Working position with recomposed production systems: devices

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Abstract. The article presents the current trends in the recomposed work stand and the terminology used. Technical solutions were considered in order to optimize the use of this system type. Intermodular element of locating and fixing - multi-tiered was proposed. This device contains automatic plug-in units, layout - multi-tiered. Tiered layout does not always meet the requirements of the technical process. Industrial robot for automatic replacement of nodes was proposed.

1. Relevance and terminology

The most common automated production systems, such as automated line (AL) and flexible production systems (FPS), have a number of features that do not allow them to meet modern requirements [1, 2].

To develop the basics of the method for calculating performance and reliability, it was taken into account that AL have the greatest performance, but when switching to a new product release, they require huge investments and are accompanied by downtime, which can last for months. FPS have lower productivity compared to AL, but have considerable flexibility in the transition to the release of new products. It is a high level of flexibility, which is often unnecessary, that leads to a high FPS cost, which, according to manufacturers, is the main disadvantage [3, 4].

The main distinguishing feature of recomposed work stand (RWS) is the property of re-assignment based on the automatic change of aggregate nodes and modules. The inter-unit communication is automatically carried out with the basing and re-fastening of the mating nodes, thanks to the use of automatically replaceable nodes and the implementation of flexible inter-aggregate communication. One of the important issues is the reliability of the line [5, 6]. We get a flexible inter-aggregate communication in the PPP in contrast to the hard (AL, FPS). At each tier and structural level of re-establishment, automation is carried out for changing, basing and re-fixing the interchangeable aggregate assemblies and modules of various functional purposes that mate with each other. For the implementation of flexible inter-aggregate communication, RWS is equipped with built-in intermodular element of locating and fixing (IELF). When placed vertically, the aggregate nodes form a multi-tiered RWS.
An important property of FPS is the possibility of less time consuming replacement of a worn tool [7, 8]. The issue of rapid tool replacement is relevant for processing any materials, for example, steel and cast iron [9, 10]. The test results illustrate the high consumption of environmentally friendly coolant [11, 12]. Also relevant is the changing degree of variation of selected technological parameters, for example, microgeometry using FPS [13, 14].

2. RWS – two devices
Based on the developed technical solutions, the investigated RWS contains vertically arranged in several tiers sets of automatically replaceable nodes, which are interconnected IELF (figure 1).

Among the possible designs of intermodule based devices and fasteners for solving automation of inter-node changing and fastening, an intermodule based device and fasteners was considered, consisting of a body in the form of a plate on which the lower and upper base surfaces of the case are parallel. The lower base surface of the IELF housing is mated and connected to the top with the lower interchangeable node, and the upper base surface is interfacing the bottom with the upper interconnecting automatically interchangeable node. Providing mutual basing and fastening of a pair of adjacent nodes on a tier, the IELF case contains orientation, basing, and fastening mechanisms.

To solve the problem of a multi-tiered re-establishment of the working position, an industrial mounted mounted robot (figure 2), which has CNC operators, is used for simultaneous maintenance of two sets of vertically positioned units. It is allowed to use from one to three auto-operators with CNC while simultaneously servicing three multi-tier sets of nodes of the working position RWS.

Automated operators with CNC industrial robot installed with the possibility of autonomous movement on the upper longitudinal guides above the sets of interchangeable nodes of the working position.
Each auto operator has three groups of movable carriages of welded frame structure:

- longitudinal carriage,
- the carriage of vertical movement on the carriage of longitudinal movement,
- carriages on the carriage of vertical movement transversely located.

In addition, for each auto operator, the longitudinal movement carriage is located relative to the longitudinal guides with the possibility of longitudinal horizontal movement. The carriage of vertical movement is located under the carriage of longitudinal movement with the possibility of vertical movement along the guides. On the carriage of vertical movement there are two movable transversely located carriages. On the transversely arranged carriage, two manipulators with transverse displacement mechanisms inside the transversely arranged carriage and vertically movable gripping device with grippers are installed vertically. The vertical movement carriage contains two transversely positioned carriages that are autonomously movable and controlled from the CNC, where, in turn, each transversely arranged carriage has two autonomously movable and controllable manipulators from the CNC.

At each auto operator in the presence of control of the CNC system, it is possible to move four manipulators with grippers in three coordinates simultaneously.

Conclusions
This technical solution in comparison with the existing working position with a rigid inter-aggregate relation is characterized by the following number of advantages:

1. The possibility of processing on one RWS of several nomenclatures of processed products of different nomenclature.
2. Reduction of the idle time of the working position in case of a change of the removed aggregate node, due to the automatic replacement of the node by the replaced node and the movement of the removed node from the working area RWS.
3. Reduction of the idle time of the working position when changing the nomenclature of the processed product due to automatic change in the layout of the RWS.
4. The possibility of carrying out repairs and maintenance, performing test and control checks of replaceable assemblies without stopping the work of the RWS, by carrying out all the necessary work outside the RWS.

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