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CLASSIFICATION OF FUNDAMENTAL TECHNOLOGICAL MODULES

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The classification and coding of fundamental technological modules during their unification, which are the basis for modern methods of digital production preparation, are proposed.

Description of the product design with a variety of modules. Engineering products are distinguished by a huge, continuously growing variety. Therefore, in these conditions, it is important to build a single database of product designs and their parts. The existence of a single base allows you to manage the development of product designs, minimize duplication in the creation of new designs and effectively develop technologies for their manufacture [1, 2].

To solve these problems, first it is necessary to obtain information on the characteristics of product designs (PD). The traditional description of the PD includes an assembly drawing, detail drawings, an explanatory note and does not meet modern requirements. In the drawings, significant parts of the numerous characteristics are presented in an implicit, weakly formalized form. Therefore, in the part drawing the number of surfaces, their functional purpose and the connection between them are not indicated. To eliminate the noted deficiencies, a PD description with the help of set of modules is proposed [3].

Let's take a module of parts (MP) of a product as PD modules and a module of surfaces (MS) as module of part of surface. The process of joining together MP parts and MS detail surfaces is determined by the stage of the product's life cycle since at different stages MP and MS perform different roles and are represented by a different composition respectively of parts and surfaces.

Thus, the product can be represented by a set of MP, and if all details replace the sets of MS, then PD can be represented by a set of MS. The modular structure of PD can be described by a graph of a hierarchical structure, the top of which is the basic detail. For example, in a metal cutting machine, the base part is a bed.

PD graph is constructed in the following way. First, we determine the basic part of the product and take it as the top of the graph, then we establish the elements of the PD (MP or parts) installed on the base part, after that the elements installed on the elements of the previous level are specified. The graph is constructed in this way up to the last item.

As a result, we get a graph, an example of which is shown in Figure 1.

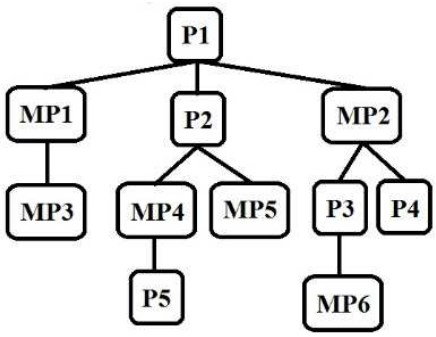

Figure 1. – Product graph

Now, to describe the PD, we'll use such characteristics of the graph as numbers of elements, levels, nodes, nodes at each level, and branches.

The edges of the graph indicate the coordinating dimensions connecting the sets of bases parts, which are the main auxiliary bases.

The main bearing surfaces are the surfaces by which the part is installed into the product, and the auxiliary based surfaces are the surfaces on which other parts are mounted on the part.

The graph node has information about the PD element characteristics. For example, if a node reflects a detail, then its mass, overall dimensions, material, etc. are indicated. It is advisable to show the characteristics of the nodes in tabular form.

Depending on the level of the PD detail description, graphs of three levels can be built. They are MP and parts not included in their composition (first level), details (second level), MS (third level).

Similarly, the surface of the part is intended to perform, respectively, some service functions. These modules are denoted as MPF and MSF.

According to the functional feature, MPF and MSF should be divided into functional technological modules (MFT, MST) and service functional modules (MFS, MSS).

MFT is a PD part with which the PD performs its official function;

MFS is a PD part which allows the MFT to fulfill its purpose.

MST is a combination of a part surfaces, with the help of which the part performs the corresponding service function;

MSS is a combination of surfaces with the help of which MST fulfills its purpose.

Combination of MPF parts and the MSF part surfaces on a functional basis ensures the unambiguity of their definitions.

For example, in the case of a lathe a spindle assembly with a chuck (MFT1) for setting the workpiece and a tool holder (MFT2) for installing the tool act as a MFT.

To ensure the law of relative motion of the MFT1 and MFT2, the gear box MFS1, the gear box MFS2, and the engine MFS3 serve as the MFS.

In the case of an MTF vehicle, a body for placing a load (MFT1) and a chassis (MFT2) to ensure the movement of the vehicle are used, and as an MFS are an engine (MFS1), a transmission (MFS2) and other devices that ensure that the MFT performs its functions.

As for the part, it is generally needed for the product to perform the workflow and is used for installing other parts on it. Therefore, the base modules and work surface modules act as MST for the part.

For example, in a gear wheel, a set of side surfaces of the teeth for transmitting torque and a second MST — a set of bases: an end, a hole, and a side surface of the key groove for mounting a gear in the product act as one MST.

To fulfill its official purpose, the listed MST are combined into a part with the help of connecting surfaces united in MSS.

Classification of functional technology modules. For the presentation of the details of the MSF set, the following classification is proposed.

By their service, all MSF can be divided into three classes: basing (MSB), working (MSW) and connecting (MSC). Such a division of the MSF gives them an unambiguous definition and is the main difference and advantage of this classification.

The next step in the development of the classification of the MSF is the division of each class into subclasses, groups and subgroups. Therefore, further each MSF class should be subdivided according to the constructive and geometrical features.

In Fig.2. a classification of MSF types is given, from which it follows that it contains 26 types of MSF, 14 of which are of MSBs type and 6 are of MSW and MSC types. Their examples are shown in Fig.3.

For the top of the graph we take the PSB, which acts as a set of main bases for the part. At the second level MSF are located, the design base of which is the first MSF level. At the next level, there are MSFs, the design base of which is the MPF of the previous level, and this continues to the last MSF details.

