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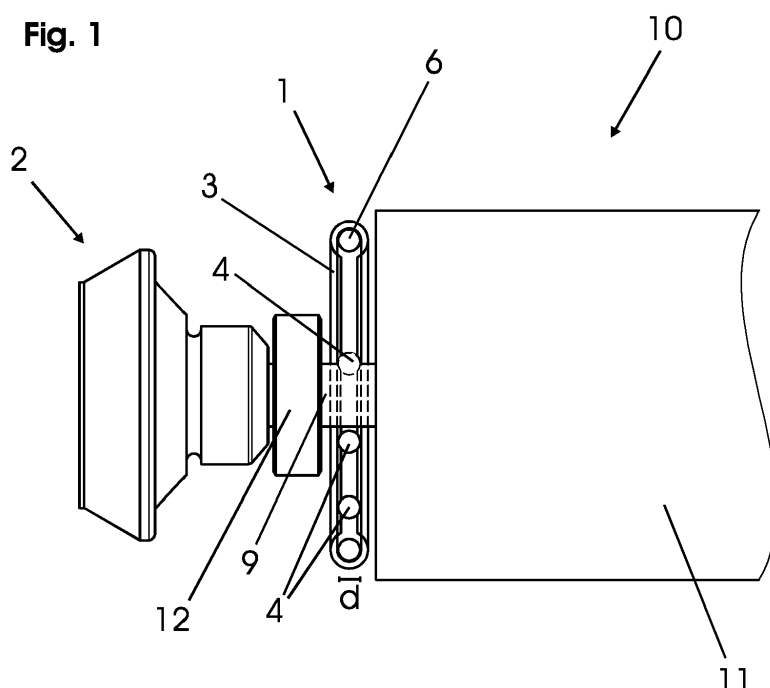
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(54) **BALANCING RING FOR COMPENSATING IMBALANCES OF A SPINNING MACHINE ROTOR**

(57) The invention relates to a balancing ring (1) for compensating imbalances of a spinning machine rotor (2) with balance weight elements (4) guided by a circular guidance body (3) and a supporting element (5) for arranging the circular guidance body (3) coaxially to an axis of rotation of a spinning machine rotor (2). Additionally, the invention relates to a spinning machine rotor unit comprising at least one balancing ring as well as a method

for compensation imbalances of a spinning machine rotor unit utilizing at least one balancing ring. To propose a balancing ring for compensating imbalances of a spinning machine rotor which can be easily and cost-efficiently produced and which is self-balancing without any external control, the balance weight elements (4) are movable along the full circumference of the circular guidance body (3).

Fig. 1



Description

[0001] The invention relates to a balancing ring for compensating imbalances of a spinning machine rotor as well as a spinning machine rotor unit with a corresponding balancing ring. Additionally, the invention relates to a method for compensating imbalances of a spinning machine rotor unit.

[0002] Spinning rotors are widely used in spinning machines, in particular in open-end rotor spinning machines. The output rotors connected to spinning boxes of open-end rotor spinning machines spin with a high number of revolutions per minute. Accordingly, even a small imbalance of the spinning rotor leads to large forces acting on the parts of the spinning machine.

[0003] Document DE 26 40 111 A1 discloses a rotor of an open-end spinning unit consisting of the spinning rotor as well as a shaft attached thereto, a cylindrical rotor part connected coaxially to the spinning rotor, and magnetized permanent magnets radially fixed on the inner wall of the cylindrical rotor part. The magnets form a rotor drive together with windings on a stator part, which is projecting into the rotor part. The magnets are fixed to the rotor part by plastic webs, wherein at least a part of the plastic webs arranged in parallel to the magnets comprises substantially axially extending channels for receiving rod-shaped materials, in particular balancing weights, for balancing the rotor.

[0004] It may be considered a first object of the present invention to propose a balancing ring for compensating imbalances of a spinning machine rotor as well as a corresponding spinning machine rotor to at least reduce imbalances and preferably to balance out the spinning rotor completely.

[0005] A further objective of the invention may be to propose a balancing ring for compensating imbalances of a spinning machine rotor with a simple mechanics and which therefore can be easily and cost-efficiently produced.

