

DIAGNOSTIC OF ASYNCHRONOUS MOTORS BY USE LEAKAGE MAGNETIC FIELD

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Abstract: Detection of mechanical and electrical faults by use the leakage magnetic field as quantity able to give evidence about state of electrical machine. Solution of problems connected with measurements on electrical machines at difficult operation conditions.

Keywords: Diagnostic method, magnetic field, asynchronous motor faults

1 INTRODUCTION

For diagnostic all production arrangement it is important to detect the state of its function properties and so its reliability or supposed life without operating interruption, dismantling etc. From that reason we use by our measurements such quantities, those have ability to evidence about state of electric machines, but generated by the machine during its standard operating.

2 DIAGNOSTIC TECHNIQUES

One of the techniques used for asynchronous motors state detection is measurement of stator current and resulting frequency analysis (for mechanical and rotor winding faults detection), eventually measuring and filtering of stator current during start up of the motor for detection of starting cages faults of the double cages motors.

Though we master these methods very well and preparation of this measurement and its evaluation does not greater problems in common operational conditions, there are cases when current measuring is very difficult.

The conversion of electrical energy to mechanical energy passes through magnetic field energy. So in main and leakage magnetic field namely as in air gap of the machine as round of the machine all electrical and mechanical asymmetries are shown. From that reason we developed and innovated diagnostic method, by that as quantity able of evidence about state of functional properties of asynchronous motors the leakage magnetic field round of the machine is used.

This measurement is very simple because it suffices to apply on one place on the motor surface a probe scanning the leakage magnetic field round the motor without danger of touch with lived parts. A motor with any asymmetry of electrical or mechanical circuit develops the asymmetric field. This field we can extend to symmetric sequence, back and zero field. Back component of the field induces in stator winding the current with frequency

$$f_3 = f_1(1-2s) \quad (1)$$

f_1 network frequency

s motor slip

This component is superimposed on stator current I_1 with frequency f_1 . The greater asymmetry is the above mentioned component is more expressed at frequency spectrum of stator current. We can locate them by two methods:

- harmonic analysis of stator current by constant load, when the current component (I_3) with this frequency will create side bands along the basic frequency f_1
- record of starting current of the motor and synchronous record of filtered component of this current e.g. about frequency 10 Hz.

In Fig. 1 the analysis of stator current of a motor by rated load by fault of one and eight rotor bars is shown. Side bands distant from $f_1=50$ Hz about frequency f_3 according to equation (1). Size of side bands is proportional to number of faulty bars.

In Fig. 2 the record of stator current by starting of the motor is shown. Glimmers round 15 Hz are symptom of faults of rotor winding.

In ambient of underground mine an asynchronous motor was diagnosed. The course of filtered stator current and magnetic field are shown in Fig. 3. After dismounting of the motor broken bars of starting cage were detected. Starting time of the same motor after repair shows the course of magnetic field by starting time of the same motor after repair in Fig. 4.

