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(72) Inventors:

- **Uyttebroeck, Bert**
2500 Lier (Koningshooikt) (BE)
- **Hendrickx, Jos**
2500 Lier (Koningshooikt) (BE)
- **Claassen, Rudolf**
2500 Lier (Koningshooikt) (BE)

(74) Representative: **Brantsandpatents bvba**
Pauline Van Pottelsberghelaan 24
9051 Ghent (BE)

which said shell at each head-end comprises an annular end frame doubler plate (23); and in which at each head-end said container posts are permanently connected to said end frame doubler plate by means of a bridge element (22) disposed between said container post and said end frame doubler plate and permanently connected to said container post and said end frame doubler plate, preferably by a weld.



Description

TECHNICAL FIELD

[0001] The present invention is related to a container, in particular a tank container for the storage and/or transport of gas, liquid and/or solid substance.

BACKGROUND

[0002] A tank container is an intermodal container for the transport of liquid and/or gas. A standard tank container has a manhole and at least one coupling. Loading and discharge take place by connecting hoses of the loading and discharge installation to connection couplings of the tank container. Subsequently, loading or discharge can take place. A connection coupling forms part of a closing device, also called discharge valve, which can interrupt the supply or discharge of liquids and/or gases if necessary. The connections are made via a composite closing device according to legal regulations.

[0003] Tank containers often also contain corner fittings (also known as corner castings) on the extremities of the front and rear frame, said corner fittings together being provided with lifting openings (lifting lugs) to allow the container to be lifted or stacked by means of a crane. Said corner fittings are standardised, tank containers thus usually being limited to gross weights of maximally 34 tons, with exceptions up to 38 or 40 tons.

[0004] EP 3 115 676 discloses tank containers with increased volume and load capacity. This relates to tank containers for which the gross weight of the tank container amounts to more than 40000 kg. By the use of a better material quality for the corner fittings of the container, it can be prevented that they suffer permanent deformation at such high loads, e.g. when lifted.

[0005] US 2010/320727 discloses an intermodal tank container of an improved design and with an improved usability of the tank container in intermodal environments.

[0006] NL 2 010 790, DE 11 2009 000182 and GB 2 339 592 describe related implementations of tank containers.

[0007] A problem with the known intermodal tank containers is that these are not strong enough to be stacked high. Nevertheless, for reasons of efficiency of storage or transport, it can be desirable to stack tank containers on top of each other in stacks of two, three or even four tank containers. Certain ISO standards, for example, require a stackability of up to nine loaded containers. Particularly for tank containers with increased volume and/or load capacity, such as have been disclosed in EP 3 115 676, this is an essential problem, in which a design according to EP 3 115 676 and US 2010/320727 allows only a too limited stackability. Tank containers according to NL 2 010 790, DE 11 2009 000182 and GB 2 339 592 are also insufficiently stackable.

[0008] Another problem with the prior art intermodal tank containers is that these can insufficiently withstand forces acting on them, for example forces in the longitudinal direction and/or the transversal direction of the tank container. Upon designing a tank container, it is therefore also important to ensure that the tank container is resistant to shocks and impacts on the tank container in the event of accidents, such as collisions upon transport on the road, by rail, in terminals or per ship. A good design expresses itself in successful resistance to testing programmes, for example crash tests, as carried out in professional testing environments. The frames and transfer beams as disclosed in US 2010 320727 and EP 3 115 676 must be improved in order to withstand such testing programmes, even if tank containers with increased volume and/or load capacity are concerned. Tank containers according to NL 2 010 790, DE 11 2009 000182 and GB 2 339 592 also require improvement in order to be able to withstand such testing programmes.

[0009] The present invention has an improved arrangement of a tank container as an object offering a solution for at least one of aforementioned disadvantages in the transport of gases and/or liquids, as described by claim 1.

SUMMARY

[0010] The present invention, in a first aspect, is related to a tank container for the storage and/or transport of gas and/or liquid, said tank container comprising a frame and an elongated and essentially cylindrical tank vessel comprising two head-ends and a shell; said frame comprising at each head-end a head-end frame comprising two top corner fittings, two bottom corner fittings and two upright container posts; in which said shell at each head-end comprises an annular end frame doubler plate; and in which at each head-end said container posts are permanently connected to said end frame doubler plate by means of a bridge element constructed between said container post and said end frame doubler plate and permanently connected to said container post and said end frame doubler plate, preferably by a weld.

[0011] The advantage of such a tank container is the increased stackability. This is due to the rigidity with regard to forces from above. Upon vertical stacking of tank containers according to the present invention, stacks can be formed of three, four, five or six loaded tank containers. For non-loaded tank containers, the stackability can be even greater. The improved stackability is mainly due to the stability of the post construction, the advantageous end frame doubler plate, and the materials used. The transmission takes place by the entirety of a reinforcement bridge. Said reinforcement bridge consists of the container post, the bridge element and the end frame doubler plate, all preferably consisting of metal, with more preference for steel.

[0012] In a preferred embodiment of the invention, said tank container comprises a reference volume defined by

said two top and bottom corner fittings of each head-end frame, said tank vessel extending along a longitudinal direction of said tank container beyond the reference volume. Such an embodiment relates to a tank container with a "cut through" tank or a "protruding" tank, a type of tank container that is advantageous for increased load volumes. It concerns in this regard a preferred embodiment wherein said end frame doubler plate, at at least one head-end and preferably at each head-end near the bridge element, extends distally along the longitudinal direction of the tank container over a distance of at least 50 mm beyond a centre of the bridge element, with more preference at least 175 mm, with still more preference at least 225 mm, with most preference approximately 275 mm. "Distally along the longitudinal direction" refers in this regard to an extending along the longitudinal direction in a direction away from the centre of the tank container. By allowing the end frame doubler plate to extend further and preferably in both directions along the longitudinal direction of the tank container, a more stable construction is obtained. This stands in contrast to the embodiments according to NL 2 010 790, DE 11 2009 000182 and GB 2 339 592, for which the tank vessel is fully disposed within said reference volume, and such a solution is therefore not meaningful. This is related to the different objective of NL 2 010 790, DE 11 2009 000182 and GB 2 339 592, which all focus on tank containers with tank vessels which are fully enclosed in the reference volume. This is not surprising, since the great majority of tank containers available on the market are expected to comply with the traditional restrictions imposed on the external dimensions, such as the generally known ISO specifications and UIC files for 20-foot or 40-foot tank containers. Since NL 2 010 790, DE 11 2009 000182 and GB 2 339 592 also exclusively describe tank containers with traditional restrictions on the external dimension, they offer no instruction to the person skilled in the art regarding a deviation from said traditional restrictions.

[0013] Further preferred forms are elaborated on in the part claims.

[0014] The explicit characteristics, advantages and objectives of the present invention will become further clear to the person skilled in the art in the technical field of the invention after reading the detailed description hereinafter of the embodiment of the invention and of the drawings enclosed herewith. The drawings serve to explain the invention further, without thereby limiting the scope of the invention.

DESCRIPTION OF THE DRAWINGS

[0015]

Figures 1a and 1b offer a perspective view from above of a preferred embodiment of a tank container according to the present invention.

Figure 2 shows a perspective view from below of an alternative embodiment of a tank container accord-

ing to the present invention.

Figure 3 shows an exploded perspective view of a preferred embodiment of a tank container according to the present invention.

Figures 4a and 4b show a perspective view of an exemplary embodiment of a frame according to the present invention.

Figures 5a and 5b show a perspective view and a side view of a preferred embodiment of a container post according to the present invention.

Figure 6 shows a perspective view of a preferred embodiment of a transfer beam according to the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[0016] In the following, the invention in its various embodiments is described in detail. In this regard, reference marks are used to refer to Fig. 1-6; this should only be considered as an example and should not be interpreted as limiting the scope of the invention.

[0017] In a first aspect, the invention relates to a tank container (1) for the storage and/or transport of gas and/or liquid, said tank container (1) comprising a frame (3) and an elongated and essentially cylindrical tank vessel (5) comprising two head-ends (13) and a shell (2); said frame (3) comprising at each head-end (13) a head-end frame (4) comprising two top corner fittings (7), two bottom corner fittings (7) and two upright container posts (21); said shell (2) comprising at each head-end (13) an annular end frame doubler plate (23); and said container posts (21) being permanently connected at each head-end (13) to said end frame doubler plate (23) by means of a bridge element (22) constructed between said container post (21) and said end frame doubler plate (23) and permanently connected to said container post (21) and said end frame doubler plate (23), preferably by a weld.

[0018] In a preferred embodiment, said tank container (1) comprises a reference volume defined by said two top and bottom corner fittings (7) of each head-end frame (4), in which said tank vessel (5) extends along a longitudinal direction of said tank container (1) beyond the reference volume. This offers the further advantages mentioned in the summary.

[0019] In another preferred embodiment, said tank vessel (5) extends according to said longitudinal direction of said tank container (1) beyond the reference volume over a distance (E1, E2) of at least 200 mm, preferably at least 400 mm, and this preferably at each head-end (13) of said tank container (1). In a related preferred embodiment, said shell (2) of the tank vessel (5) extends according to said longitudinal direction of said tank container (1) beyond the reference volume over a distance of at least 100 mm, preferably at least 120 mm, and this preferably at each head-end (13) of the tank container (1). In such a case of a "cut through" tank, the invention offers the advantageous measure of an end frame doubler

plate which extends sufficiently far distally beyond the bridge element, which leads to a more stable construction. Preferably, the end frame doubler plate extends along the longitudinal direction both distally and proximally over at least 50 mm beyond the centre of the bridge element (22), with more preference at least 175 mm, with still more preference at least 225 mm, with most preference approximately 275 mm, which further contributes to a more stable construction.

[0020] In a preferred form of the invention, said tank container (1) comprises a reference volume defined by said two top and bottom corner fittings (7) of each head-end frame (4); each of said two container posts comprising a medial post section (27), preferably a medial post surface (27), which is disposed outside the reference volume; and in which said container post (21) is connected to said bridge element (22) in the proximity of said medial post section (27). The advantage of such an embodiment is that the container posts (21) are in this way not limited in cross section by the reference volume, but can also have a larger cross section than in tank containers according to the prior art. Since part of the container posts (21) can extend outside the reference volume, it becomes possible to let the corner fittings (7) still push as much as possible above the middle of the container posts (21), even if the container posts have a relatively larger cross section.

[0021] According to a preferred embodiment, said bridge element (22) is elongated and has a U-shaped cross section. The advantage hereof is that the U-form allows a light and sturdy embodiment.

[0022] In a preferred form of the invention, said bridge element (22) comprises a bridge element surface (220) and said container post (21) comprises a medial post surface (27), said bridge element (22) and said container post (21) being connected by a connection of said bridge element surface (220) with said medial post surface (27), preferably by a weld. Such an embodiment has as an advantage that a very solid connection is possible between the container post (21) and the bridge element (22), so that the buckling away of said medial post surface (27) is avoided.

[0023] According to another preferred embodiment in which said medial post surface (27) and said bridge element surface (220) are mutually connected by a weld, said medial post surface (27) associated with the container post (21) comprises a plurality of recesses (270) for ensuring a durable weld, said recesses (270) preferably being implemented elongatedly along the longitudinal direction of the container post (21). This is advantageous because the openings can ensure a good weld. The shape and orientation is advantageous because it allows a greater opening to be provided per recess than for a round opening, and simultaneously compromising the structural strength of the container post (21) as little as possible, since the recesses exhibit only a small dimension crosswise to the longitudinal direction.

