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(54) **A method of rolling extrusion with regulated axis spacing of axi-symmetrical stepped parts**

(57) The way of rolling extrusion with regulated axis spacing of axi-symmetrical stepped parts is characterized in that a formed semi-finished product (3) in the form of a bar or tube part is placed in the seat of the front rotary holder (1) and in the seat of the back rotary holder (2), next, the front rotational holder (1) and back rotational holder (2) together with semi-finished product (3) move with a translational motion with constant velocity (V) into the workspace, which is made by the same three (4a), (4b) and (4c) formed rolls, next the same three (4a), (4b) and (4c) formed rolls are put into rotational motion in the same direction and with the same velocity (n_1), then revolution motion of the same three (4a), (4b) and (4c) formed rolls is activated with the velocity (n_2) and the same three (4a), (4b) and (4c) formed rolls are brought closer to the semi-finished product (1), yet rotary movement trajectories (7a), (7b) and (7c) of the same three (4a), (4b) and (4c) formed rolls are of spiral shape, next the semi-finished product (3) is affected by the (4a), (4b) and (4c) formed rolls working (4a₁), (4a₂), (4b₁), (4b₂), (4c₁) and (4c₂) surfaces and the semi-finished product (3) is put into rotary motion with constant velocity (n_3) in the direction opposite to the direction of rotations of the same three (4a), (4b) and (4c) formed rolls.

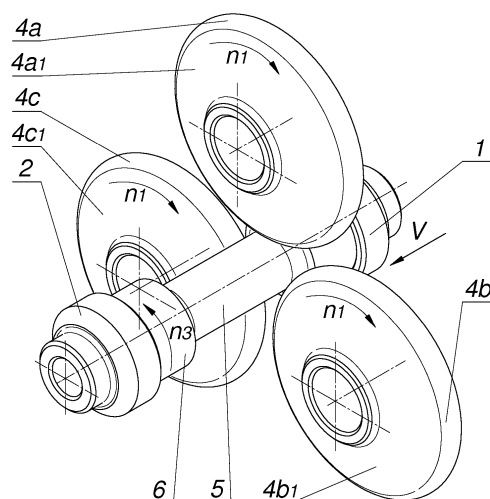


Fig. 6

Description

[0001] The subject of the invention is a method of rolling extrusion with regulated axis spacing of axi-symmetrical stepped parts.

[0002] Until now, there exist and are applied numerous methods of axi-symmetrical stepped forgings manufacturing, full and hollowed, which are used as semi-finished products of stepped shafts, sleeves and others. The most widely applied methods include: die forging on presses and hammers, drawing, forging and piercing, rotary swaging, rotary forging, internal high pressure forming, rolling extrusion in cold, rolling extrusion in cold with deep drilling and cross-wedge rolling. These processes are described in details in the literature by Bartnicki. J, Pater Z. "Cross-wedge processes of hollowed products", ed. Lublin University of Technology, Lublin 2005. As it is given by the authors, the largest products precision is obtained in the drawing processes, however, limits connected with this technology application for manufacturing of hollowed parts are small possibilities within the scope of the obtained elements shapes. The forging technology finds application only in the case of forming of shafts with large dimensions and weight. Yet, piercing is used for thick-walled and short sleeve production. Swaging processes allow for reduction of bars and tubes diameters. Parts formed by means of that method are characterized by large precision, and, at forging on a mandrel, they can possess very accurate cylindrical and conical holes. Another method of hollowed parts manufacturing is hydrostatic extrusion, which allows for forming of products of assumed geometry. In this method, a product is formed under high pressure caused in the element inside. Cold extrusion processes are widely applied in industry for manufacturing of hollowed parts, they form due to extruding by the die hole on mandrel. Recently, numerous ways of forming of hollowed parts basing on cross-wedge rolling and wedge-rolls rolling methods have been worked out. In the cross-wedge rolling and wedge-rolls rolling methods at least one of the forming tools constitutes a flat wedge rolled on a roll, which reduces billet diameter by driving into it, displacing certain metal volume at sides. In the result the product undergoes elongation during forming and the wall thickness in the area of the formed necking lowers. This leads to the product weakening in the area of the rolled step and imposes application of thick-walled billets, which can be formed only in hot conditions. Additionally, this method requires usage of complex wedge tools of large dimensions, which results in large implementation costs of the cross-wedge rolling technology.