[0006] It might be finally considered an objective of the present invention to propose a balancing ring for compensating imbalances of a spinning machine rotor as well as a method for compensating imbalances of a spinning machine rotor unit which is easily executable and in particular which comprises a self-balancing of the spinning system without any external controlling.

[0007] These and further objectives may be achieved by a balancing ring according to claim 1, a spinning machine rotor unit according to claim 9 or a method for compensating imbalances of a spinning machine rotor unit according to claim 14. Dependent claims refer to preferred embodiments of the invention.

[0008] A balancing ring for compensating imbalances of a spinning machine rotor according to the invention comprises balance weight elements guided by a circular guidance body as well as a supporting element for arranging the circular guidance body coaxially to an axis of rotation of a spinning machine rotor, wherein the bal-

ance weight elements are movable along the full circumference of the circular guidance body.

[0009] Further, the present invention relates to a spinning machine rotor unit with a balancing ring according to the invention, wherein the balancing ring is mounted on a rotor shaft between a drive motor and a spinning machine rotor.

[0010] The method for compensating imbalances of a spinning machine rotor unit of the present invention comprises as a first step the mounting of at least one balancing ring on a rotor shaft of a spinning machine rotor, followed by starting the spinning machine rotor with a first rotation speed of the rotor shaft for self-balancing several balance weight elements of the balancing ring, wherein this first speed is lower than a rotation speed during regular operation of the spinning machine rotor. After the self-balancing phase, the spinning machine rotor is accelerated to the regular operation speed of rotation as a further step of the inventive method.

[0011] The inventors have recognized that arranging several objects with a given distance to an axis of rotation in a spinning machine rotor unit and allowing the objects to freely move along the circumference leads to a self-balancing system in view of initial imbalances of the spinning machine rotor unit. The balancing ring according to the invention uses this principle and therefore easily balances out a spinning machine rotor leading to a smoother operation, less wear and longer operation times of the corresponding spinning machine.

[0012] The inventors have further realized that a balancing ring according to the invention does not require any external control and can be built with only very few components, hence reducing the production costs and leading to a simple, yet effective system which is less prone to errors than more complex and/or actively controlled systems.

[0013] A balancing ring according to the invention is any part or module which comprises several balance weight elements movable along its full circumference, preferably at a constant radius or distance to the center of the balancing ring and/or an opening for mounting the balancing ring on a rotatable axle or shaft. The balancing ring might be made out of any material, though metals and/or polymers are preferred. Even more preferably, the balancing ring is only made out of one single material, wherein the balance weight elements might be made from a different material.

[0014] The balancing ring is preferably especially built for a rotating axle or shaft of a spinning machine for processing fiber material or roving into workable yarn or thread and in particular for a motor shaft of an open-end spinning machine rotor. Such a rotor might spin with over 100,000 revolutions per minute and even up to 200,000 revolutions per minute during regular operation. Accordingly, even small imbalances would lead to large forces action upon the rotating parts.

[0015] In the method according to the invention, the spinning machine rotor with the balancing ring is initially

started at a lower speed of rotation to allow the balance weight elements to move to the required positions along the circumference of the circular guidance body. The rotation might be started and quickly accelerated to a constant speed of revolution which is lower than the speed of revolution during regular operation, preferably between 5 % and 75 %, more preferably between 10 % and 60 % and most preferably between 25 % and 50 % of the speed of rotation during regular operation. It is further preferred that this constant, lower speed of rotation is maintained for several seconds, in particular between 1 s and 3 s, to allow for the positioning of the balance weight elements. Alternatively, the rotation might be started and accelerated, in particular constantly accelerated, over a period of several seconds, preferably between 5 s and 60 s, more preferably between 10 s and 30 s.

[0016] The circular guidance body can have any shape as long as it can guide balance weight elements along a circular path coaxially to an axis, in particular of rotation of the spinning machine rotor. Accordingly, it is advantageous that the circular guidance body has a shape of a ring and/or is arranged in a plane perpendicular to the axis of rotation of the spinning machine rotor or a corresponding rotor shaft. The outer surface of the circular guidance body might have any shape, although preferably the circular guidance body and more preferably the whole balancing ring are built with a rotational symmetry to its center and/or is shaped to be mostly free of imbalances regarding the intended rotational axis of the balancing ring.

