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ASPECTS OF THE HEATING OF ASYNCHRONOUS MOTORS FOR DIFFERENT OPERATING PROCEDURES

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ABSTRACT:This paper aims the heating of induction motors under overload, system stimulated by a mechanical progressive brake rotor of an induction motor with a power of 0.37 kW.The progressive braking system is working in the same time with a circuit that monitorize the current drawn

АСПЕКТИ ПРИ НАГРЯВАНЕ НА АСИНХРОННИТЕ ДВИГАТЕЛИ ПРИ РАБОТА В РАЗЛИЧНИ РЕЖИМИ

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РЕЗЮМЕ: Статията има за цел да опише нагряването на индукционните двигатели при претоварване, като е използвана система с индукционен двигател с мощност 0,37 Kw. Използвана е модерна спирачна система, снабдена с мониторингова мрежа за следене на тока.

1.INTRODUCTION

Induction machines belong to c.a electric cars group. Like all electric cars, they are reversible and can operate both as a motor and as generator. In practice, induction machines are some of the most-watched resin electrical machinery,which are operating in the engine regime. The operating principle of induction machines is based on the use of rotating magnetic field. Circular rotating magnetic field is that field at which magnetic flux phasors is constant in size but it rotates with constant angular speed Ω1 respectively with a synchronism n1 (a steady size)._Rotating magnetic field can be obtained from two identical and mutually perpendicular windings by passing current, forming a symmetrical biphasic:

$$i_1 = I_m \sin \omega t; \quad i_2 = I_m \cos \omega t \qquad (1)$$

To obtain the current system (of phase angle 90 °) is required in a winding circuit to be included an element of active resistance and the other winding stream - element with reactance (capacitive or inductive). The two windings are powered from the same variable and alternative voltage source. In Fig. 1 is a schematic diagram for obtaining the rotating magnetic field with two windings 1-1 and 2-2 alternately assigned and mutually orthogonal ,in which the reactive element in circuit winding 2-2 is a capacitor with capacity C

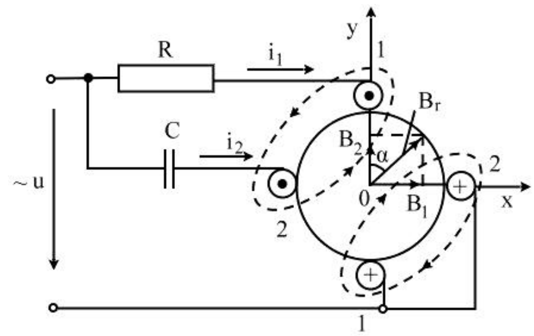


Fig.1. Diagram for obtaining the rotating magnetic field with two windings 1-1 and 2-2 alternately assigned and mutually orthogonal ,in which the reactive element in circuit winding 2-2 is a capacitor with capacity C

The paper aims to monitorize the heating process of an asynchronous electrical motor with the rotor in cage for a normal operating and for an overload operating .Knowing that experimental determination of electric machines heating is a major requirement in determining the operation time of winding insulation,the heating process monitoring with thermovision camera is a novelty regarding the study of electric machines.

Starting from the fact, that the heat transmission, from the bodies in which occurs at the environment, occurs once with the increasing of body warming to the environment ,it is very important to monotorizeze the heating process in all active parts of electrical engines. .The active parts of the induction motors with rotor in subcircuit are the windings and their ferromagnetic core.

From the winding conductors, respectively the ferromagnetic core laminations, heat is transmitted to the coils surface, respectively to the ferromagnetic core surface because of the heat conduction phenomena.

Inside the winding, the heat transfer between the middle coil and his front parts occurs by thermal conduction.