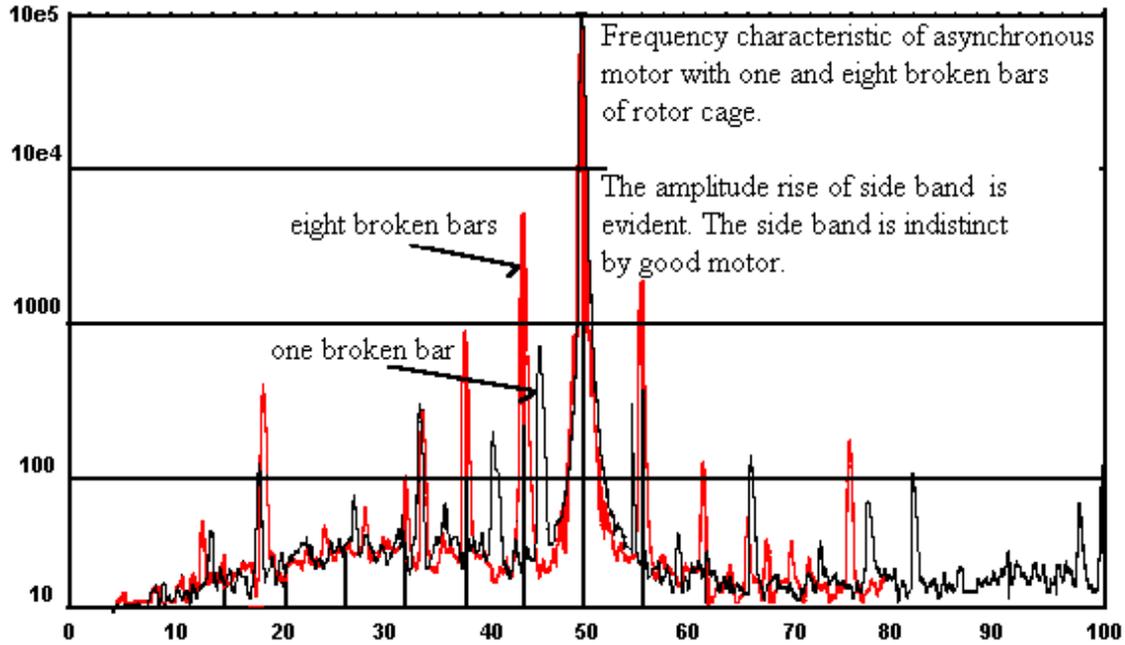
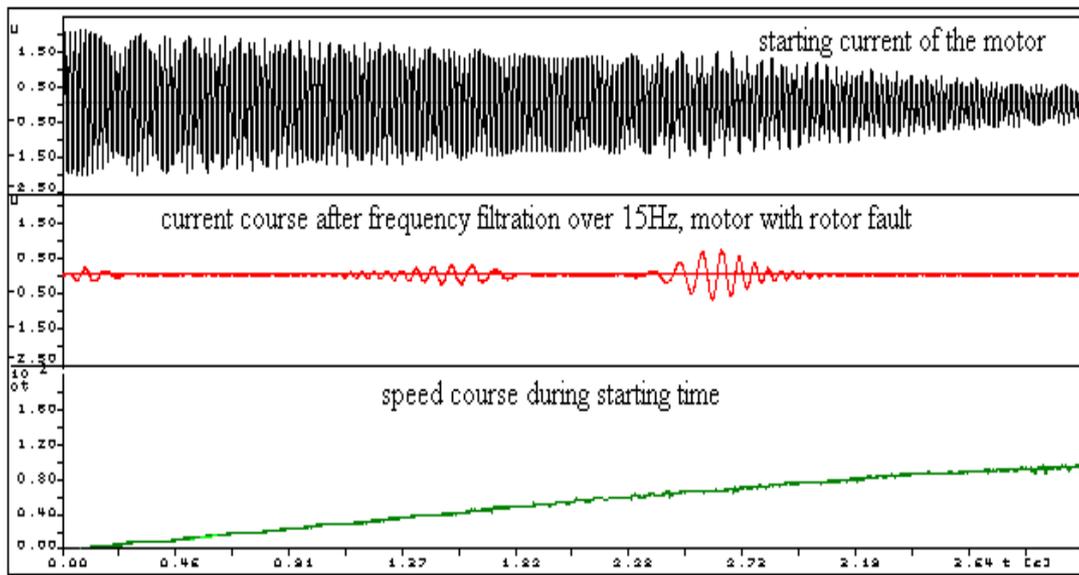


Figure 1. Harmonic analysis of steady state stator current measured by constant load of motor with one and eight broken rotor bars



Starting method: motor starting with rotor unsymmetry (broken bars of the cage), stator current is scanned and then filtered.

