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(54) **TILTING CONVERTER**

KIPPKONVERTER

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Description

Field of the invention

[0001] The present invention refers to a tiltable converter provided with a suspension system of the converter container, said suspension system connecting said container to a support ring.

State of the art

[0002] Converters are tiltable metallurgical vessels which are used for producing or treating liquid metals and metal-alloys. The converter vessel is supported by means of several suspension elements which are arranged underneath or on top of a trunnion ring and are fixed with one of their ends to the converter vessel and with their other ends to the trunnion ring.

[0003] The main object of an oxygen converter is to convert the cast iron produced in the blast furnace into raw liquid steel, which can be then refined in the secondary steel production department. Converters can also be e.g. used for de-vanadization or de-phosphorization of liquid hot-metal to so called e.g. semi-hot-metal which can be charged to an oxygen converter for further treatment.

[0004] The principal functions of such converters, herein further called as B.O.F. (Basic Oxygen Furnace), are to decarbonize and remove phosphorus, vanadium, silica, etc. from the hot-metal, liquid iron or liquid pre-melt and optimize the temperature of the steel so that further treatments can be carried out before casting with minimum heating and cooling of the steel.

[0005] The exothermic oxidation reactions which are generated in the converter produce a lot of thermal energy, more than the energy needed for reaching the determined temperature of the steel. This extra heat is used to melt the scrap metal and/or the added ferrous mineral.

[0006] As the B.O.F. substantially is a furnace, it is also subject to significant thermal expansions. Due to this effect the converter is mantled by a trunnion ring with a determined clearance.

[0007] Additionally to the thermal loads high mechanical loads caused by the weight of the equipment effect the connecting (suspension) elements, said mechanical loads varying in relation to the tilting angle of the converter vessel. This means that the suspension elements have to be arranged in a way that there is no overloading of these elements in any tilting angle.

[0008] Further these elements have to be protected against spill over of liquid steel or slag from the converter mouth.

[0009] According to state of the art there are several types of converter suspension systems available on the market. An example of a known oxygen converter is described in the document DE1903685B2.

[0010] Said converter consists of a container or vessel, defining the reactor and having a substantially cylindrical

shape, supported by a support ring or mantle trunnion ring, surrounding the container and suitably spaced therefrom, provided with two diametrically opposed supporting pins ("trunnions"), the assembly being supported by two supports anchored to the ground. The container rotation control is keyed or fixed onto one of the two supporting pins.

[0011] Said converter has a suspension system based on lamella type elements for the vertical support of the converter within the trunnion ring. Said lamella type elements are arranged underneath the trunnion ring, taking into account the vertical position of the converter with the mouth facing upwards.

[0012] The support of the converter in horizontal position, when the converter is rotated by + 90 or - 90 degrees starting from said vertical position, is provided by means of rigid supports fixed to the vessel and rigid supports fixed to trunnion ring.

[0013] Another suspension for a converter is disclosed by WO2008092488 which uses lamella elements for a part of the suspension and a rigid rod connected like a pendulum. This suspension is too rigid and gives problems in a dirty and warm environment where the converter are placed,

[0014] Publication WO2011069395 discloses a suspension made of blocking mechanisms and pendulums which gives also problems in dirty and warm environment and are prone to rapid wear.

[0015] In order to avoid shock loads, additional contact elements between the supports on the vessel as well as on the trunnion ring should be arranged and adjusted in order to avoid clearances. However, any temperature difference in the additional elements would cause additional loads to the suspension elements.

[0016] The need is therefore felt to provide a tiltable converter which allows the aforementioned drawbacks to be overcome.

Summary of the invention

[0017] Primary object of the present invention is to provide a suspension device for a container of a tilting converter, connecting said container to the support ring, which allows both avoiding shock loads as well as overloading in the areas between the device part fixed to the container and the device parts fixed to the support ring, and to compensate the thermal expansions, while being able to work reliably and with reduced wear in dirty and hot environments.

[0018] A further object of the invention is to provide a converter having a suspension system capable to absorb the vibrations caused by the melting process. Therefore, the present invention proposes to achieve the above-discussed objects by providing a tilting converter which, in accordance with claim 1, comprises:

a container defining a first axis X;
a supporting ring, coaxial to the container and

spaced apart from said container,
provided with two diametrically opposite load-bearing pins defining a second axis Y orthogonal to the first axis X, adapted to allow the converter to rotate about said second axis;

at least one pair of first suspension devices and a plurality of second suspension devices, connecting said container to said supporting ring
wherein said second suspension devices are lamella suspension elements fixed in a build-in configuration, restrained at a first end thereof to the container (1) and at a second end thereof to the supporting ring, and wherein each first suspension device comprising

- a central structure, fixed to the container or to the supporting ring,
- a first lateral structure, arranged at a first side of said central structure and fixed to a surface of the supporting ring or to the container,
- a second lateral structure, arranged at a second side of said central structure, opposite said first side, and fixed to said surface of the supporting ring or to the container, in the same way like the first lateral structure,

wherein said first lateral structure and said second lateral structure respectively comprise two first support lugs, spaced apart to each other, and a group of elastic elements arranged adjacent and parallel to each other and supported at ends thereof by said two first support lugs,
and in that said central structure comprises a second support lug, arranged transversally to and between the groups of elastic beams of said first lateral structure and said second lateral structure,
whereby said elastic beams act as resilient support for the second support lug in case of deviation from the rest position.

[0019] The suspension devices of the invention have been designed for the horizontal support of the converter, that is for the sustenance of the loads when the converter assumes horizontal position (e.g. for tapping of charging, etc.). Thanks to the fact that a part of the horizontal loads, about 20 to 30%, is supported by the lamella elements that mainly support the loads produced by the converter in vertical position, the horizontal suspension can be designed with smaller constituting elements.

[0020] Due to the fact that the clearances between the elastic beams and the second support lugs as well as the elasticity of the elastic beams can be chosen by the designer of the suspension system, a large variety of different loading scenarios is possible like:

- with low elasticity (very stiff beams) as well as no clearances between the elastic beams and the second support lug the horizontal suspension devices

work almost like rigid supports;

- with high elasticity of the elastic elements and large clearances between the elastic beams and the second support lugs the suspension system is soft and the loading is supported mainly by the two sides of the first support lugs.

