Journal of the Technical University of Gabrovo

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FROM HAND MACHINE TO INTELLIGENT MOBILE MACHINE – ROBOT

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ARTICLE INFO

Article history:
Received 26 October 2023
Accepted 20 November 2023

Keywords:
automation, machine tool, robotics, motor-spindle, genetic prediction

ABSTRACT

The analysis of the evolution of technical systems, which include machine tools, shows the significant impact of industrial revolutions on the change in the structural and functional features of new generations of technology. Using the convergence of knowledge and an interdisciplinary approach, it is possible to carry out long-term genetic prediction during the transition from manually controlled machines to intelligent mobile robots, on which the processing of products is carried out while moving from the loading position of the workpiece to the unloading position of the finished product.

1. PROBLEM STATUS

All human activity is aimed at meeting social and personal needs, which forces people to interact with the surrounding nature and enter into certain relationships with each other. In the process of such activity, Man creates and continuously complicates existing anthropogenic systems (from the Greek anthropos - man, genesis - origin, formation of a developing phenomenon), which are created as a result of consciously directed human activity. Sometimes scientific and technological progress harms humanity; there are more than enough examples in the recent history of earthly civilization. Advanced nuclear, chemical and biological weapons, which are from the point of view of abstract science a masterpiece and the crown of high technologies, have turned into real power today, capable of changing the world map and influencing the fate of millions of Earth's inhabitants. Under the influence of external influences of the environment or Man, elementary solid bodies can have or acquire different solid forms, changing. If we turn to the origins of the creation of mechanical systems by Man, the tools of the Stone Age represented simple forms of bodies, on the basis of which all subsequent inventions in mechanics appeared [4]. It is from such positions that one can trace the development of technology from the past through the present to the future, using the example of the evolution of the development and synthesis of machines, as machines that create other machines, using geometric constructions for this. In the history of the development of technology, with the advent of machines, they began to talk about industrial revolutions (Fig. 1). The first industrial revolution occurred with the advent of the steam engine in the second half of the 18th century, making the transition from manual labor to machine labor. The second industrial revolution is connected with the discovery and development of electricity and the emergence of conveyor production. The third industrial revolution began in the second half of the 20th century with the creation of electronic computing machines, and then digital computers - the basis of information technologies (IT technologies). A few years ago, humanity faced the challenges of the fourth industrial revolution "Industry 4.0" with the widespread penetration of automation, robotics, informatization, communication and everything related to society, business, production and education. And today we have come closer to "Industry 5.0" and "Society 5.0".

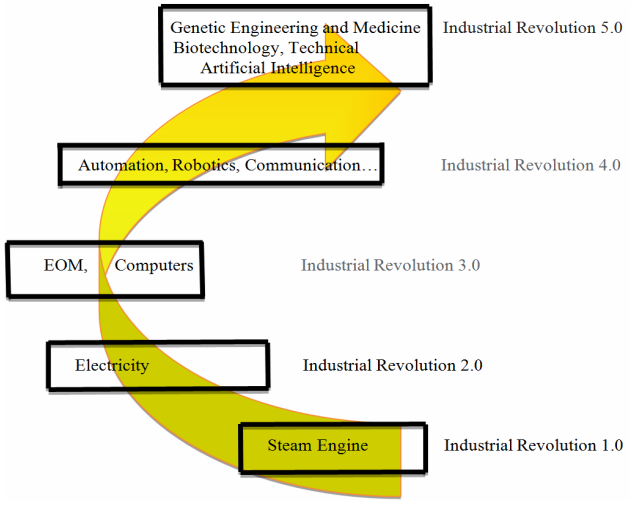

Fig. 1. Industrial revolutions and their impact on the evolution of technical systems

The founder of the World Economic Forum, Klaus Schwab, noted that the time has come for the mass adoption of cyber-physical systems in production, which blurs the boundaries between the physical, digital and biological

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http://doi.org/10.62853/QOAT3195

spheres. There have been smart robots, drones, smart homes and cities, brain research, and a product in the process of being released can itself identify the equipment capable of producing it.