[0024] In a preferred embodiment, said medial post

surface (27) is connected to the top and bottom corner fitting (7) by means of distal post surfaces (28), an angle of β being defined between the medial post surface (27) and at least one of the two distal post surfaces (28), where β is not less than 2° and not more than 20° , preferably not less than 5° and not more than 10° . The design choice to set β greater than zero has as an advantage that the corner fittings (7) can push more in the middle of the container post (21), thus providing a better force distribution. Correspondingly, the corner fittings (7) are positioned as much as possible in the middle of the relatively larger medial cross bulkheads (25), whereby forces between the corner fittings and the medial cross bulkheads are better transmitted. This stands in contrast to a container post according to the prior art, which typically concerns a simple straight bar of which the cross section is not greater than that of the corner fittings. With such relatively narrower container posts, there is no need for an angle of β greater than zero. In this regard, the present invention with angle of β greater than zero therefore makes it possible to work with a thicker and thus sturdier container post, with a cross section greater than that of a corner fitting. This makes it possible for the corner fitting (7) to meet the restrictions on the dimensions as imposed by ISO-standards, while still working with a thicker and thus sturdier container post (21).

[0025] In another preferred embodiment of the present invention, each head-end frame (4) comprises a bottom cross beam (14) and a top cross beam (15) which are elongated and which permanently connect the two container posts (21), said container post (21) comprising, at at least one extremity in the proximity of said permanent connection, a distal cross bulkhead (26); an angle of α being defined between the distal cross bulkhead (26) and a longitudinal direction of said bottom cross beam (14) and/or top cross beam (15); where said angle α is not less than 40° and not more than 60° , preferably not less than 45° and not more than 55° . By choosing the angle to be slightly greater than 45° and approximately equal to 50° , however, the downward forces exerted via the container post become slightly more "constricted" and thereby lead to a greater extent in the direction of the corner fitting (7). This is advantageous, since the corner fitting concerns a very strong part with a high yield strength, capable of diverting a large part of the forces.

[0026] In a favoured preferred form of the invention, said tank container (1) comprises a manhole (10) and a loading/discharge connection (60). This has as an advantage that the tank container can be efficiently cleaned. In a further favoured preferred form, three or more manholes are provided, so that the tank container can be optimally cleaned. In a preferred form of the invention, one or more discharge valves are provided at an extremity or on the left-hand and/or righthand side of the tank container.

[0027] In another preferred embodiment, the maximum gross weight of the tank container is more than 40000 kg. In a more further preferred form of the inven-

tion, the gross weight of the tank container is more than 50000 kg. In a yet more further preferred form of the invention, the gross weight of the tank container is more than 60000 kg. In a yet more further preferred form of the invention, the gross weight of the tank container is more than 70000 kg. In a most further preferred form of the invention, the gross weight of the tank container is 75000 kg. This characteristic is particularly suitable for the storage and/or transport of heavy liquids, i.e. with a density between 0.4 and 2 kg/l, preferably between 1.0 and 1.7 kg/l, which can increase the weight of the load accordingly.

[0028] In a preferred form of the invention, said tank container (1) comprises at least four bottom and four top corner fittings (7), the corner fittings (7) being manufactured from a material having a yield strength of minimally 600 N/mm². An advantage hereof is the improved stackability of said tank container (1), in particular for tank containers with increased volume and/or load capacity, in which the corner fittings (7) can sufficiently resist to applied forces. A further advantage is the improved capability of the corner fittings and particularly the bottom corner fittings (7) to transmit forces to the transfer beam (30) near the contact between the corner fitting (7) and the beam (31).

[0029] In a preferred form of the invention, the distance between said head-end-saddle supports (19) and the associated head-end frames (4) is not less than 1600 mm and not greater than 2200 mm, said tank container (1) further comprising a central saddle support (18), and said head-end saddle supports and said central saddle support maintaining a free height of at least 10 mm, preferably 12 mm. In this regard, the central saddle support (18) is preferably provided approximately halfway the length of said tank container (1). This is advantageous because it makes optimal support of the container during storage and transport possible, particularly due to the central saddle support (18). When the container lies on a train wagon, said saddle supports do not normally come into contact with the upper side of the wagon, considering the at least 10 mm of free height. Upon mounting the container on a bearer, e.g. a trailer of a lorry, the saddle supports are brought into contact with the bearer.

[0030] In a preferred form of the invention, said tank container (1) is minimally 20 feet (6058 mm) long, preferably 26 feet (7820 mm), 30 feet (9144 mm), 40 feet (12192 mm), 45 feet (13716 mm), 50 feet (15240 mm) or more than 50 feet long; said tank container (1) is minimally 8 feet (2438 mm) or 8.4 feet (2550 mm) wide; and said tank container (1) is minimally 8 feet (2438 mm), 8.6 feet (2591 mm) or 9.5 feet (2895 mm) high.

[0031] In a preferred form of the invention, the volume of the tank container is minimally 24000 l, more preferably minimally 30000 l, still more preferably minimally 37500 l, still more preferably minimally 50000 l, still more preferably minimally 62000 l, still more preferably minimally 63000 l, still more preferably minimally 73500 l and most preferably minimally 95500 l.

[0032] In a preferred embodiment, the present invention provides a frame (3) and/or a tank vessel (5) in which one or more parts such as the container posts (21) and/or the bottom (14) and top (15) cross beams and/or the bridge element (22) and/or the end frame doubler plate (23) and/or the beams (31) and/or the gussets (32) and/or the corner fittings (7) comprise high-quality steel. With high-quality steel, steel qualities are meant with a yield strength between 355 N/mm² and 700 N/mm² or steels with a yield strength between 355 N/mm² and 1100 N/mm² that can resist large stresses without rupture or deformation. In other embodiments, said one or more parts of the frame (3) can comprise another material or a combination of other materials, such as stainless steel or duplex steels.

[0033] In a further aspect of the invention, which is not intended to limit the invention in any sense, the invention relates to a tank container (1) for the storage and/or transport of gas and/or liquid, said tank container (1) comprising a frame (3) and an elongated and essentially cylindrical tank vessel (5) comprising two head-ends (13), the frame (3), at each head-end (13), comprising an associated head-end frame (4) with at least two bottom corner fittings (7) and an associated head-end saddle support (19); in which regard, at each head-end (13), said head-end frame (4) and said head-end saddle support (19) are mutually connected by two associated transfer beams (30), each transfer beam (30) comprising a beam (31) which, near one of said bottom corner fittings (7), connects the head-end frame (4) to the associated head-end saddle support (19); said transfer beam (30) further comprising a gusset (32) which is permanently connected to said beam (31) and which, viewed away from the associated head-end frame (4), extends over a distance of A1 beyond the associated head-end saddle support (19), in which said distance A1 is at least 200 mm, preferably at least 400 mm. An advantage of a tank container (1) with such transfer beams (30) is that it resists better to forces acting along the longitudinal direction and/or the transversal direction of said tank container (1) than a tank container according to the prior art. Such a tank container (1) provides relatively better results in crash testing. This is due to the better design of the transfer beam, which is capable of distributing forces transmitted via the small surface of the bottom corner fittings (7) over an appreciable part of the shell (2) of said tank vessel (5). This transmission corresponds to a conversion, in which an appreciable force on the bottom corner fittings (7), corresponding to a large pressure, is transmitted via the transfer beam (30) to an appreciable force over various larger portions of the shell, corresponding to a smaller pressure. The portions concern both parts of the shell disposed in the proximity of the gusset (32) as parts which make contact with the head-end saddle support (19). The direction in which the gusset (32) extends is advantageous in distributing forces and/or shocks in particular, along the longitudinal direction of said tank container (1).

[0034] In a preferred embodiment of the present inven-

tion, said gusset (32) which is permanently connected to said beam (31) forms an acute angle of γ with said beam (31), where said angle γ is not less than 5° and not more than 35° , preferably not less than 10° and not more than 30° . Such a choice for γ differing from zero is adapted to realise the connection of the bottom cross beam (14) with the head-end saddle support (19) sufficiently close to the extremities of these structures as much as possible, which benefits the rigidity. For the bottom cross beam (14), this concerns the bottom corner fittings (7); for the head-end saddle support (19), this concerns the extremities of the saddle support bottom (190), which has an important reinforcing function as part of the head-end saddle support (19).

[0035] In a preferred embodiment, said gusset (32) also extends further, viewed towards the associated head-end frame (4), over a distance of A2 beyond the associated head-end saddle support (19), in which said distance A2 is at least 300 mm, preferably at least 500 mm. The advantage of such an embodiment is that the portion of the shell over which the transmitted forces can be distributed increases even further. This benefits the rigidity of said tank container (1) and leads to better results in crash testing. In addition, the direction in which the gusset (32) extends further is adapted for even better distributing, in particular, forces and/or shocks along the longitudinal direction of said tank container (1).

[0036] According to a preferred form of the invention, said tank container (1) comprises a longitudinal direction, said tank vessel (5) comprising a shell (2) extending around said tank vessel (5) according to said longitudinal direction, and both said beam (31) and said gusset (32) being clamped by the head-end saddle support (19), said head-end saddle support (19) being adapted in shape to be directly connected to both said beam (31) and said gusset (32), and in which the gusset (32) is directly connected to the shell (2). In a further preferred embodiment, said beam (31) and said gusset (32) are jointly clamped by the head-end saddle support (19) in the proximity of said permanent connection between the beam (31) and the gusset (32). Such clamping is advantageous since a better attachment of the transfer beam (30) to the head-end saddle support (19) is obtained than according to the prior art. If the clamping is done jointly, this is moreover efficient because simultaneously, with one clamping, movement in all directions is prevented. The attachment is such that it can accommodate both pushing and pulling forces, which allows forces to be transmitted in any direction. This makes it possible that the transfer beam (30) and the head-end saddle support (19) work together in transmitting forces between the head-end frames (4) and said tank vessel (5). Where the forces can already be transmitted per se by the transfer beam (30) via the gusset (32), said transmission can be appreciably improved because of the fact that the head-end saddle support (19) clamps around it. Moreover, the head-end saddle support (19) itself is also capable of transmitting part of the forces transmitted via the beam

(31) directly to said tank vessel (5). In addition, forces reaching the head-end saddle support (19) via a saddle support bottom (190) are not only transmitted via the saddle support arms (191) (if present), but also via the gussets (32), since this forms an integral part of the whole.

[0037] In a preferred embodiment, said shell (2) comprises a plurality of transverse rings (50) for the reinforcement of said shell (2), said transfer beam (30) being directly connected to at least two of said plurality of transverse rings (50), preferably three of said plurality of transverse rings (50), preferably by means of said gusset (32) which is directly connected to said at least two of said plurality of transverse rings (50). In a related preferred embodiment, said gusset (32) is directly connected to said at least two of said plurality of transverse rings (50), and comprises said shell (2), a transfer plate (38) directly connected to said gusset (32) and to at least three of said plurality of transverse rings (50), preferably at least four of said plurality of transverse rings (50). This is advantageous for the rigidity of said tank container (1): because of the fact that, by making contact not only with the wall parts of the shell (2) but also with the transverse rings (50), the shell (2) of said tank vessel (5) forms a solid entity. In this regard, both the transverse rings (50) and any transfer plates (38) and any doubler plates (39) can be regarded as reinforcement plate of the shell (2), in which more of the transverse rings (50) and any transfer plates (38) are moreover mutually connected. This ensures a rigidity unknown in the prior art, and which moreover optimally takes into account the contact points where forces are transmitted, especially near the head-end saddle support (19) and the transfer beam (30).

