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(54) **PRESSURIZED CONTAINER**

(57) The present invention relates to a pressurized container for the containment and transport of parts of rotary machines and/or machines with a cylindrical symmetry, such as turbine rotors or parts thereof, used mainly in the hydrocarbon extraction industry.

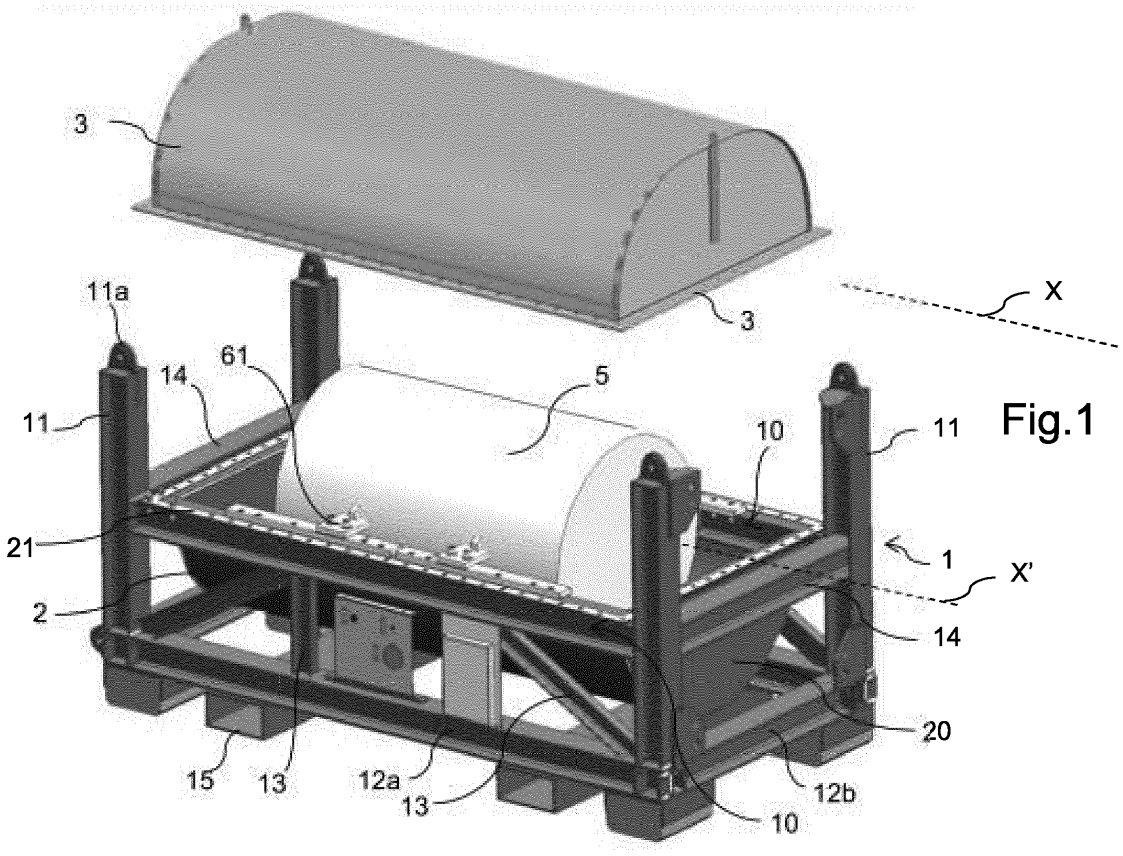

Fig.1

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Description

[0001] The present invention relates to a pressurized container for the containment and transport of parts of rotary machines and/or machines with a cylindrical symmetry, such as turbine rotors or parts thereof, used mainly in the hydrocarbon extraction industry (namely the oil and gas sector).

[0002] The known containers have numerous drawbacks. Firstly the manufacture thereof involves relatively high production costs. In fact such containers are nowadays designed such that they are practically tailor-made for the parts which they are intended to contain.

[0003] Moreover, the containers which are currently used do not comply with the most recent standards in terms of strength, such as EN12079 and DNV2.7-3.

[0004] In greater detail, the known containers are substantially cylindrical and formed by two half-shells which are sealingly joined together by a bolted flange so as to allow the internal pressurization condition to be maintained; this pressurization is particularly important for keeping the load under a controlled atmosphere at the desired pressure and therefore preventing deterioration thereof. It should be considered in fact that the parts of rotary machines and/or machines with a cylindrical symmetry are made of very costly special materials with very precise tolerances. A pressure fluctuation or the penetration of water, moisture or dust inside the container may alter the part which therefore becomes unusable; for example, parts which must be kept in a nitrogen atmosphere may be affected by oxidation if any oxygen penetrates into the container. Ensuring a correct connection of the half-shells is therefore particularly complex, also because this connection must be sealed despite elastic deformation of the structure which occurs during the handling and raising operations.

