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(54) LIFTING APPARATUS

(57) A lifting apparatus (10) comprising a support member (100) which extends from a first support member end (102) to a second support member end (104); a first support cord (200) which extends from the support member (100) at a first support cord anchor end (202) to a first support cord free end (204); and a second support cord (300) which extends from the support member (100) at a second support cord anchor end (302) to a second support cord free end (304). The lifting apparatus (10) further comprises an actuator assembly (400). The first support cord (200) and the second support cord (300) are coupled to the actuator assembly (400). The actuator assembly (400) is operable to control the first support cord (200) and the second support cord (300) to change between: a **first configuration** in which a first length of the first support cord (200) and the second support cord (300) extends from the support member (100) to their respective free end (204, 304); and a **second configuration** in which a second length of the first support cord (200) and the second support cord (300) extends from the support member (100) to their respective free end (204, 304).

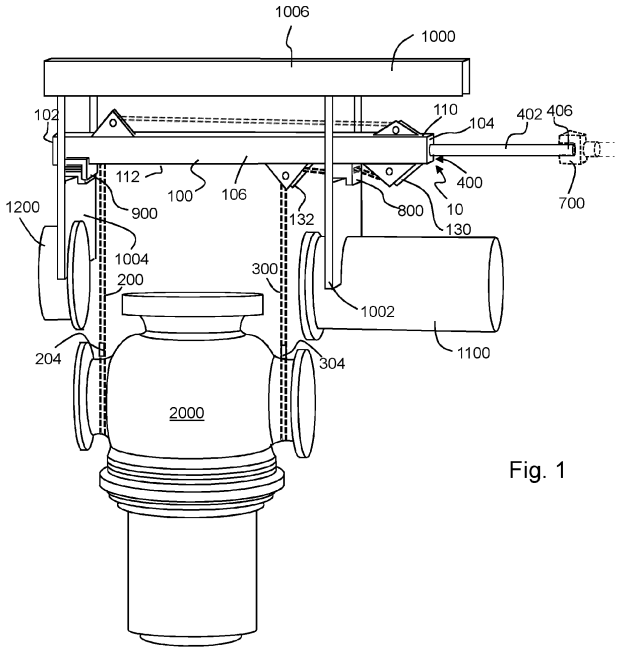

Fig. 1

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Description

FIELD

[0001] The present disclosure relates to a lifting apparatus.

BACKGROUND

[0002] It is a requirement to provide a safe method of lowering and/or lifting heavy components from one location to another, for example when removing and/or fitting parts of an assembly.

[0003] A winch is a common solution to this. However, a winch requires an anchor point above it from which it can be suspended. In some examples, where access is limited above the component being removed and/or replaced, it is not possible to fit a winch.

[0004] A known solution is to use a scissor table which can be located under the working area to support the component while it is lowered from, and/or raised to, its mounting location. However, this may result in a top heavy (and hence unstable) structure which may risk injury of the user.

[0005] Another possible solution used is to remove part or all of the structure above where the component is to be mounted, allowing space for a winch to be mounted above. However, this solution leads to significant downtime, disruption and risk to the integrity of the surrounding structure.

[0006] Hence a lifting apparatus that is configured to enable the safe lifting and/or lowering of a heavy component in a location with limited access is highly desirable.

SUMMARY

[0007] According to the present disclosure there is provided an apparatus as set forth in the appended claims. Other features of the invention will be apparent from the dependent claims, and the description which follows.

[0008] Accordingly there may be provided a lifting apparatus (10) comprising: a support member (100) which extends along an x-axis from a first support member end (102) to a second support member end (104) and extends from a first support member side (106) to a second support member side (108) along a y-axis; and which extends from an upwardly facing side (110) to a downwardly facing side (112) along a z-axis.

[0009] The lifting apparatus (10) may comprise a first support cord (200) which is operable to extend from the support member (100) at a first support cord anchor end (202) to a first support cord free end (204). The lifting apparatus (10) may comprise a second support cord (300) which extends from the support member (100) at a second support cord anchor end (302) to a second support cord free end (304). The lifting apparatus (10) may comprise an actuator assembly (400); the first support cord (200) and the second support cord (300) being coupled to the actuator assembly (400), and the actuator assembly (400) is operable to control the first support cord (200) and the second support cord (300) to change between: a **first configuration** in which a first length of the first support cord (200) and the second support cord (300) extends from the support member (100) to their respective free end (204, 304); and a **second configuration** in which a second length of the first support cord (200) and the second support cord (300) extends from the support member (100) to their respective free end (204, 304). The first length may be less than the second length.

[0010] The support member (100) may have a length (L) which extends in the direction of the x-axis, a width (W) which extends in the direction of the y-axis and a height (H) which extends in the direction of the z-axis.

[0011] The height (H) may be in the range of 40 mm to 140mm and the width (W) may be in the range of 70mm to 120mm.

[0012] The actuator assembly (400) may be operable to control the speed at which the first support cord (200) and the second support cord (300) are drawn from and into the support member (100) so that they are drawn from and/or into the support member (100) at the same speed.

[0013] The actuator assembly (400) may be operable to maintain the same tension in the first support cord (200) and the second support cord (300) as the first support cord (200) and the second support cord (300) are drawn from and/or into the support member (100).

[0014] The actuator assembly (400) may comprise a shuttle (600) with a support cord engagement end (602). The shuttle (600) may be constrained to travel in the direction of the x-axis of the support member (100). The first support cord (200) and the second support cord (300) may be engaged with the shuttle support cord engagement end (602) such that movement of the shuttle (600) in the direction of the x-axis moves the first support cord (200) and the second support cord (300) between the **first configuration** and the **second configuration.**

[0015] The support member (100) may define a shuttle guide path (610) which extends in the direction of the x-axis. The first support cord (200) may extend from the first support cord anchor end (202) on the downwardly facing side (112) of the support member (100), across the shuttle support cord engagement end (602), and then to a first support cord first guide feature (120) on the upwardly facing side (110). The second support cord (300) may extend from the second support cord anchor end (302) on the upwardly facing side (110) of the support member (100), across the shuttle support cord engagement end (602), and then to a second support cord first guide feature (130) on the downwardly facing side (112) of the support member (100). Hence movement of the shuttle (600) in the direction of the x-axis towards the first support member end (102) draws the first support cord free end (204) and the second support cord free end

(304) towards the support member (100); and movement of the shuttle (600) in the direction of the x-axis towards the second support member end (104) enables the first support cord free end (204) and the second support cord free end (304) to be drawn away from the support member (100).

[0016] The actuator assembly (400) may comprise an actuator arm (402) which extends between a shuttle coupling end (404) to an actuator arm free end (406). The shuttle (600) may be coupled to the shuttle coupling end (404) of the actuator arm (402) such that the shuttle (600) is moveable with the shuttle coupling end (404) along the x-axis. The motion of the actuator arm (402) may cause the shuttle (600) to travel in the direction of the x-axis.

[0017] The actuator arm (402) may be constrained to travel in the direction of the x-axis of the support member (100) to thereby draw the shuttle (600) along the x-axis.

[0018] The actuator arm (402) may be operable to extend from the support member (100) in the direction of the x-axis for engagement with a tool for moving the actuator arm (402) in a direction along the x-axis such that: in the **first configuration** the free end (406) of the actuator arm (402) is a **first distance** from the support member (100); and in the **second configuration** the free end (406) of the actuator arm (402) is a **second distance** from the support member (100). The **first distance** may be less than the **second distance.**

[0019] The first support cord first guide feature (120) may be spaced apart from a first support cord second guide feature (122) in the direction of the x-axis. The first support cord first guide feature (120) may be located along the x-axis closer to the second support member end (104) than to the first support member end (102). The first support cord second guide feature (122) may be located along the x-axis closer to the first support member end (102) than to the second support member end (104). The first support cord (200) may extend from the first support cord anchor end (202) in a first direction along the x-axis towards the support cord engagement end (602) of the shuttle (600), the first support cord (200) then extending around the support cord engagement end (602) of the shuttle (600). The first support cord (200) may be then extend from the support cord engagement end (602) of the shuttle (600) to the first support cord first guide feature (120) in a second direction along the x-axis. The first support cord (200) may then extend from the first support cord first guide feature (120) to the first support cord second guide feature (122) in the first direction along the x-axis. The first support cord (200) may then extend from the first support cord second guide feature (122) to the first support cord free end (204).

[0020] The second support cord first guide feature (130) may be spaced apart from a second support cord second guide feature (132) in the direction of the x-axis. The second support cord first guide feature (130) may be located along the x-axis closer to the second support member end (104) than to the first support member end (102). The second support cord second guide feature (132) may be located along the x-axis closer to the first support member end (102) than to the second support member end (104). The second support cord (300) may extend from the second support cord anchor end (302) in the first direction along the x-axis towards the support cord engagement end (602) of the shuttle (600). The second support cord (300) may then extend around the support cord engagement end (602) of the shuttle (600). The second support cord (300) may then extend from the support cord engagement end (602) of the shuttle (600) to the second support cord first guide feature (130) in the second direction along the x-axis. The second support cord (300) may be then extend from the second support cord first guide feature (130) to the second support cord second guide feature (132) in the first direction along the x-axis. The second support cord (300) may then extend from the second support cord second guide feature (132) to the second support cord (300) free end (304).

[0021] The first support cord (200) and the second support cord (300) may be located adjacent to one another in the y-axis across the width of the shuttle (600).

[0022] The first support member end (102), the first support cord second guide feature (122), the second support cord second guide feature (132) and the second support member end (104) may be provided in series along the x-axis.

[0023] The first support cord second guide feature (122) may be located on the upwardly facing side (110). The second support cord first guide feature (130) may be located on the downwardly facing side (112).

[0024] The lifting apparatus (10) may further comprise a location block (800) and a shim block (900) for engagement with a support structure (1000). The location block (800) may be fixed to the downwardly facing side (112) of the support member (100). The shim block (900) may be located on and moveable along the downwardly facing side (112) of the support member (100). The shim block (900) may comprise a first part (902) engaged with, and slideable relative to, a second part (904) in a direction in the z-axis.

[0025] Hence there is provided a lifting apparatus that is configured and operable to enable the safe lifting and/or lowering of a heavy component in a location with limited access.

BRIEF DESCRIPTION OF THE FIGURES

[0026] Embodiments of the invention will now be described by way of example only with reference to the figures, in which:

Figure 1 shows a diagrammatic representation of a first side on view of an example of a lifting apparatus according to the present disclosure, the lifting apparatus shown in situ carried on a support structure and

supporting a component;

Figure 2 shows an end on view of the lifting apparatus shown in figure 1;

Figure 3 shows the same view as presented in figure 1, with much of the support structure removed, with the lifting apparatus in a **first configuration;**

Figure 4 shows the same view as presented in figure 3, with the lifting apparatus in a **second configuration;**

Figure 5 shows a plan view of the lifting apparatus, showing an upwardly facing side;

Figure 6 shows an underside view of the lifting apparatus, showing a downwardly facing side;

Figure 7 shows the first side view of the lifting apparatus, with part of the first side removed to show internal features of the lifting apparatus;

Figure 8 shows a second side view of the lifting apparatus, with part of the second side removed to show internal features of the lifting apparatus;

Figure 9 shows the first side of the lifting apparatus, with part of the first side removed, in an example mounting process;

Figure 10 shows the same view as figure 3, with part of the first side removed, with the lifting apparatus in the **first configuration;**

Figures 11, 12 show the same view as figure 4, with part of the first side removed, with the lifting apparatus in the **second configuration;**

Figures 13, 14 show views of a shuttle of the lifting apparatus;

Figure 15 shows an end on view of the lifting apparatus with part of the end removed to show internal features;

Figures 16, 17 show different views of a location block which forms part of the lifting apparatus of the present disclosure; and

Figures 18, 19 show different views of a shim block which forms part of the lifting apparatus of the present disclosure.