[0021] The suspension system can be optimized in such a way that the designed thermal expansion of the second supports lugs, fixed to the container shell, is identical to the clearances between the elastic beams and said second support lugs. This means the thermal expansion is compensated by the clearance in order to avoid overloading and then all components are in full contact to each other.

[0022] Moreover, by varying the elasticity of the elastic beams the load distribution between the second side support lugs and a possible third middle side support lug can be varied as well. The beams can be also shaped as rectangular or square plates, with dimensions appropriately designed. In the description and in the claims it is referred indifferently to beams or plates, without limiting the scope of the invention.

[0023] In particular, the horizontal suspension devices of the converter according to the invention have the following advantages:

- allowing the thermal dilatations of the container to be easily absorbed, taking advantage solely of the elasticity of said elastic elements;
- allowing thermal dilatations of the structure, also of irregular type, without causing overloading to the mechanical parts;
- efficiently absorbing the vibrations which are generated during the insufflation of oxygen into the container;
- efficiently absorbing the forces generated by the inertia of the container when starting and ending its rotation;
- keeping the container centred with respect to the support ring with high precision in all inclination conditions;
- requiring extremely simple assembly;
- they are suitable for all sizes of converters.

[0024] The excellent precision of the centring between container and support ring allows the thermal expansions of the container, caused by the high temperatures reached during the conversion process, without any interference between container and support ring.

[0025] A further advantage is that the whole structure of the converter, protuberances included, is configured so as to be inserted within a sphere, the radius of which is determined by the layout requirements of the plant comprising the converter.

[0026] The dependent claims describe preferred embodiments of the invention.

Brief description of the figures

[0027] Further features and advantages of the invention will become clearer in light of the detailed description of preferred but not exclusive embodiments of an oxygen converter, shown by way of non-limiting example with the aid of the attached drawings in which:

Figure 1 a represents a side view of a first embodiment of a converter according to the invention, in the vertical melting position;

Figure 1 b represents a partially sectioned top view of the converter in Figure 1 a;

Figure 2a represents a side view of a second embodiment of a converter according to the invention, in the vertical melting position;

Figure 2b represents a partially sectioned top view of the converter in Figure 2a;

Figure 3 represents a section view of part of the converter according to the plane identified in Figure 1 b and Figure 2b by the line B-B;

Figure 4 represents a partially sectioned side view of part of the converter of Figure 2b;

Figure 5 represents a partially sectioned top view of the part of converter in Figure 4.

[0028] The reference numbers in the figures identify the same elements or components.

Detailed description of preferred embodiments of the invention

[0029] With reference to the Figures, preferred embodiments of an oxygen converter are represented. Said converter comprises:

- a container or vessel 1, defining an axis X, provided with a loading mouth 7 for scrap metal and liquid hot metal, liquid iron or liquid pre-melt, and provided with a lateral tapping hole (not shown) for the liquid steel obtained at the end of the conversion process;
- a support ring 2 for supporting the container 1, said ring 2 being arranged coaxial to container 1 and suitably spaced therefrom;
- two supporting pins or tilting pins 3, 4 of said support ring 2, or "trunnions", diametrically opposed to each other and defining an axis Y, orthogonal to axis X, with at least one of said supporting pins connected to a tilting mechanism (not shown);
- first and second suspension devices, which connect container 1 to support ring 2 and which also carry out a centring function between container and ring.

[0030] The first suspension devices are designed for the horizontal support of the converter, when the container is rotated by up to + 90 or - 90 degrees with respect to the position of Figure 1 a or 2a.

[0031] The second suspension devices are designed

for mainly supporting the loads of the converter in a vertical position, i.e. in a position with the mouth 7 of the container facing upwards (Figure 1 a or 2a). Due to their structure and disposition the second suspension devices contribute also to supporting part of loads generated by the converter when it is rotated by up to + 90 or - 90 degrees with respect to the position of Figure 1 a or 2a, thus allowing a reduction in dimension of the first suspension devices.

[0032] Defining a further axis Z as the axis orthogonal to the plane X-Y and passing through the point of intersection of axes X and Y, a plane Y-Z, which can be considered an "equatorial" plane of the converter, and a plane X-Z, both the planes orthogonal to the plane X-Y, are identified.

[0033] Container 1 comprises a cylindrical central area and two truncated cone areas, each truncated cone area being arranged laterally to said cylindrical central area. A first truncated cone area is welded or fixed at one end to said cylindrical central area while at the other end it comprises the loading mouth 7 of the container. A second truncated cone area is welded or fixed at one end to said cylindrical central area, on the opposite side with respect to the first truncated cone area, while at the other end it comprises the bottom of container 1. Other examples of container may have said second area having a different shape with respect to the truncated cone shape, for example spherical-bowl-shaped or having another appropriate geometrical shape.

[0034] Support ring 2, arranged at central area of container 1, is hollow and preferably has a rectangular cross-section. Ring 2 has a first surface 20 facing the part of the container comprising loading mouth 7; a second surface 21, opposite the first surface 20, facing the part of container 1 comprising the bottom thereof; a third internal surface facing the central part of the container; a fourth external surface opposite the internal surface.

[0035] Advantageously the converter is provided with at least two first suspension devices, designed for the horizontal support of the converter. Said first suspension devices are arranged substantially parallel to the plane Y-Z substantially orthogonal to the plane Y-X, and are substantially symmetrically arranged with respect to the plane X-Z underneath (Figure 1a) or above (Figure 2a) the supporting ring 2. In an embodiment (not shown) the converter is provided with two pairs of first suspension devices: a first pair of first suspension devices being arranged at a first side of the plane Y-Z and a second pair of first suspension devices being arranged at a second side of the plane Y-Z.

[0036] Said first suspension devices comprise (see in particular Figures 4 and 5):

- a central structure fixed, for example by welding, to the container 1 of the converter;
- a first lateral structure arranged at a first side of said central structure and fixed, for example by welding, to a surface 20 or 21 (Figure 1 a or 2a) of the sup-

- porting ring 2 of the container 1;
- a second lateral structure arranged at a second side of said central structure, opposite said first side, and fixed, for example by welding, to said surface 20 (Figure 2a) or 21 (Figure 1 a) of the supporting ring 2.

