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SYSTEMS FOR ON-LINE MONITORING OF VIBRATIONS

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Abstract: The paper presents systems on-line monitoring of vibrations, with the connection parameters for accelerometers: industrial measurements, to align the trees and rotors, for noise measurement, for proximity systems.
Key words: *on-line monitoring of vibrations, proximity systems.*

1. INTRODUCTION

Systems for on-line monitoring of vibrations and other industrial parameters are intended for continuous monitoring of all vibrations from industrial equipment and machinery and for the study and analysis of vibration on the stands. Also, the system can be used for on-line monitoring of industrial, other parameters such as temperature, pressure, flow, voltages, etc [Bay 99].

Systems can be used both as a stationary, laboratory apparatus and portable, for measurements in the field.

Measurements of vibrations that can be performed are: absolute vibration measurement, measurement of vibration bearings relative to shafts, and they are structured according to the type of machine.

These types of measurements can be performed on the following practical applications:

- vibration control and analysis pertaining to the shafts to steam turbines, hydro and gas from the other machines and compressors, who possess the sliding bearings;
- absolute vibration monitoring machine which posses camps rollover-bearings, such as electric motors, fans, traps, reducers, etc.

The system enables measurements above and on a bench study of vibration, which is composed of both bearings and slide bearings.

Systems for on-line monitoring of vibrations fall into two categories:

- systems for on-line monitoring of FFT spectral analysis without vibrations;
- systems for on-line monitoring of vibration with FFT spectral analysis.

1.1. Monitoring systems on-line of vibrations without FFT spectral analysis

Monitoring systems on-line of vibrations without FFT spectral analysis are intended to monitor vibrations from a diversified range of dynamic rotating machinery, such as: electric motors has, reducers, pumps, fans, compressors etc. [Don 02]

1.2. Monitoring systems on-line of vibrations with FFT spectral analysis

Systems for on-line monitoring of vibration with FFT spectral analysis for continuous monitoring of vibration in a diversified range of dynamic rotating machinery has to be: steam turbines, water turbines, extruded, centrifuges and other machinery, which shall have priority in the production process.

The system provides comprehensive solutions in a technique to measure the vibrations and process parameters, like this:

- the possibility for the diagnosis of vibration fault for setting the machine in its infancy,

- store data measured in both module hardware acquisition, and on your PC,
- can view of the process,
- synchronous acquisition and the simultaneous signals,
- save directly to your device, process parameters,
- monitoring values and generating reports.

1.3. Main types of measurements that can be performed with the on-line system

The on-line systems have the capability to perform the following types of vibration measurements:

- Magnitudes global vibration time-Trend.
- Waveform - Oscilogrames vibration.
- Magnitudes vibration depending on the frequency Spectrograms frequency – including type revolving. Types of Windows: “Hanning, Flat Top etc", minimum 1600 lines per channel.
- Magnitudes vibration depending on frequency and time-frequency Spectrograms cascade 3D.
- XY-the Marshalling all vibrations at the same time, used in the measurement of force and displacements.
- Orbit diagram of two-composition of waveform at the same time with the vibrations, which is used to measure relative to proximate.
- Polar diagram - magnitudes vibration depending on the global stage.
- Possibility of simultaneous visualization of measurement data.
- The ability to configure different applications simultaneously and view technical drawings, images, graphs, spectrograms with the parameters of vibration or techniques.

1.4. Main defects that can be explored with on-line system

The main types of damage that can be analyzed and studied in connection with the on-line system are:

- static and dynamic imbalance;
- errors of alignment;
- the weakening system *;
- eccentricity;
- mechanical games;
- the phenomenon of resonance;
- cavitation;
- defects of sliding of the camps;
- defects of the roll-up bearings of the camps;
- crankshaft;
- rotor friction;
- problems of electric motors;
- defects of gearing etc.

2. CONNECT THE SENSORS TO MONITORING AND ANALYSIS SYSTEM

The system is able to perform measurements of vibration with the following types of sensors [Bay99]:

- compatible ICP and capacitive accelerometers for measuring the absolute, vibrating
- proximity systems for measuring relative vibrating
- vibrating velocity sensors,
- laser sensors for alignment of trees,
- temperature sensors non-contact, termorezistance,
- class 1 microphones ICP or class 2.