DETAILED DESCRIPTION

[0027] The present disclosure relates to a lifting apparatus 10. The present disclosure relates to a lifting apparatus 10 for lifting and/or lowering an object (e.g. a component) 2000. The lifting apparatus 10 may be configured for being supported on a support structure 1000 and operable to carry / support and adjust the position of a component 2000. The lifting apparatus 10 may be configured for being supported on a support structure 1000 to which the component 2000 is to be attached. The structure 1000 may be any assembly, and the object 2000 may be any sub component of the structure 1000. In one example the structure 1000 may be part of a vehicle (for example the structure of a ship / watercraft) and the object 2000 may be a valve which forms a part of the structure of the ship. By way of non-limiting example, as shown in the figures, the valve may form a fluid connection between, and be fitted between, a first duct 1100 and a second duct 1200.

[0028] The figures show a lifting apparatus 10, or parts thereof, according to the present disclosure.

[0029] Figure 1 illustrates the lifting apparatus 10 of the present disclosure in situ, fitted to a support structure 1000 and carrying an object 2000. In the example shown the lifting apparatus 10 is shown located on support elements 1002, 1004 which form part of, and extend from, a main body 1006 of the support structure 1000. The support elements 1002, 1004 may be flanges/-beams/members (for example an H-frame) extending from the structure 1000 configured for supporting the object 2000 (e.g., where the object 2000 may be a valve).

[0030] In the example shown, the object 2000 is configured to be fitted to the support structure 1000, for example fitted to one or both of the support elements 1002, 1004, or another part of the support structure 1000. The support elements 1002, 1004 may be plates provided to connect to the lifting apparatus 10 to hold it in place. As shown in the figures, the support elements 1002, 1004 may have edges, lands and/or surfaces which the lifting apparatus 10 sits on. The support structure 1000 may be part of a larger structure, for example a housing, a vehicle (e.g. a ship (i.e. a water vessel), or other vehicle), a building (e.g. a house or a factory), or a module / sub-unit of the larger structure.

[0031] In the example shown there is only a small clearance height above the edges of the support elements 1002, 1004 and the main body 1006. The structure 1000 may also include other features above the main body 1006.

[0032] The lifting apparatus 10 comprises a support member 100. The support member 100 may be elongate. For example, the support member 100 may be longer than it is wide and/or high.

[0033] The support member 100 may have a first support member end 102, a second support member end 104, a first support member side 106, a second support member side 108, (in use, e.g. as shown in the figures) an upwardly facing side 110 and (in use, e.g. as shown in the figures) a downwardly facing side 112.

[0034] As illustrated in figures 2, 5, 6, 10, the lifting apparatus 10 may extend along an x-axis from the first support member end 102 to the second support member end 104. The lifting apparatus 10 may extend from the first support member side 106 to the second support member side 108 along a y-axis. The lifting apparatus may extend from the upwardly facing side 110 to the downwardly facing side 112 along a z-axis. The y-axis may be at right angles to the x-axis. The z-axis may be at right angles to the x-axis and the y-axis.

[0035] The lifting apparatus 10 may comprise a first support cord 200 which is operable to extend from the support member 100 at a first support cord anchor end 202 to a first support cord free end 204.

[0036] The first support cord 200 may comprise a long, slender material (e.g. a flat strip, for example narrower

than it is wide), such as a strap of webbing (for example polyester webbing). The first support cord 200 may be operable to extend from the support member 100. For example, the first support cord 200 may be operable to extend from the support member 100 in the direction of the z-axis and/or at an angle to the x-axis and y-axis. The first support cord anchor end 202 may be fixed to the support member 100. The first support cord anchor end 202 may be fixed to the support member 100 between the first support member end 102 and the second support member end 104. The first support cord free end 204 may be located external to the support member 100 (for example as illustrated in figure 9).

[0037] The lifting apparatus 10 may comprise a second support cord 300 which is operable to extend from the support member 100 at a second support cord anchor end 302 to a second support cord free end 304.

[0038] The second support cord 300 may comprise a long, slender material (e.g. a flat strip, for example narrower than it is wide), such as a strap of webbing (for example polyester webbing). The second support cord 300 may be operable to extend from the support member 100. For example, the first support cord 200 may be operable to extend from the support member 100 in the direction of the z-axis and/or at an angle to the x-axis and y-axis. The second support cord anchor end 302 may be fixed to the support member 100. The second support cord anchor end 302 may be fixed to the support member 100 between the first support member end 102 and the second support member end 104. The second support cord free end 304 may be located external to the support member 100 (for example as illustrated in figure 9).

[0039] The support cords 200, 300 may be configured to be attached to the object 2000 in any appropriate manner. For example, as illustrated in figure 2, the free ends 204, 304 of the support cords 200, 300 may be wrapped around the object 2000 in a choke hitch. In other examples the support cords 200, 300 may be configured to be attached to the object 2000 using an alternative appropriate coupling means, for example hooks, couplings etc.

[0040] The support cords 200, 300 may be configured to support the required weight. For example, the support cords 200, 300 may be rated to 250Kg. Hence the lifting apparatus 10 as a whole may be rated to 500kg.

[0041] The lifting apparatus 10 may further comprise an actuator assembly 400.

[0042] The first support cord 200 and the second support cord 300 may be coupled to the actuator assembly 400. The actuator assembly 400 may be operable to control (e.g. vary and/or govern) the first support cord 200 and the second support cord 300 to change between a **first configuration** and a **second configuration.**

[0043] In the **first configuration** a first length of the first support cord 200 and the second support cord 300 extend from the support member 100 to their respective free end 204, 304. For example, as shown in figure 3, in the **first configuration** a first length of the first support cord 200 and the second support cord 300 may extend downwards from the downwardly facing side 112 of the support member 100 to their respective free end 204, 304. In the **second configuration** a second length of the first support cord 200 and the second support cord 300 extends from the support member 100 to their respective free end 204, 304. For example, as shown in figure 4, in the **second configuration** a second length of the first support cord 200 and the second support cord 300 may extend downwards from the downwardly facing side 112 of the support member 100 to their respective free end 204, 304. The first length is less than the second length.

[0044] As illustrated in figures 2, 5, 6, 10 the support member 100 has a length L which extends in the direction of the x-axis, a width W which extends in the direction of the y-axis and a height H which extends in the direction of the z-axis.

[0045] The overall height H of the lifting apparatus 10 (e.g. the distance it extends in the z-axis) may be in the range of 40 mm to 140mm. The overall height H of the lifting apparatus 10 may be in the range of 40 mm to 120mm. The overall height H of the lifting apparatus 10 may be in the range of 40 mm to 80mm.

[0046] The width W may be in the range of 70mm to 120mm. The width W may be in the range of 70mm to 100mm. The width W may be in the range of 70mm to 90mm.

[0047] As illustrated in figures 7 to 14, the actuator assembly 400 may comprise a shuttle 600 with a support cord engagement end 602.

[0048] As illustrated in figures 7 to 12 the shuttle 600 may be constrained (i.e. operable) to travel in the direction of the x-axis of the support member 100. The support member 100 may define a shuttle guide path 610 which extends in the direction of the x-axis.

[0049] That is to say, the support member 100 may define a channel 612 which extends in the direction of the x-axis to define the shuttle guide path 610, and the shuttle 600 travels along the guide path 610 (and hence also travels along the channel 612).

[0050] The first support member side 106, the second support member side 108, the upwardly facing side 110 and the downwardly facing side 112 may be defined by walls of the support member 100 which define the channel 612.

[0051] The shuttle 600 may comprise a central body flanked by shoes 620 to help reduce the turning motion induced on the shuttle 600 during use. The shoes 620 help to guide the shuttle 600 along the shuttle guide path 610. That is to say, the shoes 620 are configured to keep the shuttle 600 aligned correctly in the guide path 610, and thus prevent the shuttle 600 from turning/twisting when under load.

[0052] The shuttle 600 may run along the internal length of the support member 100. The shuttle 600 is thus configured to carry the full load being lifted by both of the cords 200, 300.

[0053] The first support cord 200 and the second sup-

port cord 300 are engaged with the shuttle support cord engagement end 602 of the shuttle 600 such that movement of the shuttle 600 in the direction of the x-axis moves the first support cord 200 and the second support cord 300 to achieve the **first configuration** and the **second configuration.**

[0054] That is to say, operation of the actuator assembly 400 to move the shuttle 600 along the guide path 610 to allow the length of the cords 200, 300 in the channel 612 to shorten, in turn allows the length of the cords 200, 300 extending away from the lifting apparatus 10 to lengthen, so that the lifting apparatus 10 may change from the **first configuration** to the **second configuration.** Hence, in the example shown in the figures, moving the shuttle 600 away from the first end 102 towards the second end 104 (i.e., from left to right in figures 9 to 12) results in the length of the cords 200, 300 extending away from the lifting apparatus 10 to increase.

[0055] Conversely, operation of the actuator assembly 400 to move the shuttle 600 along the guide path 610 to allow the length of the cords 200, 300 in the channel 612 to increase, causes the length of the cords 200, 300 extending away from the lifting apparatus 10 to shorten, so that the lifting apparatus 10 may change from the **second configuration** to the **first configuration.**

[0056] Hence, in the example shown in the figures, moving the shuttle 600 towards the first end 102 away from the second end 104 (i.e., from right to left in figures 9 to 12) results the length of the cords 200, 300 extending away from the lifting apparatus 10 to shorten.

[0057] The actuator assembly 400 may be operable to control (e.g. vary, govern) the speed at which the first support cord 200 and the second support cord 300 are drawn from and into the support member 100 so that they are drawn from and/or into the support member 100 at the same speed and at a controlled speed. The actuator assembly 400 may be operable to control (e.g. vary, govern) the rate at which the length of each of the first support cord 200 and the second support cord 300 extending from the support member 100 to their free ends 204, 304 to be the same.

[0058] The actuator assembly 400 is operable to maintain the same tension in the first support cord 200 and the second support cord 300 as the free end 204 of first support cord 200 and the free end 304 of the second support cord 300 are drawn away from and/or drawn towards the support member 100.

[0059] In the examples shown (and as best illustrated in figure 8), the first support cord anchor end 202 may be provided on the downwardly facing side 112 of the support member 100. In this example, the first support cord 200 extends from the first support cord anchor end 202 on the downwardly facing side 112 of the support member 100, across the shuttle support cord engagement end 602, and then extends to a first support cord first guide feature 120 on the upwardly facing side 110, and then extends to a first support cord second guide feature 122 on the upwardly facing side 110 of the support member 100. The first support cord first guide feature 120 is spaced apart from the first support cord second guide feature 122 along the direction of the x-axis.

[0060] The first support cord first guide feature 120 may be located along the x-axis closer to the second support member end 104 than to the first support member end 102. The first support cord second guide feature 122 may be located along the x-axis closer to the first support member end 102 than to the second support member end 104.

[0061] In the same example, the second support cord anchor end 302 may be provided on the upwardly facing side 110 of the support member 100. In this example, the second support cord 300 extends from the second support cord anchor end 302 on the upwardly facing side 110 of the support member 100, across the shuttle support cord engagement end 602, and then extends to a second support cord first guide feature 130 on the downwardly facing side 112 of the support member 100, and then extends to a second support cord second guide feature 132 on the downwardly facing side 112 of the support member 100. The second support cord first guide feature 130 is spaced apart from the second support cord second guide feature 132 along the direction of the x-axis.

