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EXPERIMENTS WITH ASYNCHRONOUS MOTORS EXTERNAL MAGNETIC FIELDS

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Annotation. This article discusses a device for measuring the external magnetic leakage field of an asynchronous motor.

In the proposed device, a sensor (measuring conductor) of an external magnetic stray field is installed around the motor housing and is a ring coil without a core, and the dimensions of the coil depend on the dimensions of the asynchronous motors. To oscilloscope the external stray magnetic field, the output ends of the sensor (measuring conductor) are connected to the oscilloscope vibrator.

Keywords: electrical engineering, asynchronous motors, design, increasing the reliability of the device, measurements, magnetic field, sensor, measuring conductor, housing, ring coil, oscilloscope.

Introduction.

One of the most important factors in increasing the reliability and economic efficiency of using electromechanical energy converters (EMEC) is the introduction of diagnostic tools [1-8].

The purpose of diagnostics is to identify and prevent failures and malfunctions, maintain operational indicators within established limits, and predict the condition in order to fully utilize the resource [8]. The most common methods for diagnosing EMPE are based on external examination, registration of vibration, thermal and electrical parameters. However, their use is not always operationally justified. Vibration diagnostics makes it possible to determine defects in the bearing assembly, eccentricity and, to a lesser extent, defects in the stator winding [7].

The main disadvantages of vibration diagnostics are: the need to use special vibroacoustic sensors, the complexity of their installation and the difficulty of interpreting the results. Diagnostics based on the analysis of electrical parameters have not found wide application due to the need to take into account the influence of power supply network parameters, the nature of the load, the influence of external electromagnetic fields, and transient processes in the drive on the electrical parameters of the drive. Thermal imaging control methods make it possible to accurately determine the condition of bearing units of electrical machines. However, they are not suitable for monitoring internal damage to the machine insulation. The diagnostic method based on the analysis of external magnetic field (EMF) parameters does not have the disadvantages described above. In this case, non-contact sensors are used, which are economically the most preferable, since they do not require temporary removal of electrical equipment from operation.

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The essence of the VMF diagnostic method is to place an electromagnetic sensor next to the EMPE, which makes it possible to record the external magnetic field that forms around it during its operation and represents echoes of the multiplicative field in the magnetic gap. It has been established that the external magnetic field of electric machines is largely determined by various types of asymmetry of the stator windings and the magnetic system. Asymmetries caused by emerging defects change the nature of the external magnetic field, causing a spectrum of spatial induction harmonics. This makes it possible to use the analysis of the induction of an external magnetic field for the tasks of diagnosing and assessing the further development of faults. The signal from the sensor is sent to a personal computer, where it is digitized and recorded. Next, a spectral analysis of the received signal is performed, and based on certain characteristics of the resulting picture, the type of malfunction is determined. The reliability of the diagnostic results of this method is 92% [7].

When studying the problems of diagnostics using EMF, a number of scientific publications were considered, in which the relationships between the presence of defects in the engine and the manifestation of certain harmonics in the spectrum of the external magnetic field of the engine were analyzed.

A known device for measuring inductionexternal magnetic field (VMP) [1].

This device works as follows. From the power supply, the voltage is supplied to low-pass filters with a cutoff frequency Fcp = 1000 Hz, designed to filter the input voltage from high-frequency components and noise from the power source. Next, the filtered voltage is supplied to a linear magnetic field sensor (Hall sensor). When a Hall sensor is placed in a magnetic field, the magnetic induction vector generates a potential difference in the sensor that is equivalent to the applied external magnetic field. The output voltage from the Hall sensor is supplied to an amplifier, in which it is amplified and then fed to the input channel of the digital unit. In the digital recording unit, the analog signal is converted into digital form and stored for further playback and analysis.

The disadvantage of this device is the complexity of the design and unreliability, since the device consists of many elements.

A device for measuring the external magnetic field of an asynchronous motor is also known [2].

To measure the external magnetic field of the engine, an electromagnetic sensor is used, which is a U-shaped open magnetic circuit with a winding. To measure the magnetic field in the air gap, an internal inductive sensor was used, which is a coil of wire wound around a stator tooth. An optical tachometer is used to measure the current slip of the electric motor. The signal from the sensors enters the computer through a special oscilloscope board. The board contains a 14-bit analog-to-digital converter (ADC) that converts the analog signal to digital.

The research method used was spectral analysis of the EMF induced in the sensor. Data processing and analysis were carried out in the MATLAB software package.

The disadvantage of this device is its inaccuracy, since in the model the U-shaped open magnetic circuit with a winding does not completely cover the motor housing.

The closest analogue is a device for measuring the external magnetic field of an asynchronous motor [3].

Block diagram of a diagnostic device for asynchronous motors with a squirrel-cage rotor, which consists of three types of sensors: T1 - magnetic field sensor, T2 - angular velocity sensor, T3 - vibration sensor connected to the measuring unit and the computer. Sensors of types T1, T2, T3 consist of Hall elements, an optical sensor, a three-component vibration sensor, respectively, each sensor has a buffer,analog-to-digital converter (ADC). Using sensors of the first type T1 containing a Hall element, the number of which is determined by the design of the electric motor, installed on the housing, at a distance of pole division from each other, the parameters of the external magnetic stray field of the electric motor are recorded. The signal from each sensor enters the filter buffer, then comes to the ADC where it is digitized. After the ADC, the signal from all sensors comes to the measuring unit, which coordinates the signals from all sensors and transmits them to the computer. The angular velocity is measured by one optical sensor, installed permanently, and a disk with marks printed on it, mounted on the motor shaft, the signal from which is processed in the same way as from magnetic field sensors. The magnitude of vibration is measured by a three-component sensor, which is installed on the engine housing to record the tangential, as well as the normal and axial components of vibrations, the signal from which undergoes the same processing as the signal from the magnetic field and angular velocity sensors.

