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ANALYSIS OF THE FLEET OF MODERN ROBOTIC TECHNOLOGY COMPLEXES IN MECHANICAL ENGINEERING

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Annotation. In modern mechanical engineering, the automation of technological processes is one of the main development trends. The creation of new machines for industrial sectors is directly related to the transition to a system of comprehensive mechanization and automation of technological processes, using automatic machine systems based on the latest achievements of modern science and technology. This article evaluates the effectiveness of the fleet of robotic technological complexes used in modern mechanical engineering production. The variety of modern robotic technological complexes used in mechanical engineering has been analyzed. It has been established that the use of transport robots designed to automate transport operations is a significant innovation in the operation of robotic technological complexes. It has been determined that in modern machine-building production, robotic technological complexes are fundamentally new technological means that allow for the completion of comprehensive automation of production. In the system of comprehensive automation of production, they provide rational technological capabilities for flexible reconfiguration to various technologies and manufactured machine-building products. The article focuses on the fact that the operation of modern robotic technological complexes is characterized by the absence of conveyors, which significantly simplifies the design and increases its reliability. The improvement and modernization of robots in mechanical engineering are aimed at enhancing their technical characteristics and increasing their efficiency.

Keywords: mechanical engineering, automation, robotics, robotics complex, industrial robots, manipulator.

Introduction

In modern production conditions, automation of technological processes in mechanical engineering is one of the main trends in its development. The main requirements for the automation of machine-building production are to increase technological and technical levels at all stages of the production and technological process. In modern conditions of machine-building production, the creation of new machines for industries is carried out in the context of the transition to integrated mechanization and automation of technological processes, using automatic machine systems based on the latest achievements of modern science and technology, in particular electronics. Modern robotic technological complexes (RTC) used in mechanical engineering provide automation of individual technological operations or their combination. The functioning of industrial robots (IR) and RTC is provided by technological automatic equipment, industrial robots and auxiliary devices provided as part of the RTC. According to the functional purpose of industrial robots, there are complexes in which robots perform a number of auxiliary functions for servicing the fleet of basic technological equipment (for example, the functions of industrial robots for automating the loading and unloading of technological equipment by a batch of pieces). Along with this, there are complexes with independent execution of technological operations using portable tools.

Materials and methods.

The stages of RTC construction also depend on the types of automated technological processes, on the characteristics of their organizations, and on the characteristics of the classes of industrial robots used [1-3]. The main equipment of the RTK is the following technological

machines: a fleet of automatic machines, automatic presses, a fleet of foundry machines, plastic recycling machines, etc. Modern industrial robots provide automated loading and unloading operations for technological machines and perform a number of additional maintenance operations (processes of blowing base surfaces, changing tools, mold lubrication processes, etc.).

Auxiliary equipment in the RTC includes complexes of automated storage devices for storing stocks of processing facilities, a set of devices for the initial orientations of processing facilities, a set of devices for piece-by-piece delivery, clock tables and other auxiliary equipment.

During the operation of the RTC, the need for auxiliary equipment is determined by a number of limited capabilities of industrial robots and basic technological equipment. Thus, the main idea of using RTC includes the effective use of industrial robots in combination with certain technological equipment designed to perform one or more specific technological operations. The modern fleet of industrial robots is capable of performing some specific technological operations (painting, welding, assembly, etc.). At the same time, industrial robots perform the functions of basic technological equipment. During these operations, simultaneous and coordinated functioning of several interacting industrial robots is acceptable, which complement each other when performing certain technological operations. The robotics complex shown in Figure 1 includes two production modules and a linear type transport storage device.