[0003] From Polish patent claim number P.392275 is well known a way of rolling extrusion of hollowed parts, which is based on forming of a semi-finished part in the form of a sleeve or a tube part between three rotating tools. Yet, one of the tools or all tools move additionally in the direction of the semi-finished part axis, putting it into rotation and reducing particular steps of formed mul-

ti-stepped shaft. A characteristic feature of this process is tools outline representation on the part external surface, in the result of which section reduction and increase of the product wall thickness take place.

[0004] From Polish patent claim number P.393242 is known a way of forming of hollowed products by means of rolling extrusion, which is based on forming of axi-symmetrical hollowed parts from a semi-finished product in the form of a tube. In the described in the claim rolling extrusion process, the semi-finished product is placed in the rotational head, later, it is displaced into the direction of three rotational tools, which are placed around the billet axis every 120°. In the result of tools action, the diameter of external billet pivot is reduced and hollowed stepped part is obtained.

[0005] The issue of rolling extrusion process with regulated axis spacing, of stepped axi-symmetrical parts, is the fact that the formed semi-finished product in the form of a bar or a tube part is placed in the front rotational holder seat and the seat of back rotational holder, next the front rotational holder and back rotational holder together with semi-finished product move with a translational motion with constant velocity into the workspace, which is made by the same three formed rolls, next the same three formed rolls are put into rotational motion in the same direction and with the same velocity, then revolution motion of the same three formed rolls is activated and the same three formed rolls are brought closer to the semi-finished product, yet, rotary movement trajectories of the same three formed rolls are of spiral shape, next the semi-finished product is affected by the formed rolls working surfaces and the semi-finished product is put into rotary motion with constant velocity in the direction opposite to the direction of rotations of the same three formed rolls, and, at the same time the semi-finished product is squeezed by working surfaces and the necking is formed on the part circumference.

[0006] An advantage of the invention is the fact that it allows for metal forming of multi-stepped parts of full and hollowed shafts, due to which mechanical characteristics of such manufactured products improve. Thanks to the application of automatic change of the axles distance during rolling extrusion process of parts the process technological possibilities enlarge in comparison with used so far manufacturing methods. The invention gives the opportunity of application of one set of simple rotary tools in the form of rolls for manufacturing of various products, both full and hollowed. The invention is universal and allows for forming of parts from all alloys destined for metal forming.

[0007] The invention is presented in the example of realization in figure, in which Fig.1 shows the beginning of the process and tools and semi-finished product placement in the front view, Fig.2-view from the side of the process and tools at the beginning of rolling extrusion, Fig.3-isometric view of the process, tools and semi-finished product at the beginning of rolling extrusion, Fig. 4-view from the front of the process and tools and part

placement at the end of rolling extrusion, Fig.5-view of the side of the process and tools at the end of extrusion, yet, Fig.6-isometric view of the process, tools and forging at the end of rolling extrusion.