[0038] In another further aspect of the invention, which is not intended to limit the invention in any sense, the invention relates to the use of a tank container (1) according to the present invention for the storage and/or transport of gas, liquid and/or solid substance, in which said tank container (1) is placed on a chassis, wagon or container terminal.

[0039] In another further aspect of the invention, which is not intended to limit the invention in any sense, the invention relates to following embodiments.

[0040] In a preferred form of the invention, a slight inclination is provided on the tank container along the longitudinal direction, preferably an inclination of not less than 0.08° and not more than 0.1° , with most preference approximately 0.09° , which corresponds to a difference in height of the vessel of approximately 20 mm, measured on the circumferential weld of a 40-foot tank container, or more preferably an inclination of 0.3° , corresponding to 50-60 mm inclination along the whole length of a 45-foot tank container. This inclination in particular allows an improved drainage in embodiments in which a discharge valve is present on the lowest-lying extremity of the tank container, e.g. when the tank container is immovably mounted on a wagon.

[0041] In a preferred form of the invention, the tank container is insulatable and/or heatable.

[0042] In an alternative embodiment, the invention relates to, instead of a tank container, a box container for the storage and/or transport of solid substances, in which the gross weight of the box container amounts to more than 40000 kg. In a preferred form of the invention, the maximum gross weight of the box container is more than 50000 kg. In a yet more further preferred form of the invention, the gross weight of the box container is more than 60000 kg. In a yet more further preferred form of the invention, the gross weight of the box container is more than 70000 kg. In a most further preferred form of the invention, the gross weight of the box container is 75000 kg. This characteristic is particularly suitable for the storage and/or transport of much or heavy cargo, for example steel coils.

[0043] In a further aspect, the invention relates to a system for the storage and/or transport of gas, liquid and/or solid substances with a tank container or box container, characterised in that the tank container or box container is placed on a chassis, wagon or container terminal associated with said system.

[0044] According to a further preferred embodiment of the invention, the corner fittings (7) of the tank container are provided with lifting openings for the passage of a twistlock for attaching the tank container to a chassis or wagon (at the bottom) or container terminal (at the top), said lifting openings being suitable for allowing expansion of the material of said tank vessel (5) under influence of heat. When, for a 40-foot or 45-foot container, the temperature difference between the environment and the inside of the tank container is 100°C, it can be expected that a stainless steel container wall will expand by approximately 20-25 mm.

[0045] In a further aspect, the invention offers a use of the tank container according to the present invention the stacking of one or more tank containers, preferably at least three tank containers, with more preference at least four tank containers, with further preference at least five tank containers, on said tank container, the tank container being placed on a chassis, wagon or container terminal.

[0046] According to a further aspect, which is not intended to limit the invention in any way, the invention is related to following points 1-15.

1. Tank container (1) for the storage and/or transport of gas and/or liquid, said tank container (1) comprising a frame (3) and an elongated and essentially cylindrical tank vessel (5) comprising two head-ends (13) and a shell (2); said frame (3) comprising at each head-end (13) a head-end frame (4) comprising two top corner fittings (7), two bottom corner fittings (7) and two upright container posts (21); characterised in that said shell (2) at each head-end (13) comprises an annular end frame doubler plate (23); and that at each head-end (13) said container posts (21)

are permanently connected to said end frame doubler plate (23) by means of a bridge element (22) constructed between said container post (21) and said end frame doubler plate (23) and permanently connected to said container post (21) and said end frame doubler plate (23), preferably by a weld.

2. Tank container (1) according to preceding point 1, characterised in that said tank container (1) comprises a reference volume defined by said two top and bottom corner fittings (7) of each head-end frame (4); that each of said two container posts comprises a medial post section (27), preferably a medial post surface (27), which is disposed outside the reference volume; and that said container post (21) is connected to said bridge element (22) in the proximity of said medial post section (27).

3. Tank container (1) according to preceding points 1 and 2, characterised in that said bridge element (22) is elongated and has a U-shaped cross section.

4. Tank container (1) according to each of preceding points 1 to 3, characterised in that said bridge element (22) comprises a bridge element surface (220) and that said container post (21) comprises a medial post surface (27), and that said bridge element (22) and said container post (21) are connected by a connection of said bridge element surface (220) to said medial post surface (27), preferably by a weld.

5. Tank container (1) according to preceding point 4, characterised in that said medial post surface (27) and said bridge element surface (220) are mutually connected by a weld, and that said medial post surface (27) associated with the container post (21) comprises a plurality of recesses (270) for ensuring a durable weld, said recesses (270) preferably being implemented elongatedly along the longitudinal direction of the container post (21).

6. Tank container (1) according to each of preceding points 2 to 5, characterised in that said medial post surface (27) is connected to the top and bottom corner fitting (7) by means of distal post surfaces (28), in which an angle of β is defined between the medial post surface (27) and at least one of the two distal post surfaces (28), where β is not less than 2° and not more than 20°, preferably not less than 5° and not more than 10°.

7. Tank container (1) according to each of preceding points 1 to 6, characterised in that each head-end frame (4) comprises a bottom cross beam (14) and a top cross beam (15) which are elongated and which permanently connect the two container posts (21), said container post (21) comprising, at at least one extremity in the proximity of said permanent connec-

tion, a distal cross bulkhead (26); an angle of α being defined between the distal cross bulkhead (26) and a longitudinal direction of said bottom cross beam (14) and/or top cross beam (15); where said angle α is not less than 40° and not more than 60°, preferably not less than 45° and not more than 55°.

8. Tank container (1) according to each of preceding points 1 to 7, characterised in that said tank container (1) comprises a manhole (10) and a loading/discharge connection (60).

9. Tank container (1) according to each of preceding points 1 to 8, characterised in that the gross weight of the tank container amounts to more than 40000 kg, preferably more than 50000 kg, more than 60000 kg, more than 70000 kg or 75000 kg.

10. Tank container (1) according to each of preceding points 1 to 9, characterised in that said tank container (1) comprises at least four bottom and four top corner fittings (7), and that said corner fittings (7) are manufactured from a material having a yield strength of minimally 600 N/mm².

11. Tank container (1) according to each of preceding points 1 to 10, characterised in that the distance between said head-end saddle supports (19) and the associated head-end frames (4) is not less than 1600 mm and is not greater than 2200 mm; that said tank container (1) further comprising a central saddle support (18); and that said head-end saddle supports and said central saddle support maintaining a free height of at least 10 mm, preferably 12 mm.

12. Tank container (1) according to each of preceding points 1 to 11, characterised in that said tank container (1) is minimally 20 feet (6058 mm) long, preferably 26 feet (7820 mm), 30 feet (9144 mm), 40 feet (12192 mm), 45 feet (13716 mm), 50 feet (15240 mm) or more than 50 feet long; that said tank container (1) is minimally 8 feet (2438 mm) or 8.4 feet (2550 mm) wide; and that said tank container (1) is minimally 8 feet (2438 mm), 8.6 feet (2591 mm) or 9.5 feet (2895 mm) high.

13. Tank container (1) according to each of preceding points 1 to 12, characterised in that the weight of the filled tank container (1) is minimally 50 tons, preferably minimally 60 tons, minimally 70 tons or minimally 75 tons.

14. Tank container (1) according to each of preceding points 1 to 13, characterised in that the container posts (21) and/or the bottom (14) and top (15) cross beams and/or the bridge element (22) and/or the end frame doubler plate (23) and/or the corner fittings (7) comprise high-quality steel.

15. Use of a tank container (1) according to each of preceding points 1 to 14 for stacking one or more other tank containers, preferably at least three tank containers, on said tank container (1), in which said tank container (1) is placed on a chassis, wagon or container terminal.

EXAMPLE

[0047] The invention is further explained hereinafter on the basis of the following example, without, for that matter, being limited hereto, herewith referring to Figures 1-6.

[0048] The tank container 1 is provided with an elongated tank vessel 5 comprising a essentially cylindrical shell 2 which extends along a longitudinal direction of the tank container around the tank vessel 5. The tank container comprises at each corner a corner fitting 7, with a total of four bottom and four top corner fittings 7. In agreement with its intended use, the tank container 1 has a base surface defined by the four bottom corner fittings 7 and parallel to the longitudinal direction, and further also a height direction which is perpendicular to said base surface, and crosswise to the longitudinal direction. The base surface is defined purely geometrically and is not intended to coincide with any physical surface. A direction pointing to the middle of the tank container is inward, a direction pointing away from said middle is outward.

[0049] Said tank container 1 further comprises a frame 3, which comprises two head-end frames 4 at the two head-ends 13 of said tank container 1. In this regard, the distance between the extremity of said tank vessel 5 and the head-end frame 4 can vary in various embodiments, as is clearly apparent from the differences between Fig. 1a and 1b with a relatively smaller distance on the one hand, and Fig. 2 with a greater distance on the other hand. Said frame 3 carries the tank vessel 5. Said tank vessel 5 is composed of various mutually welded parts. In this way, the shell 2 of said tank vessel 5 comprises a plurality of transverse rings 50 and also two end frame doubler plates 23. Said transverse rings 50 and said end frame doubler plates 23 extend in this regard on all sides around said shell 2 along a transversal direction crosswise to the longitudinal direction of said tank container 1. Said tank container 1 is further provided with an entirety of a loading/discharge connection 60 comprising one or more discharging connections and cocks for loading and discharging a content of said tank container 1, mainly provided at an upper side of said tank container 1. In the embodiment according to Figure 1a, on the upper side of said tank container 1, a manhole 10 is provided in the shell. Further, said frame 3, at each frame head-end 4, is provided with a bar system 11 comprising a plurality of bars.

[0050] The frame 3 carries the tank vessel 2. To this end, said frame 3 comprises at a bottom side two head-end saddle supports 19 and a central saddle support 18 which are connected to said shell 2 of said tank vessel

5 and extend over said shell 2 along the transversal direction, and together with the head-end frames 4 carry said tank vessel 2. Said head-end frames 4 each comprise a bottom and top cross beam 14, 15 according to a direction crosswise to both the longitudinal direction as the height direction, and parallel to the base surface. The bottom and top cross beam 14, 15 are mutually connected by two upright container posts 21. The container posts 21 are upright with respect to the base surface. Each head-end frame 4 comprises said two top and two bottom corner fittings (corner castings) 7 which are provided near the connection between the container posts 21 and the bottom 14 and top 15 cross beam.

