ANNALS of the ORADEA UNIVERSITY.

Fascicle of Management and Technological Engineering, Volume VI (XVI), 2007

TYPOLOGICAL IMPRESSION OF MECHANISMS IN MACHINES-TOOLS ACTUATION

Petru SURU, Dănuț ŞOŞDEAN, Eugen PĂMÎNTAŞ, Adrian-Ilie DUME
„Politehnica" University of Timişoara, Integrated Engineering Research Centre
E-mail: psuru@eng.upt.ro, dsosdean@eng.upt.ro, epamintas@eng.upt.ro, adume@eng.upt.ro

Keywords: machines-tools, maintenance, vibration, ball bearing

Abstract: In the cinematic structure of the machines-tools actuations there are a few categories of mechanisms with a major impact under the silent working of the whole machine assembly. In the case of modern machines-tool and especially of the machines that are integrated in the automatic fabrication systems, their working in certain limits of silenceness is an important hint on their status concerning running and maintenance. This paper works out a strategy for a database on the mechanisms having a major impact on the working status of machines-tools and production equipments.

1 Introduction

Functioning of the machines, machineries and equipments at nominal parameters in the fabrication systems represents an essential condition, whereas in automatic or integrated systems it is unconceivable.

Satisfying such a condition requires in the fabrication structure the existence of some machinery with high performance characteristics capable of being highly reliable during normal exploiting conditions.

It is well known that during the exploitation machines-tools function in variable mode conditions, with variable charging and stress in changing environmental conditions (temperature, atmosphere etc), all of which may have influences on their normal functioning during exploitation.

The general tendency is well known, it aims by all means at minimizing the standing period of machinery. In such conditions, reliability and maintenance activities play a decisive role in exploiting the machines-tool.

In modern fabrication systems machines-tool and work machineries are equipped with specific pursue, control and surveillance programs for their functioning, through diagnosis and autodiagnosis of their functioning state [1].

Recognizing an abnormal state of functioning is an important aspect and it depends on a series of conditions and factors which may interfere and intercondition, which makes it difficult to forecast a certain state of functioning.

In such conditions we use recognizing means and methods through comparative analyzes, by taking into account the frequency of noise and vibration phenomena that occur.

This paper tries to emphasized a few specific aspects linked to the functioning state of machines-tools and machineries from fabrication systems.

2 Behavior of mechanisms in the actuation of machines-tools

The normal functioning of machine-tools or of machinery as a whole is determined by the normal functioning of each mechanism in the actuation structure. Any deviation from the state of normality in the functioning of a machine is a sign that an element from the kinematics structure is not functioning at the projected parameters, and in such conditions,

this latter must be discovered and fast decisions must be taken to remove the phenomenon.

The elements of the machines and the machines in motion which work in variable regions of speed and charging in different working environments, may encounter weaknesses in their functioning, these latter's being signalized by noise, vibrations or shocks which indicate an abnormal state of functioning.

The most usual mechanisms which are part of an actuation structure and which have potential germs that may generate dysfunction of functionary nature are:

- Belt transmission mechanisms;
- Gearshift mechanisms;
- Shaft bearings.

In comparison with the disjunctions these mechanisms may generate, in the machines' integrated systems we talk about permanent or cyclic monitoring of the behavior of their functional state. This requires the placement in some sensitive areas of certain sensors that may transmit signals on the functioning of the mechanisms.

A solution for arranging these sensors in the bearings' area is presented in figure 1[2].

It is recommended that the position of the translator be on the direction of the propagation wave in order to discover as better as possible the existing phenomena.

