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(54) **A SYSTEM AND APPARATUS FOR MOVING OBJECTS**

(57) A trolley for lifting and/or moving a load on one or more lines is disclosed. The trolley comprises: a. first and second spaced plates (10, 12), b. at least two fixed sheaves (30) that are disposed for rotation about respective parallel axes between the first and second plates (10, 12), and c. a removable sheave component (48). The removable sheave component (48) is, while in use, disposed for rotation about an axis parallel to that of the fixed sheaves between or adjacent to the first and second plates (10, 12). The removable sheave components is, while in use, carried on a shaft (24) that is connected to the plates, which connection is capable of being disconnected to permit removal of the removable sheave components from connection with the plates. Also disclosed is an installation for lifting and/or moving a load that includes such a trolley and a method of installing such an installation.

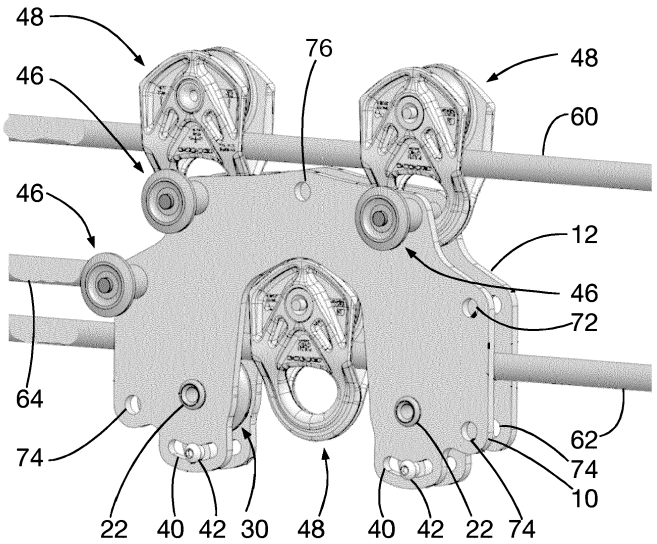

Fig 3

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Description

[0001] The present invention relates to a system and apparatus for moving objects.

[0002] A Tyrolean traverse is performed by connecting a main line between two remote locations, and placing a carriage on the main line. The carriage has a plurality of sheaves or other low-friction devices that allow it to travel along the main line. Control lines are connected to the carriage to control its movement along the main line. The carriage also has connection points to which a load can be connected. As the control lines are used to move the carriage along the main line, it is possible to move a load connected to the carriage between the remote locations. This arrangement has a variety of applications, including movement of inanimate objects, such as timber from a cut-down tree, or transport of people, either to cross a void, or to rescue an incapacitated person.

[0003] In EP 3 159 052, the present applicant disclosed an improved system and apparatus for performing a Tyrolean traverse. Such apparatus has proven to be highly effective and versatile in use. However, there is now a desire to provide apparatus with similar function that is simpler and therefore less costly to manufacture.

[0004] To this end, from a first aspect, the present invention provides a trolley for lifting and/or moving a load on one or more lines comprising:

first and second spaced plates,

at least two fixed sheaves that are disposed for rotation about respective parallel axes between the first and second plates, and

a removable sheave component that is, while in use, disposed for rotation about an axis parallel to that of the fixed sheaves between or adjacent to the first and second plates, the removable sheave components element being carried on a shaft that is connected to the plates, which connection can be disconnected to permit removal of the removable sheave components from connection with the plates.

[0005] When the removable sheave components are not *in situ* on the plates, lines can be introduced into or removed from a space between the plates to come into contact with the fixed sheaves. Once the removable sheave components are connected to the plates, such lines can make rolling contact with the sheaves and sheave components, but cannot be removed from between the plates (other than by allowing an end of the line to pass between the plates).

[0006] A typical trolley includes two or more removable sheave components.

[0007] One or more of the removable sheave components may be constituted by a pulley wheel that is part of a pulley assembly that includes the shaft. In such embodiments, the pulley assembly typically includes a body upon or within which the pulley wheel is carried for rotation. Most typically, in such cases, part of the body is disposed between the plates to enable it to be connected to the plates. For example, the body may have an eye, and securing pin may be passed through the eye and apertures in the plates to secure the body to the plates. In such embodiments, one or more sheave component (that is part of a pulley assembly) typically rotates about a respective axis that is adjacent to the plates and one or more sheave component may be wholly or partly external to the plates.

[0008] One or more of the removable sheave components may be constituted by a sheave that includes a rim that is carried on a hub. The hub typically includes a bearing to permit free rotation of the rim about an axis passing through the hub. In such embodiments, the sheave may be connected to the plates for use by a removable securing pin that passes through the hub and through apertures in the plates to secure the hub to the plates and to constitute the shaft about which the sheave component rotates. The pin is typically centred on the axis of rotation of the rim. In such embodiments, one or more sheave component typically rotates about a respective axis that passes through the plates and one or more sheave component may be wholly or partly disposed between the plates.

[0009] Advantageously, each plate includes a void that is constituted by a recess formed into an edge of the plate. The void can receive a device for connection with a load, such as a pulley, when the trolley is in use, which helps to reduce the extent to which a load suspended from the trolley can swing when it is being moved.

[0010] From a second aspect, this invention provides an installation for lifting and/or moving a load that includes a trolley embodying the first aspect of the invention, a main line that extends between two fixed anchorages, and which, in use, passes between the plates of the trolley, whereby the main line makes contact with one or more sheave or sheave component of the trolley whereby the trolley can be suspended from and travel along the main line.

[0011] A typical installation further includes a control line that is connected to the trolley whereby the trolley can be drawn along the main line.

[0012] A typical installation further includes a lifting line that passes between the plates of the trolley and over two or more sheaves or sheave components of the trolley, the lifting line carrying, between the sheaves or sheave components, a device such as a pulley for connection with a load.

[0013] From a third aspect, this invention provides a method of installing an installation according to the second aspect of the invention comprising:

a. installing a main line between two fixed anchorages;

b. in the absence of a removable sheave component,

passing part of the main line between the plates of the trolley;

c. installing one or more removable sheave component to retain the main line between the plates.

[0014] Typically, prior to step c., part of a lifting line is passed between the plates of the trolley.

[0015] Embodiments of the invention will now be described in detail, by way of example, and with reference to the accompanying drawings, in which:

Figures 1 and 2 are views of a basic assembly being a component of a system;

Figure 3 shows apparatus for moving objects being a first embodiment of the invention;

Figure 4 shows a section in a plane parallel to plates through the apparatus of Figure 3;

Figure 5 shows a section in a plane perpendicular to plates through the apparatus of Figure 3;

Figures 6 to 10 show a sequence of steps for assembling the apparatus of Figure 4

Figure 11 shows the apparatus of the first embodiment in use;

Figure 12 shows apparatus for moving objects on a main line that slopes substantially;

Figure 13 shows apparatus for moving objects being a second embodiment of the invention;

Figure 14 shows apparatus for moving objects being a third embodiment of the invention;

Figure 15 shows a sheave being a component of the third embodiment of the invention;

Figure 16 shows the provision of a spacer to add strength to an embodiment of the invention; and

Figure 17 is a detailed section of the spacer of Figure 15.