[0051] Said tank container 1 comprises a reference volume defined by said two top and bottom corner fittings 7 of each head-end frame 4. Said tank vessel 5 extends along a longitudinal direction of said tank container 1 beyond the reference volume over a distance E1 at one head-end and over a distance E2 at the other head-end. Preferably, the distances E1 and E2 are substantially equal, but these can also be equal. In the preferred embodiments according to Fig. 1a-1b on the one hand, and Fig. 2 on the other hand, the head-ends exhibit a flattening, whereby the distances E1 and E2 essentially relate to a distance between the surface defined by the four corner fittings of the related head-end and the essentially parallel geometrical surface of the flattening, as illustrated. In an alternative embodiment, a head-end has, or both head-ends have, another form, such as a convex form. In such a case, the distances E1 and E2 describe the distance between the surface defined by the four corner fittings of the related head-end and those portions of said tank vessel 5 which are furthest removed from the middle of the tank vessel 5. In a preferred embodiment, the distance E1 and/or the distance E2, preferably both distances, is/are at least 200 mm, preferably at least 400 mm. Related hereto is that, at each head-end 13, a distance can also be defined between the plane defined by the four corner fittings of the related head-end and those portions of said shell 2 of said tank vessel 5 that are furthest removed from the centre of said tank vessel 5. In a preferred embodiment, this distance, preferably for both head-ends, is at least 100 mm, preferably at least 120 mm. In this way, an improved transmission of forces is realised near each head-end 13 of said tank container 1. In the first place, this leads to a better stackability for said tank container 1, but also to a better resistance with respect to crash testing and collisions. During transport and storage, and in particular when stacking loaded tank containers on top of each other, said tank container 1 is subject to large forces connected to the very high permitted load of the tank containers. Since, upon stacking, connection is made near said head-end frames 4, these are designed such that they can accommodate large forces without significantly deformation. On the one hand, this is realised by measures which increase the rigidity and which only relate to the head-end frame 4, while on the other hand this is realised by a plurality of transmis-

sion mechanisms, which allow the forces exerted on said head-end frames 4 to be transmitted to other parts of said tank container 1.

[0052] A first measure with regard to the head-end frame is the U-shaped cross section of the container posts 21 and the bottom and 14 and top 15 cross beams. A U-shaped cross section, after all, ensures a greater strength with respect to both transversal and longitudinal forces. Further, a U-shaped cross section also enables the connection, preferably a weld connection, between the container posts 21 and the bottom and 14 and top 15 cross beams to extend over a greater length than the case would be if the cross section were flat, which allows a sturdier connection.

[0053] A further measure to increase the rigidity concerns a plurality of medial cross bulkheads 25 and distal cross bulkheads 26. In this regard, each medial cross bulkhead 25 extends over the U-shaped cross section of the container post 21 near a middlemost portion of said container post 21. In this regard, the medial cross bulkhead 25 on the side, viewed away from the U-shaped cross section, is provided with a concavely curved outer edge 250. In that regard, the concave curvature such as chosen to transmit forces optimally between the various surfaces connected by the medial cross bulkhead 25. Each distal cross bulkhead 26 extends over the U-shaped cross section of the container posts 21 as final piece on an extremity of the container post 21. In this regard, a side touches an innermost extremity of the bottom corner fitting 7. In this regard, there is an angle of α (alpha) between the bottom cross beam 14 and the distal cross bulkhead 26. In a preferred embodiment, α is not less than 40° and not more than 60° , with more preference not less than 45° and not more than 55° , with most preference approximately 50° . In this regard, a choice for α in the proximity of 45° is advantageous because this distributes the forces between the container post 21, the bottom cross beam 14 and the bottom corner fitting 7 evenly. By choosing the angle to be slightly greater than 45° and approximately equal to 50° , however, the downward forces exerted via the container post become slightly more "constricted" and thereby guided to a greater extent in the direction of the corner fitting 7. This is advantageous, since the corner fitting concerns a very strong part with a high yield strength, capable of diverting a large part of the forces.

[0054] Another measure for the reinforcement of the head-end frame 4 concerns the rear side of the container post 21, viewed away from the tank vessel 5. Said rear side comprises a medial post surface 27 and two distal post surfaces 28. In this regard, there is an angle of β (beta) between the medial post surface 27 and each of the two distal post surfaces 28. Said angle is preferably not less than 2° and not more than 20° , with more preference not less than 5° and not more than 10° , with most preference approximately 7.5° . The design choice to set β greater than zero has as an advantage that said corner fittings 7 can push more in the middle of said container

post 21, thus providing a better force distribution. Correspondingly, said corner fittings 7 are positioned as much as possible in the middle of the relatively larger medial cross bulkheads 25, whereby forces between the corner fittings and the medial cross bulkheads are better transmitted. In this regard, it is further remarked that the choice of the angle β is related to the ratio of the height H2 with respect to the total height H1. In this regard, the height H2 is the shortest distance between the medial cross bulkhead 25 and the distal end surface of the bottom corner fittings 7, and thus also the distance over which the rear side of said container post 21 describes an angle of β . Further, H1 concerns the reference height of said tank container 1, i.e. the distance between the distal end surfaces of the bottom corner fittings and the distal end surfaces of top corner fittings 7. In a preferred embodiment, the reference height H1 is not less than 2500 mm and not greater than 3000 mm, with more preference not less than 2600 mm and not greater than 2800 mm, with most preference approximately 2700 mm. In a preferred embodiment, the height H2 is not less than 400 mm and not more than 750 mm, with more preference not less than 500 mm and not more than 650 mm, with most preference not less than 550 mm and not more than 600 mm, with utmost preference approximately 575 mm. Correspondingly, the ratio between H2 and H1 is preferably not less than 0.13 and not more than 0.3, with more preference not less than 0.17 and not more than 0.25, with most preference approximately 0.21.

[0055] As mentioned elsewhere in this document, forces are further also accommodated by transmitting them via various transmission mechanisms. In this regard, part of the forces exerted on said head-end frames 4 are transmitted to other parts of the tank container (and vice versa), which in this way fulfil a supporting role. A first such mechanism concerns a reinforcement bridge 20 near each container post 21 for the transmission of forces to said tank vessel 2. In addition, a transfer beam 30 near each bottom corner fitting 7 provides for a transmission of forces to the head-end saddle support 19 and said tank vessel 2.

[0056] The first mechanism concerns the reinforcement bridge 20. Each reinforcement bridge 20, two per head-end frame 4, comprises a container post 21, a bridge element 22 and an end frame doubler plate 23, all preferably consisting of metal, with more preference for steel. In this regard, said container post 21 and said bridge element 22 are part of the head-end frame 4 and the end frame doubler plate 23 is part of said shell 2. Said end frame doubler plate 23 lies around on all sides according to said shell 2 of said tank vessel 5 near said head-end 13. The distance from the end frame doubler plate 23 to the extremity of said tank vessel 5 is such that the head-end frame 4 can enclose said end frame doubler plate 23, and is thus connected with the distance between the extremity of said tank vessel 5 and the head-end frame 4. The latter distance is dependent upon the embodiment, as is clearly apparent from the differences be-

tween Fig. 1a and 1b with a relatively smaller distance on the one hand, and Fig. 2 with a relatively larger distance on the other hand.

[0057] The end frame doubler plate 23 is essentially ring-shaped and comprises two cross-beam-related sections 231 which are mutually diametrically disposed and which as part of said tank container 1 point to the top 15 and bottom cross beam 14. In addition, the end frame doubler plate 23 also comprises two container post related sections 232 which are mutually diametrically disposed and as part of said tank container 1 point to the container posts 21 and are mutually connected by said two cross-beam-related sections 231. Said two cross-beam-related sections 231 are characterised by a substantially uniform dimension L1 over the circumference along the longitudinal direction of said tank container 1. The dimension L1 is preferably not less than 100 mm and not more than 500 mm, with more preference not less than 200 mm and not more than 400 mm, with most preference approximately 300 mm. Said two container post related sections 232 can have a substantially uniform dimension over the circumference according to a direction parallel to the longitudinal direction of said tank container 1, which moreover can be equal to said dimension L1. In a preferred embodiment, said two container post related sections 232 are nonetheless characterised by a dimension according to the same direction wherefrom the transition with the cross-beam-related section 231 on both extremities passes from a value L1 to a greater value near middlemost portions of the container post related sections, with a maximum equal to L2. The dimension L2 is preferably not less than 350 mm and not more than 750 mm, with more preference not less than 450 mm and not more than 650 mm, with most preference approximately 550 mm. The essentially annular end frame doubler plate 23 is characterised by a diameter preferably concerning not less than 2000 mm and preferably concerning not more than 2920 mm, with more preference concerning not less than 2230 mm and not more than 2690 mm, with most preference approximately 2460 mm.

[0058] Said end frame doubler plate 23 extends distally at both head-ends near said bridge element 22 along the longitudinal direction of said tank container 1 over a distance of at least 50 mm beyond the centre of said bridge element 22. Said distance is preferably at least 175 mm, with even more preference at least 225 mm, with most preference approximately 275. This is in agreement with the aforementioned dimension of L2, which is preferably not less than 350 mm, with more preference not less than 450 mm, and with most preference approximately 550 mm. Since the centre of the bridge element is preferably situated approximately half way the width of the end frame doubler plate, so that forces can be distributed in both directions, this preferably corresponds to half of the dimension of approximately 550 mm, i.e. approximately 275 mm. On each of the container post related sections 232 of the end frame doubler plate 23, an elongated

bridge element 22 is disposed, preferably welded, extending over the end frame doubler plate 23 according to a bridge element longitudinal direction crosswise to the longitudinal direction of said tank container 1. In a preferred embodiment, the bridge element is attached to the end frame doubler plate 23 by a weld. Said bridge element 22 has a U-shaped cross section according to a surface crosswise to the bridge element longitudinal direction, the open side of the U-shaped cross section pointing toward said shell 2 of the tank vessel 5. In this regard, the edges of said bridge element 22 in the proximity of said open side are concavely curved to ensure a good connection with the essentially annular end frame doubler plate 23. Said bridge element 22 comprises a bridge element surface 220 pointing away from said shell 2 of said tank container 1 which is adapted in shape to connect, with maximal mutual grip, to the medial post surface 27 of said container post 21. In a preferred embodiment as illustrated in Fig. 1 to 5, the bridge element surface 220 and the medial post surface 27 are both essentially flat, but they can also exhibit angles or slopes as a function of the mutual grip and/or the nature of the weld.

[0059] The medial post surface 27 is provided with a plurality of recesses 270 which are elongatedly implemented along the longitudinal direction of said container post 21 and are arranged mutually spaced according to two parallel rows. This combination of shape, direction and arrangement is advantageous because it allows a greater opening to be provided per recess than for a round opening, while simultaneously compromising the structural strength of said container post 21 as little as possible, since the recesses exhibit only a small dimension crosswise to the longitudinal direction. By their large opening and appreciable number, said recesses 270 are adapted to realise a durable weld with maximal attachment between the bridge element surface 220 and the medial post surface 27. This makes a very sturdy attachment between said container post 21 and said bridge element 22 possible. Said attachment, together with the attachment between said bridge element 22 and the end frame doubler plate 23, together realise the function of the reinforcement bridge 20, with a solid transmission of forces from said head-end frames 4 to said shell 2 of the tank vessel 5. An additional advantage of the reinforcement bridge 20 is that this transmits a load near a small portion of the medial post surface 27 to a much greater portion of said shell 2 of the tank vessel 5, especially the portions of said shell 2 which are in contact with said end frame doubler plate 23. By this "conversion", an appreciable force over said small portion of said medial post surface 27, corresponding to a large pressure, is transmitted to an appreciable force over said great portion of said shell 2, corresponding to a smaller pressure. This is advantageous since it prevents the surface of said shell 2 becoming deformed or damaged by the transmission of forces. In particular, the dimensions L1 and L2 of said end frame doubler plate 23 are chosen sufficiently large,

so that as low a pressure as possible is exerted on portions of said shell 2. In general, it is useful to provide said end frame doubler plate 23 between said shell 2 and said bridge element 22 so that forces transmitted via said bridge element 22 are sufficiently distributed over said shell 2, therewith avoiding the possibility of said bridge element causing a compression of said shell 2. In an alternative embodiment (not illustrated in the drawings), there is nonetheless no end frame doubler plate 23, the reinforcement bridge 20 consisting only of said container post 21 and said bridge element 22. In such an alternative embodiment, said bridge element 22 would be directly welded on other parts of said shell 2, such as on a transverse ring 50.

