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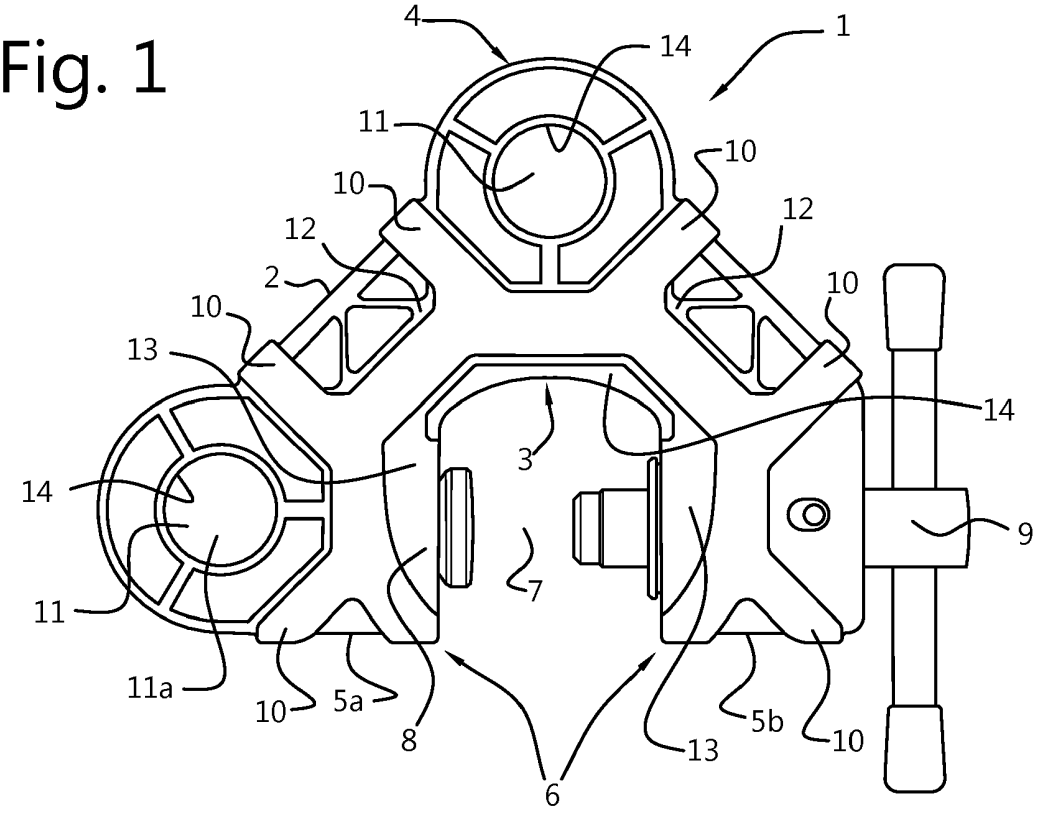
(54) **LIFTING TOOL**

(57) A lifting tool (1) for lifting a load of at least 1000 kg, comprising a substantially rigid main body (2) provided with a first connecting portion (4) configured for releasable attachment to a lifting device and a second connecting portion (6) configured for releasable attachment to a load. The main body (2) is made of a fiber reinforced material and further comprises an outer surface (8) covered at least in part by an impact resistant layer (10) comprising a polymer based material, a fiber reinforced resin, a fiber reinforced laminate or a combination thereof.

Fig. 1



EP 3 584 210 A1

Description

Field of the invention

[0001] The present invention relates to a lifting tool for lifting and handling large and heavy articles of at least 1000 kg.

Background art

[0002] US patent publication US4,850,630 discloses a screw-type clamp for gripping structural members such as steel sheets, wherein the clamp has the general form of a U-shaped clamp body and comprises a screw member threadedly received through a portion of the body and a jaw member pivotally mounted to the body opposing the screw such that articles may be securely gripped by a gripping surface on the screw and a gripping surface of the jaw. The clamp may further comprise one or more bores for attaching a shackle, for example, such that articles can be lifted.

[0003] US patent publication US 3,675,961 discloses a load positioner comprising an I-beam connectable intermediate the ends thereof to a hoist line by spreader cables. One end of the beam adapted for carrying a load and the opposite end of the beam having a plurality of removable counterweights connected thereto for balancing the load to maintain the beam in a horizontal position.

[0004] US patent application US 2009/0008953 A1 discloses a shackle having particular utility in underwater salvage operations. The shackle that has a generally U shaped body that is comprised of a bow portion and first and second spaced apart arms. Each arm has an end portion with an opening for receiving a shackle pin. The shackle pin is sized and shaped to simultaneously fit through the shackle pin openings, and end portion of the pin having external pin threads. A nut provides an internally threaded opening for engaging external threads of a shackle pin. In an embodiment, the shackle pin and nut can be made out of lightweight material such as titanium to reduce weight to make the shackle of the present invention more worker friendly.