For the monitoring of other parameters, the system supports industrial sensors that have standard outputs: 0 and 4-20 mA, 0-10 V, ±10 V For thermocouple and thermorezistance. It is appropriate that they should be able to connect directly to the device.

2.1 Connect compatible ICP and capacitive accelerometers (Fig. 1)

In the diagram in Figure 1 is given a single measuring channel. Capacitive accelerometers for block diagram are similar, with the difference that, instead of ICP accelerometer, you can use a capacitive accelerometer and module ICP will be replaced with a capacitive signal processing.

The system supports the full range of accelerometers, low, medium and high frequency [Lal 90].

2.2. Connecting systems of proximity – without contact displacement transducers

Measurement of vibrating relative to trees will be achieved with two transducers proximity arranged at 90° to one another (Fig. 2).

These types of metrics are used to monitor the machines, who possess the sliding bearings, e.g. turbines, by composing oscillogrames (relative vibration displacement) on two directions X-Y, at the same time, obtaining the orbit of the time in the camp, as shown in Figure 3

Block diagram of vibration monitoring system with proximity systems is shown in Figure 4.

The connection speed of vibration sensors are usually directly in the measuring instrument. Sensors will be with output 4-20 mA and will measure the velocity of vibrating effective rms. Block diagram of the system of monitoring of vibration speed sensor is shown in Figure 5.