[0016] With reference to Figures 1 and 2, a basic assembly being part of apparatus for moving objects comprises similar first and second planar metal plates 10, 12. Each plate 10, 12 is symmetrical about a median plane M. The plates 10, 12 are parallel and spaced in a direction normal to the plane of each plate. The surfaces of each plate 10, 12 that face one another will be referred to as the inner surfaces and the opposite surfaces, which face away from one another will be referred to as the outer surfaces. The peripheries of the plates 10, 12 are coincident when projected in a direction normal to their planes.

[0017] Each plate 10, 12 is shaped generally as an inverted "U", with two leg regions interconnected by a bridge region, the bridge region extending across the median plane M. A plurality of apertures extend through the plates 10, 12, the similarity and symmetry of the plates meaning that each aperture in the first plate 10 is paired with and aligned with a corresponding aperture in the second plate 12. A void 14 is defined between the leg regions, the void 14 being a recess that extends from an edge of the plate 10, 12.

[0018] Each leg region includes a circular sheave axle aperture 20 (making a total of four sheave axle apertures 20, two in each plate, each having a corresponding paired aperture in the other plate). A sheave axle is carried by each pair of sheave axle apertures 20. The sheave axle has a head 22 from which a shaft 24 extends. The shaft 24 is a close fit within the sheave axle apertures 20 and passes through both of the sheave axle apertures 20 in the pair. The head 22 is of a size that it cannot pass through the sheave axle aperture 20 and is in abutment with the outer surface of the first plate 10. A threaded spigot 28 extends from the shaft 24 to project beyond the outer surface of the second plate 12. A nut 26 is applied to the spigot and tightened against the outer surface of the second plate 12 to retain the sheave axle in place and to substantially prevent any movement of the sheave axle within its apertures. Each sheave axle carries a respective fixed sheave 30 upon its shaft 24 between the plates 10, 12. Each sheave 30 includes a rope-bearing rim 32 with a central hub within which a rolling-element bearing 34 is contained, an inner race of the rolling element bearing 34 being carried on the shaft 24 whereby the sheave 30 can rotate about an axis normal to the plates 10, 12. The sheave 30 is selected to be of width such that there is minimal clearance between it and each plate 10, 12. The sheave axle apertures 20 are positioned such that the sheaves 30 closely approach but do not enter into the void 14.

[0019] At a location remote from the bridge region, a plate joiner aperture 40 is formed through each leg region. Each plate joiner aperture 40 is formed as an arcuate slot that is centred approximately on the nearby sheave axle aperture 20. A plate joiner is carried by each pair of plate joiner apertures 40. The plate joiner has a head 42 from which a shaft 44 extends. The head 42 is of a size that it cannot pass through the plate joiner aperture 40 and is in abutment with the outer surface of the first plate 10. A threaded spigot 50 extends from the shaft 44 to project beyond the outer surface of the second plate 12. A nut 46 is applied to the spigot 50 and tightened against the shaft 44 such that it is not tight against the second plate 12. The nut 46 retains the plate joiner in place while allowing it to slide along the arcuate length of the plate joiner apertures 40.

[0020] The basic assembly described so far is a permanent or semi-permanent assembly - that is to say, its

components are assembled during manufacture and are subsequently disassemble (if at all) only during a repair procedure and not when the apparatus is in use.

[0021] This embodiment makes use of quick-release securing pins 46 which are commercially available products and will be described only sufficiently to make their operation in the embodiment of the invention clear. Each securing pin 46 has a head from which a cylindrical shaft extends. A plurality of projections extend radially from the shaft in a locking condition (the normal state of the securing pins). A control button on the head can be depressed to cause or to allow withdrawal of the projections into the shaft. Each securing pin 46 cooperates with a pair of circular apertures through which the shaft is a close sliding fit. When the securing pin 46 is manually grasped by its head and the control button is depressed, the shaft can slide freely within the apertures. When the control button is released, and that part of the shaft from which the projections extend is prevented from passing through the apertures. The securing pins 46 are chosen to have a length that is slightly greater than the distance between the outer surfaces of the plates 10, 12, such that when inserted through a pair of apertures, while in the locking condition minimal axial movement is possible. Simpler fasteners, such as nuts and bolts may provide an alternative to the quick-release pins.

[0022] The apparatus further includes a plurality of pulleys 48, which are also of conventional design, and many readily available pulleys are suitable for use. These constitute removable sheaves. The significant features of a suitable pulley is that it has a pulley wheel carried for free rotation between plates, and that there is an eye extending through the plates parallel to the axis of rotation of the pulley wheel. The pulleys must also be dimensioned to operate properly with the lines to be used. It is preferable, but not essential, that the pulleys are of a type that can be installed on a line without the requirement to feed an end of the line through the pulley - for example, it may have plates that can be mutually rotated to an open position allow it to be installed upon a line.

[0023] The basic assembly and associated pins and pulleys when assembled for use will be together referred to as the "trolley".

[0024] In addition to the apparatus described above, an installation for performing a Tyrolean traverse includes several lines of rope or cable. A main line 60 is fixed when the installation is in use and extends between fixed locations at opposite ends of a space to be traversed. A lifting line 62 also spans the space to be traversed, but can be lengthened or shortened at one or both of its ends, for example by being secured to a winch. A control line 64 extends from one end of the traverse to the trolley.

[0025] The sequence of assembling apparatus for performing a Tyrolean traverse will now be described with reference to Figures 6 to 10.

1. The basic assembly is lifted such that the lifting line 62 passes between its plates 10, 12 (Figs 6 and 7).

2. Two pulleys 48A, 48B, referred to as the suspension pulleys, are installed such that their pulley wheels are carried on the main line 60. The eye of each pulley is passed between the plates 10, 12 towards opposite ends of the bridge region, and a respective securing pin 46 is passed through a pair of circular locating apertures 70 in the plates 10, 12 and through the eye to secure the suspension pulleys 48A, 48B to the basic assembly. The trolley, in its present state of construction, is now suspended from the main line 60 and has the lifting line 62 passing between its plates 10, 12, supported by the sheaves 30 (Fig 8).

3. A third pulley 48C, referred to as the lifting pulley, is installed on the lifting line 62, which may first be slackened to create a loop onto which the pulley 48C may be fitted. The lifting line 62 is then tightened, and the lifting pulley 48C is drawn into the void 14 (Fig 9).

