Rebuilding of heavy machine tools

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Abstract. The article studies the questions of modernization reasonability, important tasks and activities of heavy cutting machines overhaul.

1. Introduction
Nowadays it is possible to find the use of heavy metal-cutting machines in production which have worked for more than 30 years. The restoration of their physical and moral deterioration requires an individual approach, depending on the conditions of production. One example of such machines is the horizontal boring machine with NC Skoda W200, which is used for drilling, boring, countersinking and milling operations in the production of heavy large parts, the weight of which reaches about 20 tons.

2. Description of the Problem
There is a problem of unsatisfactory accuracy of geometric shapes and the location of the machined surfaces, low positioning accuracy, presence of CNC system failures.

According to the test report on the geometric accuracy, the actual error exceeds the permissible values in several times, and some indicators - in a factor of ten [1,2].

In this regard, the decision to upgrade to restore geometric accuracy and improve the technical characteristics of the machine was made.

An important task of the overhaul and modernization of the equipment is to study all possible options for changing the design, as a result of which it will be more accurate, productive, reliable and safe in operation [3,4].

In modern conditions, when it comes to the reasonability of modernization of technological equipment, conflicting opinions can appear. Some believe that if there is a financial opportunity, it is better to buy new equipment. Others consider that modernization is expedient; firstly, for the economic reasons since the machine park is not enough updated at the enterprises. If we talk about the repair of small serial Chinese machines, then, perhaps, it is not necessary to invest in their modernization, because after three warranty periods parts wear begins, and the purchase of spare parts can take from 6 to 8 months. However, if we are talking about the repair of large and very heavy machines, as horizontal boring machine Skoda W200, worked for more than 30 years, such a new machine costs from 6 to 8 million euros. Technological progress is not as fast in the line of very large machines as in high-speed ones. There is no need for fast feed and high speed in heavy machines. Therefore, in this case, modernization is more appropriate than the purchase of a new machine.

3. Development of Activities for Modernization
According to the nature of the machine defects, identified in the tests for geometric accuracy, the following activities should be performed with major repairs:
1. Bed and saddle slideways repair.
   The bed slideways and racks of a horizontal boring machine are efficiently repaired by grinding. When repairing heavy equipment, the most effective choice is mobile metal-cutting machines, which make it possible to provide high quality machining and save time and money.

   The restoration of the saddle slideways should be performed using polymeric materials. The use of such polymers allows forming a response guide surface directly assembled with the saddle, reducing friction and wearing slideways on the machine bed.

2. Spindle unit repair with manufacturing new bushings and replacement of bearings and tool clamping mechanism.

3. The equipping of the machine with a new NC system, modern frequency converters complete with asynchronous electric motors and a DC Converter of the main drive, modern reference system for coordinate movements.

After equipping the machine with a modern NC system, it is possible to ensure the necessary processing accuracy using software control functions [5,6]. Previously, it was possible to influence the factors that affect the deviation from the geometric accuracy only by adjusting and repairing individual components of the machine. At present, modern NC systems are equipped with intelligent functions to reduce the impact of machine mechanics errors on the trajectory of the cutting edge of the tool. There are the following types of program compensations:

1. Backlash compensation. In the feed drive, the backlash leads to a delay in the movement of the movable body. To compensate for the backlash the movement with each change in direction is adjusted by the amount of correction entered for this axis in the corresponding machine data. The backlash value can be measured by testing the positioning accuracy.

2. Interpolation compensation. It allows to fix positioning errors, errors of misalignment of the movement, unevenness between the axes and the angular error. Correction values, equal to the error values, are determined by testing and recorded in the compensation table of the NC system memory with reference to the position along the axis. The compensated portion of the movement is divided into several sections of the path. The actual positions that limit these sections of the path are designated as "anchor points". The corresponding axis is corrected with linear interpolation between the reference points.

3. Dynamic preliminary control (compensation of error latency). With the help of preliminary control, the axial delay error can be reduced to zero. The delay results in a velocity-dependent error of the contour, especially in acceleration processes at the curves of the contour, such as circles and angles.

4. Friction compensation. It most strongly affects the error in the processing of rest friction in the slideways. The errors of the circuit caused by the rest friction can be well compensated by setting an additional motion pulse with the corresponding sign and amplitude.

5. Drift compensation. Temperature-dependent drift in the analog feed drives means that the analog speed control circuits must be controlled with a small set speed value other than zero to achieve a quiescent state. To prevent this error, a small additional set value of the engine speed is connected.

6. Electronic weighing balance. A mobile node of vertical flow actuators without weight trim inadvertently omitted after release and the error occurs on the axis. Electronic weighing balance prevents the axis with weight loads drawdown when the control is turned on. After releasing the brake, the available constant moment of weight balancing holds the position of the vertical axis.

Compensations are valid in all operating and control modes as soon as the necessary data is entered [7].

4. Conclusion

Implementation of the modernization of the machine with these measures should provide:
• efficiency compared to buying a new machine;
• improved processing performance;
• ability to handle complex surfaces;
• improved processing accuracy.

Reference

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