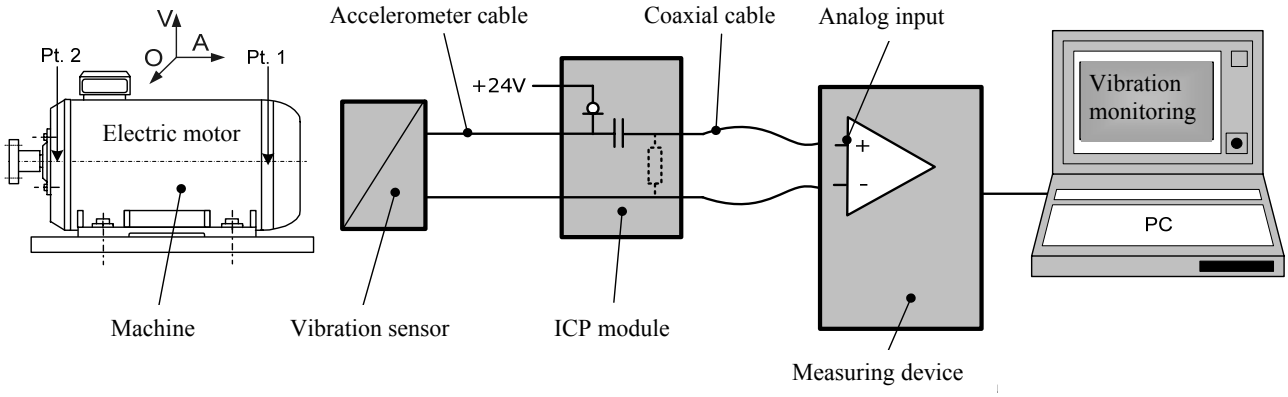

Fig. 1. Monitoring of vibration system with compatible ICP accelerometers

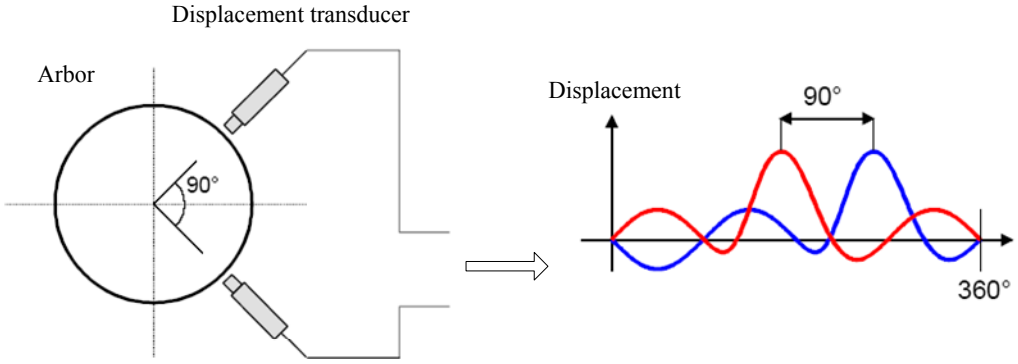

Fig. 2. Monitoring of vibrations system with proximity systems

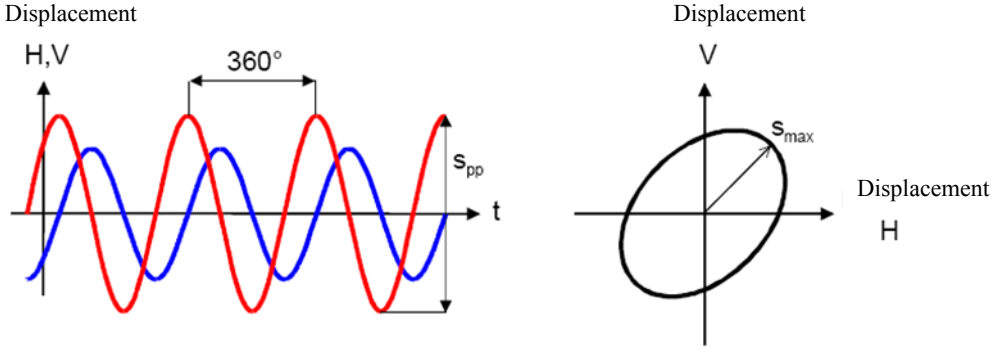

Fig. 3. The spindle orbit in bearing

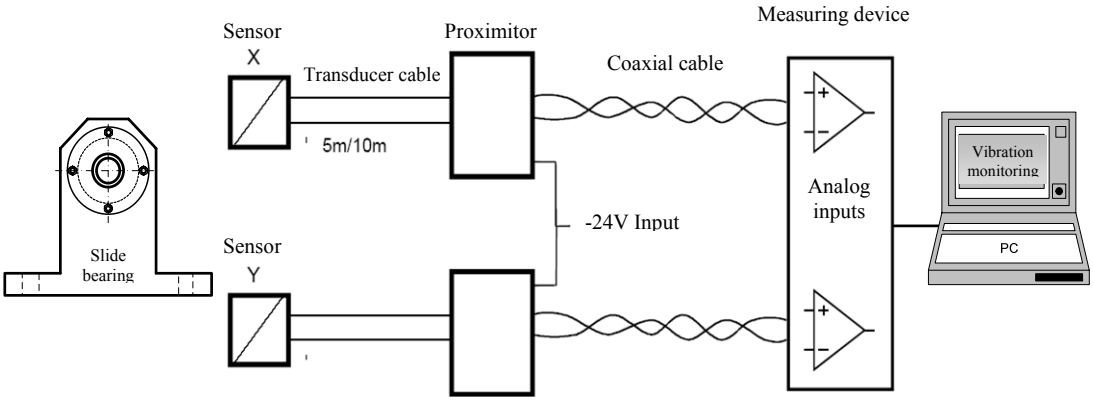

Fig. 4. Monitoring system of vibrations with proximity systems

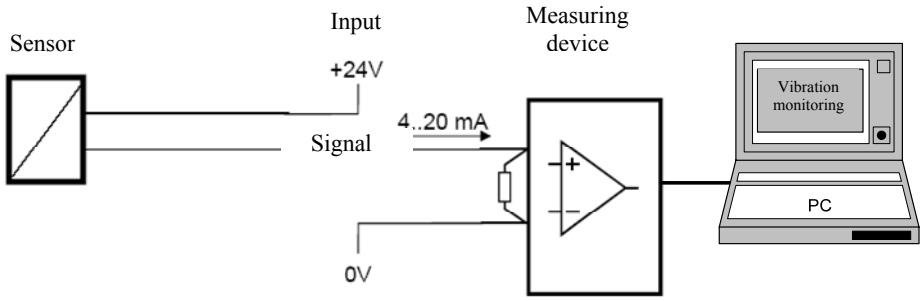

Fig. 5. Monitoring system of vibrations with speed sensors

2.3. Connecting to industrial sensors for measuring the parameters

To connect standard sensors with outputs: 0-4-20 mA, 0-10 V, ±10 V is identical to the schema shown in Figure 4.18. To measure temperatures (e.g. bearings, etc.) with thermocouples and thermorezistances is shown that the device can be connected to a greater range of thermocouple and thermorezistances (all types, if possible) directly to the device.

Block diagram of the system for monitoring temperatures with thermocouple and thermorezistances is shown in Figure 6. Block diagram for connecting sensors, laser or optical required for measuring revolution and phase, is identical.