[0017] The circular guidance body has preferably an inner surface for directly guiding the balance weight elements inside the circular guidance body and is more preferably adapted to the shape of the balance weight elements so that each balance weight element can freely move, most preferably roll on the inner surface of the circular guidance body without a high rolling resistance.

[0018] The balancing ring may be a separate part or can be part of the rotor shaft or can even be included in the spinning rotor. Accordingly, the supporting element may be a part of the spinning rotor and/or the circular guidance body may be directly fixed to or built as part of the spinning rotor or the rotor shaft. Preferably, the supporting element has however no further function and/or is not part of the spinning rotor. Even more preferably, the balancing ring including all its components is built as an independent part which can be mounted to a spinning rotor or a rotor shaft.

[0019] The main function of the support element is to arrange the circular guidance body at a constant distance and/or coaxially to an axis of rotation, which is preferably positioned in the center of the opening of the balancing ring. Generally, the support element might be made out of a single part or several separate parts. Further, the support element might be built from any material. It is however preferred that the support element is built from the same material as the circular guidance body and/or is attached to or built as one piece with the circular guid-

ance body. Advantageously, also the support element is built with a rotational symmetry to its center to be mostly free of rotational imbalances.

[0020] The balance weight elements may have any shape and may be made from any material. Preferably, all balance weight elements have a spherical shape with an identical diameter and/or weight. Further preferred, all balance weight elements have an identical weight and most preferably all balance weight elements are completely identical to one another. This advantageously allows not only a simple and cheap construction of the balancing ring, but also an exact guidance of each of the balance weight elements by a single circular guidance body. To ensure a precise positioning of the balance weight elements in the circular guidance body of the balancing ring, the diameters of the balance weight elements are preferably almost identical to the cross section of the circular guidance body, possible slightly smaller to allow for a low-friction movement. To ensure a high weight of the balance weight elements and at the same time to minimize the wear which might impair the ability to freely move within the circular guidance body, all balance weight elements are preferably made out of metal.

[0021] According to an advantageous embodiment of the balancing ring, at least three balance weight elements, preferably precisely three balance weight elements are arranged inside the circular guidance body so that on the one hand a reliable compensation of imbalances is possible, but on the other hand the balance ring is still easy to produce and has a reasonably low weight. Albeit it would be theoretically possible to place significantly more balance weight elements inside the circular guidance body, it is preferred that only less than half as many balance weight elements as tightly fit, more preferably less than 10 and most preferably between 3 and 6 balance weight elements are arranged in one circular guidance body.

[0022] In a preferred further developed version of the balancing ring, the balance weight elements are arranged in a closed volume inside of the circular guidance body which is further preferred filled with a liquid having a high viscosity, in particular of at least 50 mPas. Building the circular guidance body with a closed inner volume ensures that the balance weight elements cannot roll out and further minimizes external effects on the movement and positioning of the balance weight elements. Further, filling the space surrounding the balance weight elements with viscous liquid leads to a further stabilisation and/or damping of fast movements like vibrations. Most preferably the space surrounding the balance weight elements is completely filled with liquid and is in particular free of any gas. A high viscosity liquid has at least a viscosity of 10 mPas, preferably of at least 50 mPas and in particular of at least 100 mPas. Although the liquid may have any chemical composition, the liquid is preferably homogeneous and is in particular an oil.

[0023] A further embodiment of the balancing ring is favoured where a disk with an opening in the center for

mounting the balancing ring on a rotor shaft of a spinning machine rotor unit is attached in the middle of the circular guidance body as the supporting element wherein the disk is most preferably a solid disk with a constant thickness. Such an embodiment allows a simple construction of the balancing ring with a high stability. Alternatively, the disk may have further openings and may for example be constructed as a spoke wheel. The opening has preferably the shape of the cross section of the rotor shaft to avoid any play between the balancing ring and the rotor shaft during operation.

[0024] To avoid introducing further imbalance to the spinning machine rotor, an advantageous embodiment of the balancing ring has a rotationally symmetrical shape in relation to an axis of rotation, in particular the axis of rotation around a rotor shaft of a spinning machine rotor unit.

