PERFORMANCE OF SIX PHASE INDUCTION MOTOR USING SPECIAL TRANSFORMER CONNECTION

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Abstract

For machine drive applications, multiphase induction motor could potentially meet the demand for high power electric drive systems which are both rugged and energy efficient. High phase number drives possess several advantages over conventional three phase drives such as high torque, higher reliability,higher efficiency and increased power. Multiphase induction motors have found many applications such as electric/hybrid vehicles, aerospace applications, ship propulsion etc.

Keywords-six phase transformer design, Circle Diagram, Torque and efficiency comparison.

I. INTRODUCTION

Six phase induction motor works on six phase supply.So we have to make six phase supply. For that purpose we convert three phase supply into

six phase supply by using Transformer. For use of six phase induction motor it is necessary to develop a six phase supply by using special connection of Transformer. For Transformation of three to six phase connection we have to make this type of Transformer with special guide. The Transformer output has six phases and every phase has 60 degree phase angle.

II. CONNECTION OF INDUCTION MOTOR

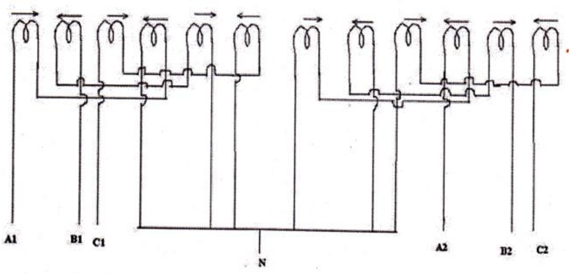

Fig.Connection diagram of six phase I.M.

A poly phase induction motor consists essentially of two major parts, the stator and the rotor. The construction of each one is basically a laminated core provided with slots which house windings. When one of the windings is exited with AC voltage, a rotating field is set up. This field produces an emf (Electromotive Force) in the other winding by transformer action which in turn circulates current in the later if it is short circuited. The currents flowing in the second winding interact with the field produced by the first winding thereby producing a torque which is responsible for the rotation of the rotor. As shown in fig. 12 coils are used in the connection of motor winding. End point of first coil is connected to End of forth coil. Start point of first coil for input A1. Start point of second coil is connected to the start of fifth coil and end point of second coil for input B1. End point of third coil is connected to end of sixth coil. Start point of third coil for input C1. Start point of 3^{rd},5^{th},7^{th},9^{th} and end point of 4^{th},6^{th},8^{th} coils are connected to the common Neutral. End point of 10^{th} coil is connected to End of 7^{th} coil. Start point of 10^{th} coil for input A2.Start point of 11^{th} coil is connected to the start of 8^{th} coiland end point of 11^{th} coil for input B2.End point of 12^{th} coil is connected to End of 9^{th} coil. Start point of 12^{th} coil for input C2..

Fig.6 Phase Induction Motor

III. CONNECTION OF SIX PHASE TRANSFORMER

As shown in fig. the Transformer contain total six coil. Each coil has three terminals start,tap and end. Bottom coil of each limb tapping are get connected to neutral. The top coil of each limb is start point for input supply. Top coil of each limb tap and start of each limb of bottomcoil are output of Transformer and those are six phase input supply of six phase inductionmot

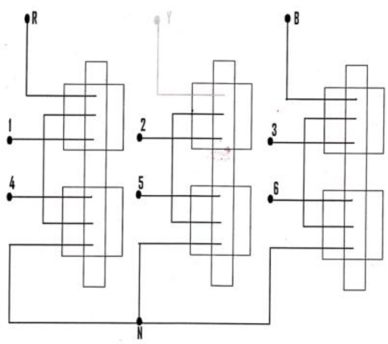

Fig.Connection diagram of six phase Transformer

IV. DESIGN SPECIFICATIONS FOR TRANSFORMER CORE

Q =output=5 Kva

K =constant= 0.4500

Et =voltage per turn=1.006v

Bm =maximum flux density=1.2000 wb/m^2

Ai =Net iron area= 0.0038 m^2

d =diameter of circumscribed circle = 0.0916

Agi =gross iron area=0.0042

kv =kilo volt=1.1100

Kw =window space factor=0.2893

del =current density=1.5000

Aw =area of window= 15.2678

Wc =width of core= 0.0648

D =Distance between two adjacent cores= 0.1620

Ww =Width of window= 0.0704

Fig.Transformer

V. Performance Calculations

For 3 Phase Induction Motor:

$V_0 = 411$ V

$I_0 = 1.62$ A

$W_0 = 80$ W

Vc = 130 V

$I_s = 4.5$ A

$W_s = 840$ W

$\Phi o = 86.02^0$

$\Phi_s = 34.04^0$

Power scale is 1 cm =1397.984 Watt

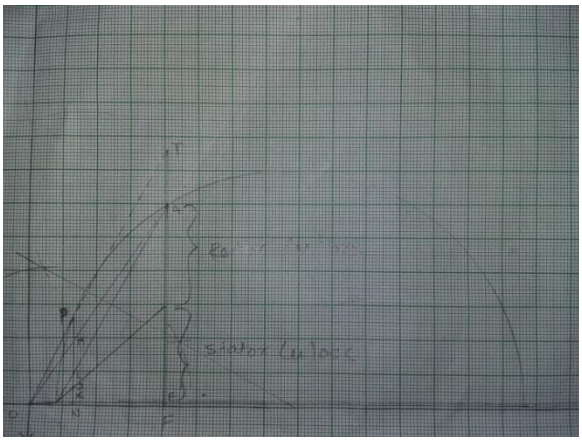

Fig.Circle Diagram of 3 Phase I.M.

Full Load line current OP = 2.9 cm

As per current scale, 1 cm = 2 Amp

Hence full load current = 5.8 Amp

Full load CosΦ = PN / OP = 2.6 / 2.9 = 0.89 lag

Full load torque = Rotor input = PJ = 1.55 cm

As per power scale 1 cm = 1397.984 W

Hence,

full load torque = 1.55 x 1397.984 = 2166.87 Synchronous watts

Full Load Efficiency = PL / PN = 1.55 / 2.6 = 59.61 %

For 6 Phase Induction Motor:

$V_0 = 207$ V

$I_0 = 0.6$ A

$W_0 = 120$ W

Vc = 107 V

Ic = 4.5 A

Wc = 640 W

$\Phi o = 73.80^0$

$\Phi_s = 67.43^0$

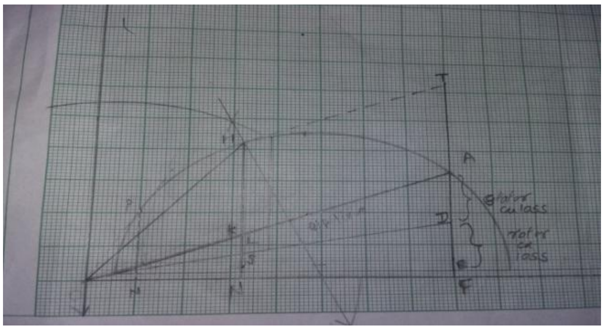

Fig. Circle Diagram of 6 Phase I.M.

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Full Load line current OP = 5.35 cm

As per current scale, 1 cm = 1 Amp

Hence full load current = 5.35 Amp

Full load CosΦ = NH/OH =4.2/5.35 = 0.78 lag

Full load torque = Rotor input = HS = 3.5cm

As per power scale 1 cm = 720.53 W

Hence , full load torque = 720.53*3.5 = 2521.85 Synchronous watts

Full Load Efficiency = HL/HN = 2.9/4.2 = 69.04 % .

VI. CONCLUSION

The full load torque of 3 HP, 4 pole, 400 volts, 3 phase induction motor is 2166.87 Synchronous Watts and full load torque of 3 HP, 4 pole, 207 volts, 6 phase induction motor is 2521.85 Synchronous Watts.

Thus, Full Load torque of 6 phase IM / Full Load torque of 3 phase IM = 2521.85/2166.87 = 1.16. Also efficiency of 6 phase IM = 69.04% While efficiency of 3 phase IM = 59.61% .From the circle diagram and calculations it is clear that the torque of six phase induction motor is more and found to be approximately 1.16 times more than equivalent three phase motor. Also Efficiency of six phase induction motor is 1.15 times more than that of equivalent three phase induction motor. The torque of six phase induction motor is much higher than equivalent three phase induction motor. Though the initial cost of six phase induction motor is increased as compared to three phase induction motor but at the same time efficiency and torque are significantly improved.

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