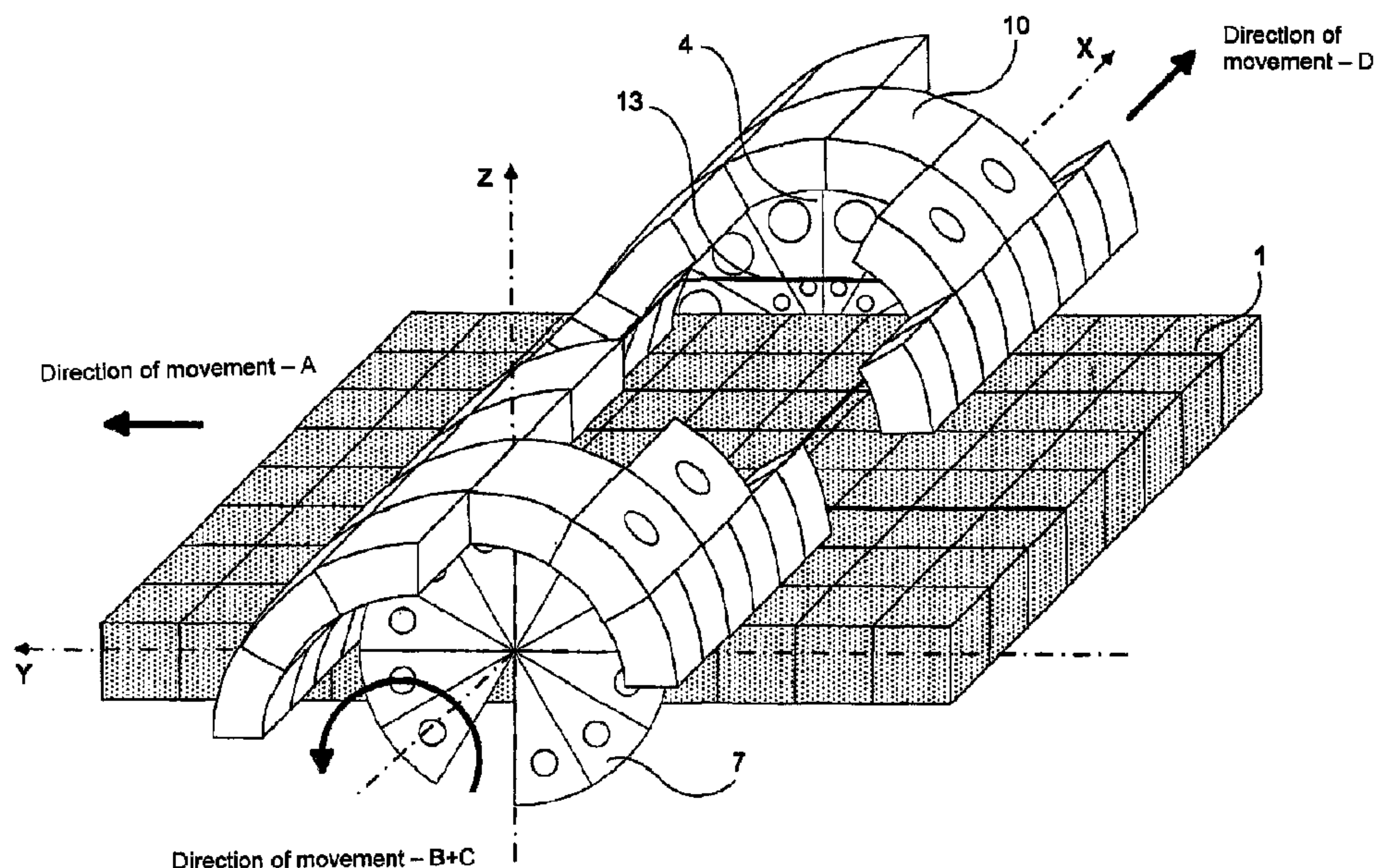




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(57) **Abrégé/Abstract:**

The invention relates to methods and to devices for a melting furnace, or for the conveying lines of the product to be melted, having an infinite life (furnace campaign). The same is achieved by means of the continuous/periodic, e.g. cyclic, exchange, in the optimum case, of all of the components surrounding the furnace interior/melting space, or surrounding the conveying lines, in that the components can be arranged/placed next to each other in a modular manner and that said components move in a certain direction while new individual parts are added at one of the free ends of the respective assembly and while worn/used individual parts are removed at the other free end of the respective assembly. For this purpose the individual components are held and/or moved by suitable receptacles, wherein the furnace interior/melting chamber remains stationary.

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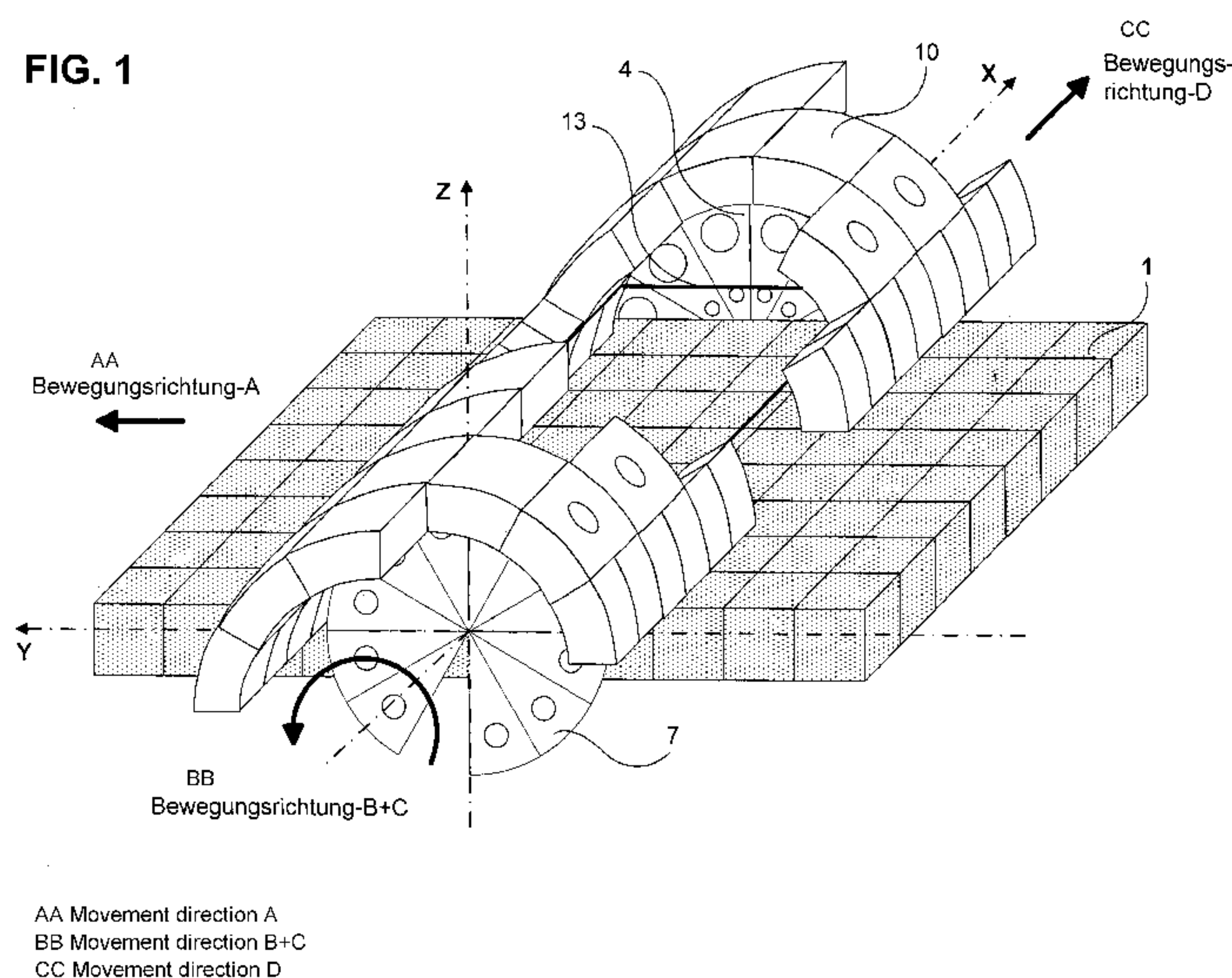
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FIG. 1



(57) Abstract: The invention relates to methods and to devices for a melting furnace, or for the conveying lines of the product to be melted, having an infinite life (furnace campaign). The same is achieved by means of the continuous/periodic, e.g. cyclic, exchange, in the optimum case, of all of the components surrounding the furnace interior/melting space, or surrounding the conveying lines, in that the components can be arranged/placed next to each other in a modular manner and that said components move in a certain direction while new individual parts are added at one of the free ends of the respective assembly and while worn/used individual parts are removed at the other free end of the respective assembly. For this purpose the individual components are held and/or moved by suitable receptacles, wherein the furnace interior/melting chamber remains stationary.

(57) Zusammenfassung:

[Fortsetzung auf der nächsten Seite]

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Die Erfindung bezieht sich auf Verfahren und Vorrichtungen eines Schmelzofens bzw. der Förderstrecken des Schmelzguts, mit unendlicher Lebensdauer (Ofenreise). Dies wird durch den kontinuierlichen/periodischen, also zyklischen, Austausch, im optimalsten Fall aller, den Ofeninnenraum/Schmelzraum bzw. der Förderstrecken umgebenden Bauteile realisiert, indem die Bauteile modular aneinander reih-/fügbar sind, sich in eine bestimmte Richtung bewegen, während an einem der freien Enden der jeweiligen Baugruppe neue Einzelteilstücke angefügt werden, während am anderen freien Ende, der jeweiligen Baugruppe, verschlissene/gebrauchte Einzelteilstücke entfernt werden. Die einzelnen Bauteile werden hierbei von geeigneten Aufnahmen gehalten und/oder bewegt, wobei der Ofeninnenraum/Schmelzraum stationär verbleibt.

MELTING FURNACE HAVING AN INFINITE FURNACE CAMPAIGN

Background

5 [0001] The invention relates to methods and apparatus of a melting furnace with up to infinite furnace campaign. This is implemented by a continuous/periodical thus cyclic exchange of, in the best case, all components of the melting furnace that surround the interior of the furnace/melting space, wherein the components are modularly placed or arranged next to each other, move in a predetermined direction, have a specific shape
10 and are supported by suitable receptacles and are moved and/or turned, wherein the components enclosing the melt remain substantially stationary.

[0002] A melting furnace of this type is known from document FR-A-1156001.

15 [0003] Known apparatuses in the area of glass melting technology are furnaces which are assembled from selected refractory materials. In the simplest case they are composed essentially of a base plate or base plate, sidewalls, a vault and an end walls which together surround the inner space of the furnace or furnace interior/melting space. In order to keep the individual components in their predetermined position and in order to
20 absorb the in some areas considerable forces, comprehensive steel constructions are necessary, which are summarised under the term bracing or anchorage.

[0004] The entire glass melting furnace is subject to wear (corrosion/erosion) and has therefore a limited lifetime (furnace campaign). This type of furnace design for melting
25 of glass is with respect to today's modern mechanical components, data analysis systems and control possibilities, short-lived, cost intensive and inefficient.

[0005] An exchange of worn out components of the melting furnace is, mainly due to the high temperature, only possible by shutting down and cooling down of the entire
30 glass melting furnace whereby the fabrication of glass is stopped for a long period in time.

[0006] Repair of worn out components without shutting down and cooling down is only possible under limitations and prolongs the furnace campaign of the glass melting furnace only marginally.

5 [0007] After a few years the entire melting furnace has to be completely renewed.

Summary of Invention

[0008] It is therefore an object of the disclosure to provide methods and apparatuses
10 that enable an infinite furnace campaign of melting furnaces, by implementing a continuous/periodical, thus cyclic exchange of the worn components of the melting furnace of all components of the melting furnace, wherein the components are modularly aligned/arranged next to each other, move in a certain direction, thereby providing a specific shape and supported by adapted receiving elements and moved and/or turned,
15 wherein components enclosing the melt remain quasi stationary.

[0009] In an embodiment, the invention comprises a method for operating melting furnaces, or for haulage tracks for the melt, wherein individual elements or component subassemblies enclosing the melt are exchangeable moving or turning them in certain
20 direction such that new individual elements or component subassemblies can be added at one free end and worn out/used individual elements or component subassemblies can be removed at an other free end outside the melt, wherein the component subassembly is rotationally turnable.

25 [0010] In an embodiment, the invention comprises a melting furnace or haulage track for melt, wherein support and/or moving elements of individual elements and/or component subassemblies enable turning for exchanging individual elements and/or component subassemblies such that new individual elements or component subassemblies can be added at one free end and worn out/used individual elements or
30 component subassemblies can be removed at an other free end, wherein the component subassembly is a cylinder segment.

[0011] Advantages achieved by the present disclosures are essentially that the melting furnace produces glass without interruption or without essential interruption and can be continuously adapted to new method and materials.

5 **Brief Description of the Drawings**

[0012] The figures show:

[0013] Fig. 1 is a perspective view of the entire melting furnace with view into the
10 interior of the melting furnace through cut-out parts of the entire sidewall with vault (10).