[0008] The way of rolling extrusion with regulated axis spacing of axi-symmetrical stepped parts is based on that a formed semi-finished product 3 in the form of a bar or tube part is placed in the seat of the front rotary holder 1 and in the seat of the back rotary holder 2. Next, the front rotational holder 1 and back rotational holder 2 together with semi-finished product 3 move with a translational motion with constant velocity $\underline{V}$ into the workspace. The workspace is made by the same three 4a, 4b and 4c formed rolls. Next the same three 4a, 4b and 4c formed rolls are put into rotational motion in the same direction and with the same velocity $\underline{n}_1$. Then revolution motion of the same three 4a, 4b and 4c formed rolls is activated with the velocity $\underline{n}_2$ and the same three 4a, 4b and 4c formed rolls are brought closer to the semi-finished product 3. Rotary movement trajectories 7a, 7b and 7c of the same three 4a, 4b and 4c formed rolls are of spiral shape. Next the semi-finished product 3 is affected by the 4a, 4b and 4c formed rolls working 4a₁, 4a₂, 4b₁, 4b₂, 4c₁ and 4c₂ surfaces and the semi-finished product 3 is put into rotary motion with constant velocity $\underline{n}_3$ in the direction opposite to the direction of rotations of the same three 4a, 4b and 4c formed rolls. At the same time the semi-finished product 3 is squeezed by working 4a₁, 4a₂, 4b₁, 4b₂, 4c₁ and 4c₂ surfaces and the necking 5 is formed on the part circumference 6.

posite to the direction of rotations of the same three (4a), (4b) and (4c) formed rolls and at the same time the semi-finished product (3) is squeezed by working (4a₁), (4a₂), (4b₁), (4b₂), (4c₁) and (4c₂) surfaces and the necking (5) is formed on the part circumference (6).

Claims

1. The way of rolling extrusion with regulated axis spacing of axi-symmetrical stepped parts **characterized in that** a formed semi-finished product (3) in the form of a bar or tube part is placed in the seat of the front rotary holder (1) and in the seat of the back rotary holder (2), next, the front rotational holder (1) and back rotational holder (2) together with semi-finished product (3) move with a translational motion with constant velocity ($\underline{V}$) into the workspace, which is made by the same three (4a), (4b) and (4c) formed rolls, next the same three (4a), (4b) and (4c) formed rolls are put into rotational motion in the same direction and with the same velocity ($\underline{n}_1$), then revolution motion of the same three (4a), (4b) and (4c) formed rolls is activated with the velocity ($\underline{n}_2$) and the same three (4a), (4b) and (4c) formed rolls are brought closer to the semi-finished product (3), yet rotary movement trajectories (7a), (7b) and (7c) of the same three (4a), (4b) and (4c) formed rolls are of spiral shape, next the semi-finished product (3) is affected by the (4a), (4b) and (4c) formed rolls working (4a₁), (4a₂), (4b₁), (4b₂), (4c₁) and (4c₂) surfaces and the semi-finished product (3) is put into rotary motion with constant velocity ($\underline{n}_3$) in the direction op-