The graph of the MSF details shows its structure at the modular level, the MSF composition and the level of the design complexity. On the edges of the graph the MSF coordinating dimensions tolerances can be indicated.

Conclusion. The description of a product structure with the help of a hierarchical graph at the first level makes it possible to identify functional technological modules of the product and, on their basis, to construct a unified classification of products as exploitation objects. Representation of parts by a set of modules allows to identify modules of based, working and connecting surfaces and on their basis to build a single classification of parts, focused on different stages of the product life cycle.

The proposed unified methodological base allows you to manage the development of product designs, eliminate duplication in the creation of new designs and effectively develop technologies for their manufacture.

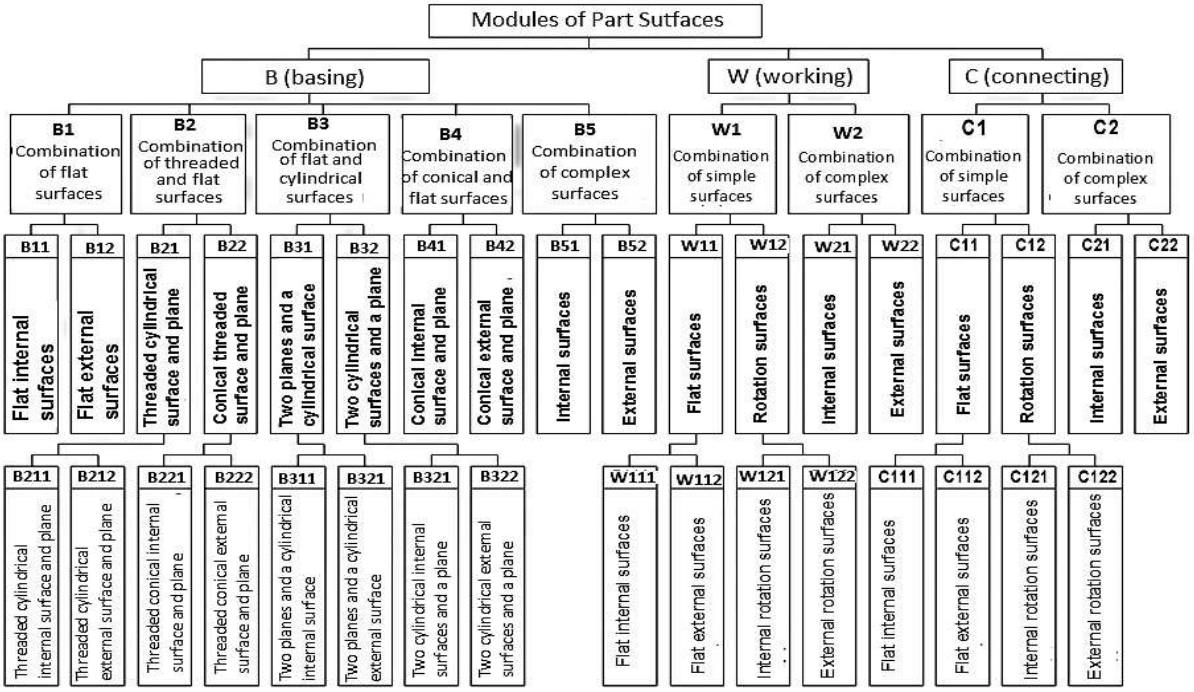

Figure 2. – Classification of MSP

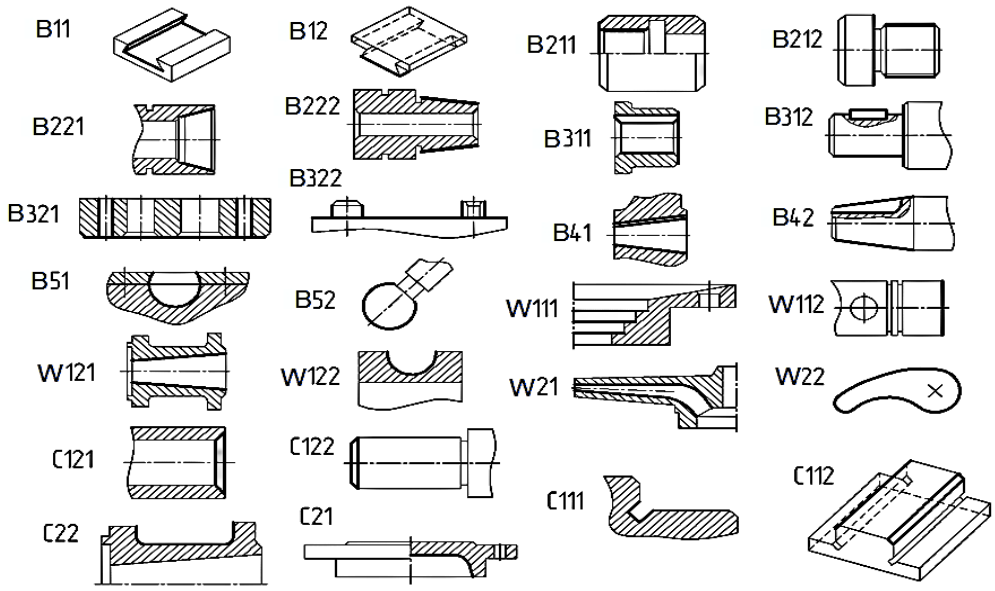

Figure 3. – Examples of constructive design types of MSF

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