4. The control line 64 is connected to the trolley. In this example, it is connected to a securing pin 46 placed in apertures 72 that pass through a leg region between the main line 60 and the lifting line 62, as shown in Fig 10.

[0026] The completed apparatus is shown in Figure 11.

[0027] An object to be moved (not shown) is carried on a load line 66 which is secured to the eye of the lifting pulley 48C. The height of the load can be controlled by shortening or lengthening the lifting line 62 to raise or lower the load, respectively. The position of the trolley on the main line 60 can be controlled by drawing in or letting out the control line 64. Shortening of the lifting line 62 causes the lifting pulley 48C to rise from a lowered position, as shown in Figure 11, until it enters into the void 14 within the plates 10, 12, as shown in Figure 12. This minimises the amount by which the load hanging from the lifting pulley 48C can swing as it travels along the main line 60.

[0028] In many installations, a single control line 64 will suffice, as shown in Figure 3, the trolley being pulled in one direction along the main line 60 using the control line, and returning in the opposite direction under the influence of gravity. In Figure 11, a second control line 68 is shown, which allows the trolley to be pulled in either direction on the main line 60. This could be connected directly opposite the first control line 64, or alternatively, as shown in Figure 11, to a securing pin 46 inserted through apertures 74 located further from the main line 60.

[0029] In situations where the main line 60 slopes significantly, as shown in Figure 13, it may be advantageous to position the plate joiners towards one end of the plate

joiner apertures 42 to maximise clearance between the plate joiners and the lifting line 62.

[0030] In another embodiment, the opeanble pulleys 48 described above are replaced with pulleys 80 that have a fixed frame that cannot be opened, as shown in Figure 13. The sequence of assembling the installation described above must be varied to ensure that the suspension pulleys 80A, 80B and the lifting pulley 80C are installed on their respective lines 60, 62 before the ends of the lines are secured. The construction and operation is otherwise as described above.

[0031] In a further embodiment, the suspension pulleys 48A, 48B are replaced by removable sheaves 86A, 86B, as shown in Fig 14. Each sheave 86 comprises a rope-engaging rim 88 carried on a roller bearing 90, as shown in Figure 15. Each sheave is carried on the shaft of a respective securing pin 46 that is passed through the locating apertures 70. This embodiment is more compact that the embodiments described above, and reduces the spacing between the main line 60 and the lifting line 62.

[0032] It is also possible to install a sheave 86 on a securing pin 46 in other apertures if it is desired to create a more complex route for lines to pass through the trolley, for example, to increase mechanical advantage over a load.

[0033] In order to add strength to the trolley, securing pins 46 may be inserted into apertures even if no external component is to be connected, for example as shown in Figures 11, 13 and 16. This can help to prevent the plates 10, 12 spreading. A tubular cylindrical spacer may be carried on the shaft of one or more securing pin 46A to prevent the space between plates 10, 12 from closing. In this example, a spacer is installed using apertures 76 at the centre of the bridge region.

Claims

1. A trolley for lifting and/or moving a load on one or more lines comprising:

a. first and second spaced plates (10, 12),
b. at least two fixed sheaves (30) that are disposed for rotation about respective parallel axes between the first and second plates (10, 12), and **characterised by**
c. a removable sheave component (48) that is, while in use, disposed for rotation about an axis parallel to that of the fixed sheaves between or adjacent to the first and second plates,

wherein the removable sheave components is, while in use, carried on a shaft (24) that is connected to the plates, which connection is capable of being disconnected to permit removal of the removable sheave components (48) from connection with the plates (10, 12).

2. A trolley according to claim 1 including two or more removable sheave components (48).

3. A trolley according to claim 1 or claim 2 in which one or more of the removable sheave components is constituted by a pulley wheel that is part of a pulley assembly (48A, 48B) that includes a body upon or within which the pulley wheel is carried for rotation.

4. A trolley according to claim 4 in which part of the body is disposed between the plates (10, 12) to enable it to be connected to the plates.

5. A trolley according to claim 5 in which the body includes an eye, a securing pin extending through the eye and apertures in the plates to secure the body to the plates.

6. A trolley according to any preceding claim in which one or more of the removable sheave components is constituted by a sheave that includes a rim (42) that is carried on a hub, which hub includes a bearing to permit free rotation of the rim about an axis passing through the hub.

7. A trolley according to claim 9 in which the sheave is connected to the plates for use by a removable securing pin (46) that passes through the hub and through apertures in the plates to secure the hub to the plates

8. A trolley according to any preceding claim in which one or more sheave component rotates about a respective axis that passes through the plates.

9. A trolley according to any preceding claim in which one or more sheave component is wholly or partly disposed between the plates.

10. A trolley according to any preceding claim in which each plate includes a void being a recess (14) that extends from an edge of the plate.

11. An installation for lifting and/or moving a load that includes a trolley according to any preceding claim, a main line (60) that extends between two fixed anchorages and which, in use, passes between the plates (10, 12) of the trolley, whereby the main line (60) makes contact with one or more sheave or sheave component of the trolley and whereby the trolley can be suspended from and travel along the main line (60); and a control line (64) that is connected to the trolley whereby the trolley can be drawn along the main line.

12. An installation according to claim 11 further including a lifting line (62) that passes between the plates (10, 12) of the trolley and over two or more sheaves or

sheave components of the trolley, the lifting line carrying, between the sheaves or sheave components, a device (48C) for connection with a load.

13. An installation according to claim 12 in which the device for connection with a load includes a pulley.

14. An installation according to claim 11 or claim 12 as dependent from claim 10 whereby the device for connection with a load (48C) can be at least partially received within the void (14).

15. A method of installing an installation according to any one of claims 11 to 14 comprising:

a. installing a main line (60) between two fixed anchorages;
b. in the absence of a removable sheave component (48), passing part of the main line (60) between the plates (10, 12) of the trolley;
c. passing part of a lifting line (64) between the plates of the trolley;
d. installing one or more removable sheave component (48) to retain the main line (60) between the plates (10, 12).