Within the paper has been made the monitoring of the operation of an asynchronous electric motor with the rotor in cage (Figure 1) in a time of 86 minutes for three different cases:
- No load;
-Rated load;
-Overload.;

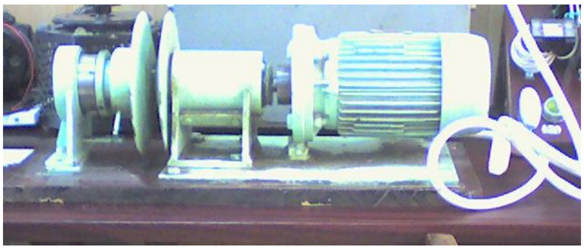


Fig.2 Asynchronous electric motor with the rotor in cage

It must be mentioned the fact that that results obtained from monitorization have target the temperature variation on the three cases to highlight the influence of overloads that occur in technological flows over the life of insulation and implicitly of electric motors,the overload being achieved through a system mounted engine.

The asynchronous electric motor with the rotor in cage prezented în figure 1 has the following characteristics:
-rated voltage Un=220 /380
-conection Δ
-rated current In=10,19/2,05
-power P= 0,37 kW

2.MONITORING OF THE ENGINE HEATING PROCESS

This paper aims the heating of induction motors under overload, system stimulated by a mechanical progressive brake rotor of an induction motor with a power of 0.37 KV.The progressive braking system is working in the same time with a circuit that monitorize the current drawn.

As a novelty in the monitoring schemes of induction motor overload, in the paper is used a thermovision camera that is termographing in time the heating of electric motor windings.

To operate the electric motor load behavior is shown in thermograms in Figure 3.

For operation at full load electric motor behavior is shown in thermograms in Figure 4.

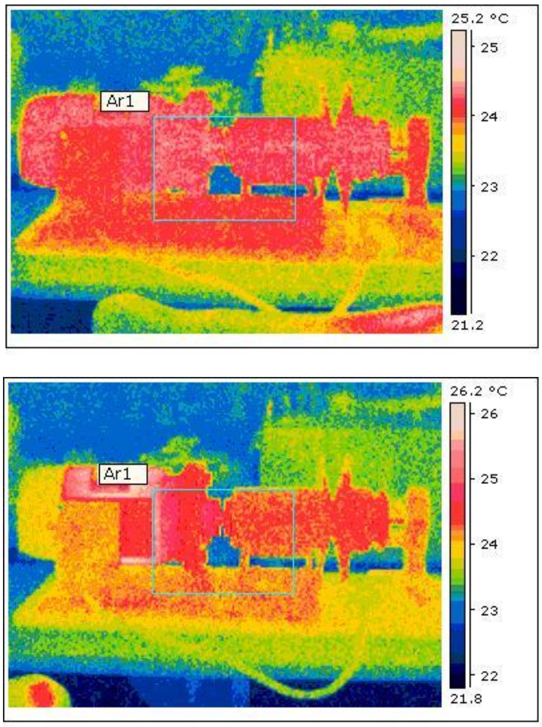


Fig. 3. Thermograms on operation load

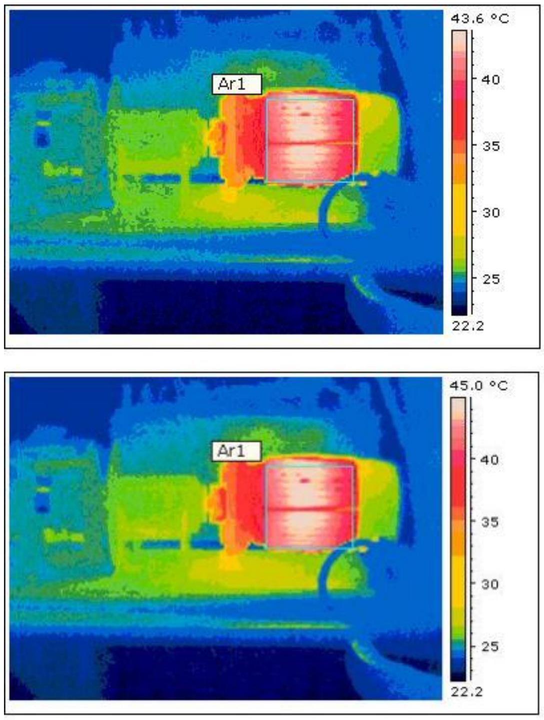
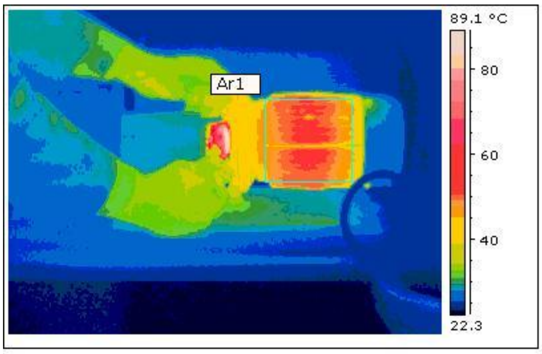


