BRIEF REVIEW OF ACTIVE ON-LINE BALANCING DEVICES

Ivkina O.P.
Tomsk Polytechnic University, Russia, Tomsk
Scientific Supervisor: Ziyakaev G.R., Ph.D., Assoc. Prof.
Language advisor: Morozov V.S.

The imbalance of the rotating parts is the most frequent cause of the increased vibration in rotary machines. It appears because of imperfection of cylindrical shape of the parts, or it can appear in the technological process, for example, as a result of uneven wear of abrasive wheels or uneven carbon buildup on the blades of the fan.

Presently, on-line balancing devices (OBD) for rotating spindles are being actively introduced. They allow to decrease vibration in devices and machines, decrease wear of bearings and other rotating parts, and, in the long run, they increase device and machine life.

On-line balancing devices are divided into 2 types: active and passive. In passive devices, balancing weights move under the effect of internal forces, but in the active ones this happens by means of outside force. Both of them have advantages and disadvantages: passive devices work only when the rotation speed is above the natural frequency of the machine, i.e. above the resonance; active devices are much more complicated and expensive, but work with all spindle modes and can help to achieve higher balance accuracy.

This article provides a brief overview and history of on-line balancing devices.

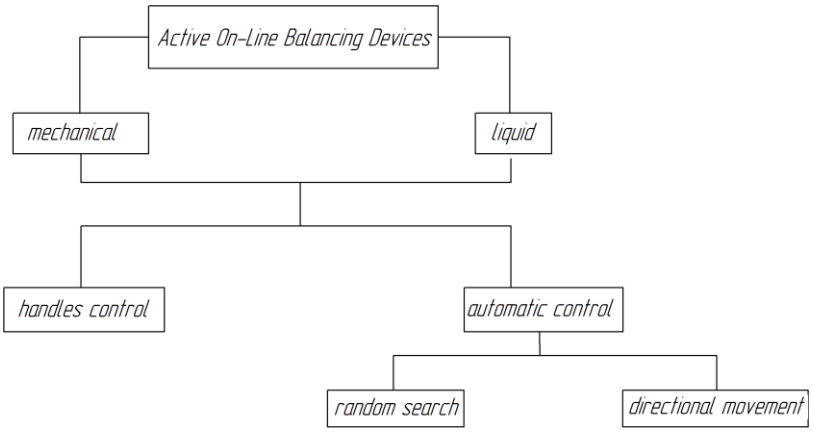

Fig. 1. Classification of active on-line balancing devices.

The history of development of such devices began with the devices for balancing of abrasive wheel grinders during operation. Balancing weights control is performed in manual mode using control handles. A scheme of one of such devices is shown below (fig.2).

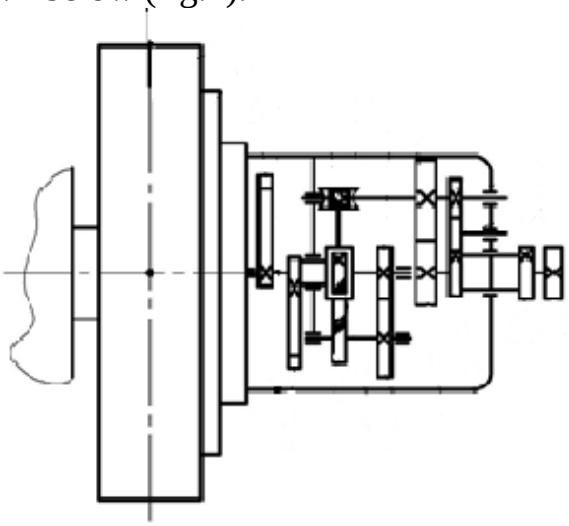

Fig. 2. Manually operated balancing device of abrasive wheel grinder.

The next stage of the development of active on-line balancing devices were devices with automatic control. They work on the following principle: a vibration sensor measures the vibration on the machine's casing or support and feeds the data to a controller, where it is processed. The controller gives a control signal to driving mechanisms, which set balancing weights relative to the spindle in such a way that they compensate for its imbalance and dampen the vibration (fig.3).

