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Variable Frequency Drive Source Based Efficiency Measurement of an Induction Motor

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Abstract: Induction motor loss separation and efficiency measurement needs loading dynamometers and other tools as like variable voltage sinusoidal power supply. These are costly and not always usable except though a loading tool is usable. Variable frequency drives are also commonly utilized for running induction machinery and are readily accessible and low cost. Nevertheless, their usage in lieu of a constant frequency sinusoidal power supply to calculate system performance precisely is interesting, but potentially difficult because of the PWM output voltage. This paper provides few studies into the usage of variable frequency drives. The usage of the machine, the measurement criterion and the protocols shall be reported and addressed. The output presented describes the possibility of the suggested idea of calculating machine effectiveness with a PWM power source.

Keywords: Induction machines, PWM supply, Variable Frequency Drive (VFD).

I. INTRODUCTION

A.C machines obtain electrical control by 'mutual induction.' It is the similar as the secondary conductor of the electrical machine that transmits electrical energy obtains its power from the primary. Hence these generators are referred as asynchronous machines. In fact, the asynchronous machine may be viewed as a revolving electrical machine that transmits electrical energy (where the primary conductor is constant but the secondary conductor revolves). The transmission of energy from the rotary system to the rotating element of the inductive machine happens whole inductively by means of the flux. As a result, the asynchronous machine is known 'rotating electrical machine that transfers electrical energy' with the rotary system making main and the rotating element making (short-circuited) rotating secondary. Since the induction engine is common electrical machinery that transmits electrical energy, the similar idea can be utilized to execute the engine as a fabrication electrical machine that transmits electrical energy. The fabrication electrical machine that transfers electrical energy needs low voltage (50 to 60 volts) and high current (up to 200A) for blending two metal elements utilizing electrical arc fabrication.

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The similar engine can also be utilized as a single stage induction engine. The working conductor of the single stage working shall be kept in the similar slots utilized for the three stage working. And at a time, each of them may be utilized to provide or generate arousal to use a rotating element rotation. When conducting single step working, the capacitor may be utilized to generate preliminary torque after speeding up, beginning conductor can be detached by clear setting. When three stages of supply are provided, the emf is induced in conductor and utilized for single stage working. The start and end of all the coil community is carried out. When linked in a series manner, creates out partial of the input supply and thus step down of the voltage, and when linked in parallel, creates high current that acts as the ideal supply utilized for 'Electric Arc Fabrication. As contrast to the idea discussed above, when the supply is utilized to function a single-stage machine, after the condenser is started, the input supply (400V) is doubled crossways the open-circuit stage of the three-stage conductor junction point. Hence, machine creates step up working. The traditional induction engine comprises of one group of conductors in the rotary system and the DWIM comprises of two groups of conductors in the similar rotary system. A three-stage supply is executed to the rotary system conductors, a rotating magnetic area is created in the air gap and this area is distributed by both conductors. Later, multi-stage machines assisted to address the existing restrictions of semiconductor elements by reducing the current by stage rate as defined in [4]. Multistage machines, consisting of two conductor groups, also provided a good answer for providing both AC and DC power to aircraft and ships: DC power was provided by means of a rectifier linked to one conductor set, while AC power was provided by the other conductor set. The machine needed less filtering and also weighs less than the standard three stage generator-electrical machine that transfers electrical energy-rectifier method (Schiferl and Ong, 1983a). [3]Multistage elements with two three-stage rotary system conductors space-shifted by 30 electrical degrees are examined in numerous studies from the 1970s on. These elements were referred to as dual three-stage, dual rotary system conductor or dual-star conductor elements. Razik (2006) described that the rotary system conductors of the double-conductor asynchronous machine can be set with various shift angles.

II. RELATED WORKS

Nandawadekar Ajit Dattu (2016) An induction or asynchronous machine is an AC electric machine in which the electrical current present in the rotating element create a torque caused by electromagnetic induction from the magnetic field of the rotary system conductor.

