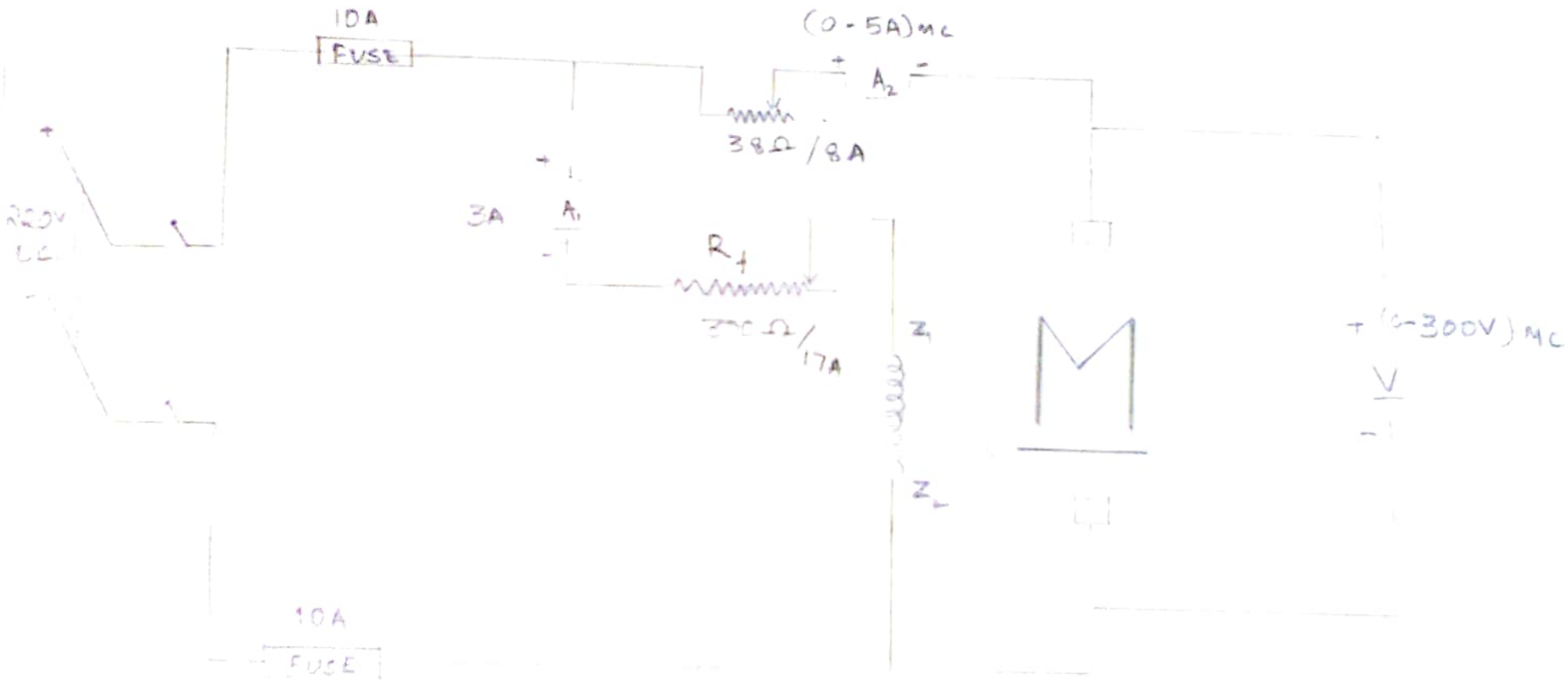
CIRCUIT DIAGRAM



Date: 23.1.12

EXPERIMENT NO - 2

AIM OF THE EXPERIMENT

Speed control of DC motors by

- Variation of armature circuit resistance.
- Variation of field circuit resistance.

EQUIPMENTS AND INSTRUMENTS USED:

- A dc shunt motor with starter.
- One moving coil ammeter 0-5 A
- One moving coil ammeter 0-3 A
- One moving coil voltmeter 0-300 V.
- One rheostat of 500 ohms 5 Amps.
- One rheostat of 300 ohms, 2 Amps
- One S.P.S.T Switch.

THEORY:

If V is the applied voltage across the motor terminals, E_b is the back emf developed, then $V = E_b + I_a R_a$.

where I_a and R_a are the current and resistance in the armature circuit respectively.

But $E_b = \frac{\phi Z N P}{60 A} = k \phi N$.

Hence, $V = k\phi N + I_a R_a$

i.e. $N = k' \frac{(V - I_a R_a)}{\phi}$

This shows that :-

i) An increase in the $I_a R_a$ drop will decrease the value of speed if V remains constant.

ii) Speed varies inversely as the field flux and hence varies inversely as the exciting current, if below saturation. Thus by increasing the resistance in the armature circuit, a motor can be operated at speeds

CASE A ARMATURE RESISTANCE CONTROL

I_f = 1.6A R_a = 1.1Ω

	V_a	I_a	$E_b = V_a - I_a R_a$	N
		A	V	r.p.m
	155	1.57	143.27	950
	162	1.60	150.24	995
	168	1.67	156.16	1030
	175	1.70	163.13	1085
	182	1.75	170.07	1125
	188	1.75	176.07	1200
	196	1.825	183.99	1300

I_f = 1.5A R_a = 1.1Ω

	V_a	I_a	$E_b = V_a - I_a R_a$	N
		A	V	r.p.m
	146	1.50	144.35	975
	154	1.65	152.185	1015
	160	1.70	158.13	1075
	166	1.70	164.13	1100
	173	1.725	171.10	1170
	182	1.75	180.07	1250
	186	1.8	184.02	1355

below normal By increasing the resistance in the field circuit, a motor can be operated at speeds above normal

PROCEDURE

Case A Speed control by variation of armature circuit resistance

(i) Connect the circuit as in the diagram. Make R_2 and R_f zero at the time of starting the motor (which is run on no load) with the motor starter.