[0014] Fig. 2 is a perspective view of the base plate/ bottom (1) with indication of the direction of movement (A) of the base plate (1) as well as the addition of a new individual element of the base plate (2) and removal of a worn out/used individual
15 element of the base plate (3).

[0015] Fig. 3 is a front view of an individual element of the end wall at the side of the raw material feeding (4a) with openings for exhaust gas and raw material addition; in the Y-Z-plane.
20

[0016] Fig. 4 is a front view of the entire end wall at the side of raw material feeding (4) consisting of individual elements of the end wall at the side of the raw material feeding (4a) and illustration of the addition of new individual elements of the end wall at the side of the raw material feeding (5) and removal of a worn out/used individual
25 element of the end wall at the side of the raw material feeding (6); in the Y-Z-plane.

[0017] Fig. 5 is a front view of an individual element of the end wall at side of the exit of the melting material (7a) with an opening for the melting material; in the Y-Z-plane.

30 [0018] Fig. 6 is a front view of the complete end wall at the side of the outlet for the melt(7), consisting of individual elements of the end wall at side of the melt outlet (7a) with indication of the direction of movement (C) of the end wall at the side of the melt

outlet (7) and indication of the addition of a new individual element of the end wall at the side of the melt outlet (8) and removal of a worn out/used individual element of the end wall at the side of the melt outlet (9); and the Y-Z-plane.

- 5 [0019] Fig. 7 is a perspective view of an arc segment of the sidewall with vault (10.1) consisting of individual elements, the individual sidewall element (10.1a), the individual nozzle brick element (10.1b) and the individual vault element (10.1c).

- [0020] Fig. 8 is a perspective view of the entire sidewall with vault (10) consisting of
10 assembled arc segments of the entire sidewall with vault (10.1 to 10.n) with indication of the direction movement (D) of the entire sidewall with vault (10) and illustration of the addition of a new arc segment of the sidewall with vault (11) and removal of a worn out/used arc segment of the sidewall with vault (12).

- 15 [0021] Fig. 9 is a cross section of a possible design of the melting furnace with illustration of height adjustable individual elements of the base plate (1a) in the Y-Z-plane.

- [0022] Fig. 10 is a cross section of a possible design of the melting furnace with
20 illustration of the base plate (1) in form of a lying straight cylinder which is at least partly hollow, in the Y-Z-plane.

- [0023] Fig. 11 is a cross section of a possible design of the melting furnace or the
25 haulage track of the melt (13) with illustration of the four surfaces surrounding the melt (14), in the Y-Z-plane.

- [0024] Fig. 12 is a top view of a possible design of the melting furnace or of the haulage track of the melt (13) without plain covering surfaces enclosing the melt (13), with indication of four surfaces surrounding the melt (14) in the X-Y-plane.

[0025] Fig. 13 is a top view of a possible design of the melting furnace or of the haulage track of the melt (13) without the plain covering surfaces enclosing the melt (13) with indication of the three planes surrounding the melt (14) in the X-Y-plane.

5 [0026] Fig. 14 is a cross section of a possible design of the melting furnace or of the haulage track of the melt (13) with indication of the three planes surrounding the melt (14) in the Y-Z-plane.

[0027] Fig. 15 is a top view of a possible design of the melting furnace or of the
10 haulage track of the melt (13) without the plain covering surfaces enclosing the melt (13), with indication of the two plain sidewalls (17) and of two surrounding surfaces of the melt (14) in the X-Y-plane.

[0028] Fig. 16 is a top view of a possible design of the melting furnace or of the
15 haulage track of the melt (13) without plain covering surfaces enclosing the melt (13), with indication of the entire variable sidewall (20), in the X-Y-plane.

[0029] Fig. 17 is top view of a possible design of the melting furnace or of the haulage
20 track of the melt (13) without the plain covering surfaces enclosing the melt (13), with indication of the entire variable sidewall (20) and inserted body of revolution (23), in the X-Y-plane.

Detailed Description

25 [0030] The object is solved essentially in a way that at least the component subassemblies (1, 4, 7, 10, 14, 17, 20, 23) of the melting furnace enclosing the melt (13) comprise aligned with respect to each other or adjacently arranged individual components (1a, 4a, 7a, 10.1a to 10.na, 10.1b to 10.nb, 10.1c to 10.nc, 14a, 17a, 20a, 23a) or consist of a single piece that can differ in size, shape, design and material and
30 which are formed corresponding to their respective specific requirements, provide receiving possibilities for the necessary support and/or moving elements and are moved in a certain direction wherein the individual components which are not moved (1a, 4a,

7a, 10.1a to 10.na, 10.1b to 10.nb, 10.1c to 10.nc, 14a, 17a, 20a, 23a) or the component subassemblies (1, 4, 7, 10, 14, 17, 20, 23) which are not moved are locally maintained in their determined place and the moved individual components (1a, 4a, 7a, 10.1a to 10.na, 10.1b to 10.nb, 10.1c to 10.nc, 14a, 17a, 20a, 23a) or the moved component subassemblies (1, 4, 7, 10, 14, 17, 20, 23), respectively, are moved in the respective predetermined direction and wherein at each beginning of the moving direction new individual components (2, 5, 8, 11, 15, 18, 21, 24) or new component subassemblies (1, 4, 7, 10, 14, 17, 20, 23) are attached or added to the corresponding components subassemblies (1, 4, 7, 10, 14, 17, 20, 23) and worn/used individual components (3, 6, 9, 12, 16, 19, 22, 25) or worn/used component subassemblies (1, 4, 7, 10, 14, 17, 20, 23) are removed from the respective component subassemblies (1, 4, 7, 10, 14, 17, 20, 23) at the end of the moving direction after the corresponding furnace campaign and the resulting wear or tear, wherein the shape of the aligned or adjacently arranged individual components (1a, 4a, 7a, 10.1a to 10.na, 10.1b to 10.nb, 10.1c to 10.nc, 14a, 17a, 20a, 23a), or component subassemblies (1, 4, 7, 10, 14, 17, 20, 23) can adapt at their contact position a smooth shape or each other form known to a person skilled in the art, such as for example protrusions, indenting, dovetail, groove and tong solutions, etc; this results in a continuous/periodical thus cyclical exchange of at least all individual components (1a, 4a, 7a, 10.1a to 10.na, 10.1b to 10.nb, 10.1c to 10.nc, 14a, 17a, 20a, 23a) or component subassemblies (1, 4, 7, 10, 14, 17, 20, 23) of the respective single components (1a, 4a, 7a, 10.1a to 10.na, 10.1b to 10.nb, 10.1c to 10.nc, 14a, 17a, 20a, 23a) or subassembly components (1, 4, 7, 10, 14, 17, 20, 23) enclosing the melt (13), in the order of their supply or addition of the respective individual components (1a, 4a, 7a, 10.1a to 10.na, 10.1b to 10.nb, 10.1c to 10.nc, 14a, 17a, 20a, 23a) or subassembly components (1, 4, 7, 10, 14, 17, 20, 23) whereby an up to infinite furnace campaign is implemented and the components enclosing the melt (13) remain quasi stationary.

[0031] The described methods and apparatuses that are apparently connected by a common inventive concept are, as is evident to a person skilled in the art, particularly useful for the use in melting furnaces and/or haulage tracks of the (melting material) melt, for glass melting as well as for metal melting or for melt open of mineral basic materials for melting mixtures as well as for any type of melting material.

[0032] A glass melting furnace is described in the embodiments as an example.

[0033] The examples of the invention are explained with respect to figures 1 to 17 for
 5 illustrative purposes, wherein each example can be configured as melting furnace, as
 haulage track for the melting material/melt (13) or similar up to the further processing of
 the melt (13).

[0034] All figures 1 to 17 are given in a orthogonal Cartesian coordinate system (X, Y,
 10 Z), they are however, not limited to the Cartesian coordinate system (X, Y, Z), but can be
 turned, moved or built up vice versa.

[0035] The shown directions of movement (A, B, C, D, E, F, G) of the individual
 component subassemblies (1, 4, 7, 10, 14, 17, 20, 23) are not limiting, only a mutual
 15 limitation of the component subassemblies (1, 4, 7, 10, 14, 17, 20, 23) in their
 movement/displacement has to be avoided.

[0036] The control/regulation of the movement of all or parts of the component
 subassemblies (1, 4, 7, 10, 14, 17, 20, 23) or the control/regulation of movement of the
 20 individual components (1a, 4a, 7a, 10.1a to 10.na, 10.1b to 10.nb, 10.1c to 10.nc, 14a,
 17a, 20a, 23a) or at least of single parts of the individual components (1a, 4a, 7a, 10.1a to
 10.na, 10.1b to 10.nb, 10.1c to 10.nc, 14a, 17a, 20a, 23a) occurs by at least one data
 treatment system or neuronal data system in an analogue or digital way which ensures
 the relevant data for moving, turning and the limitation of occurring local forces and/or
 25 momentums of the component subassemblies (1, 4, 7, 10, 14, 17, 20, 23) or parts of the
 component subassemblies (1, 4, 7, 10, 14, 17, 20, 23) or of individual components (1a,
 4a, 7a, 10.1a to 10.na, 10.1b to 10.nb, 10.1c to 10.nc, 14a, 17a, 20a, 23a) or parts of the
 individual components (1a, 4a, 7a, 10.1a to 10.na, 10.1b to 10.nb, 10.1c to 10.nc, 14a,
 17a, 20a, 23a).

30

[0037] Fig. 1 to 8 show, as explained below, a method according to claims 1 to 3 and
 the apparatus according to claims 6 to 7 in a preferred example that is arranged such that

the melting furnace can continuously fabricate melt (13) without a considerable limitation in time.

[0038] Fig. 1 shows the melting furnace with the directions of movement (A, B, C, D) of the respective components subassemblies (1, 4, 7, 10) in a perspective view with viewing direction into the interior of the melting furnace, through cut-out parts of the entire sidewall with vault (10), wherein the shape of the furnace interior/melting space is a flat straight partial cylinder whereof a straight cutting plane is parallel to the lateral line, wherein orthogonal to the cutting plane two identical parallel segments of a circle are formed, the bottom/base and covering surface, a centre point of which is, with respect to a full circle, outside of a surface of these segments of the circle and which cross the X-axis; this bottom/base surface and the covering surface of the furnace interior/melting space is limited from the exterior by two end walls (4, 7) the centre point of which is, with respect to a full circle, also on the X-axis, wherein the vaulted or arched lateral surface of the furnace interior/melting space is delimited from the exterior by the entire sidewall with vault (10) and the remaining cutting plane of the furnace interior/melting space, the plane of section which forms a rectangle, delimits the furnace interior/melting space from the exterior with the base plate/bottom (1). Fig. 2 shows the base plate/bottom (1) of the melting furnace comprising modular cuboidal shaped individual elements of the base plate (1a) that can be aligned or arranged next to each other, which move translationally in a predetermined direction, the direction of movement-A along the Y-axis in the direction of positive Y-values, while a continuous/periodical, thus cyclic addition of new individual elements of the bottom (2) at the side of negative Y-values occurs and worn/used individual elements of the bottom (3) are removed at the side of positive Y-values, wherein the velocity of the movement of the bottom (1) occurs in a manner corresponding to the wear or use of the individual elements of the bottom (1a) such that the entity of bottom (1) remains quasi stationary and the distance at the bottom (1) in direction of the Y-axis is larger than two times R_2 of the sidewall with vault (10) to ensure an addition of new individual elements of the bottom (2) and/or the removal of worn out/used individual elements of the bottom (3) outside of the furnace interior/melting space wherein the surface of the bottom (1) which is oriented towards the furnace interior/melting space is in the X-Y-plane, for $Z = h$ and $h > 0$ in order to

ensure a secure closure of the furnace interior/melting space with respect to the entire sidewall with vault (10) and the two end walls (4, 7) and to enable a rotational movement of the sidewalls (4, 7) wherein a portion of both surfaces of the bottom (1) form a limitation to both end walls (4, 7) they are in contact with in the Y-Z-plane. Fig. 3 shows an individual element of the end wall at the side of raw material feeding (4a) in the Y-Z-plane in form of a straight cylinder segment, each with a lead-through for the feeding of raw material and for the exhaust gases. Fig. 4 shows the assembled end wall at the side of the raw material feeding (4), comprising individual elements of the end wall at the side of the raw material feeding (4a) adjacently aligned/ arranged next to each other, such that a cylinder segment with an obtuse angle forms, a centre point of which crosses, with respect to two oppositely arranged individual elements of the end wall at the side of the raw material feeding (4a), the X axis and wherein the end wall at the side of the raw material feeding (4) rotates around this X-axis in direction of movement-B, such that at one of both free ends of the end wall at the side of the raw material feeding (4) new individual elements of the end wall at the side of the raw material feeding (5) is added in the same angel degree or essentially in the same angle degree, while at the other free end of the end wall at the side of raw material feeding (4) the worn/used individual elements at the side of the raw material feeding (6) can be removed and that the rotating speed of the end wall at the side of the raw material feeding (4) depends essentially on the wear of the individual elements of the end wall at the side of the raw material feeding (4a), wherein each individual element of the end wall at the side of raw material feeding (4a) normally performs during its furnace campaign a rotational movement which is less than a complete three-hundred-sixty degree rotation and the surface of the end wall at the side of raw material feeding (4) oriented towards the furnace interior/melting space closes or terminates in the Y-Z-plane with the surfaces of the bottom (1) they are in contact with in the Y-Z-plane. Fig. 5 shows an individual element of the end wall at the side of melt outlet (7a) in the Y-Z-plane in form of a straight cylinder segment with a lead-through the molten material/melt (13). Fig. 6 shows the assembled end wall at the side of the melt outlet (7) which is arranged parallel to the end wall at the side of the raw material feeding (4) at the opposite side of the bottom (1) in the Y-Z plane, the end wall at the side of the raw material feeding (4), comprising individual elements of the end wall of the side of the melt exit (7a) aligned or arranged next to each other in a form such that a

cylinder segment with a obtuse angle forms, a centre point of which is with respect to two individual elements of the end wall at the side of the melt outlet (7a) which are arranged opposite to each other, on the X-axis and wherein the end wall at the side of the melt outlet (7) turns in rotation around this X-axis, the direction of movement-C such that at one of both free ends of the end wall at the side of the melt outlet (7) new individual elements of the end wall at the side of the melt outlet (8) can be repeatedly added in the same angle degree or essentially in the same angle degree while at the other free end of the end wall at the side of the melt outlet (7) a worn out/used individual element of the end wall at the side of the melt outlet (9) can be removed and the rotational speed of the end wall at the side of the melt outlet (7) is mainly based on the wear of the individual elements at the end wall at the side of the melt outlet (7a) wherein each one of the individual elements of the end wall at the side of the melt exit (7a) normally performs during a furnace campaign a rotational movement which is less than a complete turn and the surface of the end wall at the side of the melt outlet (7) facing towards the furnace interior/melting space in the Y-Z-plane terminates/close with the surface of the bottom (1) in the Y-Z-plane, which is opposite to the surface of the end wall at the side of the raw material feeding (4) oriented towards the furnace interior/melting space, the furnace interior/melting space.