[0062] Hence the first support cord anchor end 202 and second support cord anchor end 302 may be provided on opposing sides of the support member 100 (e.g., the downwardly facing side 112 and the upwardly facing side 110 respectively).

[0063] The second support cord first guide feature 130 may be located along the x-axis closer to the second support member end 104 than to the first support member end 102. The second support cord second guide feature 132 may be located along the x-axis closer to the first support member end 102 than to the second support member end 104.

[0064] The first support member end 102, the first support cord second guide feature 122, the second support cord second guide feature 132 and the second support member end 104 may be provided in series along the x-axis.

[0065] At least one of the first support cord first guide feature 120 and the first support cord second guide feature 122 may comprise a roller bearing 124 for engagement with the first support cord 200. At least one of the second support cord first guide feature 130 and the second support cord second guide feature 132 may comprise a roller bearing 134 for engagement with the second support cord 300.

[0066] As illustrated with reference to figures 7, 8, the first support cord 200 and the second support cord 300 are located adjacent to one another in the y-axis across the width W of the shuttle 600. In examples in which the cords 200, 300 are webbing, to enable the faces of the cords 200, 300 to be parallel as they extend away from the lifting member 100, the first support cord first guide feature 120 and the first support cord second guide feature 122 may be angled relative to one another and

with respect to the x-axis, and the second support cord first guide feature 130 and the second support cord second guide feature 132 may be angled relative to one another and with respect to the x-axis.

[0067] As illustrated in figure 5, the first support cord first guide feature 120 may be angled relative the x-axis by an angle A1. As illustrated in figure 5, the first support cord second guide feature 122 may be angled relative to the x-axis by an angle A2. The angle A2 may be larger than the angle A1.

[0068] As illustrated in figure 6, the second support cord first guide feature 130 may be angled relative the x-axis by an angle B1. As illustrated in figure 6, the second support cord second guide feature 132 may be angled relative the x-axis by the angle B2. The angle B2 may be larger than the angle B1.

[0069] As illustrated in figure 5 the first support cord first guide feature 120 may be offset from the x-axis relative to the first support cord second guide feature 122. As illustrated in figure 6 the second support cord first guide feature 130 may be offset from the x-axis relative to the second support cord second guide feature 132.

[0070] The arrangement of the first support cord 200 and the second support cord 300 in the support member 100 (i.e. how the first support cord 200 and the second support cord 300 are anchored to and threaded through the support member 100, and how the support cords 200, 300 are fitted relative to the shuttle 600) has the effect that movement of the shuttle 600 in the direction of the x-axis towards the first support member end 102 draws the first support cord free end 204 and the second support cord free end 304 towards the support member 100.

[0071] The arrangement of the first support cord 200 and the second support cord 300 in the support member 100 (i.e. how the first support cord 200 and the second support cord 300 are anchored to and threaded through the support member 100, and how the support cords 200, 300 are fitted relative to the shuttle 600) has the effect that movement of the shuttle 600 in the direction of the x-axis towards the second support member end 104 enables the first support cord free end 204 and the second support cord free end 304 to be drawn away from the support member 100.

[0072] As best illustrated in figures 7 to 12 the actuator assembly 400 comprises an actuator arm 402 which extends between a shuttle coupling end 404 to an actuator arm free end 406. The actuator arm 402 may extend between the shuttle coupling end 404 to the actuator arm free end 406 through an actuator arm mount 408 provided at the second support member end 104. The shuttle 600 may be coupled to the shuttle coupling end 404 of the actuator arm 402 such that the shuttle 600 is moveable with the shuttle coupling end 404 of the actuator arm 402 along the x-axis. That is to say, the shuttle 600 may be coupled to the shuttle coupling end 404 of the actuator arm 402 such that the shuttle 600 is moveable with the shuttle coupling end 404 of the actuator arm 402 along the shuttle guide path 610.

[0073] The actuator arm free end 406 may be configured for engagement with a tool for moving the actuator arm 402 in a direction along the x-axis.

[0074] In use, the actuator arm 402 will take the complete weight of the object 2000, and so there is considerable load transferred through the actuator arm 402. Hence movement of the actuator arm 402 (e.g., rotation about its longitudinal axis) may require significant force. The actuator arm free end 406 should therefore be configured and accessible such that sufficient force can be applied to it (for example with a hand tool or power tool). Alternatively, the lifting apparatus 10 may comprise a motor coupled to the actuator arm 402 in order to move the shuttle 600.

[0075] In some examples, a torque load of about 20Nm may be required to rotate the actuator arm 402 to lift an object 2000 weighing about 250kg. This may increase to 25-30Nm to pull the object 2000 into final position (for example to overcome interference fit with the features of the structure 1000 it is being fitted to).

[0076] These are acceptable values for a user to deliver, even if working at height (for example from a step ladder or scaffold platform)

[0077] The actuator arm 402 may be constrained (i.e. operable) to travel in the direction of the x-axis of the support member 100 to thereby draw the shuttle 600 along the x-axis.

[0078] The actuator arm 402 is coupled to the shuttle 600 such that motion of the actuator arm 402 causes the shuttle 600 to travel in the direction of the x-axis along the shuttle guide path 610. That is to say, the actuator arm 402 is coupled to the shuttle 600 such that motion of the actuator arm 402 in the direction of the x-axis along the shuttle guide path 610 causes the shuttle 600 to travel in the direction of the x-axis along the shuttle guide path 610. The actuator arm 402 may be fixed and rotatable relative to the shuttle 600. That is to say, the coupling between the actuator arm 402 and the shuttle 600 may be configured such that the actuator arm 402 may rotate around its longitudinal axis while the shuttle 600 remains in a fixed orientation with respect to the guide path 610.

[0079] The actuator arm mount 408 may have a passage 410 with a screw thread. The actuator arm 402 may have a screw thread. The actuator arm 402 may be configured to be located in and engage with the actuator arm passage 410 so that rotation of the actuator arm 402 around its longitudinal axis causes the actuator arm 402 to move along the shuttle guide path 610.

[0080] The combination of screw thread on the actuator arm 402 and the actuator arm mount 408 results in a system in which only the positive act of a user to turn the actuator arm 402 will result in movement of the shuttle 600, and hence movement of the cords 200, 300, which obviates the need for an additional braking system. A braking system would be a requirement on any winch operated device, only available in larger/heavier winch assemblies, not suitable for this situation.

[0081] The arm actuator free end 406 may be provided

with, or configured to couple to, a handle, lever or a grip (not shown) for rotating the actuator arm 402 around its longitudinal axis. That is to say, the arm actuator free end 406 may be configured for coupling to a tool 700 to rotate the actuator arm 402 around its longitudinal axis. An illustration of an example head of a tool 700 is shown in figure 7, engaged with the arm actuator free end 406.

[0082] The actuator arm 402 may be operable to extend from the support member 100 only in the direction of the x-axis. The actuator arm 402 may be operable to extend from the support member 100 in the direction of the x-axis such that in the **first configuration** the free end 406 of the actuator arm 402 is a **first distance** from the support member 100. The actuator arm 402 may be operable to extend from the support member 100 in the direction of the x-axis such that in the **second configuration** the free end 406 of the actuator arm 402 is a **second distance** from the support member 100. The **first distance** may be less than the **second distance.**

[0083] As best illustrated in figure 8, the first support cord 200 may extend from the first support cord anchor end 202 in a first direction D1 along the x-axis towards the support cord engagement end 602 of the shuttle 600. The first support cord 200 may then extend around the support cord engagement end 602 of the shuttle 600. The first support cord 200 may then extend from the support cord engagement end 602 of the shuttle 600 in a second direction D2 along the x-axis and then through a first slot 140 in the upwardly facing side 110 of the support member 100 to the first support cord first guide feature 120. The first direction D1 may be in an opposite direction to the second direction D2.

[0084] The first support cord 200 may then extend from the first support cord first guide feature 120 to the first support cord second guide feature 122 in the first direction D1 along the x-axis. The first support cord 200 may then extend from the first support cord second guide feature 122 through a second slot 142 in the upwardly facing side 110 of the support member 100 and then through a third slot 144 in the downwardly facing side 112 of the support member 100 to the first support cord free end 204.

[0085] As best illustrated in figure 7, the second support cord 300 may extend from the second support cord anchor end 302 in the first direction D1 along the x-axis towards the support cord engagement end 602 of the shuttle 600. The second support cord 300 may then extend around the support cord engagement end 602 of the shuttle 600. The second support cord 300 may then extend from the support cord engagement end 602 of the shuttle 600 in the second direction D2 along the x-axis and then through a fourth slot 146 in the downwardly facing side 112 of the support member 100 to the second support cord first guide feature 130. The second support cord 300 may then extend from the second support cord first guide feature 130 to the second support cord second guide feature 132 in the first direction D1 along the x-axis. The second support cord 300 may then extend from the second support cord second guide feature 132 to the second support cord free end 304.

[0086] The first support cord second guide feature 122 may be located on the upwardly facing side 110 offset from the actuator arm 402 in a direction along the z-axis. The first support cord 200 may extend from the first support cord first guide feature 120 to the first support cord second guide feature 122 at an angle to the x-axis in a plane defined by the x-axis and z-axis.

[0087] The second support cord first guide feature 130 may be located on the downwardly facing side 112 offset from the actuator arm 402 in a direction along the z-axis. The second support cord 300 may extend from the second support cord first guide feature 130 to the second support cord second guide feature 132 at an angle to the x-axis in a plane defined by the x-axis and z-axis.

[0088] Hence there may be provided two support cords 200, 300 (or slings), that each travel over the shuttle support cord engagement end 602 as the shuttle 600 moves along the guide path 610. However, the support cords 200, 300 travel in opposite directions over the shuttle support cord engagement end 602 as the shuttle 600 moves along the guide path 610.

[0089] As illustrated in figures 1, 3, 4, 10-12, 16 to 19, the lifting apparatus 10 may further comprise a location block 800 and a shim block 900 for engagement with the support structure 1000. That is to say, the location block 800 and the shim block 900 are configured for locating and seating the lifting apparatus 10 on the support structure 1000. The location block 800 may be fixed to the downwardly facing side 112 of the support member 100. The shim block 900 may be located on and moveable along the downwardly facing side 112 of the support member 100. As best illustrated in figures 18, 19 the shim block 900 may comprise a first part 902 engaged with, and slideable relative to, a second part 904 in a direction in the z-axis. The first part 902 and the second part 904 are slideable relative to one another in the z-axis to thereby enable levelling of the support member 100 on the support structure 1000. There may also be provided a shim or shim pack 906. One or more shims 906 may be located between the first part 902 and the second part 904 of the shim block 900 to space the first part 902 and the second part 904 apart from one another, to thereby lift the end of the support member 100 where the shim block 900 is located relative to the end of the support member 100 where the location block 800 is located, to thereby to level the support member 100. It is important the support member 100 is level so that the load in both of the cords 200, 300 are the same.

[0090] As illustrated in figures 7, 8, 16, 17 the location block 800 may define a fifth slot 148 for the second support cord 300 to extend through between the second support cord first guide feature 130 and the second support cord second guide feature 132. The fifth slot 148 is configured to protect the second cord 300 as it extends / travels between the second support cord first guide feature 130 and the second support cord second

guide feature 132 on the downwardly facing side 112 of the support member 100. Hence the location block 800 lifts the support member 100 and provides a clearance (the fifth slot 148) for the second cord 300 to move unhindered during use, preventing contact of the second cord 300 against the supporting structure.