[0037] First and second lateral structures are arranged substantially symmetrically with respect to the central structure.

[0038] Advantageously each lateral structure comprises two first support lugs 14, 15, spaced apart to each other, and a group of elastic beams 11 arranged adjacent and parallel to each other and supported at ends thereof by said two first support lugs 14, 15. Moreover, the central structure comprises a second support lug 12, arranged transversally to and between the two groups of elastic beams 11 of said lateral structures, whereby the elastic beams 11 act as resilient support or bumper for the second support lug 12 in case of deviation from a rest position, defined by the position of the converter with mouth facing upwards (Figures 1 a, 2a). The elastic beams can be, if necessary shaped as plates, e.g. rectangular with thickness of magnitude much smaller than the other two dimensions.

[0039] The first suspension devices, or horizontal suspension devices, are each arranged at a respective load-bearing pin 3, 4 and transversally to the plane X-Y.

[0040] The second support lug 12 of each first suspension device is substantially parallel to the surfaces 20, 21 of the supporting ring 2 and substantially perpendicular to the respective groups of elastic beams 11. The beams 11 are, thus, arranged perpendicular to the surfaces 20, 21 of the supporting ring 2. In a preferred embodiment the elastic beams 11 are in the form of metallic plates.

[0041] The elastic beams 11 of each group are arranged side by side and freely arranged between the first support lugs 14, 15 and mechanical stops 16 and 17. The mechanical stops 16 and 17 are, for example, arranged at the ends and / or on top of the elastic beams 11 and overlap partially to the external surfaces of the support lugs 14 and 15.

[0042] The beams 11 are arranged more or less freely in order to allow any deformation. Therefore the beams 11 are not rigidly fixed but just kept in position by the mechanical stops 16 and 17. This feature gives maximum elasticity and avoids additional stress caused by restriction of thermal expansion. This feature provides the additional advantage that these elastic beams 11 can be changed or be adjusted after a certain time of operation in order to change or adjust the mechanical characteristic of the bumper.

[0043] Said elastic beams 11 of each group, in the position of the converter with mouth 7 facing upwards, have clearances with respect to the respective second support lug 12 or are in direct contact with said respective second support lug 12. In both cases the thermal expansion of the support lugs 12, fixed to the container shell, is com-

pensated by an elastic deformation of said elastic beams 11. Advantageously, as better shown in Figure 5, the second support lugs 12 have a base 22 proximal to the converter shell and a head 23 shaped so as to be inserted in the space between the two groups of elastic beams 11.

[0044] The second support lugs 12 have sides of the head 23 having a convex shape 24 adapted to get into contact with at least one of the respective groups of elastic beams 11. In order to provide a tridimensional movement of the support lugs 12, fixed to the converter vessel, under operation condition the contact area of the side of support lugs 12 with the beams 11 is shaped spherically, preferably spherical-bowl-shaped. The support lugs 12 can, thus, move along directions parallel to the three axes X, Y and Z.

[0045] The support on the trunnion ring 2 is made by the two supports lugs 14, 15, one on each end of the elastic beams 11 which are permanently in contact with said elastic beams 11.

[0046] In the embodiments shown in the Figures 4 and 5, a third support lug 13 is provided in both the lateral structures and is placed between the two first support lugs 14, 15. Preferably, the third support lug 13 is arranged parallel and in a central position with respect to the corresponding two first support lugs 14, 15.

[0047] Each third support lug 13, in a position of the converter with mouth 7 facing upwards, has advantageously a clearance with respect to the corresponding group of elastic beams 11. When the elastic beams 11 are deformed by the loading of the converter container during tilting, the middle support lugs 13 get in contact with the elastic beams 11 at a determined tilting angle, limiting the deformation of the elastic beams 11 and taking over part of the loads.

[0048] Alternatively each third support lug 13, also in the rest position, is in direct contact with the respective group of elastic beams 11. In this case it is possible to have a more or less rigid arrangement or a soft arrangement, depending on the particular design.

[0049] A further embodiment of the invention (not shown in detail), suitable e.g. for converters of reduced sizes, does not need the third support lugs 13, whereby said support lugs 13 are not provided.

[0050] In all embodiments of the invention shown in the Figures there are provided groups of vertical suspension devices, arranged substantially equally spaced apart from one another along the supporting ring 2, which comprise lamella suspension elements 9, in which the lamellae 10 are provided in a build-in configuration, restrained at a first end thereof to the container 1 and at a second end thereof to the supporting ring 2.

[0051] Alternatively, said groups of vertical suspension devices comprise elastic bars (not shown), in which said bars are provided in a build-in configuration, restrained at a first end thereof to the container 1 and at a second end thereof to the supporting ring 2.

[0052] Each horizontal suspension device is arranged between two respective groups of vertical suspension

devices directly underneath the supporting ring 2 (Figures 1 a, 1 b), or is arranged between two respective groups of vertical suspension devices in a projection area above the supporting ring 2 (Figures 2a, 2b).

[0053] The two supporting pins 3, 4, actuated by at least one tilting mechanism, allow the rotation of the converter about axis Y.

[0054] The converter usually moves from a first position in which it is in a vertical position with the loading mouth 7 facing upwards (Figure 1 a or 2a) to a second position inclined by around 30° with respect to the vertical, by means of rotation of the supporting pins 3, 4 in a first direction of rotation. In this second position, loading of the liquid cast iron and scrap metal takes place through mouth 7.

[0055] After loading, the converter returns to the first position in Figure 1a. One or more lances, introduced into the container by means of mouth 7, provide for inflation of oxygen for a predetermined period of time so as to drastically lower the content of carbon and reduce the concentration of impurities such as sulphur and phosphorus.

[0056] Once the conversion into raw liquid steel has been completed, the converter moves from the first position in Figure 1 a to a third position inclined by up to +90° or -90° with respect to the vertical, by means of rotation of the supporting pins 3, 4 in a second direction of rotation, opposite to the first one. In this third position, the tapping of the liquid steel takes place usually by means of a tapping hole provided in the container of the converter.

[0057] In all the variants of the invention the load, determined by the sum of the weights of container 1, liquid cast iron and scrap metal, is unloaded to the ground by means of support ring 2, the horizontal and vertical suspension devices, the tilting pins 3, 4 and the related supports.