[0039] Fig. 7 shows an arc segment of the entire sidewall with vault (10.1) in form of a lying straight partial hollow cylinder, the straight cutting plane of which is parallel to the lateral line, wherein two identical parallel annular segments form orthogonal to the cutting plane, the bottom surface and the cover surface of the arc segment of the entire sidewall with vault (10.1), the centre point of which is, in relation to the entire circular ring is outside of the centre point of the plane of these annular elements and which goes through the X-axis, wherein, for the distance $h = 0$, the bottom surface and the cover surface of the arc segment of the entire sidewall with vault (10.1) would form circular rings, wherein the arc segment of the entire sidewall with vault (10.1) is a straight hollow cylinder, wherein the difference of the radii $R_2 - R_1$ (for $R_1 < R_2$) represents the wall thickness of the arc segment of the entire sidewall with vault (10.1) and the both cutting planes of the straight partially hollow cylinder of the arc segment of the entire sidewall with vault (10.1), which are rectangles, respectively that are in the X-Y-plane for $Z = h$

with $h > 0$ and smallest distance of which from the X-axis is $R1$ respectively, lie on the surface of the bottom (1) which faces towards the furnace interior/melting space in order to delimit the furnace interior/melting space, wherein the arc segment of the entire sidewall with vault (10.1) comprises individual elements (10.1a, 10.1b, 10.1c) corresponding to the respective
5 requirement, such that, from the Z-plane for $Z = h$ the bricks in contact with glass are formed as soldier courses or palisades and built the individual sidewall element (10.1a), on which the nozzle brick/throat/quarl in form of an individual nozzle brick element (10.1b) is arranged, and the vault formed from an individual vault element (10.1c), which form together the entire partial hollow cylinder of the arc segment of the entire sidewall with vault (10.1), the vaulted inner
10 lateral surface of which limits the lateral surface of the furnace interior/melting space. Fig. 8 shows the entire sidewall with vault (10) in a form, wherein the individual arc segments of the entire sidewall with vault (10.1 to 10.n) are aligned/arranged next to each other at their respective bottom surfaces and their cover surfaces such that both cutting planes of the straight partial hollow cylinders of the respective arc segments of the entire sidewall with vault (10.1 to 10.n)
15 which are a rectangle, respectively, that lie in the X-Y-plane for $Z = h$ and the lowest distance of which is $R1$ from the X-axis, respectively, lie in a plane and on the surface of the bottom (1) oriented towards the furnace interior/melting space in order to delimit the furnace interior/melting space, wherein the total number of arc segments of the entire sidewall with vault (10.1 to 10.n) of the entire sidewall with vault (10) forms at least one cover for the entire vaulted
20 casing/mantle of the furnace interior/melting space and the entire sidewall with vault (10) moves in a predetermined direction in translation with direction of movement-D along the X-axis in the direction of positive X-values while new arc segments of the entire sidewall with vault (11) are continuously/periodically thus cyclically added at the side of negative X-values and worn out/used arc segments of the entire sidewall with vault (12) are removed at the side of positive X-
25 values, wherein the velocity of movement of the entire sidewall with vault (10) occurs in a manner corresponding to the occurrence of wear/use of the individual arc segments of the entire sidewall with vault (10.1 to 10.n).

[0040] It is, of course, although possible that the raw material feeding and/or the removal of
30 the melt (13) occurs via the base plate/bottom (1) in a manner, that suitable openings are provided in selected individual elements of the base plate (1a), in this case an infinite furnace campaign without interruptions of the flow of melting material is possible.

[0041] The addition of raw materials, energy, the removal of melt (13), exhaust gases and the intake of measurement probes or others can, if it makes technical sense, be inserted through suitable openings in all component subassemblies (1, 4, 7, 10, 14, 17, 20, 23) or in the respective individual elements (1a, 4a, 7a, 10.1a to 10.na, 10.1b to 10.nb, 10.1c to 10.nc, 14a, 17a, 20a, 23a) of the respective component subassemblies (1, 4, 7, 10, 14, 17, 20, 23), or can be integrated in individual elements (1a, 4a, 7a, 10.1a to 10.na, 10.1b to 10.nb, 10.1c to 10.nc, 14a, 17a, 20a, 23a) of the respective component subassemblies (1, 4, 7, 10, 14, 17, 20, 23), this also applies for bridge walls or individual elements of bridge walls; with suitable arrangement of quarls/nozzle bricks of individual nozzle brick/quarl elements (10.1b to 10.nb), it is possible to exhaust the exhaust gases through these openings, after removing of the burners.

[0042] By lifting or lowering of individual elements of the bottom (1a), as shown in Fig. 9 out of the plane of the entire surface of the bottom (1), a modification of the current in the melt (13) or barriers in the melt (13) for the promotion of current fields in the melt (13) or aid for the withdraw or local binding of impurities in the melt (13) can be achieved, as well as the lifting of single pieces of the bottom (1a) for modifying the gaseous current fields in the upper part of the furnace, as well as for the follow up of the individual elements of the bottom (1a) in an existing wear of the individual elements of the bottom (1a) or for a cross movement of the individual element of the bottom (1a) with corresponding implementation of the individual element of the bottom (1a) from the plane of the entire surface of the ground plate (1), wherein these cross wise movements as well as the follow up with existing wear is of course also possible for all other individual elements (4a, 7a, 10.1a to 10.na, 10.1b to 10.nb, 10.1c to 10.nc, 14a, 17a, 20a, 23a) of the respective component subassemblies (4, 7, 10, 14, 17, 20, 23) for all different modifications of the melting bath (13) or modifications of the gaseous phases or similar which are known to a person skilled in the art.

[0043] For easy arrangement/alignment of the individual elements of the end wall (4a, 7a), of the individual elements of a bridge wall between single separated chambers with respect to each other, individual elements of the end wall (4a, 7a) or individual elements of the bridge wall can, in place of the shape of a straight cylinder segment, be in form of a straight hollow cylinder segment in both cases, for the cylinder segment as well as for the hollow cylinder segment the expression cylinder segment is used.

[0044] The arc segments of the entire sidewall with vault (10.1 to 10.n) can also comprise more different individual elements (10.1a, 10.1b, 10.1c) than the given three individual elements (10.1a, 10.1b, 10.1c), the individual sidewall element (10.1a), the individual nozzle brick or throat element (10.1b) and the individual vault element (10.1c) which can also move with respect to each other or in opposing directions with respect to each other and/or with different velocities; the vault (10.1c to 10.nc) can be termed ceiling in a planar embodiment; the arc segments of the entire sidewall with vault (10.1 to 10.n) as well as the other component subassemblies (1, 4, 7, 10, 14, 17, 20, 23) can fulfil further requirements beside their intended use, for example, the arc segments of the entire sidewall with vault (10.1 to 10.n) over the cover of the melting furnace can be a cover for other processes of the melt (13), for example a cover of haulage tracks of the melt (13) or a cover of an exhaust channel, up to the delivery of the exhaust gases to the atmosphere and with a corresponding implementation also of the recuperative process, the heat exchange of the combustion air.

15

[0045] In case of continuation of the sidewalls with vault (10.1 to 10.n) as limitation for the exhaust gases with respect to the atmosphere, it is also possible to use a planar base plate (1) of the exhaust channel, the so-called fox as well as one or more adjacently arranged vaulted bottoms (1), in cylindrical form, as partially hollow cylinder with eventually different radii (R3, R4).

20

[0046] The entire melting furnace can also comprise a plurality of chambers arranged one after the other, the separation of which comprises an additional separation wall, bridge wall or end wall (4, 7) in between the chambers and may be connected by haulage tracks and which allow material and energy currents by suitable openings in order to separate manufacturing phases; these separation/bridge walls or end walls (4, 7) can comprise several separation walls (4, 7) or end walls arranged directly one after the other which are moveable in translation or rotation with respect to each other in order to time wise close, open or delimit openings or apertures.

[0047] In the same way the translational or rotational velocity of the respective component subassemblies (1, 4, 7, 10, 14, 17, 20, 23) can be adapted with a modification or change of individual elements (4a, 7a, 10.1a to 10.na, 10.1b to 10.nb, 10.1c to 10.nc, 14a, 17a, 20a, 23a) for serious test series, with a defect or similar, such that these individual elements (1a, 4a, 7a, 10.1a to 10.na, 10.1b to 10.nb, 10.1c to 10.nc, 14a, 17a, 20a, 23a) of the

melting furnace or the haulage track can be removed as fast as possible in order to prevent damages, problems or impurities in the melt (13) or in the entire melt and manufacturing system.

5 [0048] A rotation or turn of rotational component subassemblies (4, 7, 10, 14, 17, 20, 23) during the furnace campaign during a complete turn is also possible, as well as a fast rotational movement of rotational component subassemblies (4, 7, 10, 14, 17, 20, 23) in comparison to other moveable component subassemblies (1, 4, 7, 10, 14, 17, 20, 23) or a fast translational displacement of translational component subassemblies (1, 10, 17) in comparison to other
10 moveable component subassemblies (1, 4, 7, 10, 14, 17, 20, 23) is possible. The movement/displacement of individual component subassemblies (1, 4, 7, 10, 14, 15, 17, 20, 23) can be achieved by a force applied on the resulting alignment/arrangement/contact surface of the individual elements which was the last to be added (1a, 4a, 7a, 10.1a to 10.na, 10.1b to 10.nb, 10.1c to 10.nc, 14a, 17a, 20a, 23a) or on the alignment/arrangement/contact surface of the
15 individual element that was the last to be added (1a, 4a, 7a, 10.1a to 10.na, 10.1b to 10.nb, 10.1c to 10.nc, 14a, 17a, 20a, 23a) of the respective component subassembly (1, 4, 7, 10, 14, 15, 17, 20, 23) or in the case of a component subassembly (1, 4, 7, 10, 14, 15, 17, 20, 23) consisting of one exchangeable element at the alignment or arrangement surface of which the subsequent exchangeable element in the direction of the respective direction of movement (A, B,
20 C, D, E, F, G) of the respective component subassemblies (1, 4, 7, 10, 14, 15, 17, 20, 23).

[0049] In order to delimit forces and moments on the single elements (1a, 4a, 7a, 10.1a to 10.na, 10.1b to 10.nb, 10.1c to 10.nc, 14a, 17a, 20a, 23a) on certain individual elements (1a, 4a, 7a, 10.1a to 10.na, 10.1b to 10.nb, 10.1c to 10.nc, 14a, 17a, 20a, 23a) or on entire
25 component subassemblies (1, 4, 7, 10, 14, 15, 17, 20, 23), the individual elements (1a, 4a, 7a, 10.1a to 10.na, 10.1b to 10.nb, 10.1c to 10.nc, 14a, 17a, 20a, 23a) parts of the individual elements (1a, 4a, 7a, 10.1a to 10.na, 10.1b to 10.nb, 10.1c to 10.nc, 14a, 17a, 20a, 23a) or the entire component subassemblies (1, 4, 7, 10, 14, 15, 17, 20, 23) can be turned, twisted or moved force and back.

30

[0050] The heating up of the newly attached or added individual elements (2, 5, 8, 11, 15, 18, 21, 24) at the respective component subassemblies (1, 4, 7, 10, 14, 17, 20, 23) can happen mainly or exclusively by heat exchange with the respective component subassemblies (1, 4, 7,

10, 14, 17, 20, 23) at which the newly added or attached individual elements (2, 5, 8, 11, 15, 18, 21, 24) are added or attached, as well as the cooling down of worn or used single elements (3, 6, 9, 12, 16, 19, 22, 25) can occur in the same way.