[0005] Lifting tools such as those described above are often made of solid steel and utilized for lifting heavy loads in the construction and shipyard industry for example. Because such lifting tools are typically large as well, they are very heavy and cannot be handled easily.

[0006] US patent application US 2017/0241469 A1 describes a load-bearing component for the fastening, lashing, and/or lifting technology, such as a shackle, a snap hook, a hook, or a ring link. The component comprises a plastic-metal composite system which forms at least one load-bearing section and at least one connection section.

Summary of the invention

[0007] The present invention aims to provide an improved lifting tool configured to lift loads of at least 1000 kg, wherein the lifting tool exhibits a significantly reduced weight for a given size and further provides improved impact resistance. Even though the lifting tool is considerably lighter than known lifting tools of comparable size, the necessary strength and rigidity of the lifting tool is maintained and even improved and as a result the lifting tool can lift heavy loads safely and reliably.

[0008] According to the present invention, a lifting tool configured to lift loads of at least 1000 kg is provided comprising a substantially rigid main body provided with a first connecting portion configured for releasable attachment to a lifting device and a second connecting portion configured for releasable attachment to a load,

[0009] wherein the main body is made of a fiber reinforced material and further comprises an outer surface covered at least in part by an impact resistant layer comprising a polymer based material, a fiber reinforced resin, a fiber reinforced laminate or a combination thereof.

[0010] According to the invention, the weight of the lifting tool is significantly reduced due to the fiber reinforced material of the main body, so that the lifting tool can be manually handled and does not require special hoisting equipment to move the lifting tool around. By comparison, known lifting tools for loads of at least 1000 kg are typically made of solid steel and are difficult to handle manually. In most cases hoisting equipment is used for handling heavy lifting tools, making it more difficult and cumbersome to move the lifting tool around. On the other hand, the fiber reinforced material used for the lifting tool of the present invention allows for a weight reduction of 10% to 50% or even more compared to conventional lifting tools made of steel for example.

[0011] Because the fiber reinforced material of the main body may be more impact sensitive than e.g. steel, the impact resistant layer comprises a polymer based material, a fiber reinforced resin, fiber reinforced laminate or a combination thereof to prevent impact damage when the lifting tool collides or drops etc.

[0012] Therefore, the fiber reinforced material of the main body in conjunction with the impact resistant layer, which is arranged on at least a part of the outer surface of the main body, provides for a light, and yet durable and wear resistance lifting tool configured to lift heavy loads of at least 1000 kg whilst allowing the lifting tool to be handled manually.

[0013] In an advantageous embodiment, the fiber reinforced material comprises carbon fiber or glass fiber, both of

which significantly reduce the overall mass of the main body yet provide structural strength to the main body comparable to or even improved compared to a main body made of steel.

[0014] In a further advantageous embodiment, the polymer based material comprised by the impact resistant layer may comprise polyurethane or polyurea, which are insensitive to moisture, have good wear resistance and exhibit good adhesion to the outer surface of the main body. Moreover, both polyurethane and polyurea can reach great strength and as a result provide excellent impact resistance. Another advantage of both polyurethane and polyurea is that they can be readily repaired and reapplied to the main body should damage still occur.

Brief description of the drawings

[0015] The present invention will now be described by way of reference to a number of illustrative embodiments, as shown in the accompanying drawings in which:

Figure 1 shows a lifting tool shaped as a plate/beam lifting clamp according to an embodiment of the present invention;
Figure 2 shows a lifting tool shaped as a vertical lifting clamp according to an alternative embodiment of the present invention;
Figure 3 shows a lifting tool shaped as a shackle according to a further embodiment of the present invention; and
Figure 4 shows a lifting tool shaped as a lifting beam or spreader according to an even further embodiment of the present invention.

Detailed description of the embodiments

[0016] Figure 1 shows a lifting tool 1 according to a first embodiment of the present invention. In the embodiment shown, the lifting tool 1 is configured to lift loads of at least 1000 kg and comprises a substantially rigid main body 2 provided with a first connecting portion 4 configured for releasable attachment to a lifting device and a second connecting portion 6 configured for releasable attachment to a load.

[0017] In an exemplary embodiment, the lifting device (not shown) may be a crane provided with a hook or shackle and the like, wherein the hook/shackle may be attached to the first connecting portion 4 in releasable fashion. The load (not shown) may be a plate/sheet, beam or other construction, for example, and which is realisably attached to the second connecting portion 6.

[0018] The main body 2 of the lifting tool 1 is made of a fiber reinforced material and comprises an outer surface 8 covered at least in part by an impact resistant layer 10, wherein the impact resistant layer 10 comprises a polymer based material, a fiber reinforced resin, fiber reinforced laminate or a combination thereof.

