INDUCTION MOTORS AND SPEED CONTROL OF THEM

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Abstract - Today, the use of induction motors is very popular due to the simplicity in maintenance and service. As can be seen in picture, this form of the engine is used in the textile industry very well. These motors have good insulation class which is an excuse to use them. This article descriptively seeks to answer the research questions of induction motors' details and also maneuvers on the speed control of them. We can conclude by explained these points, readers can have a clear point of view to induction motors and speed control of them. By this knowledge, industrials can better use these induction motors.

Keywords - Descriptive article, induction motors, speed control, industrials

I. INTRODUCTION

With the development of alternating current networks and the use of three-phase electric as a power industry, today a main part of theelectric motors isthe three-phase alternating current type. Basically alternating current engines in comparisonto direct current motors have easier building, more useful life and easier maintenance which lead to the economic priority ofthis engine to DC motors. Dc motors regarding extensive facilities of rotation control and high rotation launch have their own utilizations [9].
Three-phase electric cars are classified into two main groups (synchronous machines and induction machines) which have many differences in terms of workmanship building and the use. But both main work is creating rotating magnetic field.

II. THE WORK OF THREE-PHASE INDUCTION MOTORS

According to Figure 1 [2] build a common core set with a horseshoe magnet and an aluminum piece:

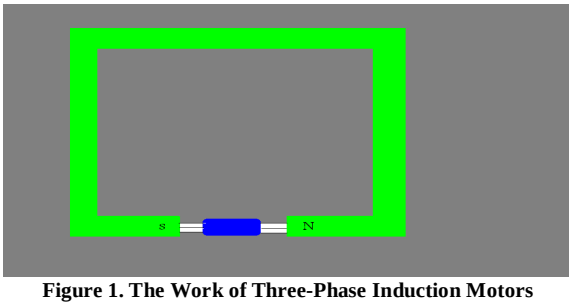


Figure 1. The Work of Three-Phase Induction Motors

If the magnet revolves around acommon corequickly enough, then the aluminum piece will begin to rotate in the direction of the magnet. Because the lines of the magnetic field are induced by the aluminum piece. This process in turn creates a magnetic field. By the impact of its interaction with the magnet torque [3], the aluminum piece will begin to move. The speed of aluminum is piece necessarily less than the speed [8] of the magnet movement so it is possible to cut lines by that.

III. ROTATING FIELD PRODUCTION

If a permanent magnet rotates around its axis, a rotating field will be created, in synchronous machine, a rotary field is created in this way. But there is another way: (to connect three windings with a local phase difference of 120 degrees to a three-phase network with a temporal phase difference of 120 degrees.)

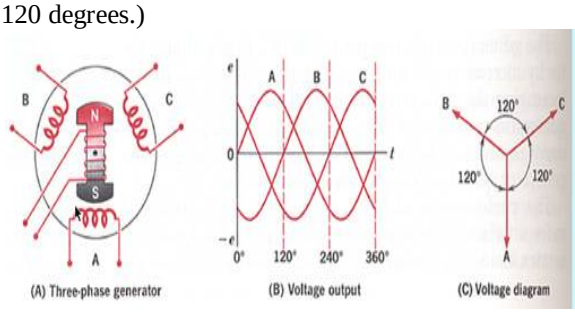


Figure 2. The Rotating Field

IV. SLIP OF INDUCTION MOTOR

The movement speed [8] of rotor in induction machines is different with that of rotating field, and this difference induces current in the rotor circuit.The amount of this difference is called slip speed.

$$\Delta_n = n_s - n_r$$

Usually instead of sliding speed, its ratio to the square Seriate is considered and it is called slip. If this ratio is multiplied by 100, it will be expressed as a percentage. The amount of slip is shown as S that such a comparison will have no units.

V. RANGE OF SLIPPING CHANGES

When commissioning an induction motor is around the zero and gradually after a predetermined time reaches around the point which is usually slightly less than the speed of the rotating field. So launching slip is a unit (100% or 1). With the increase in the slip, it is reduced to the extent that if there is no mechanical load on the axle (complete no-load), the speed of the rotor [5] relatively reachesthat of rotating field. It means at full no-load status; the slip is zero. Of

course, there is no perfect no-load status for a real engine. Because there is friction of axes and air resistance and so on creates a minimum load for motor.

VI. INDUCTION MOTOR WITH SHORT CIRCUIT ROTOR (CAGE ROTOR)

Precondition of torque [3] on the induction machine is thatrotor circuit should be closedto flow induced current in it. In cage rotor motors for closing the flow path, the short-circuit wire is used.