[0005] A support structure for the part which must be housed inside the container is then welded inside the lower half-shell. The container is then housed and welded on a saddle which is in turn welded to a frame so that it can be transported on a ship or other transport means. From the above description it is clear that the load bears with its whole weight on the lower half-shell. The loads, therefore, to which the container may be subject depend on the capacity of the half-shell to withstand these stresses.

[0006] The object of the container according to the invention is to overcome the problems described above. In particular, the aim is that the container according to the present invention should have manufacturing costs which are lower than those of the known containers and comply with the strength requirements of the standard EN12079 and DNV2.7-3 Namely, the aim is that the container according to the present invention should be more resistant than the known ones, not only to the static loads, but also to the dynamic loads which arise during transportation of the container on a transport means such as a cargo ship, train, wheeled vehicle and the like.

[0007] Furthermore, the aim is that the container according to the invention should be suitable for transportation also of different-size parts, namely be standardized for given size ranges of the part. This results in considerable savings for the end client who no longer has to order a container for each part produced, but may use of one the container sizes already provided.

[0008] These objects and aims are achieved by the container, the essential characteristic features of which are defined in the first of the attached claims.

[0009] The characteristic features and advantages of the container according to the invention will emerge more clearly from the description below of an embodiment thereof, provided by way of a non-limiting example, with reference to the attached drawings in which:

- Figure 1 shows a perspective view of a container according to the invention with an upper half-shell which is shown in exploded form, for easier understanding of the drawing, said drawing also showing in an entirely schematic manner a load housed inside a pressurised shell of the container;
- Figure 2 is another perspective view of the container according to Figure 1 shown in non-exploded form;
- Figure 3 is a side view of the container according to the preceding figures, where the upper half-shell is not shown;
- Figure 4 shows a top plan view of the container according to the invention, without the upper half-shell;
- Figure 5 is a view cross-sectioned along the plane indicated as V-V in Figure 4, where a load contained inside the pressurised shell is also schematically shown;
- Figure 6 shows an example of a constructional solution of a support structure for a load (again shown in schematic form) inside the pressurised shell; and
- Figure 6a is an isolated view of a clamping collar of the support structure according to Figure 6.

[0010] With reference to the figures, the container according to the invention is of the type which is pressurized, preferably with nitrogen. The container is adapted to contain and transport, preferably but not exclusively, spare parts of rotary machines and/or machines having a cylindrical symmetry. The load therefore has a preferably substantially cylindrical shape, with a main development along an axis of axial symmetry X'.

[0011] The container according to the invention comprises a frame 1 with a substantially box-like shape. The frame is composed of a plurality of beams, at least two support beams 10 of which with a main development along their own axis X (indicated in Figure 1), are arranged parallel to and spaced from each other. The beams of the frame can have an open section (i.e. they can be HE, IP, UPN or similar beams) or can have a closed section (i.e box-shaped section). In the embodiment represented in the figures, the beams has an open section and in particular they have a H section.

[0012] When the load is mounted the symmetry axis X' and the own axis X of the support beams 10 are parallel.

[0013] The frame also comprises a base 12 which is in turn composed of a plurality of beams and which provides the actual support for the container on the ground. Vertical beams 11 extend upwards perpendicularly from the base and have, connected to them, the support beams 10 which are therefore positioned spaced from the base 12.

[0014] In greater detail, the beams which define the base are arranged so as to form a rectangular flat frame structure; two main beams 12a in relation to which the support beams 10 are parallel and spaced, and two smaller beams 12b which are arranged perpendicularly with respect to the main beams so as to close this rectangular flat frame form and reinforce the structure.

[0015] The columns 11 are therefore four in number, being arranged at the vertices of the rectangular flat frame defined by the base and extend perpendicularly with respect to the main development direction X. A plurality of connecting beams 13 connect the main beams 12a of the base 12 to the support beams 10 and allow (together with the vertical beams 11), as will become clear below, the weight bearing on the support beams to be transmitted directly onto the beams of the base and therefore the ground. The smaller beams 12b face reinforcing beams 14 which are connected between respective pairs of consecutive vertical beams arranged perpendicularly and at the same height as the support beams 10, so as to define with them a further flat rectangular frame.