2.4. Connecting the sensors for measuring noise

Block diagram of the noise monitoring system with microphones compatible ICP is shown in Figure 7.

2.5. Connecting laser sensors to monitoring system on-line for alignment of crankshafts and slide bearings

For horizontal and vertical alignment of shafts using laser sensors and one-dimensional, for the alignment of the bearings, using laser sensors [Roe 05] two-dimensional. Connection scheme of laser sensors to monitoring system on-line is shown in Figure 8.

To align the two coordinates (two-dimensional), the scheme is similar, with the difference that you will use a single mode laser and a two-dimensional detector.

This system has the possibility of rotating machinery dynamic alignment, who works at the cold as well as on-line verification of alignment on dynamic thermal expansions from occurring.

The laser system may check the deviation from perpendicularity, parallelism, evenness, horizontality, verticality, straightness etc. of the various pieces and parts from the machines.

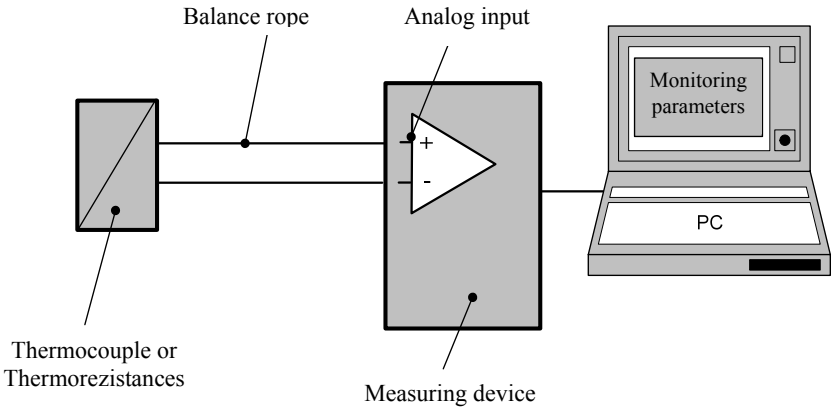

Fig. 6. System for monitoring temperatures with thermocouples and thermorezistances