[0019] According the present invention, utilizing fiber reinforced material for the main body 2 allows for great weight savings. However, in many cases fiber reinforced material is more impact sensitive than e.g. steel. So in working environments where the main body 2 may collide with various objects, such as lifting devices, the floor or the loads, the fiber reinforced material and thus the lifting tool 1 may be damaged. To make the lifting tool 1 more robust, an impact resistant layer 10 is provided and arranged on at least a part of the outer surface 8 of the main body 2. Typically, the impact resistant layer 10 is arranged on those surface parts of the outer surface 8 that are most prone to impact. Such impact prone surface parts of the main body 2 are often located at or near the first and second connecting portions 4, 6, so those surface parts that closely engage a lifting device or load, which may collide with the first and second connecting portions 4, 6.

[0020] Therefore, combining the fiber reinforced material of the main body 2 with the impact resistant layer 10 on at least parts of its outer surface 8 allows for a considerable weight reduction of the lifting tool 1 yet improve robustness and ruggedness thereof.

[0021] In an embodiment, the fiber reinforced material of the main body 2 comprises carbon fiber, glass fibers or a combination thereof, thereby providing sufficient (tensile) strength and stiffness to the main body 2 for most applications.

[0022] In an exemplary embodiment, the fiber reinforced material comprises a fiber reinforced plastic with epoxy (resin), allowing for a light weight main body 2 and for which a great variety of fibers and resins can be used to obtain optimal strength characteristics according to requirements. For example, carbon fibers and/or glass fibers may be used for the fiber reinforced plastic providing high tensile strength.

[0023] In an advantageous, the impact resistant layer 10 exhibits a Shore hardness of 40±5 to 95 ± 5 shore **A** (DIN 53505) and/or 0±5 to 70±5 shore **D** (DIN 53505), wherein these hardness values allow the impact resistant layer 10 to provide sufficient impact protection against damage of the fiber reinforced material of the main body 2.

[0024] The aforementioned Shore **A** and **D** values can be achieved by an exemplary embodiment wherein the polymer based material of the impact resistant layer 10 comprises polyurethane, polyurea or a combination thereof. That is, both polyurethane and polyurea, and combinations thereof, provide excellent impact resistance according to the Shore **A** and Shore **D** values mentioned above. Moreover, both polyurethane and polyurea can be readily reapplied should

damage to the impact resistant layer 10 occur.

[0025] In an advantageous embodiment, the fiber reinforced laminate or fiber reinforced resin may comprises aramid fibers, thereby allowing the abovementioned Shore **A** and **D** values of the impact resistant layer 10 to be achieved as well. Of course, the fiber reinforced laminate or plastic may likewise comprise carbon and/or glass fibers or other fibers for achieving good impact resistance, such as expressed by the aforementioned Shore **A** and **D** values.

[0026] From a manufacturing point of view, the impact resistant layer 10 comprising polyurethane may be applied to the outer surface 8 of the main body 2 through a casting process (e.g. using a mould), through an adhesive, spraying or even by mechanical means using fasteners, such as screws, bolts, rivets etc. The impact resistant layer 10 comprising polyurea may be applied to the outer surface 8 of the main body 2 through a casting or spraying process.

[0027] Even though not shown in Figure 1, in advantageous embodiment, the main body 2 may a solid body made of the fiber reinforced material, such as the abovementioned fiber reinforced epoxy comprising carbon and/or glass fibers. When the main body 2 is manufactured as a solid body, then this provides increased strength of the main body 2. In an alternative embodiment, the main body 2 may comprises one or more voids, i.e. the main body 2 may be hollow and not a solid. Having one or more voids in the main body 2 would allow for a further weight reduction but may lower the strength of the main body 2 compared to having a main body 2 as a solid (i.e. without voids). However, by arranging the one or more voids at specific locations, the strength and stiffness reduction of the main body 2 can be kept to a minimum.

[0028] As shown in Figure 1, the lifting tool 1 may be shaped as a plate/beam lifting clamp according to an embodiment of the present invention. In particular, in the embodiment shown, the main body 2 may be a U-shaped body having a midsection 3 (e.g. arched midsection) comprising the first connecting portion 4, and wherein the second-connecting portion 6 comprises two end legs/sections 5a, 5b spaced apart substantially parallel. Here, a space 7 between the two end sections 5a, 5b is provided for receiving a sheet-like article, for example, and wherein the two end sections 5a, 5b are configured for releasable attachment to the sheet-like article. Sheet-like articles may be steel plates, flanges of steel I/H-beams, constructions and the like.

[0029] In an exemplary embodiment, the two end sections 5a, 5b may comprises a clamp member 9 configured to clamp the load between the two end sections 5a, 5b. In an embodiment the clamp member 9 may be a threaded clamp member configured for rotation and manual control of a clamping force needed to securely lift the sheet-like article with the lifting tool 1.

[0030] In a further embodiment, the first connecting portion 4 may comprise a through hole 11 or lifting lug 11 for receiving e.g. a lifting hook or shackle, so that easy connection to a lifting device is achieved.

