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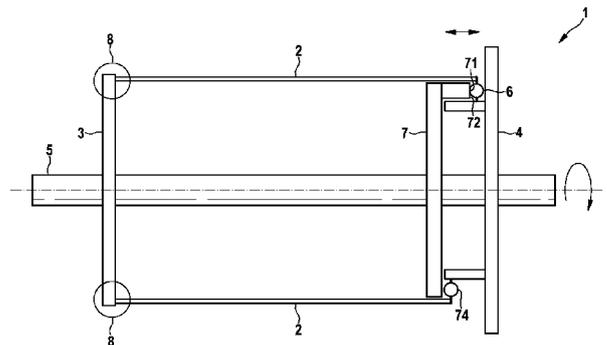
The following information is taken from the documents submitted by the applicant.

(54) Title: Energy converters with thermoelastic arrangement and energy conversion system

(5 7) Summary: The invention relates to a thermo-elastic energy converter ( 1 ), in particular a thermoelastic heating / cooling device, for use in an energy conversion system comprising:

- a thermoelastic arrangement with at least one thermoplastic elastic element ( 2 ) of a rule thermoelastic material;
- two holding elements ( 3, 4 ) between which ( at least one thermoplastic elastic element 2 ) is arranged in the longitudinal direction on;
- a fastener ( 6 ) ( For holding an end of the at least one thermoplastic elastic member 2 );
- a guide device ( 7 ), the element ( with the mounting 6 ) the at least one thermoplastic elastic elements ( 2 ) is coupled at a synchronous rotation of the holding elements ( 3, 4 ) relative to the guide device ( 7 ), a change in length of at least one element thermoelastic ( 2 ) to cause in the longitudinal direction, so that a cyclic elastic deformation and for drinks voltage of at least one thermoplastic elastic element ( 2 )

is achieved.



description

[0006] In addition, the inclination of fOhrt thermoelas tables material to at least one of the surfaces of the discs on the constraint points to a zy-cyclical bending stress, whereby the service life is reduced.

technical field

[0001] The invention relates to an energy converter, the un ter use of elastic deformation and Ent voltage of a thermo-elastic element achieve a heating effect or a Kuhlwirkung, or made possible by the use of a temperature difference, a mechanical energy.

[0007] It is therefore an object of the present OF INVENTION dung, to provide an improved power converter comprising a thermo-elastic element for grouting which has a higher efficiency and a higher service life Le.

technical background

Disclosure of the Invention

[0002] Power converter with active elements made of a shape-memory alloy make possible the Rea capitalization of alternative energy converters. These use caloric effects in ferroic materials that are comparable in terms of their efficiency to compressor-based energy converters such as heat pumps, Kuhlschranken and the like.

[0008] This object is achieved by the energy wall ler with at least one thermoplastic elastic member gema claim 1 and by the energy transforming system gema the independent claim ge lost.

[0003] From the prior art, numerous variations on the use of thermo-elastic mate rials are for Cooling of fluids known, all Sieren on a cyclic tension-and for drinks planning process of a thermo-elastic material ba.

[0009] Further embodiments are disclosed in the treatise Gigen claims.

[0010] Gema a first aspect is a thermo-elastic energy conversion, in particular a ther moelastische heating / cooling device, designed for use in a power converter system, umfas send:

[0004] For example, shows The publication US 2012/0273158 A 1 is a KO COOLING SYSTEM based on a thermoelastic effect, in which thermoelas genetic material is moved between a surrounding region and a Kuhlbereich, this is elastically deformed or relaxed to len a cow Kuhlbereichs and a discharge of heat in to effect the environment.

- a thermoelastic arrangement with Minim least a thermoplastic elastic member made of a thermoplastic elastic material;
- two holding elements between which the thermoplastic least one elastic member is arranged in a longitudinal direction min,
- a fixing member for holding an En of the at least one thermoplastic elastic ele ments;
- a guide device, the actuating element with the buildin the at least one thermoplastic elastic member is coupled to at ei ner synchronous rotation of the holding members concentration relative to guide device a Langenan alteration of effecting at least one thermoplastic elastic member in the longitudinal direction, so that a cyclic elastic deformation and relaxation of the at least one thermoelasti rule element is achieved.

[0005] From the document US 4,305,250 A is be known to cause the strain or expansion of ther moelastischen material between two co-rotating discs between which the thermo-elastic material is disposed. The discs are arranged inclined to one another. This is achieved by the rotation of the rotating discs as arranged between the thermoelastic material zy Klisch elastically tensioned and relaxed so that ei ne cyclic heat output and Kuhlwirkung can be achieved. If this apparatus is driven with a tationsbewegung Ro, the thermoelas diagram material is deformed in the longitudinal direction, wherein the axial stroke is defined by the Schragungswinkel between the two discs. The maximum stroke is axia le defines the Schragungswinkel at the obliquely placed wheels upper and the course of the deformation corresponds to a sinusoidal shape. Due to the design-dependent setting of the stroke ei ne more flexible form of debit and credit profile is not possible.

[0011] An idea of the above energy converter is be to provide a rotatable between two Halteele elements arranged or clamped thermoelastic element using at least one Fuh reasoner elastically deform and stretch to ent. The guide device is used for leadership of a fastening element, the stop, so that when hung Ore of the holding elements, the fastener is gefOhrt by the guide device one end of ther moelastischen element or moves along the contour. As a result Lan genanderung of thermo-elastic element is ER-

forced, the force to an elastic tension or relaxation of the thermoplastic elastic member.

[0012] Thermo-elastic elements are gel of a thermoplastic elastic material ausgebildet in the Re, the example having a shape-memory alloy, wherein the set latent heat released by a transformation of the lattice structure due to tension, compression, bending, torsion or shearing stress or relief is recorded.

[0013] The leadership of the fastening element on the guide device allows a purely axial deformation of the thermo-elastic element and can contribute to an incorrect loading of the thermoplastic elastic material, for example by bending or Scheitern transverse to the longitudinal extension or twist to avoid ver.

[0014] Furthermore, by appropriate Konturung the guide device, the TENSION profile of the thermoplastic elastic member free and in particular sondern be chosen efficiency-optimized so that the efficiency disadvantage of a purely sinusoidal deformation as they be from the prior art is known, can be avoided.

[0015] By providing the leadership by the guide device, to the cyclic Verspan planning and expansion of the thermo-elastic elements fOhrt, the stroke characteristic and the lift height can be freely chosen in a large area and is geometrically not limited by the dimensions of the retaining elements.

[0016] Thus, a flexible configuration of Fuh approximately facility possible. can be achieved, this allows a free choice of loading and unloading cycles during jeder revolution of the holding elements, so that several loading and unloading cycles per revolution of the holding elements. By appropriate leadership of the fastener through the guide device thermoelast the diagram element can be loaded on both train as well as pressure.

[0017] Further, another end of the min may be fixedly attached least a thermo-elastic member to einem of the holding elements.

[0018] Alternatively, a further end of the min can least one thermoplastic elastic member upper another fixing member may be coupled to another guide device to assist in the Ro of the holding elements tation relative to the Führungsein direction and the other guide device a change in length of the at least one thermoelast tables element in the longitudinal direction to cause such that a cyclic elastic deformation and decision

voltage of at least one thermoplastic elastic element is reached.

[0019] Furthermore, the guide device and the guide device can further the respective fastening element synchronously or asynchronously phase posted for a rotation angle of Hal teelemente deflect in the longitudinal direction.

[0020] It can be provided that the Führungs device and / or the further Führungseinrichtung at least one profile element have, that of having a Führungsspur for cooperation with the fastening element at least one thermoplastic elastic member, so that the performance Rotati on the holding elements relative to the Führungsein direction . the further guide device, the fastening element along a contour of the track Fuh approximately in a circumferential direction and is moved at the same time causes the change in length in the long-Rich processing.

[0021] Gema a Ausföhrungsform can Pro fileelement comprise a profile disk having a contour extending in the longitudinal direction, ent long moving the fastening element.

[0022] The profile element may have a profile ring which has an inwardly directed guide structure or the outside to the management Befestigungsele the at least one thermoplastic elastic elements ken auszulen relative to the guide device in the longitudinal direction during rotation of the holding element.

[0023] It can be provided that the Minim is maintained least one fastening element against tilting, and in particular exclusively free degrees of freedom of movement of the at least one loading fastening elements in the longitudinal direction and circumferential direction allow.

[0024] It may be provided in particular that the at least one profile element has a plurality of concentrating tric Führungspuren, at least to keep the fastening element against tilting, and in particular exclusively Freiheitsgrade the movement of allowing at least one Fixed To restriction member in the longitudinal direction and circumferential direction tung.

