Variation in torque of DSWIM by just changing voltage keeping speed constant

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Abstract- **This paper emphasizes on, the effect of varying supply voltages on the performance of three phase dual stator winding induction motor. A prototype motor is fabricated for experimental validation of the proposed machine. The motor consists of two different windings for stator wound for different number of poles (4 and 12 pole). Experimental Analysis is done for the machine with only one stator winding excited (4 pole winding excited alone and then 12 pole excited winding alone). After experimentation, the results are studied and It was observed that by varying the voltage at the two stator winding terminals, we are able to change the torque provided by the motor while keeping the speed same. Also it is possible to change speed at which the motor is operating while keeping the torque same.**

Keywords- Dual stator, Performance analysis, Experimental analysis

I. INTRODUCTION

The two stator winding induction machine is the new innovation in the area of three phase induction motor. Analysis of a new dual stator winding induction machine is described in this paper. The proposed induction machine consists of a conventional standard squirrel-cage rotor but a stator consisting two separate windings of a different number of poles. Both the stator windings are fed from an independent variable-voltage supply. The proposed motor has advantages as no speed sensor is required for operation, more reliable, and flexible such that to adjust the resultant torque-speed curve of the motor becomes almost effortless . In this, motor can be operated at zero speed by separately varying the two stator voltages, thus achieving minimum electrical frequency independent of the mechanical speed. This property is especially important to reduce the adverse impact of the stator resistance impact on motor while running at low speeds and it facilitates the operation of motor without even sensing speed. The motor can be useful for constant volts per hertz or field-oriented (FO) operation. Circulating harmonic currents, common to most dual stator machines, are eliminated by the dissimilar pole number in the ratio of 1:3 of the stator winding.

This paper includes the experimental results of various tests on this machine with simultaneously exciting both the stator windings (4 and 12 pole) as well individually exciting only one stator winding at a time . Three phase supply is fed to the two different stator winding simultaneously from two independent variable frequency power supplies. Thus, two independent torques (T_1 and T_2) are produced by the two different stator currents and thus this gives rise to a net output torque which can be controlled by controlling this two independent torques. The motor behaves like two induction motors mechanically coupled through a shaft. The two stator windings been wound for dissimilar number of poles, circulating harmonic currents are eliminated thus giving a wide band of speed for the machine to operate with very less torques pulsations. The below figure shows the block diagram of 4/12 pole Dual Stator winding Induction Motor.

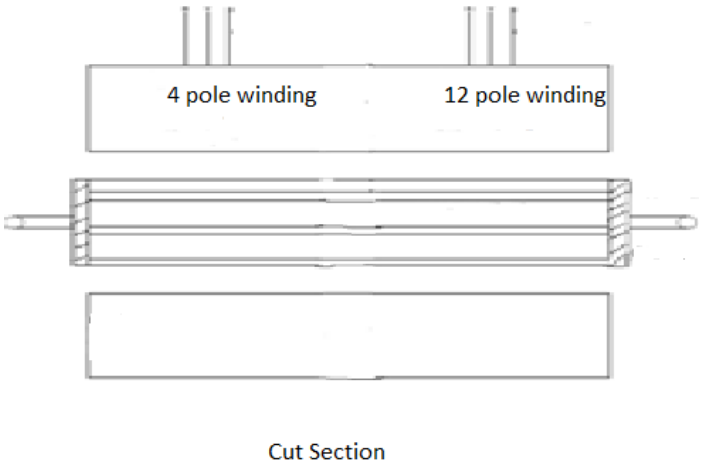


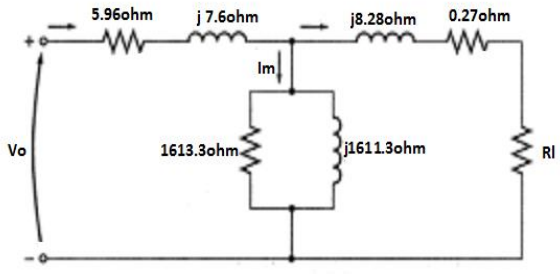
Fig1. Block diagram of dual Stator induction Motor

