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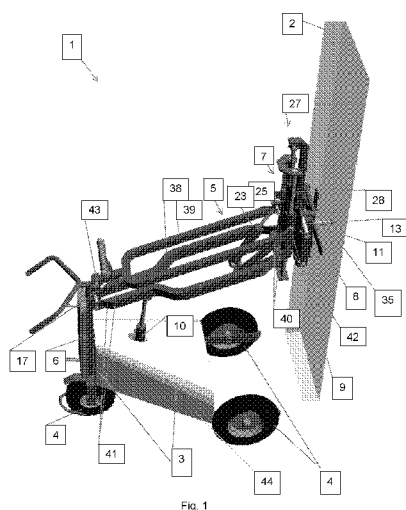
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(54) Title: MOBILE ASSEMBLY TROLLEY



(57) Abstract: Mobile assembly trolley (1) for transport and positioning of building elements. The assembly trolley (1) includes a frame (3) with a movable carrying profile (5) and a fixed, vertical profile (6) and a tool holder (7) for securing a tool (8). The carrying profile (5) is by a primary displacement design (10) designed to turn around a first turning joint (17) by which the tool holder (7) carries out a movement in vertical direction, the tool holder (7) includes a displacement design (13) for displacement of the tool holder (7) in horizontal direction. The assembly trolley (1) includes a third displacement design (23) designed to tip / turn the tool holder (7) around a horizontal axis. A highly flexible assembly trolley is achieved.

Mobile assembly trolley

The invention relates to a mobile assembly trolley for transport and positioning of building elements such as plates, beams, poles and blocks, which assembly trolley includes a frame with wheels or similar and including a movable carrying profile and a fixed and mostly vertical profile to which the movable carrying profile is rotatably mounted in a first turning joint and a tool holder for securing a tool, which tool holder is rotatably mounted to the movable carrying profile, which carrying profile by a primary displacement design such as a hydraulic cylinder is designed to rotate around the first turning joint by which the tool holder performs a movement in vertical direction and that the tool holder includes another displacement mechanism including a displacement design such as a hydraulic cylinder for displacement of the tool holder in horizontal direction.

When elements are to be mounted at a building site, it often involves heavy manual lifts, which can lower the speed of the building process, but also be harmful in the long run or directly dangerous for the personnel on the building site. There are known machines to help with this type of tasks, but they are often non manoeuvrable and non flexible in the types of tasks they can carry out.

It can also be time-consuming to move and hold the often 100 – 200 kg heavy elements, while they are mounted. The current machines built for the purpose have a lack of flexibility in both manoeuvrability and duration of function. Furthermore, these machines can also not be used at element mounting in rooms with limited room height, due to lack of ability for tilting.

From DE202012104180 U1 is known a mobile assembly trolley, as stated in the introduction. The assembly trolley is however not designed in such a way that the items, which are transported with the trolley, can be tipped around a horizontal axis, for which reason the assembly trolley's flexibility is

limited. Moreover, the assembly trolley is preferably only suited for handling items with smooth surfaces such as panes / glass plates.

5 It is therefore an object of the invention to show an assembly trolley without they stated drawbacks or at least create a useful alternative to the known technique.

This is achieved with an assembly trolley, as stated in the introduction, and where the assembly trolley includes a third displacement design such as a hydraulic cylinder designed to tip / turn the tool holder around a horizontal
10 axis system, which third displacement design includes a first movable end which first movable end is connected rotatably to the tool holder and which displacement design at a part is connected to the frame.

In this way it thus becomes possible, by application of the movable tool
15 holder, to displace horizontally and vertically and tip the building element carried by the tool, by application of primarily hydraulic mechanisms. The tool holder's gripping geometry makes it possible to change the tool as needed including drift, fork, u-bracket, clamping pliers, frame, L-shaped fork and box. These tools can lift, lower and tip different items by application of
20 the primary, first, displacement design and carry out a displacement in horizontal direction. That the assembly trolley can also handle the building elements by tipping them, is very significant when the elements must for example be let in through shallow openings to a building room, since it is necessary here to tip for example the large plates such that they lie mostly
25 flat parallel to the assembly trolley's carrying profile. When the plates are hereafter into the actual room, the hydraulic cylinder, which is a part of the rotation of the tool holder, will be activated such that it pushes the tool holder, whereby it turns around an axis, until it is positioned mostly horizontal. If the plate has to be taken out again, the hydraulic cylinder will
30 retract, whereby the tool holder turns around the axis such that the upper edge of it is tipped backwards, and the attached plate follows. Assembly

trolley can both move different elements and hold them in position while they are being mounted.

The displacement designs are above stated as hydraulic cylinders, but can also include pneumatic cylinders or actuators.