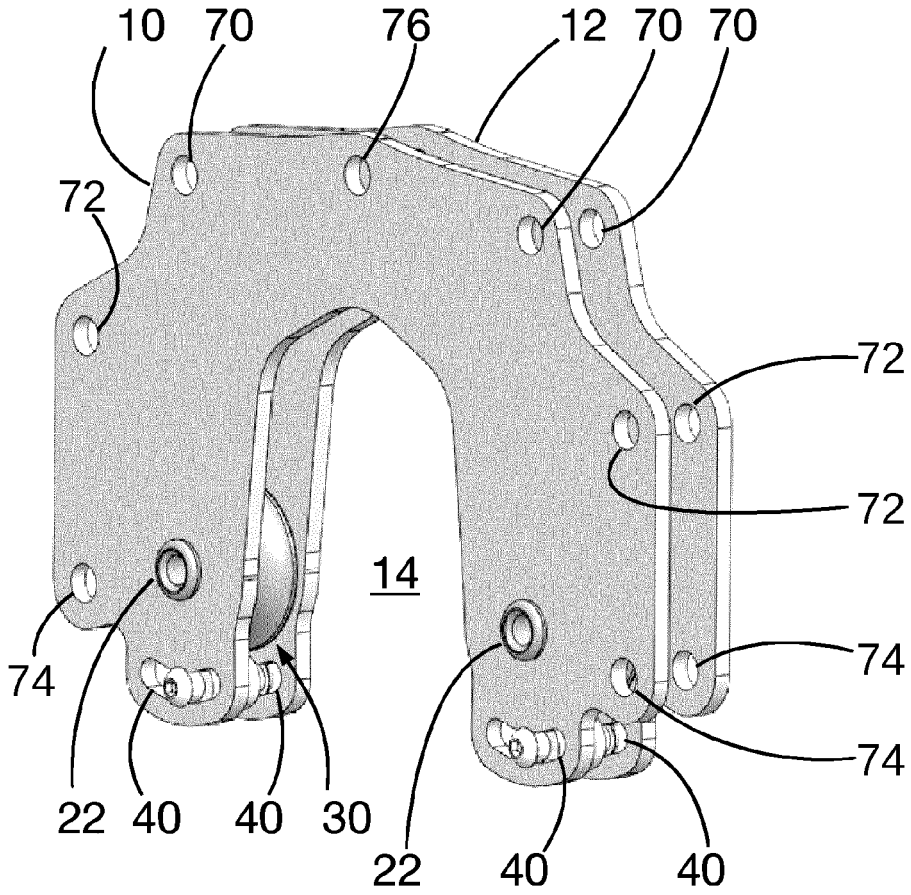
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Fig 1

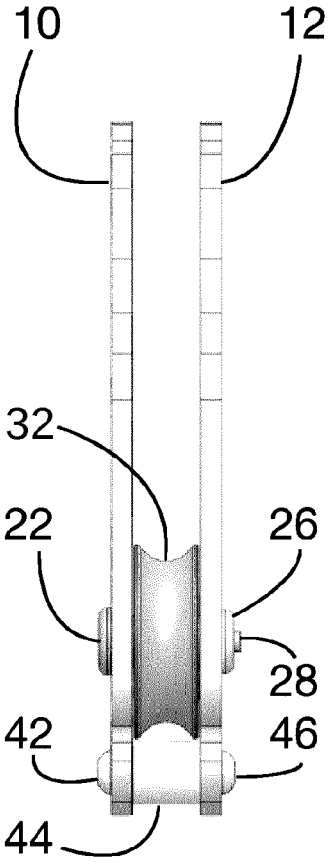
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Fig 2

