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Measurement Of Efficiency Of Shunt And Series Motors

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Abstract: ***In this paper discussed about load test of DC series and shunt motor. This paper shows measurement of Efficiency of dc shunt and series motor. The purpose of this load test is to test which is used to test the performance. DC motors were widely used in whole over the world. This can be proudly known as workhorse of industrial systems. On this Paper a comparison of efficiency is proposed to construct a DC shunt and series motor through the measurement to get a concept just about its real time Performances. DC motors are generally used in several applications due to inexpensive cost. Dc series motors are used in hoists, cranes, cars, conveyors, elevators, air compressors, vacuum cleaners, sewing machines. And Dc shunt motors are used in Lathe Machines, Centrifugal Pumps, Fans, Blowers, Lifts, Spinning machines, etc.***

Keywords: no load, speed, DPST switch, some characteristics dc shunt and series motors.

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I. INTRODUCTION

A dc means direct current, In a Dc motor Dc is named as the connection of the field winding with the armature. Mainly there are 2 types of Dc motors. 1ST One is Self-excited Dc Motor and 2ND one is Separately Excited DC Motor. The self-excited automobiles are further categorized as shunt motor, series motor and compound motor. In this paper we discussed about only Dc shunt and series motor[2]. And also discuss about the efficiency, output power, input power, speed, of both dc motors. In any electric motor, operation is based on simple electromagnetism.

When a current-carrying conductor is placed in an external magnetic field, it will experience a force i.e. Lorentz force. Due to this force torque is produced which rotates the rotor of motor.

DC SHUNT MOTOR

Shunt DC motor works on direct current (DC). In electrical terminology, a parallel connection is called shunt. In a Shunt DC motor, the armature and field windings are linked in parallel. This kind of winding is called shunt winding and the motor Shunt DC motor creation and principle of operation of a Shunt DC motor is same as any other DC motor. It additionally has all the important components-rotor (armature), stator (field windings) and commutator - required for the operation of a motor. In a Shunt DC motor, a rotational torque is produced because of the interaction between the magnetic field produced around the present day carrying armature and the magnetic control well-known across the stator windings. The resistance of shunt field winding (R_{sh}) is always higher than that is armature winding.

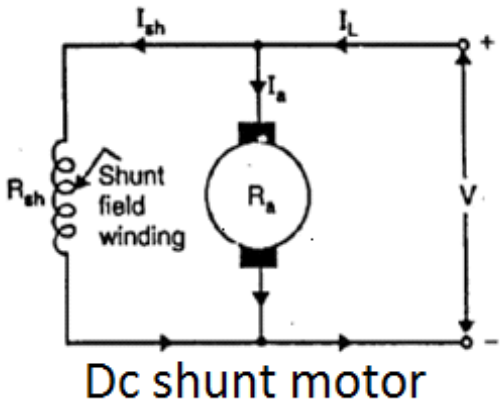

Figure 1

DC SERIES MOTOR

A Dc series motor is similar to any other types of Dc motors in almost all aspects. It consists of all the basic components like the stator (the field winding) ,the rotor(armature conductors), and the other basic parts like the commutator or the brush segments all attached in the proper sequence as in the case of a standard Dc motor. The current passing through the series winding is same as the armature current .Therefore the series field winding has fewer turns of thick wire than the shunt field winding. Also therefore the field windings will posses a low resistance then the armature winding.

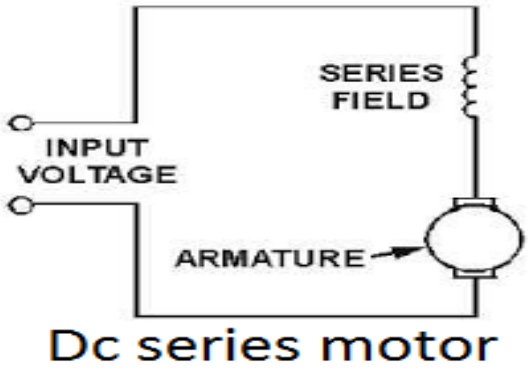

Figure 2

The load testing of DC machine is required to determine the rating of a machine. There are two types of loads available. A No- load &full –load. If a test performed to determine the input and output of dc motor is known as load test. When we run a machine, then some energy is lost in the machine, which converts into the heat and cause temperature rise. If a machine produces in addition much heat then it can affect the insulation of the machine and finally it can cause the breakdown of the machine. Therefore, the load must be set to a value that it can operate within the temperature limit.