[0025] It is further preferred that the circular guidance body as well as the disk are constructed integrally as one piece or built by several pieces which have been inseparably combined, for example by gluing. The construction of the circular guidance body as well as the disk as a monobloc part allows a particularly cheap construction of the balancing ring as well as a high stability against forces during high speed of rotation.

[0026] According to an advantageous embodiment of the balancing ring the outer diameter of the circular guidance body is between 5 and 15 times the diameter of the balance weight elements and/or of the width of the closed volume inside the circular guidance body. In other words, the ratio between the radius of the circular guidance body from the middle of the balancing ring and the radius of the spherical balance weight elements is also between 5 and 15. This advantageously leads to large enough forces due to the distribution of the balance weight elements over the circumference of the balancing ring to compensate imbalances, in which case the distribution along the circumference is uneven. Only if the spinning machine rotor unit is already in perfect balance, the distance between all balance weight elements is exactly the same along the circumference during operation of the spinning machine.

[0027] A spinning machine rotor unit may have a single or several balancing rings, in particular all placed on one rotor shaft. For static balancing purposes only one single balancing ring may be mounted on the rotor shaft, preferably placed in a spinning rotor groove area. Under static balancing the balancing in one direction is understood, in particular to avoid imbalances only in a plane perpendicular to the axis of rotation, i.e., if one side of the rotor is heavier than the side exact opposite relative to the axis of rotation. In other words, in a static imbalance the axis of rotation and the axis through the center of mass of the rotating object are parallel, but not identical.

[0028] However, a preferred embodiment of the spinning machine rotor unit can also compensate a dynamic imbalance. Therefore, in such an embodiment, at least a second balancing ring is arranged on the rotor shaft

preferably on an opposing side of the rotor shaft bearing than the first balancing ring and most preferably precisely two balancing rings are arranged on the rotor shaft. Accordingly, also imbalances in two spacial directions can be compensated, i.e., where the axis of imbalance is not parallel to the axis of rotation of the body. This is for example the case where on one end of the rotor axis the mass is higher on one side of the axis in radial direction and on the other end of the rotor axis the mass is higher on the opposite side in radial direction. Accordingly, utilizing two balancing rings also the compensation of complex imbalances is possible and a particularly smooth operation of a spinning machine rotor unit can be achieved.

[0029] A preferred embodiment of a spinning machine rotor unit is built as an open-end spinning machine rotor mounted on one end of the rotor shaft and the drive motor is connected to the other end of the rotor shaft. Further, a rotor shaft bearing is arranged between the spinning machine rotor and the drive motor and the at least first balancing ring is arranged between the drive motor and the rotor shaft bearing, therefore compensation the imbalances of the spinning machine unit close to the rotor shaft bearing and on the opposite side of the spinning machine rotor. By placing the balancing ring in this position, with only a single balancing ring most imbalances in the spinning machine rotor unit can already be compensated.

[0030] Finally, it is further preferred that the balancing ring is fixed to the rotor shaft by clearance fitting allowing a simple installation and replacement of the balancing ring. Accordingly, the opening of the balancing ring is preferably adapted to the size and shape of the rotor shaft.

[0031] These and other aspects of the invention will be apparent from and elucidated with reference to an embodiment described hereinafter:

- Fig. 1 shows a schematic side view of a spinning machine rotor unit with a balancing ring;
- Fig. 2 shows a sectional view of the balancing ring of the spinning machine rotor unit of figure 1,
- Fig. 3 shows a perspective view of the balancing ring of the spinning machine rotor unit of figure 1, and
- Fig. 4 shows a perspective view of a spinning machine rotor unit with a balancing ring in a cutaway view to show balance weight elements inside the balancing ring.

[0032] A spinning machine rotor unit 10 shown in figure 1 comprises a motor 11 driving a rotor shaft 9 as well as a spinning machine rotor 2 connected to the rotor shaft 9 at an end opposing the motor 11. Directly adjacent to the motor 11, a balancing ring 1 is arranged on the rotor shaft 9. Additionally, a rotor shaft bearing 12 is positioned on the rotor shaft 9 between the spinning machine rotor 2 and the balancing ring 1 to mount the rotor shaft 9 to

a spinning machine.