5

The item can be raised and lowered in either vertical or tilted position. The head is connected to the assembly trolley's body by parallel carrying arms, which are controlled by the primary hydraulic mechanism; these carrying arms can be displaced parallel, such that the head is held at angle by raising and lowering.

10

In this way it thus becomes possible to have an assembly trolley, which can move different elements and hold them in position, as they are being mounted.

At the same time, the assembly trolley can, via the tilting of the head, enter places with low room height.

15

By horizontal direction and plane should in this context be understood a direction / plane, which is mostly parallel with the earth surface, which the trolley stands on, and by vertical should be understood a direction, which is mostly perpendicular on the horizontal plane.

20

By circle displacement is understood that the tool holder is moved in a partial circle curve when the primary cylinder is active and is displaced.

By a movable end of a displacement design is understood the movable part hereof, which causes a force effect and which transmits movement to the body, which it is connected to.

25

By a fixed profile is understood a profile, which can not be moved.

The tool is preferably a replaceable tool, but the assembly trolley can obviously also be constructed with a tool, which is not replaceable if desired.

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In an additionally preferred embodiment, and as stated in claim 2, the

second displacement mechanism includes a gear construction and a second displacement design such as a hydraulic cylinder for creation of a horizontal displacement of the tool holder and that the second displacement design is designed for, by a displacement length L_1 , to transmit a horizontal displacement to the tool holder by which the tool holder is moved in horizontal direction with a displacement length on L_2 where L_2 is larger than L_1 .

The gearing leads to that certain throw of the hydraulic cylinder gives rise to a greater horizontal stroke and movement of the tool, which holds the building element. A mobile assembly trolley is hereby achieved that does not require large stroke cylinders and can thus more easily get ahead in areas with little space and it is easier to position the building element.

In an additionally preferred embodiment, and as stated in claim 3, the gear construction includes a curved profile composed of at least two profile pieces connected in a profile turning joint by which the two profile pieces can rotate around the turning joint in relation to each other, which curved profile includes a first end and an opposite second end, and that at least the first end is secured to the displaceable tool holder in a second turning joint, and that the second displacement design includes a first and movable end part, which first end part is rotatably connected to the profile between the profile turning joint and the second turning joint.

A stable and very solid gear construction is hereby achieved, which can withstand the high loads, which occur when working with building elements.

In an additionally preferred embodiment, and as stated in claim 4, the assembly trolley includes a fourth displacement mechanism designed to displace the tool holder in vertical direction, which fourth displacement mechanism includes a fourth displacement design such as a hydraulic cylinder including a first displacement end and a second displacement end, which first displacement end is secured to the tool holder and which second

displacement end is fixed to the frame in a first frame part, and that the fourth displacement mechanism includes a vertical guideway axis parallel to the fourth displacement design, which guideway at one end is mounted to the frame and that the tool holder includes a sliding part by which the tool holder is vertically displaceable around the guideway and axis parallel to this.

It is hereby achieved that the assembly trolley can carry out additional vertical lifts and fine-adjust the placement of a building element. This has a large significance in connection with mounting of a building element, for example a plate, which has to be fitted to already mounted plates.

In an additionally appropriate embodiment, and as stated in claim 5, the part includes an anchor plate, which anchor plate is mounted to the movable carrying profile.

It is hereby achieved that the tool holder does not change direction / position in relation to the plane, which the assembly trolley is positioned on, no matter how high / low the movable carrying profile is placed.

In an additionally appropriate embodiment and as stated in claim 6, the movable carrying profile includes a lower profile and a above this and axis parallel to it placed upper profile, which profiles include a first end part and an opposite placed second end part, which first end parts are rotatably connected to the tool holder and to each other by a first distance profile and that the second end parts are rotatably connected to each other by another distance profile.

It is hereby achieved that that when the main cylinder is displaced in vertical direction, the carrying profile's two axis parallel profiles will move up and parallel to one another in a parallelogram, and where the movement is transmitted to the tool holder whereby this and thus the tool is moved

vertically up in a partial circle curve.

5 In an additionally preferred embodiment, and as stated in claim 7, the assembly trolley includes removable tools such as a drift, U- clamping pliers, a frame with side grippers, a fork shape and which tools are designed for being able to be mounted detachably on the tool holder.

10 As a result of the tools' replaceable gripping geometry, the assembly trolley can be used for moving and positioning plates, beams, blocks, boxes and so on.

15 In an additionally preferred embodiment and as stated in claim 8, the assembly trolley includes detachable counterweights placed opposite the tool holder.

It is hereby achieved that the risk of the assembly trolley being pushed over forwards, when it carries out heavy lifts and handling building elements, is minimised. The weight can be adjusted to the type of building element such that the assembly trolley does not become strained with unnecessary weight.

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25 In an additionally preferred embodiment, and as stated in claim 9, the primary displacement design's lowering function is operated by gravity and not an applied pressure force.