[0058] In particular, the configuration of the horizontal and vertical suspension devices allows the weight to be absorbed for any inclination of container 1.

[0059] The vertical suspension devices act substantially as e.g. tie-rods for an inclination angle of the converter with respect to the vertical equal to 0°; on the other hand, they act exclusively as struts for an inclination angle equal to 180°, and gradually act both as e.g. tie-rods and as struts for angles different from 0° or 180°.

[0060] The position with inclination angle equal to 180°, with loading mouth 7 facing downwards, is provided for tapping slag, cleaning the container, once emptied or other reasons (e.g. keeping the converter hot).

[0061] The horizontal suspension devices ensure optimal support, stability and rigidity of the container. Said horizontal suspension devices serve principally to support the weight of the container in a direction transverse to axis Y when this is inclined by up to +90° or -90° (tapping position) and to support the component of load orthogonal to the axis X of the converter in any other condition.

[0062] In general, therefore, the load on the vertical suspension devices gradually goes from a maximum value with converter in the vertical position to a minimum value with converter in the horizontal position, while the load on the horizontal suspension devices gradually goes from substantially zero to a maximum value when the converter moves from the horizontal position to the vertical position. The moments which are generated with the rotation of the converter about axis Y are perfectly absorbed by the configurations of the horizontal and vertical suspension devices.

[0063] In an alternative embodiment (not shown), the single difference with respect to the above disclosed embodiments is that the first suspension devices comprise:

- a central structure fixed, for example by welding, to the surface 20 or 21 of the supporting ring 2 of the container 1;
 - a first lateral structure arranged at a first side of said central structure and fixed, for example by welding, to the container 1 of the converter;
 - a second lateral structure arranged at a second side of said central structure, opposite said first side, and fixed, for example by welding, to said container 1.
- Also in this case first and second lateral structures are arranged substantially symmetrically with respect to the central structure.

Claims

1. A tilting converter comprising:

a container (1) defining a first axis (X);
 a supporting ring (2), coaxial to the container (1) and spaced apart from said container, provided with two diametrically opposite load-bearing pins (3, 4) defining a second axis (Y) orthogonal to the first axis (X), adapted to allow the converter to rotate about said second axis;
 at least one pair of first suspension devices and a plurality of second suspension devices, connecting said container (1) to said supporting ring (2);
 wherein said second suspension devices are lamella suspension elements (9) fixed in a build-in configuration, restrained at a first end thereof to the container (1) and at a second end thereof to the supporting ring (2),
 wherein each first suspension device comprises

- a central structure, fixed to the container (1) or to the supporting ring (2),
- a first lateral structure, arranged at a first side of said central structure and fixed to a surface of the supporting ring (2) or to the container (1),

- a second lateral structure, arranged at a second side of said central structure, opposite said first side, and fixed to said surface of the supporting ring (2) or to the container (1), in the same way like the first lateral structure,

wherein said first lateral structure and said second lateral structure respectively comprise two first support lugs (14, 15), spaced apart to each other, and a group of elastic elements (11) arranged adjacent and parallel to each other and supported at ends thereof by said two first support lugs (14, 15),

wherein said central structure comprises a second support lug (12), arranged transversally to and between the groups of elastic elements (11) of said first lateral structure and said second lateral structure,

wherein the elastic elements (11) of each group are arranged side by side and

freely arranged between the two first support lugs (14, 15) and mechanical stops (16, 17), and have, in a position of the converter with mouth facing upwards, clearances with respect to the respective second support lug (12),

whereby said elastic elements (11) act as resilient support for the second support lug (12) in case of deviation from the rest position.

2. A tilting converter according to claim 1, wherein said first suspension devices are each arranged at a respective load-bearing pin (3, 4) and transversally to a first plane X-Y.
3. A tilting converter according to claim 2, wherein the elastic elements are elastic beams (11) and the second support lug (12) of each first suspension device is substantially parallel to said surface of the supporting ring (2) and substantially perpendicular to the respective groups of elastic beams (11).
4. A tilting converter according to any of the preceding claims, wherein there is provided, both in said first lateral structure and in said second lateral structure, a third support lug (13) placed between the two first support lugs (14, 15).
5. A tilting converter according to claim 4, wherein the third support lug (13) is arranged parallel and in a central position with respect to said two first support lugs (14, 15).
6. A tilting converter according to claim 5, wherein the third support lug (13), in a position of the converter with mouth facing upwards, has a clearance with respect to the respective group of elastic beams (11) or is in direct contact with said respective group of

elastic beams (11).

7. A tilting converter according to any of the preceding claims, wherein each second support lug (12) has sides of a convex shape adapted to get into contact with at least one of the respective groups of elastic beams (11).
8. A tilting converter according to claim 7, wherein the contact area of said sides with the elastic beams 11 is spherical-bowl-shaped.
9. A tilting converter according to any of the preceding claims, wherein said first suspension devices are arranged parallel to a second plane Y-Z orthogonal to the first axis X, where Z is an axis orthogonal to the first plane X-Y and crosses the intersection point between the first axis X and the second axis Y, and are symmetrically arranged with respect to a third plane X-Z underneath or above the supporting ring (2).
10. A tilting converter according to claim 9, wherein two pairs of first suspension devices are provided, a first pair of first suspension devices being arranged at a first side of the second plane Y-Z and a second pair of first suspension devices being arranged at a second side of the second plane Y-Z.
11. A tilting converter according to any of the preceding claims, wherein said second suspension devices are placed in groups arranged substantially equally spaced apart from one another along said supporting ring (2).
12. A tilting converter according to claim 11, wherein each first suspension device is arranged between two respective groups of second suspension devices underneath the supporting ring (2) or in a projection area above the supporting ring (2).