[0025] Gema a Ausföhrungsform, the at least one profile element upon rotation of the Hal teelemente relative to the guide device and the Führungseinrichtungen a tensile or a compressive load to the at least exert a thermoelast diagram element.

[0026] Further may more profile elements are provided to assist in rotation of the Halteelementen-

te zuuben both a tensile and a pressure load on the at least one fastener from.

[0027] It may be provided that both support elements each provided with at least one profile element to cause the Uingenanderung the Minim least one thermoplastic elastic member.

[0028] Gema a AusfOhrungsform can the at least one profile element to the two support members against each other to be rotatable, so that the movements of the fastening elements connected at both ends tig synchronously or asynchronously be phase shifted to understand or handle the rotation of the holding elements take place relative to the guide device.

[0029] Furthermore, the element at least one profile have a Führungsspur whose Kon has structure portions in order upon rotation of the Hal relative to the guide device un terschiedliche gradient of the change in length of at least one thermoplastic elastic member be teelemente understand or handle the angle of rotation of the holding elements ken to be Farming.

[0030] It can be provided that the min least one profile element a Führungsspur on has, separate the contour or einstOckig has to sammenhangende sections to at Ro of the holding elements tation relative to the Führungsein direction two or more long changes of at least one thermoplastic elastic member in egg ne direction to effect per revolution of the holding elements.

[0031] Furthermore, several thermoelasti rule elements can in one or more concentrated trical circuit arrangements between the Halteele elements are arranged, wherein each of the orders Kreisan a separate guide device is associated. This can additionally thermoelasti specific materials with different upper transition temperatures and / or other thermo-elastic properties are used to achieve a groere temperature difference.

[0032] Gema another aspect is a Ener giewandlersystem, in particular a heating / Kuhlsys system is provided comprising:

- a housing;
- the above thermoplastic elastic energy converter, which is accommodated in the housing;
- a drive shaft for rotating the Halteele elements relative to the guide device;
- at least two separate flow channels for conducting a fluid, in particular in gasfor miger or liquid form, such as air or water, each by a portion of a

comprises a segment least one thermoplastic elastic member DEFINE th by movement of the Minim cylindrical lateral surface or is limited by this.

[0033] Further, the drive shaft may teelementen with Hal, or be coupled to the guide device top, at least one planetary gear.

[0034] The above energy converter system can be used as heat-power machine. Here, the already erwahnte main advantage of the profile element comes into play, that the profile suit many different Erfor a torque generation can be optimally fitted to.

#### Brief Description of Drawings

[0035] AusfOhrungsformen are explained below with reference to the drawings beigefOgten near. Show it:

[0036] FIG. 1 a schematic diagram of the energy converter gema a first AusfOhrungsform;

[0037] FIG. 2 is a schematic representation of a cyclic process for Warme- and cold generation by a phase transition with reference to an diskon tinuous process;

[0038] FIG. 3 is a perspective view of a profile element of the AusfOhrungsform FIG. 1;

[0039] FIG. 4 is a schematic view of another AusfO HRU ngsform;

[0040] FIG. 5 is a perspective view of the profile element of the AusfOhrungsform FIG. 4;

[0041] FIG. 6 is a schematic view of another AusfOhrungsform for providing a push and pull on the thermo-elastic elements;

[0042] FIG. 7 is a schematic view of another AusfOhrungsform with an outside of the Kuhlzylin DERS spaced tread member;

[0043] FIG. 8 is a schematic representation of an energy converter arranged on both sides with Profilelemen th;

[0044] FIG. 9 is a cross sectional view through an energy converter System for one of the previously beschrie surrounded energy converter;

[0045] FIG. 10 is a schematic illustration of an exemplary tread pattern element, the segments of single profile is composed.

## Description of AusfOhrungsformen

[0046] FIG. 1 shows a schematic representation of an energy converter 1 with an assembly of several elements. The thermoelastic elements 2 can be in the form of a wire or other non-union material.

[0047] The thermo-elastic elements 2 in the operation of the energy converter 1 cyclically stretched and relaxed. The strain occurs in the present AusfOhrungsform by an elastic tensile load. A cyclical elastic deformation of the thermo-elastic elements 2 rich to it, they are ment between a first Halteele 3 and a second holding member 4 angeordnet.

[0048] The first and second retaining element 3, 4 are each with one end of the thermo-elastic elements Ele 2 connected with a rotatable drive shaft, and 5 coupled so that they are rotatable to each other during operation synchronously. The coupling of the retaining elements 3, 4 to the shaft 5 can be prepared by building account the holding elements 3, 4 to the drive shaft 5

or by a suitable transmission.

[0049] The first ends of the thermoelastic elements 2 are set at attachment points 8th the first holding member 3 attached. The attachment can be a long ent to the drive shaft 5 never done concentric Kreisli but can fOr other AusfOhrungs also form elliptical or other Anordnungsli nien be provided. The attachment points 8th kon NEN gleichmaig in the circumferential direction or arranged in individual different distances to each other.

[0050] Second, opposite are the first ends de end of de thermoelastic elements 2 are by means of appropriate fastening elements 6

axially movable, however, fixed in the circumferential direction on the second supporting member 4 held. The Fixed To supply elements 6 det are so ausgebil essentially that in their axial movements not you bought or shear stress transverse to the longitudinal direction of the thermo-elastic elements 2 and / or may occur Torsionsbe load.

[0051] There is a fixed (first) Profile management 7 provided that forms a Fuh reasoner an example fOr. The profile element 7 has ei ne contour line 71 on to which the respective supply elements Fixed To 6 abut by elastic tensile force in Lang's direction and run along the latter or through which the respective fastening elements 6 ent long a Führungsspur 72 are gefOhrt when the thermo-elastic elements 2 the profile element

7 or rotate relative to the profile element 7 Rotie reinder.

[0052] the Führungsspur 72 varies in the axial Rich so that the fastening elements processing according to a predetermined contour, 6 in the illustrated AusfOhrungsform in the axial direction toward the second holding member 4 are printed and then through the thermoelectric elastic members 2 by train load elastically deform or for drinks, a voltage of the thermo-elastic elements 2 in the direction of the first holding member 3 allows. When the guide device is held stationary, the deformation and relaxation of the thermoplastic elastic members can 2 always on the same areas along the circumference of the cylindrical arrangement of the elements ther moelastischen 2 the energy converter 1

be effected. Alternatively, the Führungseinrich may tung 7 be rotatably provided so that even in stationary support members 3, 4 by relative Rotati on the deformation and relaxation of thermoelas-Nazi elements 2 can be reached.

[0053] The fasteners 7 can Ver ringerung to the friction with rollers 74 be provided, the upper can roll the Führungsspur so that the sliding, friction or adhesion forces are reduced in the circumferential direction.

[0054] In the FIG. AusfOhrungsform shown 1 provides a tensile stress of thermo-elastic elements 2 in the direction of the second holding member 4 and ei ne relaxation of the thermo-elastic elements 2 in the direction of the first holding member 3 in front.

[0055] The thermoplastic elastic material of the thermoplastic elastic member 2 can alloy a Formgedachtnis such as NiTi and contain so by ei NEN phase transition, that is, absorb a conversion of Git terstruktur releasing latent heat stress during elastic bracing or Ent or. Oblicherweise an austenitic structure into a martensitic diagram material Materi transforms at Formgedachtnisle alloys which are exposed to the action of force of a mechanical deformation rule, and outputs alstruktur thereby heat a b. Ma is the TERIAL relieved so this increases due to the deformation of the elas tables original form again, whereby the martensitic material structure zuruckwandelt in an austenitic structure of the material and thereby takes up heat from the environment.

[0056] In FIG. 2 is an adiabatic cycle fOr the Warme- and cold generation by a Pha senubergang a Formgedachtnismaterials in egg nem discontinuous process illustrated. Substituted has its temperature from a phase P1, in the form of Thought nismaterial T1, in an adiabatic elastic deformation of the Formge dachtnismaterials (the elastic tension £ takes freely) latent heat, so that the Formge dachtnismaterial warmed to a temperature T2. In a phase P2 is at a constant Deformati-

on the vacant upper heat derived a Warmesen ke, so that the temperature of Formge dachtnismaterials decreases to a temperature T3. In a phase P3, the thermoelastic material is again adiabatically expanded ( £ decreases) and takes up latent heat, so that its temperature decreases and structure is obtained after the expansion process ei ne temperature T4, as illustrated in the phase P4. By absorbing heat from egg ner heat source, the temperature of Formge is dachtnismaterials increased back to the starting tempera ture T1 fOr the process of phase P1.