[0033] The balancing ring 1 comprises a supporting element 5 built by a solid disk 7 having an opening 8 in the center for mounting on the rotor shaft 9. The diameter of the opening 8 is slightly larger than the diameter of the rotor shaft 9.

[0034] At the outer rim of the disk 7, a circular guidance body 3 is formed by a tube along the whole circumference of the disk 7. The tube fully encloses a closed inner volume 6 of the circular guidance body 3 without any openings or gaps. The balancing ring 1 including the disk 7 and the circular guidance body 3 is built as one piece (see fig. 2 and 3). The closed volume 6 inside the circular guidance body 3 has a circular cross-sectional area. In the closed volume 6, three metal balls are arranged as balance weight elements 4. All three balance weight elements 4 are identical to one another and in particular have the same diameter and weight. All balance weight elements 4 are guided inside the closed volume 6 by the circular guidance body 3 to be able to roll into any position along the circumference of the balancing ring 1 (see fig. 1 and 4).

[0035] To compensate imbalances in a spinning rotor unit, in particular due to a slight asymmetry of an open-end spinning machine rotor, at least one balancing ring 1 is placed on the rotor shaft 9 of the spinning machine rotor unit 10. The opening 8 in the center of the balancing ring 1 centers the balancing ring 1 on the rotor shaft 9. When starting the spinning machine rotor unit 10, the rotor shaft 9 is first started slowly and rotated by the drive motor 11 with a low speed of rotation compared to the regular operation speed of the spinning machine. In the first few second, the three balance weight elements 4 spread around the circumference of the balancing ring 1 inside the closed volume 6 of the circular guidance body 3 automatically compensating imbalances.

[0036] If the spinning machine rotor unit 10 was already in perfect balance, the three balance weight elements 4 are positioned every 120° along the circumference of the balancing ring 1. However, if there is an initial imbalance, the balance weight elements 4 shift to the side opposite to the higher weight of the spinning machine rotor 2 and therefore automatically compensate imbalances. After the initial few seconds, typically 2 - 3 seconds, the rotor shaft 9 including the spinning machine rotor 2 is accelerated to full operation speed of rotation and the balance weight elements 4 maintain their positions in the balancing ring 1 further on compensating the imbalances in the spinning machine rotor unit 10.

[0037] In the claims, any reference signs shall not be construed as limiting the claims. The word "comprising" does generally not exclude the presence of elements or steps other than those listed. The indefinite article "a" or "an" preceding an element does not exclude the presence of a plurality of such elements. The mere fact that certain measures are recited in mutually different dependent claims does not indicate that a combination of these measures cannot be used to advantage.

List of reference signs

[0038]

5	1	balancing ring
	2	spinning machine rotor
	3	circular guidance body
	4	balance weight element
	5	supporting element
10	6	closed volume of the circular guidance body
	7	disk
	8	opening
	9	rotor shaft
	10	spinning machine rotor unit
15	11	drive motor
	12	rotor shaft bearing
	D	outer diameter of the circular guidance body
	d	diameter of the balance weight elements
	c	cross section of the closed volume
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Claims

1. Balancing ring (1) for compensating imbalances of a spinning machine rotor (2), with

- balance weight elements (4) guided by a circular guidance body (3) and
- a supporting element (5) for arranging the circular guidance body (3) coaxially to an axis of rotation of a spinning machine rotor (2),

characterized in that

- the balance weight elements (4) are movable along the full circumference of the circular guidance body (3).
2. Balancing ring (1) according to claim 1, wherein all balance weight elements (4) have a spherical shape with an identical diameter and/or weight.
 3. Balancing ring (1) according to one of the above claims, wherein at least three balance weight elements (4) are arranged inside the circular guidance body (3).
 4. Balancing ring (1) according to one of the above claims, wherein the balance weight elements (4) are arranged in a closed volume (6) inside of the circular guidance body (3) which is filled with a liquid having a viscosity of at least 50 mPas.
 5. Balancing ring (1) according to one of the above claims, wherein a disk (7) with an opening (8) in the center for mounting the balancing ring (1) on a rotor shaft (9) of a spinning machine rotor unit (10) is attached in the middle of the circular guidance body (3).