[0091] The location block 800 ensures the support member 100 is fixed relative to the support structure 1000, and the shim block 900 enables the support member 100 to be supported and levelled, while also accommodating variation in geometries of the support structure 1000 (e.g. so the shim block 900 can be moved to where there is a feature of the support structure 1000 available to support the support member 100.

[0092] By way of non limiting example, the lifting apparatus 10 of the present disclosure may be used in the following way to remove an object 2000 from a structure 1000. By way of non limiting example, and as shown in the figures, the lifting apparatus 10 of the present disclosure may be used in the following way to remove an object 2000 (which may be provided as a valve or fluid coupling) from duct/pipe work 1100, 1200 to which it is coupled.

[0093] As illustrated in figure 9, the shim block 900 is mounted on the support element 1004. Then the support member 100 is offered into position above the object 2000, to rest on the shim block 900, with the actuator arm free end 406 extending into a space where it can be accessed by the user. The support member's 100 location block 800 is located on and/or engaged relative to, the support element 1002 to anchor the support member 100 in place ready for use.

[0094] Just one of the first part 902 and the second part 904 of the shim block 900 may be used, or both the first part 902 and the second part 904 of the shim block 900 may be used. Shims 906 may be inserted between the first part 902 and the second part 904 of the shim block 900 to level the support member 100 in relation to the object 2000. Alternatively, other packing/levelling means may be used instead of one or more parts of the shim block 900 to level the support member 100. By way of example, figure 9 illustrates a condition in which only the second part 904 of the shim block 900 is used at first, resulting in the support member 100 being at an angle to the level. Figure 10 illustrates how the first part 902 of the shim block 900 and/or the shims 906 may be used to lift one end of the support member 100 relative to the end supported by the location block 800 to level the support member 100.

[0095] Levelling of the support member 100 is to ensure the load of the object 2000 is carried evenly by both of the support cords 200, 300.

[0096] As shown in figure 10, the support cords 200, 300 are attached to the object 2000, for example with coupling features and/or by looping the free ends 204, 304 of the cords 200, 300 around features of the object 2000. The object 2000 may then be uncoupled from the structure 1000 so that the full weight of the object 2000 is taken equally by the cords 200, 300 (i.e. to ensure the load is equal in both of the cords 200, 300).

[0097] The actuator assembly 400 is then operated (e.g. by winding the actuator arm 402) to move the shuttle 600 along the guide path 610 to allow the length of the cords 200, 300 in the channel 612 to shorten, and hence allow the length of the cords 200, 300 extending away from the lifting apparatus 10 to lengthen, so that the lifting apparatus 10 may change from the **first configuration** to the **second configuration.**

[0098] Hence, in the example shown in the figures, moving the shuttle 600 from a position distal to the arm mount 408 to a position proximate to the arm mount 408 (i.e., from left to right in figures 9 to 12) results in the length of the cords 200, 300 extending away from the lifting apparatus 10 to lengthen to cause (e.g. allow) the object 2000 to be lowered.

[0099] Hence, in the example shown in the figures, moving the shuttle 600 from a position distal to the arm mount 408 to a position proximate to the arm mount 408 (i.e., from left to right in figures 9 to 12) results in the length of the cords 200, 300 extending away from the lifting apparatus 10 to lengthen to cause (e.g. allow) the object 2000 to be lowered away from the part of the structure 1000 (e.g. the pipes 1100, 1200 and or support elements 1002, 1004) it was coupled to.

[0100] By way of non-limiting example, the lifting apparatus 10 of the present disclosure may be used in the following way to lift an object 2000 into where it is to be mounted in a structure 1000. By way of non limiting example, and as shown in the figures, the lifting apparatus 10 of the present disclosure may be used in the following way to fit an object 2000 (which may be provided as a valve or fluid coupling) into location relative to duct/pipe work 1100, 1200 to which it is to be coupled. The positioning and levelling of the support member 100 is done in the same way as set out above with reference to lowering an object 2000, as is the attachment of the cords 200, 300 to the object 2000.

[0101] The object 2000 may then be lifted from where it is supported so that the full weight of the object 2000 is taken equally by the cords 200, 300 (i.e. to ensure the load is equal in both of the cords 200, 300).

[0102] The actuator assembly 400 is then operated (e.g. by winding the actuator arm 402) to move the shuttle 600 along the guide path 610 to allow the length of the cords 200, 300 in the channel 612 to lengthen, and hence cause the length of the cords 200, 300 extending away from the lifting apparatus 10 to shorten, so that the lifting apparatus 10 may change from the **second configuration** to the **first configuration.**

[0103] Hence, in the example shown in the figures, moving the shuttle 600 from a position proximate to the arm mount 408 to a position distal to the arm mount 408 (i.e., from right to left in figures 9 to 12) results in the length of the cords 200, 300 extending away from the lifting apparatus 10 to shorten to cause the object 2000 to be raised. Hence, in the example shown in the figures,

moving the shuttle 600 from a position proximate to the arm mount 408 to a position distal to the arm mount 408 (i.e., from right to left in figures 9 to 12) results in the length of the cords 200, 300 extending away from the lifting apparatus 10 to shorten to cause the object 2000 to be raised into position between part of the structure 1000 (eg the pipes 1100, 1200 and or support elements 1002, 1004) to be coupled thereto.

[0104] The lifting apparatus 10 of the present disclosure is thus configured and operable to enable the safe lifting and/or lowering of a heavy component 2000 in a location with limited access in which the lifting apparatus 10 must fit to be operated.

[0105] The configuration and features of the lifting apparatus 10 (e.g., the way in which the cords 200, 300 are lengthened and shortened by the linear movement of the shuttle 600 along the channel 612) enable it to be provided as an elongate structure, of small height H and width W compared examples of the related art, so that it may be deployed in regions with poor accessibility.

[0106] Since the lifting apparatus 10 is configured to sit on a supporting structure (for example the supporting structure which locates the component 2000 being lifted), apart from (in some examples) the location block 800 and the shim block 900, it does not require suspension features to support it from a support structure 1000 above itself, for example as would be required with a winch.

[0107] In examples in which the actuator arm 402 is provided as a threaded screw, the apparatus 10 is inherently "braked" and thus does not require an additional braking system (as is required in a conventional winch system) to prevent the component 2000 from dropping when being supported by the lifting apparatus 10. Hence such an example removes risk of a run-away load and/or excessive user interaction with the device.

[0108] The absence of suspension features and/or a braking system enables the system to comprise fewer parts than the alternative solutions of the related art, reducing its complexity, and making it easier to provide the arrangement with a compact configuration.

[0109] The use of webbing (i.e., a flat strip) also enables the lifting apparatus 10 to have a low height H since webbing has a small minimum radius of curvature compared to other support materials used in heavy lift arrangements (e.g., steel rope). Additionally, the use of webbing, and in particular polyester webbing, provides the required strength but, since polyester webbing is lightweight (compared to other materials, such as steel), keeps the overall weight of the lifting apparatus 10 low. The use of polyester also reduces the cost of the lifting apparatus 10.

[0110] Attention is directed to all papers and documents which are filed concurrently with or previous to this specification in connection with this application and which are open to public inspection with this specification, and the contents of all such papers and documents are incorporated herein by reference.

[0111] All of the features disclosed in this specification (including any accompanying claims, abstract and drawings), and/or all of the steps of any method or process so disclosed, may be combined in any combination, except combinations where at least some of such features and/or steps are mutually exclusive.

[0112] Each feature disclosed in this specification (including any accompanying claims, abstract and drawings) may be replaced by alternative features serving the same, equivalent or similar purpose, unless expressly stated otherwise. Thus, unless expressly stated otherwise, each feature disclosed is one example only of a generic series of equivalent or similar features.

[0113] The invention is not restricted to the details of the foregoing embodiment(s). The invention extends to any novel one, or any novel combination, of the features disclosed in this specification (including any accompanying claims, abstract and drawings), or to any novel one, or any novel combination, of the steps of any method or process so disclosed.

Claims

1. A lifting apparatus comprising:

a support member which extends along an x-axis from a first support member end to a second support member end and extends from a first support member side to a second support member side along a y-axis; and which extends from an upwardly facing side to a downwardly facing side along a z-axis;
a first support cord which is operable to extend from the support member at a first support cord anchor end to a first support cord free end;
a second support cord which extends from the support member at a second support cord anchor end to a second support cord free end;
an actuator assembly;
the first support cord and the second support cord being coupled to the actuator assembly, and the actuator assembly is operable to control the first support cord and the second support cord to change between:

a **first configuration** in which a first length of the first support cord and the second support cord extends from the support member to their respective free end; and
a **second configuration** in which a second length of the first support cord and the second support cord extends from the support member to their respective free end;
whereby the first length is less than the second length.

2. A lifting apparatus as claimed in claim 1 wherein the support member has a length (L) which extends in

the direction of the x-axis, a width (W) which extends in the direction of the y-axis and a height (H) which extends in the direction of the z-axis, wherein the height (H) is in the range of 40 mm to 140mm and the width (W) is in the range of 70mm to 120mm.

3. A lifting apparatus as claimed in claim 1 or claim 2 wherein the actuator assembly is operable to control the speed at which the first support cord and the second support cord are drawn from and into the support member so that they are drawn from and/or into the support member at the same speed.

4. A lifting apparatus as claimed in any one of claims 1 to 3 wherein the actuator assembly is operable to maintain the same tension in the first support cord and the second support cord as the first support cord and the second support cord are drawn from and/or into the support member.

5. A lifting apparatus as claimed in any one of claims 1 to 4 wherein:

the actuator assembly comprises a shuttle with a support cord engagement end;
the shuttle being constrained to travel in the direction of the x-axis of the support member;
the first support cord and the second support cord being engaged with the shuttle support cord engagement end such that movement of the shuttle in the direction of the x-axis moves the first support cord and the second support cord between the **first configuration** and the **second configuration.**

6. A lifting apparatus as claimed in claim 5 wherein the support member defines a shuttle guide path which extends in the direction of the x-axis;

the first support cord extends from the first support cord anchor end on the downwardly facing side of the support member, across the shuttle support cord engagement end, and then to a first support cord first guide feature on the upwardly facing side; and
the second support cord extends from the second support cord anchor end on the upwardly facing side of the support member, across the shuttle support cord engagement end, and then to a second support cord first guide feature on the downwardly facing side of the support member;
such that:

movement of the shuttle in the direction of the x-axis towards the first support member end draws the first support cord free end and the second support cord free end towards the support member; and
movement of the shuttle in the direction of the x-axis towards the second support member end enables the first support cord free end and the second support cord free end to be drawn away from the support member.

7. A lifting apparatus as claimed in claim 5 or claim 6 wherein the actuator assembly comprises:

an actuator arm which extends between a shuttle coupling end to an actuator arm free end; and
the shuttle being coupled to the shuttle coupling end of the actuator arm such that the shuttle is moveable with the shuttle coupling end along the x-axis;
wherein motion of the actuator arm causes the shuttle to travel in the direction of the x-axis.

8. A lifting apparatus as claimed in claim 7 wherein the actuator arm is constrained to travel in the direction of the x-axis of the support member to thereby draw the shuttle along the x-axis.