[0016] Considering Figure 6, each support beam 10 has at least two flat faces which are opposite and parallel to each other, i.e. a lower face 10a and an upper face 10b. The lower face 10a is directed, during use, towards the ground.

[0017] A first half-shell 2 is housed inside the box-shaped frame 1 (see Figure 3) and, as will become clear, is sealingly connected together with a second half-shell 3 so as to define a pressurized shell 4 of said container.

[0018] The pressurized shell has a substantially cylindrical shape, with a length comparable to that of the support beams. Each half-shell therefore will define half of this cylinder, having a semi-circular cross-section. Furthermore, when the pressurised shell is mounted on the frame it is positioned along the main development direction X.

[0019] With reference again to that mentioned above, the first half-shell 2 is housed inside the box-shaped body 1, between the support beams 10 to which it is integrally connected. In particular, the first half-shell, or lower half-shell, is fixed integrally to the lower face 10a of each support beam 10. The connection is performed by means of a welding seam which extends between a greater edge of the half-shell and the lower face along said main development axis X. Two flat end-plates 20 are also welded onto the half-shell so as to close it at the front and back. The end-plates, which have a half-moon shape, are connected to the half-shell and between the two support beams, so that their straight edge is perpendicular to the axis X and perpendicular to and coplanar with the lower face 10b of each support beam. A flat plate is welded onto this edge so as to form the straight and short edge of the flange present on the two end-plates. The end-plates 20 face the reinforcing beams 14 and are slightly spaced from them.

[0020] A flange 21 with a rectangular rim, which runs along the edge of the lower half-shell 2, is connected to the support beams 10, preferably but not exclusively, by means of threaded connections. In particular, the flange 21 is fixed with its two greater sides to the upper faces 10b of the support beams 10, while with its smaller sides it is connected to the straight edges of the two end-plates of the half-shell. The flange 21 allows connection of the lower half-shell to the upper half-shell 3 which, for this purpose, has a flange 31 similar to that described above and matching it so that they may be sealingly connected together.

[0021] Therefore, in order to form the pressurized shell, the upper half-shell is lowered so as to rest on the support beams and be connected thereto by means of the flange 21, in a superimposed condition on the lower half-shell.

[0022] Advantageously, therefore, the load produced by the upper half-shell is supported entirely by the frame 1 and does not bear on the lower half-shell.

[0023] Moreover the flange occupies only a portion of the upper face 10b, i.e. the outermost face, while the rest of the face closest to the load is free. A load 5 (shown in the figures only in schematic form) rests indirectly on this free face portion 10b' and during use is contained inside the pressurized shell and consequently inside the box-shaped frame. As mentioned above, the load 5 may in some cases be a spare part of a rotary machine. In this case it has a mainly cylindrical shape and therefore a main axial development; it is therefore shown mounted inside the pressurized shell so that it is arranged along the direction X.

[0024] The load is associated with a support structure 6 which supports it inside the pressurized shell. The support structure may have different forms so as to adapt to the type of load contained inside the pressurised shell. In general the support structure comprises at least two clamping elements 60 designed to engage on substantially axially opposite portions of the load; each of the at least two clamping elements supports also support feet 61 which are connected to the lower face of each support beam. The connection is performed by means of threaded connections, even though other fastening solutions are nevertheless possible. As a result the weight of the load does not bear directly on the lower half-shell or on the pressurized shell broadly speaking, but rather on each support beam and consequently on the frame 1, the weight of the load being therefore directly transmitted to the ground via the beams of the frame 1.

[0025] Figure 6 shows a possible constructional solu-

tion of this structure, which is particularly advantageous in the case where the load is a rotor. In this case, the support structure comprises two clamping collars 60 (shown separately in Figure 6a) which are mounted so as to face the flat end-plates 20, at the opposite longitudinal ends of the lower half-shell. Each clamping collar has a seat 62 for seating the output shaft of the rotor. The clamping collars moreover are provided with the aforementioned support feet 61 and, therefore, when the rotor is seated on the collars, its weight is transmitted via the support feet 60 onto the beams 10 and consequently onto the frame. In the embodiment of the support structure shown above a collar 63 is also provided, being mounted on one of the output shafts of the rotor. Said collar 63 axially adapts along the direction X the position of the rotor inside the pressurized shell.

[0026] This does not prevent the support structure from having different forms. For example the clamping elements may consist of clamping rings which engage with axially opposite sides of the load and surround it circumferentially. This solution is perfectly suited for loads which do not have shaft portions projecting at the ends.