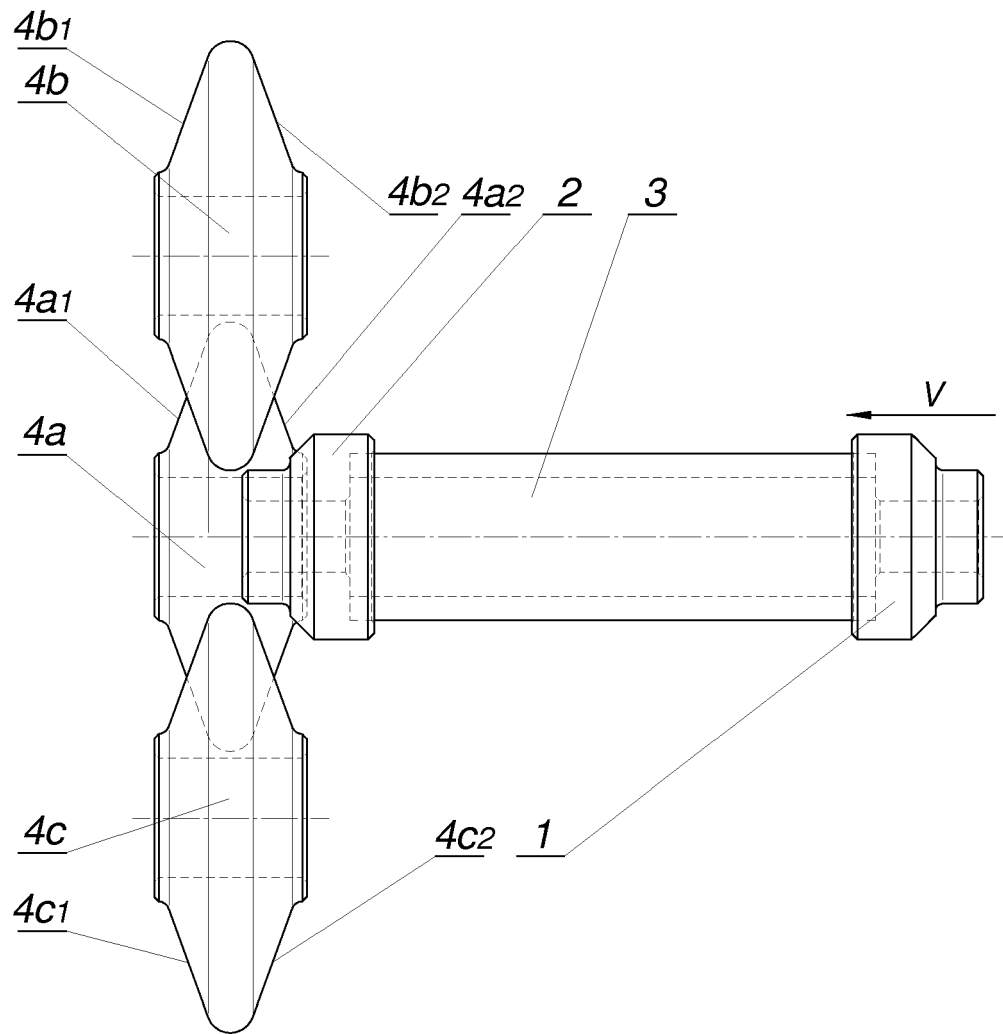


Fig. 1

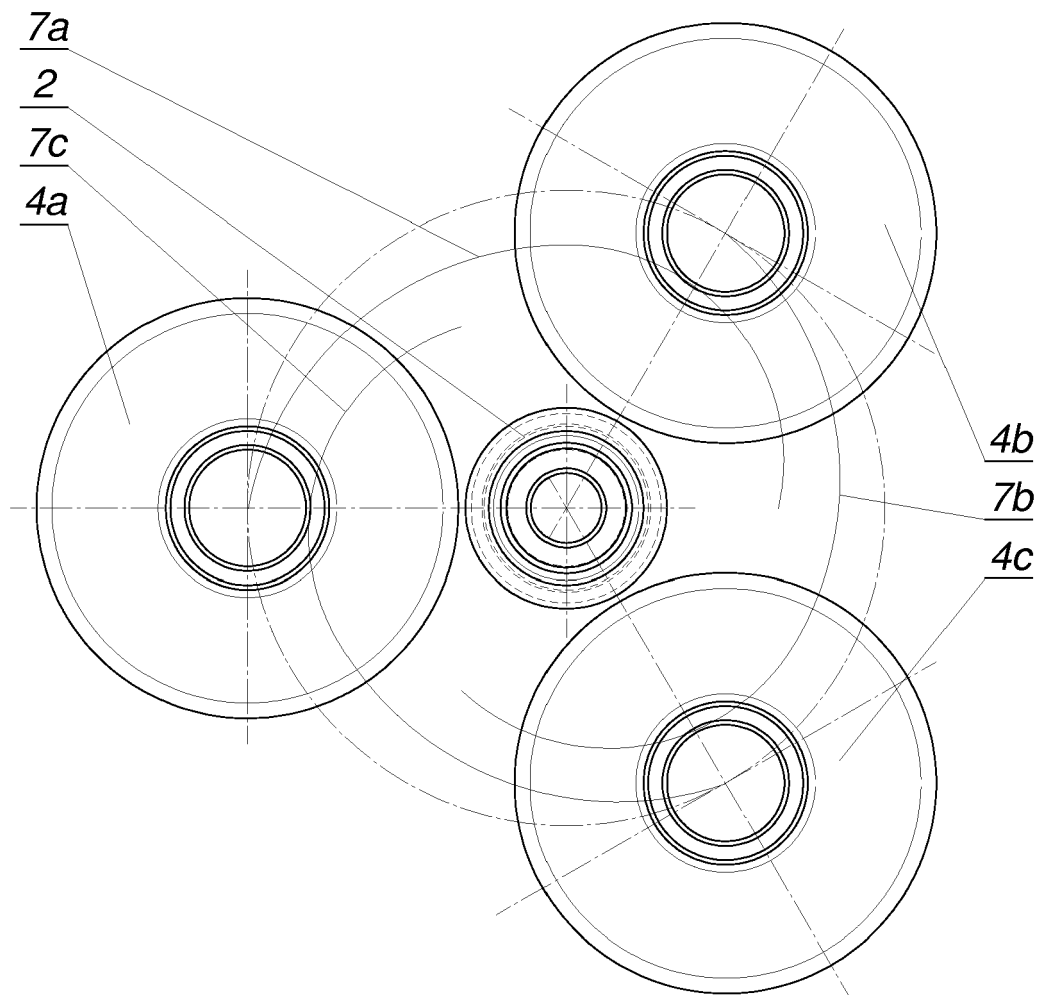


Fig. 2

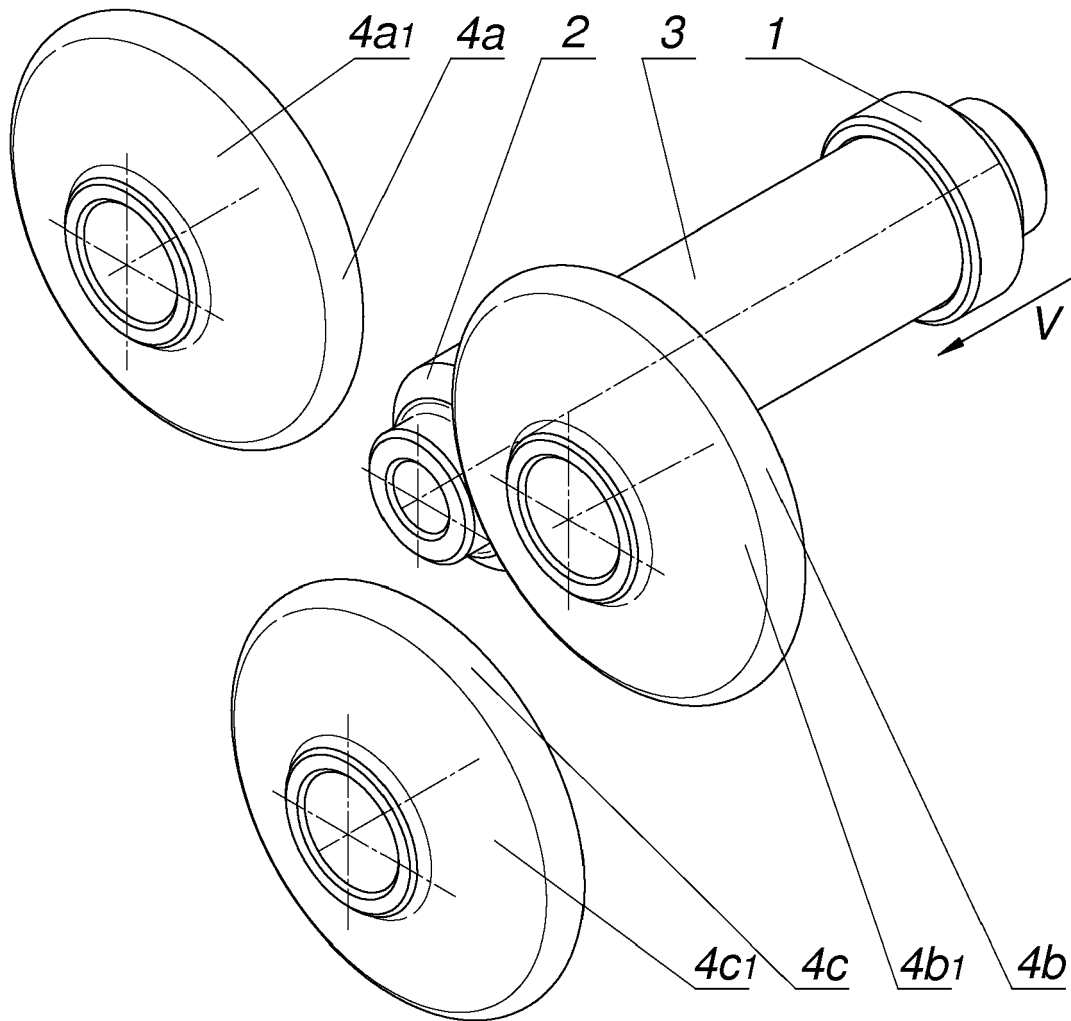


Fig. 3

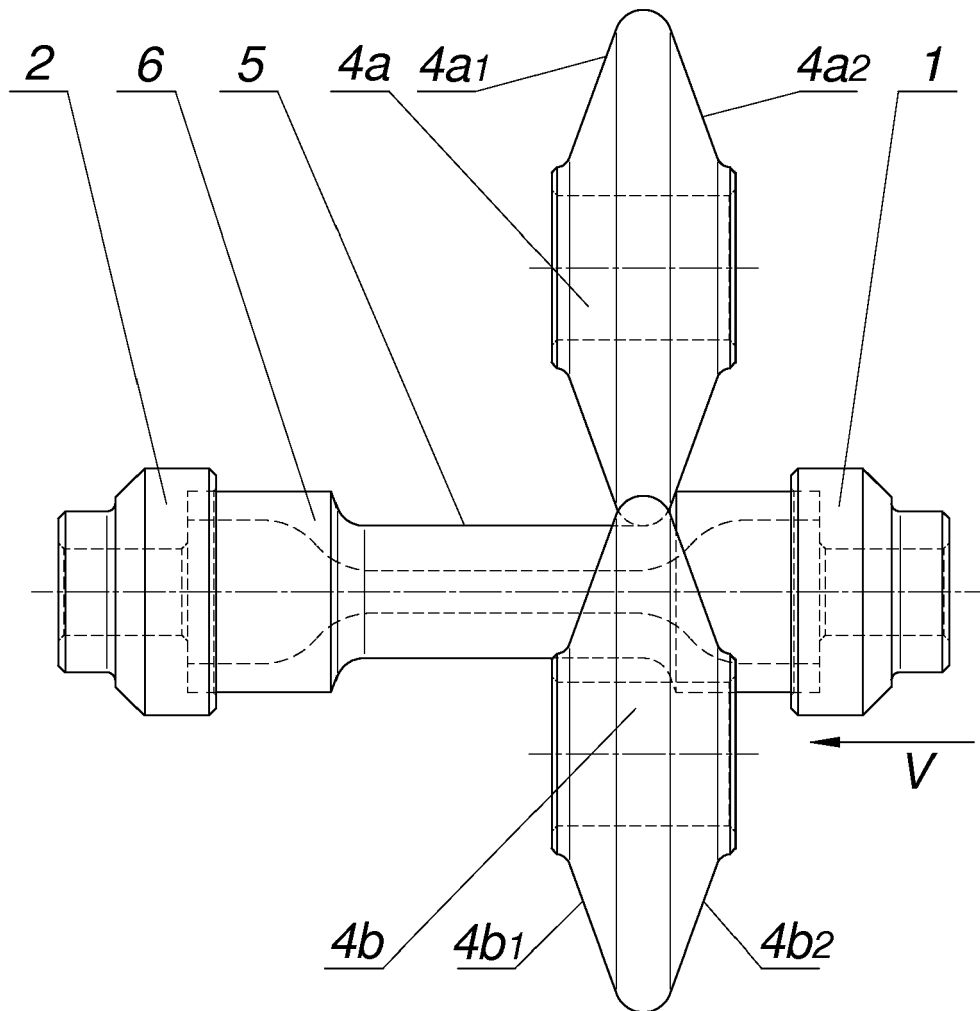


Fig. 4

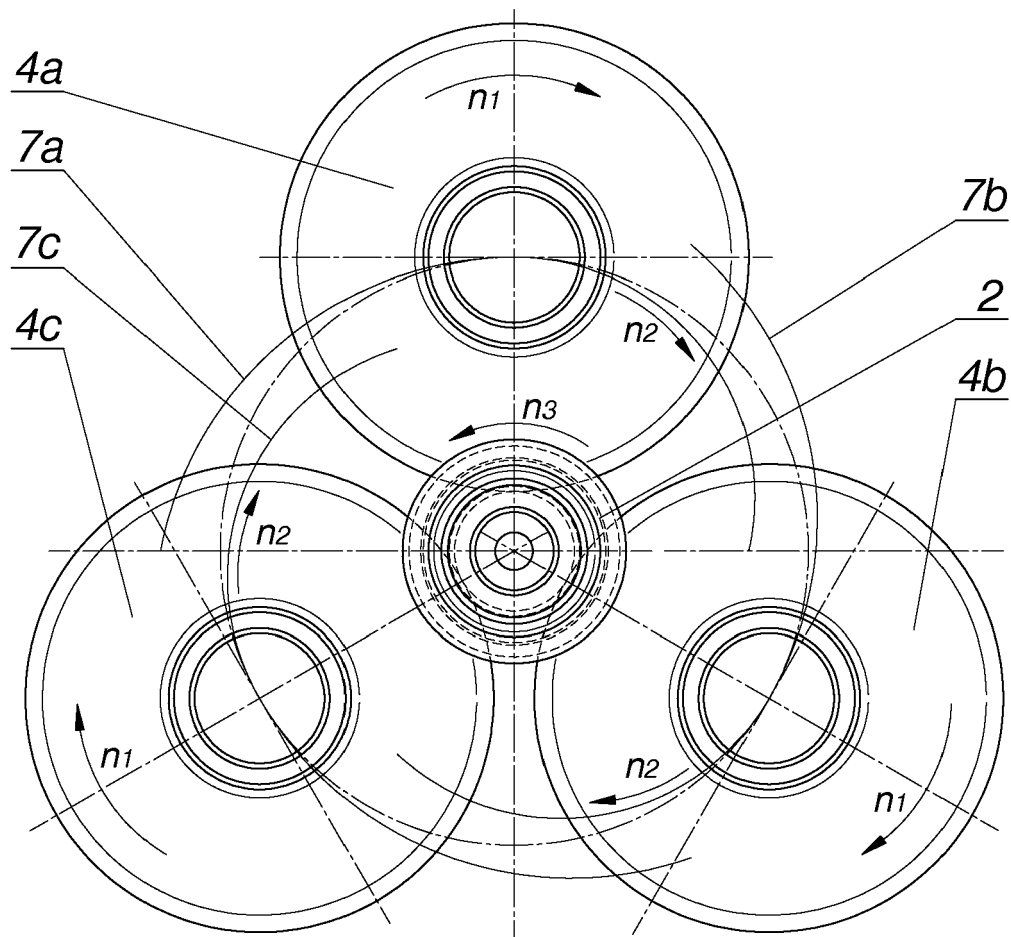


Fig. 5

