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(54) MULTI-ATTACHMENT LOADING END UNIT

(57) A device (1) for a load spreader assembly (10) comprising:

At least one connection mechanism (90) for connection to the spreader assembly (10);

a bar (20) transverse to the device (1) that comprises a first and second trunnion loading surface (21, 22) for securing slings (70) on either side of the device (1);

a main gusset (30) comprising a first through hole (33), a

first lug (31) for receiving shackles (80) for load transmission to the upper plane of the device (1);

in which the bar (20) is fastened running through the through hole to form a crosshead connection with the main gusset (30), the crosshead connection being configured to transmit loads to a load axis (a) running longitudinally through the device (1) and the load spreader assembly (10).

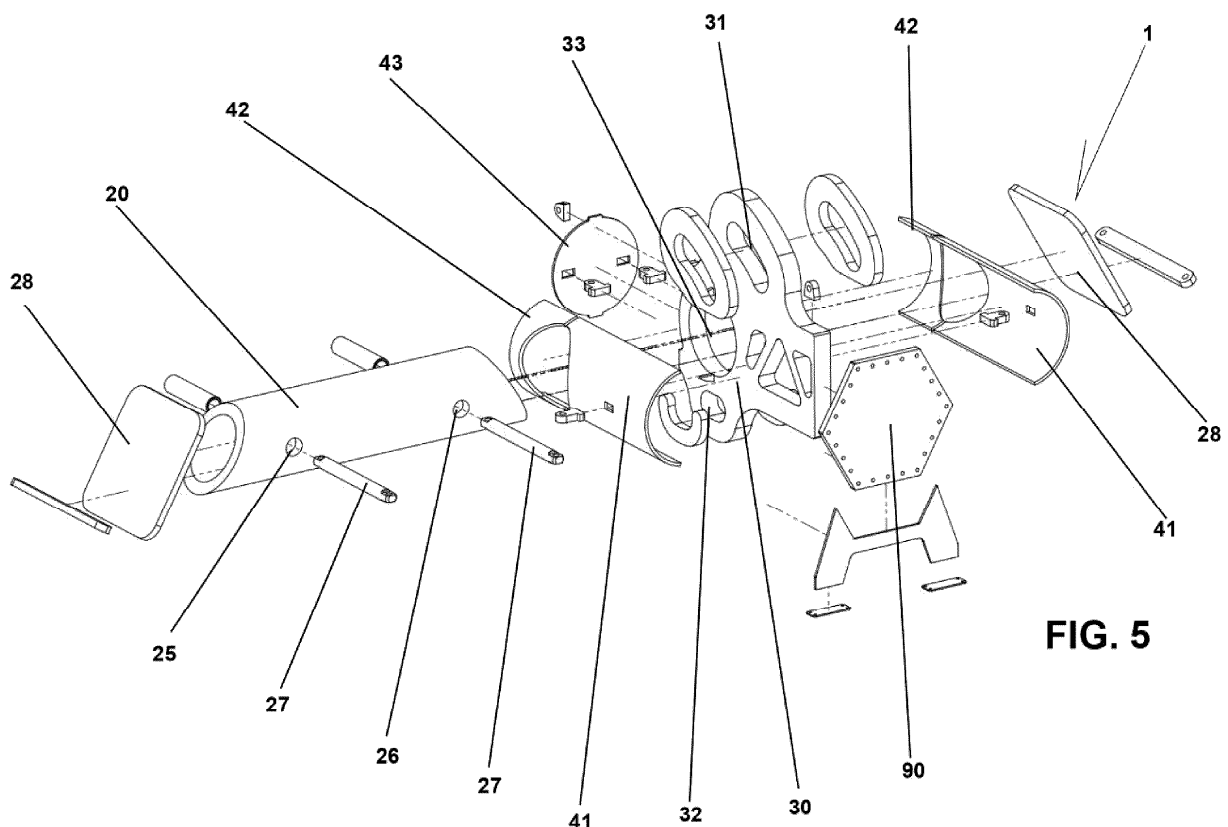


FIG. 5

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Description**Technical field of the invention**

- 5 **[0001]** The present invention relates to attachment systems with lifting elements that are applied to load spreader-type lifting beams.