[0027] Fastening lugs 11 a are arranged at the free end of each vertical beam 11 for securing ropes or chains in order to raise the container. Similar fastening lugs 11 b are also arranged at one end of each main beam. Therefore, by simultaneously raising the container via the fastening lugs 11 b connected to the main beams 12a and via the fastening lugs 11 a connected to the end of the diagonally opposite vertical beams, overturning of the container is obtained so as to bring it into the vertical position. The container may in fact be stored both in the horizontal position and in the vertical position.

[0028] Advantageously, in a further embodiment, the lugs can be oriented with an inclination towards the barycentre of the container. In detail, the four lugs 11a are reciprocal symmetrical and arranged on oblique lines of connections that intersect on the barycentre. This arrangement of the lugs is advantageous during the lifting of the container, because the chance that the container be unbalanced during the lifting is reduced. The lifting cables hence converge at the lifting hook and this, with the arrangement of the lugs, prevents the container by the unbalancing.

[0029] In addition of that, with the arrangement of the lugs described, the operation of lifting or rotation in a vertical asset, are performed without any lifting beam or spreader bar.

[0030] If necessary the base may be provided underneath with tubular (or forklift) elements 15 used for movement by means of forks and/or guides in the form of an overturned U, inside which wooden chocks are inserted, again in order to provide support feet on the ground.

[0031] Furthermore, Figure 1 shows a gas cylinder 7 which forms part of a system for pressurization of the pressurised shell 4. The gas cylinder contains preferably nitrogen. Advantageously the box-shaped frame therefore defines a space sufficient also for containing such an installation.

[0032] The container according to the invention offers numerous advantages.

[0033] The frame of the container according to the invention is formed by means of a plurality of beams connected together preferably by means of full-penetration welds. This allows the frame to withstand particularly well both static loads and dynamic loads (which arise when the container is transported on cargo ships, airplanes or other transportation means). Moreover, the static load does not bear on the pressurized shell, but on the frame support beams and therefore the container according to the invention is particularly strong and for the same load requires, compared to the known containers, the use of less material. This results in significant savings in terms of costs. It should be considered in fact that, in the container described above, the complex operations such as welding are performed mainly on the beams of the frame or on flat surfaces (e.g. the sealed weld between the upper half-shell and the flange). Therefore these operations are simpler and hence less costly than those which are performed on the known containers and which involve mainly the lower half-shell. As mentioned above, the container is able to withstand in particular also dynamic loads, owing to the presence of the box-shaped frame which surrounds the pressurized shell, protecting it from both front and lateral accelerations. In particular, the container according to the invention withstands a frontal acceleration of up to 2.5 g, a lateral acceleration of up to 1 g and an upward acceleration of 1.5 g.

[0034] The container according to the invention therefore complies with the strength requirements stipulated by the most recent standards.

[0035] Furthermore, the container according to the invention may be standardized, namely it is possible to implement a series of measures for allowing the transport of most of the currently known spare parts with cylindrical symmetry used in the extraction industry. In this connection the support structure allows the safe containment of the load inside the frame even though the latter is not designed with dimensions to axially match the load. In particular, the support structure is able to be adapted also to parts which a different overall volume lengthwise; it is merely required in fact to perform the connection of the clamping elements in different positions along the beam 10. Advantageously, the upper face of each beam 10 may be provided with a pre-drilled plate 64. This will allow exact positioning of the support feet of the clamping elements, thereby avoiding the need for the operator to perform complex operations for positioning and alignment of said elements. The plate 64 may have more than one group of predefined holes so as to allow positioning of the clamping elements at different axial distances.

[0036] As mentioned above, the container according to the invention is designed preferably for the transport of spare parts of rotary machines having cylindrical symmetry. However it is also possible to use the container for other types of loads, adapting the collars.

[0037] Furthermore, the beams which form the frame 1 are preferably of the type with an H-section. However it is also possible to use beams with other sections of the open type, such as an HE, IPE, UPN or similar section. In addition of that, the beams could have eventually a closed section, i.e. a box-shaped section.

[0038] As mentioned above, the reinforcing beams 14 help reinforce the frame and improve the capacity of the container to withstand lateral accelerations; however, in a less advantageous embodiment, the reinforcing beams 14 could be not provided.

[0039] Furthermore, the two half-shells in general, and in particular the upper half-shell 3 could have a shape different from that described. For example, the upper half-shell could have a cross-section with a trapezoidal shape. This shape results moreover in a certain reduction in the costs of manufacture of the container.

[0040] The present invention has been described hitherto with reference to preferred embodiments thereof. It is to be understood that other embodiments relating to the same inventive idea may exist, all of these falling within the scope of protection of the claims which are attached below.