5 [0051] The invention is also applicable for a plurality of different designs of melting furnaces:

[0052] Fig. 10 shows in a cross section in the Y-Z-plane a possible design of a melting furnace or a haulage track of the melt (13) with a vaulted, thus cylindrical bottom (1), the
10 radius centre of which lies in the direction of negative Z-values on the Z-axis with radius R3 and R4, a vaulted bottom (1) the radius centre point of which lies in the direction of positive Z-values is also possible, wherein a modified shape of the individual elements of the bottom (1a) as well as a modified form of the individual sidewall elements (10.1a to 10.na) results with a curvature of the ground plate (1) with a radius centre point of the
15 ground plate (1) with positive and with negative Z-values on the Z-axis.

[0053] Fig. 11 shows in a cross section in the Y-Z-plane a possible design of a melting furnace or a haulage track of the melt (13) with representation of four surrounding surfaces of the melt (14) in cylindrical shape as partially hollow cylinders, whereof the
20 outer lateral surfaces are in contact with each other whereby their radius centre points (R5, R6) are outside of the furnace interior/melting space or the melt (13) with indication of the direction of movement (E) of the respective surrounding surfaces of the melt (14) and an exemplary representation of the addition a new individual element to one of the surrounding surfaces of the melt (15) and exemplary representation of the removal of a
25 worn out/used individual element at one of the surrounding surfaces of the melt (16), without the plain end faces.

[0054] Fig. 12 shows in a top view in the X-Y-plane a possible design for melting furnace or of a haulage track of the melt (13) without furnace interior/melting space,
30 respectively a plane covering surface delimiting the haulage track, with representation of four surrounding surfaces of the melt (14) in cylindrical form as partial hollow cylinders, whereof the outer lateral surfaces are in contact with each other, wherein their

radius centre points (R5, R6) are each outside the furnace interior/melting space, with indication of the direction of movement (E) of the surfaces surrounding the melt (14) and exemplary representation of the addition of a new individual element at one of the surrounding surfaces of the melt (15) and exemplary representation of the removal of a worn out/used individual element at one of the surrounding surfaces of the melt (16).

[0055] Fig. 13 shows in a top view in the X-Y-plane a possible design of a melting furnace or a haulage track of the melt (13) without planar covering surfaces delimiting the furnace interior/melting space, with representation of three surrounding surfaces of the melt (14) as partial hollow cylinders wherof the exterior lateral surfaces are in contact with each other, whereby the radius centre points (R5, R6) are each outside the furnace interior/melting space, with indication of the direction of movement (E) of the respective surrounding surfaces of the melt (14) and exemplary representation of the addition of a new individual element at one of the surrounding surfaces of the melt (15) and exemplary representation of the removal of a worn out/used individual element at one of the surrounding surfaces of the melt (16) wherein at least two of the surrounding surfaces of the melt (14) should be designed cylindrically while one of the three surrounding surfaces of the melt (14) can be planar, such as for example a plain sidewall (17).

20

[0056] Fig. 14 shows, as a cross section in the Y-Z-plane, a possible design of melting furnace or a haulage track of the melt (13) without a planar end walls delimited the furnace interior/melting space or the haulage track, with representation of three surrounding surfaces of the melt (14) in cylindrical, thus vaulted form as partial hollow cylinders, the outer lateral surfaces of which are in contact with each other, whereby the radius centre points (R5, R6) are each outside the furnace interior/melting space of the melt (13), respectively, with indication of the direction of movement (E) of the respective surrounding surfaces of the melt (14) and exemplary representation of the addition of a new individual element at one of the surrounding surfaces of the melt (15) and exemplary representation of the removal of a worn out/used individual element at one of the surrounding surfaces of the melt (16), whereby it is also possible that the individual surrounding surfaces of the melt (14) in form of a partial hollow cylinder

provide a gap or a plurality of gaps between the surrounding surfaces of the melt (14) or comprise one/more variably adjustable gaps in order for example enable a continuous or adjustable flow of melt/melting material as is desirable for the manufacturing of flat glass, for the controlled exhaust of exhaust gases or a controlled addition of raw material, as well as sinks in the exterior lateral surfaces of parts of the surrounding surfaces of the melt (14) in order to enable openings in the melting furnace or the haulage track wherein at least two of the surrounding surfaces of the melt (14) are cylindrically while one of three surrounding surfaces of the melt (14) can be equally planar, such as for example a plain sidewall (17). Fig. 15 shows in a top view in the X-Y-plane a possible design of a melting furnace or a haulage track of the melt (13) without planar covering faces delimiting the furnace interior/melting space, with representation of two planar sidewalls (17) with indication of the direction of movement (F) of both planar sidewalls (17) and exemplary representation of the addition of one individual element of the planar sidewall (18) at one of the two planar sidewalls (17) and exemplary representation of the removal of a worn out/used individual element of the planar sidewall (19) from one of the two planar sidewalls (17), and two surrounding surfaces of the melt (14) as end walls in cylindrical form, thus vaulted as partial hollow cylinders with indication of the direction of movement (E) of the two surrounding surfaces of the melt (14) as end walls with exemplary representation of the addition of a new individual element of the surrounding surface of the melt (15) at one of the two surrounding surfaces of the melt (14) as end wall and exemplary representation of the removal of worn/used individual element of the surrounding surfaces of the melt (16) at one of the two surrounding surfaces of the melt (14), wherein the two surrounding surfaces of the melt (14), which implement the end wall can also be turned with the rotational axis in the Y-plane wherein a rotation according to Fig. 15 in the Y-Z-plane is possible with a haulage track of the melt (13).

[0057] Fig. 16 shows in a top view in the X-Y-plane a possible design of a melting furnace or of a haulage track of the melt (13) without planar covering faces delimiting the furnace interior/melting space with representation of the entire variable sidewall (20), with indication of the direction of movement (G) of the entire variable sidewall (20) and the presentation of the addition of a new individual element of the variable sidewall (21) and removal for worn out/used individual element of the variable sidewall (22) wherein

the entire variable sidewall (20) can adapt any shape, as long as a secure delimitation by the planar, not-shown covering phases can be achieved.

5 [0058] Fig. 17 shows in a top view in the X-Y-plane a possible design of a melting furnace or a haulage track of the melt (13) without planar covering faces delimiting the furnace interior/melting room in the same way as in Fig. 16 but with an inserted body of revolution (23) with rotational axis in the Y-plane and representation of the addition of a new individual element of the body of revolution (24) and removal of a worn/used individual element of the body of revolution (25).

10

[0059] The respective surrounding surfaces of the melt (14) in the illustrative exemplary designs of the melting furnace or the haulage track of the melt (13) do not necessarily have the same radii (R5, R6).

15 [0060] All described component subassemblies (1, 4, 7, 10, 14, 17, 20, 23) can also be made from one exchangeable part.

[0061] The melting furnace and the haulage track can have any adequate and technically reasonable shape.

20

Reference list

- 1 bottom/base plate of the melting furnace
- 1a. individual element of the bottom (1) of the melting furnace
- 5 2 addition of a new individual element of the bottom (1a) of the melting furnace
- 3 removal of a worn out/used individual element of the bottom (1a) of the melting furnace
- 4 end wall at the side of raw material feeding of the melting furnace
- 4a. individual element at the end wall at the side of raw material feeding (4) of the melting furnace
- 10 5 addition of a new individual element at the end wall at side of raw material feeding (4a) of the melting furnace
- 6 removal of a worn out/used individual element at the side of raw material feeding (4a) of the melting furnace
- 15 7 end wall at the side of the melt outlet of the melting furnace
- 7a. individual element of the end wall at the side of the melt outlet (7) of the melting furnace
- 8 addition of a new individual element of the end wall at the side of the melt outlet (7a) of the melting furnace
- 20 9 removal of a worn out/used individual element at the end wall at the side of the melt outlet (7a) of the melting furnace
- 10 entire sidewall with vault of the melting furnace
- 10.1 to
- 10.n arc segment of the entire sidewall with vault (10) of the melting furnace
- 25 10.1a. individual sidewall element of the melting furnace
- 10.1b. individual nozzle brick element of the melting furnace
- 10.1c. individual vault element of the melting furnace
- 11 addition of a new arc segment of the sidewall with vault (10.1 to 10.n) of the melting furnace
- 30 12 removal of worn out/used arc segment of sidewall with vault (10.1 to 10.n) of the melting furnace
- 13 melt

- 14 surrounding surface of the melt in form of a partial hollow cylinder of the melting furnace or of the haulage track
- 14a. individual element of the surrounding surface of the melt (14) in form of a partial hollow cylinder of the melting furnace or of the haulage track
- 5 15 addition of a new individual element of the surrounding surface of the melt (14a) of the melting furnace or of the haulage track
- 16 removal of a worn out/used individual element of the surrounding surface of the melt (14a) of the melting furnace or the haulage track
- 17 planar sidewall of the melting furnace/haulage track
- 10 17a. individual element of the planar sidewall (17) of the melting furnace or of the haulage track
- 18 addition of a new individual element of the planar sidewall (17a) of the melting furnace/haulage track
- 19 removal of a worn out/used individual element of the planar sidewall (17a) of the melting furnace or of the haulage track
- 15 20 entire variable sidewall of the melting furnace or of the haulage track
- 20a. individual element of the variable sidewall (20) in the form of a regular straight prism of the melting furnace or haulage track
- 21 addition of a new individual element of the variable sidewall (20a) of the melting furnace or of the haulage track
- 20 22 removal of a worn out/used individual element of the variable sidewall (20a) of the melting furnace or of the haulage track
- 23 body of revolution with a rotational axis in the Y-plane
- 23a. individual element of the body of revolution (23)
- 25 24 addition of an individual element of the body of revolution (23)
- 25 25 removal of a worn out/used individual element of the body of revolution (23)
- A. direction of movement of the bottom (1)
- B. direction of movement of the end wall at the side of raw material feeding (4)
- 30 C. direction of movement of the end wall at the side of the melt outlet (7)
- D. direction of movement of the entire sidewall with vault (10)
- E. direction of movement of a surrounding surface of the melt (14)

- F. direction of movement of a planar sidewall (17)
- G. direction of movement of a variable sidewall (20)

- h. distance between the X-axis and the plane of the bottom (1) of the plane of the
5 bottom (1) directed towards the furnace interior/melting space

- R1 inner radius of the arc segment of the sidewall with vault (10.1)
- R2 outer radius of the arc segment of the sidewall with vault (10.1)
- R3 inner radius of the ground plate (1)
- 10 R4 outer radius of the ground plate (1)
- R5 inner radius of a surrounding surface of the melt (14)
- R6 outer radius of the surrounding surface of the melt (14)

- X. X-axis of the orthogonal Cartesian coordinate system
- 15 Y. Y-axis of the orthogonal Cartesian coordinate system
- Z. Z-axis of the orthogonal Cartesian coordinate system

Claims

1. A melting furnace having a melt chamber with an interior surface comprising at least one rotatable wall, wherein:

the at least one rotatable wall is formed as a right circular cylinder sector having a longitudinal axis, a first radial edge extending along the longitudinal axis, and a second radial edge extending along the longitudinal axis;

the at least one rotatable wall is formed from a series of wall elements extending from the first radial edge to the second radial edge;

the at least one rotatable wall is rotatable about the longitudinal axis; and

unworn wall elements are added at the first radial edge, worn wall elements are removed at the second radial edge, and rotation of the at least one rotatable wall brings the unworn wall elements into contact with the melt chamber, moves the wall elements along the melt chamber as said wall elements wear, and permits the worn wall elements to exit the melt chamber.