II. THEORY

The shunt motor has a specific no load speed subsequently it does not run away when load is thrown off furnished the field circuit stays closed. The drop in velocity from no-load to full load is small for this reason this motor is standard mentioned a normal velocity motor.

The efficiency curve is normally of the same form for all electric automobiles and turbines. The form of efficiency curve and the point of most performance may be very extensive by way of the method expensive, though it's miles effective to have an efficiency curve which within reason level. In order that there is little operate in performance between load and 25% overload and to have the maximum performance as near to the full load as possible. Since the curves load is determined this is positive charge of current is needed even if output is 0. The motor enter below no-load conditions is going to meet the various losses, happening in the system. Compared to other motors a shunt motor is stated to have a lowest beginning torque. But this have to no longer be taken off involve this is shunt motor is incapable of beginning heavy load. actually this way that collection and compound motor as able to starting heavy load with les extra of current inputs over normal values then the shunt motor and the consequently the decrease on the motor could be particularly much less. The velocity of the DC motor is inversely propositional to the flux consistent with pole, while the armature voltage is stored constant. By using lower the flux. The velocity may be extended and vice –versa. As a result the main flux of area control method the flux of a DC motor may be changed through changing field cutting-edge with assist of a shunt field rheostat. since shunt area modern is respectively small shunt field rheostat has to carry best a small amount of modern which means I2R losses is small in order that rheostat is small in size .This approach could be very green. Armature control method is used while speed below the no load speed are required. Because the supply voltage is normally steady the voltage across the armature is varied via inserting a variable rheostat in collection with the armature circuit. As conductor resistance is improved potential difference throughout the armature is reduced, herby reducing the armature speed. F or a load of steady torque speed is approximately propositional to the capacity characteristic all through the armature.

III. DETERMINATION OF EFFICIENCY

The efficiency of DC machine like any other machine is determined by the ratio of output power to that of the input power. There are three methods of determining the efficiency of a machine.

$$Efficiency\ (\eta) = \frac{output}{input}$$

$$or,\ \eta = \frac{input\ -\ losses}{input}$$

$$or,\ \eta = \frac{output}{output\ +\ losses}$$

LOSSES AND EFFICIENCY

The losses taking place in the motor are the same as in generators. These are (*i*) Copper losses (ii) Core (or) Iron (or) Magnetic losses and (*iii*) Mechanical losses.

The condition for maximum *power* developed by the motor is

$$I_a R_a = W2 = E_b$$

The condition for maximum *efficiency* is that armature Cu losses are equal to constant losses

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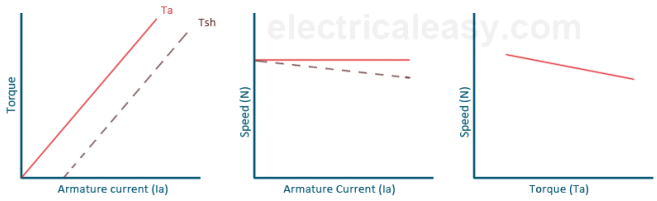
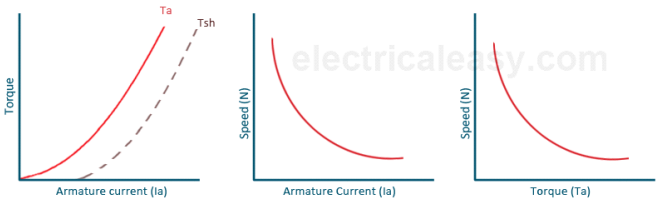
IDEAL CHARACTERISITCS OF SHUNT MOTOR



Characteristics of DC shunt motor

IDEAL CHARACTERISTUCS OF SEREIS MOTOR



Characteristics of DC series motor

Figure 3

SUMMARY OF APPLICATIONS

Summary of Applications

Type of motor	Characteristics	Applications
Shunt	Approximately constant speed Adjustable speed Medium starting torque (Up to 1.5 F.L. torque)	For driving constant speed line shafting Lathes Centrifugal pumps Machine tools Blowers and fans Reciprocating pumps
Series	Variable speed Adjustable variying speed High Starting torque	For traction work *i.e.* Electric locomotives Rapid transit systems Trolley, cars etc. Cranes and hoists Conveyors

LAB REPORTS

The purpose of this paper is about comparing of both shunt and series motor efficiency &plot the graphs. To determine the efficiency of dc shunt and series motor by using load test which is used in many industries now a days. Actually purpose of this load test is to test the performance of motor.

