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Condition monitoring and fault diagnosis

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Abstract

The paper deals with detection of fault conditions based on measurements of vibration made on rotary machines in various industries. Detection of sources of vibration will be made based on the amplitude spectra and phase relationships of vibrations of individual machine parts, using the envelope of technology in detecting recurring events with low levels of the measured signal and processing of high-frequency signal in the range of acoustic emission. Because the display of a set of symptoms to the space of fault conditions for these methods is not simple, it is advisable to use a multi-parameter approach which means that important decisions are made on the basis of different types of measurements, for example, with using techniques of modal analysis and operational modal analysis. The paper presented the results of various measurements on the machinery.

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Keywords: vibration; spectrum; condition monitoring; modal analysis; excitation source;

1. Introduction

The risk of repeated failures machinery leads frequently to look for the causes of this phenomenon. If technologies are part of machines with rotating parts and there are indications to suggest high levels of vibration then one of the ways of eliminating these risks is to understand the symptoms of vibration. A common method is to measure vibration using accelerometers in selected points. The measured values provide initial information on the level of vibration and spectral properties. But such an analysis does not necessarily provide a satisfactory answer to the question of what is causing these vibrations and how to reduce or eliminate. The problem may be divided into three parts and analyzed as:

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- Excitation sources, such as internal: unbalance, misalignment, mechanical looseness, resonance, damage of bearings, gears, belts, excitation of hydraulic and aerodynamic forces, vibration caused by electrical problem etc. and external: other stimulus and also understanding the triggers that activate those resources as stimulus, [1-4].
- Transfer path to amplify, attenuate, respectively filters the excitation signal on the path from the source to the point of measurement.
- Vibrations at the point of measurement which are determined by the excitation signal and the modal properties of this place.

In the following part of the paper I will be presented on real outcomes measurement technology.

2. The detection of the vibration sources

The relationship between the event or fault conditions using the selected processing method and its symptoms is shown in Fig. 1. Difficulties may arise in ambiguous detection of a fault condition on the basis of established symptoms. Because the display of a set of symptoms to multiply fault conditions for these methods is not simple, it is advisable to use a multi-parameter approach which means that important decisions are made on the basis of different types of measurements.

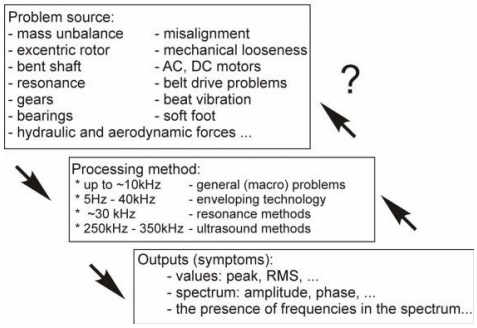

Fig. 1 The ambiguous detection of a fault condition on the basis of established symptoms.

A detection of sources of vibration will be made based on the amplitude spectra and phase relationships of vibration of individual machine parts. The results of some selected cases to identify the sources of vibration problems are presented by Fig. 2–6.

Kinematics scheme of cement mill gearboxes 2x1.6MW is shown by Fig. 2. They contain the indicated number of teeth and to the input speed of the gear are determined the tooth frequencies of the different gears.

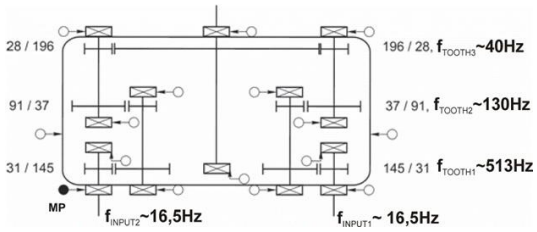

Fig. 2 The Kinematics scheme of cement mill gearboxes with numbers of teeth, the tooth frequencies and one of the measure points (MP).