[0060] A further mechanism to transmit forces exerted on said head-end frames 4 to other parts of the tank container (and vice versa), concerns the transfer beam 30 near each bottom corner fitting 7 for the transmission of forces to said head-end saddle support 19 and said tank vessel 2 (and vice versa). Each transfer beam 30 comprises a beam 31, a gusset 32, a transfer beam heel 33, a transfer beam support 34, a transfer plate 38 and a doubler plate 38, all preferably manufactured from metal, with more preference from steel, with most preference high-quality steel. In this regard, said beam 31, said gusset 32, said transfer beam heel 33 and the transfer beam support 34 are part of the frame 3, while said transfer plate 38 and said doubler plate 38 are part of said shell 2 of said tank vessel 5.

[0061] Each transfer beam 30 connects the head-end frame 4 near a bottom corner fitting 7 with a supporting entity attached to said tank vessel 2. To this end, each head-end frame 4 comprises a pair of beams 31, each comprising a first and second extremity. Each of said beams 31 extends inwardly from the first extremity with respect to both the longitudinal direction and the transversal direction of said tank container 1. In this regard, the connection of the first extremity with the head-end frame 4 is supported by a reinforcing transfer beam support 34. Said transfer beam support 34 is, in this regard, adapted to the fact that said beam 31 and the bottom cross beam 14 mutually form an acute angle γ . To obviate the forces associated herewith, said transfer beam support 34 comprises an edge extending over said acute angle and exhibiting an adapted concave curvature. Said beams 31 are attached to the second extremity near said head-end saddle supports 19. Said head-end saddle supports 19 transmit forces to other parts of said tank vessel 5. To this end, each of said head-end saddle supports 19 is attached to a doubler plate 39 which is part of, and extends according to, said shell 2 of said tank vessel 5 according to a direction crosswise to the longitudinal direction of said tank container 1. Said doubler plate 39 thus provides support in a direction crosswise to the longitudinal direction. By providing said doubler plate 39, forces transmitted via said beam 31 and said head-end saddle support 19 are sufficiently distributed over said shell 2, and possible compression of said shell

2 by said head-end saddle support 19 is avoided. Related hereto, a central-saddle support-arch 58 is also provided near the central saddle support 18 which extends along said shell 2 of said tank vessel 5 according to a direction crosswise to the longitudinal direction of said tank container 1. Said central-saddle support-arch 39 also ensures that forces transmitted via the central saddle support 18 are sufficiently distributed over said shell 2. Otherwise than with said doubler plate 39, said central-saddle support-arch 58 should not accommodate forces transmitted by a transfer beam, whereby these can be implemented smaller than said doubler plate 39.

[0062] In a tank container according to the prior art, said beams are only brought into contact with the shell of the tank vessel via the head-end saddle supports. For a tank container 1 according to the present invention, this is not the case. Said beams 19, after all, not only make contact with said head-end saddle supports 19 but also with the aid of transfer beam feet 32 which are not part of the head-end saddle supports. In this regard, said transfer beam 30 extends over an appreciable distance along the longitudinal direction, exceeding the distance between said head-end saddle support 19 and the head-end frame 4 to a considerable extent. In this regard, said gusset 32 and said beam 31 are mutually permanently attached, and the entirety of beam 31 and gusset 32 is clamped by said head-end saddle support 19 near the connection between beam 31 and gusset 32. In this regard, said gusset 32 is directly connected to the shell 2, allowing optimal transmission of forces between the shell and the tank vessel. Said clamping 37 pushes on said beam 31 as well as on said gusset 32, whereby a better clamping is obtained than according to the prior art. In order to make said clamping 37 possible, said head-end saddle support 19 is adapted in shape and material to receive and clamp beam 31 and gusset 32 in their entirety, said head-end saddle support 19 differing at least in this respect from a head-end saddle support according to the prior art.

[0063] Similar and complementary to said doubler plate 39, a transfer plate 38 is also provided which is part of said shell 2, and which is adapted to sufficiently distribute forces transmitted via said gusset 32 over said shell 2, avoiding therewith that said gusset 32 causes a compression of said shell 2. Different from said doubler plate 39 is nonetheless that said transfer plate 38 extends according to said shell 2 of said tank vessel 5 along the longitudinal direction of said tank container 1. Said gusset 32 and said transfer plate 38 thus jointly ensure support in the longitudinal direction. In this regard, said transfer beam 30 therefore extends further in the longitudinal direction than in the case of a transfer beam according to the prior art. After all, said gusset 32 extends over a distance of A1 beyond the inwardly pointing saddle support-transversal wall 192, said transfer plate 38 extending even further. In this regard, the inwardly pointing saddle support-transversal wall 192 is the wall of said head-end saddle support 19 crosswise to the longitudinal direction

and inwardly directed with respect to the longitudinal direction. In other words, said gusset 32 extends pointing away from the associated head-end frame 4 over a distance of A1 beyond the associated head-end saddle support 19. In a preferred embodiment, the distance A1 is not less than 200 mm and not more than 2000 mm, with more preference not less than 400mm, with still more preference not less than 600 mm, with most preference approximately 800 mm.

[0064] As is clear from Fig. 1-3, said gusset 32 makes contact with three various transverse rings 50 and said transfer plate 38 makes contact with four various transverse rings 50, said transverse ring 50 near said head-end saddle support 19 being included in each case. Since contact is not only made with the wall parts of said shell 2 but also with said transverse rings 50, said shell 2 of said tank vessel 5 forms a solid entity. In this regard, both said transverse rings 50 and said transfer plates 38 and doubler plates 39 can be regarded as reinforcement plate of said shell 2, in which more of said transverse rings 50 and the transfer plates 38 are moreover mutually connected. This ensures a rigidity unknown in the prior art, and which moreover optimally takes into account the contact points where forces are transmitted, especially near said transfer plates 38 and doubler plates 39. In order to facilitate such contact optimally, said gussets 32 extend along the longitudinal direction over an appreciable distance. In an inward sense, they extend over a distance of A1 (see above), in an outward sense they extend over a distance of A2. In other words, said gusset 32 extends pointing toward the associated head-end frame 4 over a distance of A2 beyond the associated head-end saddle support 19. In a preferred embodiment, the distance A2 is not less than 300 mm and not more than 2100 mm, with more preference not less than 500 mm, with still more preference not less than 700 mm, with most preference approximately 900 mm. In a preferred embodiment, the distance between the outwardly pointing saddle support-transversal wall 191 associated with said head-end saddle support 19 and the inwardly pointing cross-beam-transversal wall 140 associated with the cross beam 14 is between 1400 and 1500 mm. According to this preferred embodiment, said gusset 32 thus spans more than half this distance.

[0065] In transmitting forces between said head-end frames 4 and said tank vessel 5, said transfer beam 30 and said head-end saddle support 19 work together and fulfil a joint double role. Although the forces per se are already transmitted by said transfer beam 30 via said beam 31, said transmission can be appreciably improved by said head-end saddle support 19 clamping around it. In addition, said head-end saddle support 19 itself is also capable, via said doubler plate 39, of transmitting part of the forces transmitted via said beam 31 to said tank vessel 5. In addition to this, forces reaching said head-end saddle support 19 via a saddle support bottom 190 are not only transmitted via the saddle support arms 191, but also via said gussets 32. Said gussets, after all, extend

essentially over the whole distance between the saddle support bottom 190 and said tank vessel 5, thereby offering an appreciable reinforcement. In this regard, it is ensured that the forces coming via the saddle support bottom 190 are transmitted not only via the saddle support arms 191 according to a direction crosswise to the longitudinal direction, but also via said gussets 32 along the transversal direction. This leads to a better distribution of the forces over said transverse rings 50 and other parts of said shell 2 of said tank vessel 5.

[0066] Near the connection between said beam 31 and said gusset 32, for reinforcement purposes, a transfer beam heel 33 is provided which is permanently connected to both, preferably by a weld. Since said beam 31 and said gusset 32 are mutually at an acute angle of γ (gamma), said transfer beam heel 34 comprises an edge extending over said acute angle γ and exhibiting an adapted concave curvature 35 to obviate forces connected to said acute angle γ .

[0067] In a preferred embodiment in which said gusset 32 is implemented parallel to the longitudinal direction of said tank container 1, the contact edge 36 of the gusset is implemented essentially straight in order to ensure a good connection with the also essentially straight transfer plate 38. In such an embodiment, the angle γ is preferably not less than 5° and not more than 35° , with more preference not less than 10° and not more than 30° , with most preference approximately 20° . In an alternative embodiment, in which said gusset 32 is implemented non-parallel to the longitudinal direction of said tank container 1, the contact edge 36 and said transfer plate 38 can be implemented correspondingly non-straight fashion and the angle γ can also assume other values between 0° and 90° .

[0068] It is assumed that the present invention is not limited to the embodiments described above, and that some adaptations of, or changes to the described examples can be added without revaluation of the attached claims.

Claims

1. Tank container (1) for the storage and/or transport of gas and/or liquid, said tank container (1) comprising a frame (3) and an elongated and essentially cylindrical tank vessel (5) comprising two head-ends (13) and a shell (2); said frame (3) comprising at each head-end (13) a head-end frame (4) comprising two top corner fittings (7), two bottom corner fittings (7) and two upright container posts (21); **characterised in that** said shell (2) comprises, at each head-end (13), an annular end frame doubler plate (23); and that, at each head-end (13), said container posts (21) are permanently connected to said end frame doubler plate (23) by means of a bridge element (22) disposed between said container post (21) and said end frame doubler plate (23) and permanently con-

nected to said container post (21) and said end frame doubler plate (23), preferably by a weld.

