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New Approaches To The Substantiation Of The Concept Of Optimum Of The Technological Process Of Manufacturing Facilities Of Atomic Power Engineering

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Abstract
The article considers the new approaches while substantiationing the conception of an optimal technological fabrication process of heavy large-sized case-shaped constructions of atomic power engineering. The WTFM- «work piece - tool- fixture-machine» system is proposed instead of known MFTW system - «machine- fixture-tool-work piece». This system makes it possible to use small-sized mobile technological equipment that can be located on the processed object and used as the base instead of using heavy large-sized technological equipment. Exemplary drawings of modern and proposed processes with technological equipment using in the course of the machining process and relocation of the objects are shown. The example of using heuristic methods during the projection of technological processes with technological equipment that are used in the course of the machining process and relocation of the objects with the use of wildlife examples- «the principle of a spider», «the principle of an ant», «the principle of a beaver». The use of well-grounded factors of quality during the projection of technological process allows minimizing decision makers influence in the course of the projection.

Keywords: process, new approaches, heuristic methods, atomic power engineering.

Introduction

The objects of atomic power engineering are characterized by the presence of large-sized massive heavy-walled parts and assembly units working at high temperatures and pressures and ensuring safety in the course of transubstantiation of atomic energy into heat, mechanical, and electric energy.
Let's have a look at the scheme of a technological fabrication process of the case-shaped equipment of the water-water energetic reactor (WWER)installations- cases of reactors, steam generators, pressure compensators, capacities of the system of emergency cooling of atomic reactor zone. These are the objects of the cylindrical form which are made of cylindrical shell rings and the ellipsoidal bottoms welded in a single assembly unit with reducing pipes for a connection with water, vapor-water, and gas- vapor systems.
Traditionally the technological machining process of that objects was projected on the basis of the MFTW system - «machine- fixture-tool-workpiece». According to this system the machine is chosen on the basis of mass-overall characteristics of the processed detail.
It's to be noted that earlier modern technological machining processes of constructions of atomic power engineering were projected unopposed exactly with the use of the MFTW system's basis, without the use of searching inventive methods at the projection, but with decision maker's conclusive influence (DM).

The solution of the equation of the extreme current line

Figure 1 presents the scheme of the machining process, relocation and canting of the cylindrical heavy-walled shell rings of the WWER type reactor's case.

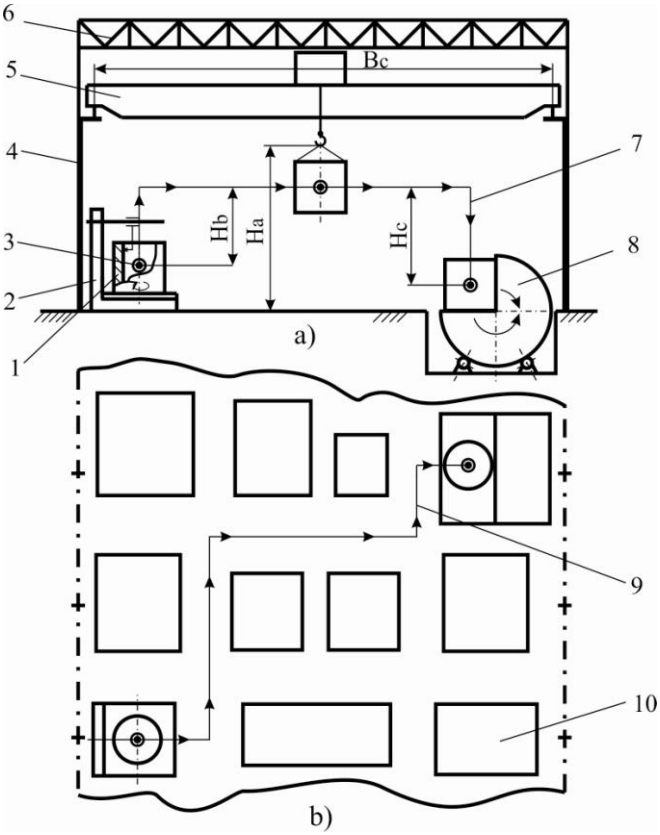

Figure1: The scheme of the relocation and canting of the objects in the course of the machining process according to