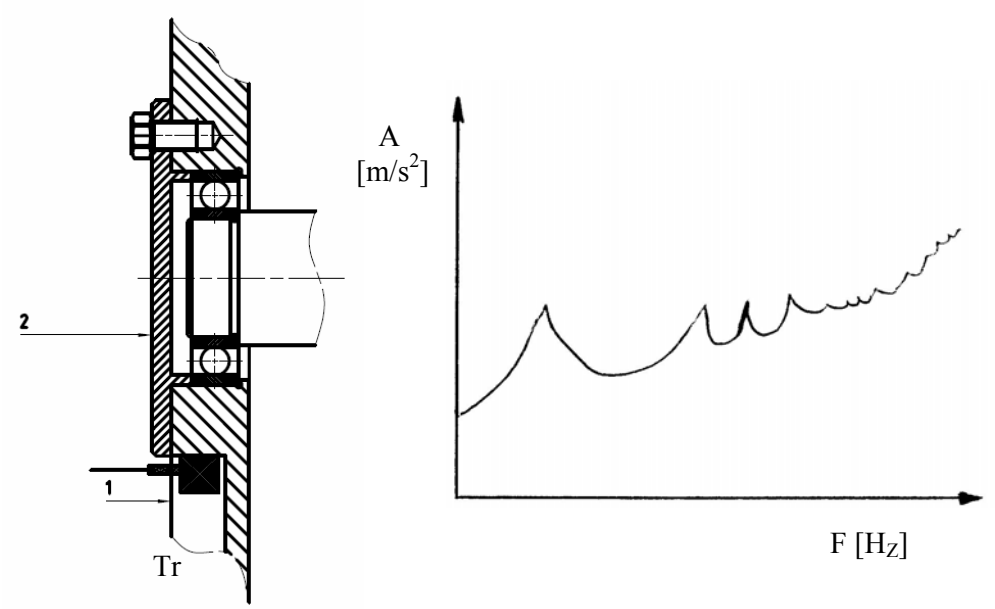

Figure 1. Solutions for arranging the translators on the shafts' bearings; bearing structure

According to figure 1, position 1 is optimal for a translator "Tr" to measure the vibrations, and it has to consider the propagation direction of the elastic wave. For a more truthful reproduction of the measurements, we recommend that between the source of generation of the vibration and the translator there is as few separating planes as possible.

In figure 1, the immediate source of vibrations is the rolling bearing, which may manifest itself under different shapes, according to the contractions which result from the shaft- bearing and bore-bearing fitting and to the fault conditions that may occur on the rolling paths and rolling bodies.

A normal functioning of a rolling bearing may be recorded as a diagram like the one in figure 2, in which we see certain uniformity of the amplitude and of the frequency of the vibrations [2].