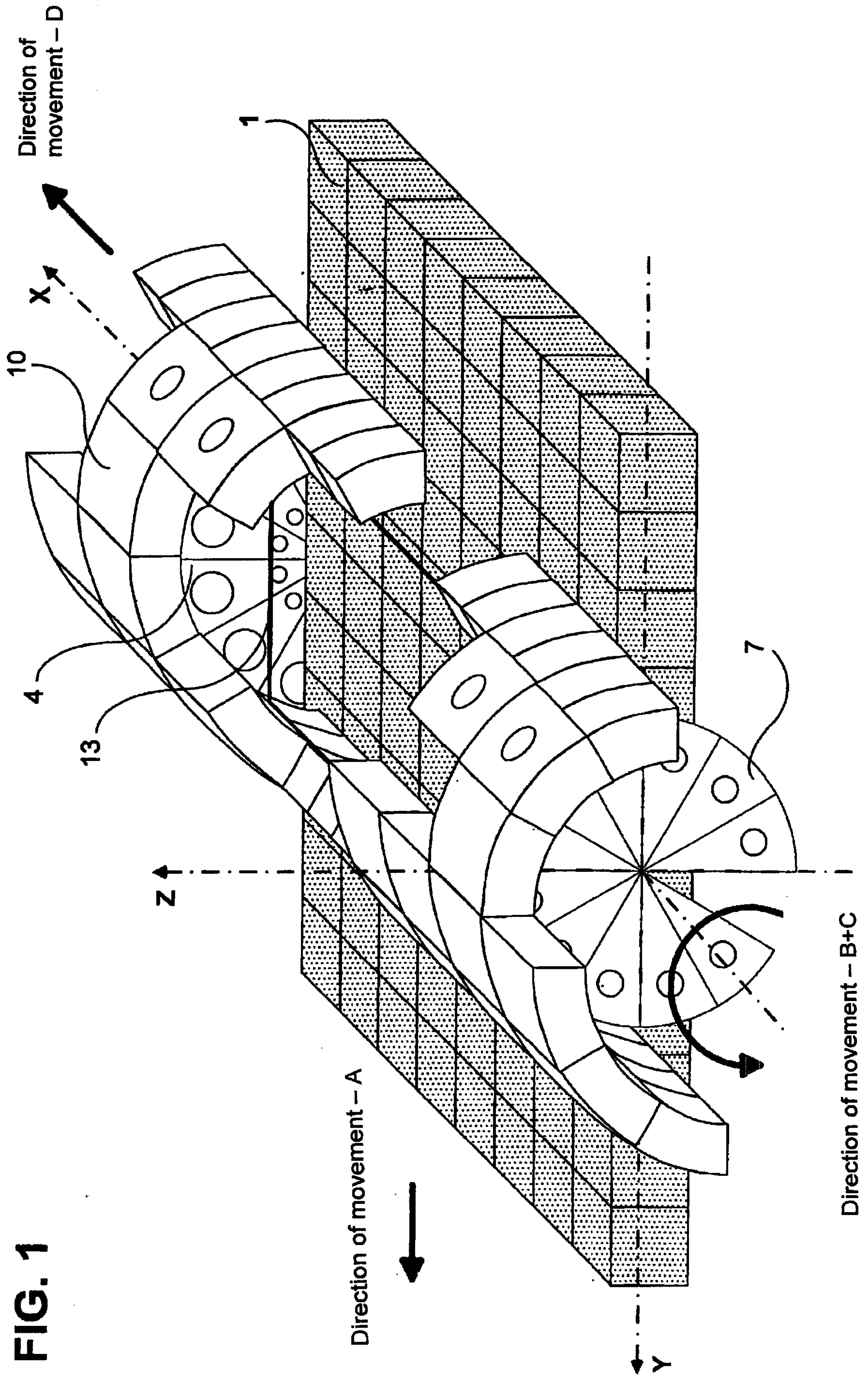
2. The melting furnace of claim 1, wherein the cylinder sector is a hollow cylinder sector.
3. The melting furnace of claim 1, wherein the wall elements are arc-shaped segments of the right circular cylinder.
4. The melting furnace of claim 1, wherein the interior surface of the melt chamber comprises at least one further wall.
5. The melting furnace of any one of claims 1 to 4, wherein the interior surface of the melt chamber comprises one rotatable wall.
6. The melting furnace of any one of claims 1 to 4, wherein the interior surface of the melt chamber comprises two rotatable walls.

7. The melting furnace of any one of claims 1 to 4, wherein the interior surface of the melt chamber comprises three rotatable walls.
8. The melting furnace of any one of claims 1 to 4, wherein the interior surface of the melt chamber comprises four rotatable walls.

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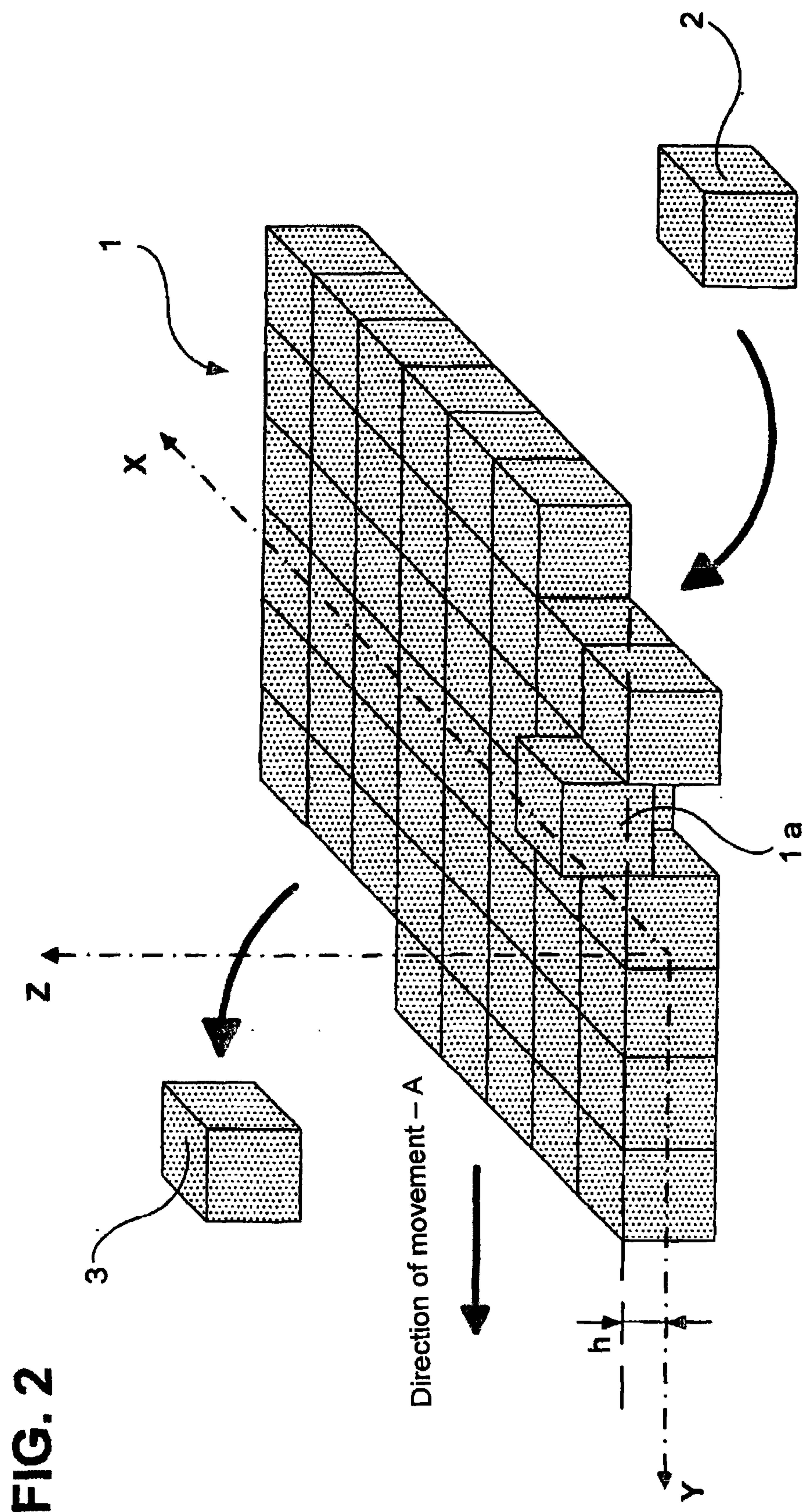
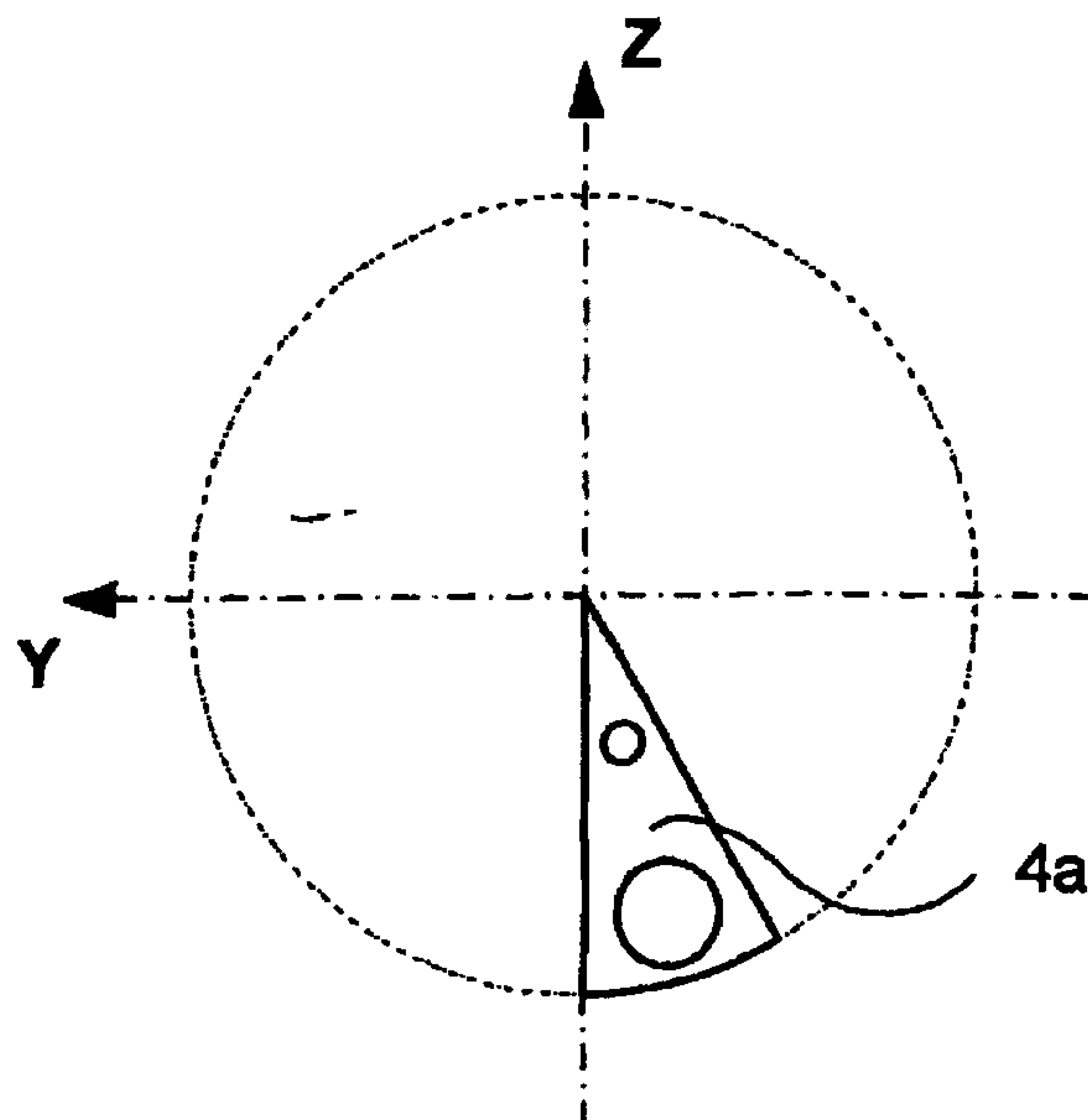
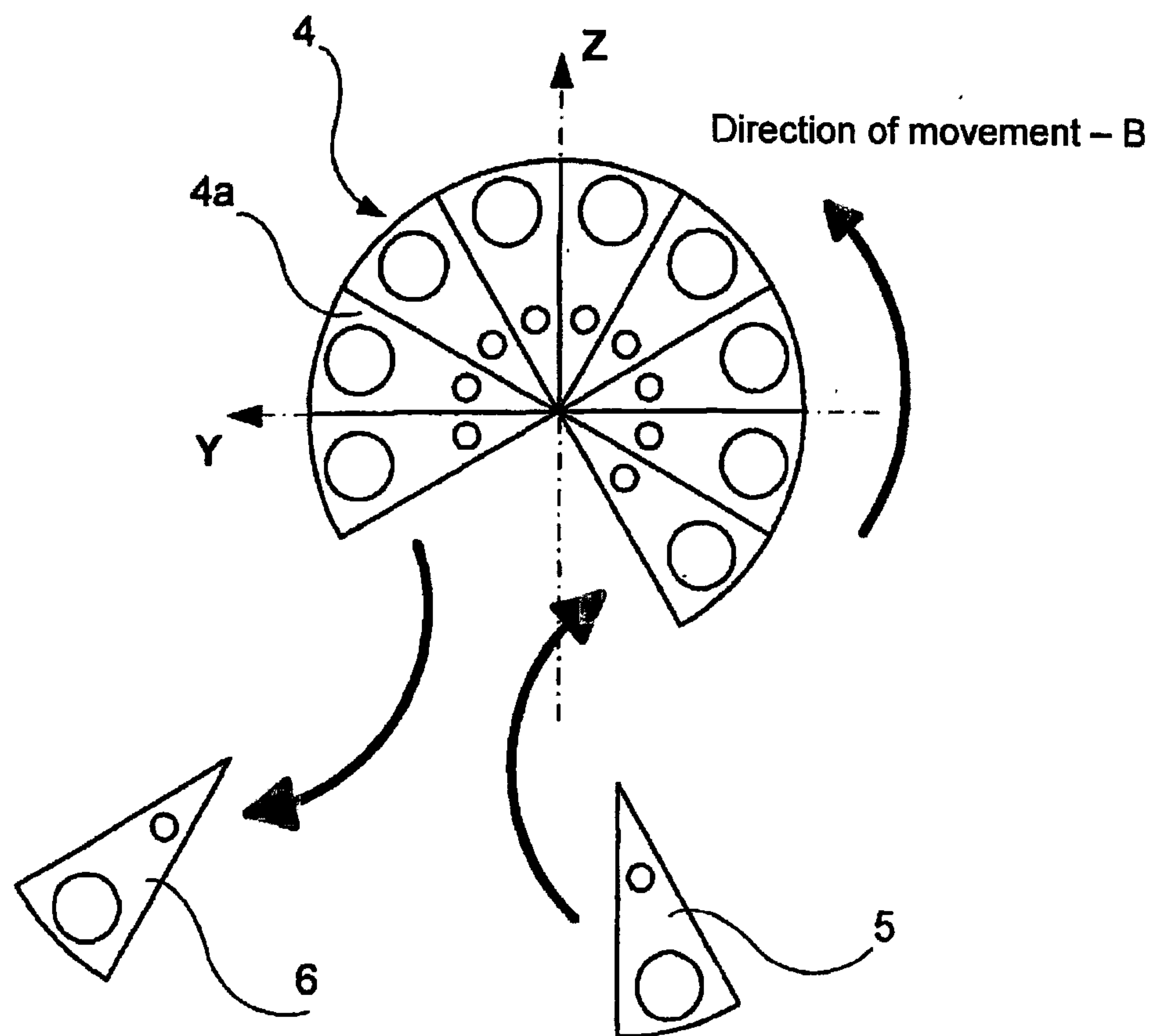