CALCULATION FORMULAS

$$R = \frac{\text{Circumference}}{100 \times 2\pi} \text{ m}$$

Torque T = (S1 ~ S2) x R x 9.81 Nm

Input Power = V_{DC} x IDC Watts

$$\text{Output power} = \frac{2\pi NT}{60} \text{ Watts}$$

$$\text{Efficiency} = \frac{\text{OutputPower}}{\text{InputPower}}$$

Apparatus required:

S.NO	APPARATUS	RANGE	TYPE	QUANTITY
1.	Ammeter	(0-20)A	MC	1
2.	Voltmeter	(0-300)V	MC	1
3.	Tachometer	(0-1500)rpm	DIGITAL	1
4.	Connecting Wires	2.5 Sq.mm	COPPER	FEW

DC SHUNT MOTOR

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Figure 4

BY DOING EXPERIMENT ON LAB WE ARE GETTING

Some values which are used to measure the efficiency of dc series and shunt motor. Where I am getting some interesting efficiency values. Which are used for testing the performance of the dc series and shunt motor. And also I plot the graph between some characteristics of dc shunt and series motor. At last I plot the graph about efficiency of dc shunt and series motor individually. Because it has different speed values. I am given below the tables about dc shunt and series motor .

Sl.No	Voltage (V)	(Amps) (I_L)	Speed (N) (rpm)	Spring Balance Readings S_1 kg	S_2 kg	(S_1~ S_2) Kg	Torque (T) (Nm)	Input Power (Watts)	Output Power (Watts)	Efficiency (%)
1	221	2	1500	0	0	0	0	442	0	0
2	221	4	1486	1	2.8	1.8	1.69	884	261.17	29.5
3	221	6	1470	1.2	6.4	5.2	4.90	1326	749.10	56.46
4	221	8	1464	2	9.8	7.8	7.35	1768	1119.08	63.29
5	220	10	1457	4	14.8	10.8	10.18	2210	1542.55	69.79
6	220	12	1438	4.6	17.8	13.2	12.44	2652	1860.42	70.15
7	220	14	1420	5.0	22.2	17.2	16.21	3080	2395.30	77.60
8	220	16	1400	6.6	26	20.6	19.42	3520	2828.39	80.35
9	220	18	1380	7	30.6	23.6	22.25	3960	3237.8	81.70

Table 1

Sl. No	Voltage (V)	(Amps) (I_L)	Speed (N) (rpm)	Spring Balance Readings S_1 kg	S_2 kg	(S_1~ S_2) Kg	Torque (T) (Nm)	Input Power (Watts)	Output Power (Watts)	Efficiency (%)
1	220	10.6	1982	18	9.2	8.8	8.28	2332.6	1717.62	73.65
2	220	12	1850	22	11	11	10.38	2640	2009.91	76.13
3	219	13	1769	24	11.4	12.6	11.86	2847	2195.94	77.13
4	218	14	1710	26	12.4	13.6	12.50	3052	2290.94	75.06
5	217	15	1630	28.6	13.4	15.2	14.31	3255	2441.38	75.03
6	216	16	1571	31.8	14.6	17.4	16.38	3456	2613.38	75.61
7	216	17	1528	34.4	15.5	18.9	17.84	3672	2853.16	77.70
8	215	18	1465	35	16.0	19	17.93	3670	2743.72	74.76

Table 2

IV. RESULT AND DISSCUSIONS

For this paper we are using online tool for plot the graphs. But by using Lab VIEW software also we plot the graphs. National Instruments developed Lab VIEW software for the first time in the year 1986 for the Apple Macintosh Company. It was conceptualized as a programming environment for hardware control. The graphical user interface, which is used

to simulate the controlled instrument on the computer, monitors itself with the help of Lab VIEW software [4].

PRACTICAL CHARACTERISTICS

Mechanical characteristics of Direct Current motor are to be analyzed in that speed vs torque and speed vs efficiency characteristics plays a key role in analyses of Dc shunt an series motor.