Patentansprüche

1. Kippkonverter, umfassend:

einen Behälter (1), der eine erste Achse (X) definiert;

einen Stützring (2) koaxial zu dem Behälter (1), der von dem Behälter beabstandet und mit zwei diametral gegenüberliegenden Lastlagerstiften (3, 4) versehen ist, die eine zweite Achse (Y) orthogonal zu der ersten Achse (X) definieren, und der derart angepasst ist, um zu ermöglichen, dass der Konverter um die zweite Achse drehen kann;

zumindest ein Paar erster Aufhängungsvorrichtungen und eine Mehrzahl zweiter Aufhängungsvorrichtungen, die den Behälter (1) mit

dem Stützring (2) verbinden;
wobei die zweiten Aufhängungsvorrichtungen Lamellenaufhängungselemente (9) sind, die in einer Einbaukonfiguration fixiert und an einem ersten Ende davon an dem Behälter (1) und an einem zweiten Ende davon an dem Stützring (2) gehalten sind,
wobei jede erste Aufhängungsvorrichtung umfasst

- einen Zentralaufbau, der an dem Behälter (1) oder dem Stützring (2) fixiert ist,
- einen ersten Seitenaufbau, der an einer ersten Seite des zentralen Aufbaus angeordnet ist und an einer Fläche des Stützrings (2) oder an dem Behälter (1) fixiert ist,
- einen zweiten Seitenaufbau, der an einer zweiten Seite des Zentralaufbaus gegenüberliegend der ersten Seite angeordnet ist und an der Fläche des Stützrings (2) oder an dem Behälter (1) auf dieselbe Weise wie der erste Seitenaufbau fixiert ist,

wobei der erste Seitenaufbau und der zweite Seitenaufbau jeweils zwei erste Stützansätze (14, 15), die voneinander beabstandet sind, sowie eine Gruppe elastischer Elemente (11) umfassen, die benachbart und parallel zueinander angeordnet und an den Enden davon durch die zwei ersten Stützansätze (14, 15) gelagert sind, wobei der Zentralaufbau einen zweiten Stützansatz (12) umfasst, der quer zu und zwischen den Gruppen elastischer Elemente (11) des ersten Seitenaufbaus und des zweiten Seitenaufbaus angeordnet ist,
wobei die elastischen Elemente (11) jeder Gruppe Seite an Seite und frei zwischen den beiden ersten Stützansätzen (14, 15) und mechanischen Anschlüssen (16, 17) angeordnet sind und in einer Position, wenn die Konvertermündung aufwärts weist, Zwischenräume in Bezug auf den jeweiligen zweiten Stützansatz (12) aufweisen,
wobei die elastischen Elemente (11) als nachgiebiger Träger für den zweiten Stützansatz (12) im Falle einer Abweichung von der Ruheposition wirken.

2. Kippkonverter nach Anspruch 1, wobei die ersten Aufhängungsvorrichtungen jeweils an einem jeweiligen Lastlagerstift (3, 4) und quer zu einer ersten Ebene X-Y angeordnet sind.
3. Kippkonverter nach Anspruch 2, wobei die elastischen Elemente elastische Träger (11) sind und der zweite Stützansatz (12) jeder ersten Aufhängungsvorrichtung im Wesentlichen parallel zu der Fläche des Stützrings (2) und im Wesentlichen rechtwinklig zu

den jeweiligen Gruppen elastischer Träger (11) liegt.

4. Kippkonverter nach einem der vorhergehenden Ansprüche, wobei sowohl in dem ersten Seitenaufbau als auch in dem zweiten Seitenaufbau ein dritter Stützansatz (13) vorgesehen ist, der zwischen den beiden ersten Stützansätzen (14, 15) angeordnet ist.
5. Kippkonverter nach Anspruch 4, wobei der dritte Stützansatz (13) parallel und in zentraler Position in Bezug auf die beiden ersten Stützansätze (14, 15) angeordnet ist.
6. Kippkonverter nach Anspruch 5, wobei der dritte Stützansatz (13) in einer Position, wenn die Konvertermündung aufwärts weist, einen Zwischenraum in Bezug auf die jeweilige Gruppe elastischer Träger (11) aufweist oder in direktem Kontakt mit der jeweiligen Gruppe elastischer Träger (11) steht.
7. Kippkonverter nach einem der vorhergehenden Ansprüche, wobei jeder zweite Stützansatz (12) Seiten mit einer konvexen Form aufweist, die derart angepasst sind, um in Kontakt mit zumindest einer der jeweiligen Gruppen elastischer Träger (11) zu treten.
8. Kippkonverter nach Anspruch 7, wobei die Kontaktfläche der Seiten mit den elastischen Trägern (11) kugelschalenförmig ist.
9. Kippkonverter nach einem der vorhergehenden Ansprüche, wobei die ersten Aufhängungsvorrichtungen parallel zu einer zweiten Ebene Y-Z orthogonal zu der ersten Achse X angeordnet sind, wobei Z eine Achse orthogonal zu der ersten Ebene X-Y ist und den Überschneidungspunkt zwischen der ersten Achse X und der zweiten Achse Y kreuzt und symmetrisch in Bezug auf eine dritte Ebene X-Z unterhalb oder über dem Stützring (2) angeordnet sind.
10. Kippkonverter nach Anspruch 9, wobei zwei Paare erster Aufhängungsvorrichtungen vorgesehen sind, wobei ein erstes Paar der ersten Aufhängungsvorrichtungen an einer ersten Seite der zweiten Ebene Y-Z angeordnet ist und ein zweites Paar erster Aufhängungsvorrichtungen an einer zweiten Seite der zweiten Ebene Y-Z angeordnet ist.
11. Kippkonverter nach einem der vorhergehenden Ansprüche, wobei die zweiten Aufhängungsvorrichtungen in Gruppen platziert sind, die im Wesentlichen gleich beabstandet voneinander entlang des Stützrings (2) angeordnet sind.
12. Kippkonverter nach Anspruch 11, wobei jede erste Aufhängungsvorrichtung zwischen zwei jeweiligen Gruppen zweiter Aufhängungsvorrichtungen unterhalb des Stützrings (2) oder in einem Projektionsbereich

oberhalb des Stützringes (2) angeordnet ist.