**[0057]** In the AusfOhrungsform FIG. 1, in which in the upper part of the energy converter 1 the thermoelasti rule elements 2 be elastically stretched and in the lower part of the thermo-elastic element 2

are relaxed, that occurs Kuhlwirkung by a heat absorption in the lower part and He warmung through a heat output accordingly in the upper part. Thus, the above energy converter can 1 as a heating and / or cooling device is to be set.

**[0058]** Essentially, the contour of the profile element 7 are freely determined. However, it was found that the efficiency of warming or Cooling is all the higher, the faster the deformation occurs Ver or relaxation. For this reason, the profile element 7 track with a Fuhrungs 72 be formed, which has a contour which, for example, in FIG. is shown. 3

**[0059]** It can be seen that an elastic deformation and relaxing in areas of relatively high Gradient (posted for the course of the circumferential direction) of the contour of the Fuhrungsspur 72 he follows. The release of heat and the absorption of heat is then performed in the areas of the energy converter 1, that appeal to the passage of the thermo-elastic elements 2

is done by the areas with high gradient, in de NEN the deformation or expansion, to Schlieen.

**[0060]** Between the areas of high Gradi ducks which can Fuhrungsspur 72 substantially be flat, ie no change in length of the thermo-elastic elements 2, ie no Ver tension or relaxation, effect.

**[0061]** The AusfOhrungsform the FIG. 4 provides that the fasteners 6 with which the second ends of the thermo-elastic elements 2

are connected, a DoppelfOhrung along two concentric Fuhrungsspuren 72 have, Zvi rule each of which the thermoplastic elastic element

2 is held by its second end, so that the fastening elements 6 posted for the longitudinal direction of the thermo-elastic elements 2 are not allowed to tilt. In this way, a bending, shear

and torsional loading to derVerbindungsstelle Zvi rule the second end of the thermo-elastic elements 2 and the respective fastening element 6

locked out.

**[0062]** The fasteners 6 can, for example, to in each case a hub shell 61 verbundene Laufrader 62 respectively. the hub 61 is a thermo-elastic element 2 firmly connected. the Laufrader 62 are arranged so that they each weils attached on the two mutually concentricly arranged Fuhrungsspuren 72 the profile element 7

run along and so, as in connection with the AusfOhrungsform FIG. described 1, an elastic stress on the thermo-elastic elements 2 exert or relax them. For always providing bending, shear and torsional loading at the joint between the second end of the thermoplastic elastic member 2 and the jeweil gen fastener 6 to exclude, the contouring of both Fuhrungsspuren 72 posted for the identical angular position.

**[0063]** In FIG. 5 is, for example, the arrangement of fastener ei nes 6 Upper with a hub 61 associated running wheels 62 ren two Fuhrungsspu 72 the profile element 7 shown. Furthermore ei ne contouring the profile element 7 shown as circumferential sections of high and low from cuts gradient present. Insbesondere, the profile element 7 the FIG. 5 fOr a To run the retaining elements 3, 4 two warming cycles and two Kuhlzyklen, so that in each case in two areas of thermoelasti by the rotating rule elements 2 One cylinder shaped formed telfache of the energy converter 1 a Kuhlwirkung and a heat delivery is achieved.

**[0064]** FIG. 6 shows a further AusfOhrungsform, wherein a further guide device in the form ei nes second profile element 7 ' in addition to the Profilelement 7 is provided. elements by the two profile 7, 7 ' Both a tensile load accordingly the function that men in the AusfOhrungsfor FIG. 1 and FIG. described 4, and ei ne compressive load on the thermoelastic Element e 2 be formed. These can the thermo-elastic elements 2 be with different geo provided geometries that can also absorb pressure load without bending. Possible Pro file of the thermo-elastic elements 2 round profile may be elliptical or polygonal profiles, hollow profiles and the like.

**[0065]** In the AusfOhrungsform FIG. 6, the profile elements 7, 7 ' formed so that these tracks have approximately Fuh with contours corresponding to each other and so a Fuhrungsschlitz

76 fOr the fasteners 6 form, so that the fastening elements 6 mogli waxed play be-

rule the contours of the two profile elements 7, 7' gefOhrt be, depending on the rotational angle position to the holding elements 3, 4 an axial tensile load or an axial compressive load to the corresponding thermo-elastic elements 2 auszuuben. In a not shown alternative AusfOhrungsform only the second profile element 7' be provided that the thermoplastic elastic members 2 only subjected to compressive load. In this case, the fasteners 6 by elastic pressure impingement on the contour of the second Profilele ments 7' gefOhrt.

[0066] In the AusfOhrungsform FIG. 7 is a drit th profile element 7" as a ring for guide device mig formed. At the inner lateral surface of the third molding member 7" a projection or groove ei ne as a guide structure 77 actually elements for leadership ei ner corresponding guide structure of the buildin 6 provided that the attachment elements 6 fOhrt and can move in the axial direction.

[0067] Furthermore, the fastening elements 6 on an outer side of the second holding member 4 attached so that they will be taken in the circumferential direction and can be pushed in the axial direction ver. For this purpose, another end of the fastener 6 ment at the second Halteele 4 be held in an axially movable so that the second support member upper 4 the Befestigungsele mente 6 along the guide structure of the third Pro filelements 7" be moved to achieve the axial Auslen effect.

[0068] Gema a AusfOhrungsform the FIG. 8 substantially of the AusfOhrungsform FIG. Nelt 1 ah, an energy converter 1 also in the area of the first holding member 3 ment with a fourth Profilele 7" ' be provided. By relative rotation of the contours of the profile element 7 and the fourth profile member 7" ' an adaptation of the elements can resultie in power load profile of the thermoelastic Ele 2 be achieved during the process. By the first and fourth Pro twisting filelements 7, 7" ' relative to one another may also, a degree of elastic deformation of the elements rule thermoelasti 2 are set, and in particular by the performance of the system or the thermoplastic elastic members Ver schlei 2 unabhan gig the speed of the arrangement with which the drive shaft to 5 is driven, can be influenced.

[0069] FIG. 9 shows an energy conversion system 20 with the erwarmtes / gekuhltes fluid under USAGE a wall of the energy previously described dung ler 1 can be produced or motion energy can be zuruckgewonnen of heat energy. The cross section of the FIG. 9 shows a home Ge 21 from which the drive shaft 5 protrudes,

in the interior of the energy converter 1 is coupled. The drive shaft 5 is in a WellenfOhrung 22 kept integral with the housing 21 or is connected is formed by this.

[0070] Upper each a planetary gear 23, 24, the drive shaft 5 the first and second retaining element 3, 4 driving, as washers 33, 34 in the interior of the housing 21 are rotatably mounted. A respective storage 35, 36 of the rings 33, 34 is for absorbing axial and radial forces laid out and can be placed anywhere, such as at au older peripheral edge or axially offset relative to the planetary gears 23, 24 be disposed.

[0071] Posted for the section of the power converter system 20 At least two other vonein separated flow channels 25, 26 each along a partial segment of the energy converter 1

formed by the can stromen a fluid such as water or air. the flow channels 25, 26 each comprise a Stromungsabschnitt, the thermo-elastic elements 2 From a cut in the circumferential direction around or upper current, resulting so a Wärmeübertragung between the thermo-elastic elements 2 and aware afford the fluid. mung kanale the Stromungsabschnitte the Stro 25, 26 can, for example, in the form of cylinder segments within the housing 21

be formed to such a mogli waxed close To brindling the thermo-elastic elements 2 to reach.

[0072] The use of the planetary gear 23, 24 allows it, within the rotating retaining elements 3, 4 and the thermo-elastic elements 2 to make possible fixed components, so that the respective profile element 7, 7', 7", 7''' can be kept correspondingly fixed.

[0073] Gema another from fOhrungsform not shown can also be a plurality of concentrically to each other arranged thermoelastic Anordnun gen with each form of a ring, that can be provided in a cylinder of parent thermoelastic elements. The thermoelastic assemblies can by separate Führungseinrichtungen in synchronic manner ner elastically deformed or relaxed who the. It can also be provided posted for the angle of rotation of the energy converter staggered phases elas genetic deformation and relaxation.

[0074] In FIG. 10 schematically exemplifies provided, the profile element 7 th from Einzelprofilsegmen 75 reassemble. The Einzelprofilsegmen te 75 have a predefined contour upper one be voted angle range. The properties of the energy converter 1 can by replacing one or more of the individual profiled segments 75 with un-

terschiedlichen profiles or contours are adapted to the wished ge system  
behavior. Wei terhin is characterized exchange a simplified installation  
**and from the profile element 7 in the power conversion system 20 u**  
nterstOzt.

QUOTES INCLUDED IN THE DESCRIPTION

Oiese list of the Anme / the aufgefOhrten Ookumente generated automatically and I included to help the reader's convenience SHARES / IEF-3 /. The list is not Bestandtei / German patent or utility model application. Oas OPMA top right not Hartung fOr any Feh / he or Off / rovals.