[0031] In an advantageous embodiment, both the first and the second connecting portions 4, 6 may each comprise a through hole/lifting lug 11 for receiving a lifting hook/shackle, and wherein the second connecting portion 6 further comprises a clamp member 9 configured to clamp the load between the two end sections 5a, 5b. This embodiment, as depicted in Figure 1 for example, both the first and second connecting portion 4, 6 are provided with a through hole or lifting lug 11 for connecting the lifting tool 1 to a lifting device. For example, using the lifting lug 11 of the first connecting portion 4 may be advantageous for lifting large, flexible sheets/plates and constructions, mainly because these favour vertical clamping. The through hole/lifting lug 11a of the second connecting portion 6, as shown on the left side of the lifting tool 1 of Figure 1, may be advantageous when I/H beams having flat flanges are to be lifted when lifting and lowering the I-/H beam in place and to transport plates and constructions in a horizontal position.

[0032] Figure 2 shows a lifting tool 1 shaped as a vertical lifting clamp according to an alternative embodiment of the present invention. The depicted embodiment is identical to the embodiment of Figure 1, except that only the first connecting portion 4 is provided with a through hole/lifting lug 11. The clamp member 9 as shown is a self-tightening clamp member configured for clamping a sheet-like article under influence of its own weight, thus wherein the clamping force of the self-tightening clamp member 9 is determined by the weight of the sheet-like article being lifted. In an exemplary embodiment, the self-tightening clamp member 9 comprises serrated jaws configured to improve grip on the sheet-like article.

[0033] In Figure 1 and 2, the impact resistant layer 10 may cover at least in part a first surface part 12 of the midsection 3 and/or a second surface part 13 of the two end legs/sections 5a, 5b. This is embodiment provides impact protection to the main body 2 for those areas most prone to impact, such as the midsection 3 comprising the first connecting portion 4, and/or the second connecting portion 6 comprising the two end legs/sections 5a, 5b. Since the first connecting portion 4 and the second connecting portion 6 engage the lifting device and load, respectively, they are prone to collide when the lifting tool 1 is positioned into place. This typically occurs when the lifting tool 1 is handled with little accuracy, so that the first connecting portion 4 may collide with the lifting device when being attached to the lifting tool 1, and wherein the second connecting portion 6 may collide with the sheet-like article as it is moved into the space 7 between the two end legs/sections 5a, 5b. Impact protection is also needed in case the lifting tool is subject to throwing on the floor or when is gets stuck between steel plates, for example.

[0034] In an advantageous embodiment, the impact resistant layer 10 may be a mesh shaped layer covering in part the outer surface 8 of the main body 2. In this embodiment the impact resistant layer 10 is arranged in a mesh or web-like fashion over the outer surface 8 of the main body 2, so that the main body 2 is not completely covered by the impact resistant layer 10 but wherein the main body 2 remains exposed at particular areas only. Those areas of the main body

2 left exposed are not likely to be impacted, so having a mesh shaped impact resistant layer 10, such as a polyurethane and/or polyurea mesh, provides an efficient yet effective application of the impact resistance layer 10. Of course, in an alternative embodiment the impact resistant layer 10 may completely cover the outer surface 8 of the main body 2, thereby eliminating any exposed areas of the outer surface 8 and as such provide maximum impact protection to the main body 2.

[0035] As mentioned earlier, the first and/or the second connecting portions 4, 6, may each comprise a through hole or lifting lug 11, 11a for connecting the lifting tool 1 to a lifting device, such as a hook or shackle. In an embodiment, the impact resistant layer 10 may then cover at least in part a lifting lug/through hole 11 of the first connecting portion 4 and/or a lifting lug/through hole 11a of the second connecting portion 6. The impact resistant layer 10 may cover the lifting lug/through holes of the first and/or second connecting portion 4, 6 completely or in mesh shaped fashion.

[0036] Since a through hole/lifting lug 11 is an integral part of the main body 2, hence made of the fiber reinforced material, it is advantageous to protect each lifting lug 11 from abrasion when an inserted hook applies lifting forces on parts of an inner circumference of the through hole/lifting lug 11. To that end, an embodiment is provided wherein the first connecting portion 4 and/or the second connecting portion 6 comprises a steel reinforced part 14, as shown in the figures, and configured to engage a lifting device or load. Such as a steel reinforced part 14 may be arranged a long at least a part of the inner circumference of the through hole 11 for engagement with e.g. a hook.

[0037] According to this embodiment the steel reinforced part does not only allow protection of an inner circumference of the lifting lug 11 from abrasion, but it may also be configured to distribute lifting forces over the inner circumference such that point-like loads thereon are minimized and larger lifting forces can be transferred through the lifting lug 11 and thus the main body 2.

[0038] Note that in an embodiment a steel reinforced part/ 14 may also be arranged along the midsection 3 of the first connecting portion 4, wherein the midsection 3 faces the space 7 between the two end sections 5a, 5b. Such a steel reinforced part 14 may improve strength of the midsection 3 and protects it against impact of e.g. a plate being inserted.