2. RESEARCH RESULTS

Everything that happens in the 21st century can be explained only by using the laws of evolution of systems of various origins, which are felt in computer engineering, electromechanics, automobile engineering, aircraft engineering, robotics, solid body mechanics, including industrial machine tools and equipment.

Electromechanics became one of the first technical disciplines where the foundations of the theory of genetic evolution of the structures of electromechanical systems were developed [6], in which the genetic classification of the primary sources of the electromagnetic field and the resulting electric charge was carried out. Using the interdisciplinary approach of electromechanics and mechanics, the world's first autonomous (hybrid) motor-spindles were created (Fig. 2) and a single information language was proposed to describe electromechanical (electric motors) and mechanical (bearings) systems with identical genetic codes.

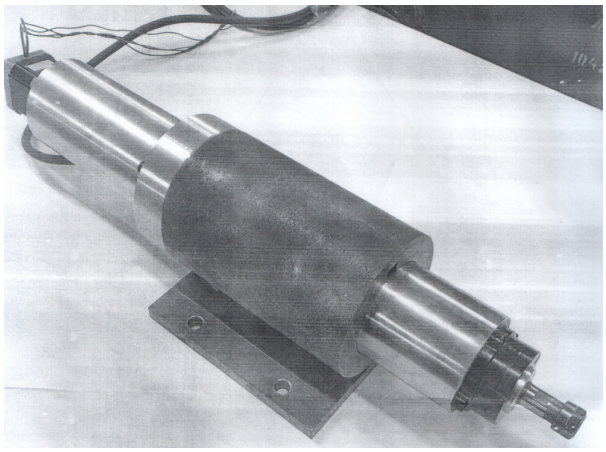

Fig. 2. Modular design of the self-acting motor-spindle

The use of high-speed motor-driven spindles (M-S) in multispindle automatic and semi-automatic lathe machines allows to discard the gears from the main drive (past) (Fig. 3a), as well as individual motors with couplings (present) (Fig. 3, b) and significantly shorten kinematic chains and the mass of the spindle carrier (SC) (future) (Fig. 3 c,d) [4, 5].

Even now, if desired, and state support can be resumed in Ukraine production of competitive multi-spindle automat lathe CNC (Fig. 4), using the latest scientific achievements [4].

The questions of philosophy and the construction of the future, which is connected with genetic prediction, become relevant. An example of scientific genetic prediction is the multi-purpose machine-robot of the future (Fig. 5).

