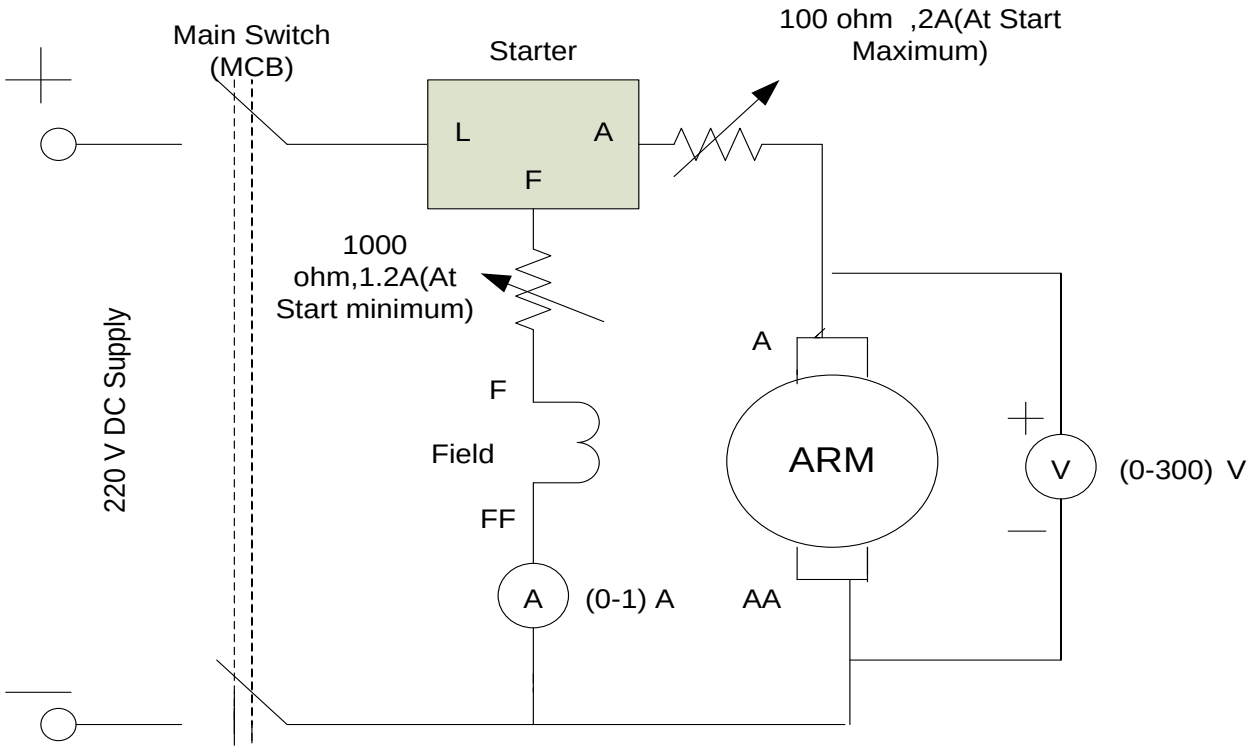
OBJECTIVES/EXPECTED LEARNING OUTCOMES:

- To Study factors responsible for variation of speed of DC shunt motor.
- To observe the control of speed of DC shunt motor by two methods.
- Compare these two methods of speed control

APPARATUS:

S. No	Name of the Apparatus	Range	Type	Quantity
1	DC Motor	3.7KW,5HP,19A,220V	Shunt	1
2	Voltmeter	(0-1000) V	Digital	1
3	Ammeter	(0-20)A	Digital	1
4	Rheostat	1000 Ω ,1.2A 290Ω,1.2A	Resistive	2
5	Connecting Wires	As required		

CIRCUIT DIAGRAM:



THEORY:

The speed of the d. c. shunt motor is given by the relation

$$N = K_n \times \frac{V - I_a r_a}{\phi} \quad r.p.m.$$

Where K_n= constant for a given motor,

$= (60 \times A) / (ZP)$, Z= number of armature conductors.

P= number of poles and

A= number of parallel paths in armature circuit.

V= applied voltage, in volts.

I_a= armature current, in amperes.

r_a= armature resistance, in ohms.

Φ= field flux, in weber per pole.

The speed of the d. c. shunt motor can be varied by varying

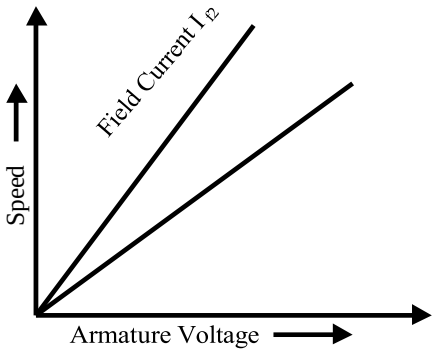
1. the applied voltage V
2. the voltage applied to the armature $V_a=V-I_ar_a$
3. The field flux Φ.