Background of the invention

- 10 **[0002]** Load spreader assemblies are used to distribute the load from a single lifting point to at least two distant points or in a cascade configuration to multiple attachment points of the load. The single lifting point may correspond, for example, to the hook of a lifting means such as a crane. The use of multiple attachment points allows the stresses on the load to be distributed and partially or completely relieves said load from oblique stresses that would increase the tension on the attachment point and the very structure of the load.
- 15 **[0003]** Spreader assemblies can lift greater loads than a conventional lifting beam with a much lower weight since spreader assemblies work primarily with pure compression rather than with bending as conventional lifting beams do.
- [0004]** Spreader assemblies are more stable than conventional lifting beams due to the greater height between the crane attachment point and the load attachment points. This improves safety by minimising the risk of the load swinging or turning during lifting operations.
- 20 **[0005]** A load spreader assembly is usually attached by hoisting accessories such as slings, grommets or chains. These elements are usually fastened to the load spreader assembly by means of intermediate attachment accessories such as shackles or hooks. They can also be secured directly to elements integrated in the tooling such as weldable hooks or hooks secured by pins or bolted as eyebolts. Even elements with the appropriate shape and function, known as hubs or trunnions, can be integrated into the load or lifting tooling.
- 25 **[0006]** One desirable feature of load spreader assemblies is that the forces transmitted to the beams are primarily compressive forces, with bending forces being avoided. In this way, it is possible to reduce the volume and material costs of load spreader assemblies due to this particular feature of force transmission.
- [0007]** Modular load spreader assemblies are known. Modular systems comprise assemblable longitudinal elements of multiple lengths that can be attached together, thus allowing different hoisting configurations to be adopted. End units are typically located at both ends of the spreader assemblies. These units also have attaching means for attaching to the longitudinal elements, as well as fastening means for fastening to hoisting accessories such as slings or shackles. The modularity of the load spreader assemblies allows them to be transported more easily to the place where the lifting operation is to be carried out.
- 30 **[0008]** Trunnion end units are known. Trunnion end units applied to spreader beams have two loading surfaces perpendicular to the longitudinal structure that are suitable for securing slings. These loading surfaces are usually cylindrical and are symmetrically arranged with a load-bearing part on each side of the beam. A trunnion end unit can accept more than one sling, so that the same surface can receive one sling directed towards the load and one sling directed towards the lifting means. Trunnion and hub variants, all of which are suitable for securing slings, are also known.
- [0009]** Patent document WO17033024 discloses a trunnion end unit describing load spreader assemblies that comprise a beam and four trunnion loading surfaces for fastening slings. The trunnion loading surfaces are arranged in pairs, one pair at each end of the beam, and each pair of trunnion loading surfaces is fastened with respect to the beam and is symmetrically arranged with a load-bearing part on each side of the beam. Each trunnion loading surface comprises a retaining element arranged to retain the sling on the trunnion loading surfaces.
- 40 **[0010]** Lug end devices for shackles are known. Shackle end units have a pair of lugs suitable for attaching shackles, which in turn will be attached to cables or slings.
- 45 **[0011]** Patent document WO07102002 describes a load spreader assembly with two shackle end units, each of which comprises a lower load attachment point for attachment to the load to be lifted by means of a shackle, and an upper lifting attachment point for attachment to a crane hook or the like by means of a shackle.
- [0012]** A person skilled in the art must dimension the load spreader assembly to adapt it to the lifting configuration in terms of length and load, as well as angles of the strands depending on the available height, in order to thus choose the most suitable size. If it is a modular spreader, more spreader elements will be necessary to increase the length and even change all the elements to a larger size if the buckling length increases sufficiently.
- 50 **[0013]** Due to the high mechanical demands placed on the spreader assemblies, these systems are complex and costly to produce. New devices are needed to facilitate the use of spreader systems while maintaining their complexity and being more lightweight.
- 55

Description of the invention

[0014] In order to overcome existing limitations, a device for a load spreader assembly is disclosed, comprising:

At least one connection mechanism for connection to the spreader assembly;
a bar transverse to the device that comprises a first and second trunnion loading surface for securing slings on either side of the device;
a main gusset comprising a first through hole, a first lug for receiving shackles for load transmission to the upper plane of the device;
in which the bar is fastened running through the through hole to form a crosshead connection with the main gusset, the crosshead connection being configured to transmit loads to a load axis running longitudinally through the device and the load spreader assembly.

[0015] Load spreader assemblies are used to distribute the load from a single lifting point to multiple lifting points spaced apart. A device is located at each end or vertex of the load spreader assembly. Although load spreader assemblies usually have a longitudinal beam shape, square or even polygonal load spreader assemblies are also known. Load spreader assemblies consist of different intermediate sections which can be assembled by means of connection mechanisms such as bolted flanges or pinned couplings to form a specific length and shape, finished at the ends or vertices by end units that have the connection elements to allow for these geometries. In this particular configuration, the device is an end terminal.

[0016] During the operation of a load spreader assembly, the load will be attached by means of hoisting accessories to the devices of the load spreader assembly on its lower plane. The part of the device intended to attach to the load on the lower plane is called the lower strand.

[0017] In addition, a load spreader assembly will be attached to the lifting point by means of hoisting accessories on its upper plane. The part of the device intended to attach to the lifting point on the upper plane is called the upper strand.

[0018] The upper planes are defined as the planes which, during operation, are located between the load spreader assembly and the lifting point.

[0019] The lower planes are the planes which, during operation, are located between the load spreader assembly and the load.

[0020] Just as the use of load spreader assemblies having different geometries is known, so is the use of different load spreader assemblies combined in cascade, so that the lower strand of one end unit will connect to the upper strand of the next end unit. This configuration allows the number of attachment points to be multiplied with a balanced weight distribution due to the possibility of balancing each individually suspended element.

[0021] Hoisting accessories are available in a wide range of sizes, materials and shapes. Examples of these are: slings, grommets, steel cables, chains, ropes, lyre shackles, wide body shackles, etc. Hoisting accessories are commonly divided into connector-type accessories such as a shackle or hook and sling-type accessories such as a grommet or chain. Shackle accessories are those that are received on lugs, while sling accessories are either secured to lugs or directly to trunnion bars. Until now, only end units capable of connecting to one type of accessory, either of the sling or shackle type, were known.

[0022] Advantageously, the device of the invention provides the lifting assembly with greater versatility of use by allowing the use of pre-existing hoisting accessories such as slings or shackles. Likewise, they can be combined indistinctly on the upper or lower planes.

[0023] An advantage of the device of the invention is that all the stresses on it or on the spreader assembly are essentially of the axial type so that the resistant section works with pure compression, without considering primary bending, in other words, considering a structure subjected only to pure buckling and thus having lighter longitudinal elements, which results in a lower weight which in turn applies little additional bending, lower weight which benefits the hoisting capacity of the crane and also reduces the overall cost.

[0024] The load axis is the axial axis of the load spreader assembly which runs longitudinally through the device and the load spreader assembly and which for the purpose of stress calculation represents the neutral axis.

[0025] Spreader assemblies with more than one connection system have the problem that, regardless of the connection system used in the lower or upper plane, they must transmit the load to the load axis.