Claims

1. A container for the containment and transport of a heavy load substantially with a cylindrical shape with a main development along an axis of axial symmetry (X'), comprising a frame (1) for resting on the ground, said frame being substantially box-shaped and comprising two support beams (10) mutually parallel, spaced and extending along a main development axis (X), the symmetry axis (X') and the main development axis (X) being parallel when the load is mounted in said container, said frame supporting between said support beams a lower half-shell (2) integrally connected to said support beams (10), an upper half-shell (3) being removably engaged on said two support beams (10) and positioned in a superimposed position on said lower half-shell, so that said upper half-shell defines with said support beams (10) and said lower half-shell (2) a pressurized shell (4) for the containment of said load, the latter being supported inside said pressurized shell by means of a support structure (6) fixed to said support beams (10) so that the weight of said load bears on said support beams and therefore on said frame (1), wherein said frame (1) comprises a base (12) for resting said container on the ground, vertical beams (11) extending upwards perpendicularly from said base, said support beams (10) being connected to said vertical beams (10) and therefore supported by them in a spaced arrangement from said base (12).

2. The container according to claim 1, wherein said base (12) is defined by a plurality of beams positioned to form a rectangular flat frame structure, two main beams (12a) thereof being spaced and parallel with respect to said support beams (10) and two smaller beams (12b) being perpendicular to said main beams.

3. The container according to claim 2, wherein said vertical beams (11) are arranged at the vertices defined by said base and extend perpendicularly therefrom.

4. The container according to claim 3, wherein a plurality of connecting beams (13) extend between said support beams (10) and said main beams (12a) of said base (12) and are positioned to reinforce the frame.

5. The container according to any one of the preceding claims, wherein each of said support beams (10) comprises at least an upper flat face (10b) on which a flange (21) for fastening said upper half-shell (3) is connected.

6. The container according to claim 5, wherein said support frame comprises two clamping elements (60) adapted to engage with said load to support and fix it stably inside said pressurized shell, each clamping element having support feet (61) for resting on and connection with said respective support beam (10).

7. The container according to claim 6, wherein said support feet (61) are connected to said upper face (10b) of each of said support beams (10).

8. The container according to claim 7, wherein a predrilled plate (64) is mounted on said upper face (10b) of said support beam, a respective support foot (61) being connected on each plate.

9. The container according any one of the preceding claims, wherein at least said support beams of said frame are beams of the type having an H-section.

10. The container according to any of the previous claims, wherein said pressurised shell is pressurized with nitrogen.

11. Use of the container according any one of claims 1 to 10, for the containment and transport of rotary machines and/or machines with a cylindrical symmetry such as those used in the oil and gas industry, or parts thereof.