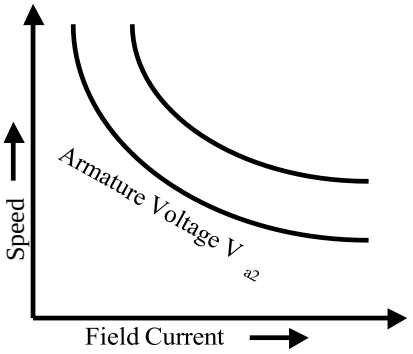
The voltage equation of motor is given by $V=E_b+I_ar_a$, where E_b is back emf and is given by

$$E_b = \frac{\phi ZN}{60} \times \frac{P}{A} \quad Volts$$

At the time of start, the speed N=0, so $E_b=0$ and the armature current $I_a=(V-E_b)/r_a = V/r_a$ which is very high and more than rated armature current. Therefore additional resistance is required to limit the current. This additional resistance is inserted in between Line and Armature by the use of starter. Hence STARTER is needed to start the dc shunt motor. During start, move the handle of the starter SLOWLY from off to on. At on position the handle is held up by No Volt release coil. For stopping the motor, simply DISCONNECT the supply. Do not TOUCH the handle. After disconnecting the supply, handle will come automatically to its off position.

When the motor is at rest, high starting torque is required to start the motor. The torque of dc motor is given by $T_e=K_tI_aI_f$. For high starting torque, $I_a$and I_f should be maximum. I_a is maximum due to zero speed and E_b= 0 at start. So keep armature rheostat at MAXIMUM position. In order to make I_f maximum, keep field rheostat at MINIMUM position.





PROCEDURE:

1) Make the connections as per circuit diagram.
2) Make sure that all the meters are connected properly.
3) Set up the armature rheostat to maximum value and field rheostat to minimum value.
4) Switch on the dc supply with the help of main switch or MCB. Move the handle of starter ***slowly*** and start the dc motor.
5) Adjust the field current to rated value (approximately 0.5 Amp.)
6) Note the voltage across armature and the speed of motor with the help of tachometer.
7) Keeping the field current constant (0.5 Amp), vary the resistance of armature rheostat to change the armature voltage and note down the speed.
8) Note down the armature voltage and speed in observation table.
9) Now vary field current to some other value and again by keeping it constant repeat the above steps.
10) Now keep the armature voltage constant (200 Volts) and note down the field current and speed.
11) Keeping the armature voltage constant (200 Volts), vary the resistance of field rheostat to change the field current and note down the speed.
12) Note down the field current and speed in observation table.
13) Now vary armature voltage to some other value and again by keeping it constant repeat the above steps.
14) Plot the graph as shown in theory.

OBSERVATION TABLE:

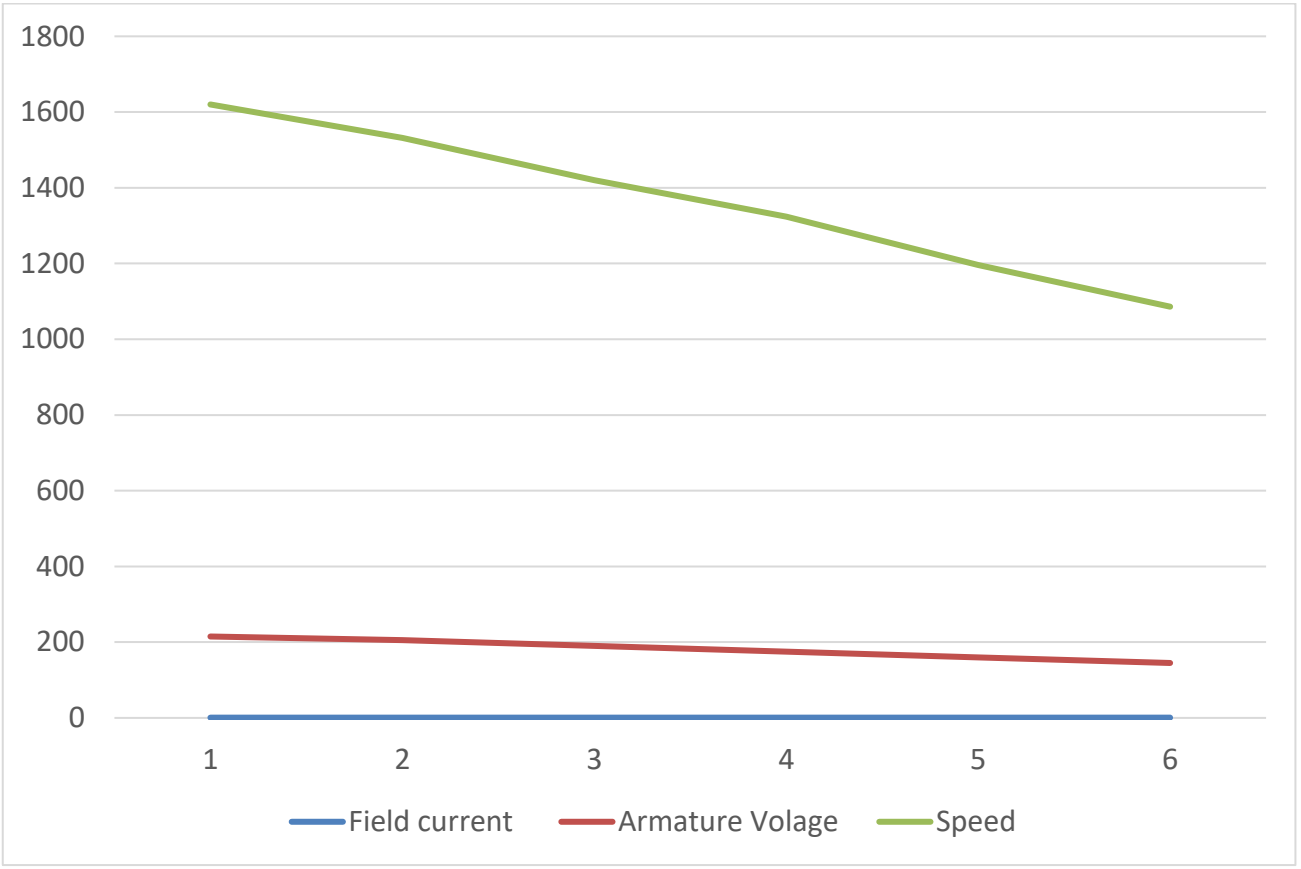
a) Varying armature voltage with field current kept constant.

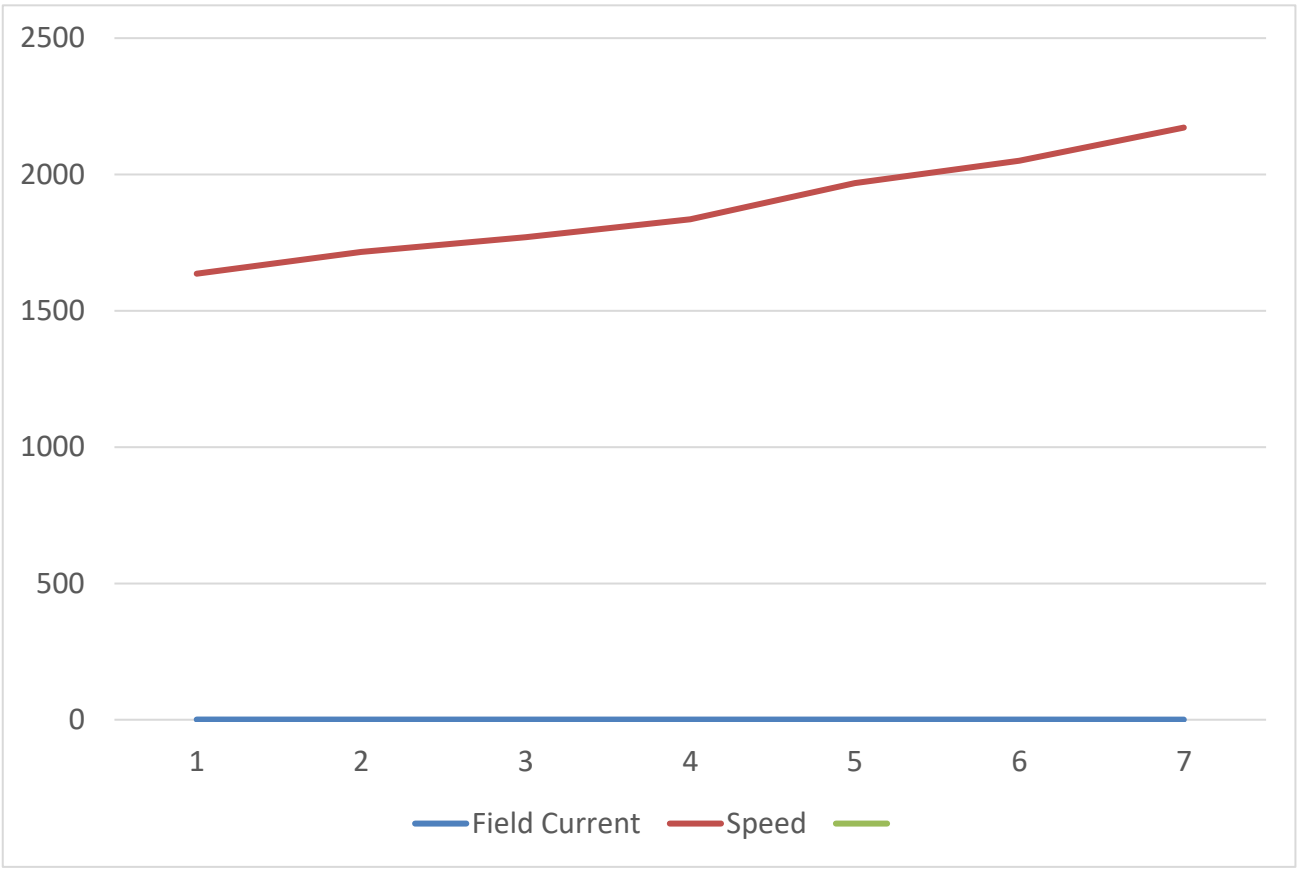
Sr. No	Field Current (Constant)A	Armature Voltage (Va) Volts	Speed (N) RPM
1)	0.67	215	1620
2)	0.67	205	1532
3)	0.67	190	1420
4)	0.67	175	1324
5)	0.67	160	1196
6)	0.67	145	1086