the traditional technology 1- the cylindrical heavy-walled shell ring; 2 – the turning-and-boring machine; 3 – the center of mass of the shell ring; 4 – the bearing crane way columns; 5 – the bridge crane; 6 –the buildings structures of the ceilings; 7 –the center of mass of the shell ring motion trajectory in the frontal projection; 8 – ground-type canting machine; 9 – the center of mass of the shell ring motion trajectory in the horizontal projection; 10 –metal processing equipment; H_a – the stroke of the hook of the crane; H_b, H_c– the stroke of the center of mass of the shell ring in the course of relocation and canting; B_c– the width of the span of the crane.

The shell ring 1 is installed on the turning-and-boring machine 2 with the use of the bridge crane 5; after the machining process the shell ring 1 moves on the trajectory 7, 9 on the canting machine 8 it is reinstalled on the processed butt end, later the shell ring is returned on the machine 2 for the machining process of the unprocessed butt end.

In the course of the relocation and canting of the shell ring 1 it is necessary to do 9 realigning – in the course of the location on the machine, in the course of resigning that are carried out while the installing on the track-type platform, in the course of installations and the removal of the shell ring on the ground-type canting machine and its backspacing to the machine.

It's to be noted that in the course of movement there is a lift motion of the object on the height of H_b and $H_c$in the course of the relocation and canting at the stroke of the hook H_a of the crane. The process of the relocation of the shell ring lasts, as motion studies observations present, a few hours.

The mass of the turning-and-boring machine M_c for the machining process of the object is 2 … 5 times greater than the mass of the object M_o; the mass of going round parts of the machine is close to the mass of the object. During the machining process on the turning-and-boring machine a cutter feed is not significant, the object revolves with the circular table together and that demands considerable energy consumption.

The process of the relocation and canting of the object demand also considerable energy consumption because the object changes its location with the crane together the mass M_k of which is greater than the mass of the shell ring M_o, especially at the great width B_c of the span of the crane.

The metal processing equipment that is used according to MFTW system is notable for the great mass-overall characteristics; the bearing crane way constructions and the buildings structures of the ceilings of a shop have also considerable mass-overall characteristics. In view of that the technological machining process of the objects of atomic power engineering on the basis of the MFTW system is very expensive.

Alternative system

Let's have a look at the alternative scheme of the technological machining process on the basis of the WTFM-«work piece- tool- fixture-machine» system as can be seen from Figure 2.

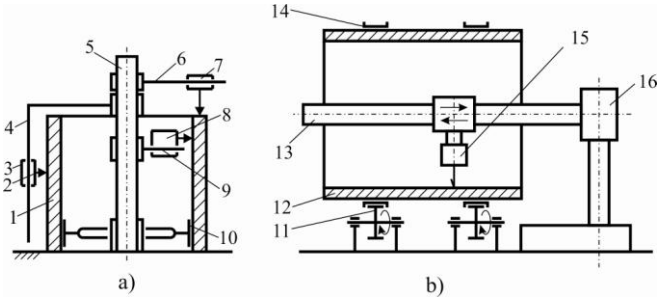

Figure 2: The scheme of application options of mobile metal processing blocks in the course of the machining process of the shell ring and blocks of the welding equipment. 1- the shell ring; 2- the cutting tool; 3 – the mobile metal processing block for processing of an external surface of the shell ring; 4 – the bracket-like rotary column; 5 –the basic bearing pipe column; 6 – the rotary column for the block of the machining process of a face surface of the shell ring; 7 – the block for the machining process of the butt end of the shell ring; 8 – the block for the machining process of an internal surface of the shell ring; 9 – the rotary column for the block 8; 10 – the basic fixing block for the installation of the basic bearing column. 11 – the power-operated roller carriage; 12 –the shell ring; 13 – the basic horizontal column; 14 – the directing ring; 15 – the welding machine; 16 –the basic mobile adjuster.