[0026] The invention solves the problem by forming a crosshead connection between the main gusset and the cross bar to directly accommodate circular attachment accessories such as slings or cables, positioned in line and transversely, respectively, with the main gusset. And they complement them with top and bottom lugs.

[0027] Furthermore, the device can be used in other types of non-spreading lifting systems, as well as in other types of tooling such as mechanical or motorised grippers, C- and J-hooks, turners, and also lifting points of loading platforms or containers, or even hoisting points to be integrated in other equipment for handling them, both for the upper portion as a crane attachment or another tool or on the lower portion to attach other loads or equipment.

[0028] Although not shown, a double sling can also be mounted after both the upper and lower shackles, and another

intermediate accessory such as a ring can be used to provide more strands or a coaxial slot instead of a shackle.

[0029] In an exemplary embodiment, the main gusset further comprises a second lug for receiving shackles for load transmission to a lower plane of the device.

[0030] In an exemplary embodiment, the bar comprises a trunnion tube with respective covers at its ends to retain the slings on the first and second loading surface.

[0031] Conveniently, the trunnion tube for direct attachment of hoisting accessories must have a diameter of at least four times the diameter of the hoisting accessory so that said accessory does not lose its rated working capacity, which is known as bending loss.

[0032] Bending loss occurs at lower bending radii due to uneven stress distribution between the inner and outer fibres of the hoisting accessory which, in case of limit load, would cause individual fibres to reach the limit prematurely, resulting in a tearing process as the first fibres fail until the total section breaks.

[0033] In another exemplary embodiment, the bar comprises a second and third through hole configured to accept a spreader bar that divides the first and second loading surfaces generating a third and fourth loading surface.

[0034] The function of the spreader bar on each side of the trunnion tube is to limit the working position of the slings and to separate the loading areas for the slings. This prevents any sling from slipping as well as one sling from overlapping another. These aspects are relevant for proper sling positioning.

[0035] Furthermore, it may be the case that only the slings are used at the top or bottom, and in this case it is particularly important to have an anti-slip system to restrict free travel.

[0036] In another exemplary embodiment, the first and second loading surfaces are configured to accept slings directed towards a plane below the device at an angle of between -15° and 30° with respect to the plane formed by the load axis and the lifting axis and between -6° and 6° with respect to the plane perpendicular to the load axis and where the third and fourth loading surfaces are configured to accept slings directed towards a plane above the device at an angle of between -15° and 15° with respect to the plane formed by the load axis and the lifting axis and between 20° and 45° with respect to the plane perpendicular to the load axis.

[0037] In an exemplary embodiment, the bar comprises retaining elements arranged to retain the slings on the bar.

[0038] In another exemplary embodiment, the retaining elements are safety slings. The safety slings are secured to the spreader bar, the main gusset and the side cover on both sides of each side of the trunnion hollow cylindrical profile, i.e., in four sets. This limits the possibility of the sling accidentally coming out by performing the function of a safety latch of a lifting hook.

[0039] In an exemplary embodiment, the device comprises at least one reinforcement structure attached to the main gusset and the bar.

[0040] In an exemplary embodiment, the first lug has a slotted shape for receiving an upper shackle at an angle of between 20° and 45° with respect to the plane perpendicular to the load axis and where the second lug has a slotted shape for receiving a lower shackle at an angle of between -6° and 6° with respect to the plane perpendicular to the load axis.

[0041] The solution of slotted holes allows for a wide range of angles of use and additionally without moving elements, which would make it more complex, cause more wear, elements could be lost, etc.

[0042] In another exemplary embodiment, the first and second lugs comprise thickenings.

[0043] In another exemplary embodiment, the joints are welded joints.

[0044] In an exemplary embodiment, the device further comprises attachment points.

[0045] In another exemplary embodiment, the invention is a load spreader assembly system configured for the range of loads from 9 to 1350 tonnes and comprising:

at least two devices according to any of the preceding claims wherein:

the bar has a diameter of 20 to 700 mm and is 200 to 4000 mm long;

the main gusset is 200 to 2000 mm long, 200 to 2200 mm high and 15 to 150 mm thick; and

at least one modular beam where the modular beam is 500 to 6000 mm long.

Brief description of the drawings

[0046]

Figure 1a Figure 1a shows a load spreader assembly in a square layout with four end devices that is known in the state of the art.

Figure 1b Figure 1b shows three load spreader assemblies in a cascade arrangement known in the state of the art.

Figure 2 Figure 2 shows a schematic representation of a device 1 according to the invention.

Figure 3 Figure 3 shows a schematic representation of a spreader assembly 10 comprising a device 1 according to the invention at each end as an end unit.

Figure 4 Figure 4 shows a schematic representation of a main gusset 30 according to the invention.

- Figure 5 Figure 5 shows an exploded schematic representation of a device 1 according to the invention.
- Figure 6 Figure 6 shows a schematic representation of the device 1 according to the invention, showing the trunnion loading surfaces 21, 22, 23, 24 for securing slings.
- Figure 7a Figure 7a shows a representation of the device 1 according to the invention with a shackle 80 on the upper lug 31 and a shackle 80 on the lower lug 32.
- Figure 7b Figure 7b shows a representation of the device 1 according to the invention with a shackle 80 on the upper lug 31 and a sling 70 on the bar 20 directed towards the lower plane.
- Figure 7c Figure 7c shows a representation of the device 1 according to the invention with a sling 70 on the bar 20 directed towards the upper plane and a shackle 80 on the lower lug 32.
- Figure 7d Figure 7d shows a representation of the device 1 according to the invention with a sling 70 on the bar 20 directed towards the upper plane and a sling 70 on the bar 20 directed towards the lower plane.
- Figure 8 Figure 8 shows a schematic representation of the device 1 according to the invention, being lifted by lifting accessories attached to its attachment points 70.