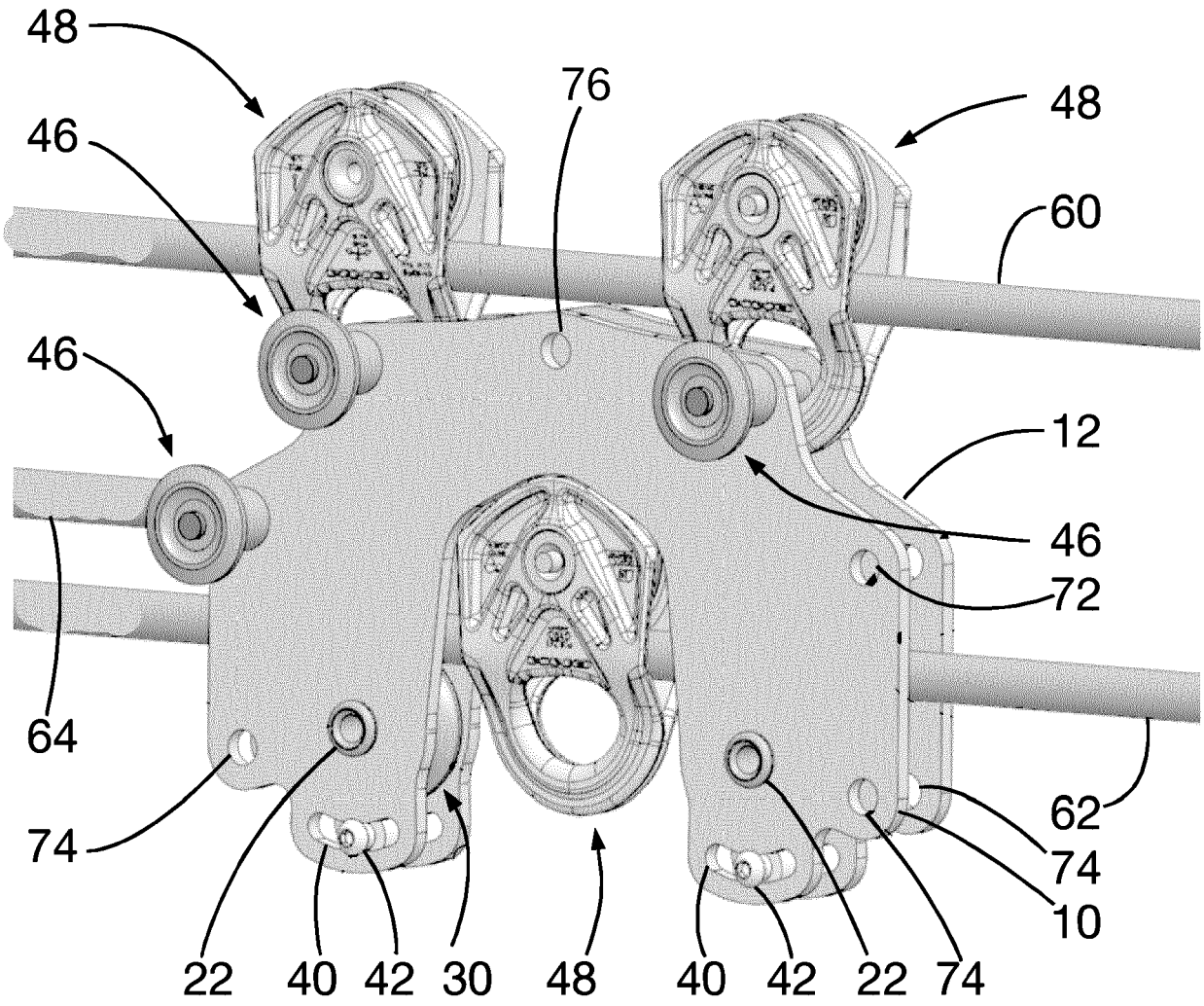


Fig 3

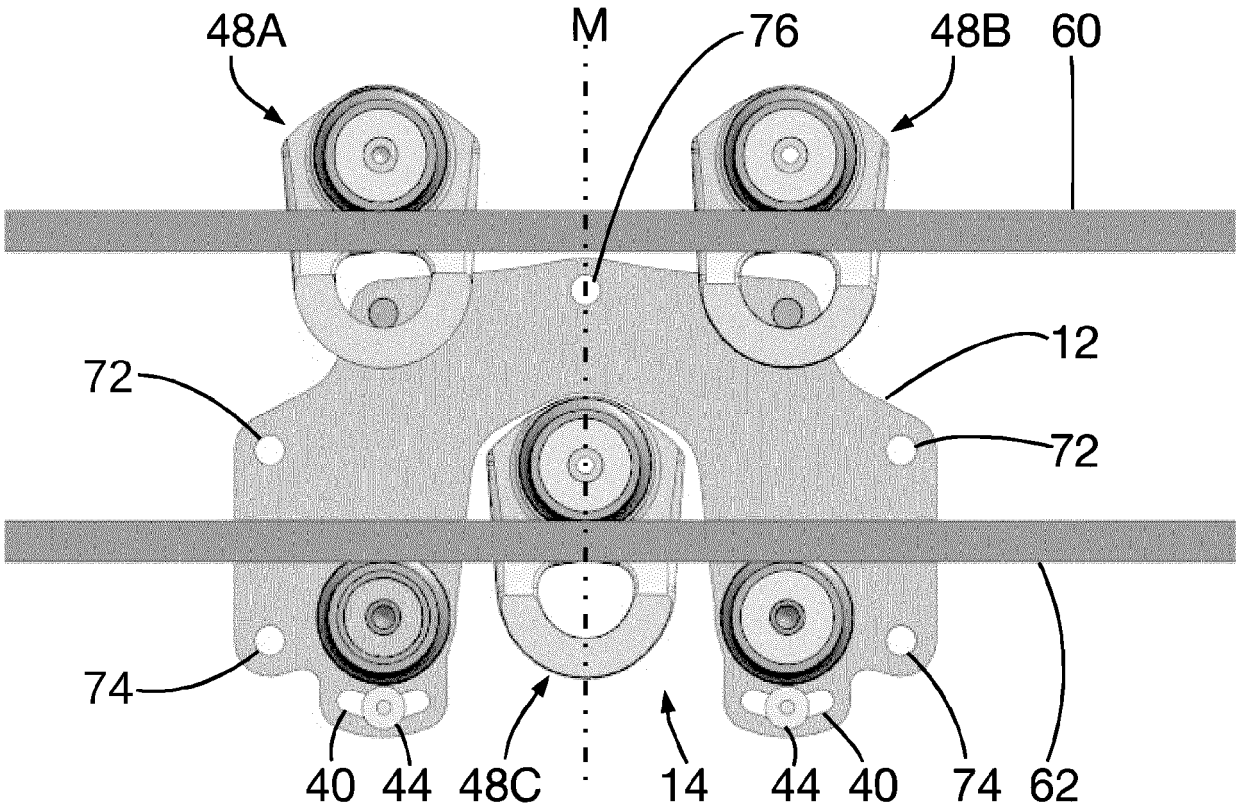


Fig 4

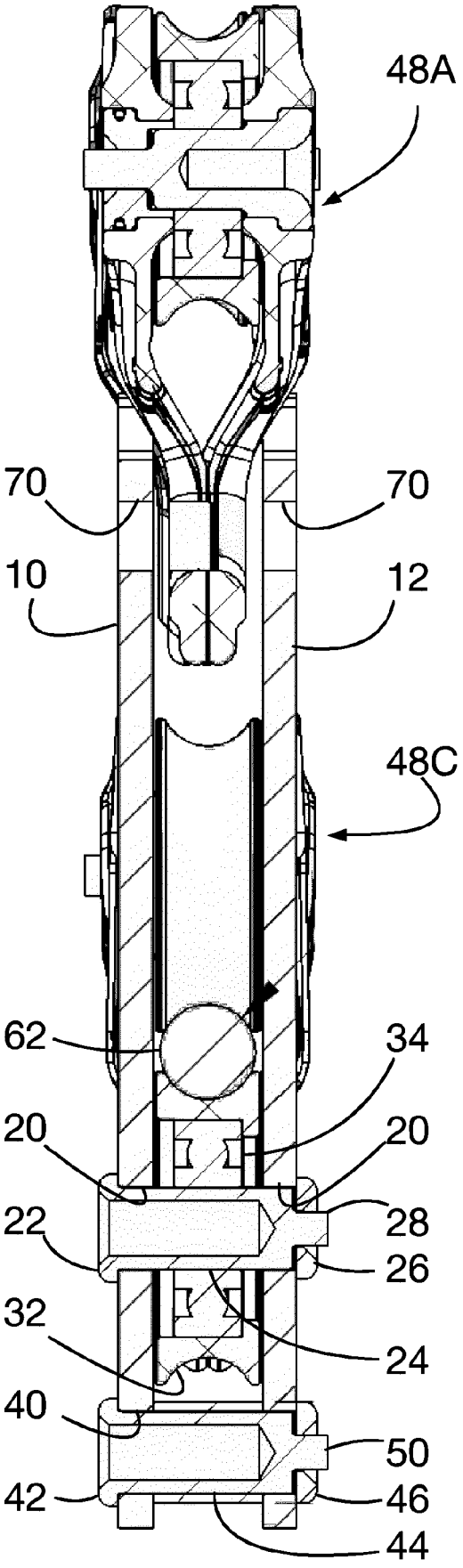


Fig 5

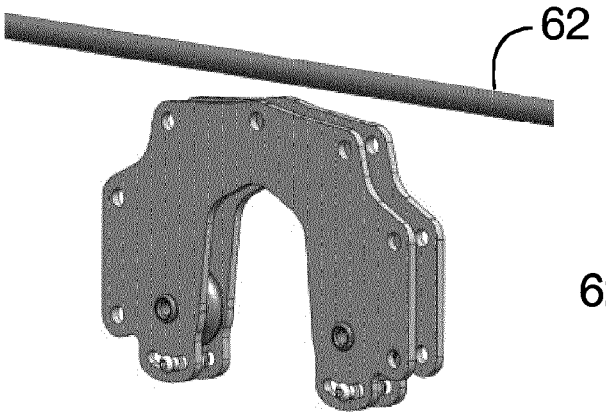


Fig 6