6. Balancing ring (1) according to one of the above claims, wherein the balancing ring (1) has a rotationally symmetrical shape in relation to an axis of rotation. 5
7. Balancing ring (1) according to one of the claims 5 or 6, wherein the circular guidance body (3) as well as the disk (7) are constructed integrally as one piece. 10
8. Balancing ring (1) according to one of the above claims, wherein the outer diameter (D) of the circular guidance body (3) is between 5 and 15 times the diameter (d) of the balance weight elements (4) and/or of the cross section (c) of the closed volume (6) inside the circular guidance body (3). 15
9. Spinning machine rotor unit (10) with a balancing ring (1) according to one of the above claims mounted on a rotor shaft (9) between a drive motor (11) and a spinning machine rotor (2). 20
10. Spinning machine rotor (2) unit according to claim 9, wherein for static balancing purposes only one single balancing ring (1) is mounted on the rotor shaft (9). 25
11. Spinning machine rotor (2) unit according to claim 9 or 10, wherein the spinning machine rotor (2) is mounted as an open-end spinning machine rotor on one end and the drive motor (11) is connected to the other end of the rotor shaft (9), wherein a rotor shaft bearing (12) is arranged between the spinning machine rotor (2) and the drive motor (11) and the balancing ring (1) is arranged between the drive motor (11) and the rotor shaft bearing (12). 30 35
12. Spinning machine rotor unit according to one of the claims 9 - 11, wherein the balancing ring (1) is fixed to the rotor shaft (9) by clearance fitting. 40
13. Spinning machine rotor unit according to one of the claims 9 - 12, wherein at least a second balancing ring is arranged on the rotor shaft (9) on an opposing side of the rotor shaft bearing (12) than the first balancing ring (1). 45
14. Method for compensating imbalances of a spinning machine rotor unit (10), with the steps: 50
- mounting at least one balancing ring (1), in particular according to one of the above claims, on a rotor shaft (9) of a spinning machine rotor (2),
 - starting the spinning machine rotor (2) with a first rotation speed of the rotor shaft (9) lower than a rotation speed during regular operation of the spinning machine rotor (2) for self-balancing several balance weight elements (4) of the 55
- balancing ring (1), and
- accelerating the spinning machine rotor (2) to the regular operation speed.