2. Tank container according to claim 1, **characterised in that** said tank container (1) comprises a reference volume defined by said two top and bottom corner fittings (7) of each head-end frame (4); that said tank vessel (5) extends along a longitudinal direction of said tank container (1) beyond said reference volume; and that said end frame doubler plate (23), at at least one head-end (13) and preferably at each head-end (13) near said bridge element (22), extends distally along the longitudinal direction of said tank container (1) over a distance of at least 50 mm beyond a centre of said bridge element (22), with more preference at least 175 mm, with still more preference at least 225 mm, with most preference approximately 275 mm.
3. Tank container according to claim 2, **characterised in that** said tank vessel (5), according to said longitudinal direction of said tank container (1), extends beyond the reference volume over a distance of (E1, E2) of at least 200 mm, preferably at least 400 mm, and this preferably at each head-end (13) of said tank container (1).
4. Tank container according to claims 2 and 3, **characterised in that** said shell (2) of the tank vessel (5), according to said longitudinal direction of said tank container (1), extends beyond the reference volume over a distance of at least 100 mm, preferably at least 120 mm, and this preferably at each head-end (13) of said tank container (1).
5. Tank container (1) according to each of the previous claims 1 to 4, **characterised in that** said tank container (1) comprises a reference volume defined by said two top and bottom corner fittings (7) of each head-end frame (4); that each of each of said two container posts comprises a medial post section (27), preferably a medial post surface (27), which is situated outside the reference volume; and **in that** said container post (21) is connected to said bridge element (22) in the proximity of said medial post section (27).
6. Tank container (1) according to each of preceding claims 1 to 5, **characterised in that** said bridge element (22) is elongated and has a U-shaped cross section.
7. Tank container (1) according to each of previous claims 1 to 6, **characterised in that** said bridge element (22) comprises a bridge element surface (220) and that said container post (21) comprises a medial post surface (27), and that said bridge element (22) and said container post (21) are connected

- by a connection of said bridge element surface (220) with said medial post surface (27), preferably by a weld; in which preferably said medial post surface (27) and said bridge element surface (220) are mutually connected by a weld; and in which preferably said medial post surface (27) associated with the container post (21) comprises a plurality of recesses (270) for ensuring a durable weld, said recesses (270) preferably being implemented elongatedly along the longitudinal direction of the container post (21).
8. Tank container (1) according to each of preceding claims 5 to 7, **characterised in that** said medial post surface (27) is connected to the top and bottom corner fitting (7) by means of distal post surfaces (28), an angle of β being defined between the medial post surface (27) and at least one of the two distal post surfaces (28), wherein β is not less than 2° and not more than 20° , preferably not less than 5° and not more than 10° .
 9. Tank container (1) according to each of preceding claims 1 to 8, **characterised in that** each head-end frame (4) comprises a bottom cross beam (14) and a top cross beam (15) which are elongated and which permanently connect the two container posts (21), said container post (21) comprising, at at least one end in the proximity of said permanent connection, a distal cross bulkhead (26); an angle of α being defined between the distal cross bulkhead (26) and a longitudinal direction of said bottom cross beam (14) and/or top cross beam (15); where said angle α is not less than 40° and not more than 60° , preferably not less than 45° and not more than 55° .
 10. Tank container (1) according to each of previous claims 1 to 9, **characterised in that** said tank container (1) comprises at least one manhole and/or a loading/discharge connection (60), preferably a manhole (10) and a loading/discharge connection (60); in which said loading/discharge connection (6) is preferably top discharge or bottom discharge.
 11. Tank container (1) according to each of preceding claims 1 to 10, **characterised in that** the gross weight of the tank container is more than 40000 kg, preferably more than 50000 kg, with preference more than 60000 kg, with more preference more than 70000 kg, with most preference more than 75000 kg.
 12. Tank container (1) according to each of preceding claims 1 to 11, **characterised in that** said tank container (1) comprises at least four bottom and four top corner fittings (7), and that said corner fittings (7) are manufactured from a material having an yield strength of minimally 600 N/mm².
 13. Tank container (1) according to each of preceding claims 1 to 12, **characterised in that** the distance between said head-end saddle supports (19) and the associated head-end frames (4) is between 0 and 6096 mm, preferably not less than 1500 mm and not greater than 2200 mm, with more preference not less than 1600 mm and is not greater than 2200 mm; that said tank container (1) preferably further comprises a central saddle support (18); and that preferably said head-end saddle supports and said central saddle support maintain a free height of at least 0 mm, preferably at least 10 mm, with more preference 12 mm.
 14. Tank container (1) according to each of preceding claims 1 to 13, **characterised in that** said tank container (1) is minimally 20 feet (6058 mm) long, preferably 26 feet (7820 mm), 30 feet (9144 mm), 40 feet (12192 mm), 45 feet (13716 mm), 50 feet (15240 mm) or more than 50 feet long; **in that** said tank container (1) is minimally 8 feet (2438 mm) or 8.4 feet (2550 mm) or 2600 mm wide; and **in that** said tank container (1) is minimally 8 feet (2438 mm), 8.6 feet (2591 mm) or 9.5 feet (2895 mm) high.
 15. Tank container (1) according to each of preceding claims 1 to 14, **characterised in that** the container posts (21) and/or the bottom (14) and top (15) cross beams and/or the bridge element (22) and/or the end frame doubler plate (23) and/or the corner fittings (7) comprise high-quality steel.