VII. MECHANISM/ WORKMANSHIP

Cage rotor engines at the start act as a transformer. This means that the rotating field of the stator windings cause the variable eruption in the rotor. Inthe startup time when the rotor did not move yet, speed oferuption changes is equal to the changes in frequency changes. So induction voltage in the rotor conductors occurs due to the closing of the conductway, the induced current is flown in them.

Current flows in the rotor, in turn, creates a magnetic field that opposes the stator field according to Lenz's law. The opposition reveals in a way that rotor moves in the direction of field motion in order to be terminated by lower mount of the field lines and this is the base of torque in induction motor. This torque rotates the rotor in rotating field of the stator.

VIII. INDUCTION MOTOR BEHAVIOR UNDER LOAD

At the time of the launch, the slip is equal to a unit and values of voltage and inductionreactance of current, and the rotor have their maximum amount, on the one hand,ohmic resistance of the rotor's contraptions is usually small. So the induction motor's setup current is relatively large, and due to induction property,and smallness oftorque's ohmic resistance, the starting proportional to the flow rate will not increase. (Even with the existence of the high starting torque current, the starting is not to the extent of rated torque [3].) At the beginning of the startup, the speed is still zero and gradually increases. By increasing the speed of the starting point ofmachine on the property (torque _ rev) began to move towards the critical point and reduced by crossing them with increased speed of torque. As far as the produced torque of engine is balancedwith mechanical torque. In other words,it determines the three quantities of speed, torque and produced engine power.

IX. METHODS OF LAUNCHING INDUCTION MOTORS

In launching stator, we use the starter's resistance in in the direction of stator. In this method, in order to reduce the stator voltage during start-up, the ohmic resistance is used in the stator winding path.

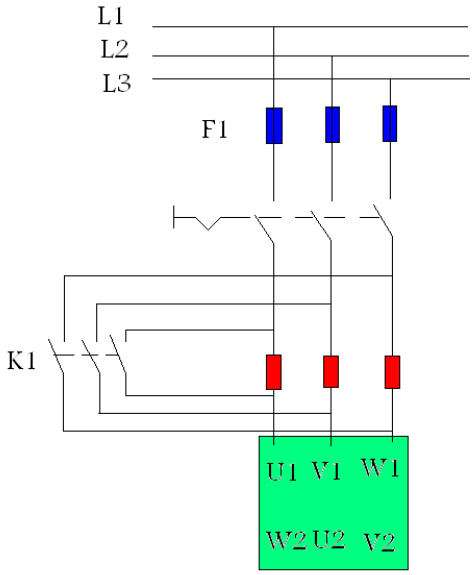


Figure 3. Launching Stator

X. THE USE OF SETUP TRANSFORMERS

Using a transformer with a variable's conversion ratio as shown in the below picture, stator voltage at the launch time can be gradually increased.

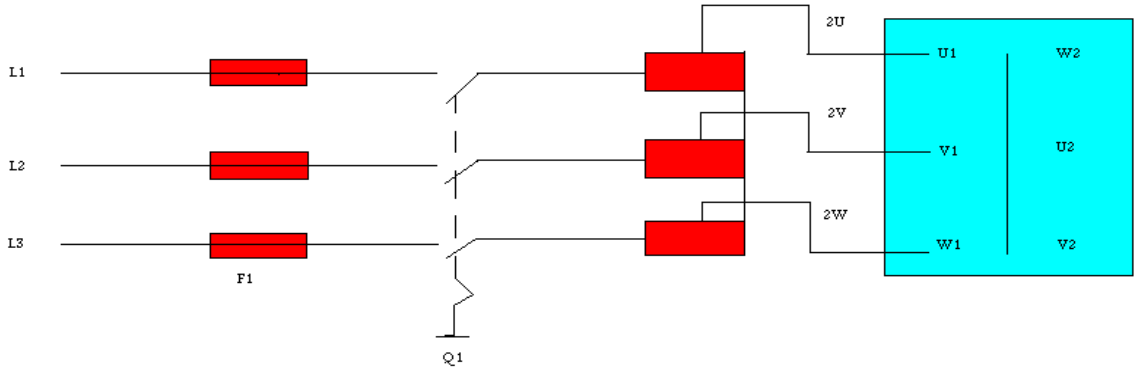


Figure 4. Setup Transformers

XI. LAUNCHING STAR TRIANGLE

For induction motors which Phase voltage is equal to the voltage network and is able to work with a delta connection, this method can be used.