Detailed description of an exemplary embodiment

[0047] In the following detailed description, numerous specific details are set forth in the form of examples to provide a thorough understanding of the relevant teachings. However, it will be apparent to those skilled in the art that the present teachings can be implemented without such details.

Example 1

[0048] Figure 2 exemplifies a device 1 with respect to the present invention. The device is made of welded structural steel, shot-blasted and painted according to standard ISO 12944 category C2 in grey RAL 9007. The device 1 is specifically designed for the transmission of loads to a load axis that runs longitudinally through the device 1. The device of the example is designed to carry a weight of up to 1350 tonnes.

[0049] Figure 3 shows an exemplary configuration that does not limit the invention. In this configuration, the spreader assembly 10 is a spreader beam assembly 10. The spreader beam is connected to the lifting point on the upper plane by means of two shackles 80 connected to the upper lugs 31. Furthermore, it is connected to the load on the lower plane by means of two shackles 80 connected to the lower lugs 31. In the example, the axial load axis a runs through the entire spreader beam 10, while the lifting axis b is perpendicular to the load axis a and runs from the load to the lifting point.

[0050] The spreader beam assembly 10 is made up of different elements that can be assembled by means of connection mechanisms 90. In the example, the connection mechanisms 90 are bolted flanges.

[0051] In the example, the spreader beam assembly 10 consists of two modular beams 2 and two devices 1 as end units 1. The modular beams 2 are 5000 mm long and have a diameter of 812 mm.

[0052] Figure 4 shows an exemplary main gusset 30 according to the invention. The hexagonal bolted flange is attached to the main gusset 30 by means of a welded joint. The main gusset is provided with two slotted lugs 31, 32 protruding from the main gusset 30. A thickening is attached to the lugs by means of a welded joint to reinforce them. The upper lug has a slotted shape for receiving an upper shackle 80 at an angle of between 20° and 45° with respect to the plane perpendicular to the load axis a. Furthermore, the lower lug 32 has a slotted shape for receiving a lower shackle 80 at an angle of between -6° and 6° with respect to the plane perpendicular to the load axis a.

[0053] The maximum capacity of the spreader varies depending on the length of the spreader beam assembly and the working angle of the upper slings or upper shackles.

	Angle of axis a	Maximum load	Length of Spreader Beam
Example 1	20°	1,350,000 kg	29 m
	30°	1,350,000 kg	23 m
	45°	1,120,000 kg	18 m

[0054] The main gusset 30 has support legs in welded attachment to the hexagonal flange 90, which are designed only to facilitate assembly, not to support the loads of securing and transport.

[0055] Optionally, the main gusset 30 comprises through holes to make the part lighter.

[0056] The main gusset 30 comprises a through hole 33 for attaching a hollow trunnion tube 20 by means of a welded joint.

[0057] The main gusset 30 is 2129 mm high, 1980 mm long and 150 mm thick from the lowest point to the highest point.

[0058] Figure 5 shows a mounting of the end joint of the example according to the invention. The trunnion tube 20 has two

pairs of holes 25 configured to accept a spreader bar 27. The spreader bar 27 limits the working position of the slings and separates the load surfaces 21, 22, 23, 24. This prevents any sling 70 from slipping as well as one sling from overlapping another.

[0059] In addition, reinforcement structures 41, 42, 43, which significantly increase the strength and loading capacity of the end unit 1, are welded to the trunnion tube 20 and the main gusset 30. Conveniently, the reinforcement structures 41, 42, 43 form a cylinder, giving the end unit 1 the appearance of a crosshead formed by two cylinders. In addition, the reinforcing structures may have through holes where attachment points 70 are welded. The attachment points 70 are used only for handling the end unit.

[0060] Figure 6 shows a front view of the end unit 1 of the example according to the invention. Each end of the trunnion tube 20 has respective covers 28 that are welded. The loading surfaces 21, 22, 23, 24 for attaching slings are highlighted. The slings are used in pairs, each one of the pair being coupled to one side of the trunnion tube 20 on respective loading surfaces 21, 22, 23, 24.

[0061] The spreader bar 27 is a removable accessory that allows a pair of additional slings to be used by separating the loading surfaces for each sling and reducing the risk of overlapping. In this configuration, each loading surface 21, 22, 23, 24 will be limited by the cover 28 and the spreader bar 27 or the spreader bar 27 and the main gusset 30. In the example, the more distal loading surfaces 21, 22 are particularly suitable for coupling slings 80 directed to the lower plane. The 30° inclination of the covers allows accepting slings 70 that are directed towards a plane below the end unit 1 at an angle of between -15° and 30° with respect to the plane formed by the load axis a and the lifting axis b and between -6° and 6° with respect to the plane perpendicular to the load axis (a). And wherein more proximal loading surfaces 23, 24 are configured to accept slings 70 that are directed towards a plane above the end unit 1 at an angle of between -15° and 15° with respect to the plane formed by the load axis a and the lifting axis b and between 20° and 45° with respect to the plane perpendicular to the load axis a.

[0062] Furthermore, retaining elements 29 are incorporated in the form of an endless sling secured to the spreader bar 27, the main gusset 30 and the covers 28 by means of shackles, on both sides of the trunnion tube 20, i.e., four equal sets of safety slings 29. This element limits the slings 70 from accidentally coming out of the trunnion tube 20 by performing the function of a safety latch of a lifting hook.

[0063] The trunnion 20 tube is 3000 mm long, has a diameter of 660 mm and is 90 mm thick.