Fig.4.Termoghrams engine at rated load

For operation at overload electric motor behavior is shown in thermograms in Figure 5.



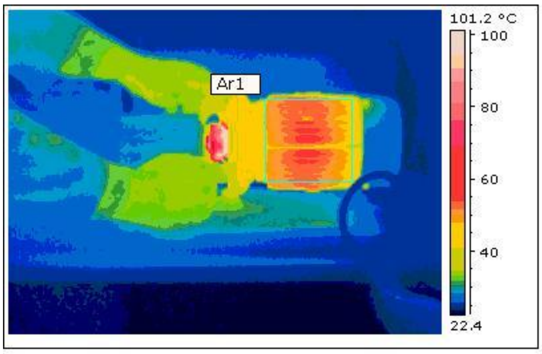


Fig.5 Thermograms engine system overload

For a steady state, the heat transimissed by conduction in time unit through the motor housing thickness Δ (assuming that no losses) and conductivity λ, is determined by the relation:

$$\theta = \lambda (\theta 2-\theta 1)/\Delta \quad (1)$$

where θ2-the temperature inside the engine
θ1-the ambient temperature

Conductivity has a major influence on the heat, after it is developing in two directions::

a) longitudinal direction of the board depending on silica content of silica
- at sheet-normal (with Si 0,4-0,8%) λ=48…41W/ºCm
-Low alloy-in sheets (with Si = 0.6 to 1.2%)
λ = 44 .. 35 W / ° Cm

-Medium-to sheet steels (with and 1.8 to 2.3%)
λ = 30 .. 26 W / ° C
-over aloy-in sheets (with and 3.6 to 4.2%)
λ = 20 .. 19 W / ° Cm

b) in the transverse direction of the silica board depending on the filling factor and on the lamination pressure resulting from core fighting .. small values are characteristic of sheets of 0.35 mm thickness and higher values being characteristic of 0.5 mm thickness sheets.

Monitoring of induction motor operation was performed for an ambient temperature of 21 ⁰ C.

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According to information taken from termograme heating was done the following graph of temperature evolution during the observation, for 80 minutes (at 5:00 p.m. was considered time zero and the maximum temperature of termograme area, which is right outside surface of the stator) :

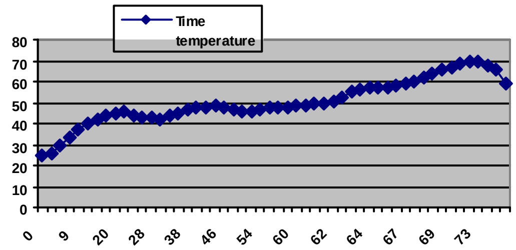

Fig.6. Graph of temperature variation on engine operating regimes

When load occurs, it is noted that the maximum temperature of termogrham is the torque load which is driven, due to increased friction due to the opposition movement of the rotor shaft.

3.Conclusions

In designing electric cars you have to calculate averages and maximum for the continous operating.Beside other technical design issues, a full solution of the heating phenomenon is not finished by determinating the heat from calculations.Because of the great influence that technological process has on the transmission coefficients heat, the experimental determination represents an necessary experimental evidence

This paper brings as novelty the monitorizing of the heating process of an induction motor squirrel cage for a normal operation and for an overload system .Knowing that the experimental determination of heating electric cars is a major requirement in determining the winding insulation life, the monitoring of the heating process with a thermovision camera ,is a novelty for regarding the study of electric machines.

4.References

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