Cited patent literature

- US 2012/0273158 A1 [0004]
- US 4305250 A [0005]

**1. Thermo Elastic energy converters ( 1 ), in particular sondere a thermoelastic heating / cooling device, for use in a power converter system (20), comprising:**

- a thermoelastic arrangement with at least one thermoplastic elastic element (2) made of a thermoplastic elastic material;
- **two holding elements ( 3, 4), between which the at least one thermoplastic elastic element (2) is arranged in egg ner Uingsrichtung,**
- **a fastener ( 6) for holding an En of the at least one thermoplastic elastic elements (2);**
- **a guide device (7, 7 ") , the fastening element with the Be ( 6) the at least one thermoplastic elastic element (2) is coupled (at a synchronous rotation of the holding elements 3, 4) rela tive to the guide device (7) to cause Uingenande tion of at least one thermoplastic elastic elements (2) in the longitudinal direction, so that a cyclic elastic deformation and for drinks voltage of at least one thermoplastic elastic element (2) is achieved.**

**2. Thermo Elastic energy converters ( 1) according to claim 1., wherein another end of the at least one thermoplastic elastic element (2) fixed (on one of the support members 3, 4) is attached.**

**3. Thermo Elastic energy converters ( 1) according to claim 1., wherein another end of the at least one thermoplastic elastic element (2) a white upper teres fastener ( 6) is coupled to a second Fuh inference means (7 ') in order tion at a Rota of the holding elements ( 3, 4) means relative to said Fuhrungs and the second guide device (7 ') a change in length of at least one thermoplastic elastic element (2) in the longitudinal direction ken to be Farming, so that a cyclic elastic deformation and relaxation least one thermoelastables element (2) is reached the.**

**4. Elastic thermal energy conversion ( 1) An entitlement to 3, wherein the guide device (7) and the second guide device (7 ') the respective actuating element buildin synchronously phase-shifted elements or asynchronously posted for a rotation angle of Halteele ( 3, 4) deflect in the longitudinal direction.**

**5. Thermo Elastic energy converters ( 1) by ei nem of claims 1 to 4, wherein the Fuhrungsein direction (7) and / or the second guide device (7 ') has at least one profile element which has a Fuhrungsspur (72) for co-operation (with the fastening element 6) the at least one ther moelastischen element (2), so that when Ro of the holding elements tation ( 3, 4) Fuh approximately relative to the means (7) and the second Fuhrungsein-**

**direction (7 '), the fastener ( 6) is moved along the contour of the egg ner Fuhrungsspur (72) in a circumferential direction and at the same time Langenan alteration in the longitudinal direction causes.**

<sup>6th</sup> **Thermo Elastic energy converters ( 1) (According to claim 5, wherein the profile element (7) comprises a profiled disc, which is to have a stretching contour in the longitudinal direction along which the Fixed To restriction member 6) moves.**

**7. Thermo Elastic energy converters ( 1) according to entitlement 5, wherein the profile element (7 ") has a profile ring, which has a GE inwards or the outside guide structure directed to supply element Fixed To the ( 6) the at least one thermoelastables element (2) (in the longitudinal direction of the holding element on at Rotati 3) deflect relative to the profile element (7 ").**

**8. Thermo Elastic energy converters ( 1) according to entitlement 5 or 6, wherein the actuating element at least one buildin ( 6) is held against tilting, and in particular exclusively degrees of freedom of movement of the at least one Befestigungsele ments ( 6) to let in the longitudinal direction and circumferential direction.**

**9. Thermo Elastic energy converters ( 1) demanding according to 5 or 6, wherein the at least one management Profilele (7, 7 ") having a plurality of concentric Fuhrungspuren to the element at least one Befestigungsele ( 6) to keep against tilting and in particular exclusively sondere degrees of freedom of movement of the at least one fixation member ( 6) allow in the longitudinal direction and the circumferential direction.**

**10. Thermo Elastic energy converters ( 1) (According to one of claims 5 to 9, wherein the elements at least one profile element (7, 7 ") during rotation of the Halteele 3, 4) relative to the guide device (7) a tensile or a compressive load to the Minim least a thermo-elastic element (2) exerts.**

**11. Thermo Elastic energy converters ( 1) according to any one of claims 5 to 9, wherein a plurality of profile elements (7, 7 ', 7 ") are provided (on rotation of the support members 3, 4) relative to the direction Fuhrungsein (7, 7 ") both a tensile and a pressure load on the at least one Befestigungsele ment ( 6) auszuuben.**

**12. Thermo Elastic energy converters ( 1) (According to one of claims 5 to 9, wherein both elements Halteele 3, 4) are each provided with at least one Profilele element (7, 7 " ), to effect the change in length of at least one thermoplastic elastic member (2).**

13th Thermo Elastic Energiewandele ( 1 ) according to claim 12, wherein the respective at least (a profile elements 7, 7 ") (On both retaining elements 3, 4) are rotated in opposite directions so that the movements of the fastening elements BEWE ( 6 ) synchronously on both sides, out of phase or asynchronously posted for the rotation of the holding elements ( 3, 4 ) (Relative to the guide device 7) respectively.

(3, 4) (Or with the guide device 7) Upper min least a planetary gear ( 23, 24) is coupled.

This is followed by 10 pages of drawings

14. Thermo Elastic energy converters ( 1 ) according to any one of claims 5 to 13, wherein the (at least one profile element 7, 7 ") a Führungsspur ( 72) has on whose contour sections to tation at Ro of the holding elements ( 3, 4) approximating means relative to the Fuh ( 7) Different gradients of the at least one Uingenänderung thermoelastisches element ( 2) (Posted for the angle of rotation of the holding elements 3, 4) to effect.

15. Thermo Elastic energy converters ( 1 ) according to any one of claims 5 to 14, wherein the Minim least one profile element ( 7) a Führungsspur ( 72) having its contour sections in order upon rotation of the holding elements ( 3, 4) approximating means relative to the Fuh ( 7) two or more long changes of at least one thermoplastic elastic elements ( 2) teeelemente in a direction per revolution of the Hal ( 3, 4) to effect.

16. Elastic thermal energy converter ( 1 ) according to any one of claims 1 to 15, wherein a plurality of ther moelastischen elements ( 2) in one or several ren concentric circular arrays (between the retaining elements 3, 4) are arranged, each of the circuit arrangements is assigned a separate Führungsein direction.

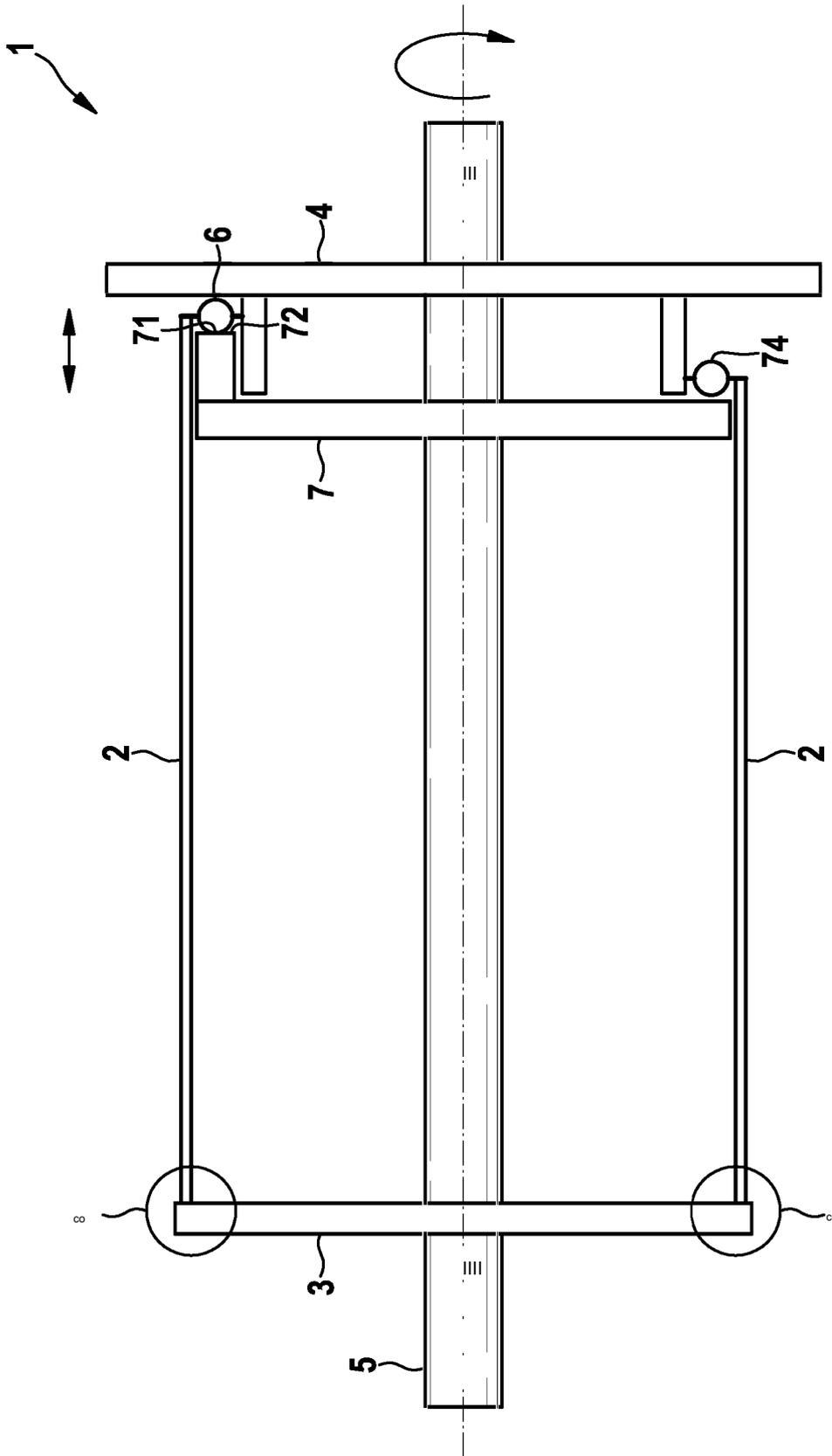
17. Thermo Elastic energy converters ( 1 ) (According to one of claims 1 to 16, wherein the management Profilele 7) (From individual profile segments 75) is put together.