[0064] Figures 7a, 7b, 7c, 7d show the different configurations of lifting accessories that can be used with the device 1: a shackle 80 on the upper lug 31 and a shackle 80 on the lower lug 32, a shackle 80 on the upper lug 31 and a sling 70 on the bar 20 directed towards the lower plane, a sling 70 on the bar 20 directed towards the upper plane and a shackle 80 on the lower lug 32 and a sling 70 on the bar 20 directed towards the upper plane and a sling 70 on the bar 20 directed towards the lower plane.

[0065] Figure 8 shows the end unit of the example being handled by slings attached to its attachment points 70.

Claims

1. A device (1) for a load spreader assembly (10) comprising:

At least one connection mechanism (90) for connection to the spreader assembly (10);
a bar (20) transverse to the device (1) that comprises a first and second trunnion loading surface (21, 22) for securing slings (70) on either side of the device (1);
a main gusset (30) comprising a first through hole (33), a first lug (31) for receiving shackles (80) for load transmission to the upper plane of the device (1);
in which the bar (20) is fastened running through the through hole to form a crosshead connection with the main gusset (30), the crosshead connection being configured to transmit loads to a load axis (a) running longitudinally through the device (1) and the load spreader assembly (10).

2. The device (1) of claim 1, wherein the main gusset (30) further comprises a second lug (32) for receiving shackles (80) for load transmission to a lower plane of the device (1).

3. The device (1) of any of the preceding claims, wherein the bar (20) comprises a trunnion tube with respective covers (28) at its ends to retain the slings (70) on the first and second loading surface (21, 22).

4. The device (1) according to the preceding claim, wherein the bar (20) comprises a second and third through hole (25, 26) configured to accept a spreader bar (27) that divides the first and second loading surfaces (21, 22) generating a third and a fourth loading surface (23, 24).

5. The device (1) according to the preceding claim, wherein the first and second loading surfaces (21, 22) are configured to accept slings (70) directed towards a plane below the device (1) at an angle of between -15° and 30° with respect to the plane formed by the load axis (a) and the lifting axis (b) and between -6° and 6° with respect to the plane perpendicular to the load axis (a) and where the third and fourth loading surfaces (23, 24) are configured to accept slings (70) directed towards a plane above the device (1) at an angle of between -15° and 15° with respect to the plane formed by the load axis (a) and the lifting axis (b) and between 20° and 45° with respect to the plane perpendicular to the load axis (a).
6. The device (1) of any of the preceding claims, wherein the bar (20) comprises retaining elements (29) arranged to retain the slings (70) on the bar (20).
7. The device (1) of any of the preceding claims, wherein the device (1) comprises at least one reinforcement structure (41, 42, 43) attached to the main gusset (30) and the bar (20).
8. The device (1) of any of the preceding claims, wherein the first lug (31) has a slotted shape for receiving an upper shackle (80) at an angle of between 20° and 45° with respect to the plane perpendicular to the load axis (a).
9. The device (1) according to claims 2 to 8, wherein the second lug (32) has a slotted shape for receiving a lower shackle (80) at an angle of between -6° and 6° with respect to the plane perpendicular to the load axis (a).
10. The device (1) according to claims 2 to 9, wherein the first and a second lug (31, 32) comprise thickenings.
11. The device (1) of any of the preceding claims, wherein the joints are welded joints.
12. The device (1) of any of the preceding claims, wherein the device (1) further comprises attachment points (70).
13. A load spreader assembly system (10) configured for the range of loads from 9 to 1350 tonnes and comprising: at least two devices (1) according to any of the preceding claims as end units (1), wherein:
 - the bar (20) has a diameter of 20 to 700 mm and is 200 to 4000 mm long;
 - the main gusset (30) is 200 to 2000 mm long, 200 to 2200 mm high and 15 to 150 mm thick; and
 - at least one modular beam (2) where the modular beam (2) is 500 to 6000 mm long.