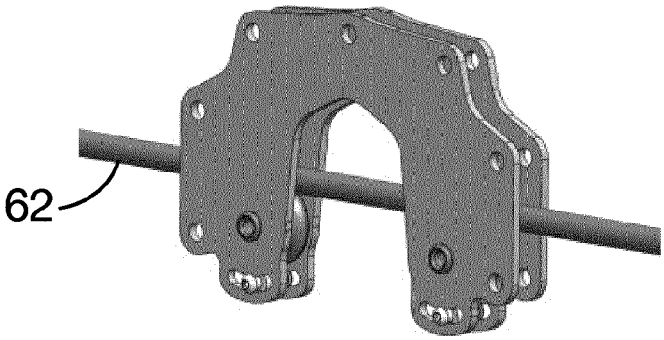


Fig 7

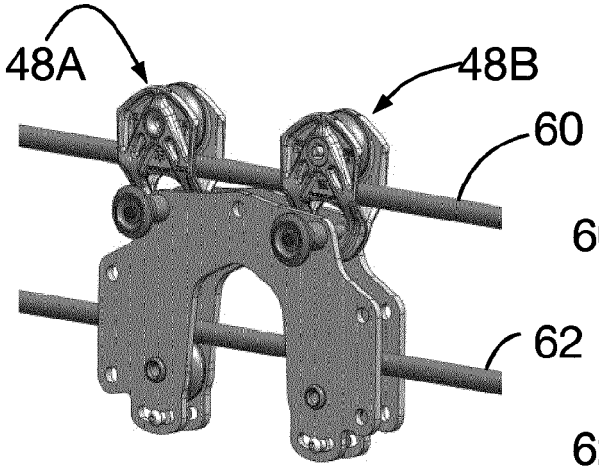


Fig 8

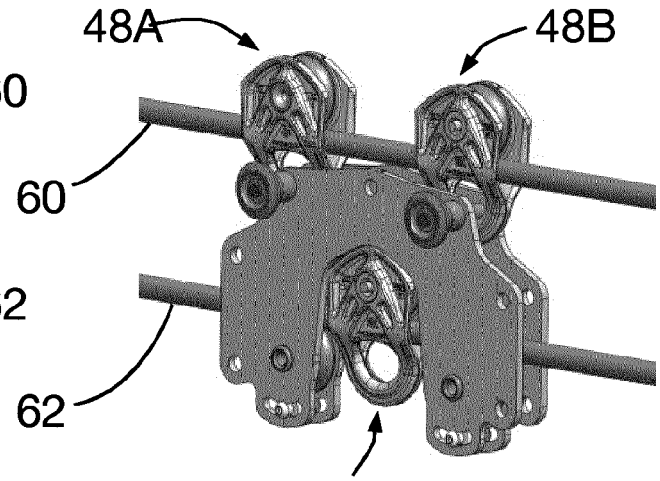


Fig 9

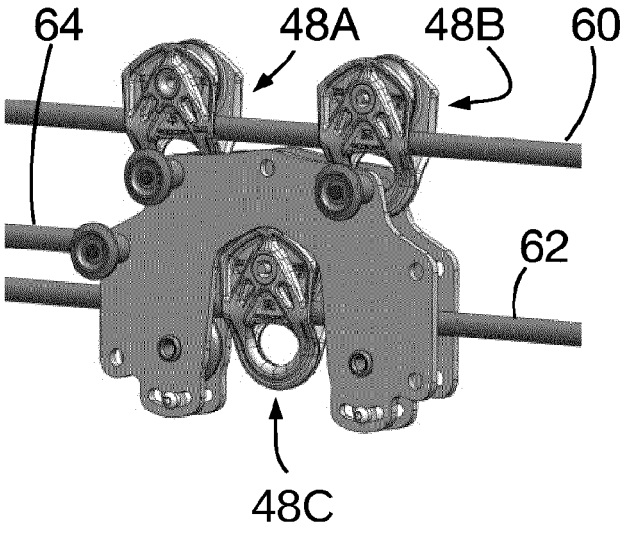
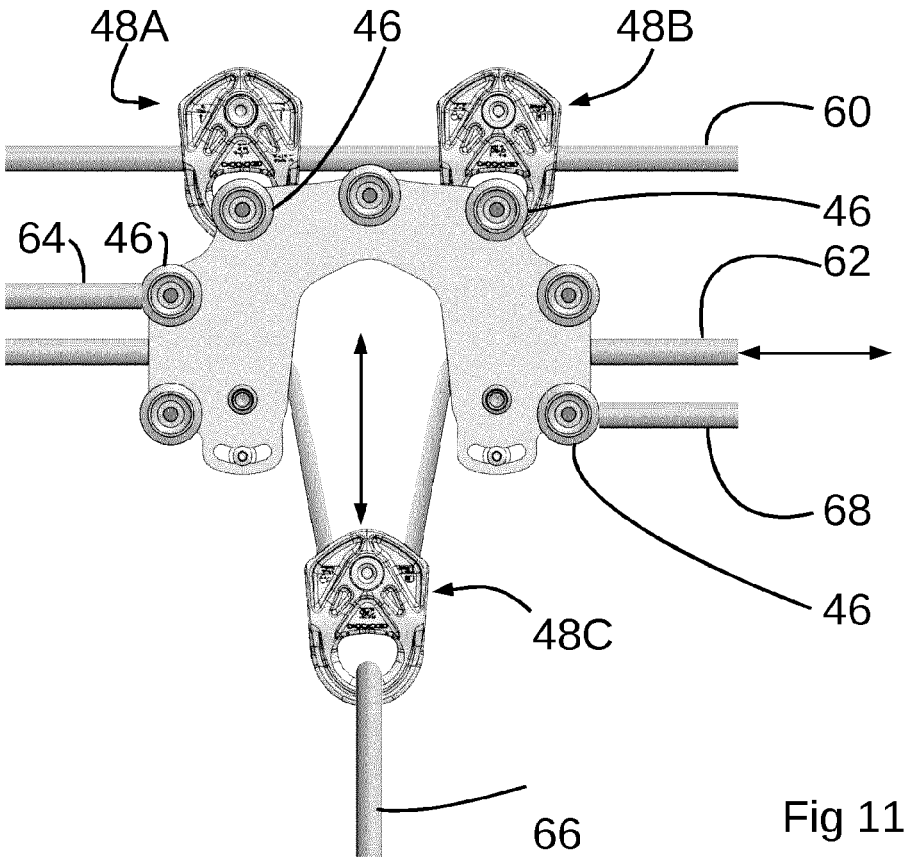