Fig. 1

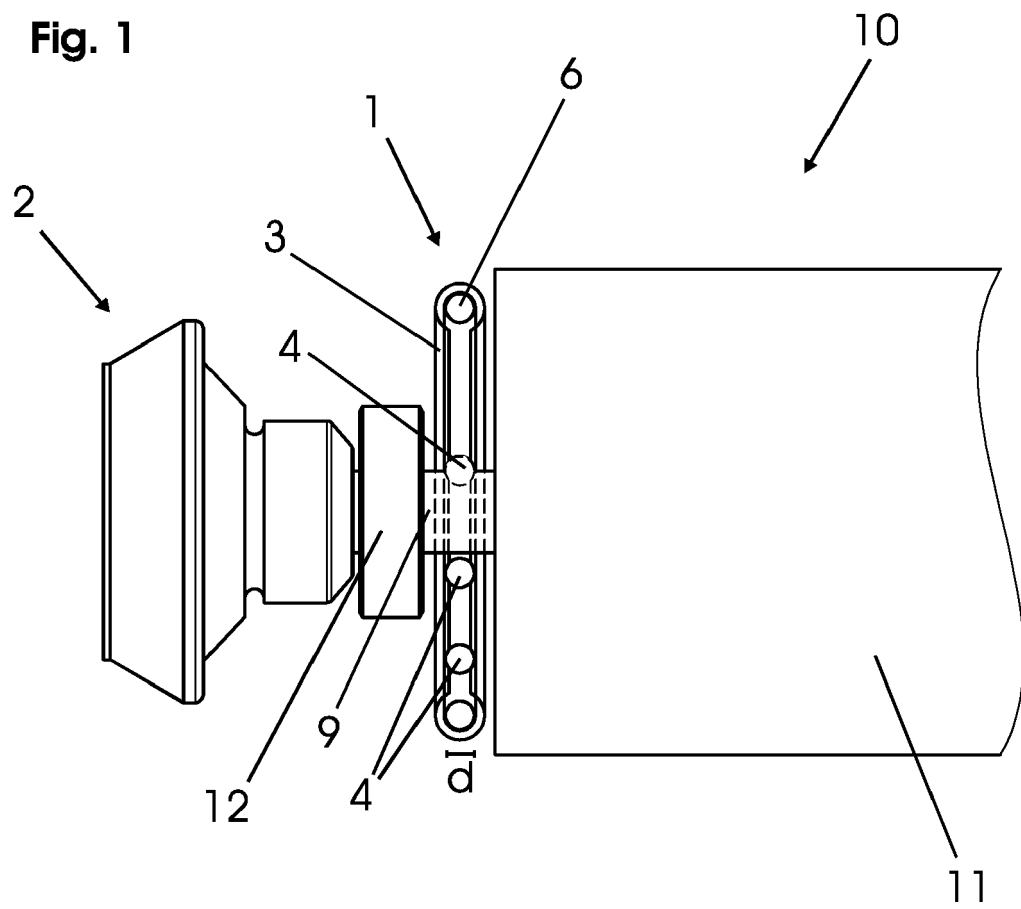


Fig. 2

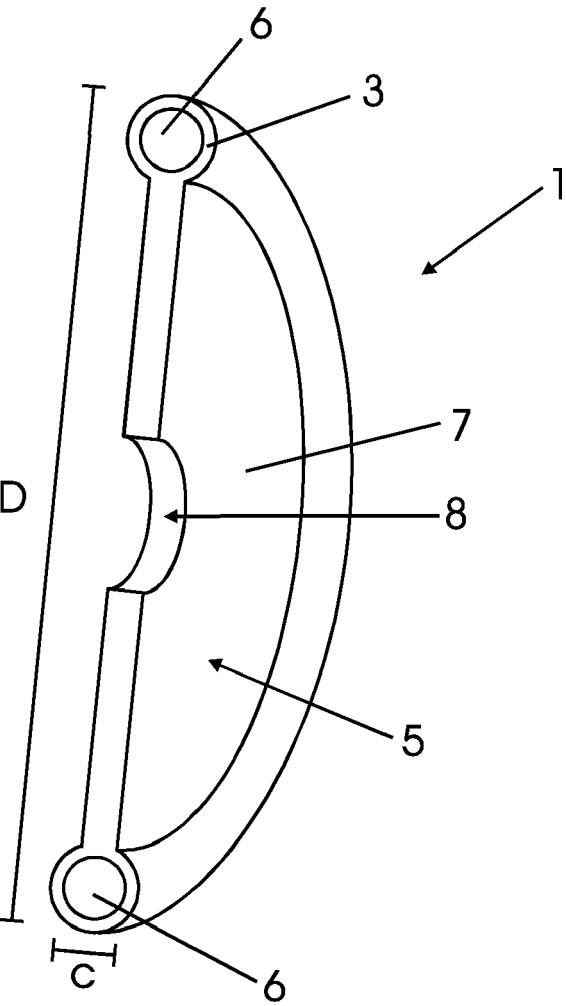


Fig. 3

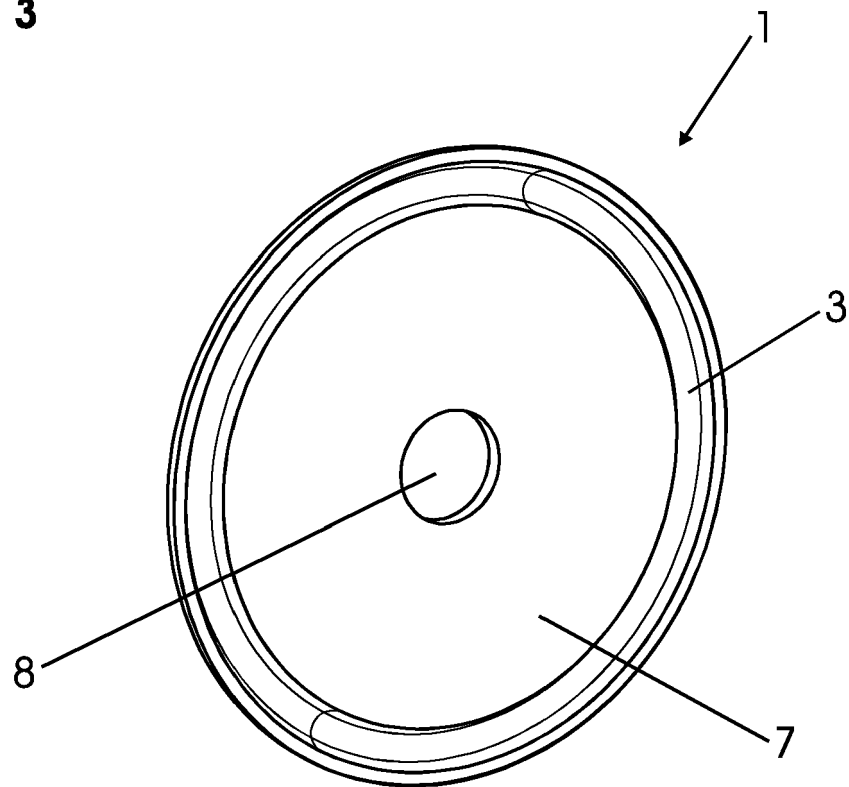
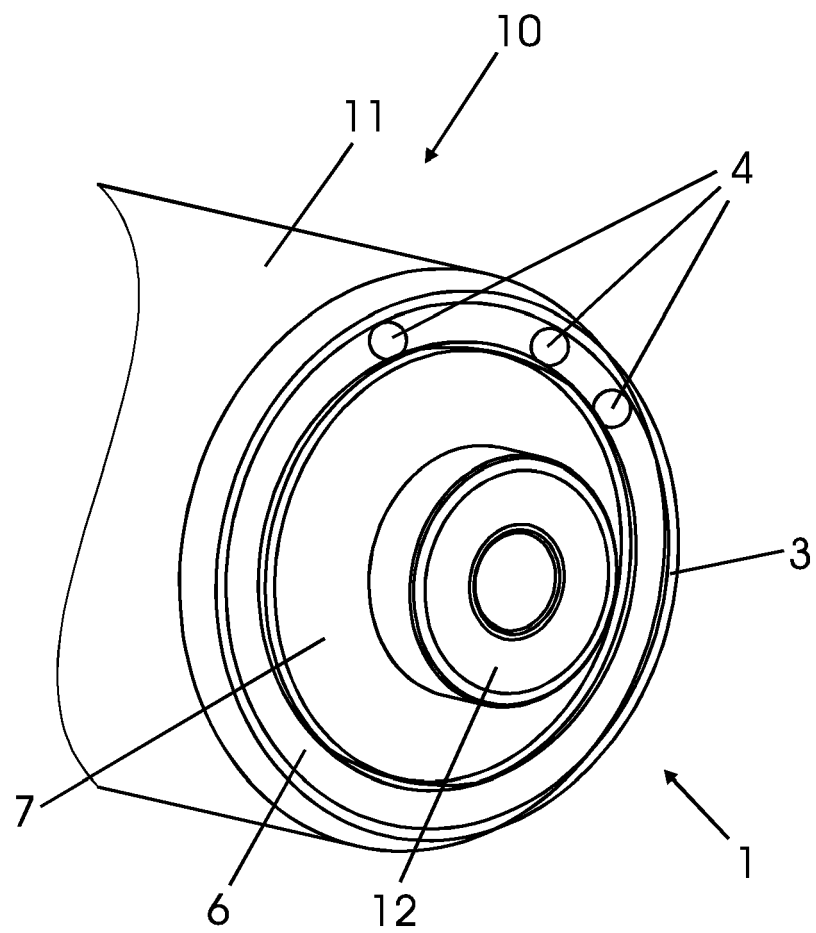


Fig. 4





EUROPEAN SEARCH REPORT

Application Number
EP 18 19 2453

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Y	* abstract; figure 1 *	9-12,14	
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The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 7 February 2019	Examiner Humbert, Thomas
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	

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EPO FORM 1503 03/82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 18 19 2453

5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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07-02-2019

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