12. Use of the container according to claim 11, for the containment and transport of a rotor.

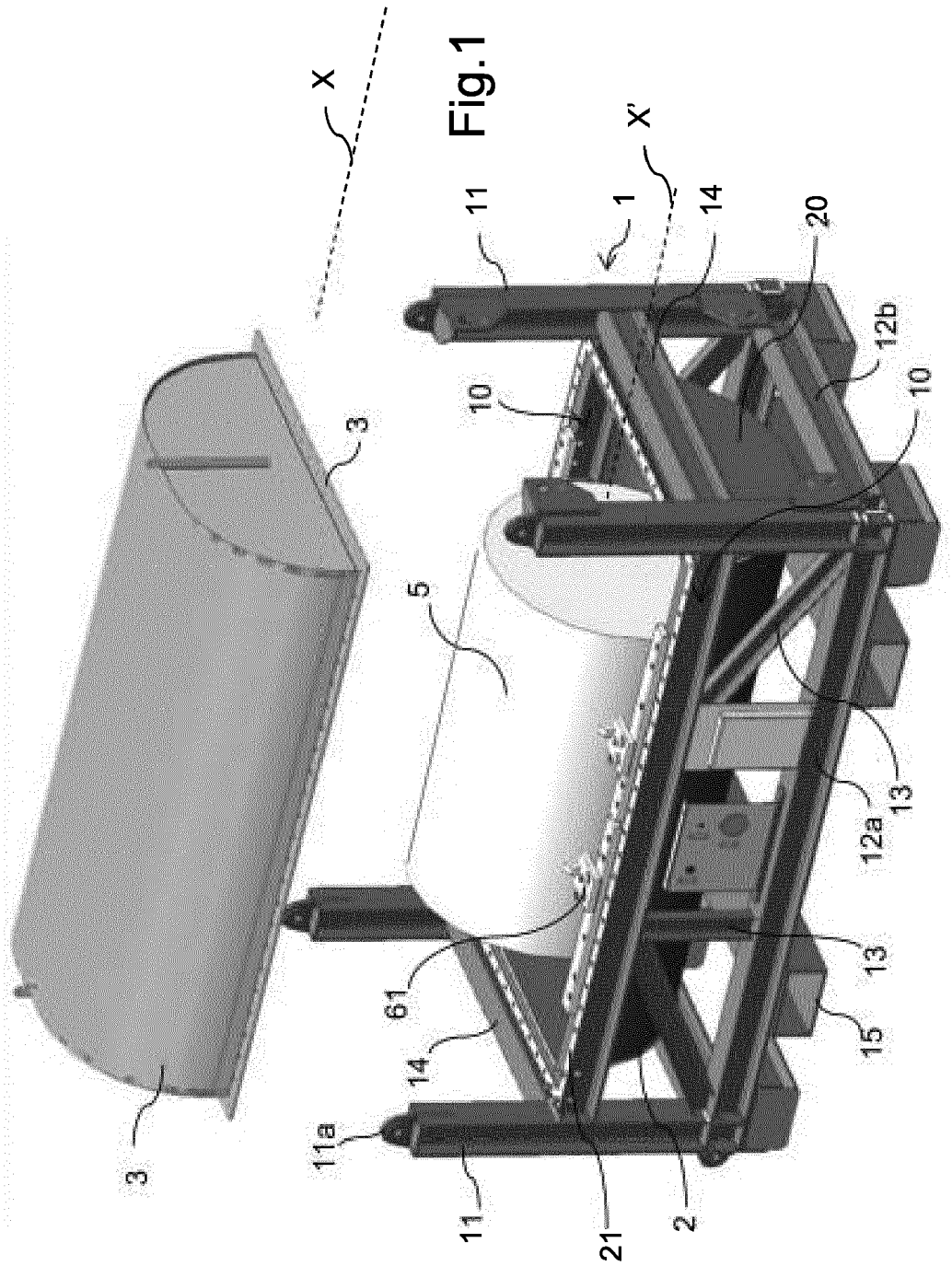


Fig.1

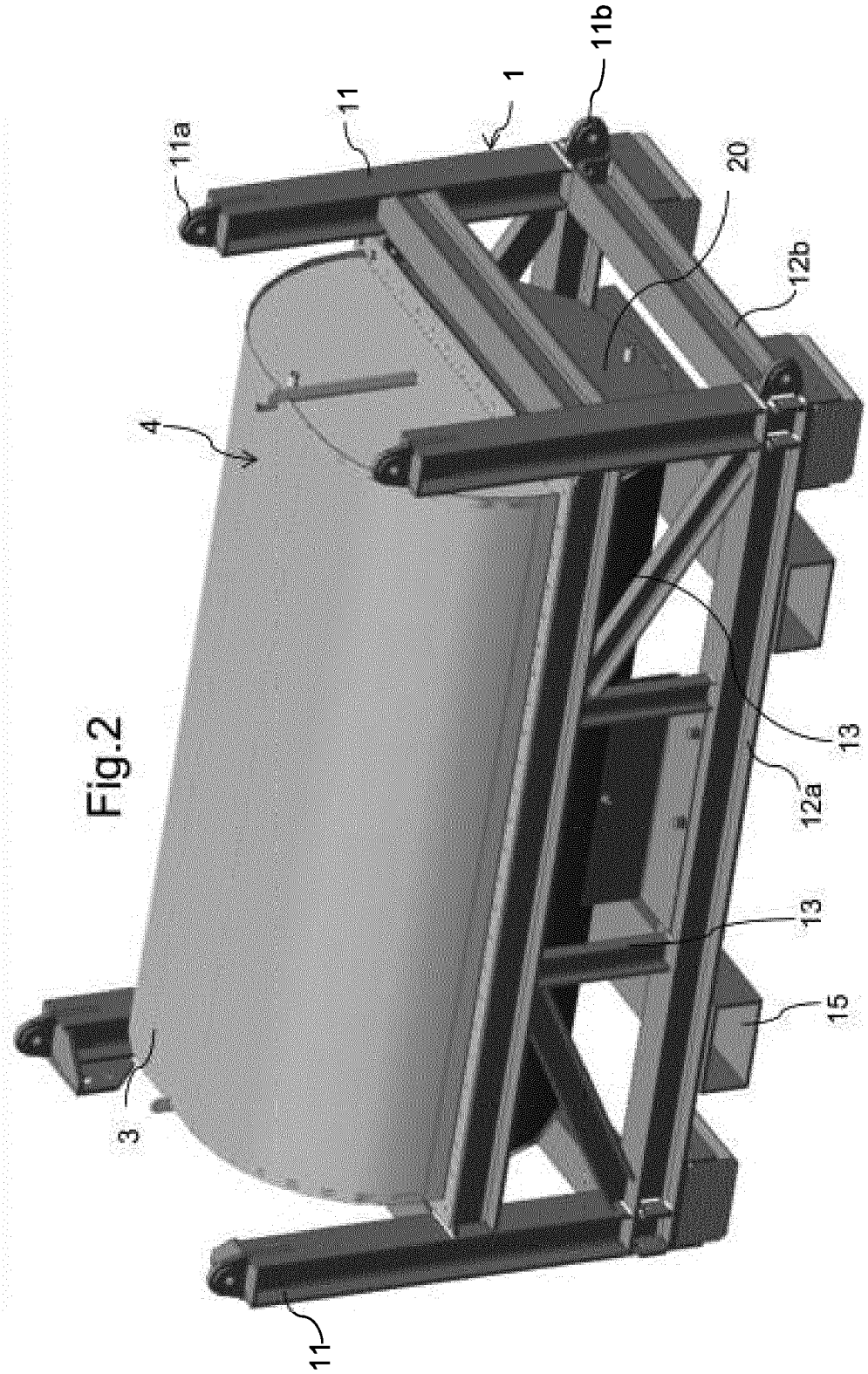


Fig.2

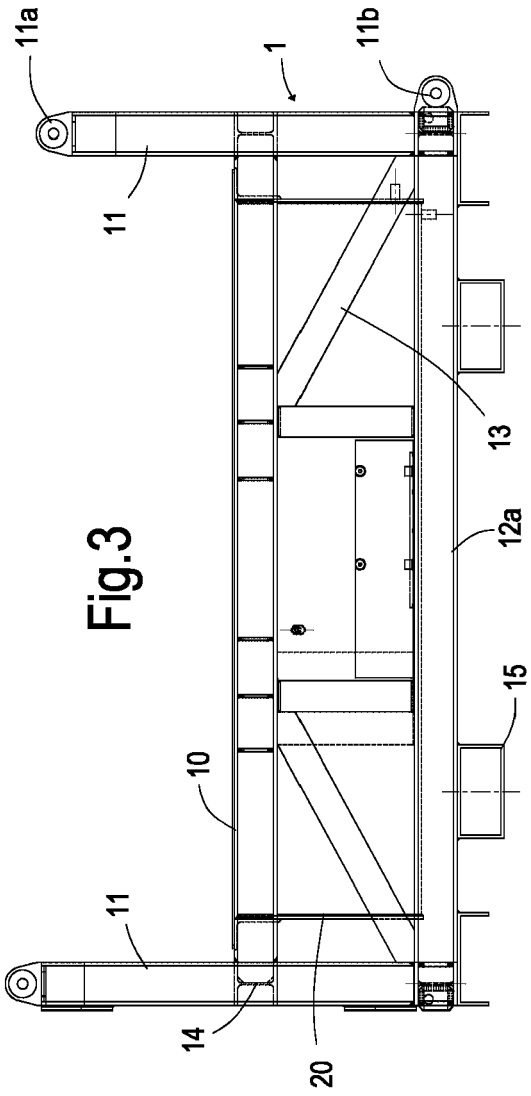


Fig.3

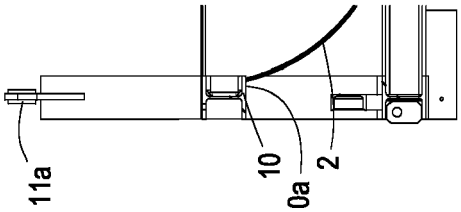


Fig.5

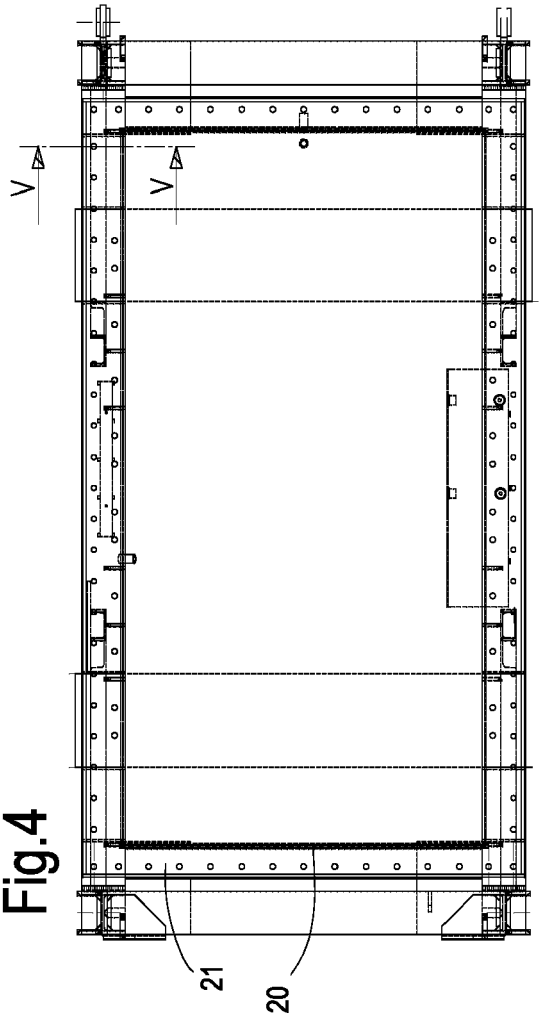


Fig.4

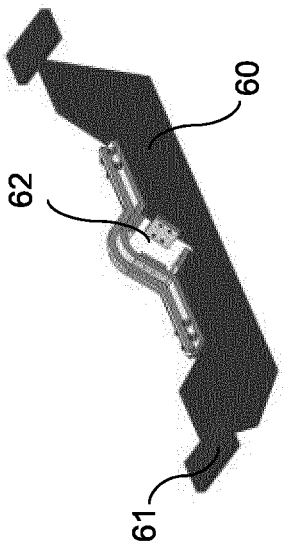