9. A lifting apparatus as claimed in claim 8 wherein the actuator arm is operable to extend from the support member in the direction of the x-axis for engagement with a tool for moving the actuator arm in a direction along the x-axis such that:

in the **first configuration** the free end of the actuator arm is a **first distance** from the support member; and
in the **second configuration** the free end of the actuator arm is a **second distance** from the support member;
whereby the **first distance** is less than the **second distance.**

10. A lifting apparatus as claimed in any one of claims 6 to 9 wherein:

the first support cord first guide feature is spaced apart from a first support cord second guide feature along in the direction of the x-axis;
the first support cord first guide feature being located along the x-axis closer to the second support member end than to the first support member end;
the first support cord second guide feature being located along the x-axis closer to the first support member end than to the second support member end;
the first support cord extending from the first support cord anchor end in a first direction along the x-axis towards the support cord engagement end of the shuttle,

the first support cord then extending around the support cord engagement end of the shuttle;
the first support cord then extending from the support cord engagement end of the shuttle to the first support cord first guide feature in a second direction along the x-axis;
the first support cord then extending from the first support cord first guide feature to the first support cord second guide feature in the first direction along the x-axis;
the first support cord then extending from the first support cord second guide feature to the first support cord free end.

11. A lifting apparatus as claimed in claim 10 wherein:

the second support cord first guide feature is spaced apart from a second support cord second guide feature along in the direction of the x-axis;
the second support cord first guide feature being located along the x-axis closer to the second support member end than to the first support member end;
the second support cord second guide feature being located along the x-axis closer to the first support member end than to the second support member end;
the second support cord extending from the second support cord anchor end in the first direction along the x-axis towards the support cord engagement end of the shuttle,
the second support cord then extending around the support cord engagement end of the shuttle;
the second support cord then extending from the support cord engagement end of the shuttle to the second support cord first guide feature in the second direction along the x-axis
the second support cord then extending from the second support cord first guide feature to the second support cord second guide feature in the first direction along the x-axis;
the second support cord then extending from the second support cord second guide feature to the second support cord free end.

12. A lifting apparatus as claimed in claim 11 wherein the first support cord and the second support cord are located adjacent to one another in the y-axis across the width of the shuttle.

13. A lifting apparatus as claimed in claim 11 and claim 12 wherein:

the first support member end;
the first support cord second guide feature;
the second support cord second guide feature; and
the second support member end
are provided in series along the x-axis.

14. A lifting apparatus as claimed in any one of claims 11 to claim 13 wherein:

the first support cord second guide feature is located on the upwardly facing side; and
the second support cord first guide feature is located on the downwardly facing side.

15. A lifting apparatus as claimed in any one of claims 1 to 14 further comprising a location block and a shim block for engagement with a support structure; wherein:

the location block is fixed to the downwardly facing side of the support member; and
the shim block is located on and moveable along the downwardly facing side of the support member;
the shim block comprising a first part engaged with, and slideable relative to, a second part in a direction in the z-axis.

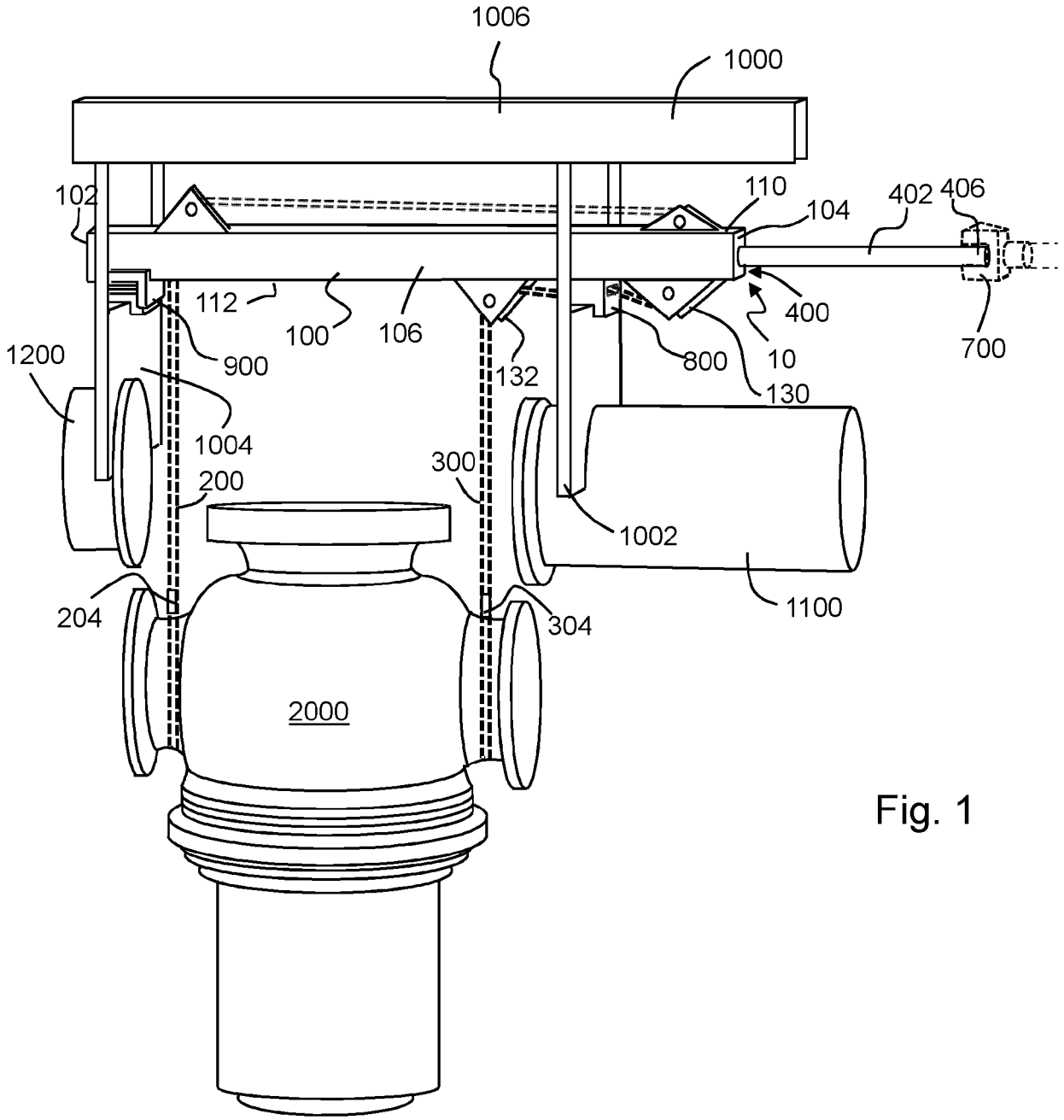
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Fig. 1

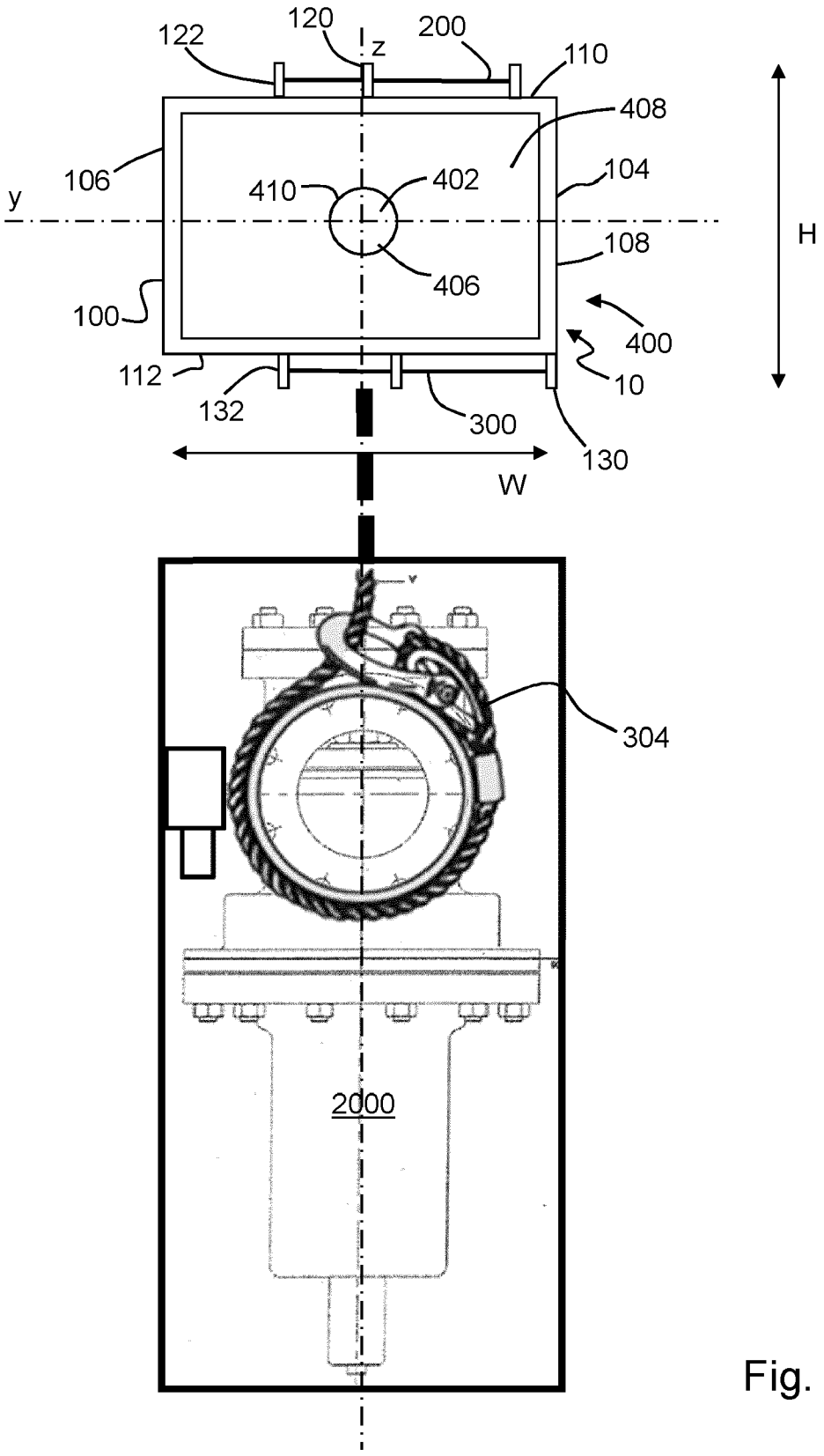
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Fig. 2