Fig 10


48A
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48B
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46
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62
68
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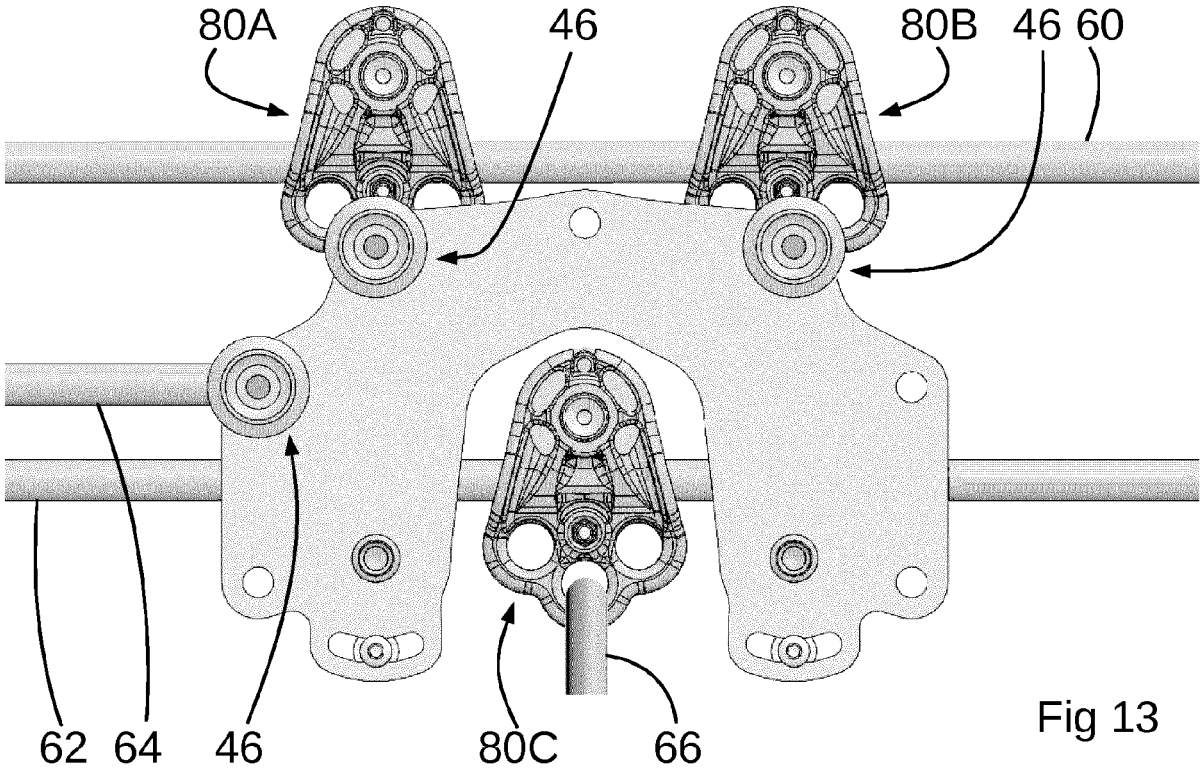
48C
66

Fig 11


80A
46
80B
46
60
62
64
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80C
66