[0039] To provide an example of weight savings that are feasible for the lifting tool 1 of the present invention, Table 1 shows a rated load capacity of a plate/beam lifting clamp and corresponding weights of a conventional plate/beam lifting clamp (e.g. made of steel) *versus* the weight of a lifting tool 1 of the present invention when shaped as a plate/beam lifting clamp as mentioned above.

Table 1: weight reduction plate/beam lifting clamps

Rated load capacity in ton [x 1000 kg]	Weight conventional lifting tool (clamp) [kg]	Weight lifting tool (clamp) of the present invention [kg]
1	2.4	2
2	4.2	3.2
3	7.6	4
4	8.8	4.9
6	14.3	7.3

[0040] From Table 1 it can be inferred that weight savings provided by the lifting tool 1 increases with the rate capacity, in this case approximately 16% weight saving for a 1 ton lifting tool 1 to approximately 49% weight savings for a 6 ton clamp. The main reason that weight savings are lower for smaller rated capacities is that the lifting tool 1 may use steel reinforced parts/inlays as mentioned above and/or a steel clamp member 9 of similar size and thus weight. So percentage wise, weight savings are more favorable for a larger main body 2 and hence a larger rated load capacity.

[0041] The lifting tool 1 of the present invention is very versatile and need not be shaped as a plate/beam lifting clamp such as those described in Figures 1 and 2. For example, Figure 3 shows a lifting tool 1 shaped as a shackle according to a further embodiment of the present invention. As depicted, the lifting tool 1 (shackle) comprises a substantially rigid main body 2 provided with a first connecting portion 4 configured for releasable attachment to a lifting device or load and a second connecting portion 6 is configured for releasable attachment to a load or lifting device, respectively. Note that for a shackle, the first connecting portion 4 is often configured for attachment to a lifting device like a hook and wherein the second connecting portion 6 is configured for connection to a load.

[0042] As mentioned earlier, by combining the fiber reinforced material of the main body 2 with the impact resistant layer 10 on at least parts of the outer surface 8 provides for a considerable weight reduction of the lifting tool 1 yet improve robustness and ruggedness thereof.

[0043] From Figure 3 it is seen that the main body 2 is a U-shaped body having a midsection 3, e.g. an arched midsection, and comprises the first connecting portion 4 and the second connecting portion 6 comprising two end

sections/legs 5a, 5b spaced apart substantially parallel to one another. An elongated pin member 15 is provided and configured for releasable attachment to the second connecting portion 6 between the two end sections/legs 5a, 5b thereof.

[0044] The pin member 15 is made of the fiber reinforced material and comprises a further outer surface 17 covered at least in part by a further impact resistant layer 18 comprising the polymer based material, a fiber reinforced resin, a fiber reinforced laminate or a combination thereof. Like the main body 2, the elongated pin member 15 made of fiber reinforced material also contributes to a weight reduction of the lifting tool 1 yet improve robustness and ruggedness thereof. The further impact resistant layer 18 protects the elongated pin member 15 from impact and/or abrasion due to interaction with a lifting device or load.

[0045] In an embodiment the polymer based material for the further impact resistant layer 18 may comprise polyurethane, polyurea, fiber reinforced resin, fiber reinforced laminate or a combination thereof. In an embodiment, the fiber reinforced resin or laminate for the further impact resistant layer 18 may comprise carbon fibres, glass fibers, aramid fibers or any combination thereof.

[0046] As mentioned earlier, in an advantageous embodiment the lifting tool 1 may comprise a steel reinforced part/inlay 14 arranged along an inner circumference of the arched midsection 3, thereby further protecting the main body 2 from impact and/or abrasion from a lifting device or load. This embodiment is likewise advantageous for the shackle of Figure 3, wherein the steel reinforced part/inlay 14 additionally protects the inner circumference of the arched midsection 3.

[0047] To provide a further example of weight savings that are feasible for the lifting tool 1 of the present invention, Table 2 shows a rated load capacity of a shackle and corresponding weights of a conventional shackle (e.g. made of steel) *versus* the weight of a lifting tool 1 of the present invention when shaped as a shackle as mentioned above.

Table 2: weight reduction shackles

Rated load capacity in ton [x 1000 kg]	Weight conventional lifting tool (shackle) [kg]	Weight lifting tool (shackle) of the present invention [kg]
8.5	2.6	2
9.5	3.66	2.5
12	4.91	3
17	8.19	4.1
25	14.22	7
35	19.85	9.5
55	39.6	20
85	62	30

[0048] From Table 2 it is readily seen that weight savings for the lifting tool 1 of the present invention shaped as a shackle are considerable and approach 40%-50% for larger rated load capacities. Such weight savings are advantageous when manual handling the lifting tool 1 as it reduces the chance of incorrect positioning and minimizes injuries. As for the shackles, weight savings may be lower for smaller rated capacities as the lifting tool 1 may use steel reinforced parts/inlays as mentioned above. So percentage wise, weight savings are more favorable for a larger main body 2 and hence a larger rated load capacity.