Fig 2 impression specific to a normal state of the ball bearing

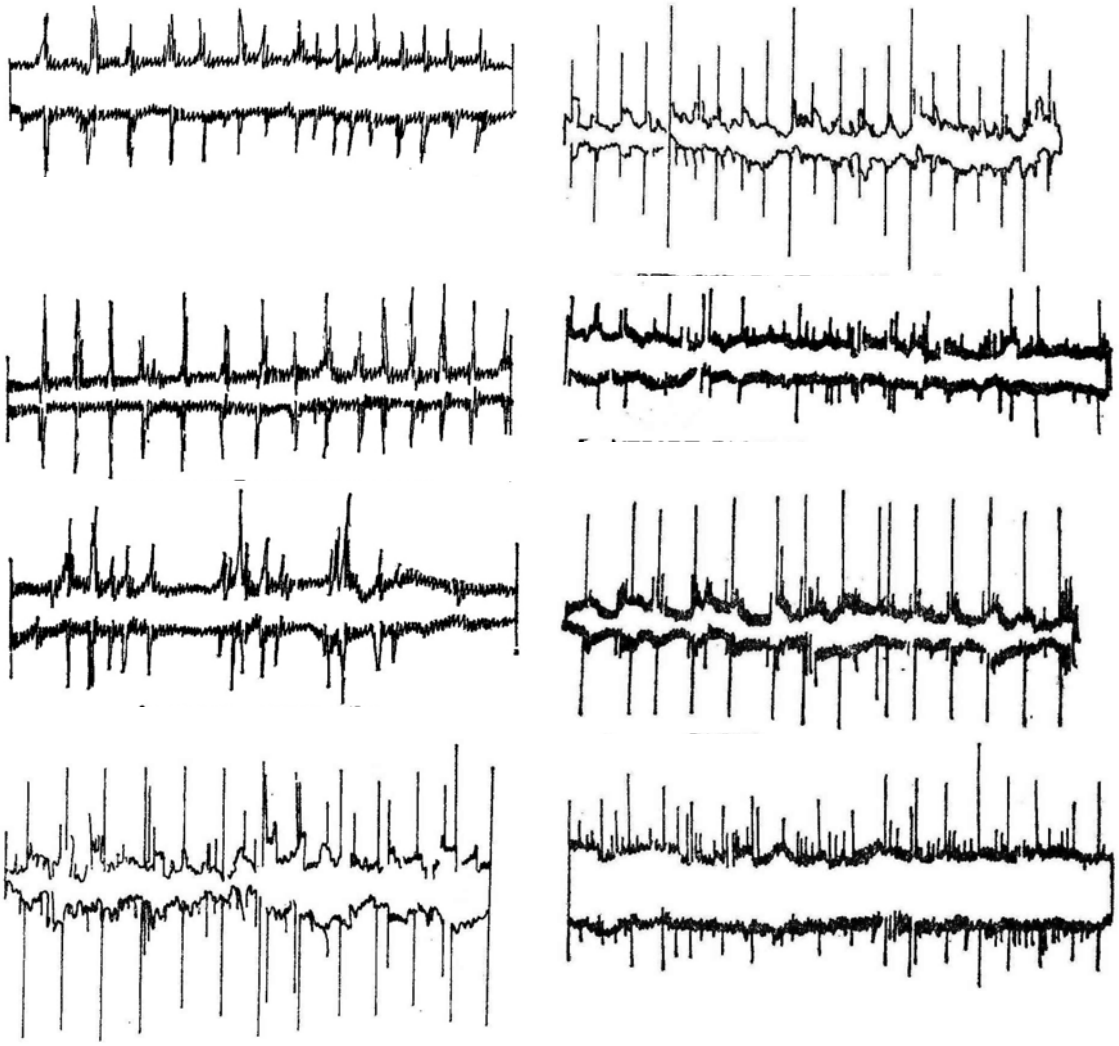

Fig 3 impression specific to ball bearings with fault conditions

The diagram indicates that the bearing has a normal functioning, which confers to this latter the quality of satisfactory quality machine organ that will ensure correct functioning of the mechanisms on which it will be put.

As opposed to the situation presented in figure 2, in figure 3 we can see a significant number of cases which emphasize fault conditions of the bearing's rolling paths (external or internal ring), of the rolling bodies (ball or reel), or the presence of some impurities – suspension-type particles – coming from the surrounding environment.

Such information represents an important source that provides clues on the functioning state of the machines-tools equipment subassemblies or machine systems, part of the integrated machine systems.