FIG. 3**FIG. 4**

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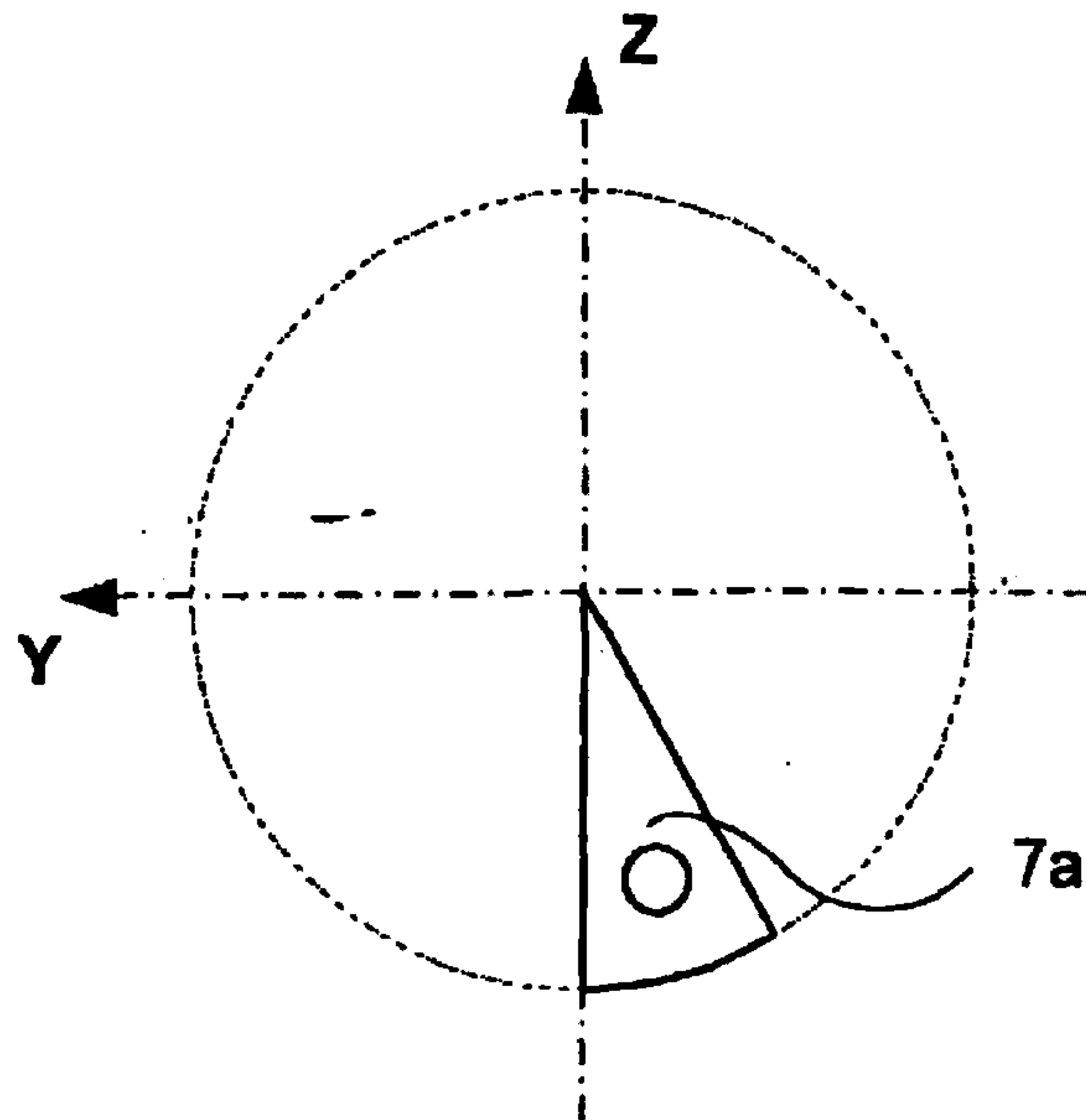
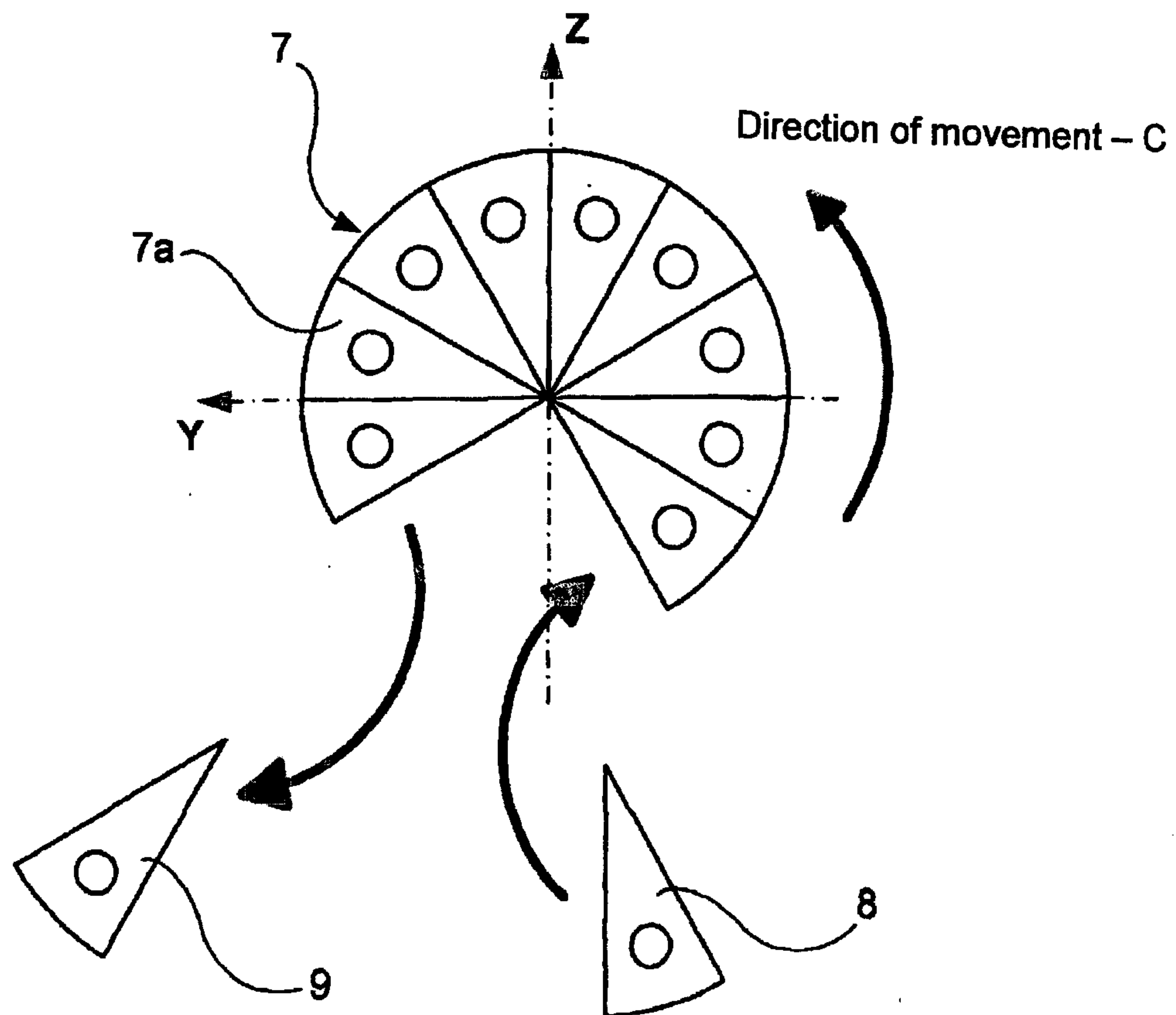
FIG. 5**FIG. 6**