Revendications

1. Convertisseur basculant comprenant :

un récipient (1) définissant un premier axe (X) ;
 une bague de support (2), coaxiale au récipient (1) et espacée dudit récipient, pourvue de deux goupilles porteuses de charge diamétralement opposées (3, 4) définissant un second axe (Y) orthogonal au premier axe (X), adaptées pour permettre au convertisseur de se mettre en rotation autour dudit second axe ;
 au moins une paire de premiers dispositifs de suspension et une pluralité de seconds dispositifs de suspension, raccordant ledit récipient (1) à ladite bague de support (2) ;
 dans lequel lesdits seconds dispositifs de suspension sont des éléments de suspension à lamelles (9) fixés dans une configuration intégrée, retenus au niveau d'une première extrémité de ceux-ci au récipient (1) et au niveau d'une seconde extrémité de ceux-ci à la bague de support (2),
 dans lequel chaque premier dispositif de suspension comprend

- une structure centrale, fixée au récipient (1) ou à la bague de support (2),
- une première structure latérale, agencée au niveau d'un premier côté de ladite structure centrale et fixée à une surface de la bague de support (2) ou au récipient (1),
- une seconde structure latérale, agencée au niveau d'un second côté de ladite structure centrale, opposé audit premier côté, et fixée à ladite surface de la bague de support (2) ou au récipient (1), de la même manière que la première structure latérale,

dans lequel ladite première structure latérale et ladite seconde structure latérale comprennent respectivement deux premiers ergots de support (14, 15), espacés l'un de l'autre, et un groupe d'éléments élastiques (11) agencés de manière adjacente et parallèles les uns aux autres et supportés au niveau de leurs extrémités par lesdits deux premiers ergots de support (14, 15), dans lequel ladite structure centrale comprend un deuxième ergot de support (12), agencé transversalement à et entre les groupes d'éléments élastiques (11) de ladite première structure latérale et de ladite seconde structure latérale,
 dans lequel les éléments élastiques (11) de chaque groupe sont agencés côte à côte et agencés

librement entre les deux premiers ergots de support (14, 15) et des butées mécaniques (16, 17), et ont, dans une position où le convertisseur a son ouverture en regard vers le haut, des débattements par rapport au deuxième ergot de support respectif (12),
 lesdits éléments élastiques (11) servant de support résilient pour le deuxième ergot de support (12) en cas d'écart par rapport à la position de repos.

2. Convertisseur basculant selon la revendication 1, dans lequel lesdits premiers dispositifs de suspension sont chacun agencés au niveau d'une goupille porteuse de charge respective (3, 4) et transversalement un premier plan X-Y.
3. Convertisseur basculant selon la revendication 2, dans lequel les éléments élastiques sont des poutres élastiques (11) et le deuxième ergot de support (12) de chaque premier dispositif de suspension est sensiblement parallèle à ladite surface de la bague de support (2) et sensiblement perpendiculaire aux groupes respectifs de poutres élastiques (11).
4. Convertisseur basculant selon l'une quelconque des revendications précédentes, dans lequel il est prévu, à la fois dans ladite première structure latérale et dans ladite seconde structure latérale, un troisième ergot de support (13) placé entre les deux premiers ergots de support (14, 15).
5. Convertisseur basculant selon la revendication 4, dans lequel le troisième ergot de support (13) est agencé parallèle et dans une position centrale par rapport auxdits deux premiers ergots de support (14, 15).
6. Convertisseur basculant selon la revendication 5, dans lequel le troisième ergot de support (13), dans une position où le convertisseur a son ouverture en regard vers le haut, présente un débattement par rapport au groupe respectif de poutres élastiques (11) ou est en contact direct avec ledit groupe respectif de poutres élastiques (11).
7. Convertisseur basculant selon l'une quelconque des revendications précédentes, dans lequel chaque deuxième ergot de support (12) a des côtés d'une forme convexe adaptés pour venir en contact avec au moins l'un des groupes respectifs de poutres élastiques (11).
8. Convertisseur basculant selon la revendication 7, dans lequel la zone de contact desdits côtés avec les poutres élastiques 11 a la forme d'un bol sphérique.

9. Convertisseur basculant selon l'une quelconque des revendications précédentes, dans lequel lesdits premiers dispositifs de suspension sont agencés parallèlement à un deuxième plan Y-Z orthogonal au premier axe X, où Z est un axe orthogonal au premier plan X-Y et coupe le point d'intersection entre le premier axe X et le second axe Y, et sont agencés symétriquement par rapport à un troisième plan X-Z en dessous ou au-dessus de la bague de support (2). 5
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10. Convertisseur basculant selon la revendication 9, dans lequel deux paires de premiers dispositifs de suspension sont prévues, une première paire de premiers dispositifs de suspension étant agencée au niveau d'un premier côté du deuxième plan Y-Z et une seconde paire de premiers dispositifs de suspension étant agencée au niveau d'un second côté du deuxième plan Y-Z. 15
11. Convertisseur basculant selon l'une quelconque des revendications précédentes, dans lequel lesdits seconds dispositifs de suspension sont placés en groupes agencés sensiblement à distance égale les uns des autres le long de ladite bague de support (2). 20
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12. Convertisseur basculant selon la revendication 11, dans lequel chaque premier dispositif de suspension est agencé entre deux groupes respectifs de seconds dispositifs de suspension en dessous de la bague de support (2) ou dans une zone de saillie au-dessus de la bague de support (2). 30
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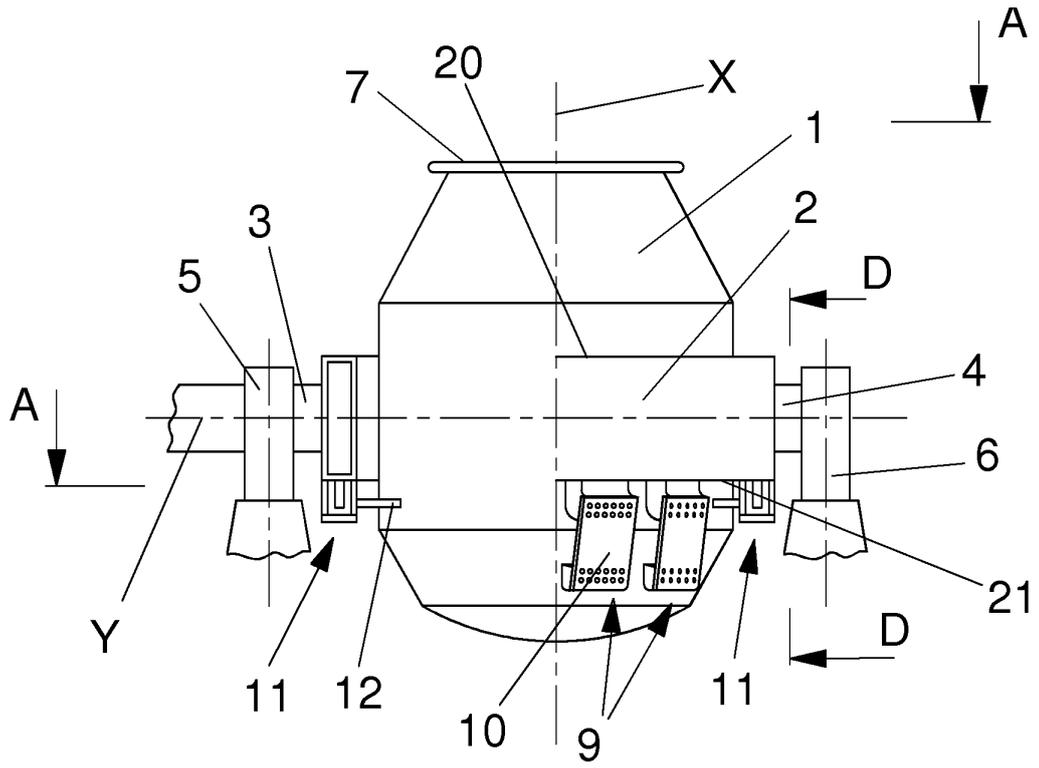