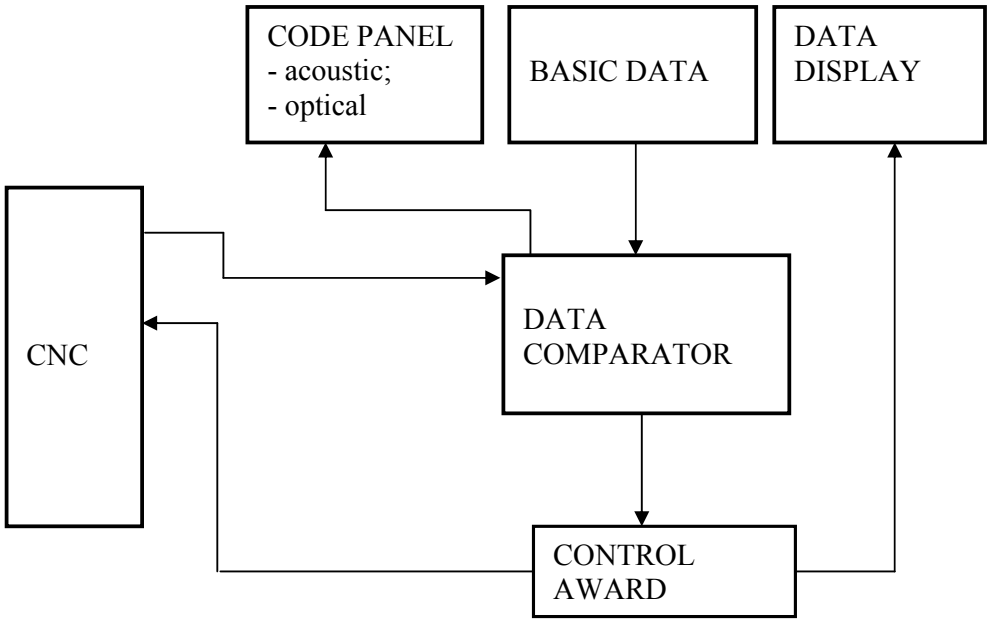

Figure 4. Block-scheme –management and control, autodiagnosis

According to figure 4, in formations are collected by the sensors or translators from the critical points of a machine and are continuously or periodically transmitted to the command system of a machine. In such systems, information's are being processed and compared to the information contained in the database and, according to the sizes that result after the comparison in the decision block, the ideal solution to adopt is established [3]. As for the database, it comprises information's and data on the normal supply conditions, like the ones presented in figure 2, encoded, they refer to the normal functioning state of all the sizes with a determining functional role in the kinematics structure of a machine-tools.

Such an automatic system of autodiagnosis of the functioning state of the machines, which is specific to the machines-tool identified systems, has for a main purpose to ensure the protection of these machines, but also the normal and eventless functioning of the system, by signalizing any conflicting states that may occur during processing.

Presenting the functional state of a machine-tool is part of the maintenances strategy on the machines and machine systems, which may led to high performance indicators.

In the case of mechanical vibrations, it is considered that the most truthful parameter is the one that may cover the effects of minimal dynamics on a measured frequency domain, which is very important when measuring only the global level, which is only the broad band one. When discovering the causes of some abnormal vibrations during functioning is necessary, measuring in frequency represents a solution.

The information's that derive from the measurement of the frequency are divided not only to detect some faults since the initial phase but also to diagnose the cause of these faults.

When diagnosing the functional state of machine-tools in the current conditions, we may use, as said before, some samples stored in a database, periodically comparing these to the results of the measurements that are being made continuously on the machine with the help of sensors or translators.

Since it is known that in conditions of a correct assembling of the mechanisms and with a good precision of the constitutive elements, for the same types of machines, their behaviors in functioning is different. The ideal, in such conditions, would be that the samples which describe the normal state of functioning of a machine be realized at the beginning (when the machine is new) and for each type of machine, and in such conditions a diagnosis strategy may be elaborated, by establishing, for each type of mechanism, a threshold, above which a decision of functional incompatibility could be taken, that is to declare a fault and to claim an intervention.

The main sources of fault in the actuation of the machines-tool are of mechanical nature and so, we considered that the size that would show the best the phenomena that take place would be controlling a mechanical size and this is almost unanimously accepted as being the level of vibrations.

We can also control other mechanical sizes as well in order to follow the state of functioning of a machine, such as the temperature, the pressure, noise etc.

For other types of mechanisms, such as belt transmissions, chain transmissions, gear transmissions, a strict control may be undertook to evaluate the functioning state of the machines.

3 Conclusions

The functioning state of a machine-tools in the more and more pronounced conditions of automation and computerization of the fabrication processes has lead to the idea that permanent control, diagnosing and autodiagnosing may have beneficial effects from an economic point of view, which has lead to more and more machines to be equipped with control and autodiagnosing systems.

Today, there are recommendations and standards through which we can establish appreciation criteria of the state of the machines by evaluating the level of noise and vibrations.

It is estimated that the superior limit over which the level of vibrations is generating some faults, must be 2-3 times the level of vibrations considered as acceptable 6-10 dB.

4 References

1. A. Darabont. Măsurarea zgomotului şi vibraţiiilor, Editura Tehnică, Bucureşti,1983;
2. M. Gofiţeanu, Vibraţii şi zgomote, Editura Junimea, Iaşi, 1980;
3. P. Suru, Cercetării asupra diminuării nivelului de zgomot şi vibraţii din acţionările maşinilor şi utilajelor de lucru, Contract CNCSIS Nr. 32/ 2005.