It is hereby achieved that the hydraulic mechanism does not continue to contract when the carrying profile has reached its starting position, which could make it possible that the trolley would become lifted from the foundation and could thereby overturn.

30

In an additionally preferred embodiment and as stated in claim 10, one or more of the wheels are powered by a motor mounted to the frame.

5 By making the assembly trolley motorised, the handling is eased of it and the service personnel shall use less energy on the transport itself of the building elements. The motorisation can for example include a powered motor, which is operated by a rechargeable battery or it can include a built-in generator, which supplies the necessary energy to the motor.

10 In an additionally preferred embodiment, according to the invention, the assembly trolley includes fastening items for mounting the removable tool.

15 The locking mechanism / the fastening items of the tool for the tool head is a simple and solid construction, preferably a pawl, which is designed to, by a displacement, to grip in a recess adapted to the tool. The changing of the tool can thereby occur quickly and efficiently while the tool is connected to the assembly trolley's tool holder without risk of falling off.

20 In an additionally preferred embodiment, according to the invention, the assembly trolley includes a tool, which is characterized by including a profile cross in which a drift is placed in the middle, which tool also includes a house, which with fastening items is mounted to the tool holder, and that the housing includes a rotational bearing, whereby the profile cross can rotate.

25 It is hereby achieved that a plate with a for that designed hole can be mounted on the drift and can rotate in relation to the assembly trolley. The rotational bearing can be a ball bearing, plain bearing, bush construction.

The invention will now be explained more fully with reference to the drawing, where

5 Fig. 1 shows a first design example of a mobile assembly trolley according to the invention with a drift tool mounted

Fig. 2 shows the in fig. 1 shown assembly trolley seen from the side

10 Fig. 3 shows a detailed image of the tool holder shown in fig. 1

Fig. 4 shows another design example of a mobile assembly trolley according to the invention including a beam fork tool.

15 Fig. 5 shows a third design example of a mobile assembly trolley according to the invention with a drift tool mounted

Fig. 6a shows the in fig. 5 shown assembly trolley with a block fork tool mounted.

20 Fig. 6b shows a detailed image of the tool holder shown in fig. 6a seen in perspective from the back

Fig. 6c shows a detailed image of the tool holder shown in fig. 6a seen in perspective from the front.

25 Figure 1 shows a mobile assembly trolley 1 according to the invention including a frame 3 on which wheels 4 are mounted. In this case three wheels 4 of which one is placed in the front and two wheels 4 closest to a tool holder 7 on which a drift tool 8 including a drift / pin 35 is mounted for
30 handling a building element 2, here a plate, in which a hole is drilled for receiving the pin 35. The drift tooling includes a cross-profile in whose

center the drift 35 is placed. The tool further includes a housing, which with fastening devices is mounted to the tool holder and the housing includes a rotational bearing, whereby the cross profile can rotate.

5 The frame 3 includes a vertical fixed profile 6. To the profile 6 is a movable carrying profile 5 rotatably mounted in a first turning joint 17 at one end of the vertical profile 6. At the opposite end of the vertical profile 6, one wheel 4 is mounted. The movable carrying profile 5 includes a lower profile 38 and an over this and axis parallel hereby placed upper profile 39, which profiles 38,39 each include a first end part 40 and an opposite placed second end part 41, which first end parts 40 are rotatably connected to the tool holder 7
10 by an axis system 9 and to each other by a first spacer 42. The second end parts 41 are rotatably connected to the vertical profile 5 and to each other by another distance profile 43.

The carrying profile 5 is by a primary - first - displacement design 10 here a
15 hydraulic cylinder movable upwards and downwards. The cylinder is attached to the lower profile 38 and at the other end to the frame 3, here a body 44 including a motor. When the cylinder's 10 piston rod is displaced, the carrying profile 5 is also displaced in a parallelogram (as is known by displacement of a balanced-arm lamp's position), whereby the movement is
20 transmitted to the tool holder 7, which is moved in vertical direction up or down in a partial circle curve.

The assembly trolley 1 further includes another displacement mechanism 11 comprising another displacement design 13 such as a hydraulic cylinder for displacement of the tool holder 7 in horizontal direction.

25 The assembly trolley 1 includes a third displacement design 23, here consisting of a hydraulic cylinder, see also fig. 3. The displacement design 23 is designed in such a way that it will tilt the tool holder 7 around a horizontal axis by an elongation / shortening, since the cylinder has a working point and attachment on the tool holder 7 in a first moveable
30 turning joint / axis situated below this horizontal axis. The cylinder is fixed to

the frame 3 and, moreover, and in this case in the end opposite situated the movable end 25.