Fig 13

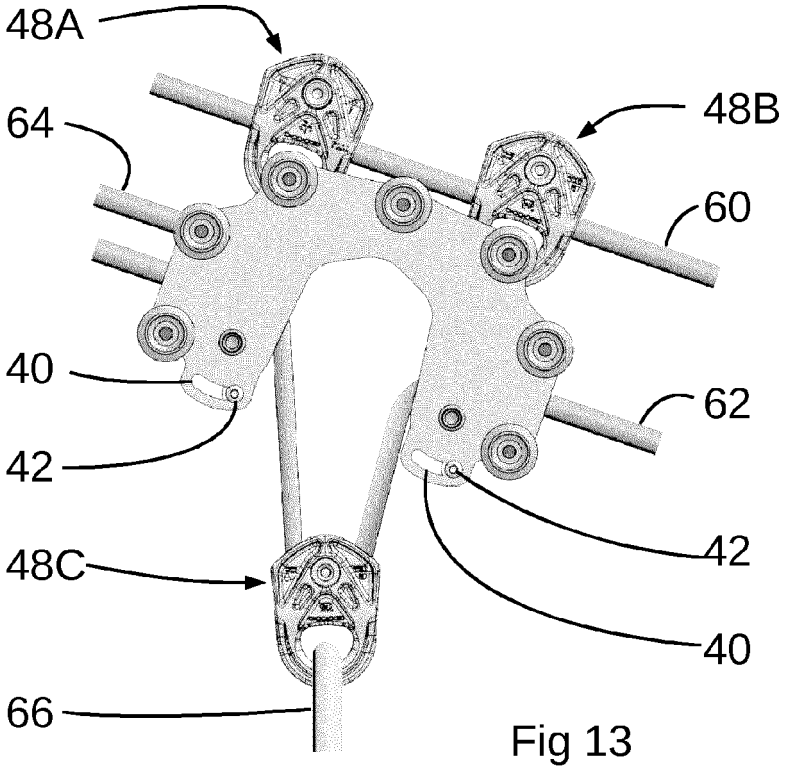

Fig 13

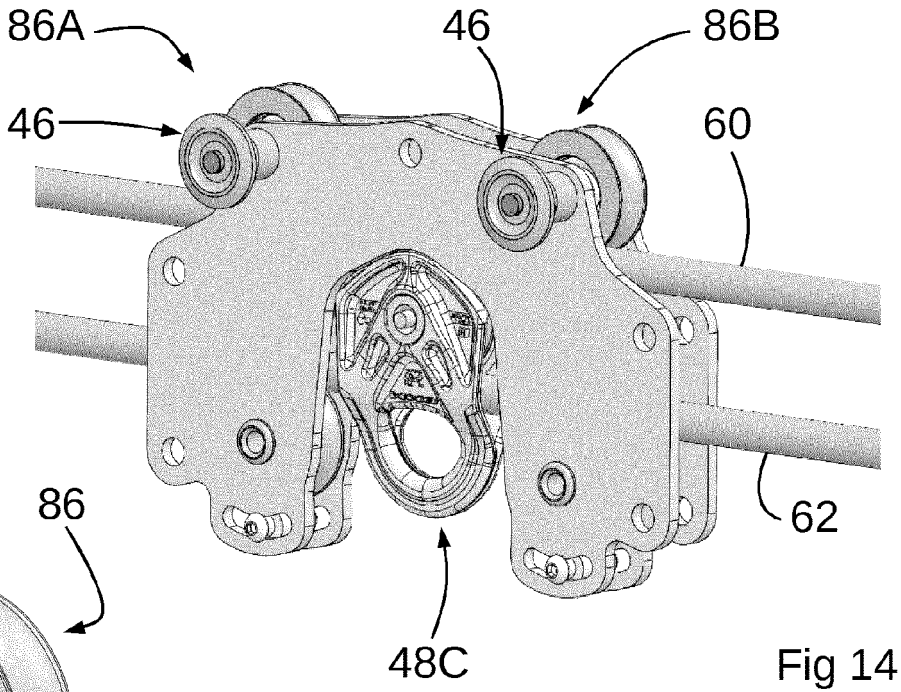

Fig 14

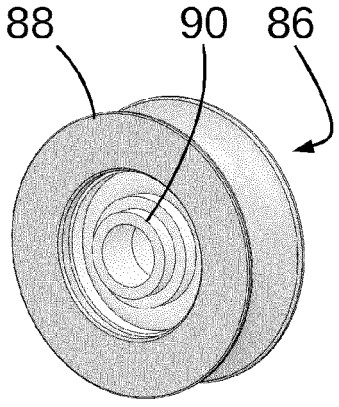

Fig 15

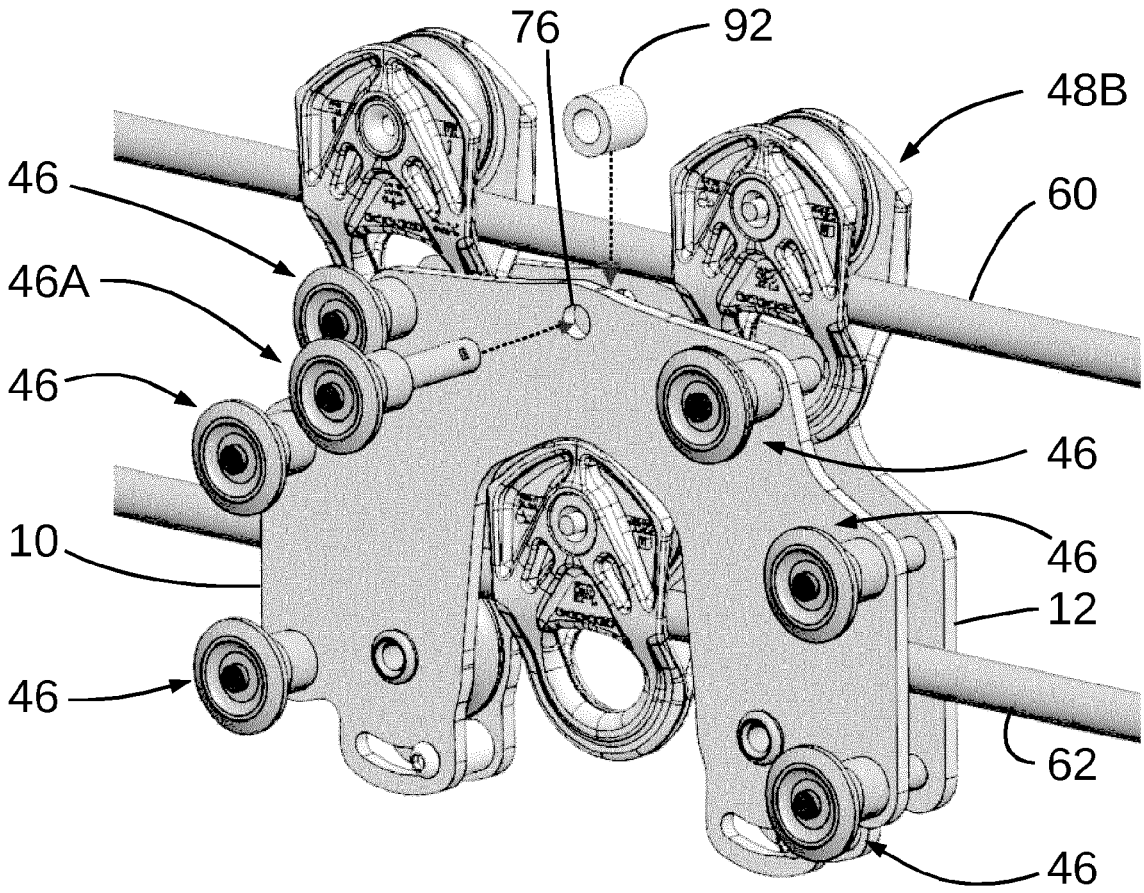

Fig 16

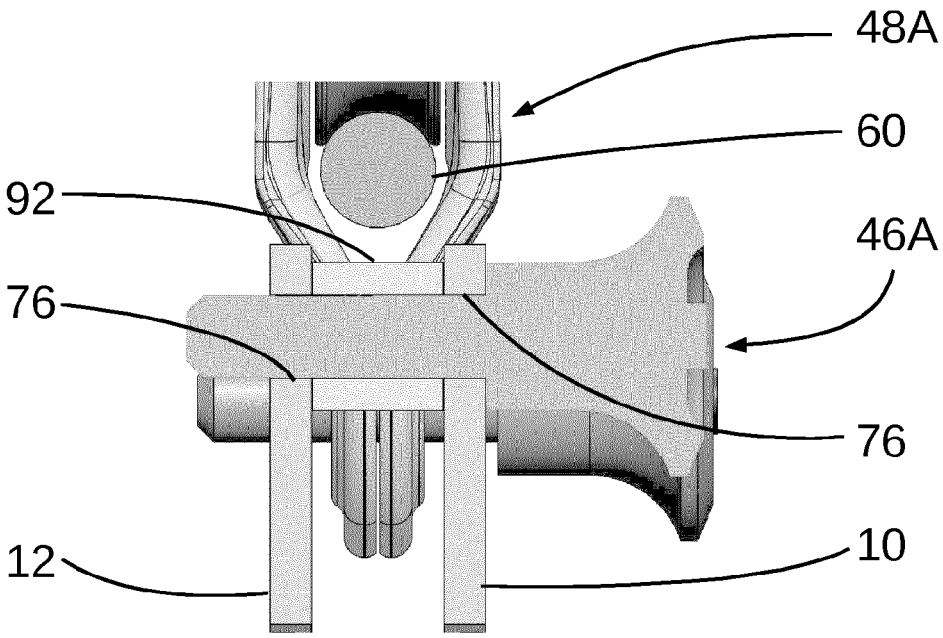

Fig 17

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EUROPEAN SEARCH REPORT

Application Number
EP 18 21 5550

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A,D	EP 3 159 052 A1 (TREEMAGINEERS LTD [GB]) 26 April 2017 (2017-04-26) * the whole document *	1,11,15	INV. B66D3/04 A63G21/22 B61B7/02
A	US 4 347 938 A (GORSH JOSEPH W) 7 September 1982 (1982-09-07) * abstract; figure 2 *	1,11,15	B66C21/00
A	US 3 094 222 A (MCALLISTER JESS L) 18 June 1963 (1963-06-18) * figure 1 *	1,11,15	

TECHNICAL FIELDS SEARCHED (IPC)

B66D
A63G
B61B
B66C
B61K

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	9 May 2019	Verheul, Omiros

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 18 21 5550

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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09-05-2019

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 3159052 A1	26-04-2017	EP 3159052 A1	26-04-2017
		GB 2543561 A	26-04-2017
		GB 2543959 A	03-05-2017
US 4347938 A	07-09-1982	NONE	
US 3094222 A	18-06-1963	NONE	

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- EP 3159052 A **[0003]**