The induction machine is utilized in a huge choice of applications as a way of transmission of electrical power to mechanical job. Without a doubt, it is the workhorse of the electrical power industry. , the induction engine is a common rotating electrical machine that transfers electrical energy. The similar idea can be utilized to execute the engine as a fabrication electrical machine that transfers electrical energy. The fabrication electrical machine that transfers electrical energy needs low voltage and high current to be linked to two metal elements by electrical arc fabrication. As a consequence, any change may be rendered in the rotary system conductor of the asynchronous machine, which can enable the asynchronous machine to behave as a fabrication electrical machine that transfers electrical energy. The similar machine may also be utilized for single stage service as well as for three stage supply. The working and preliminary conductor of the single stage working shall be kept in the similar slots utilized for the three stage working. And at a time, each of them may be utilized to provide or generate arousal to use a rotating element rotation. This article presents the building, conductor design method for the rotary system and the outputs of the recreated machine. The similar idea can be utilized to execute the engine as a fabrication electrical machine that transmits electrical energy. The fabrication electrical machine that transmits electrical energy needs low voltage and high current to be linked to two metal elements by electrical arc fabrication. As a consequence, any change may be rendered in the rotary system conductor of the asynchronous machine, which can enable the asynchronous machine to behave as a fabrication electrical machine that transfers electrical energy. The similar machine may also be utilized for single stage service as well as for three stage supply. Charles Baby T, Sabah YS, Krishna Prabhakar lal (2015) Three stage asynchronous machines are hugely utilized in industrial drives due to their robustness, trustable and easiness of building. Precision monitor of the Induction Machine has always been a challenge, preliminary from the modulation method utilized to the closed circle monitor plan. , the whole Asynchronous machine drive is created for pumping applications with modulation strategies such as Sinusoidal Pulse Width Modulation (SPWM) and IFOC Control method. The Asynchronous machine is powered by a cascaded H-Bridge 5 Level MLI and is monitored by the Indirect Field Oriented Control (IFOC) method, Multi-carrier PWM methodology. The alternating step opposition configuration (APOD) is utilized to monitor the flipping of multi-level inverters. The mathematical framework of the Pump Load is created and the functionality of the Pump Load Asynchronous machine Drive is verified by simulation. The Centrifugal Pump Affinity Law is validated utilizing the simulation outputs received.

III. METHODOLOGY

Default squirrel cage asynchronous machine, rated at 5HP, was utilized to test the current drive design. The design of an asymmetric induction engine was based on the reference to a traditional three-stage machine. The new conductor sharing has the similar frame size as the basic three-stage machine. The new conductor sharing has the similar frame size as the basic three-stage machine. In the reconstruction of the engine, first, the real design of the engine and its parameters, as presented in TABLE I, are examined. The newly created conductor is separated into three elements on the basis of the quantity of twists. Among conductors, the first conductor is constructed of the similar gage wire and half of the initial quantity of twists. As a result, this is a conductor of a 3-ph induction engine and as the quantity of twists is half the engine is half the capacity, i.e. 2.5 HP. The second and third conductors are utilized for fabrication and serve as a fabrication electrical machine that transfers electrical energy tap. Fabrication needs a high current rating; triple layer conductor is utilized to enhance the current value. The similar machine is utilized for 1-ph asynchronous machine. Therefore, these conductors are also utilized as preliminary and running conductors of the 1-ph asynchronous machine. In the real engine, a triple-layer conductor exists with 60 conductors per slot. The conductor area of the typical induction engine was 0.6567 mm2 of gage 20. It is necessary to separate this area by half so that for a new design the area is 0.341 mm2 with a gage of 22.5.

Table 1. Terms of typical motor

S.No	Specification	Values
1	Power	5HP
2	Frequency	50Hz
3	Speed	1440RPM
4	Voltage	400V
5	Connection	Star
6	Insulation Class	B
7	Phase	3 Ph
8	Pitch	1-6,1-8,1-10
9	Number of poles	4
10	Slots	36

A. Three Stage Conductor Design

For recreated machine, triple layer conductor will be present with the subsequent terms:

Triple coil=30*3=90 twists*4 set (poles) =360 twists

Total twists for three stage=360

Coil pitch = 1 to 8

Twists/coil = 30*3 = 90turns

Whole Loops = 4*3 = 12coils

Fig.2 and Fig.3 displays the association of poles and conductor diagram for three stage machine.