5 Additionally, the assembly trolley 1 includes a fourth displacement mechanism 27 designed to displace the tool holder 7 in vertical direction. With reference to fig. 3 and fig. 6b and 6, the fourth displacement mechanism 27 includes a fourth displacement design 28 such as a hydraulic cylinder comprising a first displacement end 29 and an opposite other end 30. The first displacement end 29 is secured to the tool holder 7 and the other end 30 is fixed to the frame 3 in a first frame part 31. The 10 fourth displacement mechanism 27 comprises a vertical guideway 32 parallel to the axis of the fourth displacement design 28. The guideway 32 here consists of two vertical bars, which at one end are mounted to the first frame part 31. The tool holder 7 comprises a sliding part 34, which encloses 15 the vertical rods, by which the tool holder 7 is vertically movable around the guideway and axis parallel to this. In this way, the tool holder 7 can be displaced further vertically than by the displacement provided by the first displacement design 10.

Figure 2 shows the in figure 1 shown assembly trolley 1, where it carries a 20 building plate 2, but where the plate 2 is tilted backwards until it has contact against a resting pin 45. The plate 2 is hereby parallel to the longitudinal axis of the carrying profile 5. Fig. 3 shows a detailed view of the tool holder 7. This includes for example the second displacement mechanism 11 comprising a gear construction 12 (not visible on the drawing) and the 25 second displacement design 13. The gear 12 results in that when the second displacement design 13 is displaced with a displacement length L1, this displacement will transmit a horizontal displacement to the tool holder 7. The tool holder 7 is moved in horizontal direction with a displacement length on L2 where L2 is larger than L1. The tool shown in fig. 1-3 is a drift 30 tool comprising a cross-profile in whose center a drift is placed. The tool comprises a housing, which with fastening items is mounted to the tool

holder. The housing includes a rotational bearing, whereby the profile cross can rotate.

Fig. 4 shows another design example of a mobile assembly trolley 1 according to the invention comprising a removable beam fork tool 8. The tool 8 can be mounted on top of the removable drift tool, which is shown in fig. 1-3 and which handles plates. The tool is shown in the top position, which it can take using the stroke of the primary displacement design 10. Since the carrying profile 5 is moved in a circular movement, the tool is in its uppermost position located behind the front wheels 4. If there subsequently has to occur an adjustment in vertical direction, this is done by application of the fourth displacement mechanism 27, since it functions directly vertical without displacing the tool 8 in other directions than the vertical. The, in the figure, specified reference numbers refer to the same components as in the previous figures.

Fig. 5 shows a third design example of a mobile assembly trolley 1 according to the invention with a drift tool 8 mounted. The stated reference numbers refer to the same components as in the previous figures. The difference between this assembly trolley and the one shown in figure 1, is essentially that the one in figure 5 is battery-powered and includes battery etc. 47 located at the rear wheel 4, and that the overall design is modified.

Fig. 6a shows the in fig. 5 shown assembly trolley 1 with a block fork tool 8 mounted. The stated reference numbers refer to the same components as in the previous figures. Fig. 6b shows a detailed view of the tool holder 7 shown in fig. 6a seen in perspective from the back and fig. 6c shows the tool holder 7 seen in perspective from the front. With reference to fig. 6 b, c, the second displacement mechanism 11 will, including the gear construction 12, hereby be examined, since this construction is the same for all of the specified design examples.

The gear 12 includes a curved profile 15 composed of at least 2 profile pieces 16', 16" assembled in a profile turning joint 46 by which the two profile pieces 16', 16" can rotate in relation to each other. The curved profile 15 comprises a first end 18 and an opposite placed second end 19, where the first end 18 is secured to the displaceable tool holder 7 in another turning joint 20. The other end 19 is fixed to the frame 3. The second displacement design 13 comprises a first end part 21 which is rotatably connected to the profile 15 between the profile turning joint 46 and second turning joint 20. A part of the second displacement design 13 is attached to the frame 3.

The third displacement design 23 is by a part 48 connected to the frame (3). The part 48 includes an anchor plate, which is mounted to the movable carrying profile (5).

The tool holder comprises fastening items for mounting of the tool. The attachment items comprises a pawl which is designed to, by a displacement, to grip into a, on the tool adapted, recess. The tool holder 7 is horizontally displaceable in relation to the frame and thereby becomes a displacement by application of the second displacement design 13 controlled by a horizontal guideway including horizontal and axis parallel round profiles, around which the tool holder 7 can glide for example by sliding sleeves.

The assembly trolley preferably comprises a rear wheel and two front wheels, where the front wheels can be adjusted such that they are either on the inside or on the outside of the assembly trolley's frame. The assembly trolley can be adjusted such that it has either increased stability by placing the front wheels on the outside of the frame or that it, by placing the front wheels on the inside of the frame can enter into the narrow passages of ~

80 cm. The assembly trolley preferably comprises removable counterweights opposite the tool holder, whereby the assembly trolley can lift heavy elements of +300 kg without tipping over. As it is apparent from the above, many different tools can be mounted to the assembly trolley.