[0049] In addition to a lifting tool 1 shaped as a plate/beam lifting clamp of Figures 1 and 2, or a shackles of Figure 3, the lifting tool 1 of the present invention may even be embodied as a lifting beam or spreader, which is also often used in the construction industry.

[0050] For example, Figure 4 shows a lifting tool 1 shaped as a lifting beam or spreader according to a further embodiment of the present invention. In the embodiment shown the lifting tools 1, e.g. the lifting beam/spreader, comprises the substantially rigid main body 2 provided with the first connecting portion 4 configured for releasable attachment to a lifting device and the second connecting portion 6 configured for releasable attachment to a load. The main body 2 is made of the fiber reinforced material and further comprises the outer surface 8 covered at least in part by an impact resistant layer 10 comprising a polymer based material, a fiber reinforced resin, fiber reinforced laminate or a combination thereof.

[0051] As shown, the main body 2 comprises a lifting beam 19 provided with the first connecting portion 4 and the second connecting portion 6. In an embodiment, the lifting beam 19 comprises an H/I-cross section, rectangular cross section or a circular cross section.

[0052] According to the present invention, combining the fiber reinforced material of the main body 2 with the impact resistant layer 10 on at least parts of the outer surface 8 provides for a considerable weight reduction of the lifting tool

1 yet improve robustness and ruggedness thereof.

[0053] The first connecting portion 4 is typically arranged half way the lifting beam 19, and in an embodiment the first connecting portion 4 comprises a through hole/lifting lug 11 configured for engagement with a hook for example. Note that in an advantageous embodiment the lifting tool 1 may comprise a steel reinforced part/inlay 14 arranged along an inner circumference of the through hole or lifting lug 11, thereby further protecting the main body 2 from impact and/or abrasion from a lifting device.

[0054] In an embodiment the second connecting portion 6 may comprise two opposing end sections 5a, 5b each configured for engagement with a load. For example, each end section 5a, 5b may comprise a lifting hook 20 by which ropes/cables can be connected.

[0055] As depicted on the left side of the lifting tool 1 in Figure 4, in an embodiment the impact resistant layer 10 may be arranged on the first connecting portion 4 and only the opposing end sections 5a, 5b, wherein a midsection of the lifting beam 19, i.e. the main body 2, is left exposed. In this way, those parts of the lifting tool 1 most prone to impact are sufficiently protected against impact yet minimize the weight of the lifting tool 1. As mentioned earlier, the first and second connecting portions 4, 6 engage a lifting device or load and as such are most likely to collide therewith.

[0056] As shown on the right side of the lifting tool 1 in Figure 4, in an embodiment the impact resistant layer 10 may entirely encapsulate the lifting beam 19, i.e. the main body 2, thereby maximizing protection for all type of impacts.

[0057] The present invention has been described above with reference to a number of exemplary embodiments as shown in the drawings. Modifications and alternative implementations of some parts or elements are possible, and are included in the scope of protection as defined in the appended claims.

Claims

1. A lifting tool (1) for lifting a load of at least 1000 kg, comprising a substantially rigid main body (2) provided with a first connecting portion (4) configured for releasable attachment to a lifting device and a second connecting portion (6) configured for releasable attachment to a load,
wherein the main body (2) is made of a fiber reinforced material and further comprises an outer surface (8) covered at least in part by an impact resistant layer (10) comprising a polymer based material, a fiber reinforced resin, a fiber reinforced laminate or a combination thereof.

2. The lifting tool according to claim 1, wherein the polymer based material comprises polyurethane, polyurea or a combination thereof.

3. The lifting tool according to claim 1 or 2, wherein the fiber reinforced material of the main body (2) comprises carbon fiber, glass fiber or a combination thereof.

4. The lifting tool according to any of claims 1-3, wherein the fiber reinforced resin comprises aramid fibers.

5. The lifting tool according to any of claims 1-4, wherein the main body (2) is a solid body made of the fiber reinforced material.

6. The lifting tool according to any of claims 1-4, wherein the main body (2) made of the fiber reinforced material comprises one or more voids.

7. The lifting tool according to any of claims 1-6, wherein the impact resistant layer (10) is a mesh shaped layer covering in part the outer surface (8) of the main body (2).

8. The lifting tool according to any of claims 1-6, wherein the impact resistant layer (10) completely covers the outer surface (8) of the main body (2).

9. The lifting tool according to any of claims 1-8, wherein the first connecting portion (4) and/or the second connecting portion (6) comprise a steel reinforced part configured to engage a lifting device or load.

10. The lifting tool according to any of claims 1-9, wherein the main body (2) is a U-shaped body having a midsection (3), comprising the first connecting portion (4), and wherein the second connecting portion (6) comprises two end sections (5a, 5b) spaced apart substantially parallel to one another.