18. Energy conversion system ( 20) in particular, a heating / cooling system, comprising:

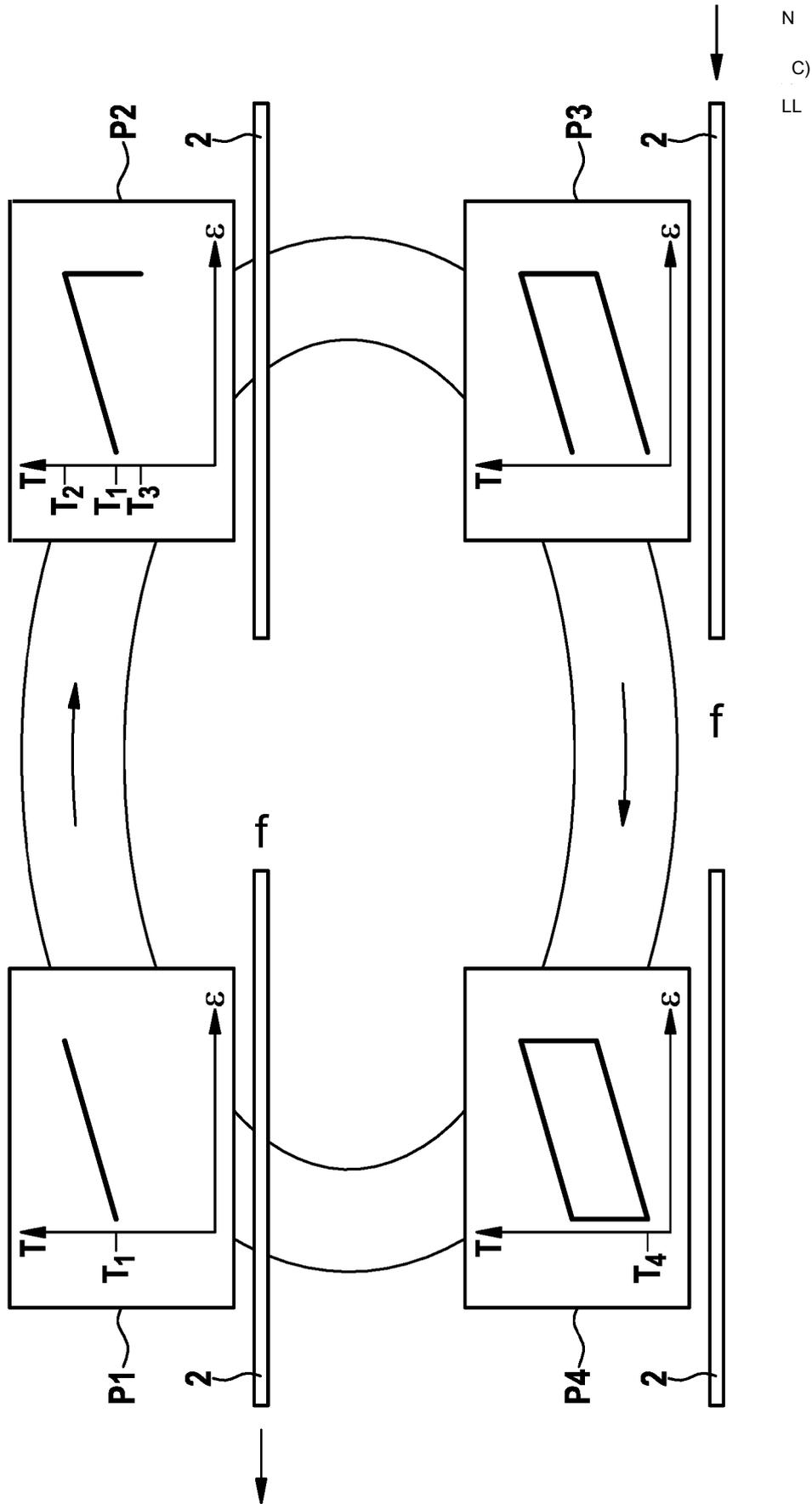
- a housing ( 21);
- a thermoelastic energy converter ( 1) according to any one of claims 1 to 17, in which the housing (21) is received;
- a drive shaft ( 5) elements for rotating the Halteele ( 3) (Relative to the guide device 7);
- at least two separate flow ducts ( 25 26) section for conducting a fluid in each case by an Ab, the a segment of the movement of the at least one thermoplastic elastic member

(2) defined cylindrical lateral surface comprises or is limited by this.

19th Energy conversion system ( 20) according to claim 18, wherein the drive shaft with the holding elements



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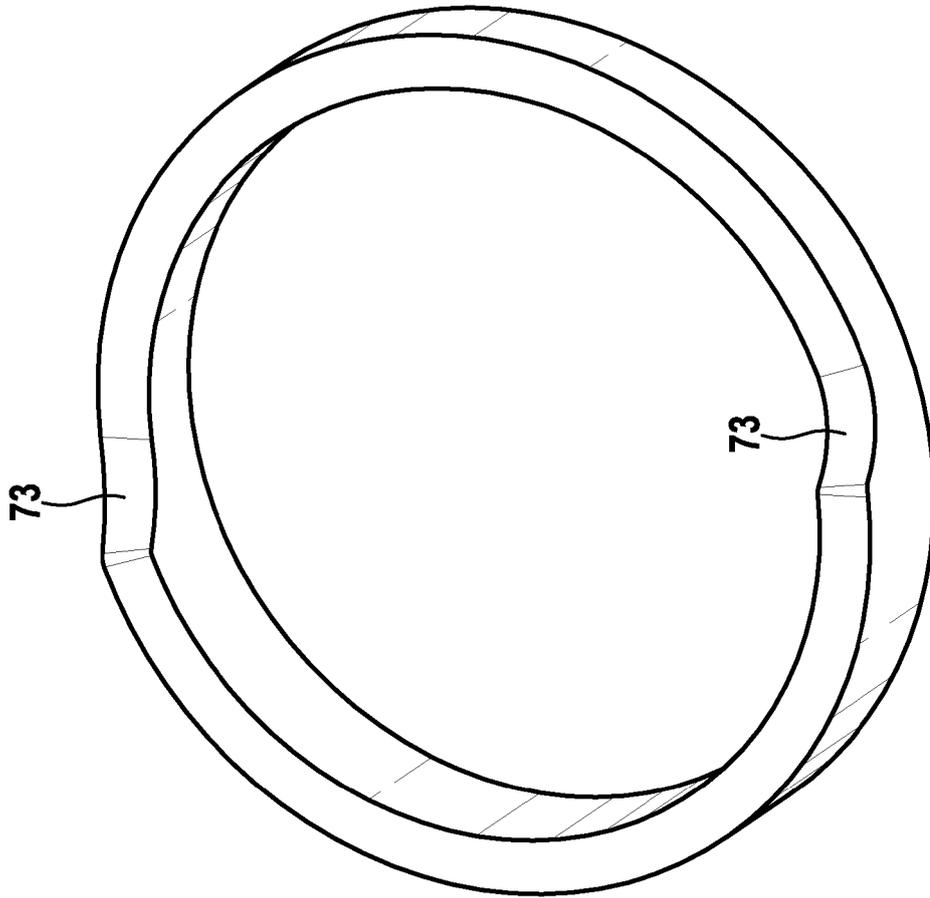