Reference numbers

B

- 1 assembly trolley
- 2 building elements
- 5 3 frame
- 4 wheels
- 5 vertical movable carrying profile
- 6 vertical profile
- 7 tool holder
- 10 8 changeable tool
- 9 axis system
- 10 first displacement design
- 11 second displacement mechanism
- 12 gear construction
- 15 13 second displacement design
- 14
- 15 curved profile
- 16 2 profile pieces
- 17 first turning joint
- 20 18 first end for 15
- 19 opposite second end for 15
- 20 second turning joint,
- 21 first end part for 13
- 22
- 25 23 third displacement design
- 24
- 25 first end for 23
- 26
- 27. fourth displacement mechanism
- 30 28 fourth displacement design
- 29 first displacement end for 28

- 30 second end for 28
- 31 first frame part
- 32 vertical guideway
- 33 guideway's first end
- 5 34 sliding part
- 35 pin/drift?
- 36 ball bearing in relation to the pin
- 37
- 38 lower profile
- 10 39 upper profile
- 40 first end part for profiles
- 41 second end part for profiles
- 42 first distance profile
- 43 second distance profile.
- 15 44 body
- 45 resting pin
- 46 profile turning joint
- 47 battery
- 48 part
- 20 49 anchor plate

Patent claims

- 5 1. Mobile assembly trolley (1) for transport and positioning of building elements (2) such as plates, beams, poles and blocks, which assembly trolley (1) includes a frame (3) with wheels (4) or similar and including a movable carrying profile (5) and a mostly vertical profile (6) to which the movable carrying profile (5) is rotatably
10 mounted in a first turning joint (17) and a tool holder (7) for securing a tool (8), which tool holder (7) is rotatably mounted to the movable carrying profile (5), which carrying profile (5) by a primary displacement design (10) such as a hydraulic cylinder is designed to rotate around the first turning joint (17) by which the tool holder
15 (7) performs a movement in vertical direction and that the tool holder (7) includes another displacement mechanism (11) including a displacement design (13) such as a hydraulic cylinder for displacement of the tool holder (7) in horizontal direction
20 **characterized in** that the assembly trolley (1) includes a third displacement design (23) such as a hydraulic cylinder designed to tip / turn the tool holder (7) around a horizontal axis system (9), which third displacement design (23) includes a first movable end (25) which first movable end (25) is connected rotatably to the tool holder and which displacement design (23) at a part (48) is
25 connected to the frame.
- 30 2. Mobile assembly trolley (1) according to claim 1 **characterized in** that the second displacement mechanism (11) includes a gear construction (12) and the second displacement design (13) such as a hydraulic cylinder for creation of a horizontal displacement of the tool holder (7) and that the second displacement design (13) is

designed for, by a displacement length L1, to transmit a horizontal displacement to the tool holder (7) by which the tool holder (7) is moved in horizontal direction with a displacement length on L2 where L2 is larger than L1.

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3. Mobile assembly trolley (1) according to claim 2 **characterized in** that the gear construction (12) includes a curved profile (15) composed of at least two profile pieces (16',16'') connected in a profile turning joint (46) by which the two profile pieces (16',16'') can rotate around the turning joint (46) in relation to each other, which curved profile (15) includes a first end (18) and an opposite second end (19), and that at least the first end (18) is secured to the displaceable tool holder (7) in a second turning joint (20), and that the second displacement design (13) includes a first and movable end part (21), which first end part (21) is rotatably connected to the profile (15) between the profile turning joint (46) and the second turning joint (20).

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4. Mobile assembly trolley (1) according to any of the previous claims **characterized in** that the assembly trolley (1) includes a fourth displacement mechanism (27) designed to displace the tool holder (7) in vertical direction, which fourth displacement mechanism (27) includes a fourth displacement design (28) such as a hydraulic cylinder including a first displacement end (29) and a second displacement end (30), which first displacement end (29) is secured to the tool holder (7) and which second displacement end (30) is fixed to the frame (3) in a first frame part (31), and that the fourth displacement mechanism (27) includes a vertical guideway (32) axis parallel to the fourth displacement design (28), which guideway (32) at one end is mounted to the frame (3) and that the tool holder includes a sliding part (34) by which the tool holder (7) is vertically

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displaceable around the guideway (32) and axis parallel to this.