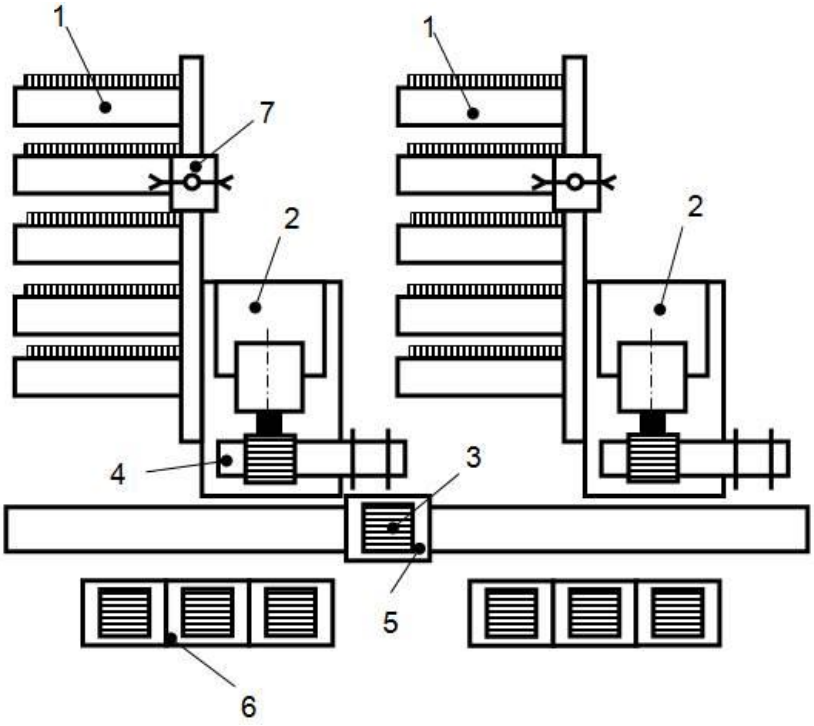

Figure 1 - Industrial robotic complex consisting of two production modules and one linear type transport storage: 1 – tool shop; 2 – PS (processing center); 3 – pallets; 4 – push–pull table; 5 – mobile transport platform; 6 – stationary storage; 7 - suspended transport robot

The interconnection of the stationary transport storage unit with the production module is carried out by means of a mobile transport platform. Using a push-pull table, the workpieces are reloaded from the stands to the machine. The processes of loading blanks into storage units are possible through the implementation of robots, robocars, with minimal piece processing time, simultaneously changing blanks on several stands. The technological processes of feeding tools from transport storage devices are performed independently and in an independent operating mode [4-6].

Research results

A feature of the operation of machine tools of modern robotic technological complexes is the absence of conveyors, which significantly simplifies the design, increases the reliability of the

RTC and provides the possibility of freely embedding any industrial modules into the production system of the machine-building industry.

The fleet of modern robotic technological complexes used in mechanical engineering is diverse and its features are determined by many conditions. In automotive engineering, industrial robots have been widely used to automate the processes of applying protective coatings to products using paint sprayers, during assembly of components and finished products, during maintenance of foundry, forging and electroplating technological machines.

A significant innovation in the operation of RTC is the use of transport robots designed to automate transport operations. In modern robotics and mechanical engineering, the processes of improving and modernizing robots take place in the areas of improving their technical characteristics and increasing efficiency. The functions of industrial robots include the use of information sensing systems that allow additional operations to be performed by providing an image of the production scene, analyzing, processing using microprocessors, and transmitting measurement results to a control device**.**

An analysis of the scientific and technical literature has shown that the most promising areas for the introduction of sensitive industrial robots of the 3rd generation in the machine-building industry to solve the problem and refine the algorithm for its implementation are: mechanical assembly, electric arc and gas welding, oxygen cutting, abrasive stripping and grinding, spray painting, installation and removal of parts from the conveyor, disassembly bulk parts and sorting of products using manipulators equipped with measuring equipment. The manipulator of an adaptive robot is most often a complex multi-link mechanism with anthropomorphic kinematics. For example, one of the most widely used industrial robots at present, Rita, from the company Unimation (USA), includes a 6- or 5-power anthropomorphic manipulator equipped with electromechanical servos. Each degree of mobility is controlled by a DC motor, equipped with feedback potentiometers and code sensors. The manipulator, which is part of the RS1 assembly robot from IBM (USA), is also a 6-power robot. It is equipped with hydraulic drives, has a load capacity of 1.3 kg, and the gripper movement speed is 1 m/s. [7-9]

In machine-building production, the machine-tool equipment of modern RTCs provides a high level of concentration and processes for combining technological processing transitions based on the use of CNC machines that meet these requirements and have fully automated work cycles, including operations for switching speeds and feeding cutting modes, operations for automated product fixation and automatic change of metal-cutting tools. Control automation processes in the processing process provide technological capabilities for performing automated functions of supplying lubricating and cooling fluids (coolants) to the cutting area