Fig. 1a

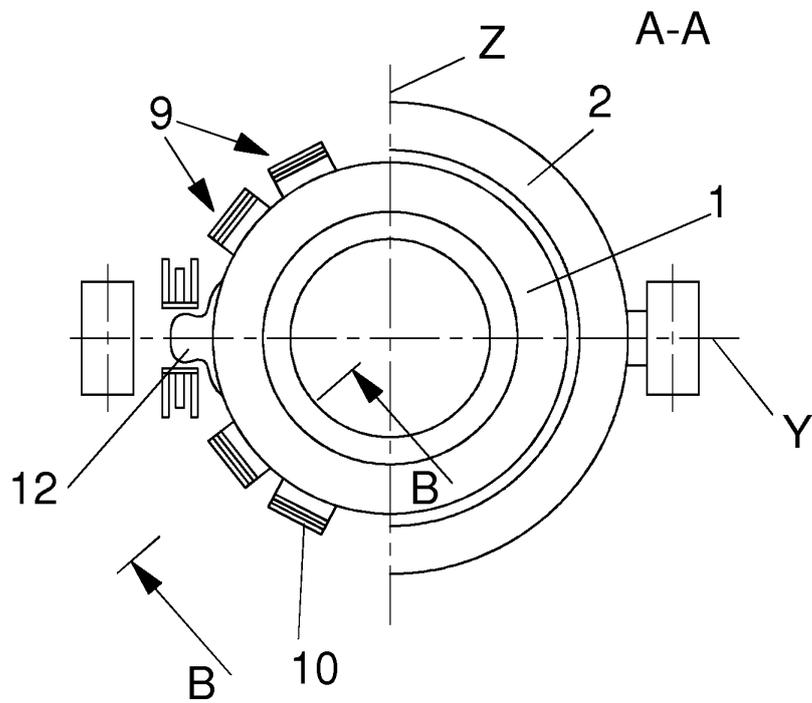


Fig. 1b

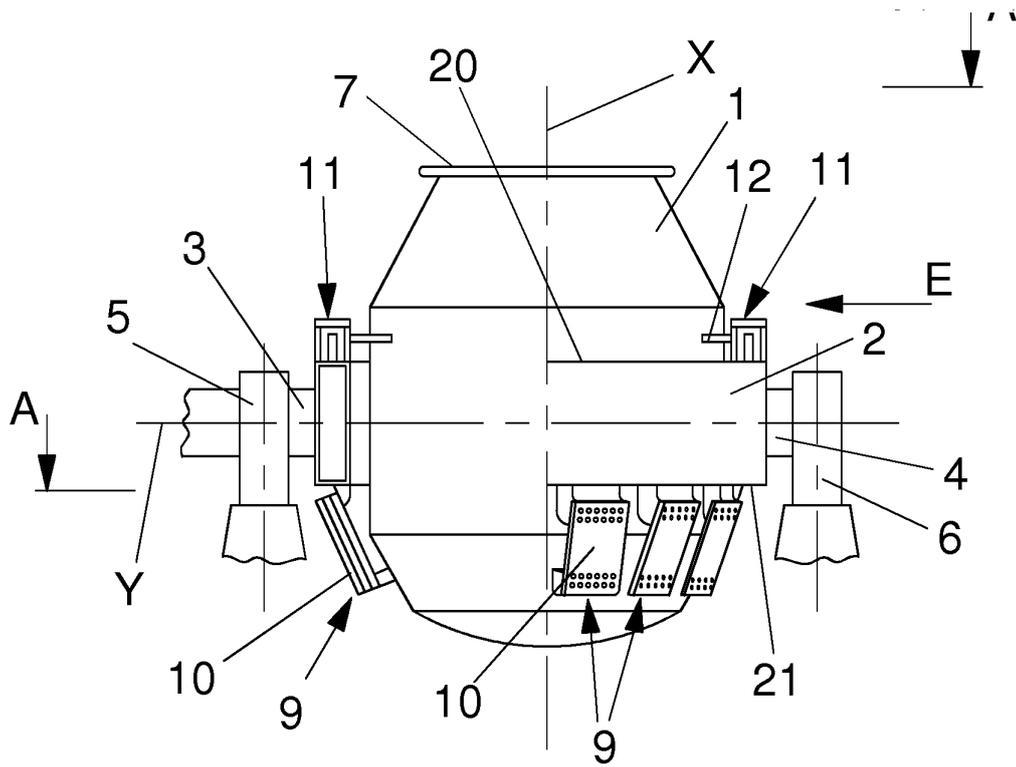


Fig. 2a

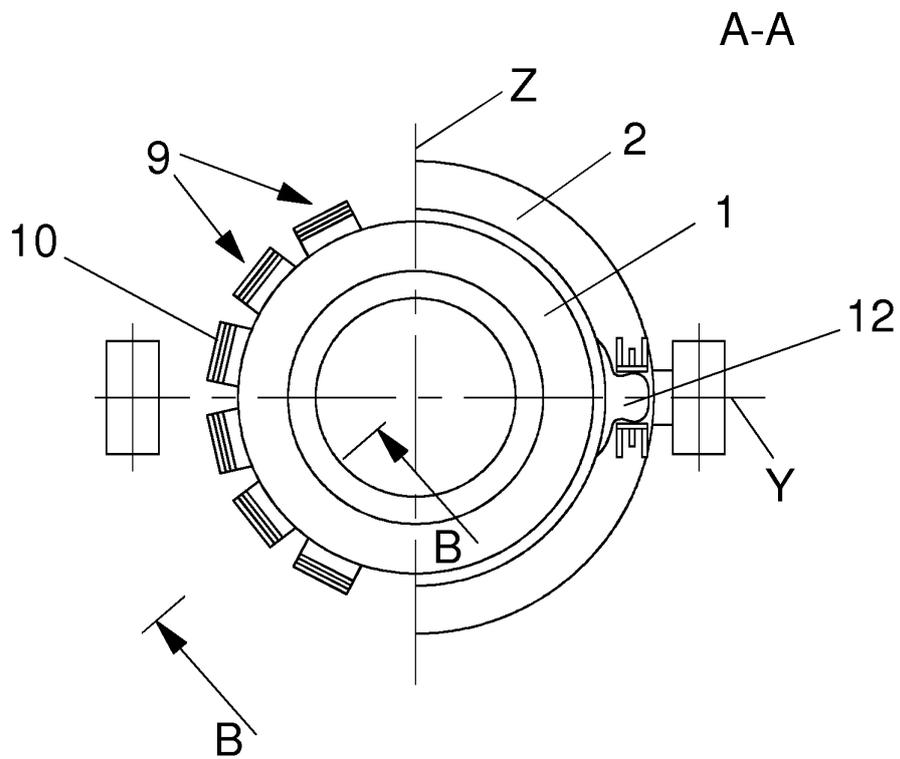


Fig. 2b

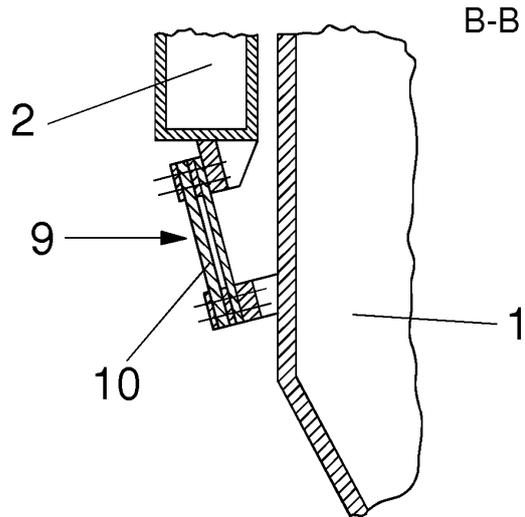


