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THE MODELING OF A BLANK'S GUIDANCE AND FASTENING SYSTEM PROCESSED IN A PNEUMATIC OPERATED DEVICE

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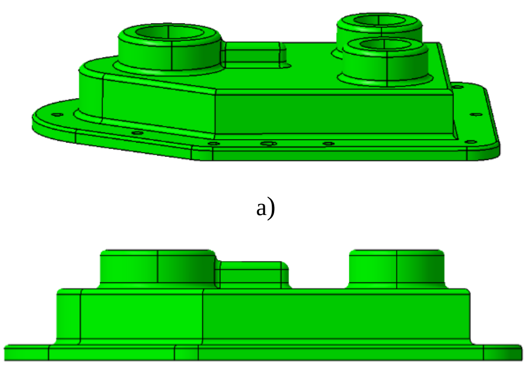
***Abstrac* —**This paper is based on an applied research, achieved by implementing a guidance and fastening device in a manufacturing system. This device's study aims to achieve a constructive and advanced outlook, allowing its operation in optimal conditions, ensuring a labor productivity and machining precision growth. These objectives are obtained by designing and implementing a mechanically actuated guidance and fastening device, with levers. This device's implementation in a mechanical manufacturing is designed for a product's processing, manufactured in large series, of which the blank's import and export operations from the device are manually done.

***Keywords*—** Fastening system, Guidance and fastening device, Guidance system, Mechanical processing system, Pneumatic operation.

I. Introduction

STARTING from the premise that, mechanizing the attachment operations to a work device, contributes to the improvement of operating conditions and labor productivity growth. This paper's author aims to present the design of a guidance and fastening device with levers, of which the blank's guidance and fastening operations into the device are mechanically done and pneumatically actuated. On this line, the work device presented in this paper, in order to work effectively, will be positioned and fixed on a tool machine's table, from the boring and milling machines category, component of a processing system, for processing the holes of a half-shell type reference. As a starting point in designing the guidance and fastening device with levers, I used a technical documentation provided by the beneficiary, making, further, an assisted design using the computer, 3D and 2D modeling the landmark, which is followed to be fixed and processed in the device [1], [2].

In Fig. 1, a) and b), through two isometric views are displayed the half-shell landmarks' models, for which a mechanical guidance and fastening device is projected [3].



a)

b)

Fig. 1. a), b) The half-shell landmark's 3D modeling Representation through two isometric views

The blank's half-shell landmark, 3D modeled in Figure 1, was produced from an aluminum alloy by die casting in the mold. This technological process, for obtaining the blank, is frequently used in large series production and mass. Casting blanks of aluminum alloy is a technological process, of high productivity, from which complex shape elements are obtained, characterized by a superior surface quality and good dimensional stability, which allows only the processing of the areas that require high dimensional precision [2].

II. The Technological Itinerary Presentation of the Guided and Fastened Landmark Processing in the Device

To the half-shell blank, obtained by die casting in the mold, the processing addition is found in the inner surfaces areas of $\phi 40$ and $\phi 30$ bores, respective on the wider flat surface, which is used in the assembly operation. Also, a $\phi 10$ hole is processed, which will be used in both, assembling and guiding the piece in the device, being chosen as a cross basis.

The flat surface's milling (required for the assembly operation, will serve to fix the piece in the device, as a main area of bazaars for subsequent operations) constituting the blank's settlement basis into the device, negating three freedom degrees, R_x, R_x, T_z.

The ϕ40 bore processing will serve as a bazaars surface for the subsequent operation, forming a piece's cross basis in the device.

The ϕ10H7 machining holes will serve as a bazaars surface for the subsequent operation, forming a piece's cross basis in the device, this being oriented in a milled cylindrical bolt.

The two ϕ 30 bores simultaneous processing justifies the reason for which the guidance and fastening device with levers was designed and the high number of processed parts recommends its mechanical operation.