The shell ring 1 here serves as the basic element-the case-surfaces of which are possessed by the cutting tools that are put in mobile metal-cutting blocks 3, 7, 8 moving to the columns 4, 6, 9. The basic element of the complete construction is the basic bearing column that is lodged by the spacer block 10 on an internal surface of the shell ring 1. The milling block serves as a metal-cutting element, providing minimal power consumption while cutting. It provides minimal power consumption in the course of the cutting process.

In the course of the machining process of the rough butt end the relocation of all the equipment s carried out in-place with the use of ground-type pickup manipulating devices.

The welding process of shell rings in blocks and surfacing of their internal surfaces can be carried out according to the diagram presented on the Figure 2, b. Then on an external surface of the shell ring or on the block of shell rings the pilot rings 14 are installed, the power-operated roller carriages 11 rotate the shell ring 12 (or the block) under the condition that the basic horizontal column 13 was installed precisely at axle of an internal surface of the shell ring. The welding machine 15 moves on the column 13 installed on the basic mobile adjuster 16.

Possible ways of the installation of the basic horizontal column on the mobile block that is fastened on the butt ends and on an external surface of the processed shell rings or blocks; the suitability of application of the mentioned options is proved by engineering calculations on durability, stability and guarantee of ensuring the demanded quality of the welding process or surfacing.

A movement of the shell ring on refusal to use travelling cranes can be made according to the diagram presented on the Figure 3.

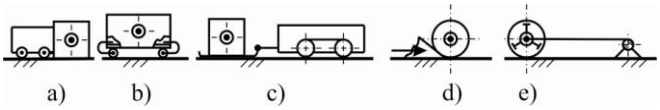

Figure3. The scheme of possible ways of the installation of the objects with the use of: a) –; b) – advance operating blocks; c) – the pallet and towing machine; d) – wedge assembly; e) – the spacer devices on the object and the stationary ground-type pulling winch.

It is possible here to use the power-fed automated lift truck (a), advance operating blocks (b), the pallet with the object and towing machine (c), the moving wedge assembly for the over rolling of the object (d), the spacer elements on the object and the stationary ground-type pulling winches with fixing of the hauling cable at the spacer elements axis (e) that provides over rolling of the object.

Two schemes in the Figure 2 show a possibility of using the ground-type equipment [1] at obvious simplification both of machining processes of the objects and their relocation and canting.

The schemes of the machining and welding processes and surfacing of the objects presented in the Figure 2 show a possibility not to use the heavy metal-working machines [1, 2].

The Figure 3 explains a possibility of using ground-type transport instead of the heavy equipment of bridge cranes.

Heuristic methods

The mentioned schemes are got with the use of heuristic methods of finding the best technical solution [3-5] at creation new objects. The wildlife examples are used: the principle of "an ant" - a lifting and relocation of massive objects by small-sized modules (the scheme 2b, 2D), the principle of "a spider" (Figure 3c, 3e), the principle of "a beaver" – a milling, (Figure 2a).

The use of heuristic methods at projecting of the technological processing of atomic power engineering constructions [1] allows to prove the conception of using the mobile metal-working blocks not only in the course of the machining process [2], but also in the course of the deinstallation the massive large-sized radioactive equipment [1, 2, 6].

New approaches for finding the closest one to optimum technological machining process of the objects of atomic power engineering consist in the following:

1. The analysis of the form mass-overall factors of objects of the processing and technological equipment in the form of the mobile metal-working and transporting blocks with the use of objects as the case (a frame) has to be the basic part at the beginning of projecting.
2. The analysis of several perspective options that are found be the group of designers and engineering managers with the use of heuristic methods has to be included in the technological process projecting.
3. Criteria of an optimality: the general: – minimum specific power consumption of the process; minimum cost of the machining process; minimum time of the process; the ensuring the demanded quality; the process safety.

Conclusion

The modern practice of the projecting of technological fabrication processes of atomic power engineering constructions doesn't use heuristic methods that lead to increasing of a capital production capacity and the cost of constructions.

With the use of the mentioned approaches the influence of the decision maker in the course of the projecting will be minimized because in the presence of several options their assessment according to reasonably accepted quality criteria will allow then to make the objective decision, the closest to optimal one.

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