Figure 2. Record of starting current, filtered current and course of speed by diagnostic of damaged motor

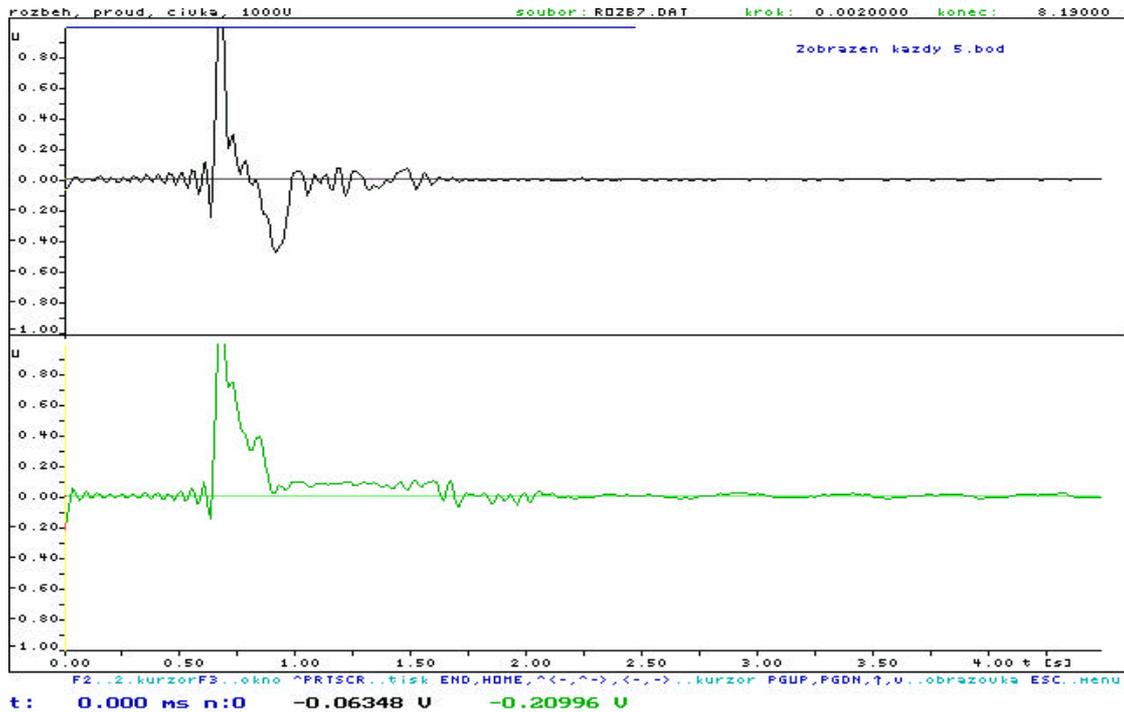
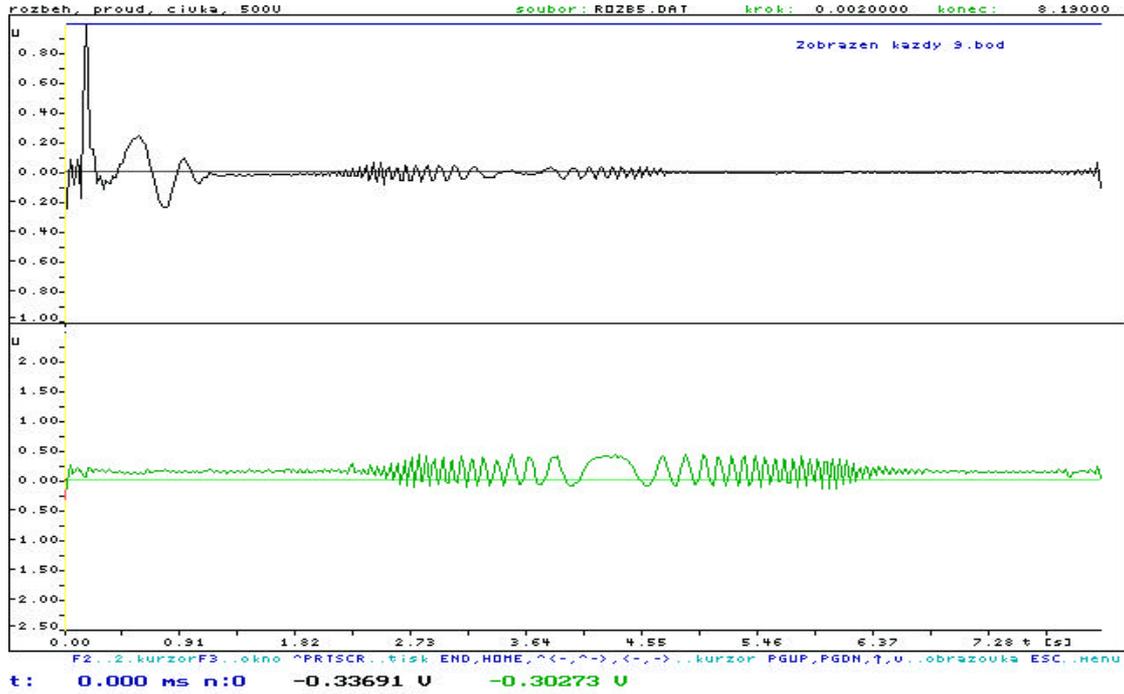