11. The lifting tool according to claim 10, wherein the impact resistant layer (10) covers at least in part a first surface

part (12) of the midsection (3) and/or a second surface part (13) of the two end sections (5a, 5b).

12. The lifting tool according to claim 10 or 11, wherein the first and the second connecting portion (4, 6) each comprise a through hole (11) for receiving a lifting hook or shackle, wherein the second connecting portion (6) further comprises a clamp member (9) configured to clamp a load between the two end sections (5a, 5b).

13. The lifting tool according to claim 10 or 11, further comprising an elongated pin member (15) configured for releasable attachment to the second connecting portion (6) between the two end sections (5a,5b),
wherein the pin member (15) is made of the fiber reinforced material and comprises a further outer surface (17) covered at least in part by a further impact resistant layer (18) comprising the polymer based material, the fiber reinforced resin, fiber reinforced laminate or any combination thereof.

14. The lifting tool according to any of claims 1-9, wherein the main body (2) comprises a lifting beam (19) provided with the first connecting portion (4) and the second connecting portion (6), wherein the second connecting portion (6) comprises two opposing end sections (5a, 5b), and wherein the lifting beam (19) comprising an H/I-cross section, rectangular cross section or a circular cross section.

15. The lifting tool according to any of claims 1-14, wherein the first and second connecting portions (4, 6) are configured to transfer loads of at least 1000 kg.