II. TESTS AND THE OBSERVATIONS.

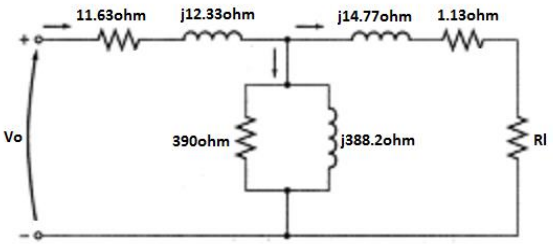
The tests which are performed on the prototype Dual Stator winding induction motor, for determining of its efficiency and other operating characteristics are

- Stator resistance test
- No load test
- Blocked rotor test
- Load test

As the Induction motor is similar to transformer with short circuited secondary, the parameters of the DSWIM can be calculated from the results of No-Load test and the blocked rotor test[2].



EQUIVALENT CIRCUIT DIAGRAM OF 4-POLE IM



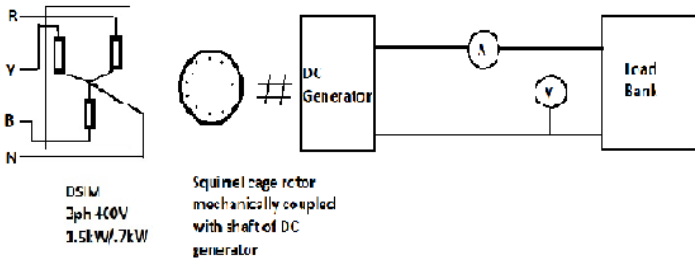
EQUIVALENT CIRCUIT DIAGRAM OF 12 POLE IM

Prototype DSWIM parameters

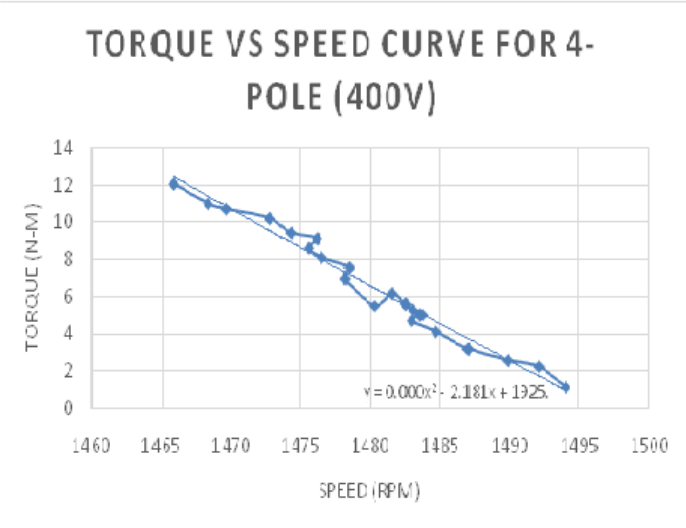
Electrical Characteristics

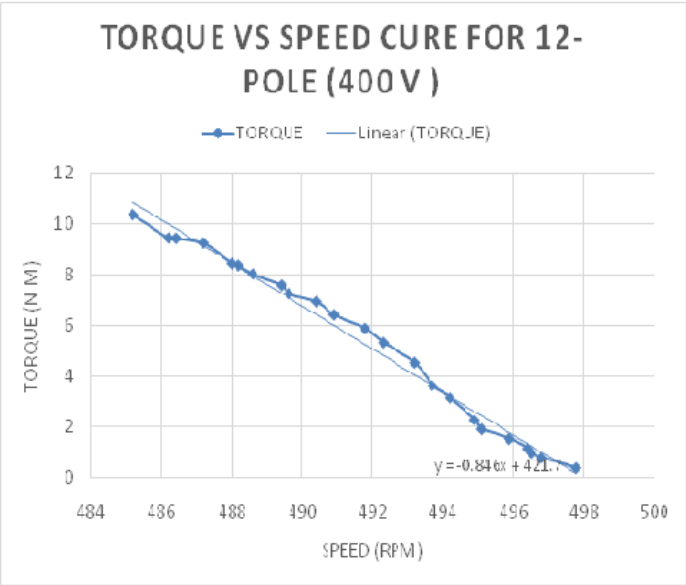
Parameter	4 Pole	12 Pole
Rated Torque	1614 W (10.27Nm)	794.59 W (16.54Nm)
Rated Output	400	400
Rated Full load Current	8.4A	6.38A
Rated RPM	1.6kW	0.7kW

Geometric Characteristics: Stator slots are 36 and the stator's outer and inner diameter is 210mm and 140 mm resp.