The disadvantage of this device is the complexity of the design and unreliability, since it contains many complex elements.

Main part.

This article is based on the task of simplifying the design and increasing the reliability of a device for measuring the external magnetic field scattering of an asynchronous motor.

The problem is solved by the fact that in a known device for measuring the external magnetic field of an asynchronous motor, including magnetic field sensors (Hall sensors) installed on some places of the motor housing, according to the proposed device, a sensor (measuring conductor) of the external magnetic field scattering of an asynchronous motor is installed around the bodyelectric motor.

The proposed device differs from its analogue in that the sensor (measuring conductor) of the external magnetic field scattering of an asynchronous motor is installed around the housingelectric motor.In this case, the sensor (measuring conductor) for measuring the external magnetic field dissipation of an asynchronous motor is a ring coil without a core and the dimensions of the coil depend on the dimensions of the asynchronous motors.

Therefore, we can conclude that the proposed device will lead to a simplified design and increased reliability of the device for measuring the external magnetic field scattering of an asynchronous motor.

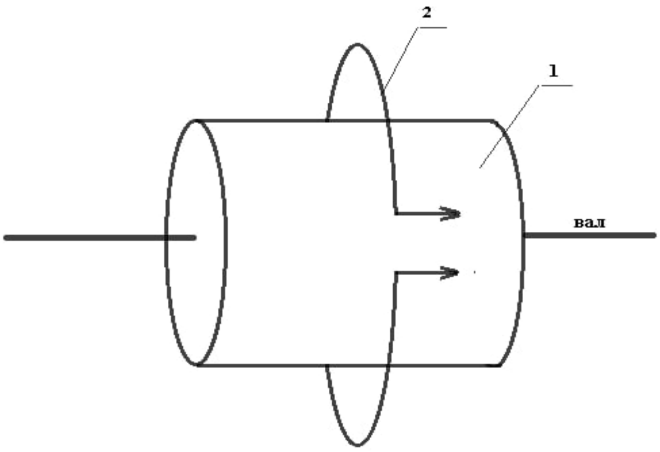

Fig.1

According to Fig. 1, the proposed device contains a housing 1, around the housing 1 there is a sensor (measuring conductor) 2, in the form of an annular coil without a core.

To measure the external magnetic stray field of an asynchronous motor, the input ends of the sensor (measuring conductor) 2 are connected to the vibrator of the oscilloscope.

Figure 2 shows an oscillogram of the EMF of the external magnetic leakage field 3 of an asynchronous motor.

The proposed device works as follows:

When power is connected to an asynchronous motor, an external stray magnetic field 3 appears around the housing 1. In this case, the external stray magnetic field 3 induces an EMF in the sensor (measuring conductor) 2; if it is necessary to oscillograph the external stray magnetic field 3, the lead ends of the sensor (measuring conductor) 2 are connected to the oscilloscope vibrator.

In the proposed device, a sensor (measuring conductor) of an external magnetic stray field is installed around the motor housing and is a ring coil without a core, and the dimensions of the coil depend on the dimensions of the asynchronous motors.

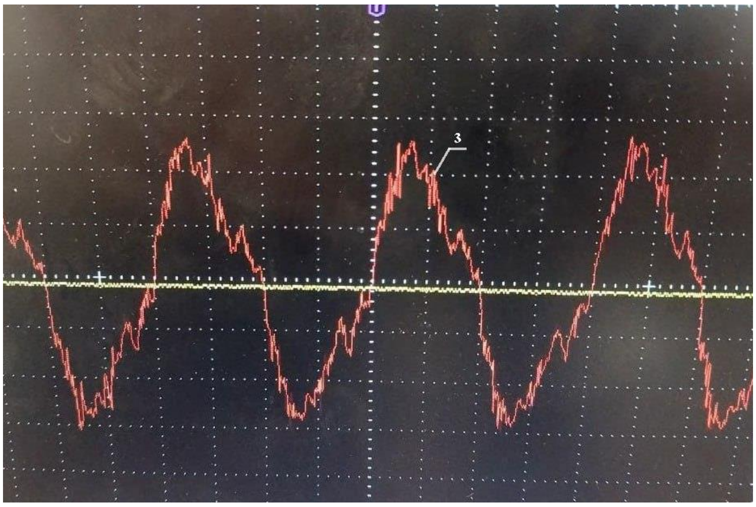

Fig.2

To oscilloscope the external stray magnetic field, the output ends of the sensor (measuring conductor) are connected to the oscilloscope vibrator.

The proposed device works as follows:

When power is connected to an asynchronous motor, an external stray magnetic field 3 appears around the housing 1. In this case, the external stray magnetic field 3 induces an EMF in the sensor (measuring conductor) 2; if it is necessary to oscillograph the external stray magnetic field 3, the lead ends of the sensor (measuring conductor) 2 are connected to the oscilloscope vibrator.

In the proposed device, a sensor (measuring conductor) of an external magnetic stray field is installed around the motor housing and is a ring coil without a core, and the dimensions of the coil depend on the dimensions of the asynchronous motors.

To oscilloscope the external stray magnetic field, the output ends of the sensor (measuring conductor) are connected to the oscilloscope vibrator.

Conclusion.

The use of the device proposed by the authors for measuring the external magnetic field scattering of an asynchronous motor will significantly simplify the design and increase the reliability of the device.

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