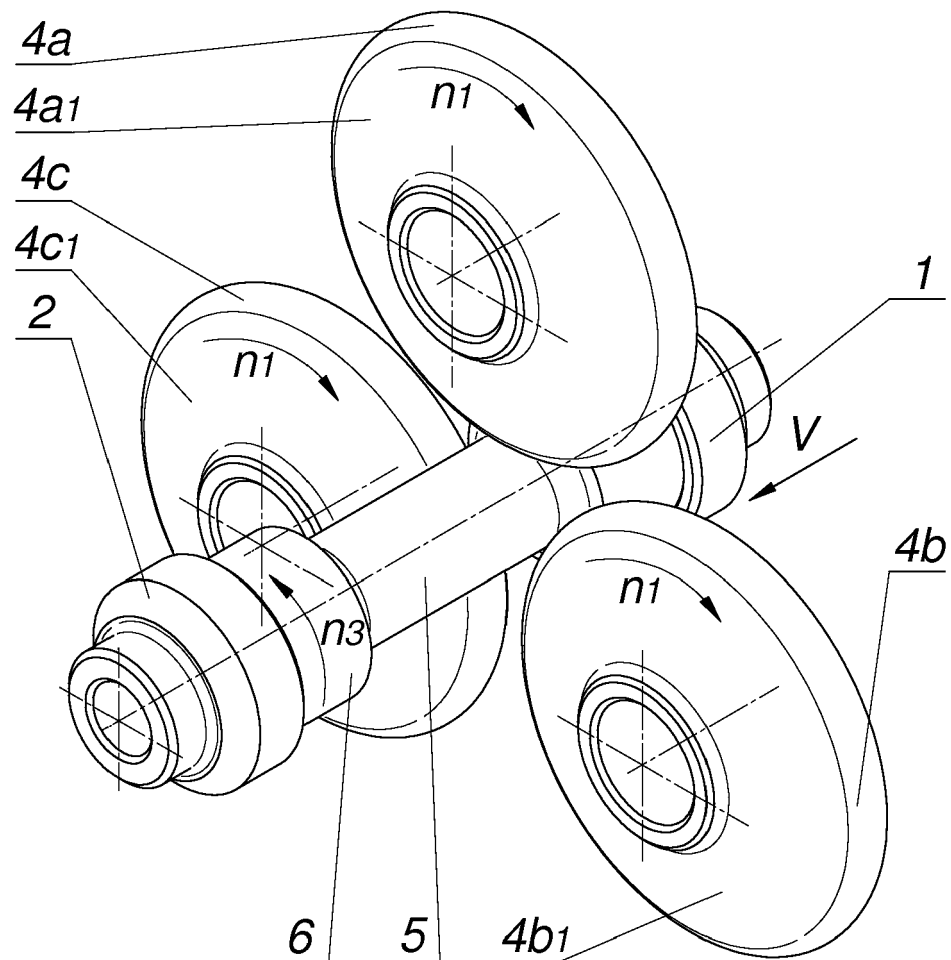


Fig. 6



EUROPEAN SEARCH REPORT

Application Number
EP 13 46 1569

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	US 2003/140674 A1 (SUZUKI YUKINORI [JP] ET AL) 31 July 2003 (2003-07-31) * paragraph [0001] * * paragraph [0034] - paragraph [0036] * * paragraph [0051] - paragraph [0057]; figures 1-3 *	1	INV. B21D22/14 ADD. B21H1/18
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			TECHNICAL FIELDS SEARCHED (IPC)
			B21D B21H
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 27 January 2015	Examiner Ritter, Florian
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EPO FORM 1503 03.92 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
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EP 13 46 1569

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The members are as contained in the European Patent Office EDP file on
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27-01-2015

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

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