Fig. 3

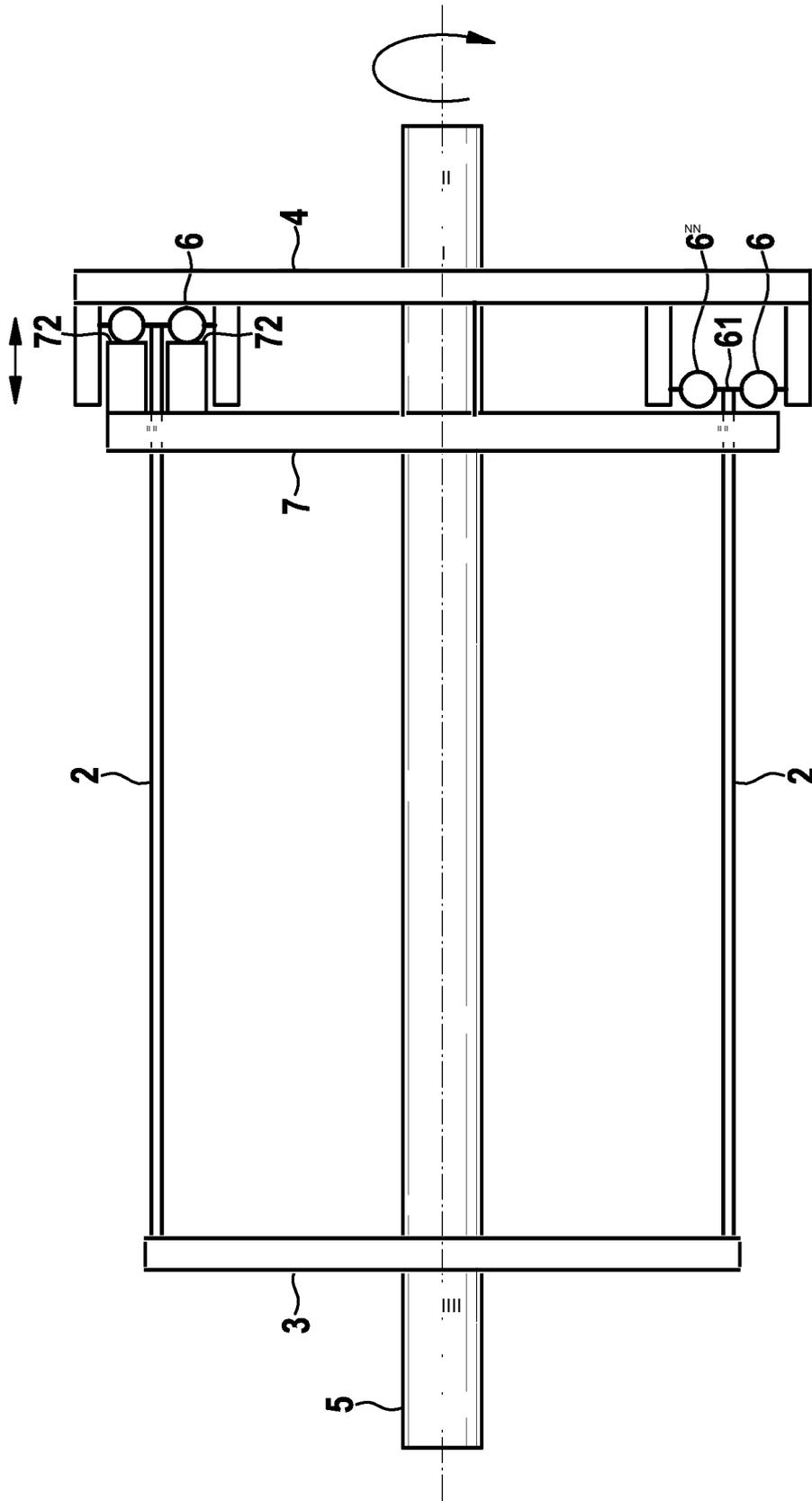
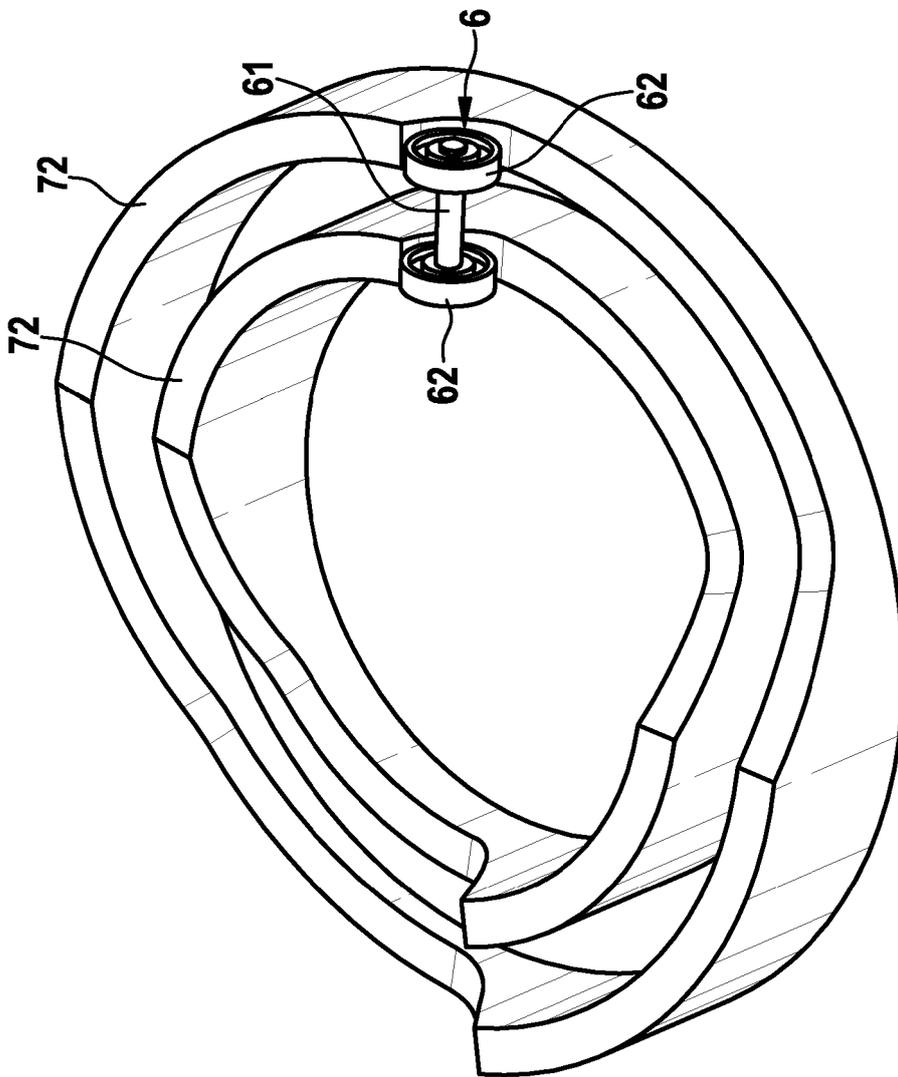
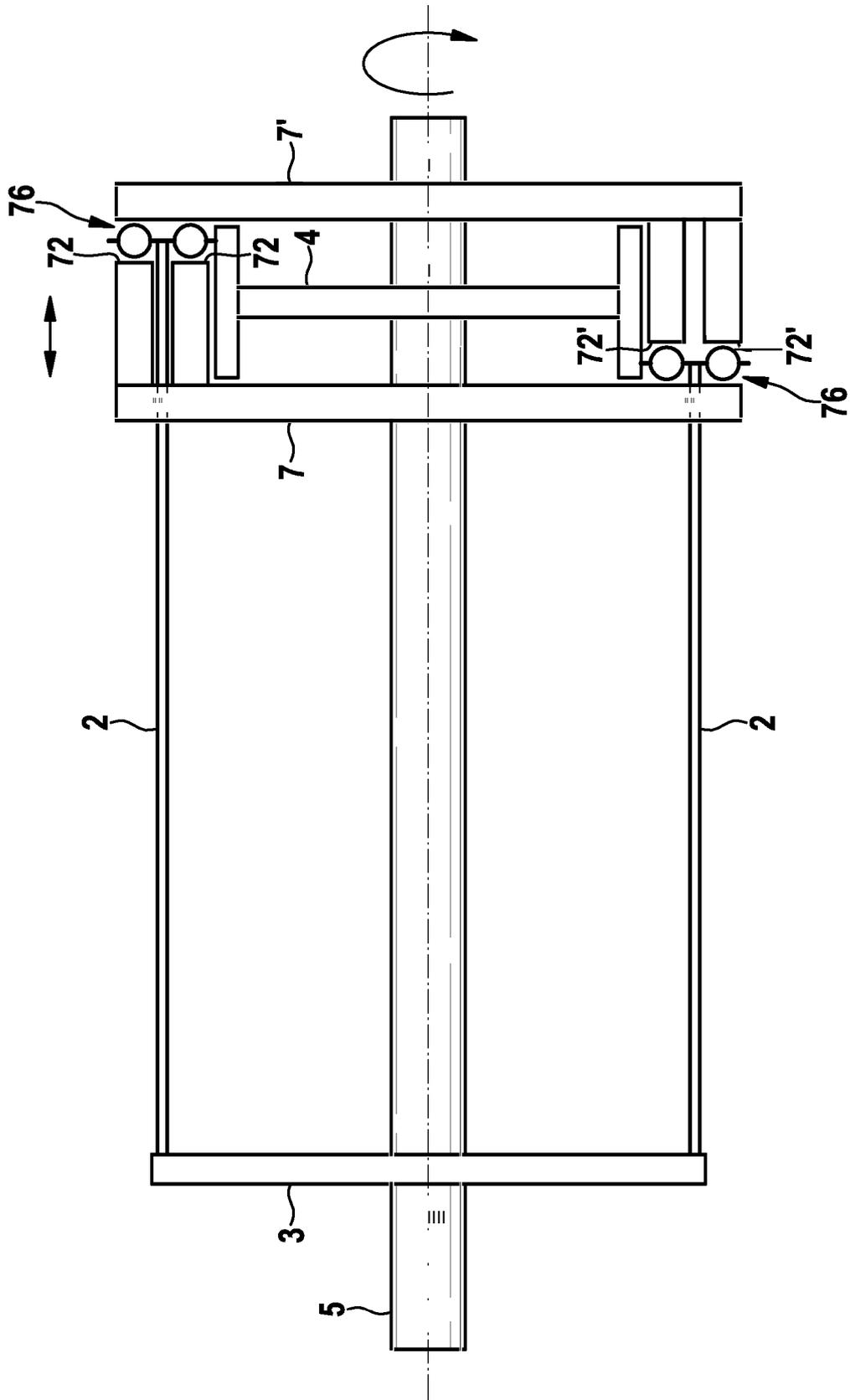