(ii) The motor is on no load. Adjust R_1 and bring the motor to its rated speed. Note the terminal voltage, V and normal excitation which corresponds to the rated speed of the motor. Keep constant throughout. During starting, ammeter A may be by passed

Case B: Speed control by variation of field circuit resistance

(i) Run the motor as before and bring it to the rated speed at no load

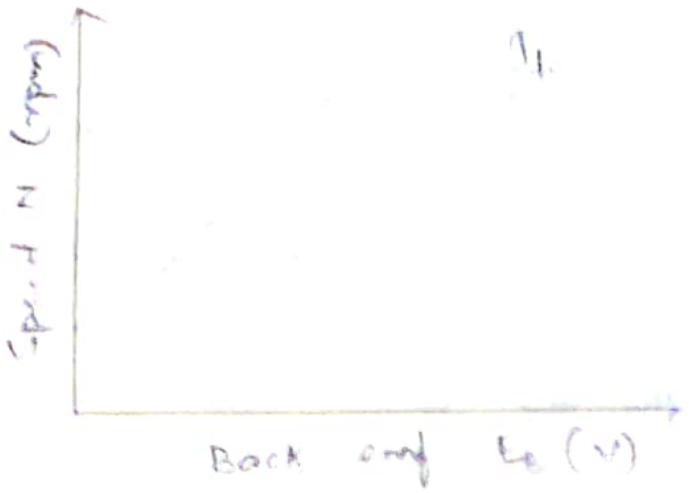
(ii) Cut out the field regulating resistance, R_f [illegible] note the speed and the field current, I_f [illegible] case. Keep the voltage across the armature terminals. Take readings for decreasing values of speed by increasing field current.

(iii) Take values of readings for increasing values of speed corresponding to same values of I_f [illegible]

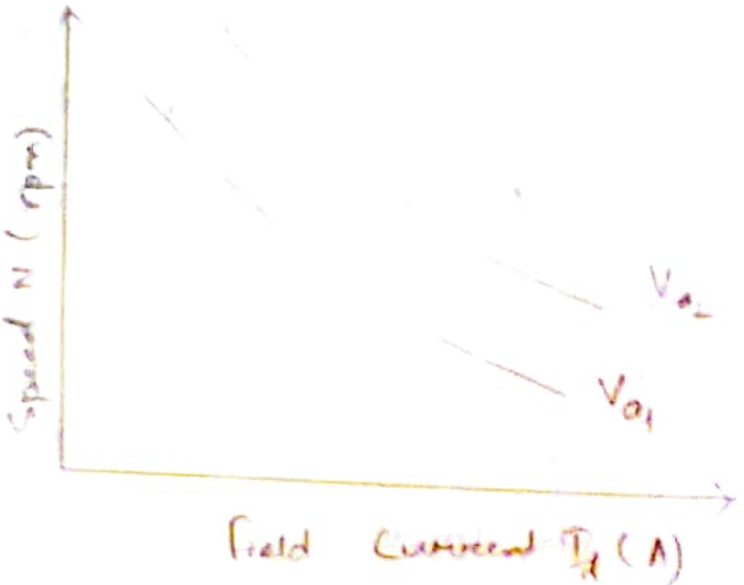
(iv) Measure R_f after test

MODEL GRAPH

E_b Vs N - Armature resistance control



T_f Vs N/N_0 const : (Field resistance control)



MACHINE DETAILS

PARAMETER	RANGE
VOLTAGE	220V
RATED SPEED	1500 rpm
CURRENT	30A
WINDING	Combined

FORMULA USED :

$E_b = V_b - I_a R_a$

where

E_b = Back emf

I_a = Current flowing through armature

R_a = Armature resistance

DISCUSSION :

Case A : Armature Resistance Control.

Advantage :

i) Since I_a is constant, torque is constant.

ii) Speed can be varied from '0' to the rated Speed

iii) Economical For short time duty.

Disadvantage :

i) Poor Speed regulation. Because of manual work in varying the external resistance, the accuracy is less.

ii) Lower efficiency & higher running cost due to high external resistance copper loss

Case B

Advantage :

i) Speed can be varied above rated Speed.

ii) Output is constant.

iii) Efficiency is good

Disadvantage :

At high Speed I_f (field current) is small, hence due to high I_a there is a huge amount of Sparking.

case B - Field Resistance control (V_a = constant)

V_a = 150V

Obs no	I_f (A)	Speed (rpm) with decreasing I_f
1	1.75	948
2	1.60	988
3	1.50	1004
4	1.40	1030
5	1.30	1050
6	1.20	1086
7	1.10	1120
8	1.05	1160
9	0.90	1206

V_a = 170V

Obs no	I_f (A)	Speed (rpm) with increasing I_f
1	0.90	1408
2	1.00	1366
3	1.10	1314
4	1.20	1272
5	1.30	1226
6	1.40	1180
7	1.50	1146
8	1.60	1118
9	1.70	1100