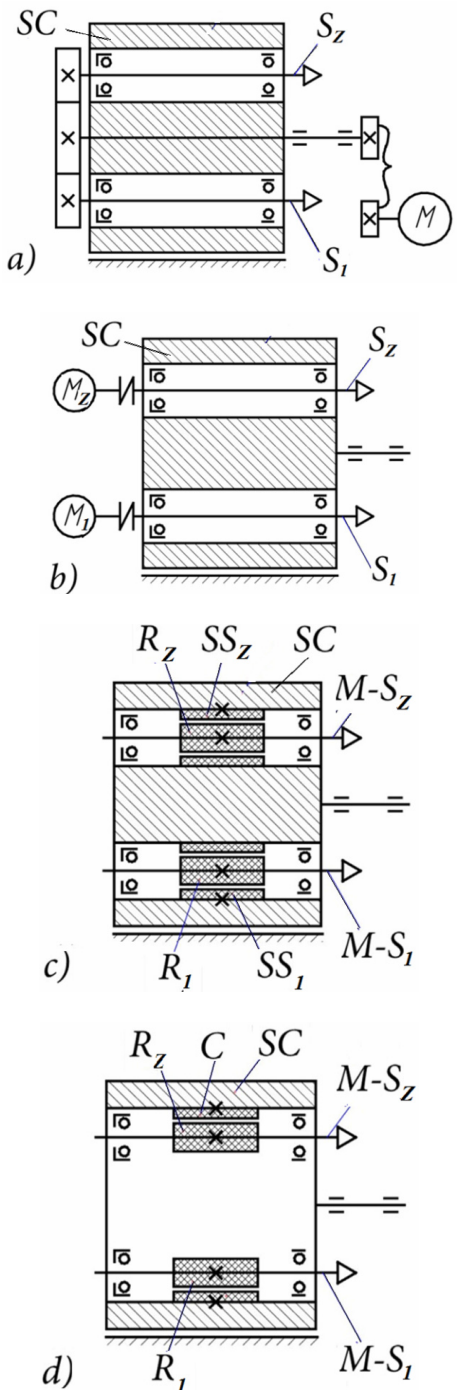

Fig. 3. The evolution of the main drive motor (spindle rotation) in multi-spindle automatic lathe machine with a rotating spindle carrier (SC): a) – past; b) – present; c) and d) – future; M - main drive motors; M_1…M_Z – spindle drive motors S_1…S_Z ; M-S_1…M-S_Z – motor-driven spindles; SS_1…SS_Z – motor-driven spindle stators; R_1…R_Z – motor-driven spindle rotors; C – common stator for all M-S

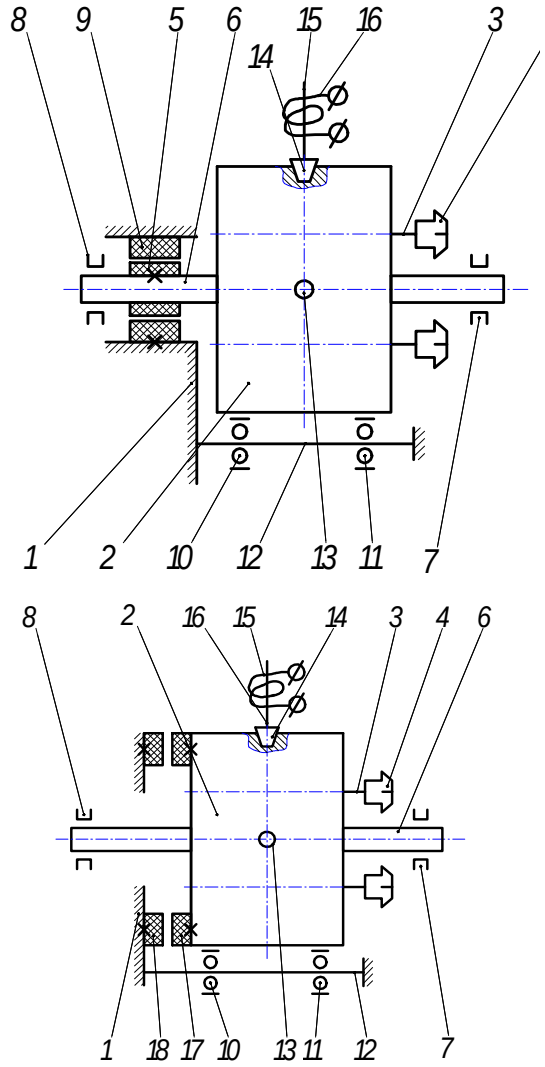

Fig. 4. Options for turning and fixing the spindle drum mechanism (Ukrainian patent No 113751): 1 - housing; 2 - spindle drum; 3 - spindles; 4 - chucks; 5 - rotor; 6,12 - axis's; 7 - front support; 8 - pillar support; 9 - stator; 10,11 - bearings; 13 - locks; 14 - fixing clamp; 15 - anchor; 16 – electromagnet

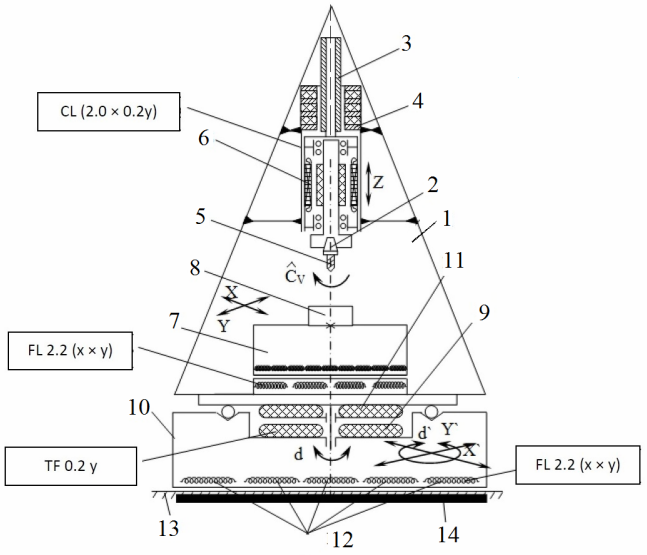

Fig. 5. Multi-coordinate mobile drilling and milling machine-robot of the future without mechanical transmissions (Ukrainian patent No. 101447) with genetic formulas of nodes (mechanisms)