According to their operation algorithms, these devices are divided into devices with a random search and devices with a directional movement of balancing weights. Devices with directional moving of balancing weights don't require the change of imbalance phases and can work with a measuring system that vibration in supports and the change in its amplitude. Often, mechanical or liquid elements with free moving small weights are used as sensors of a measuring system. It allows to simplify OBD construction.

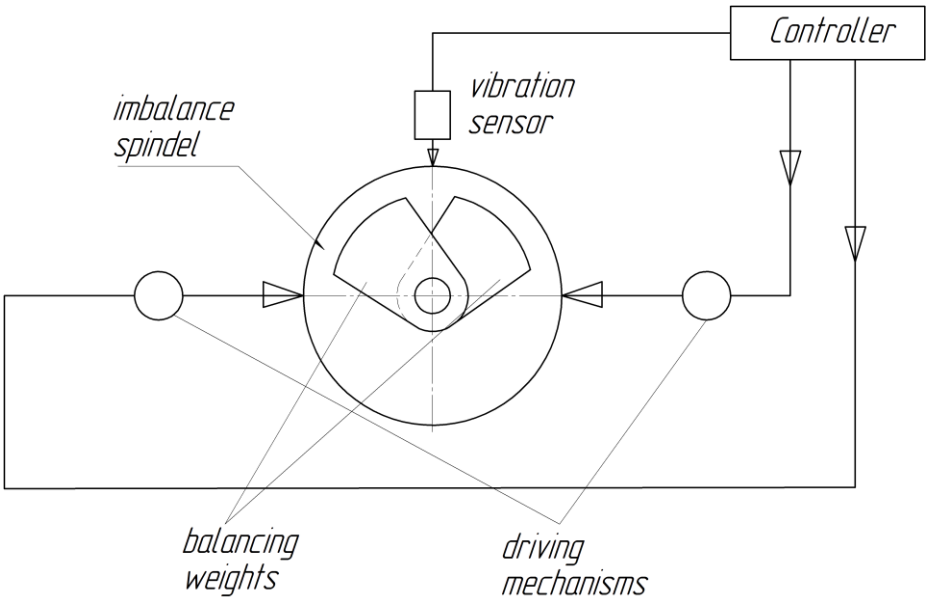

Fig. 3. Basic scheme of active OBD.

Although the development of active OBDs is underway for quite some time, and many schemes and principles of operation were patented, only a few of them made it to industrial application. An example is the "LORD Corporation" company's on-line balancing device (fig. 4).

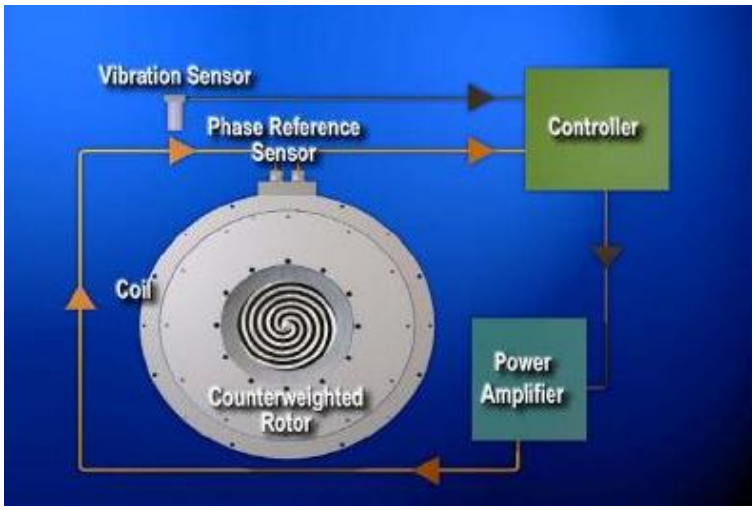

Fig. 4. The "LORD Corporation" company's on-line balancing device

One of the constraints to the development of active OBDs was the lack of relatively cheap high-performance control systems. That's why such OBDs were rather bulky and expensive. Now, thanks to development of computer technology, this limit virtually ceased to exist. Today it is easy to find sensors and high-speed controllers for processing signals from the sensors and generating control signals, as well as driving mechanisms for

moving balancing weights. That’s why further development of these devices is a very prospective line in designing vibration protection for equipment.

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