MODERNIZATION OF MILLING MACHINES MA665 WITH NUMERICAL CONTROL

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ANNOTATION

The goal is to consider the use of modernization of outdated metal-cutting equipment for modern technological tasks as one of the economically feasible options, alternative to the purchase of new expensive equipment. The use of aggregation allows in the process of modernization to create technological equipment for a specific group of products with the implementation of an optimal technological process. Simultaneous equipping of the machine with a modern control system, as well as assemblies and equipment for CAM-technologies and HSM-technologies, allows you to get a qualitatively new equipment. The article shows the practical experience of modernizing the MA665 milling machine for tool processing. It describes a deep modernization with a complete replacement of all drives, electrical and control systems.

Keywords: machine tools with numerical control, modernization of metalworking machines, high-tech production of large-size foundry equipment, aggregation.

INTRODUCTION

Today, the average age of equipment at machine building enterprises in Uzbekistan is more than 25 years. The share of equipment with such a service life, according to Rosstat, exceeds 40%. It is obvious that there is an urgent need for the modernization of fixed assets, the implementation of which is hampered by the existing problems of the industry: the steady aging and deterioration of the qualitative composition of engineering and production personnel, the insufficient level of innovative development of the Russian machine-building industry, an outdated educator. - Noah base, etc. At the same time, there are numerous examples of implemented programs of technical re-equipment, the result of which is new, but ineffectively operating equipment, which does not significantly increase profits [1-6].

Thus, enterprises need not just modernization, but effective modernization, which increases the technological capabilities and profitability of production, increases the level of product innovation and its consumer properties.

Modernization of machine tools with numerical control (CNC) is an economical alternative to purchasing equipment when introducing new technologies [7-12]. Retrofit means extending the life of a machine by replacing the most critical components or upgrading equipment that involves adding new technology or its features to older systems.

The advantages of modernization are:

• Savings on capital costs when introducing new technologies,
• Optimization of existing technological components,
• Adaptation of technology to a new or modified products,
• Improvement of production parameters,
• High probability of availability of production spare parts.

Modernization of the machine gives it a second life and extends the period of its use. In a machine tool life span of ten years or more, control technology and drive systems have undergone fundamental changes, both in terms of energy costs and new features that make the machine more efficient. In addition, new components have more readily available spare parts and this can be critical to the safe operation of the machine in many cases [13-18].

It should be noted that the mechanical condition of old machines is usually still good, so it is more economical to upgrade the control system and drives than to buy new machines. Even in case of violation of the operating rules and critical wear of the guides that affect the accuracy, there are effective methods of restoring their accuracy. At the same time, in metalworking equipment with a long service life, as a result of natural aging, there are practically no internal stresses, which makes it possible, on their basis, to create equipment with stable geometric parameters that ensure high accuracy [19-24].

As the main equipment for the implementation of the selected technology, a milling machine MA665 manufactured in 1981 was taken. The machine was equipped with an outdated cyclic CNC system "Size-2M-1104" with digital display. With the help of the matrix logic device, the operation of the auxiliary electro automatic devices was programmed. Three electrical cabinets were installed on the machine (spindle control cabinet, feed drive control cabinet, electrical cabinet), which took up a lot of space, and the equipment that was assembled in them was partially out of order and outdated.

The modernization was based on the modular principle of constructing the modernized equipment or aggregation.

When modernizing the machine itself, the 1000MDb CNC system was used, which simultaneously supports up to 16 axes with analog or pulse channels (Fig. 1) servo drives with a pulse control channel were used in the feed drive.

A frequency drive with vector control is used as the main drive. To improve the processing accuracy on the contour, optical rulers along all three axes are used as feedback sensors [25-30]. The results of the control tests confirmed that the guaranteed accuracy of the linear dimensions during finishing on a circular contour of 500 mm is no more than 0.02–0.03 mm. In this case, the speed of the working feed reaches 2 m / min.

Fig. 1. Machine-tool after modernization

The modular principle allows you to expand the technological capabilities of the machine and raise quality and productivity. In addition to the basic unit (the machine itself, which has 3 linear axes and a mounted basic end head (Fig. 3), two circular modules were developed and manufactured for rotation in two mutually pedicular axes. m, maximum speed 250 rpm), which allow you to completely abandon the mechanics (gears), as well as reinforced supports in the mechanisms.

To improve the quality of spatial holes in large molds, an additional linear motor was used, and to implement the HSM technology, a high-speed motor was used. For processing small internal technological holes in large parts, an angular accelerating head module is used.

After modernization on a modular basis, the technological capabilities of the machine were significantly expanded. The combination of various module layouts and end-to-end CAD / CAM technology based on 3D models make it possible to consistently process almost any complex parts in one or two installations without the direct involvement of the machine operator. There is no subjective factor, quality is determined only by technology and equipment capabilities. Depending on the current task, various variants of modern multi-axis machining with elements of HSM technology are carried out on one machine.

CONCLUSIONS

Modernization was carried out for specific technological tasks on a modular basis, and also a machine with new technical capabilities was obtained:

- Firstly, by combining turning, milling, processes on one machine, carrying out processing in one installation, we not only increase the overall productivity and quality of processing, but also significantly reduce the total costs (one machine instead of two or more);
- Secondly, given that we use a CAD / CAM system directly with 3D models and with end-to-end network support, this eliminates the subjective factor, which also improves the quality of processing;
- Thirdly, using modern components, you can get the technical characteristics of the modernized equipment, significantly superior to the new serially produced.

In particular, after the modernization of the machine, the accuracy of its processing showed:

• The error of the measuring system is 0.01 mm per meter of length versus 0.1 mm per meter of length in the usual version,

• The real positioning error along the Y and Z axes is no more than 0.01 mm, along the X axis no more than 0.03 mm, while new machines produced by the machine-tool plant are 0.2–0.3 mm with digital display.

It can be concluded that with the right approach, analysis of products and economic justification, modernization can be a rational solution for the development of an enterprise when entering a new technological level.

The modernization of the machines described above was carried out on the basis of an existing small enterprise.

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