Multi-coordinate mobile drilling and milling machine-robot contains a support system 1 with a tool block 2, which has a vertical feed mechanism 3 (Z coordinate) from the motor 4. The cutting tool 5 is fixed in the motor-spindle 6. The lower part of the support system 1 contains a two-coordinate table 7, made in the form of an electromechanical system of plane-parallel movement. The processed workpiece 8 is installed and clamped on the table 7. To rotate the support system 1, a flat-toroidal motor is designed, the stator 9 of which is rigidly connected to the base 10, and the rotor 11 is connected to the support system 1. The element 12 of the electromechanical system of plane-parallel movement is mounted in the base 10, which ensures the movements of the base 10 relative to the floor 13, the magnetic wire 14 of which forms the trajectory of the movement of the machine tool within the limits of the workshop.

A long-term prediction with a probability close to 100% on the basis of genetic prediction can be presented as a pyramid of prediction by levels [3-5]:

I. Ultra-precise mini-machines, which are quickly assembled from modules in a case with an integrated computer control system, implementing nanotechnology;

II. Desktop machines or 3D printers with artificial intelligence, controlled from a computer (smartphone) or a chip in a person's head;

III. Floor (ground) mobile multi-coordinate robot machines with a supporting frame-shell system that move around the workshop and simultaneously process parts;

IV. A building (workshop) with a workpiece installed on the floor (perhaps grown with the help of a 3D printer), along the walls and ceiling of which intelligent robot machines move;

V. An open area under a canopy, on the floor of which a workpiece (perhaps grown with the help of 3D printers) is installed, and around it and on it move intelligent robot machines with tools of various purposes and performance.

For the machine tools of the future, when the shape of the workpiece approaches the shape of the finished part, i.e. with a significant reduction of removable allowances, cutting forces and at high processing speeds, as well as with the transition to frame and shell bearing systems (frames, columns, racks, etc.), the weight of the machine in relation to the weight of the part is radically reduced, the need for in foundations, ranging from mini-machines to unique ones. Machine builders are waiting for new discoveries at the intersection of different sciences. No phenomenon of Nature, as the main creator, can be fully understood without the application of the laws of mechanics, awareness of their mechanical essence, and no new technique can be created without using certain objective regularities in the analysis and synthesis [1]. Therefore, mechanics is one of the foundations of the progress of natural science and technology yesterday, today, and tomorrow. Reasoning logically, it can be argued that all sciences dealing with mechanics should be united under the general name (concept) "genetic mechanics", where, depending on the environment, the information language of description (modeling) at the genetic level can be the smallest (simple) particle (a gene in the form of an electron, electric charge, atom, molecule, bit, single wave, etc.).

Historically [2], with the advent of electric motors, software control systems and the modular principle, the number of layout options, for example, drilling and milling machines, has increased. However, the genetic information about the presence of a person near the machine tool and the location of the control panels on one side of the work

area was inherited, which did not change the layout principle, leaving it asymmetrical. Returning the layout of drilling and milling machines to genetically embedded symmetry and using the achievements of technical systems, electronics and informatics allows creating a new generation of machines with open access from different sides with a support system in the form of various types of symmetrically shaped frames.

3. CONCLUSIONS

Scientifically based forecasts for the 21st century will surprise the inhabitants of the Earth with an all-conquering celebration of genetics, cybernetics, chemistry, bionics, cosmonautics, nano-robotics, as well as the creation of: the first electronic copy of a human personality with super high brain abilities - emergence; computers with ultra-high capacities; humanoid robots equipped with emotions; conditions for a significant extension of longevity; new materials with specified properties. A strategic slogan should be adopted: "The main creator is Nature, and Man is one of her unsurpassed creations and a creator after his own likeness".

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