Fig. 1

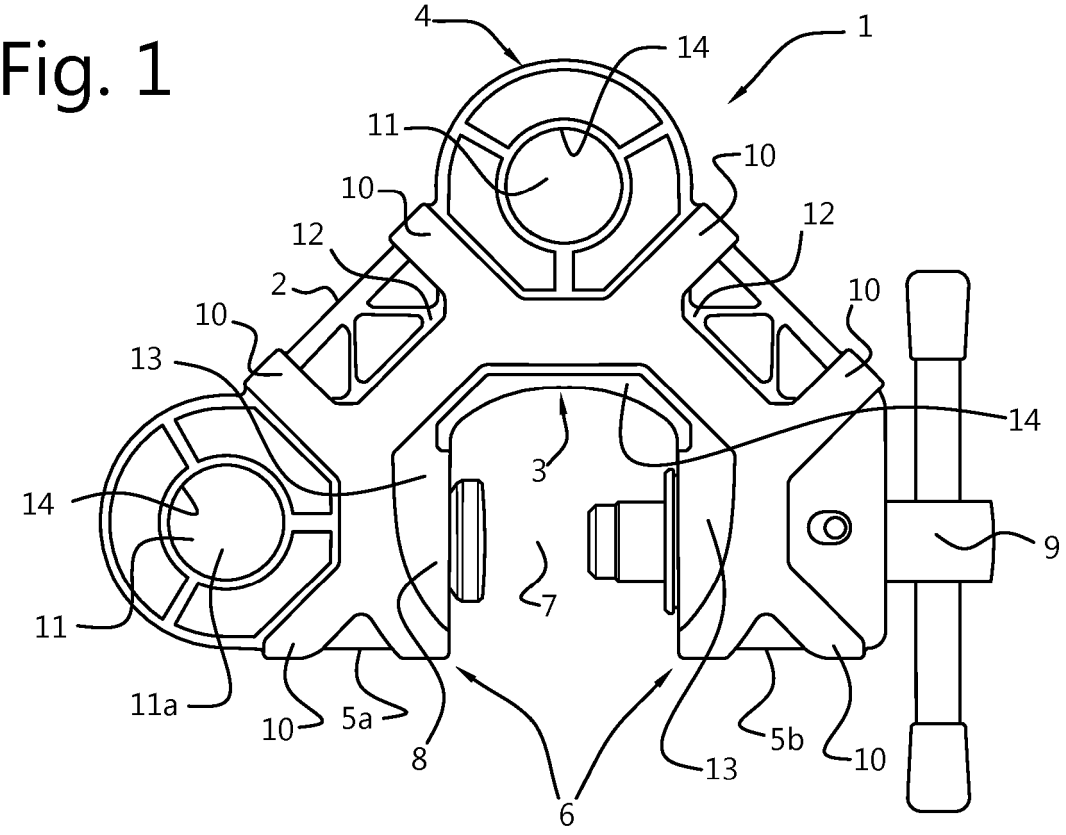

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Fig. 2

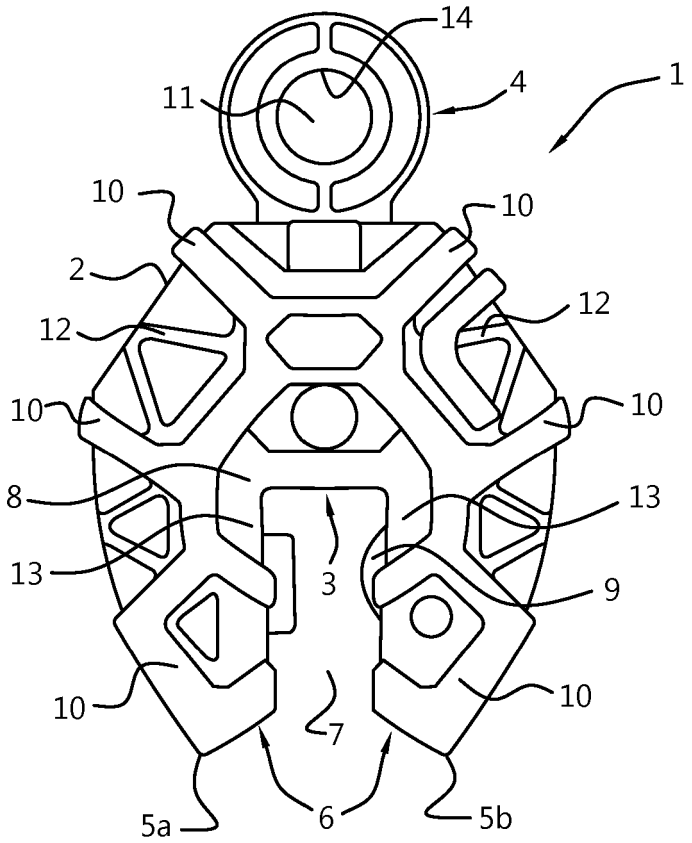
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Fig. 3

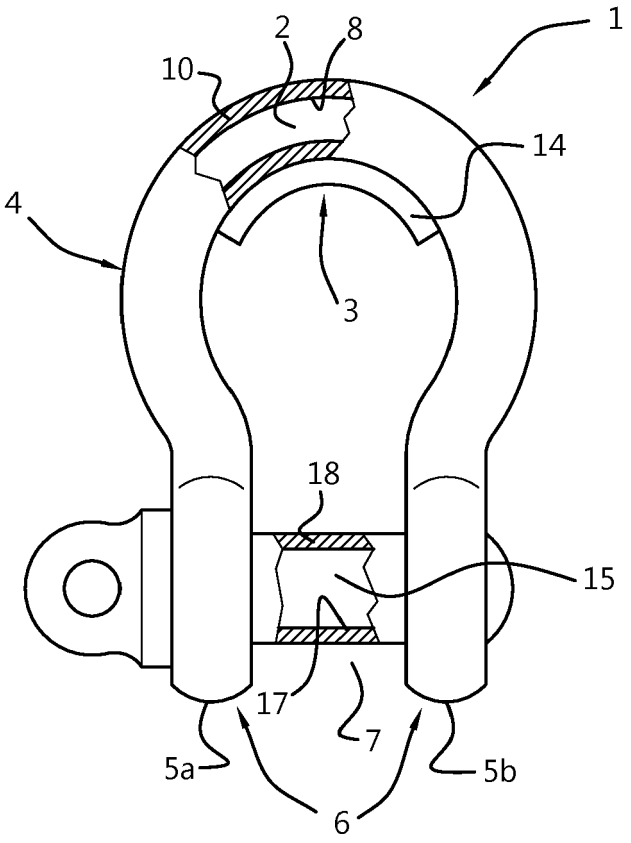
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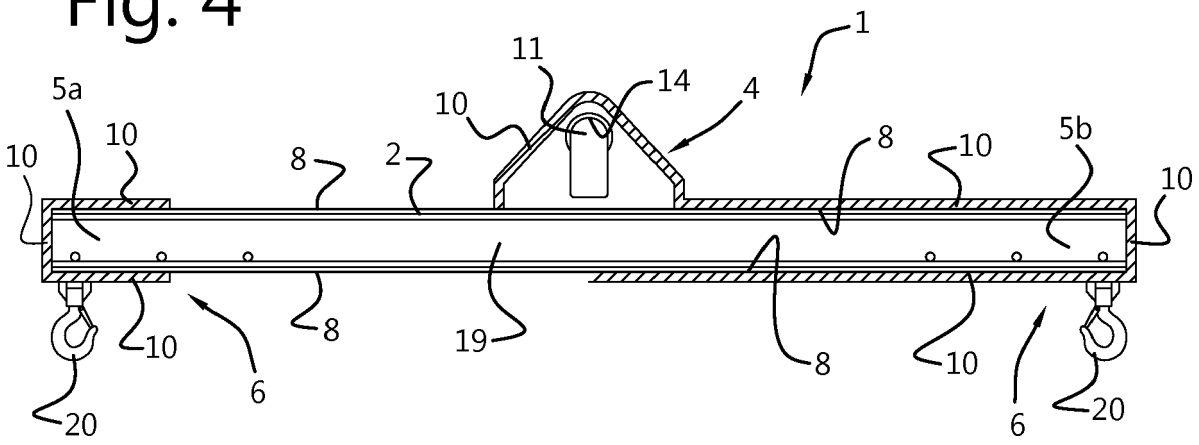
Fig. 4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EUROPEAN SEARCH REPORT

Application Number
EP 19 18 0432

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