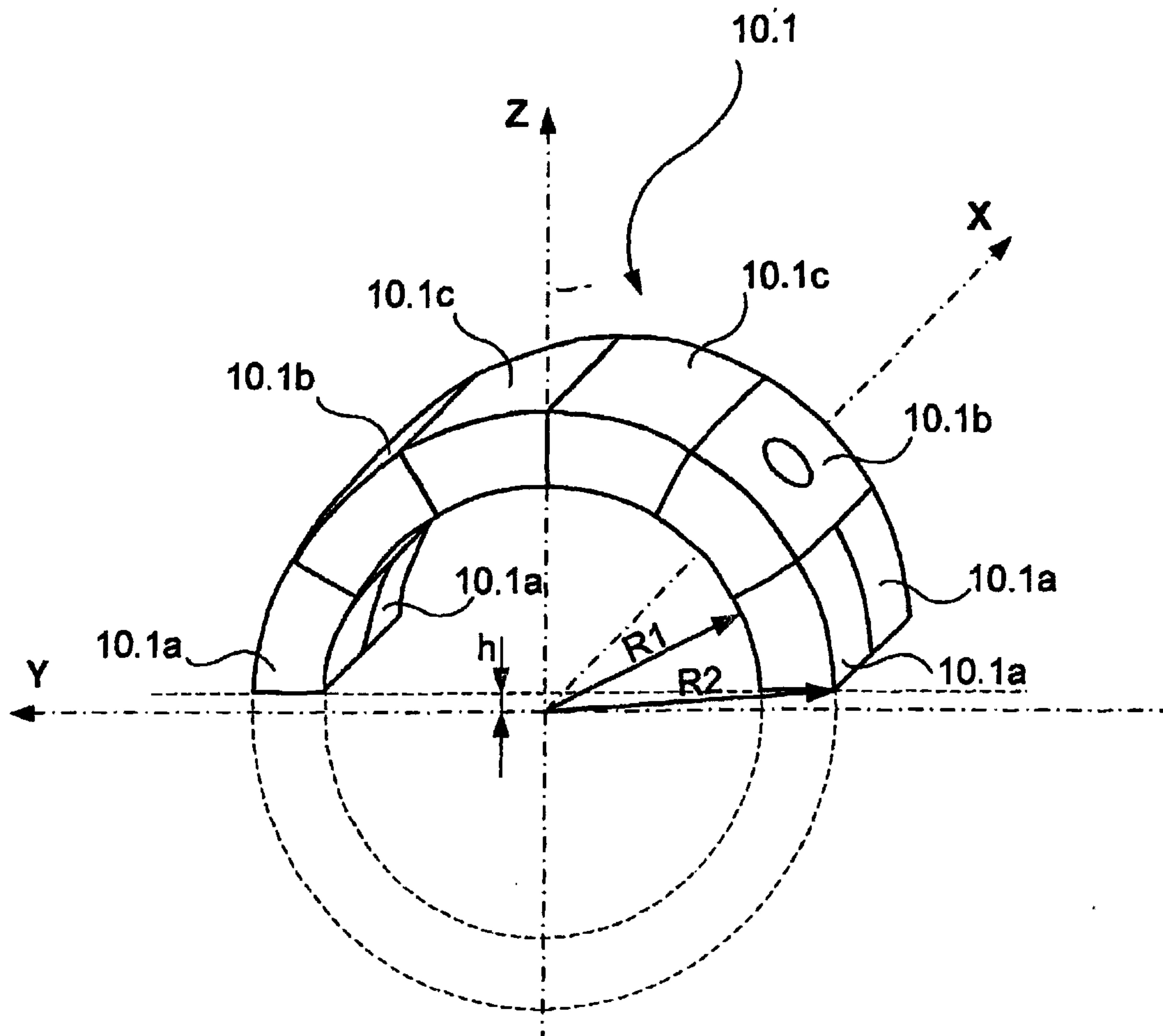
FIG. 7

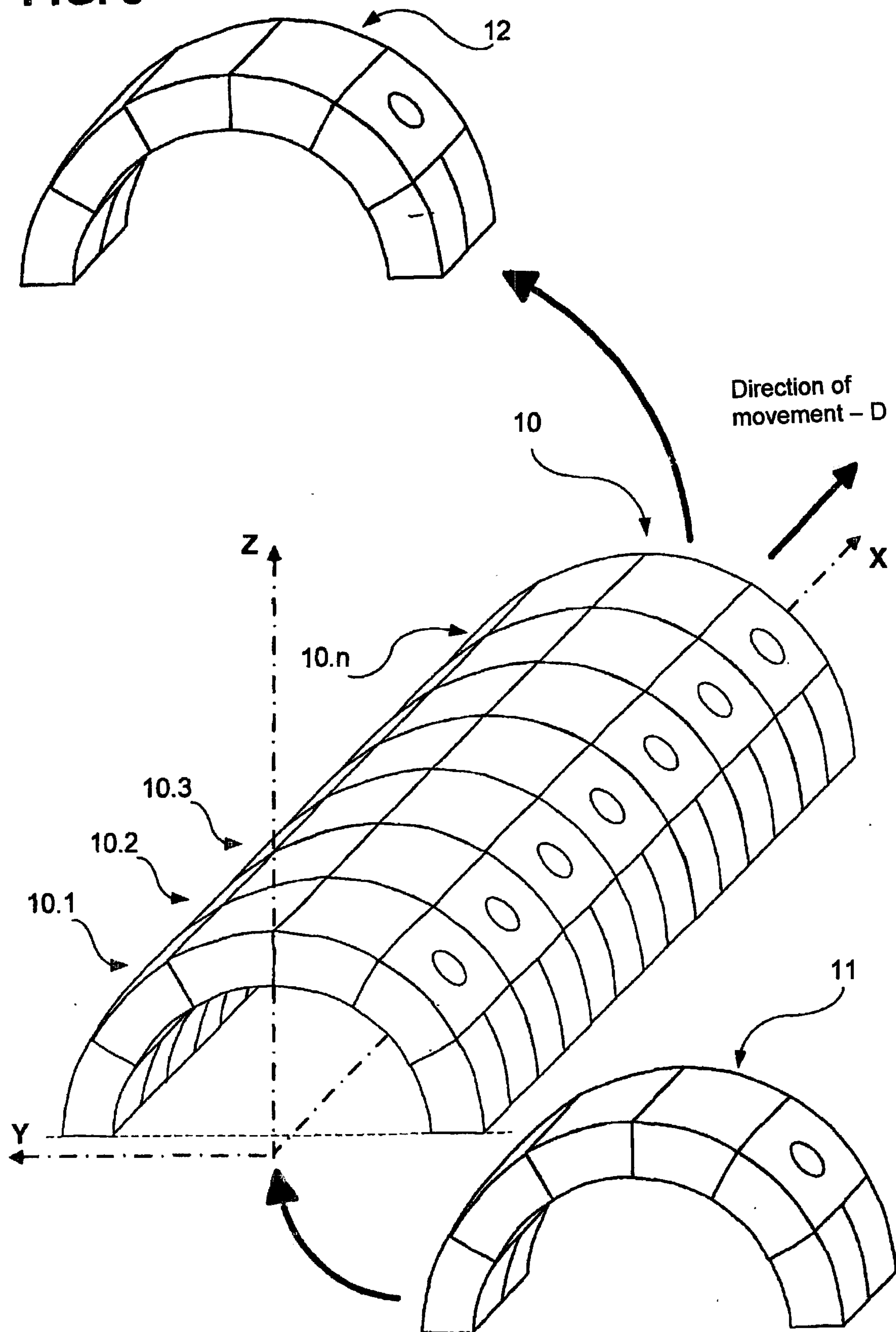
FIG. 8

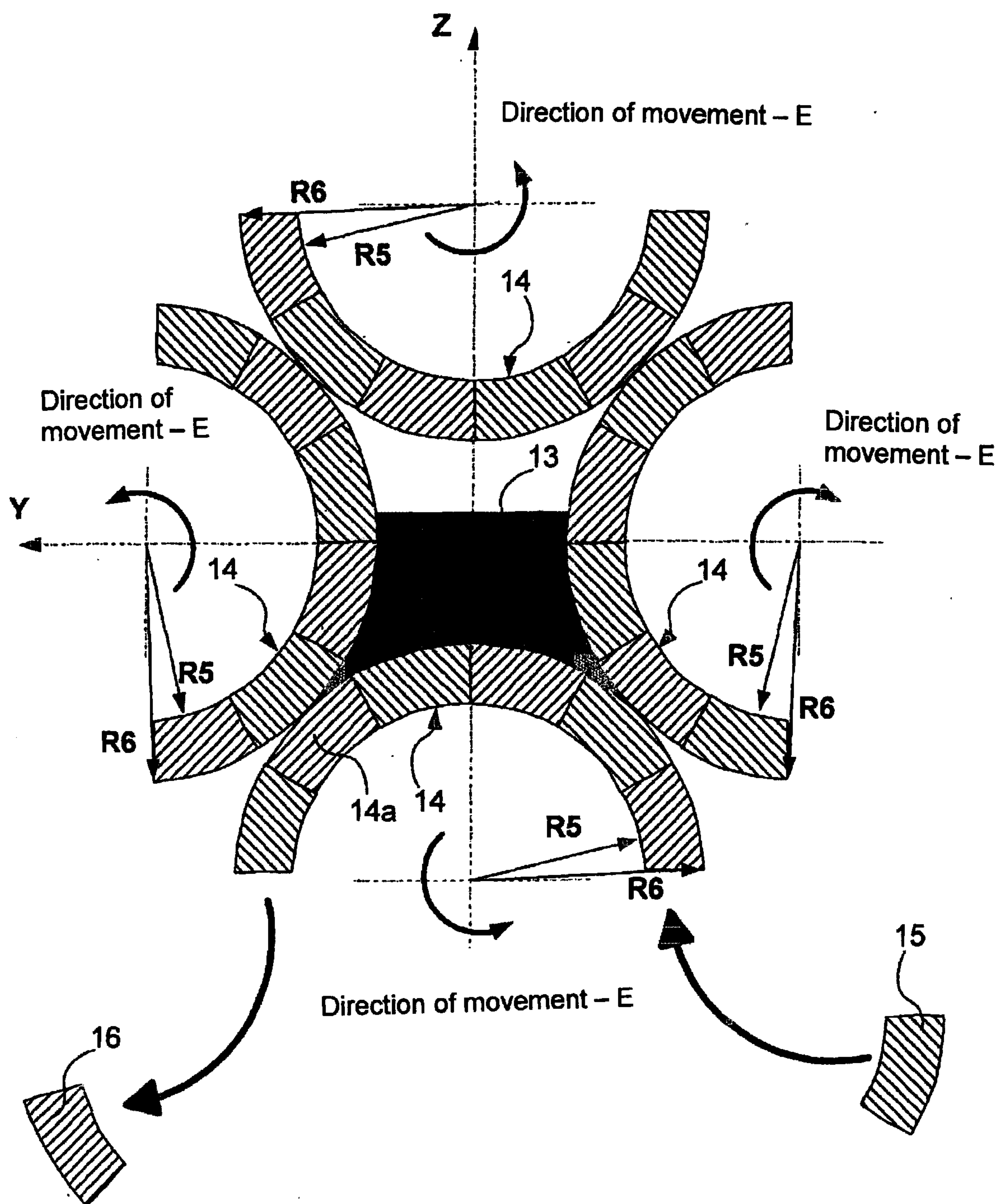
FIG. 11

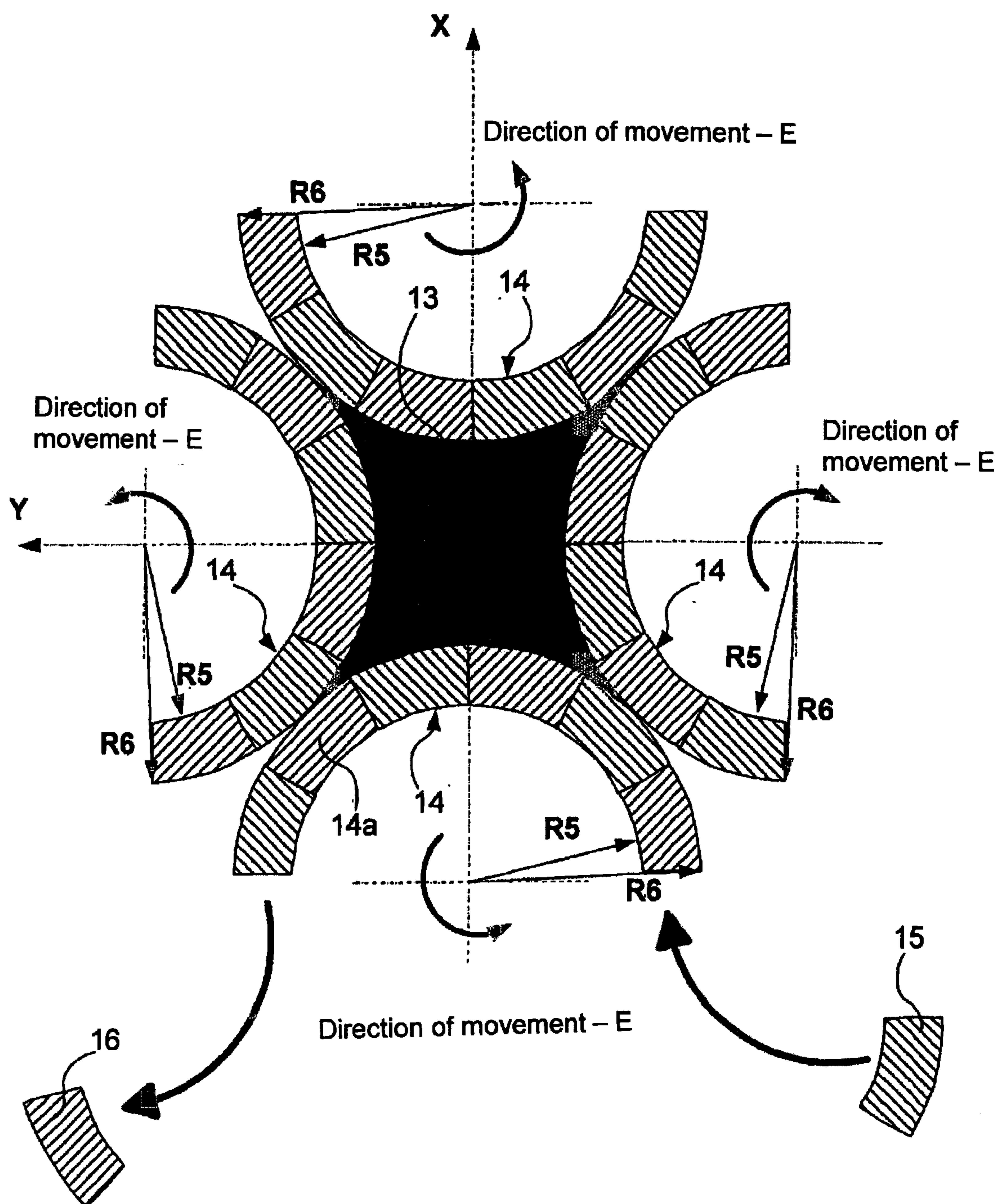
FIG. 12

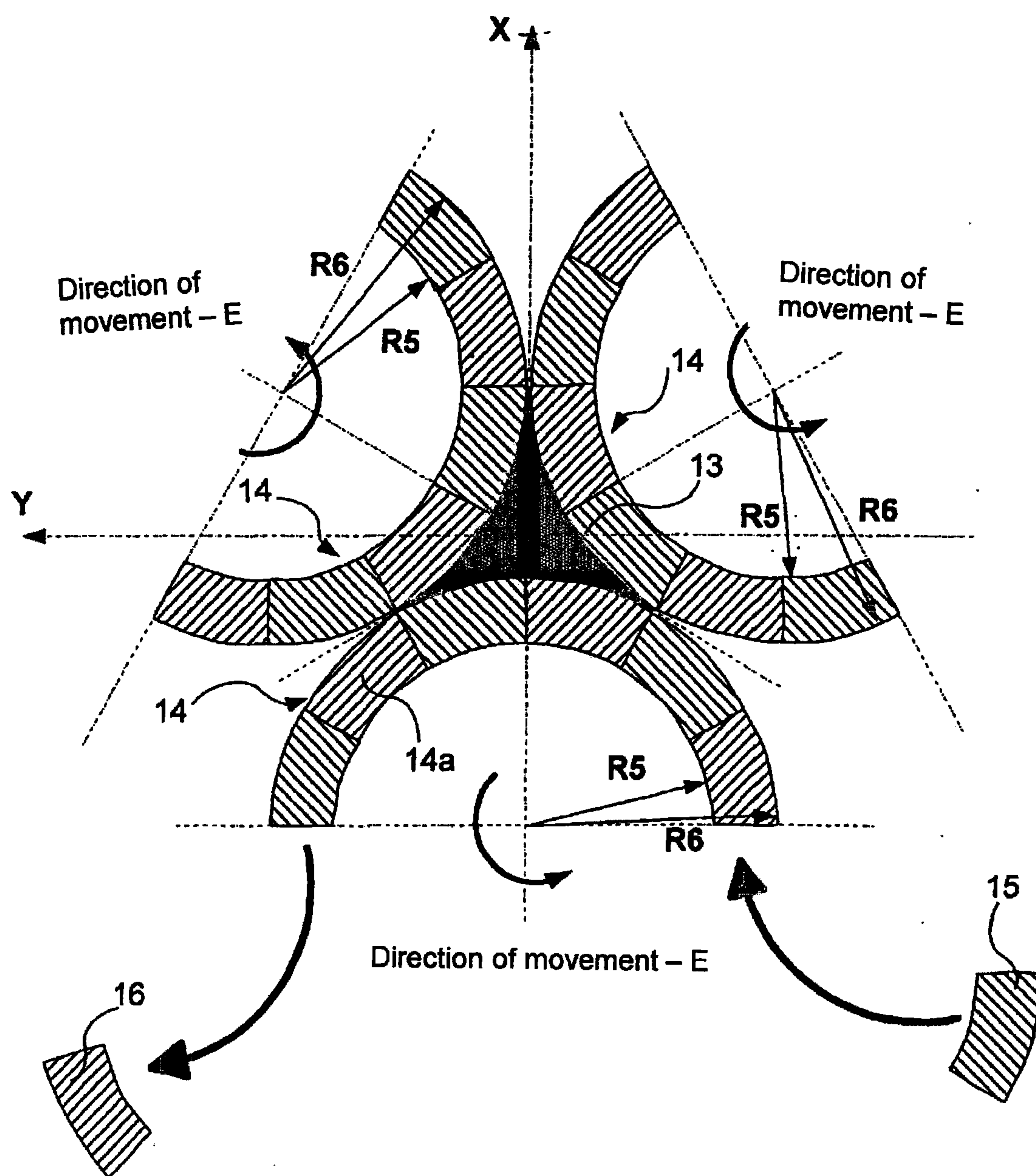