5. Mobile assembly trolley (1) according to any of the previous claims
5 **characterized in** that the part (48) includes an anchor plate (49),
which anchor plate (49) is mounted to the movable carrying profile
(5).
6. Mobile assembly trolley (1) according to any of the previous claims
10 **characterized in** that the movable carrying profile (5) includes a
a lower profile (38) and a above this and axis parallel to it placed
upper profile (39), which profiles (38,39) include a first end part (40)
and an opposite placed second end part (41), which first end parts
(40) are rotatably connected to the tool holder (7) and to each other
15 by a first distance profile (42) and that the second end parts (41)
are rotatably connected to each other by another distance profile
(43).
7. Mobile assembly trolley (1) according to any of the previous claims
20 **characterized in** that the assembly trolley (1) includes removable /
replaceable tools (8) such as a drift, U- clamping pliers, a frame
with side grippers, a fork shape, which tools (8) are designed for
being able to be mounted detachably on the tool holder (7).
8. Mobile assembly trolley (1) according to any of the previous claims
25 **characterized in** that the assembly trolley (1) includes removable
counterweight placed opposite the tool holder (7).
9. Mobile assembly trolley (1) according to any of the previous claims
30 **characterized in** that the primary displacement design's (10)
lowering function is operated by gravity and not an applied pressure
force.

10. Mobile assembly trolley (1) according to any of the previous claims **characterized in that one or more of the wheels (4) are powered by a motor mounted to the frame.**