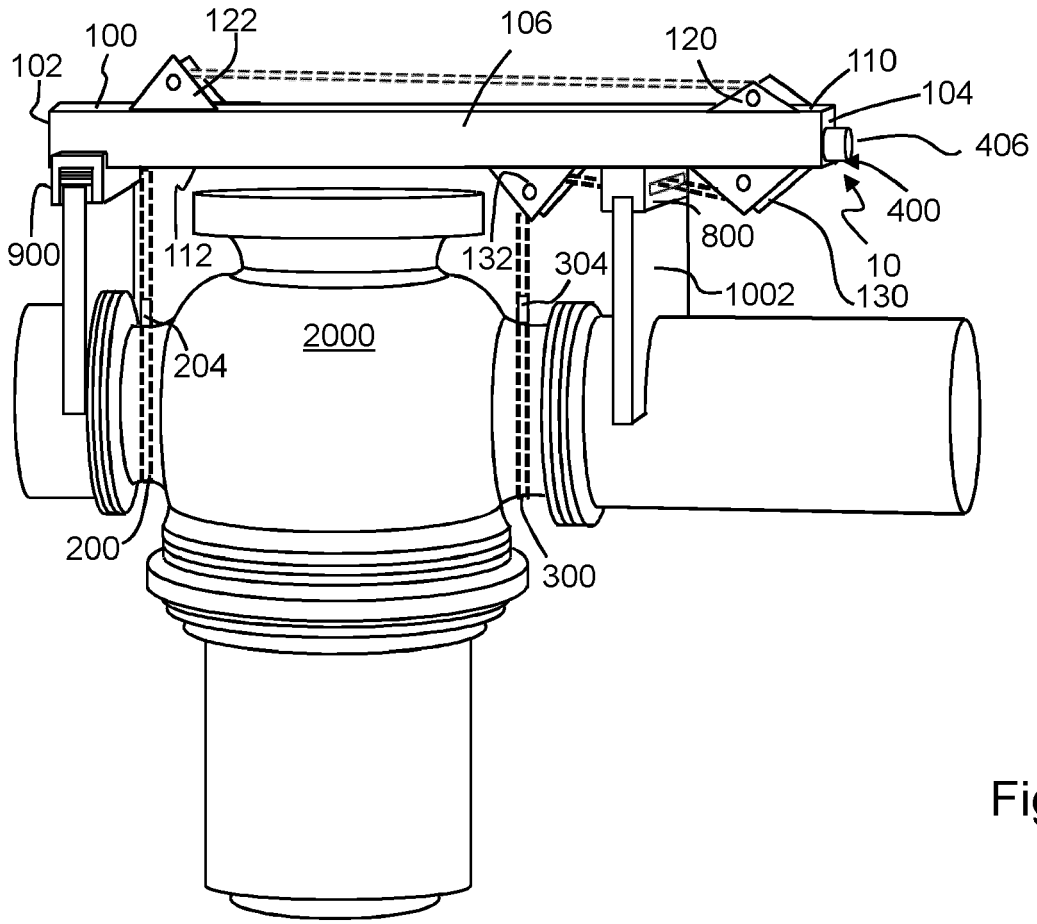
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Fig. 3

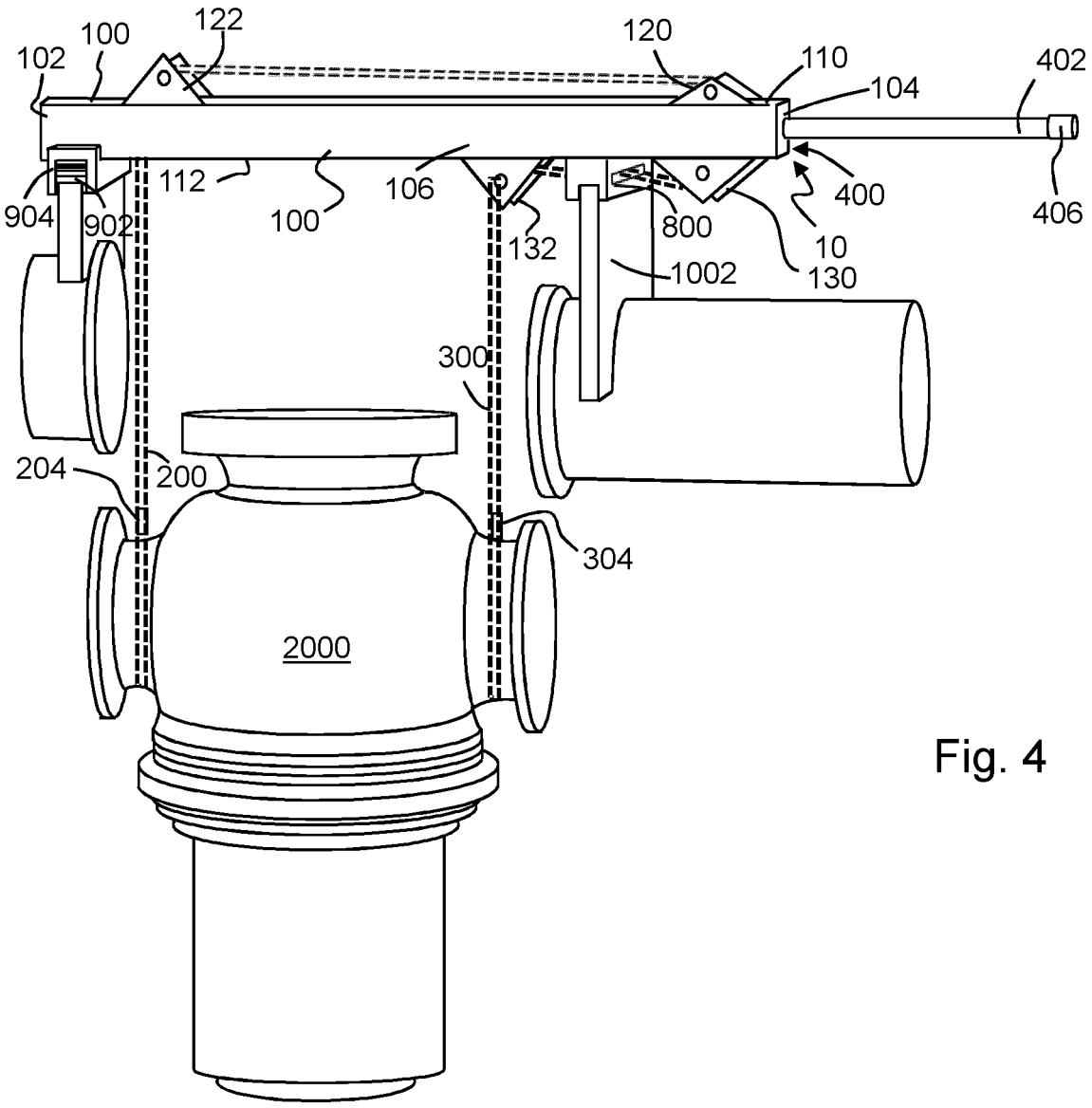
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Fig. 4

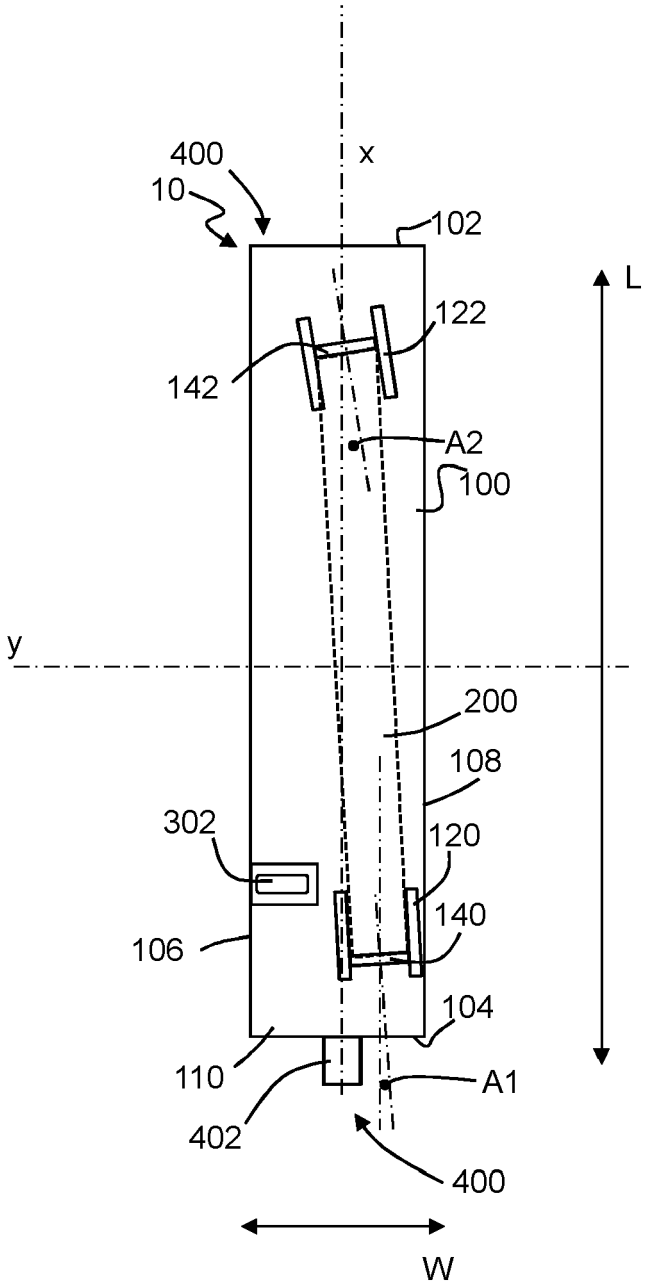
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Fig. 5

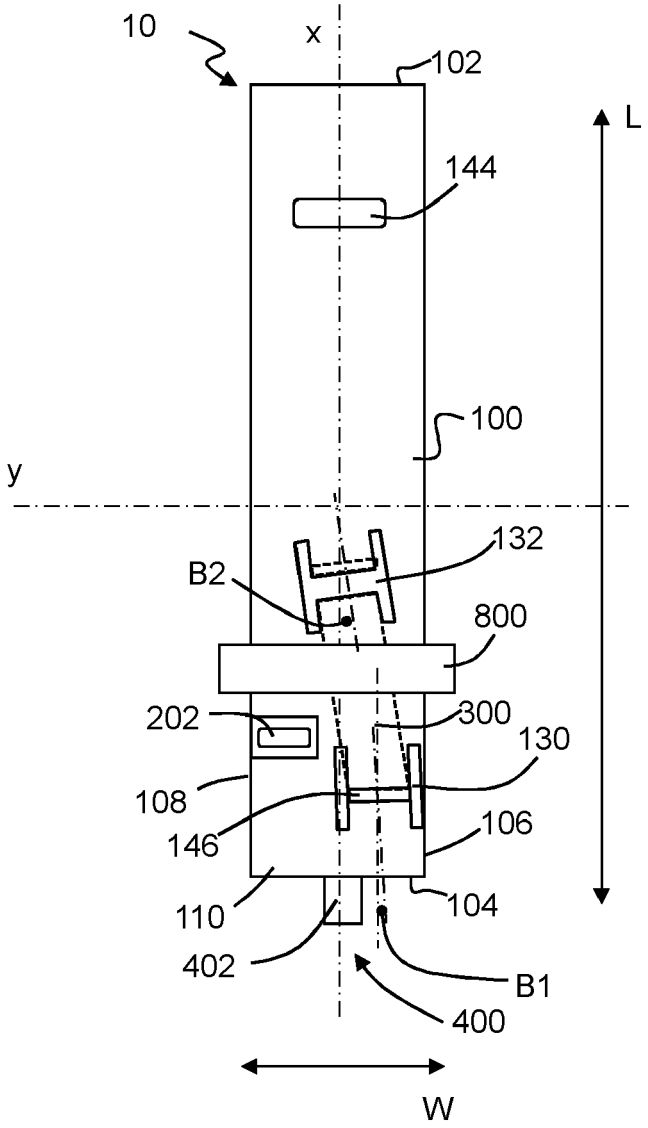
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Fig. 6