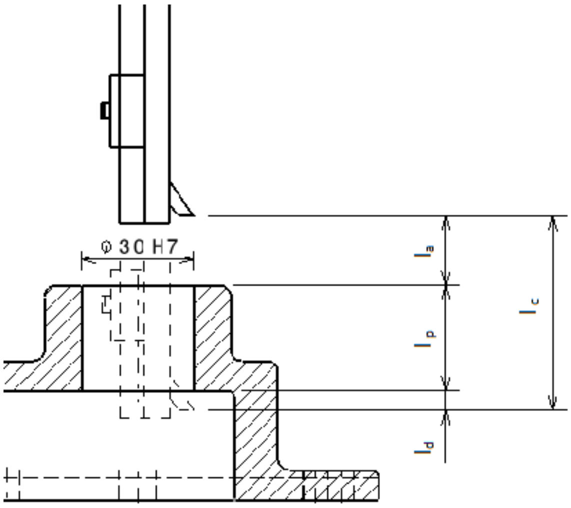


Fig. 2. 2D modeling of the l_c working stroke length determination

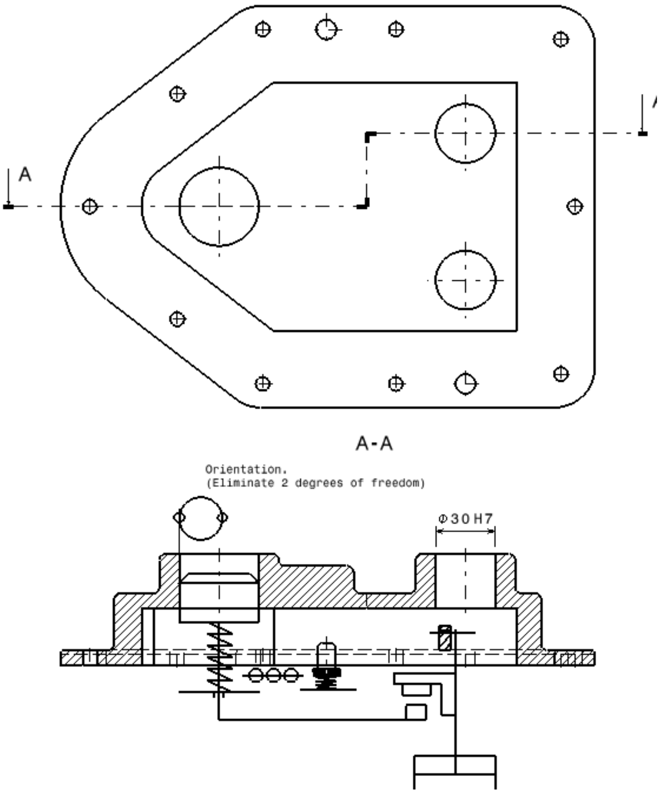


Fig. 3. 2D modeling of the half-shell landmark's guidance system in the device

According to the guidance and fastening device's constructive model presented in the paper, at every guided and fastened blank, follows the simultaneous processing of the two ϕ30 bores. The cutting tool used in the technological cutting process is a multishaft drill head, of special construction, with two metal carbides plates knifes, fixed in the cutter bar and adjusted at quota, with micrometer screws.

The half-shell blank, obtained by a casting process, has a good dimensional accuracy, the processing addition being situated between 0.5÷1 mm on phase's values [5].

The cutting speed used v_a = 100 m/min and the chosen work advance s= 0.08 mm/rot.

The cutting tool's speed is determined using the formula:

$$n = 1000 \cdot v/D \ (rot/min) \quad (1)$$

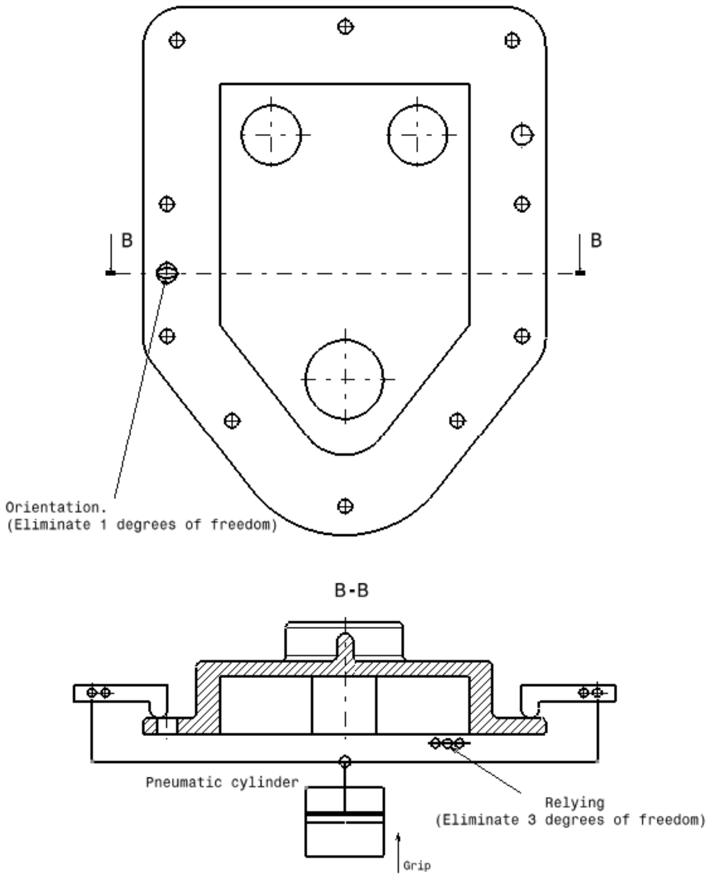


Fig. 4. 2D modeling of the pneumatically actuated centering and fastening system with levers

From the calculations results:

$n = 1000 \cdot 100/30 = 3333{,}33\, rot/min$

The tool's speed is chosen 3300 rot/min.

The tool's feed rate is determined: [4].

$S_{mi} = S \cdot n\ (mm/rot)$, respectively

$S_{mi} = 0{,}08 \cdot 3300 = 264\, mm/rot$

According to the work scheme, 2D represented and modeled in Fig. 2, we determine, by calculations, the linear size of the working stroke l_c:

$$l_c = l_a + l_p + l_d \qquad (2)$$

l_a – approximate length 2÷3 mm

l_p – working length = 25 mm

l_d – exceeding length = 2 mm

l_c = 30 mm

The determined cutting basis time will be [4]:

$$t_b = l_c/S_{mi}\ (min) \qquad (3)$$

respectively

$t_b = 0{,}11\, min = 6{,}6\, s$

III The Establishment of the Guidelines and the Device's Mechanized Fastening System

To the work device's design described in the paper, I established, from the outset, starting from the landmark's 3D model, which will be the device's orientation outlines [6].

In this sense, the choice of a designed device's guidance and fastening optimized system mechanically functional, which allows quick and easy fastening and loosening of the blank, in and from the device [5], [6].

Starting from these premises, according to Fig. 3, represented by an A-A view and section, I designed and 2D modeled a blank's guidance diagram in the device, representing through symbols the chosen fence system and the pneumatic mechanized operation mode of the centering system, using a mobile cylindrical bolt and a milled mobile cylindrical bolt [2], [6].

From the 2D modeled schematic representation of a view and B-B section, represented in Fig. 4, can be seen the rhombic shape of the milled mobile cylindrical bolt, used to center the blank in the device and the blank's lever fastening system in the work device, mechanically actuated by a pneumatic cylinder.

For the guidance elements determination of the guidance and fastening device, I designed a blank guidance scheme in the work device, shown in Fig. 5 [6], [7].