b) Varying field current with armature voltage kept constant.

Sr. No	Armature Voltage (Constant) V	Field Current (If) Amps	Speed (N) RPM
1)	217	0.60	1636
2)	217	0.55	1716
3)	217	0.50	1770
4)	217	0.45	1836
5)	217	0.40	1968
6)	217	0.35	2050

GRAPH:


1800
1600
1400
1200
1000
800
600
400
200
0
1
2
3
4
5
6
Field current
Armature Volage
Speed


2500
2000
1500
1000
500
0
1
2
3
4
5
6
7
Field Current
Speed

RESULT: The speed of the DC motor can be increased beyond the no load speed by inserting an external resistance in the shunt field circuit.

CONCLUSION: A shunt or separately excited dc motor has a torque-speed characteristic whose speed drops linearly with increasing load torque.Its speed can be controlled by changing its field current, armature voltage or its armature resistance.

DISCUSSION QUESTIONS:-

1) Explain the concept of speed control?

Ans: It is used to influence the rotational speed of motors and machinery. This has a direct effect on the operation of the machine and is crucial for the quality and the outcome of the work.

2) Explain the difference of operation between shunt and series motor?

Ans:

Parameter	DC Series Motor	Shunt Motor
Basic	In a dc series motor, the field winding is connected in series with the armature winding.	In a dc shunt motor, the field winding is connected in parallel with the armature winding.
Field current	In dc series motors, the field current is same as the armature current.	In dc shunt motors, the field current is not equal to armature current.
Voltage across armature and field windings	In dc series motors, the voltages across armature and field windings are different depending on their resistance.	In dc shunt motors, the voltage across the armature winding and field winding is same and is equal to the supply voltage.
Field winding design	A dc series motor has a field winding design with few turns of thick conductor wire.	The field winding of a dc shunt motor is designed with large number of turns of fine wire.

3) What happens if field winding of shunt motor is open circuited?

Ans: If the shunt field suddenly opens while the motor is being operated under full-load conditions, only a small voltage due to the residual magnetism of the pole pieces will be induced into the armature. Current will increase considerably. The magnitude of this current may be sufficient to burn out the motor.

4) What happens if armature winding of shunt motor is open circuited?

Ans: If the shunt field opens under a no-load condition, the armature current will once again increase. Because very little torque is needed to overcome the windage and friction,

the motor would continually increase in speed.

In shunt motor if field gets open circuit then back emf will get zero as e=kΦw. Current in armature circuit is directly propotional to voltage so the armature winding will burn .

5) What happens if series motor is operated on NO LOAD?

Ans: As the series motor started with no load, the current drawn from supply is very low. It is the same current which flows through series field winding. Hence as the current is low, flux produced by series field winding are very less. This causes increase in speed dangerously due to very low flux (field current).