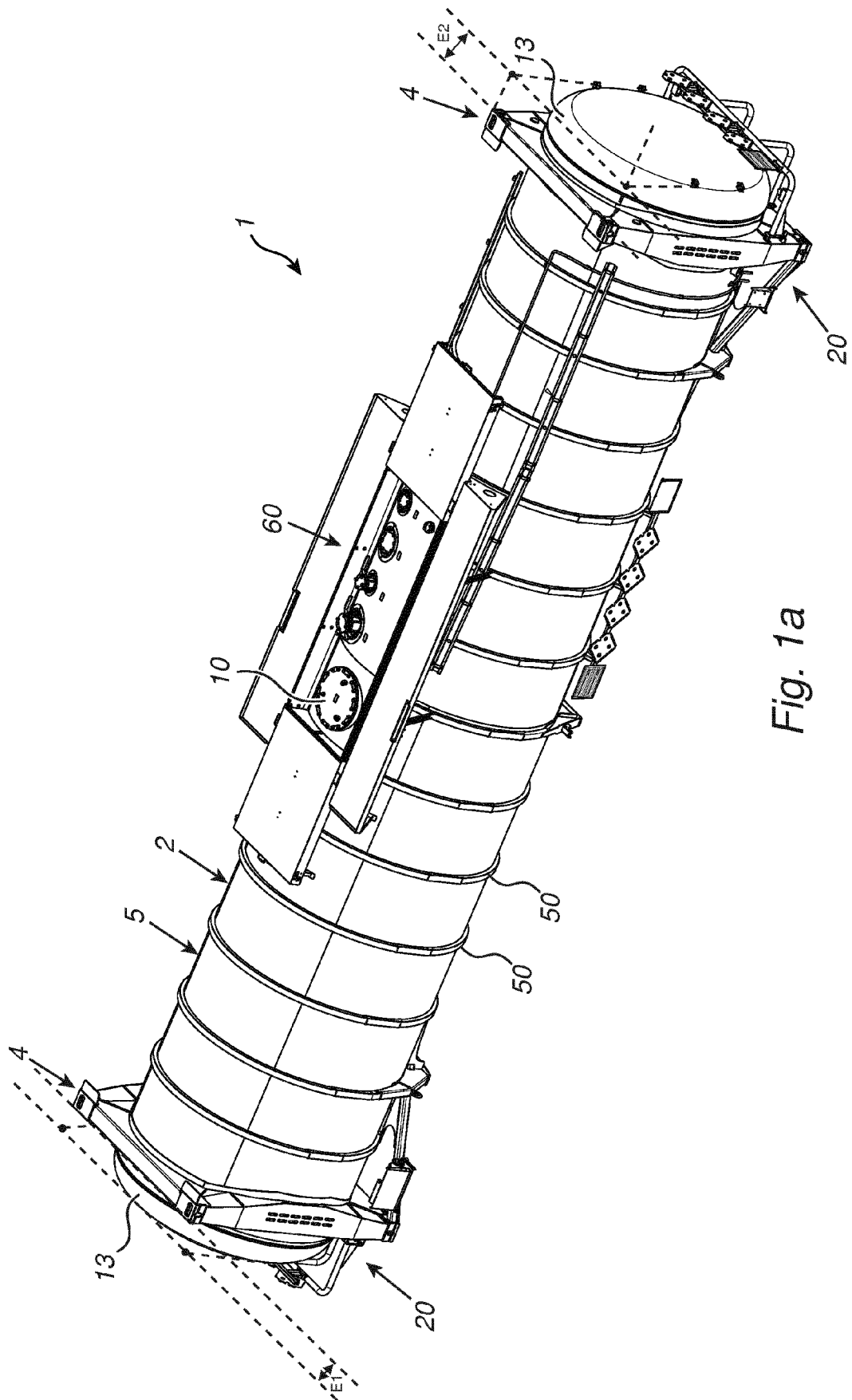


Fig. 1a

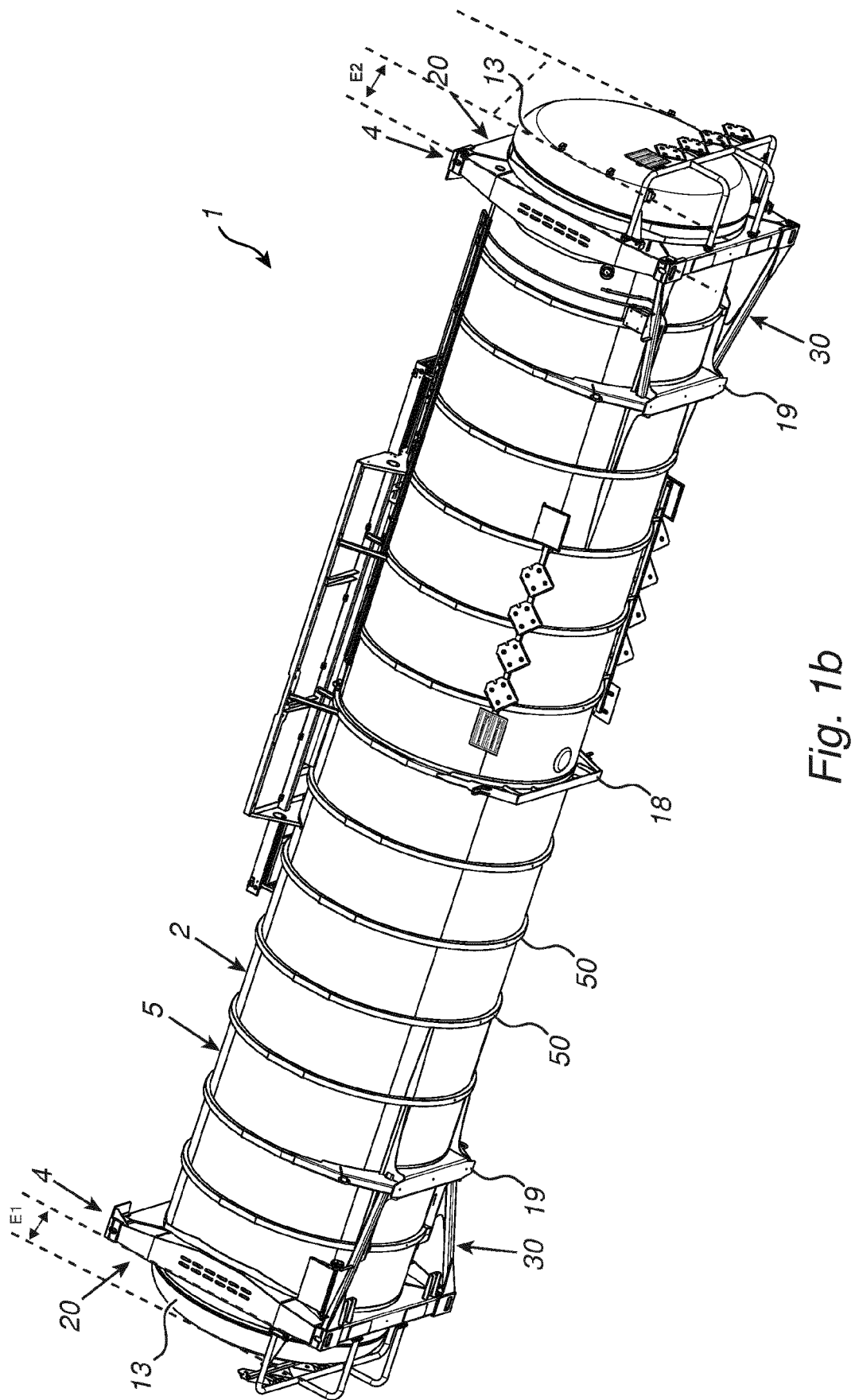


Fig. 1b

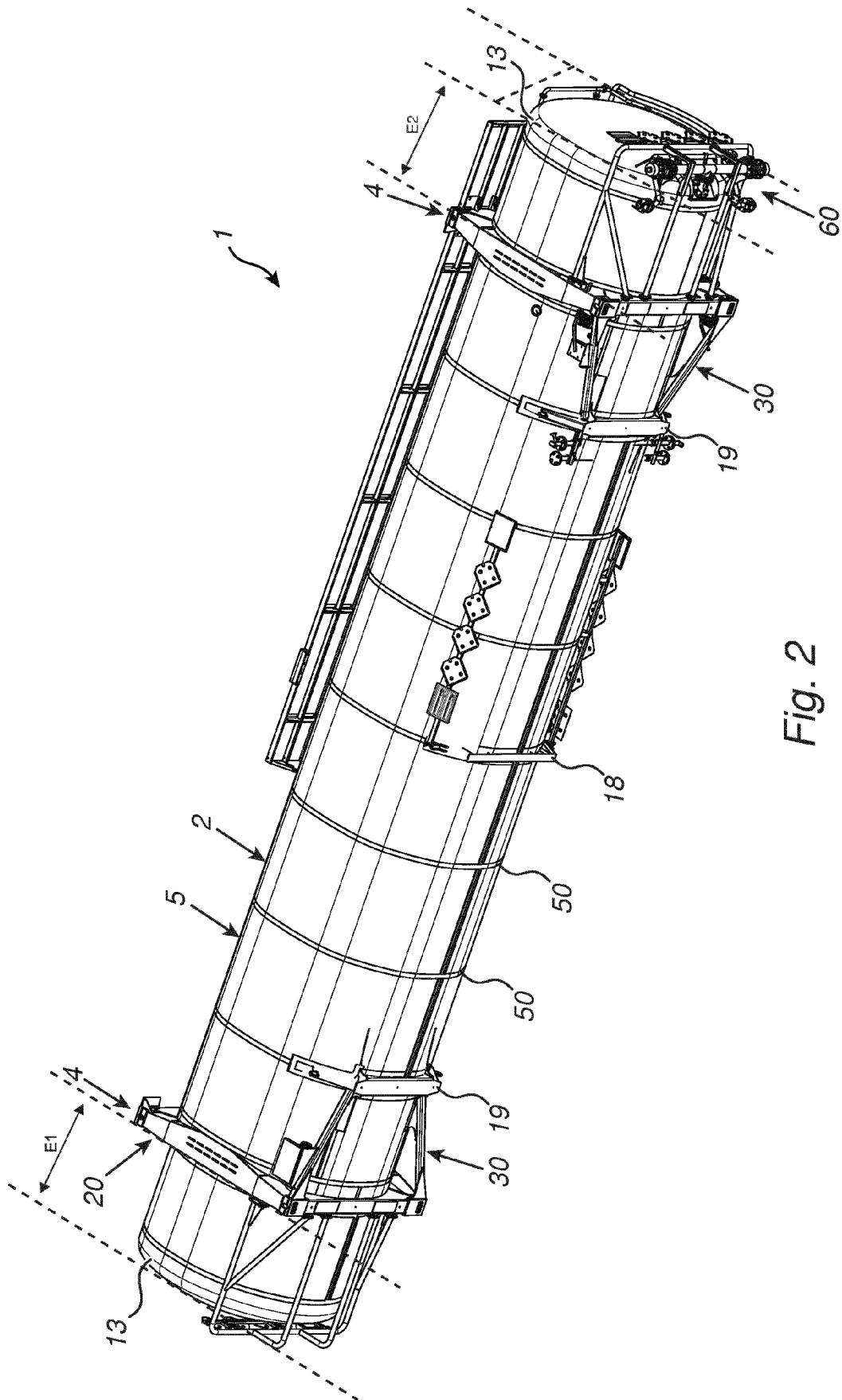


Fig. 2

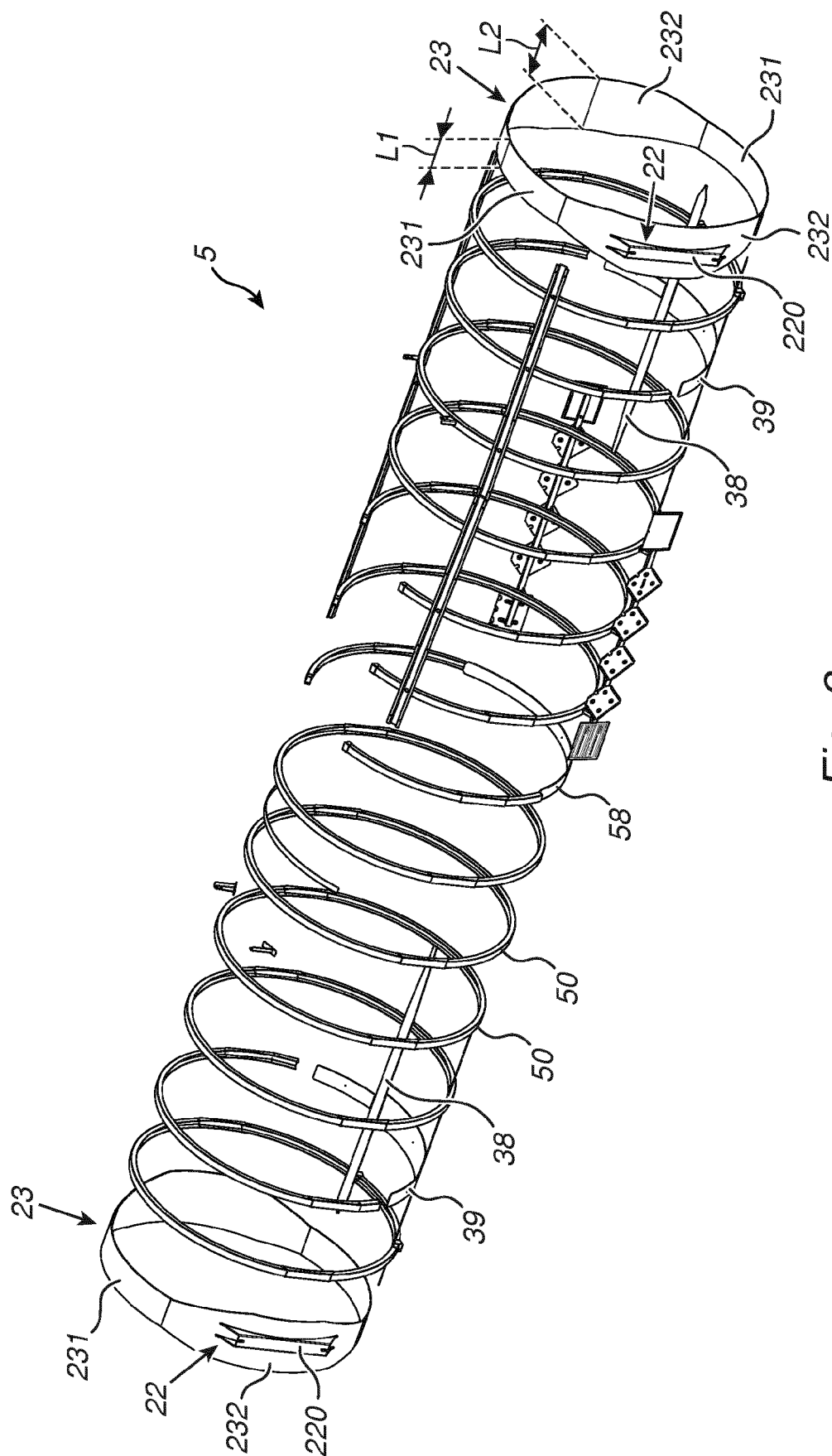


Fig. 3

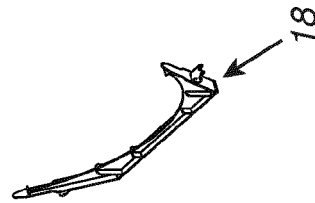
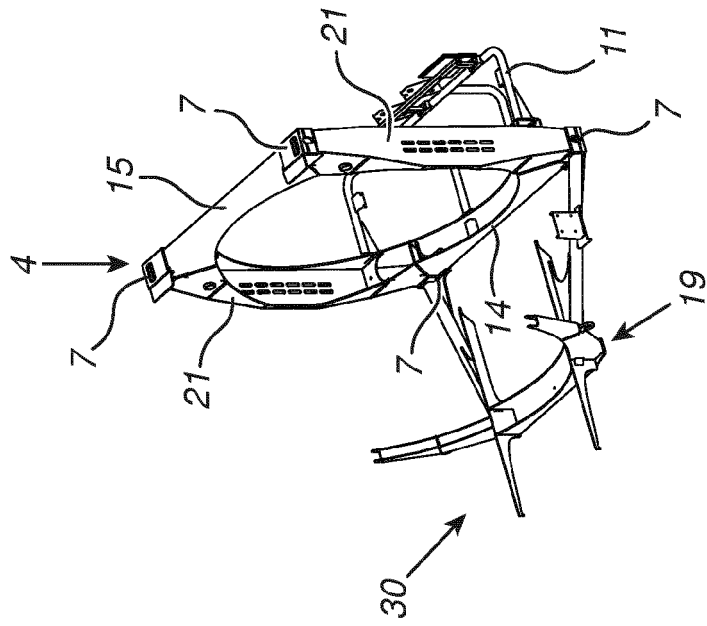
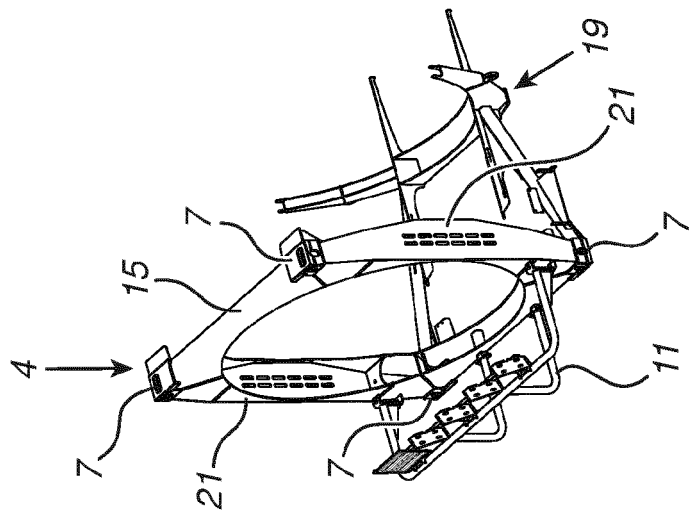