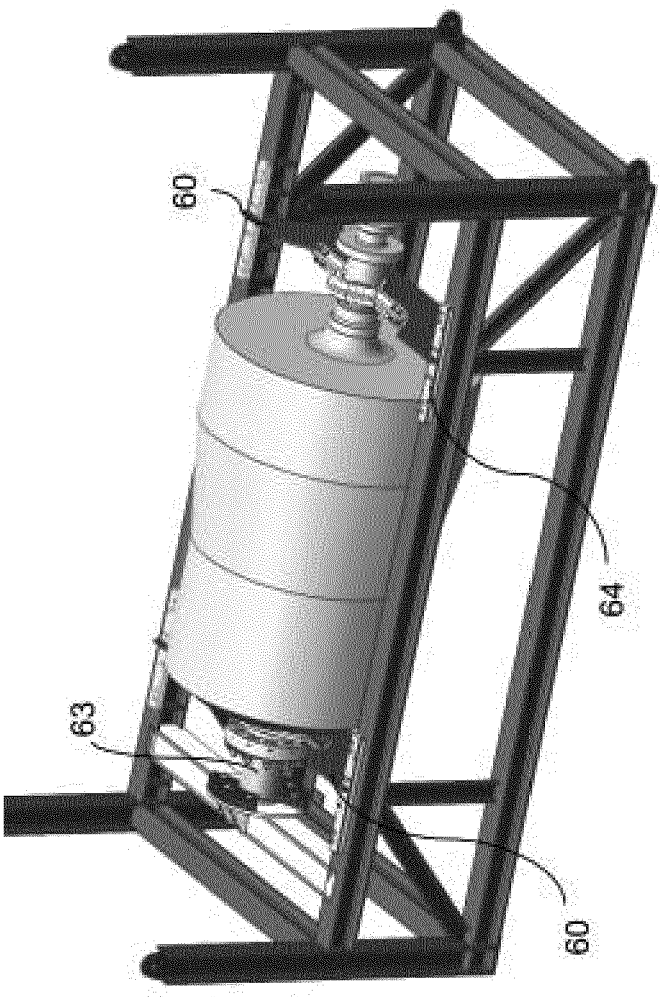


Fig.6a

Fig.6



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EUROPEAN SEARCH REPORT

Application Number
EP 15 20 0479

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	EP 1 586 515 A1 (SIEMENS AG [DE]) 19 October 2005 (2005-10-19) * paragraph [0014] - paragraph [0046]; figures 4,5 *	1-12	INV. B65D85/68 B65D88/12 B65D90/00 B65D90/08 B65D90/12 H02K15/00
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TECHNICAL FIELDS SEARCHED (IPC)

B65D
H02K

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	24 February 2016	Lämmel, Gunnar

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24-02-2016

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