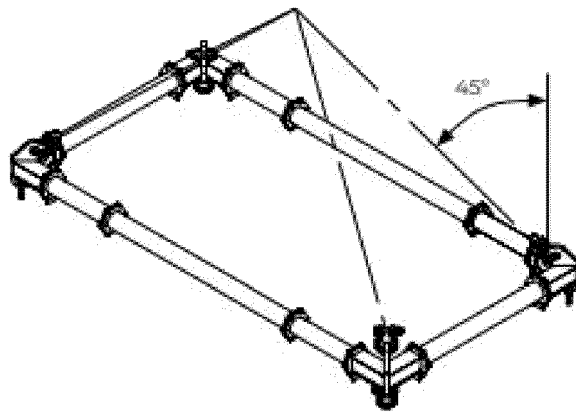


FIG. 1a

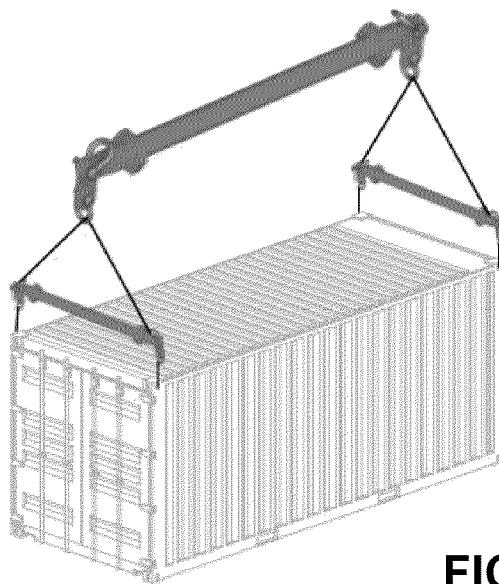
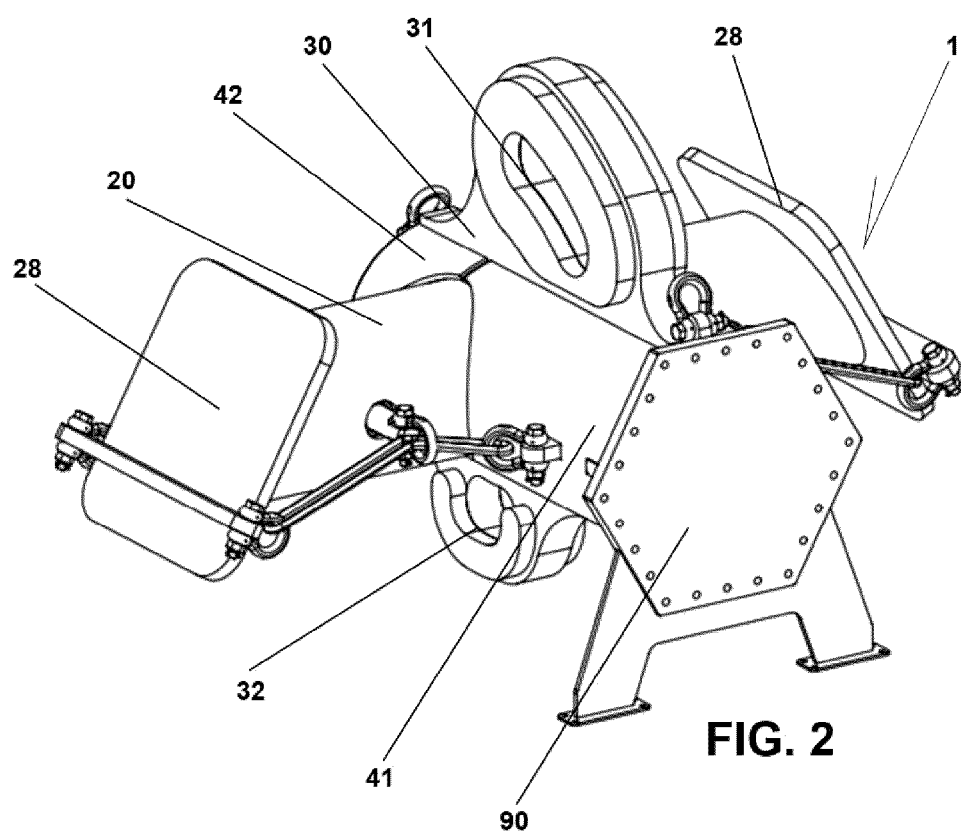
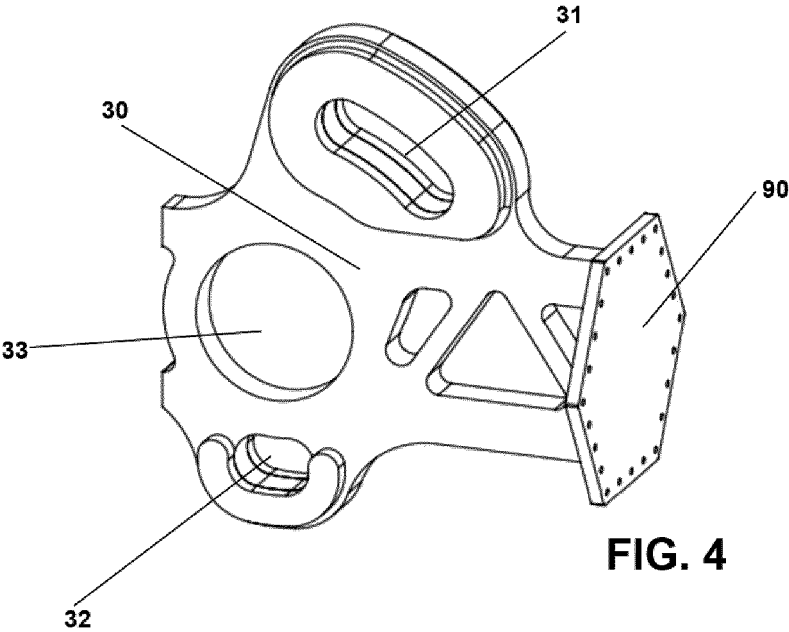
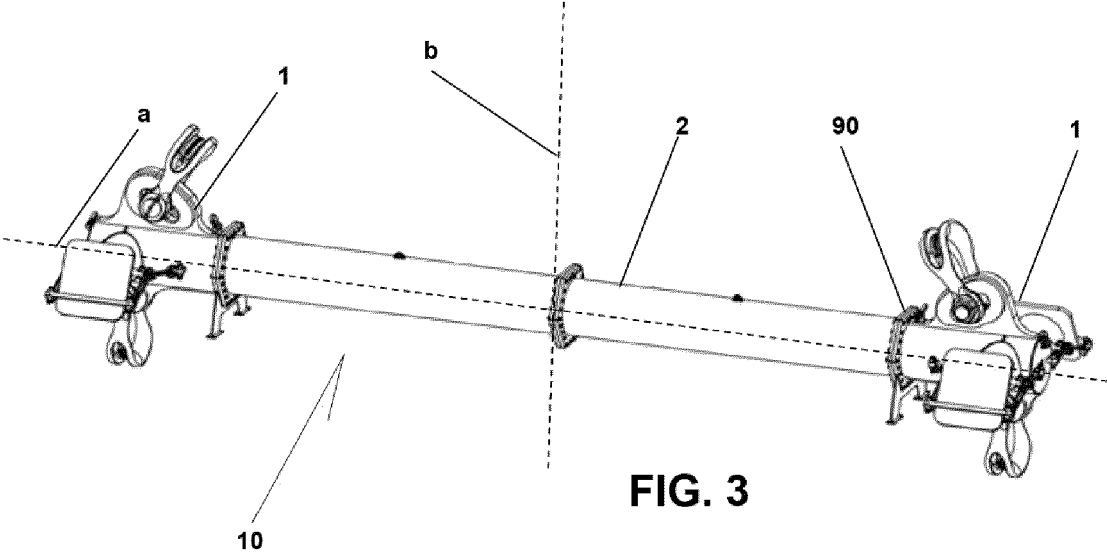