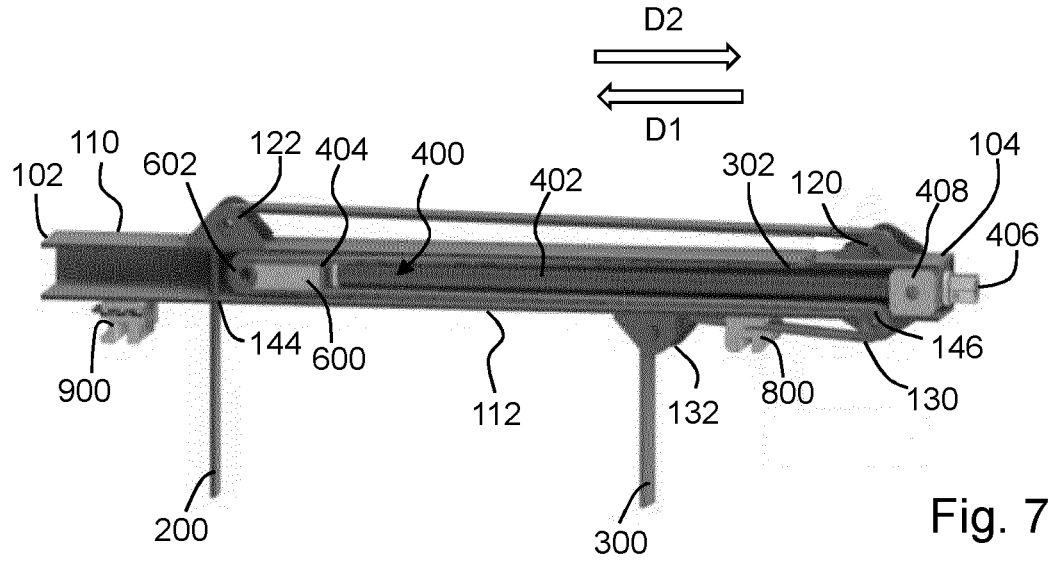
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Fig. 7

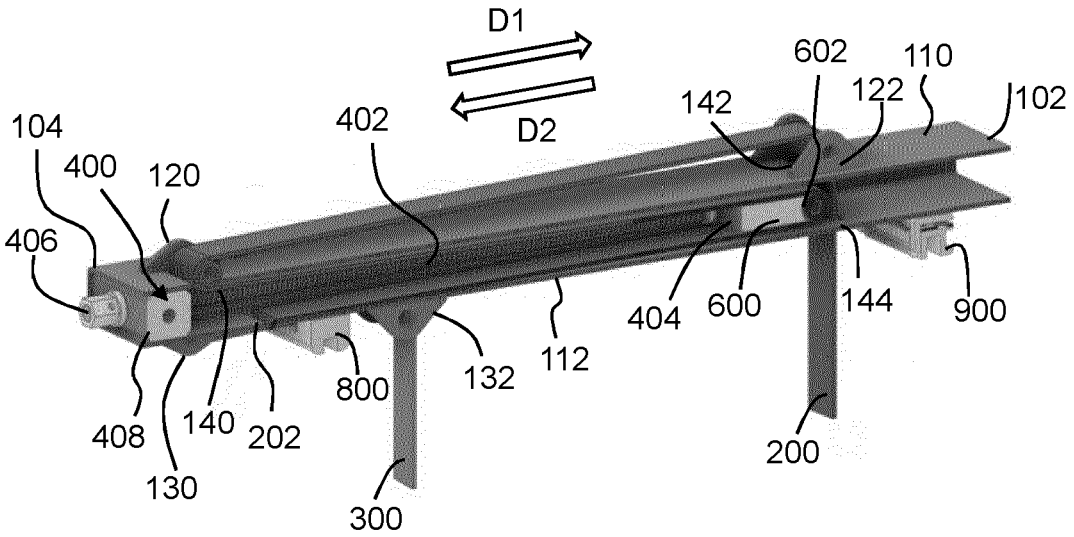
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Fig. 8

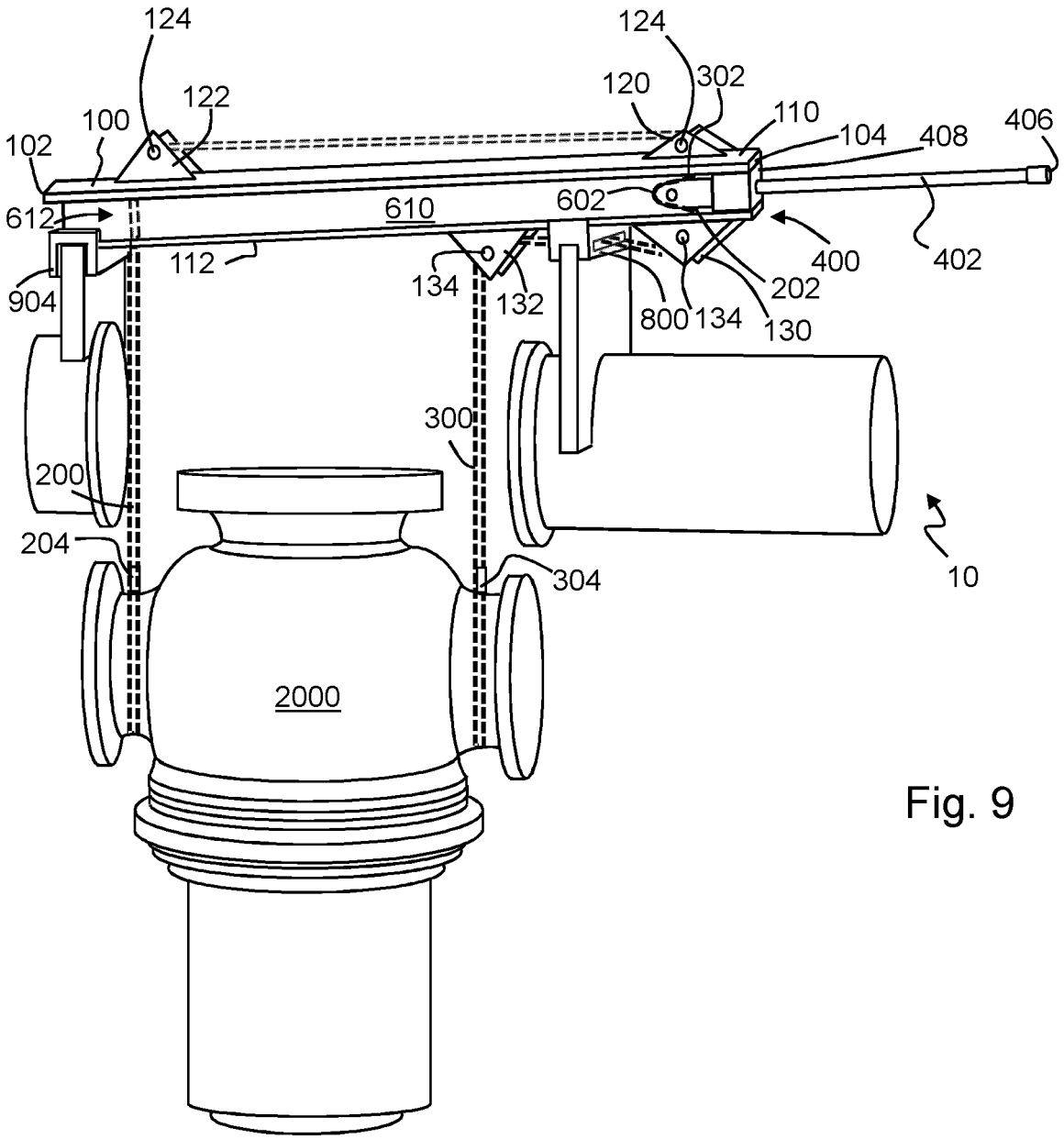
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Fig. 9

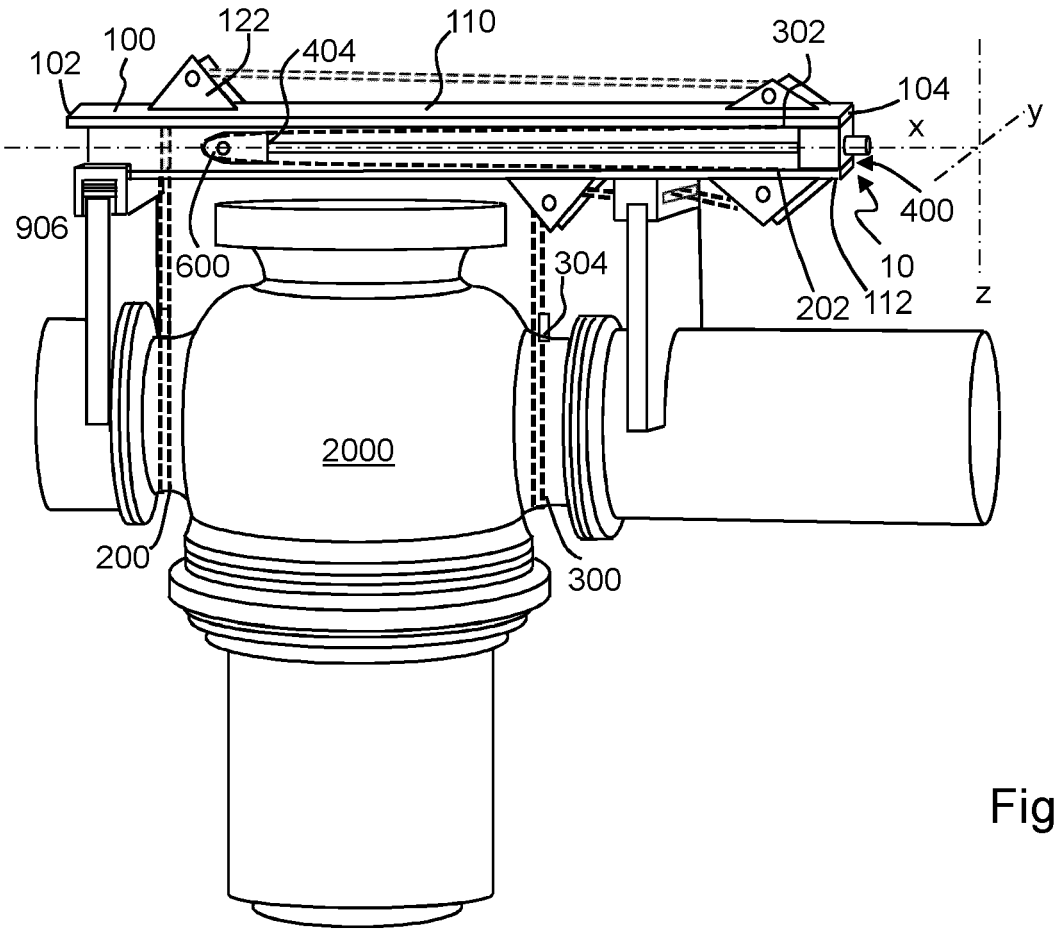
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Fig. 10