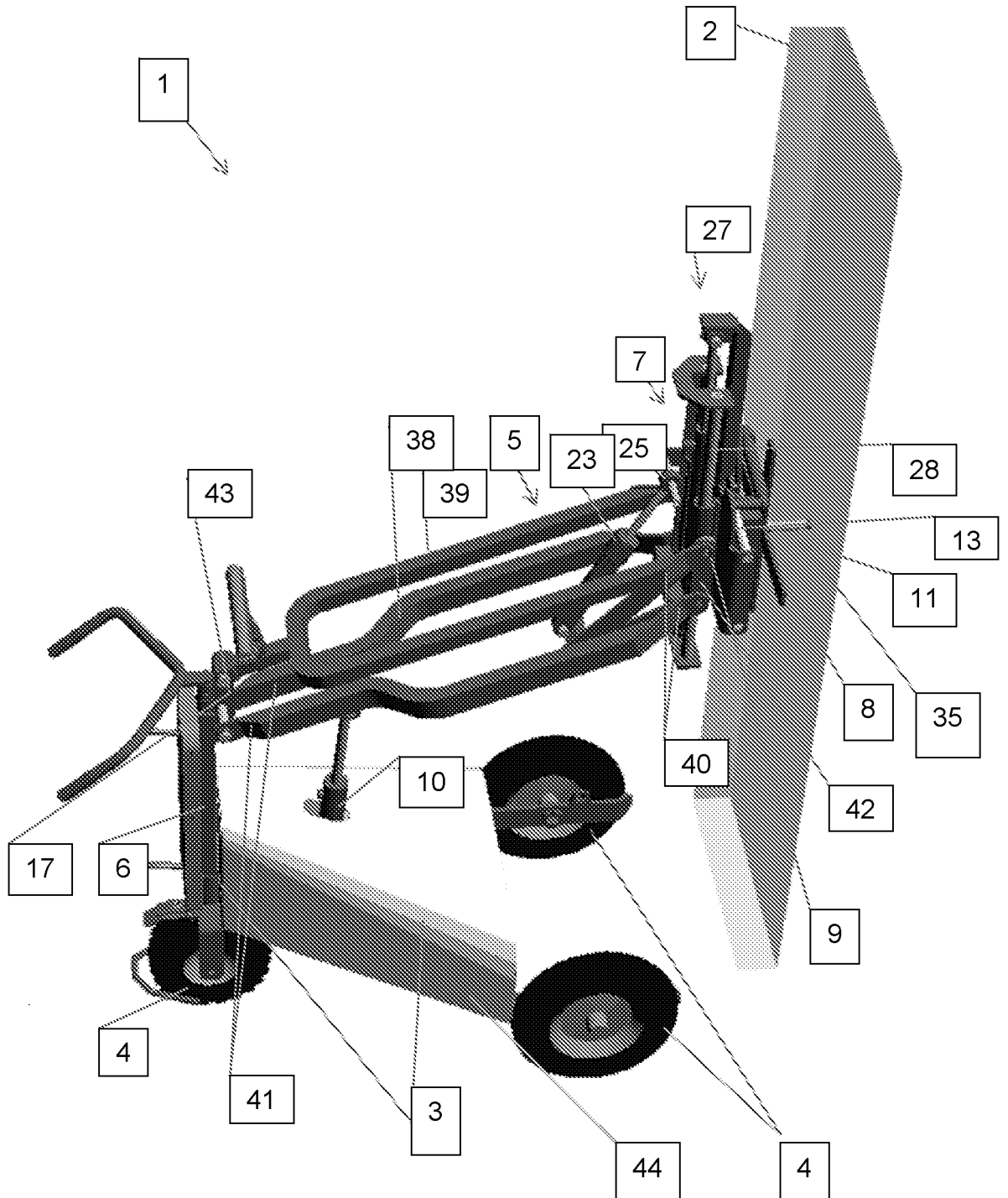


Fig. 1

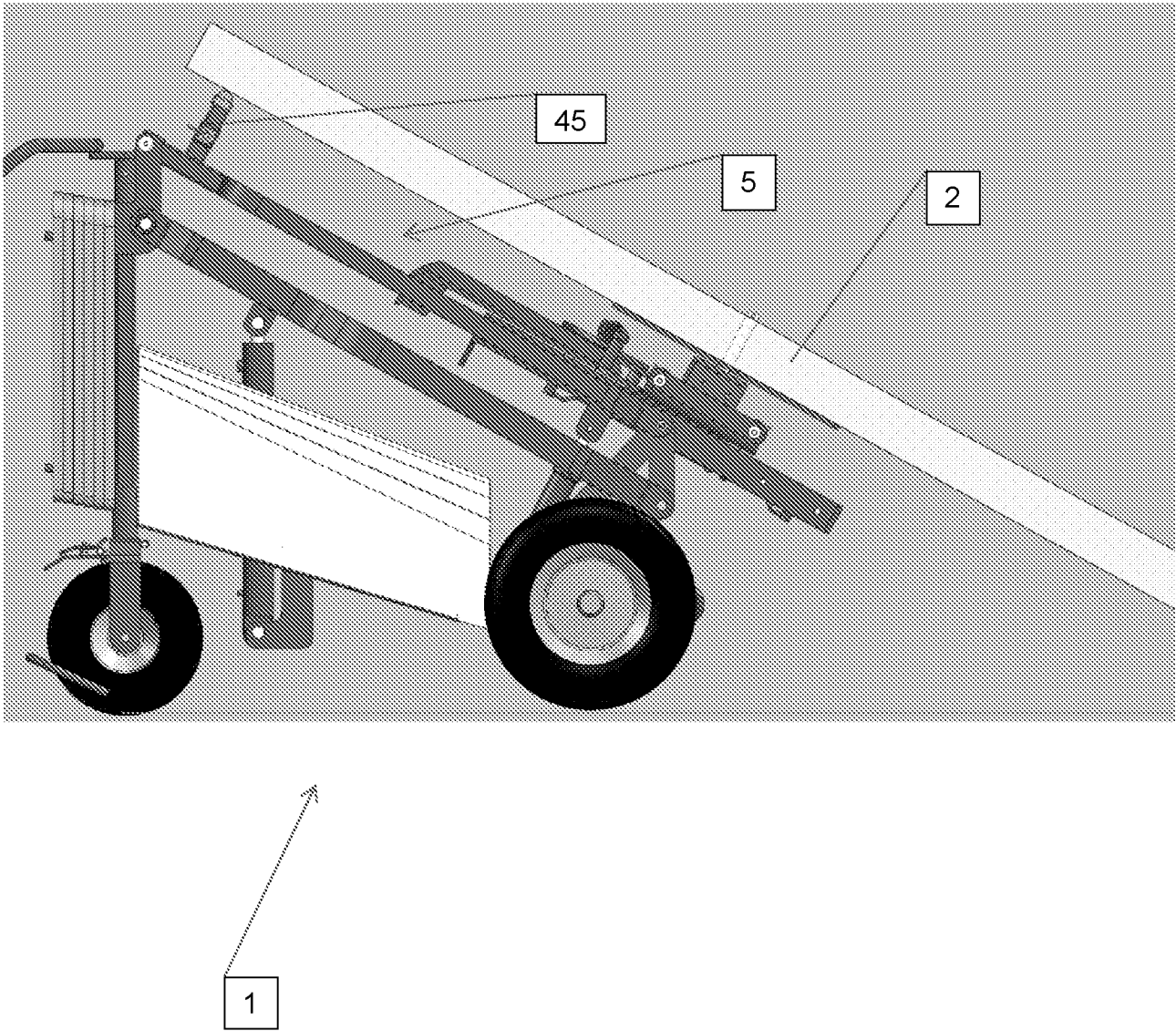


Fig. 2