Fig. 3

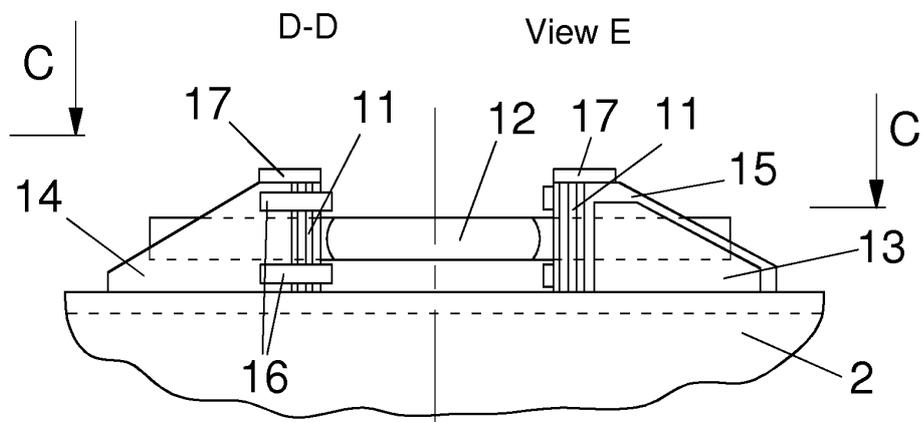


Fig. 4

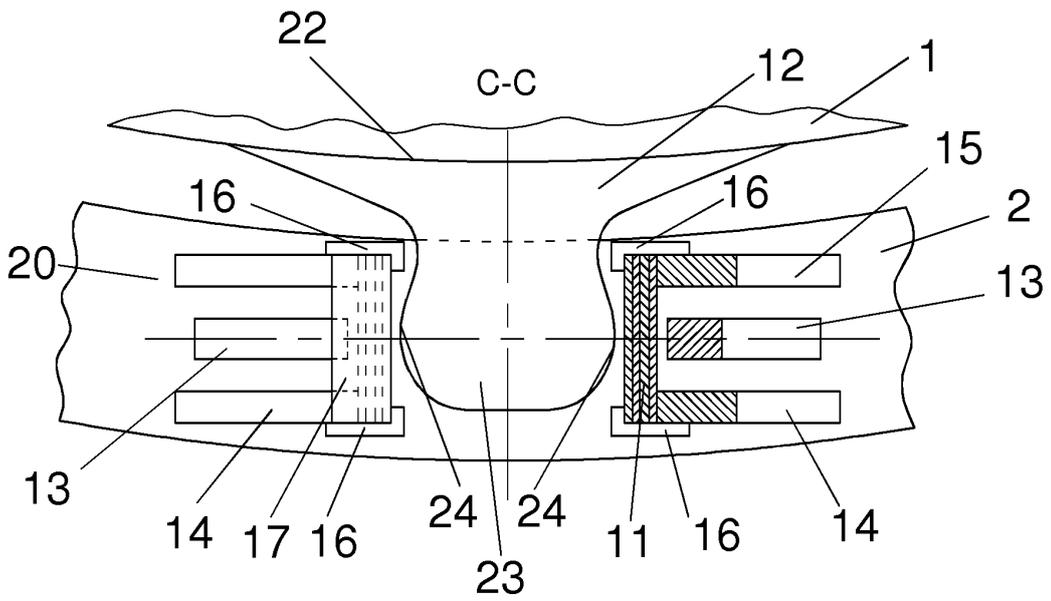


Fig. 5

REFERENCES CITED IN THE DESCRIPTION

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