Fig. 4a

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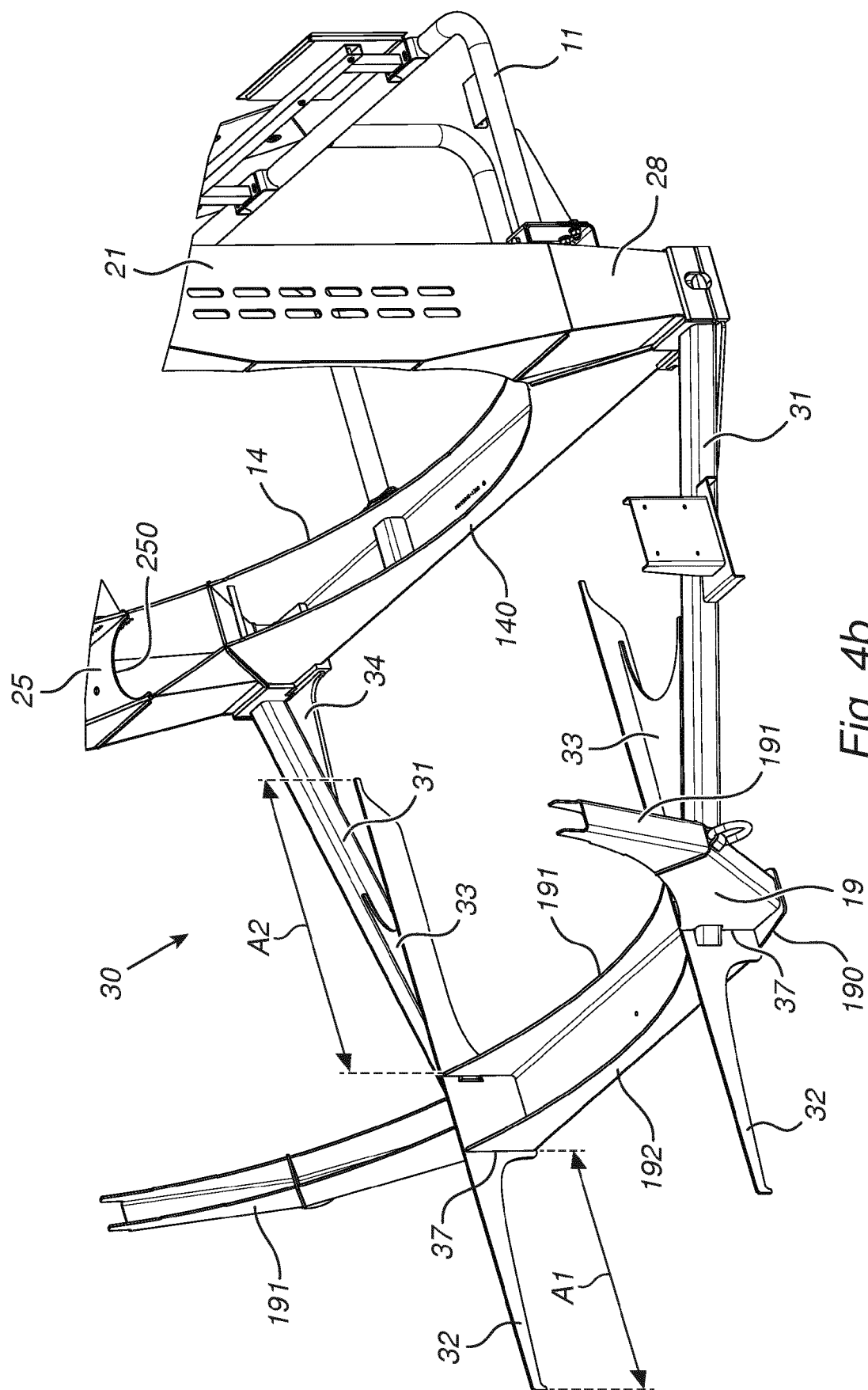


Fig. 4b

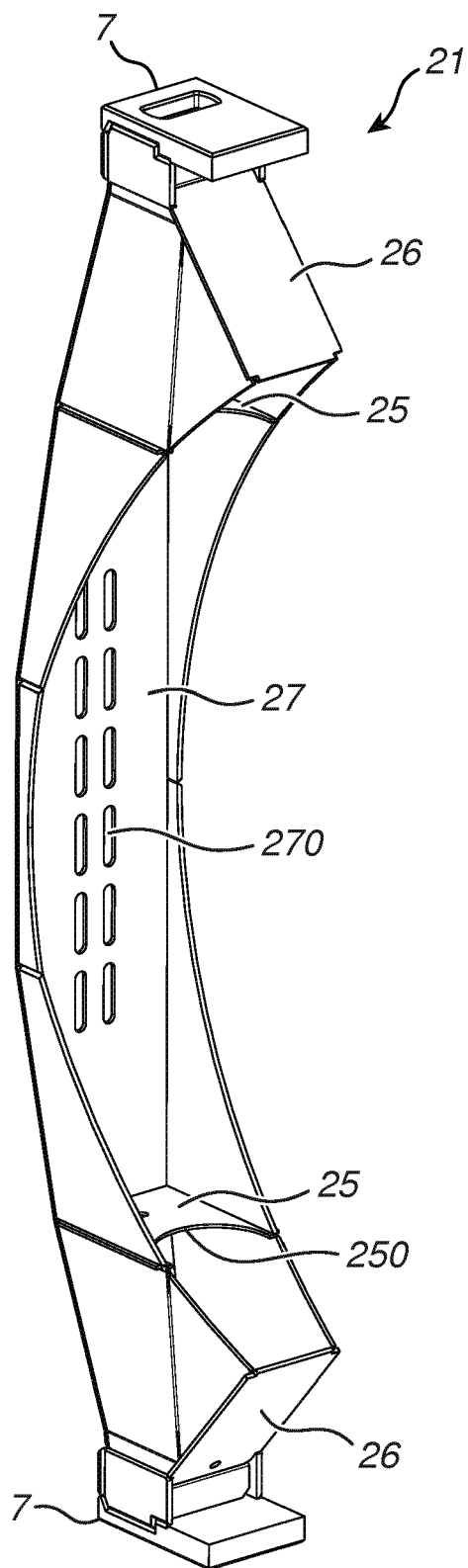


Fig. 5a

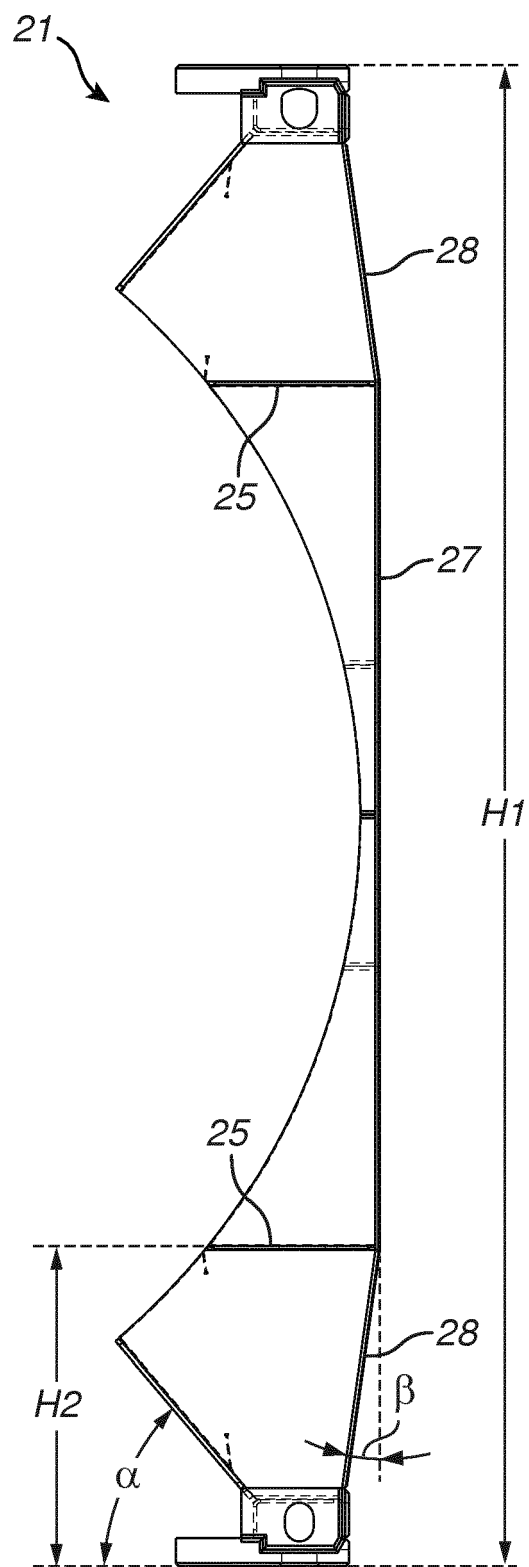


Fig. 5b

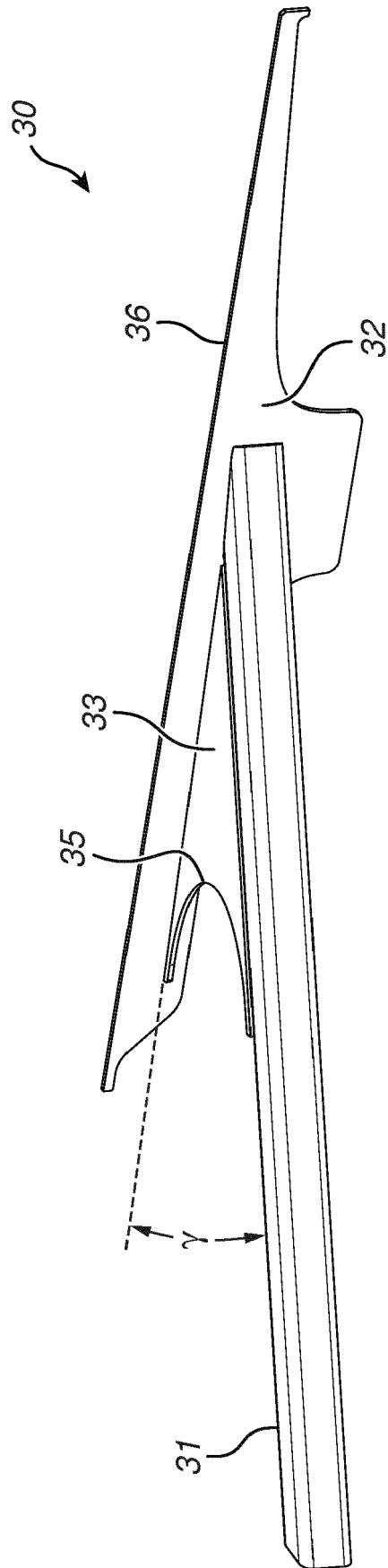


Fig. 6



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Place of search Munich		Date of completion of the search 9 July 2018	Examiner Leijten, René
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