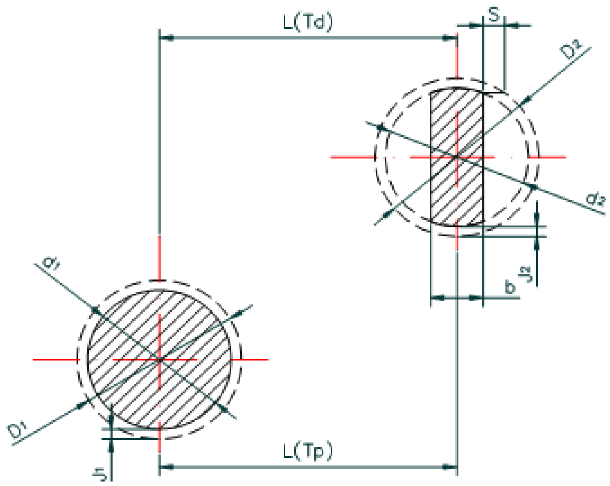


Fig. 5. The device's guidance elements schematic representation

According to the schematic representation from Fig. 5, the blank's guidance in the work device is performed on a flat surface and on two inner cylindrical surfaces, using, for this purpose, two mobile cylindrical bolts [6], [7].

The D_1 = ϕ40H7 bore is used as a cross basis, using as a guidance element a mobile cylindrical bolt, of a ϕ40 mm diameter, being a ϕ40H7/f7 loose-fitting, namely:

The pieces bore diameter fits in the specified tolerance range = $40_{0}^{+0,025}$ mm

The mobile cylindrical bolt's exterior diameter from the device's structure fits in the specified tolerance range = $40_{-0,050}^{-0,025}$

Using (3) from below, we can determinate the minimum clearance between the blank's inner bore and the outer diameter of the cylindrical centering bolt.

$$J_{1min} = D_{1min} - d_{1max} \quad (4)$$

From calculations results:

$$J_{1min} = D_{1min} - d_{1max} = 0{,}025 \ mm$$

According to the guidance scheme represented in Fig. 4, at the guidance on the milled cylindrical bolt, of a ϕ10 mm diameter, we have a ϕ10H7/f7 fit.

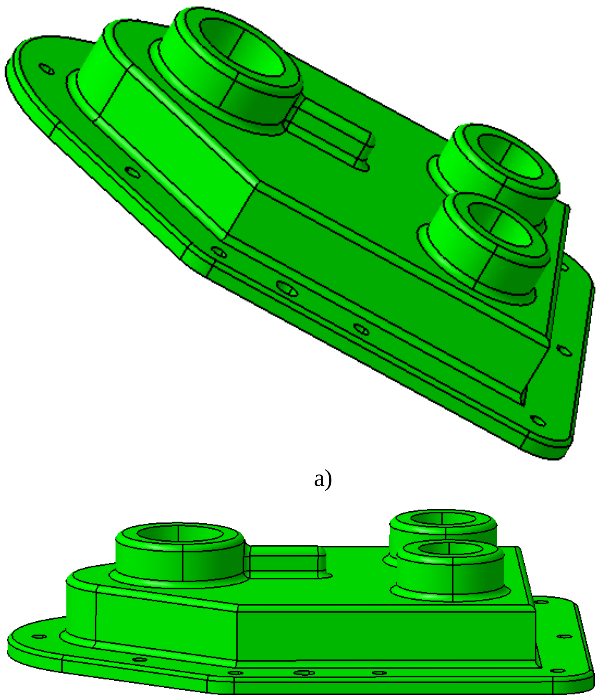
The bore's diameter from the part = $\Phi 10_{0}^{+0,015}$

The outer diameter of the milled mobile cylindrical bolt from the device = $\Phi 10_{-0,028}^{-0,013}$

From calculations results:

$$J_{2min} = D_{2min} - d_{1max} = 0{,}013 \ mm$$

In Fig. 6 is represented the half-shell landmark's 3D model, through an isometric view, which shows the landmark's position and the blank's manual input mode in the guidance and fastening device.



a)

b)

Fig. 6. a), b) Half-shell landmark's 3D modeling representation through two isometric views in input and manual extraction positions in the device

IV. CONCLUSION

The guidance and fastening system's use, presented by the author in the paper, by implementing the blank's guidance and mechanized fastening system in the device, achieves a labor productivity growth compared with a manually actuated guidance and fastening system. Also, during the blank's processing in the device, the clamping forces are constant and of the same size, causing a performed processing characterized by a high precision, compared to a manually operated processing system [1].

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