FIG. 1b





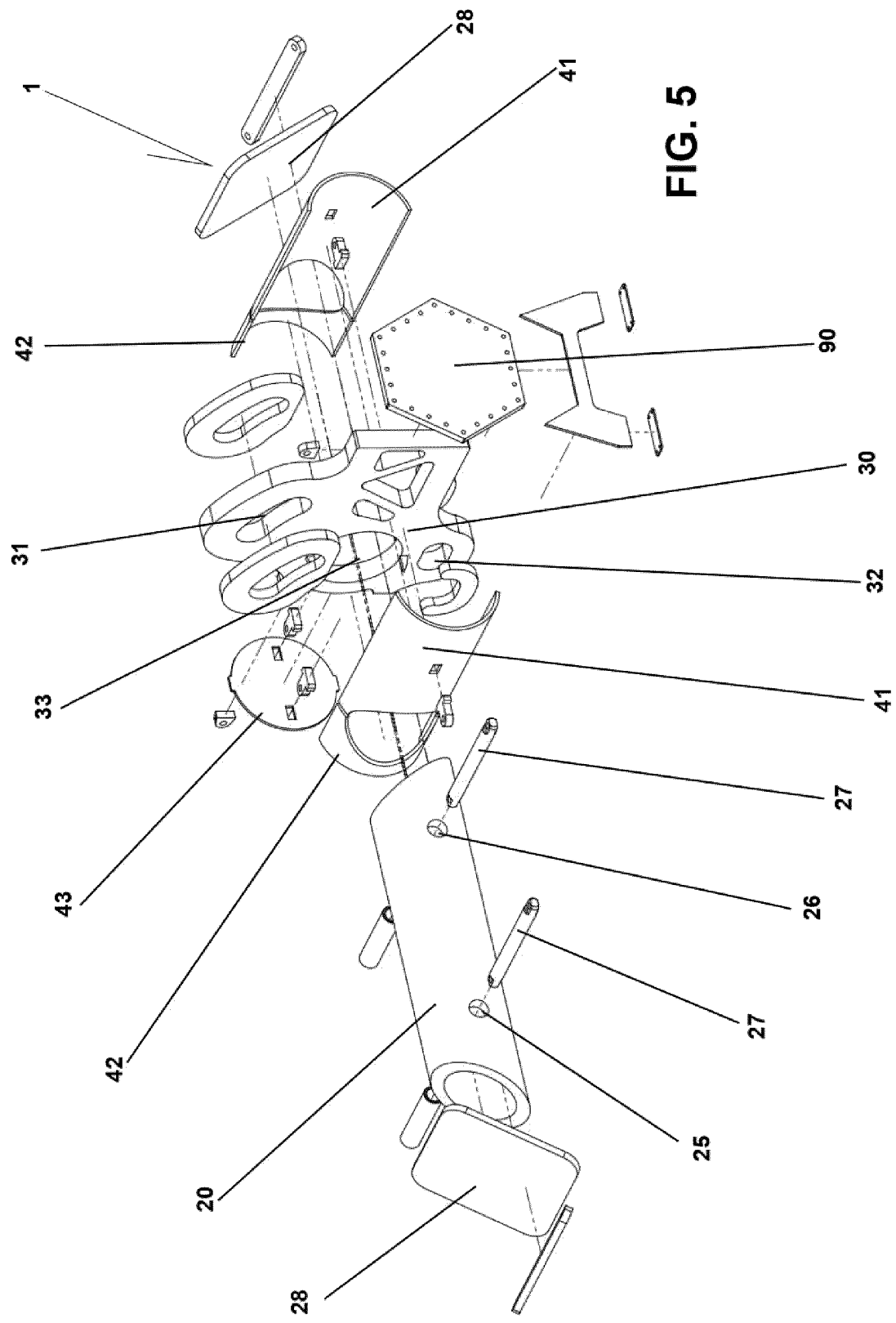


FIG. 5

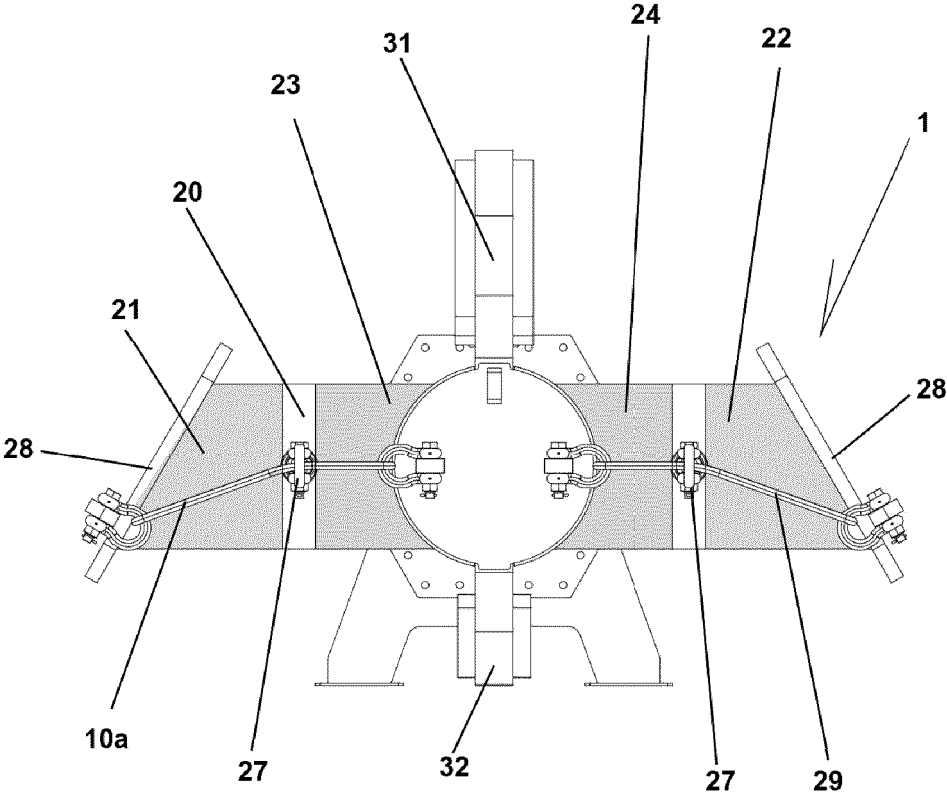


FIG. 6

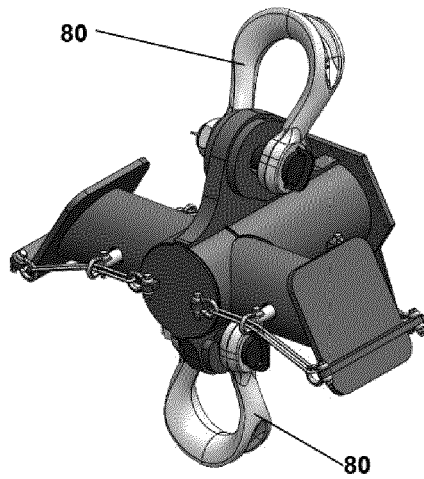


FIG. 7a

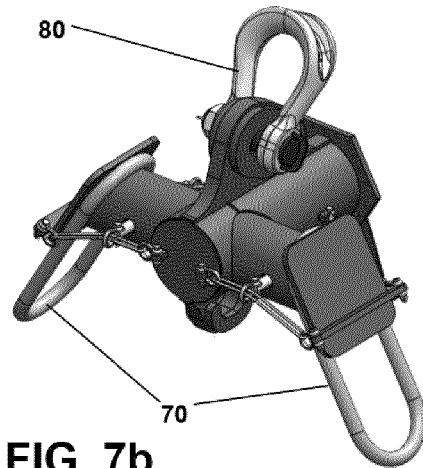


FIG. 7b

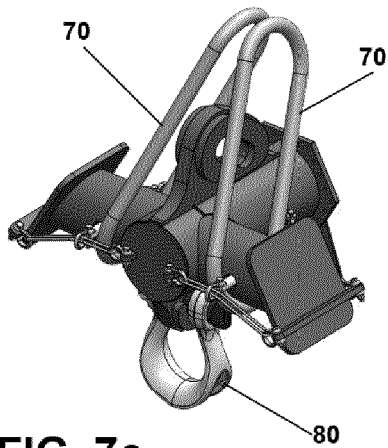


FIG. 7c

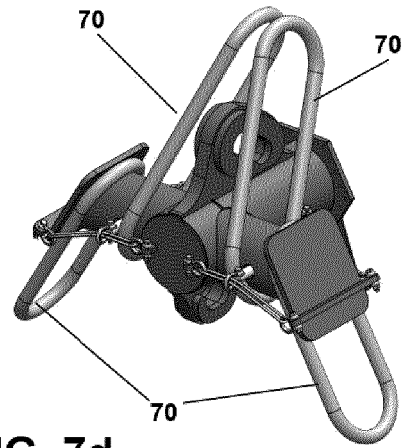


FIG. 7d

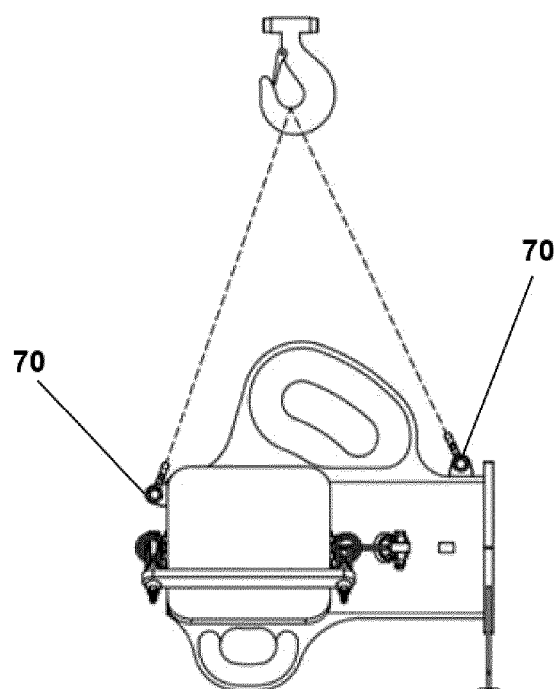


FIG. 8



EUROPEAN SEARCH REPORT

Application Number

EP 25 38 2340

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,D	WO 2017/033024 A1 (MODULIFT UK LTD [GB]) 2 March 2017 (2017-03-02)	1-3,6-13	INV.
A	* the whole document *	4,5	B66C1/10 B66C1/12
A	----- CN 220 098 258 U (OFFSHORE OIL ENG CO LTD) 3 28 November 2023 (2023-11-28) * abstract; figure 1 * -----		
			TECHNICAL FIELDS SEARCHED (IPC)
			B66C
The present search report has been drawn up for all claims			
Place of search		Date of completion of the search	Examiner
The Hague		1 September 2025	Serôdio, Renato
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