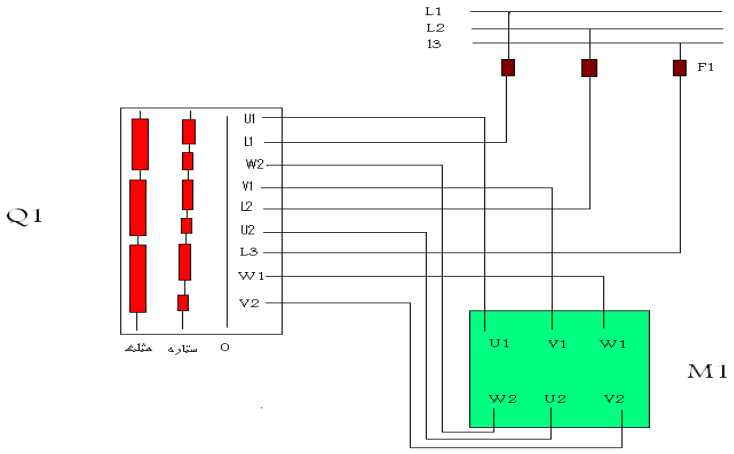


Figure 5. Launching Star Triangle

XII. INDUCTION MOTORS OF WINDING ROTOR (RING ROTOR)

This motor in comparison tocage rotor induction motors has more power and starting torque. The engine is more prevalent in areas that the characteristics of the engine is needed.

XIII. BUILDING OF WINDING ROTOR OF ROTOR ENGINES

Rotor of induction motors with winding rotor are quite different from cage rotors. Instead of aluminum solenoids, it has three-phase wiring like stator. Through three rings and coal, it is connected to motor junction box. On the rotor axis, magnetic core and rings are installed and rings are insulated with respect to the axis and against each other.In the grooves which are predicted on the rotor magnetic core, rotor windings are placed. Three-phase winding of rotor usually has star connection and its output's triceps are connected to three slippery rings.Slippery ring is connected to the out of machine through three brushes.

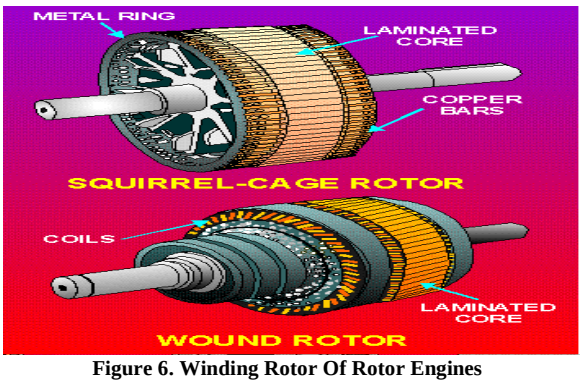


Figure 6. Winding Rotor Of Rotor Engines

XIV. SPEED CONTROL WAYS OF INDUCTION MOTORS

1. Speed control through voltage control

It must be understood that the torque of an induction motor is proportional to the square of the voltage and voltage changes will change torque – rev characteristic.By changing the voltage of an induction motor, the speed can be adjusted somewhat. Also increasing the voltage is not authorized, the voltage reduction alone changes eruption and the rotating field which adversely affect the working engine.

2. Speed control via frequency control

$$n_s = \frac{60f}{p}$$

According to the mentioned relationship, the speed of rotating field and frequency have proportional relationship.It means by the help of a power supply with variable frequency, steadily different revs can be gained.

3. Speed control by controlling the pair of poles

According to the previous formula, the field speed with the number of poles of the stator is inversely proportional.If in the stator two or more wiring used with different poles instead of one wiring, a new roundcan be gained from each of them.

4. The speed control by controlling the voltage and frequency at the same time:

If you change the voltage at the same time by changing the frequency, the amplitude of rotating

field will not change. In this situation the operating modes for induction engines will be acceptable.

$$\Phi \propto \frac{V}{f}$$

CONCLUSION

After reading this paper you will be familiar with not only different types ofspeed control [6] ways in induction motors as a response to research question but also the work of three-phase induction motors, the use of induction motors, building of winding rotor of rotor engines, launching star triangle, induction motors of winding rotor (ring rotor), the use of setup transformers, methods of launching induction motors, induction motor behavior under load, range of slipping changes, slip of induction motor, induction motor with short circuit rotor (cage rotor), and their mechanism/ workmanship. All of these are explained to have a clear point of view to induction motors and speed control of them. By this knowledge, industrials can better use these induction motors. Other researchers can work on their use in detail. Also they can extensively work on any of the explained parts.

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