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THEORETICAL ANALYSIS OF THE COMBINED EXTRUSION OF THE FLANGE BY THE UPPER EVALUATION METHOD IN THE MANUFACTURE OF THE "PICABUR BODY" PRODUCT

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Annotation:
The article talks about the work that is being carried out in the field of design and production of tools for drilling rocks. Formulas of combined extrusion by the method of upper evaluation of an axisymmetric product are given. The results of extrusion of the Picabur body, the scheme of combined extrusion with flange sediment are shown.

Keywords: stamping, extrusion, deformation, detail.

Countries with developed light and heavy industries can rightly be called developed. Recently, the production of metallurgical products has been growing rapidly in the Republic of Uzbekistan, in particular, the production of axisymmetric forgings of complex shapes for the mining industry, including the production of parts of complex shapes that are used in drilling rocks. On this basis, it is necessary to solve the issues of resource and energy conservation in the production process.
The body of the picabur is part of a drilling tool – a chisel, which is used in the mining industry. In the conditions of the State Unitary Enterprise "Geoburtechnika", the body of the picabur is made by mechanical processing (cutting). The authors have developed the technology of stamping by extrusion of this part, taking into account the serial production.
To determine the possibility of stamping by extrusion of parts, it is necessary to analyze the part, theoretically describe and simulate it using computer programs in order to determine the stressed areas in the manufacturing process. In addition to the above, it is also possible to determine the areas of the part that will be most susceptible to deformation during operation. Based on the collected data, some mechanical properties of the part can be improved by heat treatment in order to increase their service life.
So, having analyzed the "Picabur Body" part (Fig. 1.), we can say that the part is axisymmetric, having a flange in the middle part of the part. The following should theoretically describe the process of combined extrusion.

Fig. 1. The finished part "Picabur body"

The calculation scheme is shown in Fig. 2. According to the scheme, the volume is divided into two areas. The first – peripheral one is defined by ciliindric surfaces whose radii are r_1 and r_2. The radial velocity of the V_r flow of this region can be in the directions coinciding with the positive and negative directions of the r axis. The boundary surface on which V_r=0 is defined by radius r_0, the second one is defined by a cylinder whose radius is r_1.

Let's choose kinematically possible fields of flow velocities.

1st area. By analogy with the draft of a cylindrical billet

$$V_r^* - \frac{v_0}{2h}(\frac{r_0^2}{r} - r);$$

$$V_z^* = -\frac{v_0 z}{h} \qquad (1)$$

Such a velocity field satisfies the boundary conditions and the constancy of the volume. The deformation rates are determined according to the known relations

$$\xi_r^* = \frac{\partial v_r^*}{\partial r} = \frac{v_0}{2h}(1 + \frac{r_0^2}{r^2});$$

$$\xi_\varphi^* = \frac{v_r^*}{r} = \frac{v_0}{2h}(1 - \frac{r_0^2}{r^2}); \qquad (2)$$

$$\xi_z^* = \frac{v_0}{h}$$

Intensity of shear strain rates

$$H^* = \frac{v_0}{h}\sqrt{3 + \frac{r_0^4}{r^4}} \qquad (3)$$

2nd area. By analogy with the draft of a cylindrical billet, taking into account the boundary conditions

$$v_r^* = \frac{v_0}{2h^2}(\frac{r_0^2}{r_1} - r_1)\frac{r}{h};$$

$$v_r^* = \frac{v_0}{h^2}(\frac{r_0^2}{r_1} - r_1)$$

The strain rates will have the following form

$$\xi_r^* = \xi_\varphi^* = -\frac{v_0}{2h}\left(\frac{r_0^2}{r_1} - r_1\right);$$