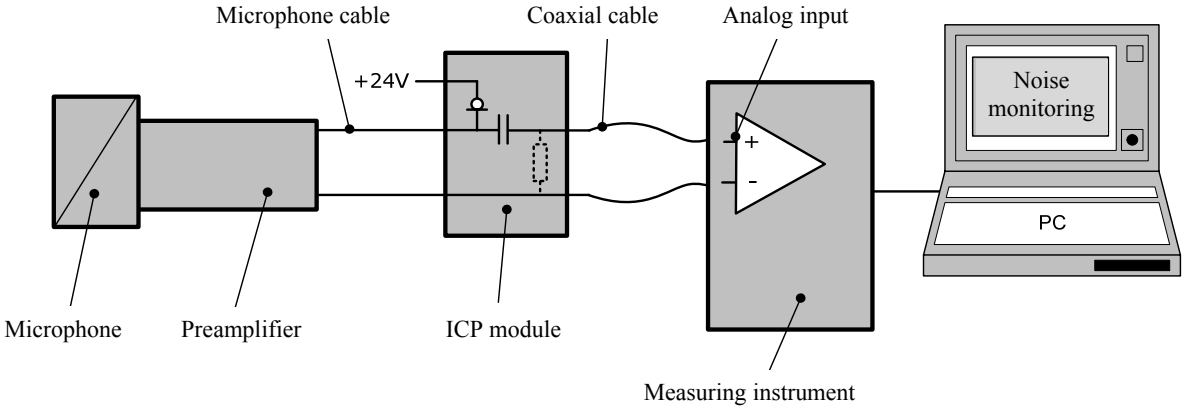

Fig. 7. Noise monitoring system with microphones compatible ICP

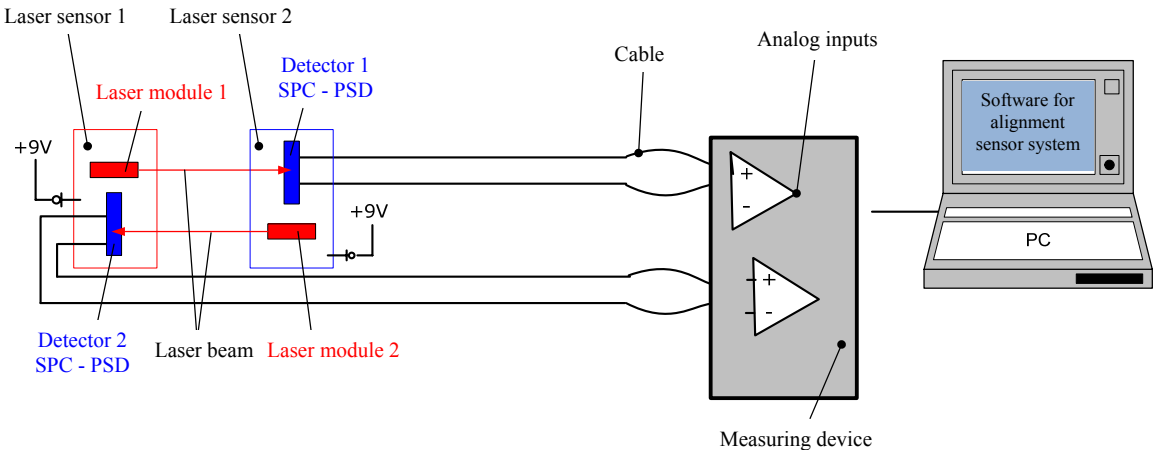

Fig. 8. System monitoring with laser sensors one-dimensional

3. CONCLUSION

Efficient implementation of predictive maintenance programmed assumes a dynamic monitoring of equipment, both during operation and during periods of repair, but only after they were brought, initially at running fit for prediction, i.e., they must operate within the limits of permissible vibration accepted standards.

Predictive and proactive comprehensive implementation leads to increased safety in the operation of the equipment of dynamic and significant reduction of the accidental shutdowns which optimize the activity of production and reduce the cost of production.
To this end, the current trend is introducing effective systems for monitoring of the parameters that affect the operation of the equipment, having an important role in the

pursuit of reliability and mentenability dynamic machinery.

Therefore, increasing quality and efficiency of repairs and safety in the operation of the equipment may be carried out by the industrial and commercial companies of maintenance policies, particularly in the field of vibrations and noise, thermograph, lubrication, balance and alignment equipment, by equipping with modern equipment and systems, which, in a relatively short time will locate in a lower cost of production.

Has an important role in preparing and serving personnel, equipment, requiring little in that sense, this sentence is meant to serve as a practical guide for the implementation of the comprehensive predictive and proactive.

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SISTEME DE MONITORIZARE ON-LINE ALE VIBRAȚIILOR

Rezumat: Lucrarea prezintă sistemele de monitorizare on-line a vibrațiilor, cu conectarea accelerometrelor: pentru măsurarea parametrilor industriali, pentru alinierea arborilor şi rotorilor, pentru măsurarea zgomotelor, pentru sisteme de proximitate.

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