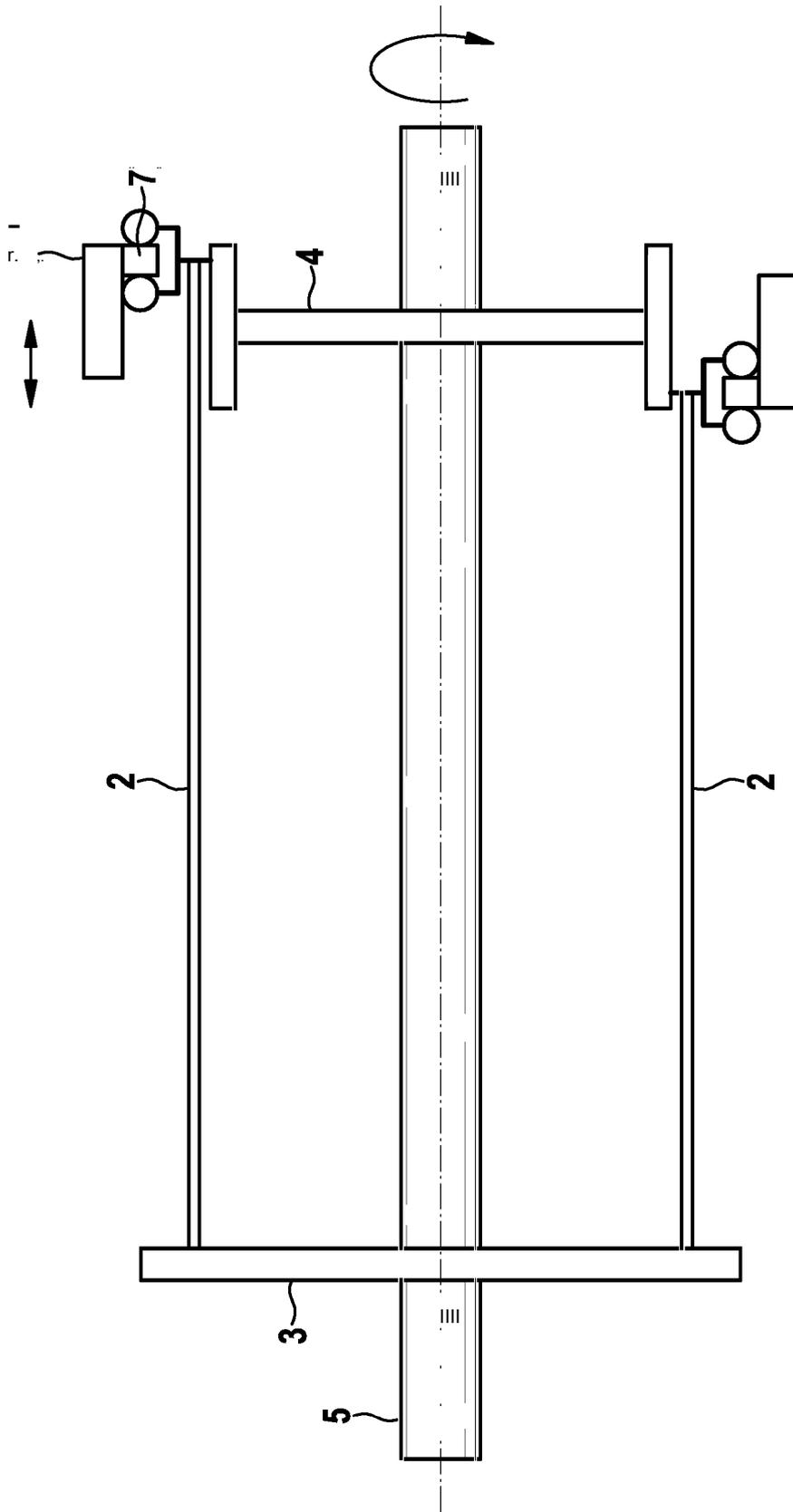
FIG. 4

In  
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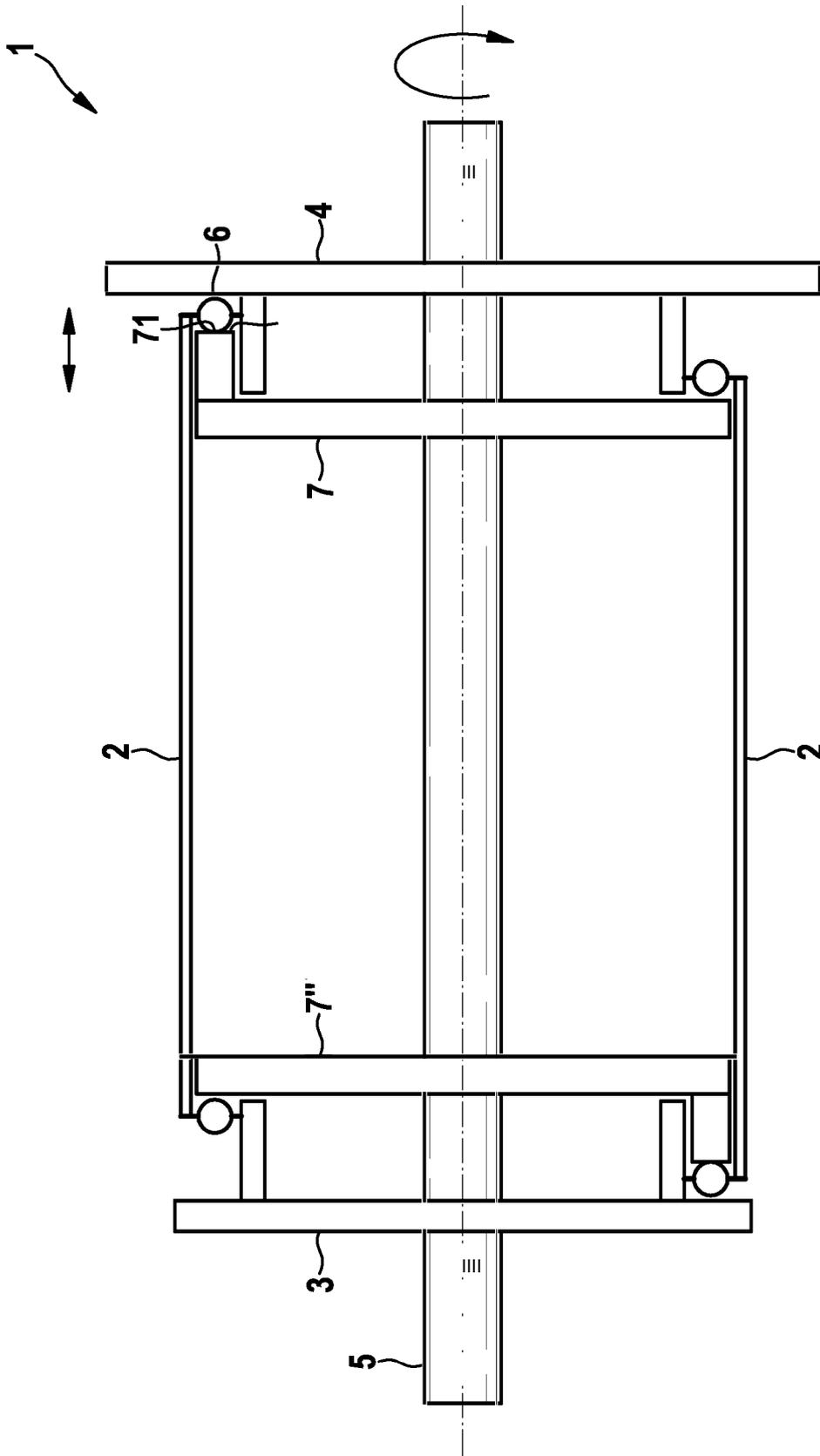