$$\xi_z^* = \frac{v_0}{h}(\frac{r_0^2}{r_1} - r_1)$$

Substituting these values into the inequality, we get

$$\int_{r_1}^{r_2} q2\pi r dr \cdot v_0 \le \frac{\sigma_s}{\sqrt{3}}\int_0^{r_1} \int_0^h \sqrt{3}\frac{v_0}{h^2}\left(\frac{r_0^2}{r_1} - r_1\right)2\pi dr \cdot dz + \frac{\sigma_s}{\sqrt{3}}\int_0^r \frac{v_0}{2h^2}\left(\frac{r_0^2}{r_1} - r_1\right) r2\pi r \cdot dr + \frac{\sigma_s}{\sqrt{3}}\int_0^h \left[\frac{v_0}{h^2}\left(\frac{r_0^2}{r_1} - r_1\right) + \frac{v_0}{h}\right] z \cdot r2\pi r_1 \cdot dz + \frac{\sigma_s}{\sqrt{3}}\int_{r_1}^{r_2}\int_0^h \sqrt{3 + \frac{r_0^4}{r^4}} \cdot 2\pi dr \cdot dz + \frac{\sigma_s}{\sqrt{3}}\int_{2h}^{v}\left(\frac{r_0^2}{r} - r\right)2\pi r dr + \frac{\sigma_s}{\sqrt{3}}\int_{2h}^{v}\left(r - \frac{r_0^2}{r}\right)2\pi r dr$$

By performing integration and transformation, we get

$$Q(r_2^2 - r_1^2) \le \left\{ \left(\frac{r_0^2 - r_1^2}{h}\right) r_1 + \frac{1}{3\sqrt{3}}(r_0^2 - r_1^2)\frac{r_1^2}{h^2} + \frac{1}{\sqrt{3}}\left[\frac{1}{h}\left(\frac{r_0^2}{r_1} - r_1\right) + 1\right]\frac{r_1 h^2}{h} + \frac{1}{3\sqrt{3}} \right.$$
$$\cdot \left[\frac{1}{h}\left(\frac{r_0^2}{r_1} - r_1\right) + 1\right]\frac{r_1 h^2}{h} + \frac{1}{3\sqrt{3}}\sqrt{\left[9(r_2 - r_1) + \frac{r_0^4(r_2^3 - r_1^3)}{r_2^3 r_1^3}\right]}$$
$$\left. + \frac{1}{3\sqrt{3}h}[r_2^3 + 4r_0^3 - 3r_0^3(r_1 + r_2) + r_1^3] \right\}$$

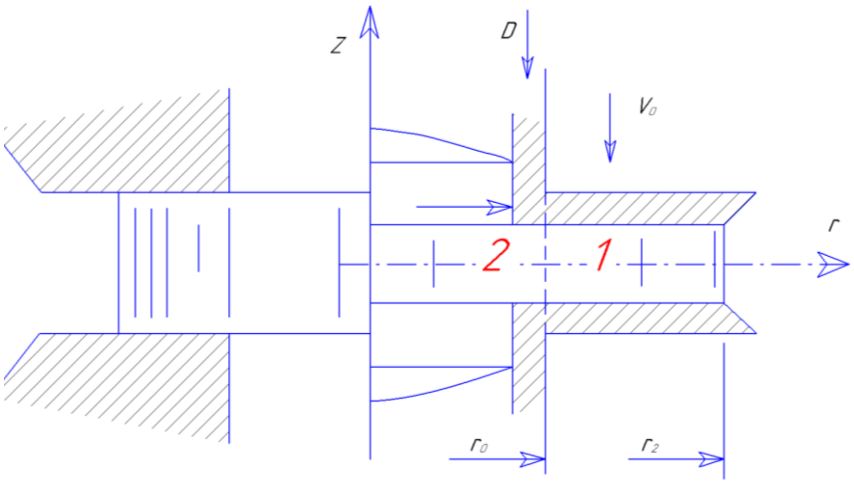

Fig. 2. Scheme of combined extrusion with flange draft

Intensity of shear strain rates

$$H^* = \sqrt{3}\frac{v_0}{h^2}\left(\frac{r_0^2}{r_1} - r_1\right)$$

To determine r_0, we will use, as with the precipitation of the ring, the condition of the minimum power consumption

$$\frac{\partial Q}{\partial r_0} = 0 = \frac{2r_1}{h} + \frac{2r_1^2}{3\sqrt{3}h} + \frac{2}{\sqrt{3}} + \frac{1}{3\sqrt{3}h}[12r_0 - 6(r_1 + r_2)] + \frac{2r^2(r_2^3 - r_1^3)^2}{r_2^3 r_1^3}$$

To determine the dependence of the deforming force, the work of deformation and the shape of the workpiece, it is necessary to divide the precipitation process in the rings into several steps, at each step determine the position of the boundary surface between the 1st and 2nd areas r_0 and then use expressions (1), (2) and (3) to find the desired values.

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