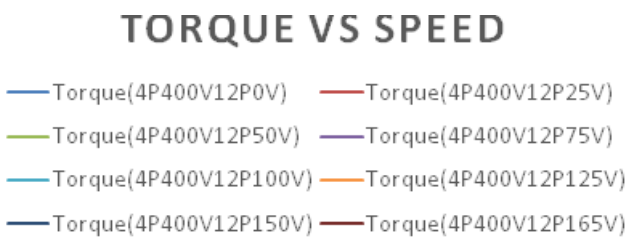


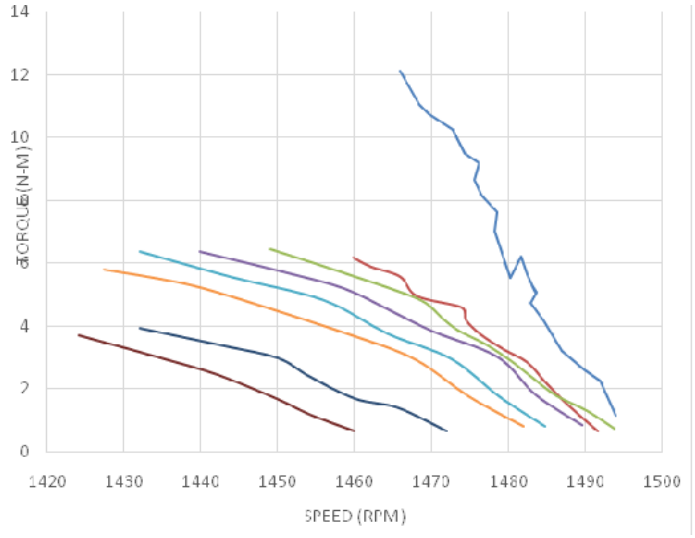
The load test is performed with only one stator winding excited at a time and then both the stator wingings are excited with 400 V supplied to 4 pole winding and the 12 pole winding supply is varied up to 200 V. The torque speed curves of the DSWIM with only one stator winding excited are as follows.





Now when both the stator windings are excited with different voltages to get smoother control over the torques/ speed variation, following are the observations.

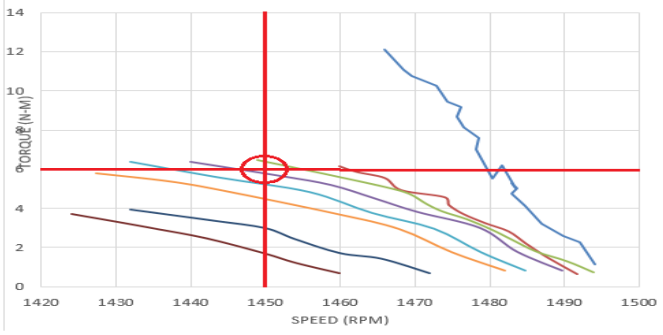




Speed-Torque Characteristics when both the stator windings excited simultaneously. The low pole stator winding is given rated voltage and high pole winding supply voltage is varied from 0V to 165V.

From the load tests (Motor coupled with DC Generator), it can be observed that when individual stator winding is excited, the Speed-Torque Characteristics is the same as a conventional induction motor. When both the stator windings are excited simultaneously, as we go on increasing the voltage of 12pole stator winding, the resultant torque decreases. This happens as the motor then operates in an asynchronous mode. The negative torque produced by 12 pole stator winding indicates that its operating in generating mode Therefore, as the torque produced by 12 pole winding increases, the net torque decreases. Even though, the efficiency decreases in this case (improving when the motor operates in synchronous mode), thus offering a smoother control over the output of the motor. It's also observed that just by changing the supply voltage at the two stator winding terminals, change in the torque can be provided (speed constant). It is proved by the graph showing movement in the vertical direction.

The change can also be done at which the motor is running keeping the torque constant by moving along the horizontal direction. Thus, using a double stator winding induction motor, a single torque speed curve is not compulsory but any point on the graph can be achieved as shown in the following figure .



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