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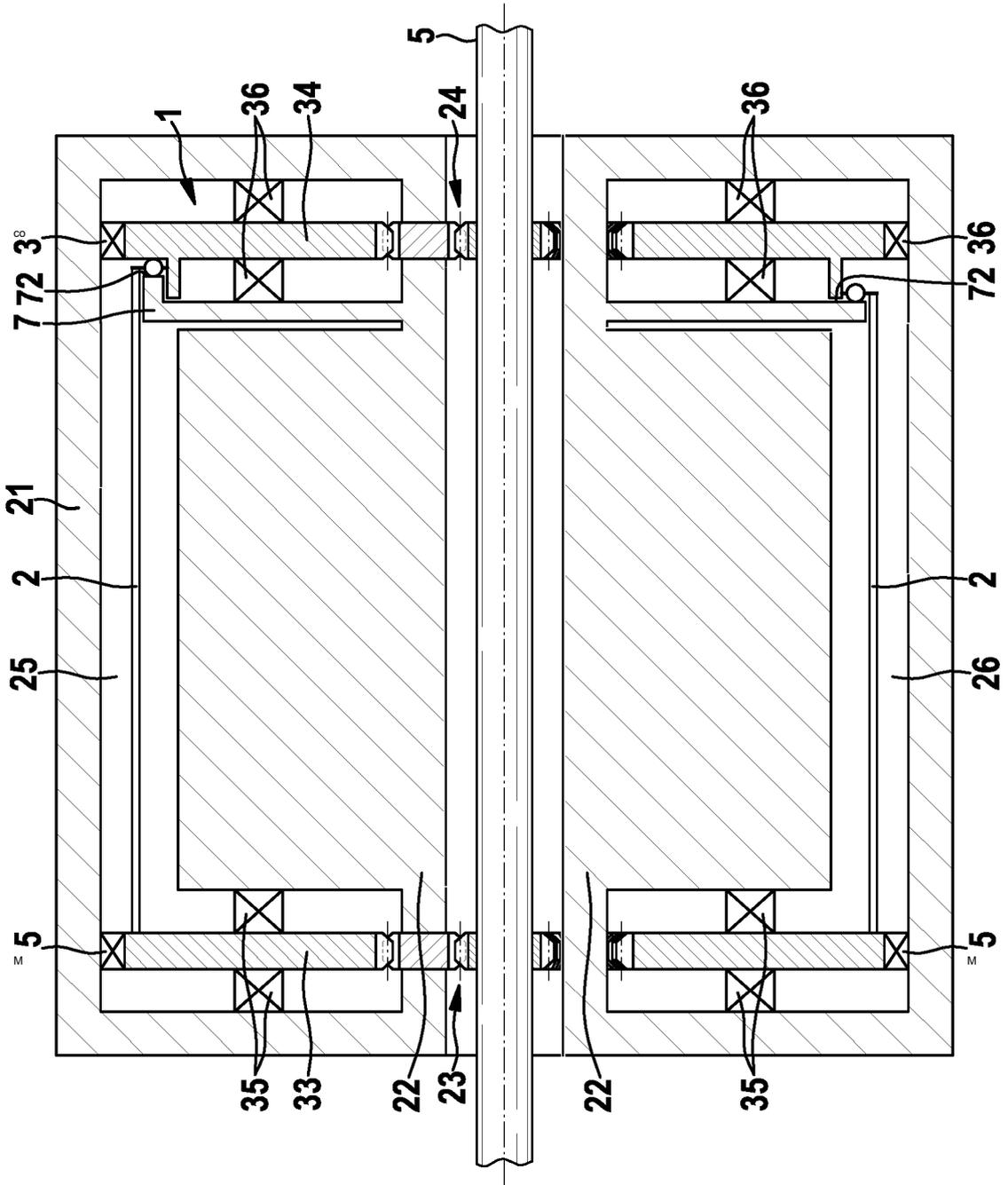
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C)  
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0')  
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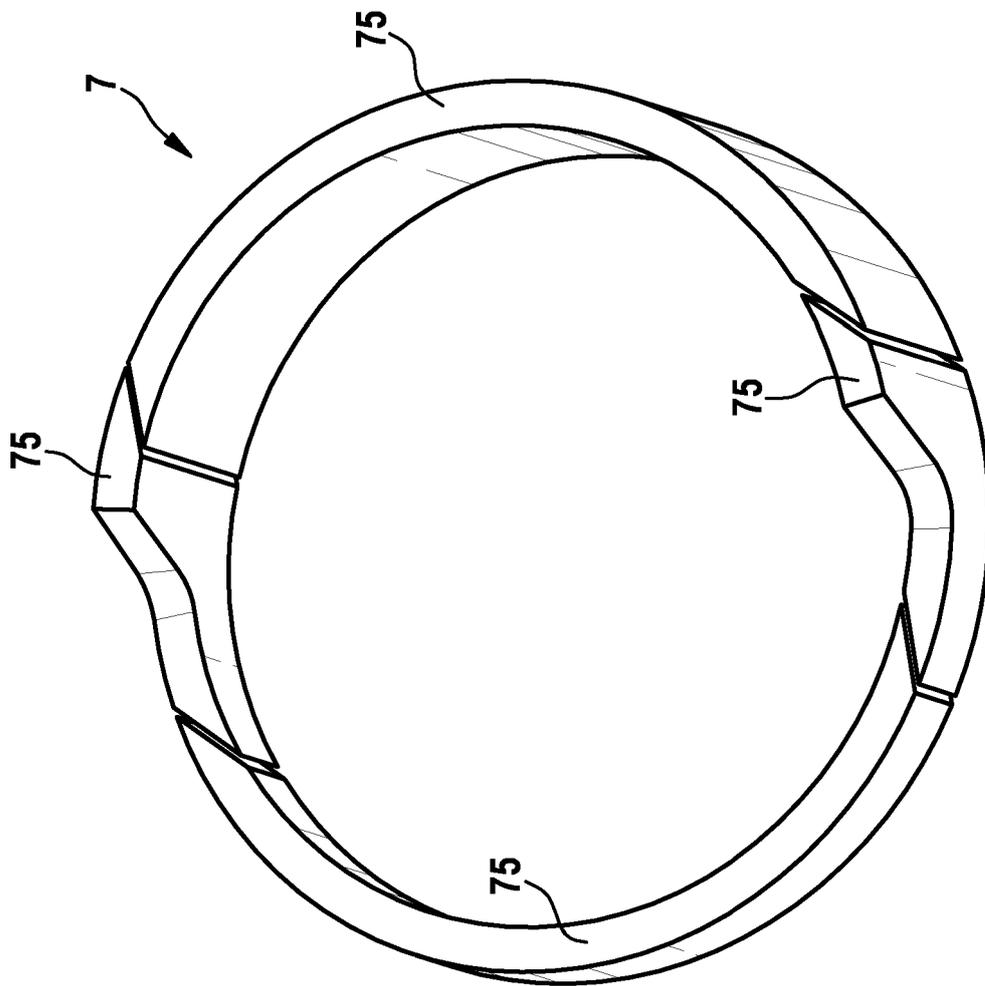


FIG. 10