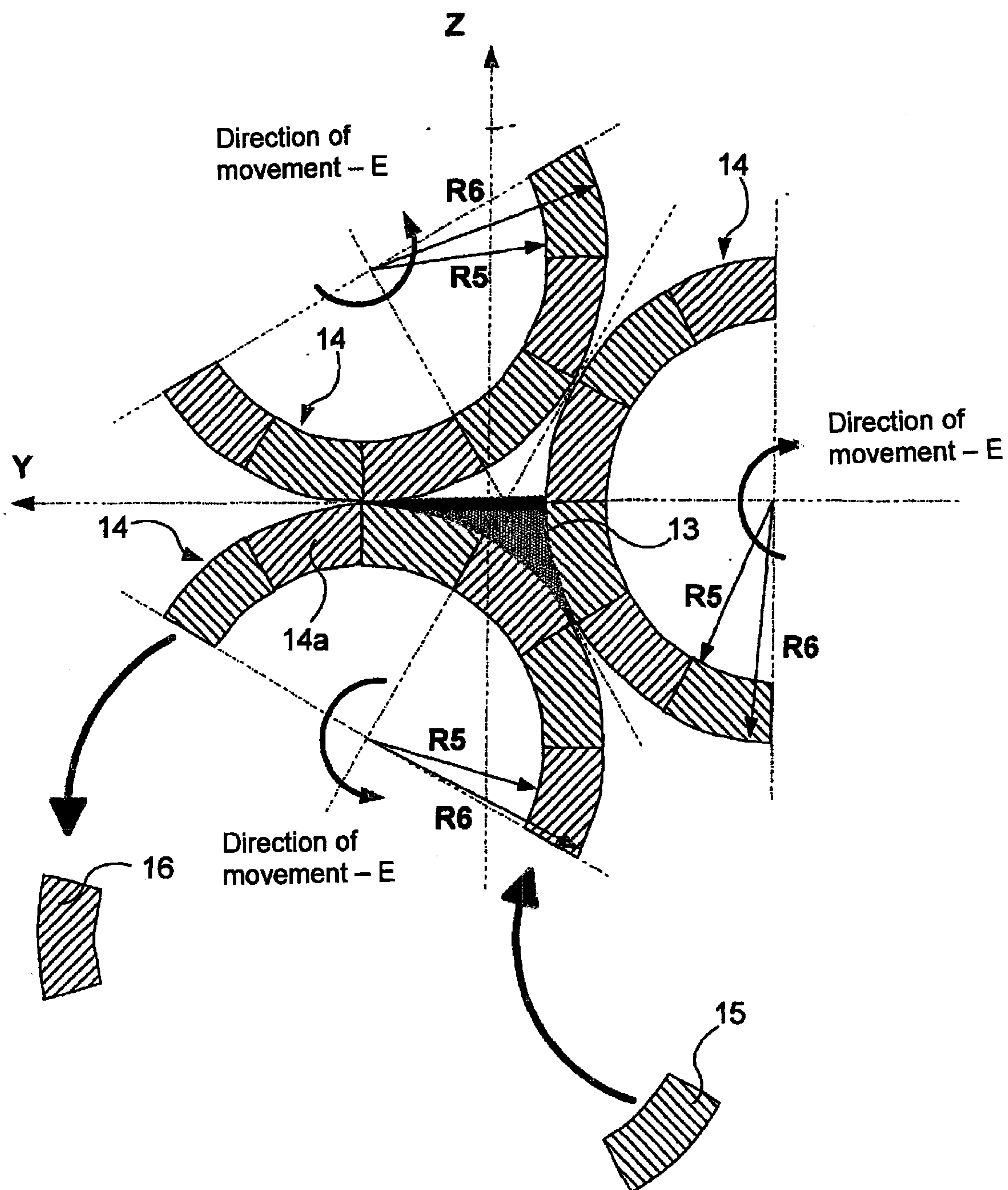
FIG. 13

FIG. 14

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FIG. 15

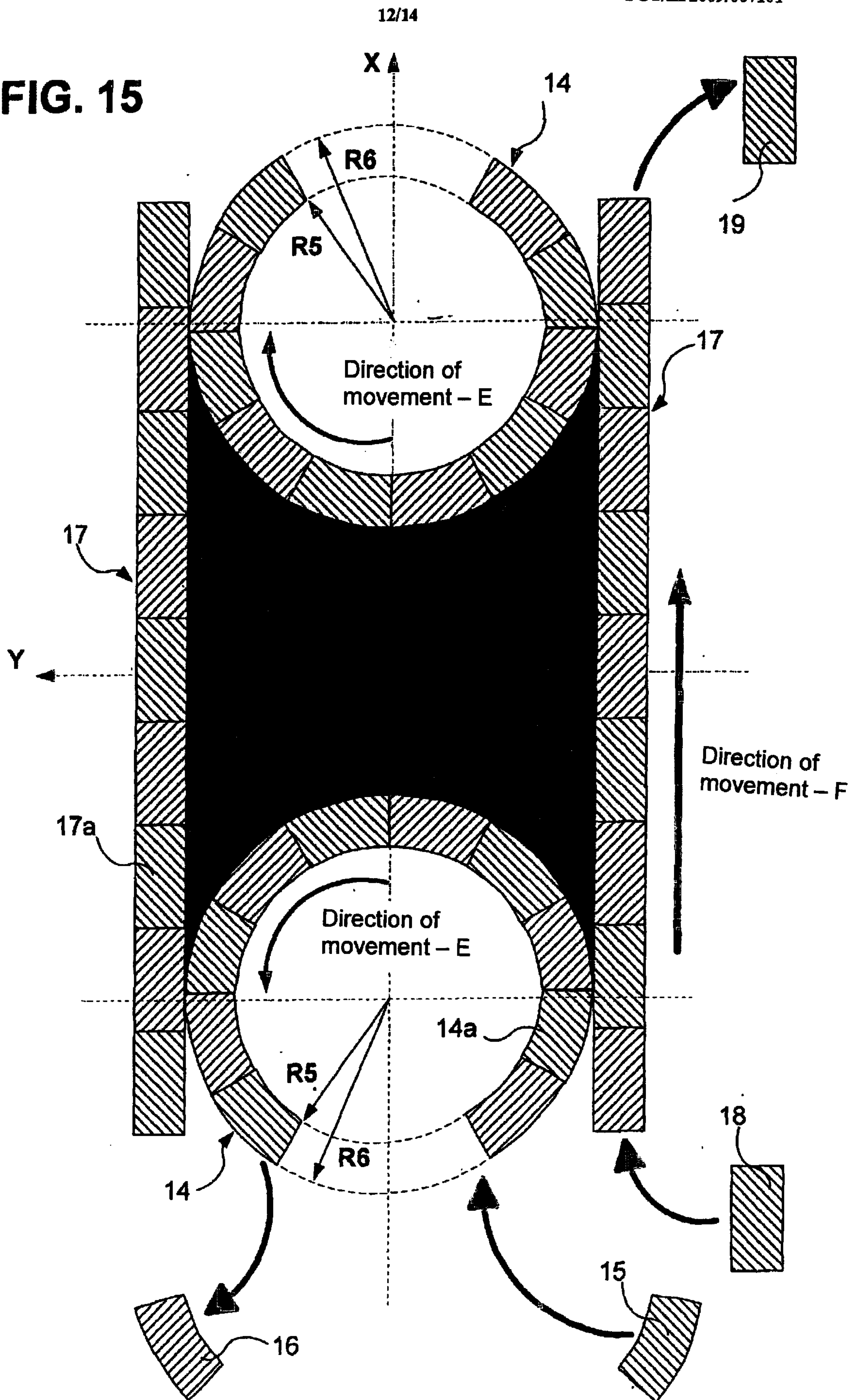


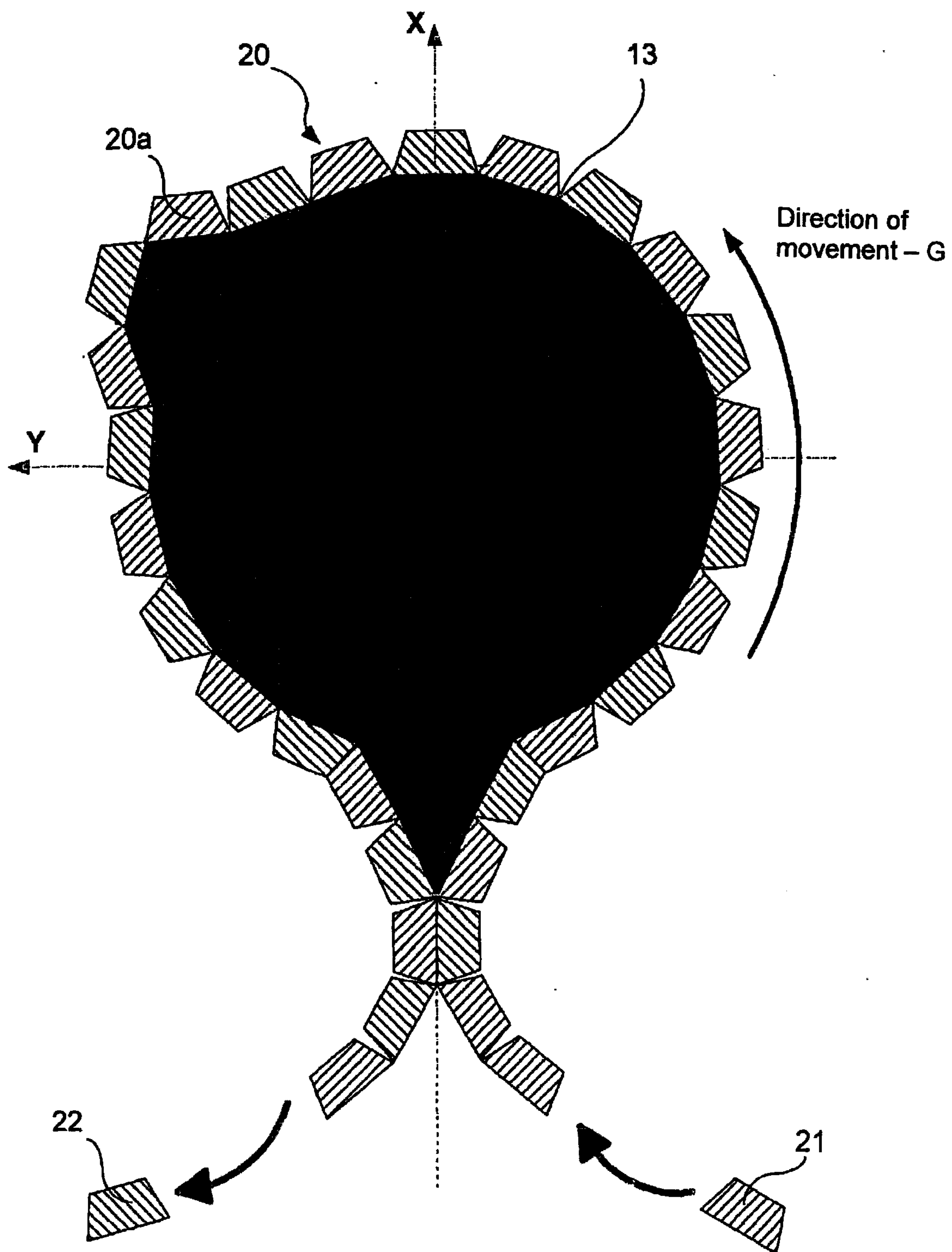
FIG. 16

FIG. 17