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PERSPECTIVE DIRECTIONS IMPROVEMENT OF TECHNOLOGICAL METHODS MANUFACTURING WORM AND SCREWS BLANKS IN THE PRODUCTION OF SCREWS TYPE DETAILS

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ПЕРСПЕКТИВНІ НАПРЯМКИ ВДОСКОНАЛЕННЯ ТЕХНОЛОГІЧНИХ МЕТОДІВ ВИГОТОВЛЕННЯ ГВИНТОВИХ ТА ШНЕКОВИХ ЗАГОТОВОК У ВИРОБНИЦТВІ ДЕТАЛЕЙ ТИПУ ШНЕКИ

In modern mechanical engineering widely used screw type details, which include solid or hollow shafts with screw continuous or discrete screw elements welded or made in one piece with the shaft, spiral products - in the form of flexible spirals. The main common constitutive and technological features of such products are the presence of windings located along the helical surface in the longitudinal direction with a large pitch. At the same time, a common part of technological processes for manufacturing all kinds of screw type details is the production of a worm (WB) or screw blanks (SB), which allows us to systematically consider the varieties of technological methods for shaping the products under consideration. The concepts "Worm" and "Screw" blanks are applied to semi-finished products, which are characterized by screw fibers and the presence of a screw body, i.e. screw surfaces and screw external and internal ribs of different configurations and direction of winding. According to the constitutive feature, the WB are integral when the winding of screws are made in one piece with the shaft, and combined, in which the SB, made in the form of a helically-formed tape, is welded to a solid or hollow shaft (tube).

To date, the developed in the mechanical engineering the varieties of methods for shaping WB and SB by methods of casting metals and alloys, cutting, assembling and metal forming. However, in modern fast-changing production, in some cases, the use of existing methods is economically and technologically inexpedient.

An important direction in the development of the manufacturing technology WB and SB by the method of metalcutting is improvement of the methods of high-speed vortex milling, which make it possible to prevent crushing and breakage of the helical surface due to the low stiffness the turns of screw.

One of the innovative methods of fabrication WB and SB is layer-by-layer synthesis technology, also known as "layer-by-layer build-up", "direct digital production", "additive production", "rapid prototyping and manufacturing processes", " building of metal" , "AF- or AM-technologies (additive technologies)".

In existing technical solutions, the contours of the layers are delineated in the XY plane perpendicular or parallel to the longitudinal axis of the blanks, and the third dimension in the Z-coordinate is realized due to the joining of the layers (the Z-coordinate is not continuous). Along with the constantly increasing volume of application of such technologies, their improvement should be aimed at providing the possibility of obtaining combined blanks by way the layer-by-layer build-up of material on the semi-finished products (supporting elements of a spiral or WB and SB manufactured by other methods).

In this case, the contours of the layers are delineated on the helical surface as a result of suitably specified rotational velocities and longitudinal movement of the blanks, while the third dimension along the radial coordinate and shaping is realized due to the longitudinal-

vertical displacement of the material feed device and the connection of the screw layers located on screw surfaces.

The main directions of the development of the manufacturing technology WB and SB is method of molding from polymeric materials, ceramics and rubber are:

- introduction of technologies for quick changeover of injection molds on the profile of other sizes of WB castings by using magnetorheological and electrorheological fluids as filling materials. They have the properties of changing the aggregate state under the influence of magnetic or electric fields;
- creation of highly productive combined methods for forming polymeric materials, ceramics and rubber on the basis of the borrowing of the principles of shaping SB and WB from the metal forming (winding on a mandrel, rolling a polymer strip);
- use of the new types of initial blanks in the form of continuously-sectional strips of polymeric materials.

A promising direction in the development of the manufacturing technology SB and WB by welding is the use of air-plasma cutting technology in spirals of thick-walled tubular and piece hollow (smooth or shaped) blanks of metallic and polymer materials, processing which is metal forming (winding, rolling, molding) and cutting has difficulty (high-alloyed, corrosion-resistant, heat-resistant and high-temperature resistant steels).

Important directions in the development of the manufacturing technology SB and WB by the method of metal forming are:

- creation of technological methods for controlled change in the curvature of the obtained blanks in the process of the production of SB. An example is the use of equipment for cold rolling long-length blanks of different cross sections with the possibility of automatically changing the compression of the strip during the shaping of the spiral. This will allow us to manufacture spirals with vary in length winding radii of the outer and inner edges winding;
- for the shaping operation, the use of special rotating or composite punches and matrices with axially movable sector helical surfaces, allowing centering and fixing of the ring section blank and preventing distortion of the shape and dimensions of the winding during its stretching on a significant step. In the first case, there is a need to use rotary dies;
- use on the rolling, winding and forging operations of special initial blanks in the form of continuous strip-section blanks, which allow to obtain wide-band SB and WB with a reduction in the volume of subsequent assembly operations.

Effective production of combined WB by assembly method is possible on the basis of the use of casting technique in molds with functional embedded helical spirals.

For all the mentioned methods, it is important to use secondary raw materials as the initial piece blanks for the general direction of improving the manufacturing technology SB and WB. Examples can be the use of worn transmission belts with friction with flexible coupling (mylar spacer or polyurethane belts) in the technology of single or multilayer winding on the supporting elements of the helical spiral (with simultaneous layer-by-layer joining).

The introduction of technology for processing polymeric containers for the use of semi-finished products in technologies of layer-by-layer synthesis, use of worn disc-shaped work tool (discs of seeding machines, cultivators) to obtain annular circular section blanks for subsequent production of them section SB way of molding.