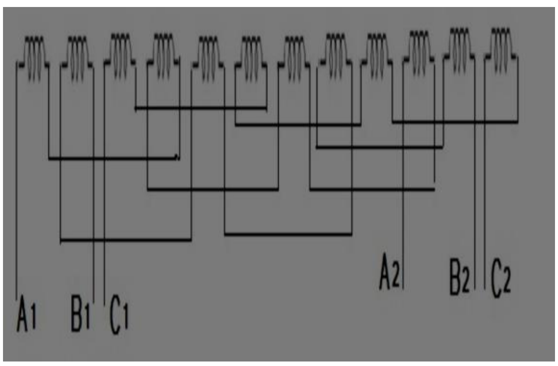

Fig. 2. Association of poles for three stage machine

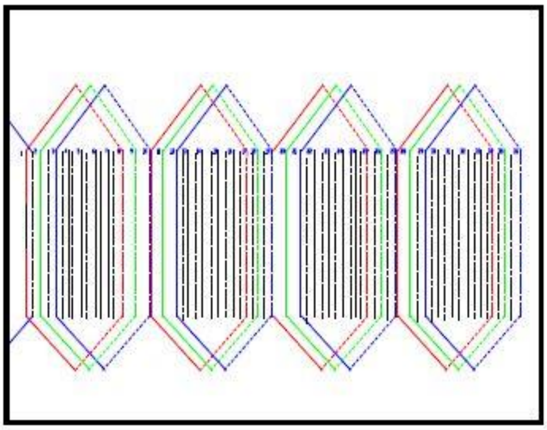

Fig. 3 Conductor diagram for three stage.

B. Single Stage Conductor Design

When supply is set to single stage asynchronous machine, its rotary system conductor creates alternating flux. Alternating flux operating on a constant squirrel cage rotating element cannot generate movement, meaning even a single stage asynchronous machine is not a self-start. The single stage induction engine is based on the idea of double field spinning theory. The single stage conductor shall be created with the following specifications:
360 twists/1.73= 208 twists
Total twists for single stage =208
208/4 (poles) =52 twists/pole
Coils/pole =3
Twists/coil =17
Table 2 show the single stage conductor specifications.

Table 2. Conductor specifications for single stage

Winding	Pitch	Coils
Starting winding	5-Jan	17 turns, double coils
	7-Jan	18 turns, double coils
	9-Jan	17 turns, double coils
Running winding	8-Jan	34 turns 22.5 gauge
	10-Jan	17 turns 22.5 gauge

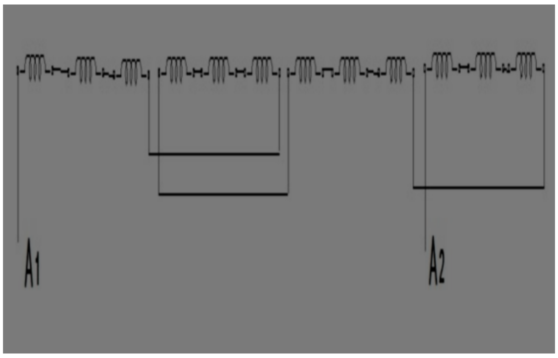

Fig. 4. Association of poles for single stage machine.

IV. RESULTS AND DISCUSSION

A. Actual load test

The output of the stage converter is weighed down by the load bank to test the machine's efficiency. This is the purpose of the three stage resistive load bank present in the lab.

B. Stage displacement test

For three stages of supply, all the stage is moved by 120 degrees. The stage displacement of the machine is controlled by CRO by means of the signal generator.
The suggested DWIM has similar rotary system conductors. To achieve outputs as a traditional induction engine, one of the conductors is attached to a three-stage or one-stage supply and the other is available. Table 3 set out the specifications for the newly created single and three stage engines.

Table 3. Specifications for single stage motor

S.No	Specification	Values
1	Power	2.5HP
2	Frequency	50Hz
3	Speed	1440RPM
4	Voltage	220V
5	Connection	-
6	Insulation Class	B
7	Current	6.5A
8	Phase	1 Ph

The engine is capable of creating two jobs (Engineering & Fabrication) at a time and has less weight than the separate combination of the fabrication electrical machine that transfers electrical energy and the asynchronous machine, thus reducing the cost of two different machines. As the rotary system conductor is being recreated, due to a separate combination of single and three stage conductors, high stress is being exerted on conductors, the real engine power ratings are reduced. Also at the time of the fabrication work, there is an increase in the load on any one stage.

V. CONCLUSION

Induction motors will be an acceptable option for continuously operating rewound engines and induction engines. In addition to performance and power factor Enhancement, energy saving may be accomplished by supplying additional load in the second collection of conductors. Thus, DWIM offers an incentive for energy saving and enhancement of efficiency. The created machine is verified on a 3 stage 415V, 50Hz and single stage 230v, 50Hz electrical loading supply. Laboratory machines and it functions well on the single stage and the three stage supply. These categories of rewound machines may be utilized as three-stage, single-stage machines, stage converters and fabrication electrical machine that transfers electrical energies.

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