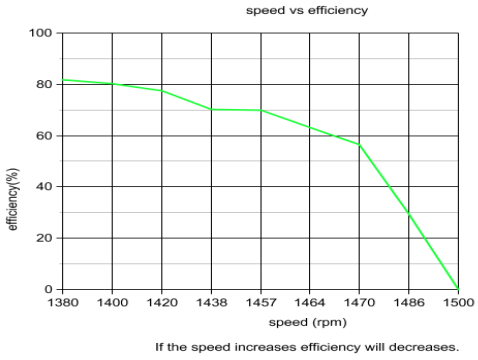
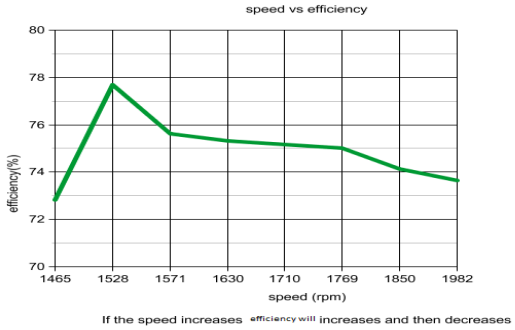


Figure 5



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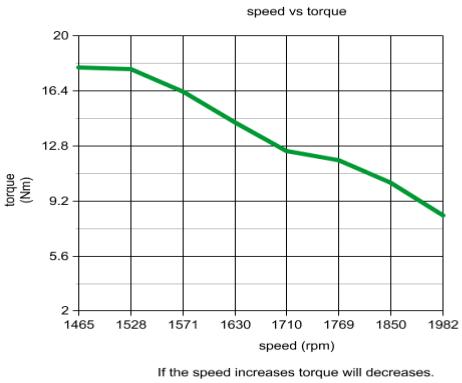

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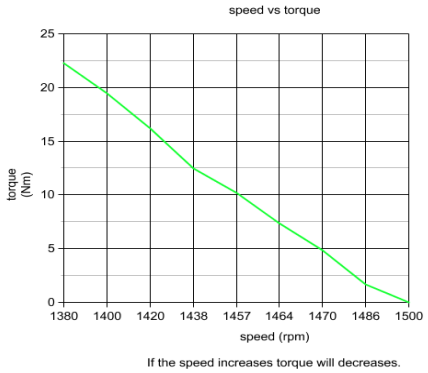

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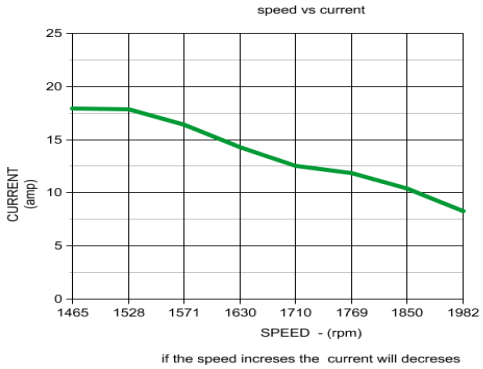

Figure 9

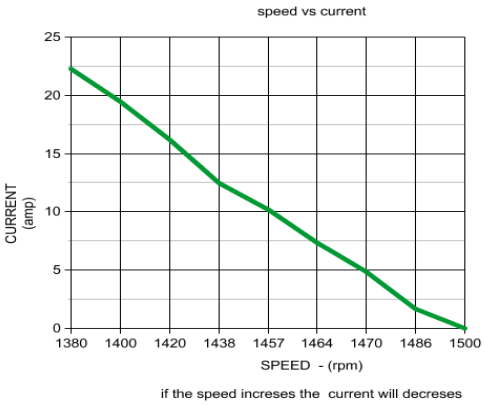

Figure 10

SPEED VS EFFICIENCY (DC SHUNT MOTOR)

If the speed increases the efficiency will decreases. Fig .5 shows that shunt motor is less efficiency at high speed. And also, if you are keep on increases the motor will damaged.

SPEED VS EFFICIENCY (DC SERIES MOTOR)

If the speed increases the efficiency will increases and then decreases. Fig.6 shows that series motor is less efficiency at high speed. But upto maximum speed it will give more efficiency after that It will reduced.

SPEED VS TORQUE

If the speed increases the torque will decreases. Fig .7 shows that shunt motor has torque vs speed characteristics which are also known as mechanical characteristics.

SPEED VS TORQUE

If the speed increases the torque will decreases. Fig.8 shows that series motor has torque vs speed characteristics which are also known as mechanical characteristics.

SPEED VS CURRENT

If the speed increases the current will decreases. Fig.9 shows that shunt motor has current vs speed characteristics. which are also known as electrical characteristics.

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SPEED VS CURRENT

If the speed increases the current will decreases. Fig.10 shows that series motor has current vs speed characteristics. Which are also known as electrical characteristics.

This paper given results efficiency of series motor is more than shunt motor. And shows some mechanical and electrical characteristics.

V. CONCLUSION

The experimental result shows that Dc series and shunt motor model efficiency performance. By using anthoer methods also to determine the Efficiency of dc motors like shunt and series motor. Those methods are 1.Direct method, 2.Indirect method, 3. Regenerative method.

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