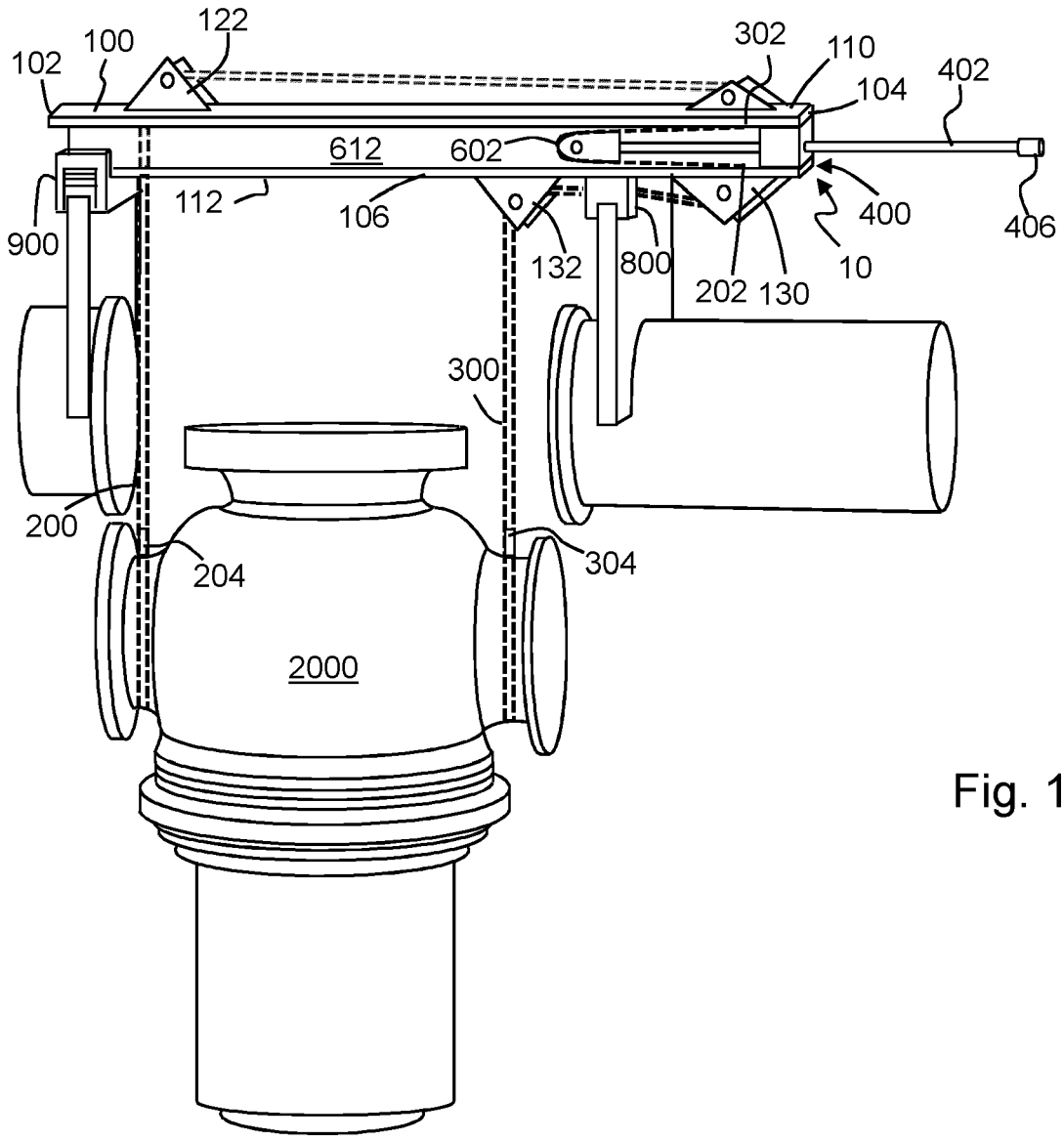
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Fig. 11

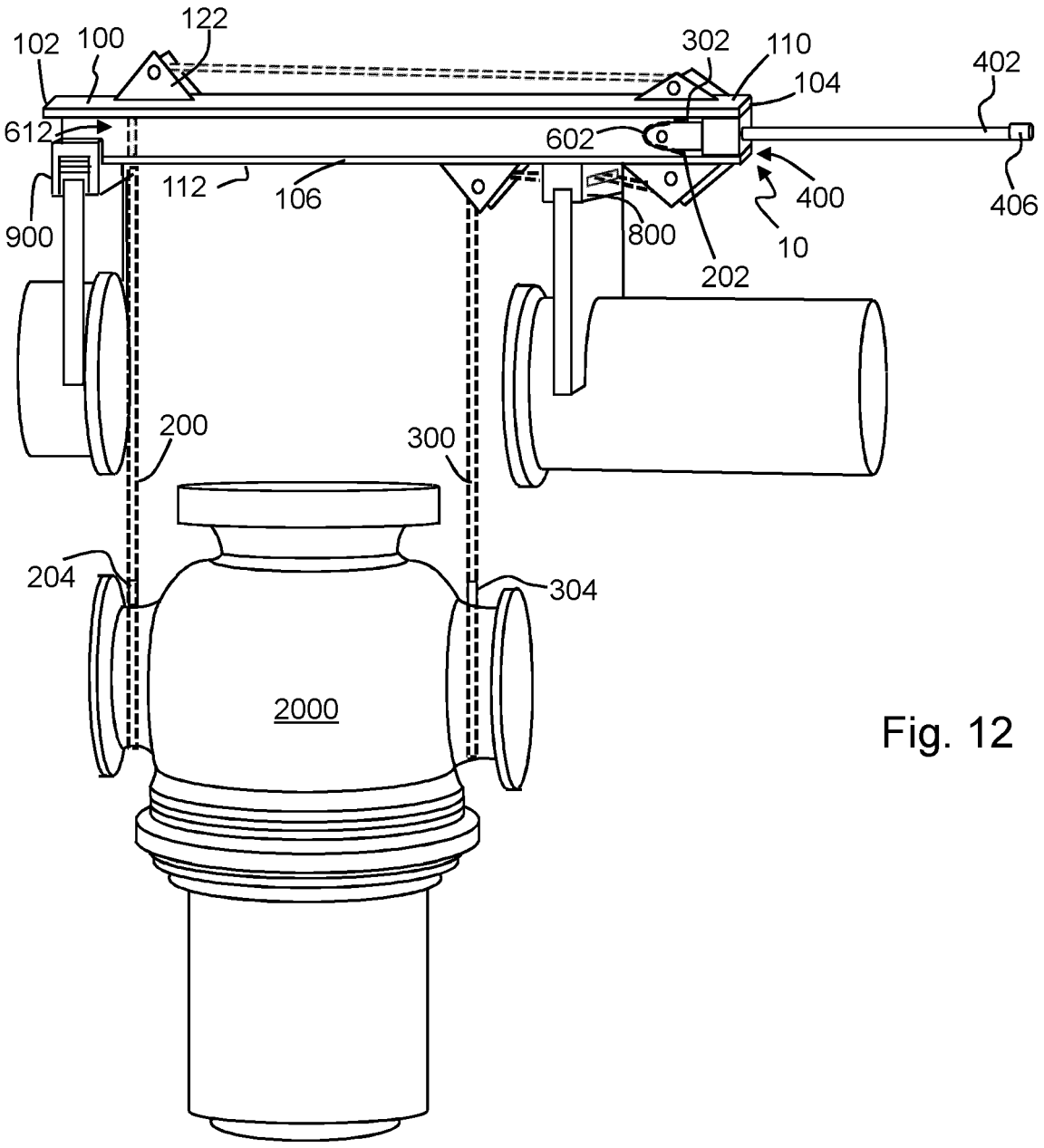
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Fig. 12

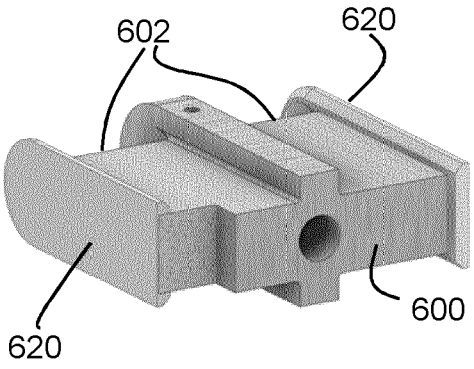

Fig. 13

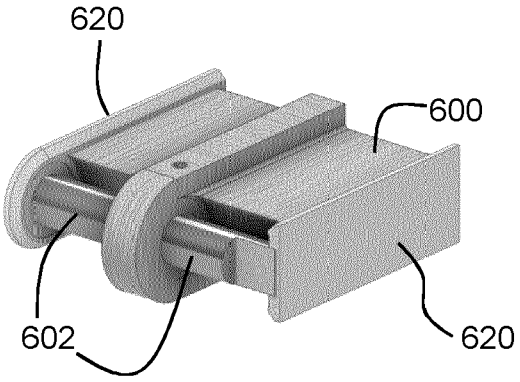

Fig. 14

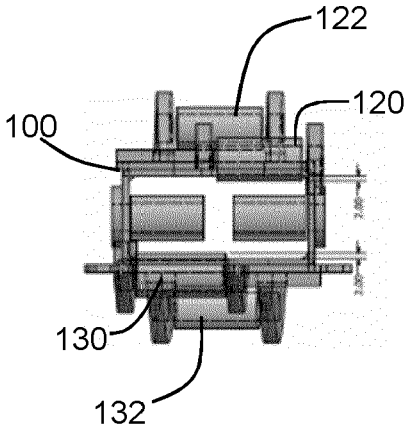

Fig. 15

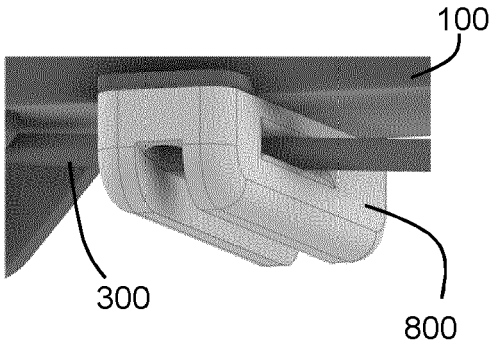

Fig. 16

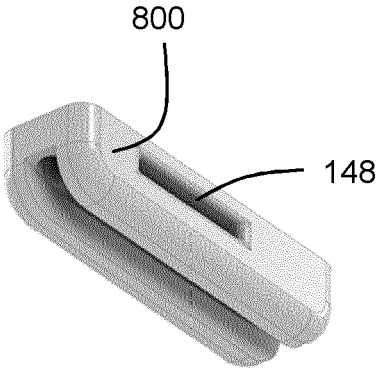

Fig. 17

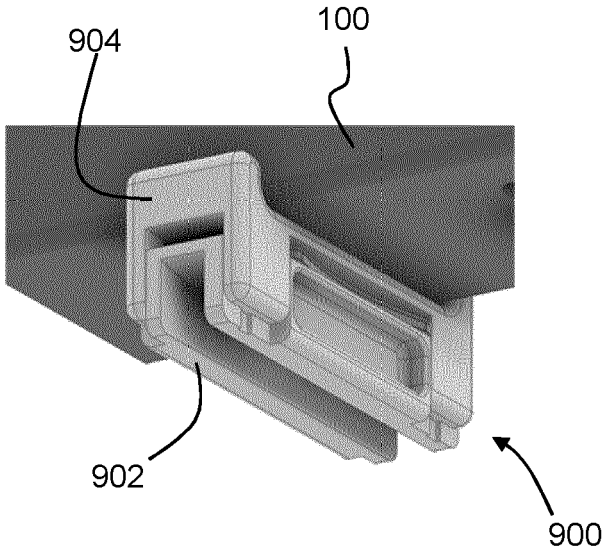

Fig. 18

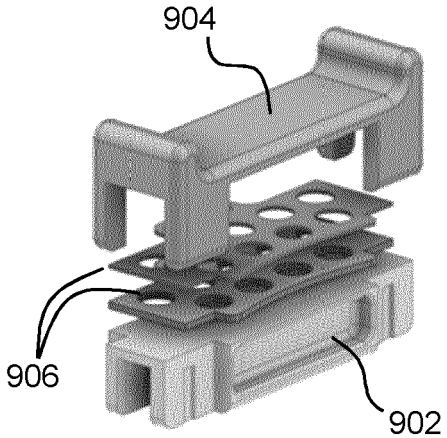

Fig. 19

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EUROPEAN SEARCH REPORT

Application Number
EP 23 27 5174

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X A	EP 3 828 062 A1 (SCHELLENBERG ALFRED GMBH [DE]) 2 June 2021 (2021-06-02) * paragraphs [0045], [0046], [0062], [0068]; figures 1-8 *	1,2,4,5, 7-9 10	INV. B66C1/10 B66D3/04 B66C1/12
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B66D
B62H
F16M
B66C

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	26 May 2024	Verheul, Omiros

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