Increasing the reliability of the RTC requires providing a reliable automation system for crushing and chip removal operations. The movement of machine components: pinoles, tailstock, fences related to the operation of industrial robots are equipped with sensors to fix their final positions. The machines of the RTC turning group provide quick stops of the spindles after processing, Automated preloading of workpieces to the bases of devices is used when using RTK cartridge machines. SHL (Germany) manufactures multifunctional robotic machine-building complexes for deburring, milling, brushing, grinding and polishing booths, production and loading lines, etc. Fully automated processes are more accurate, faster and much more economical. All the equipment is designed and assembled from proven components, modern electronics and software. In addition, several processes can be interconnected to achieve a greater degree of automation.

Automation of the RTC drilling and milling machine tools provides for the loading and unloading of parts by robocars at certain positions of the work tables, eliminating the possibility of contact edges of gripping devices or workpieces with cutting edges of tools. To perform automatic stop operations with loose or incorrectly fixed workpieces in the process equipment, the use of locking devices is provided in the RTC machine tool equipment. The machine tool equipment of modern RTC, taking into account the fact that in conditions of small-scale and mass production, with multi-stage processing of large parts with long piece service time, it is recommended to use suspended robots, provides for the use of floor robots for efficient processing of relatively small

parts with short processing time, which do not complicate machine maintenance. To solve these problems, the use of floor robots involves a complex of universal robots installed permanently or on movable rail trolleys moving along machine equipment, a complex of suspended transport robots moving on monorails and specialized robots as part of automatic electroplating lines.

Discussion

The layout of the control panel is its most important characteristic, it is made according to the criteria of compactness, service time from the conditions for ensuring a given technological process of processing the product and characterizes the following features: the type of coordinate system of the main movements and its orientation; the number of degrees of mobility and movements; the number of gripping devices. Along with this, the characteristics of the IR are the nominal load capacity, structural kinematic schemes, type of control, geometric, speed and accuracy characteristics.

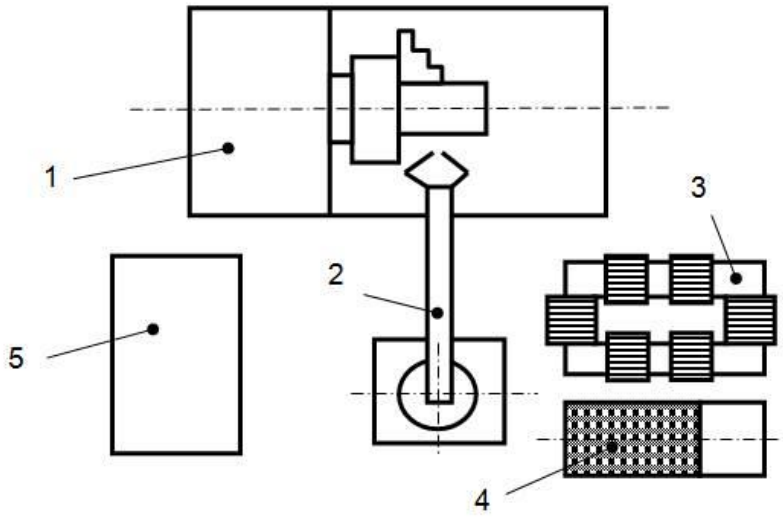

Figure 2 - Diagram of a single-stand RTC layout with a floor covering: 1 – machine tool, 2 – floor robot, 3 – storage of blanks and finished parts, 4 – tool shop, 5 – RTC control system.

In mechanical processing, suspended, floor-mounted and built-in types are used.

The following RTC layout solutions are most widely used:

- single–stand - from a single machine operated by a control unit located above the machine (suspended control unit), next to the machine (floor-mounted control unit) indicated in Figure 2 or integrated into the machine;

-multi-point circular layout with the use of floor coverings;

- multi-point linear and linearly parallel based on portal systems.

Conclusions. The main sources of economic efficiency of RTC machine tools are:

- increasing the productivity of equipment, i.e. the volume of output from the main technological equipment serviced by the robot, or increasing labor productivity in operations performed by an industrial robot;

- increased labor productivity as a result of the replacement of manual labor in auxiliary, transportation and basic technological operations;

- increasing the rhythm of production;

- increasing the equipment shift ratio without increasing the number of workers;

- reduction of losses related to the subjective characteristics of a person (constant working hours during a shift);

- reducing the percentage of defects and increasing the stability of product quality;

- reducing the size of working capital in work-in-progress.