Figure 3. Starting method of AM motor with damaged starting cage, current and leakage magnetic field with reduced terminal voltage 500 V (up) and full terminal voltage 1000 V (down)

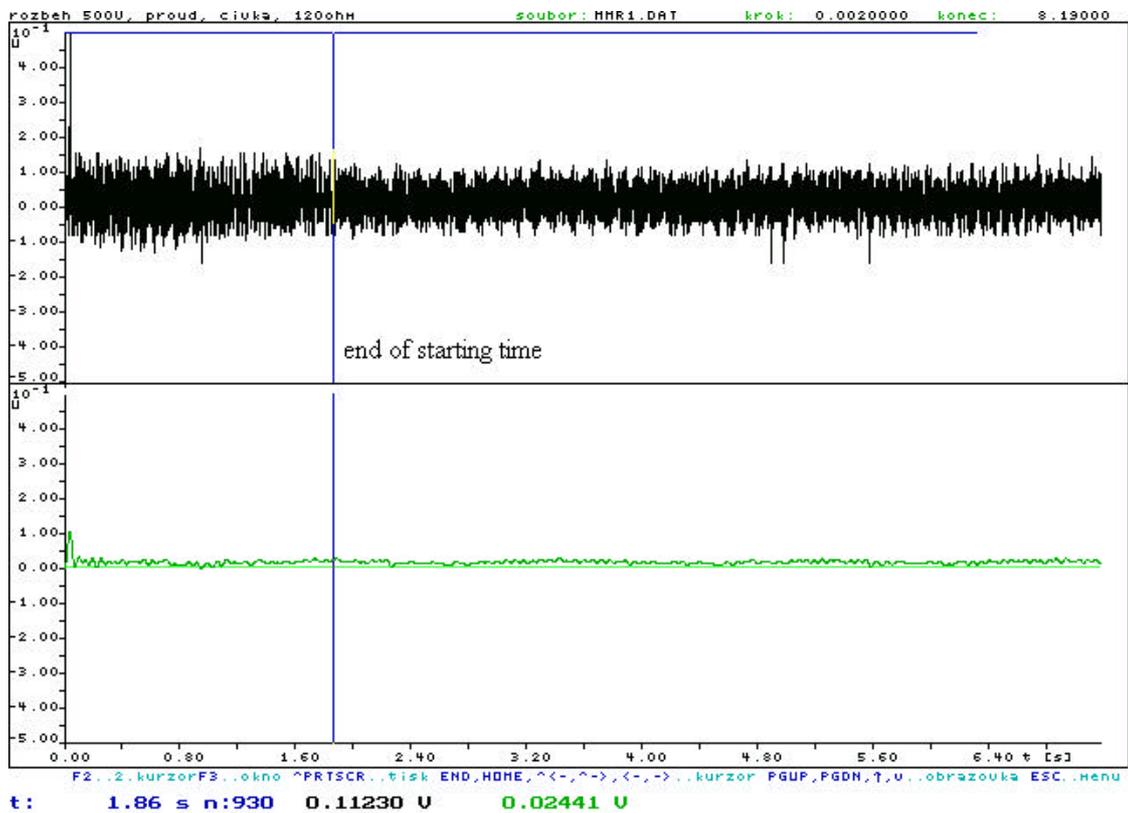
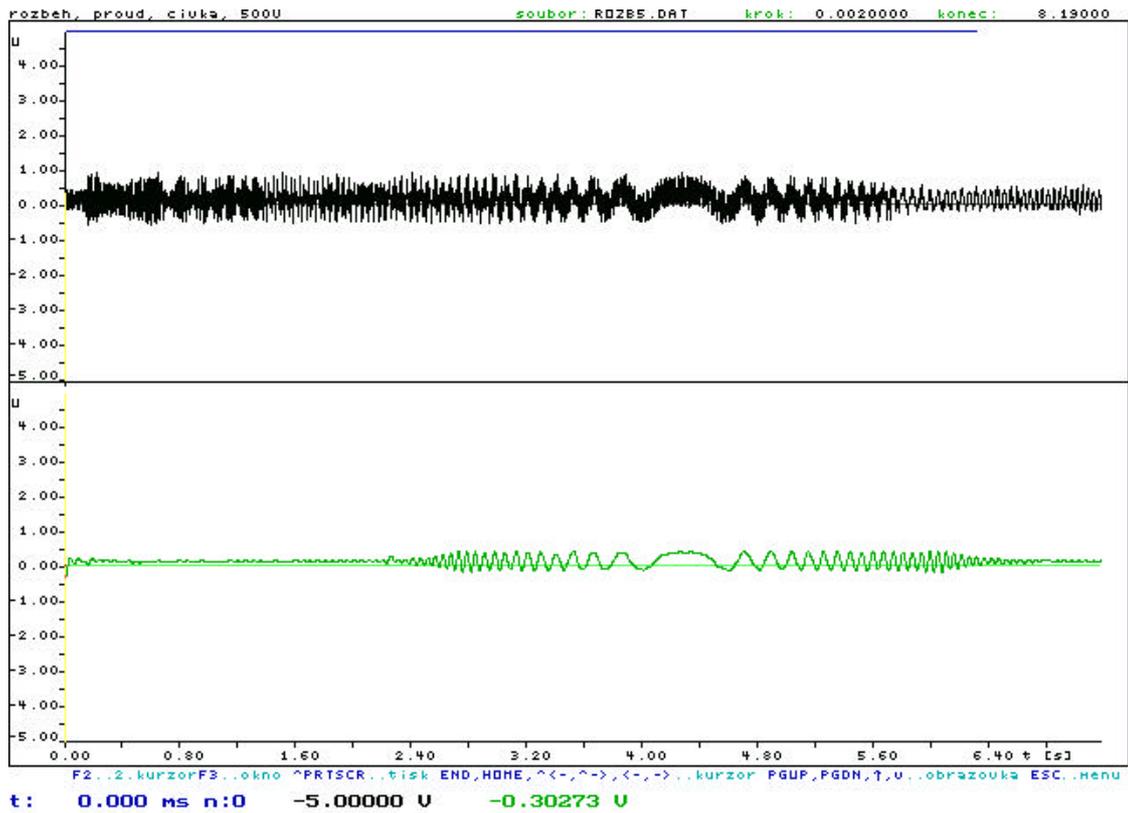


Figure 4. Comparison of results of the starting method by damaged AM motor (up) and repaired motor (down)

3 CONCLUSION

Measurement and analysis of leakage magnetic fields round asynchronous motors are not difficult and the diagnostic method gives good results. Mentioned examples give set an example.

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