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МАШИНА ЖАСАУДАҒЫ ҚАЗІРГІ ЗАМАНҒЫ РОБОТТАНДЫРЫЛҒАН КЕШЕНДІ ТЕХНОЛОГИЯЛЫҚ ПАРКТІ ТАЛДАУ

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Аңдатпа. Қазіргі машина жасауда технологиялық процестерді автоматтандыру дамудың негізгі тенденцияларының бірі болып табылады. Өнеркәсіп салалары үшін жаңа машиналар жасау қазіргі заманғы ғылым мен техниканың соңғы жетістіктеріне негізделген машиналардың автоматты жүйелерін пайдалана отырып, технологиялық процестерді кешенді механикаландыру және автоматтандыру жүйесіне көшуге тікелей байланысты іске асырылады. Мақалада қазіргі заманғы машина жасау өндірісінде қолданылатын роботты технологиялық кешендердің Станок жабдықтарының паркінің тиімділігі бағаланады. Машина жасауда қолданылатын заманауи роботтандырылған технологиялық кешендер паркінің әртүрлілігі талданды. Роботтандырылған технологиялық кешендерді пайдаланудағы маңызды жаңа өсім көлік операцияларын автоматтандыруға арналған көлік роботтарын пайдалану болып табылатыны анықталды. Қазіргі заманғы машина жасау өндірісінде роботтандырылған технологиялық кешендер өндірісті кешенді автоматтандыруды аяқтауға мүмкіндік беретін түбегейлі жаңа технологиялық құралдар болып табылады. Өндірісті кешенді автоматтандыру жүйесінде олар әртүрлі технологиялар мен өндірілген машина жасау өнімдеріне икемді қайта құрудың технологиялық мүмкіндіктерін ұтымды қамтамасыз етеді. Мақалада заманауи роботтандырылған технологиялық кешендердің станоктық жабдықтарын пайдалану конвейерлердің болмауы болып табылады, бұл дизайнды едәуір жеңілдетуге, олардың сенімділігін арттыруға мүмкіндік береді. Машина жасаудағы роботтарды жетілдіру және модернизациялау процестері олардың техникалық сипаттамаларын жақсарту және тиімділігін арттыру бағыттарында жүреді.

Түйін сөздер: машина жасау, автоматтандыру, роботтандыру, робототехника кешені, өнеркәсіптік роботтар, манипулятор.

АНАЛИЗ ПАРКА СОВРЕМЕННЫХ РОБОТИЗИРОВАННЫХ ТЕХНОЛОГИЧЕСКИХ КОМПЛЕКСОВ В МАШИНОСТРОЕНИИ

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Аннотация. В современном машиностроении автоматизация технологических процессов является одной из основных тенденций развития. Создание новых машин для отраслей промышленности реализуется непосредственно в связи с переходом к системе комплексной механизации и автоматизации технологических процессов, с использованием автоматических систем машин базирующихся на последних достижениях современной науки и техники. В статье выполнена оценка эффективности парка станочного оборудования роботизированных технологических комплексов используемых в современном машиностроительном производстве. Проанализировано разнообразие парка современных роботизированных технологических комплексов, применяемых в машиностроении. Установлено, что существенным новообразованием в эксплуатации роботизированных технологических комплексов является использование транспортных роботов, предназначенных для автоматизации транспортных операций. Определено, что современном машиностроительном производстве роботизированные технологические комплексы являются принципиально новыми технологическими средствами, позволяющим завершить комплексную автоматизацию производства. В системе комплексной автоматизации производства они рационально обеспечивают технологические возможности гибкой переналадки на различные технологии и изготовляемые изделия машиностроения. В статье сделан акцент на особенность того, что эксплуатации станочного оборудования современных роботизированных технологических комплексов является отсутствие конвейеров, что существенно позволяет упростить конструкцию, увеличить их надежность. Процессы совершенствования и модернизации роботов в машиностроении происходят в направлениях улучшения их технических характеристики и повышения эффективности.

Ключевые слова: машиностроение, автоматизация, роботизация, робототехнический комплекс, промышленные роботы, манипулятор.