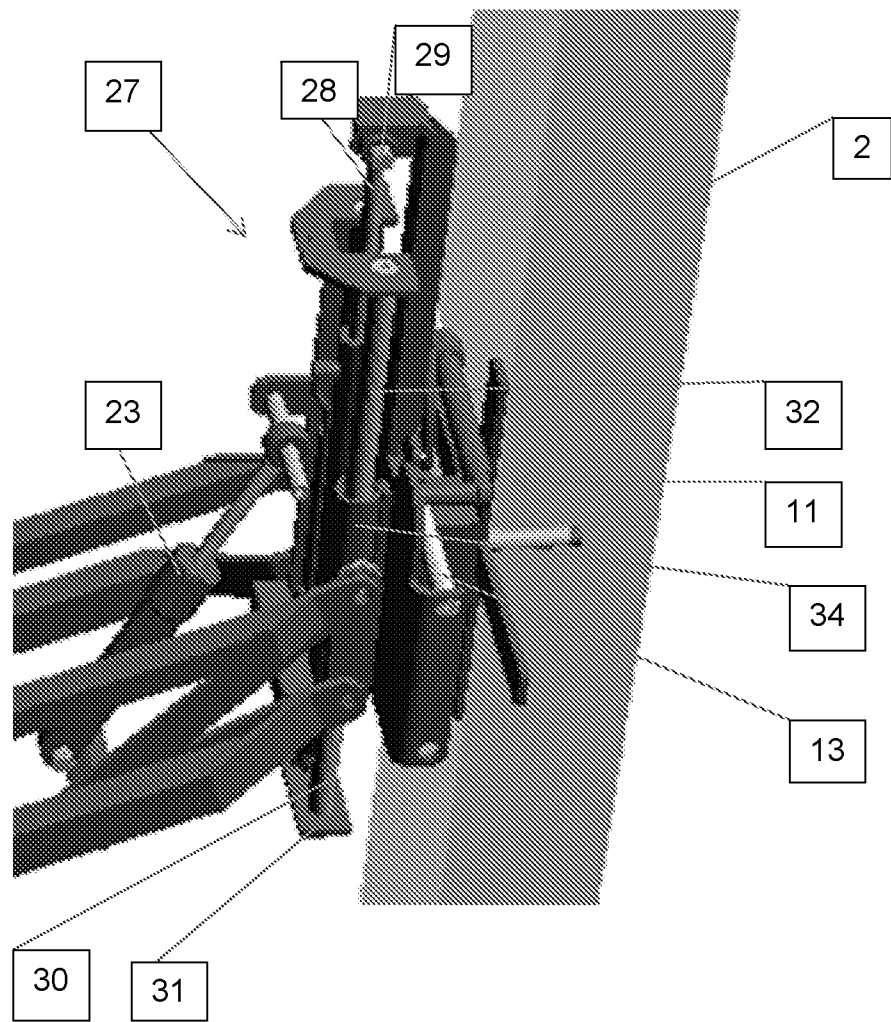


Fig. 3

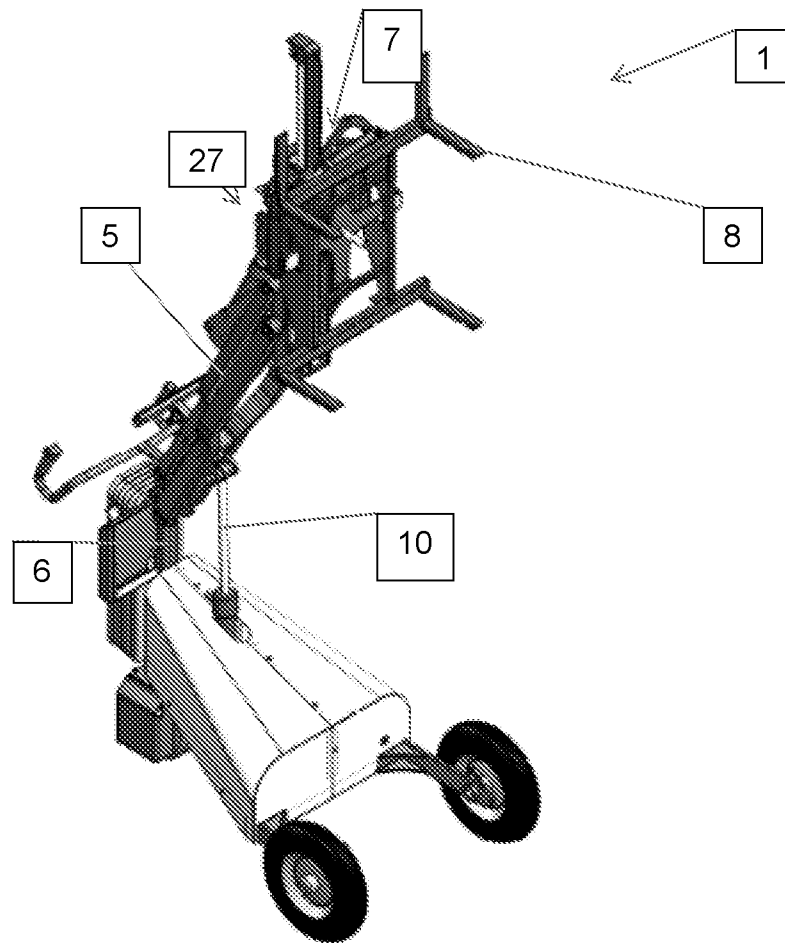


Fig. 4

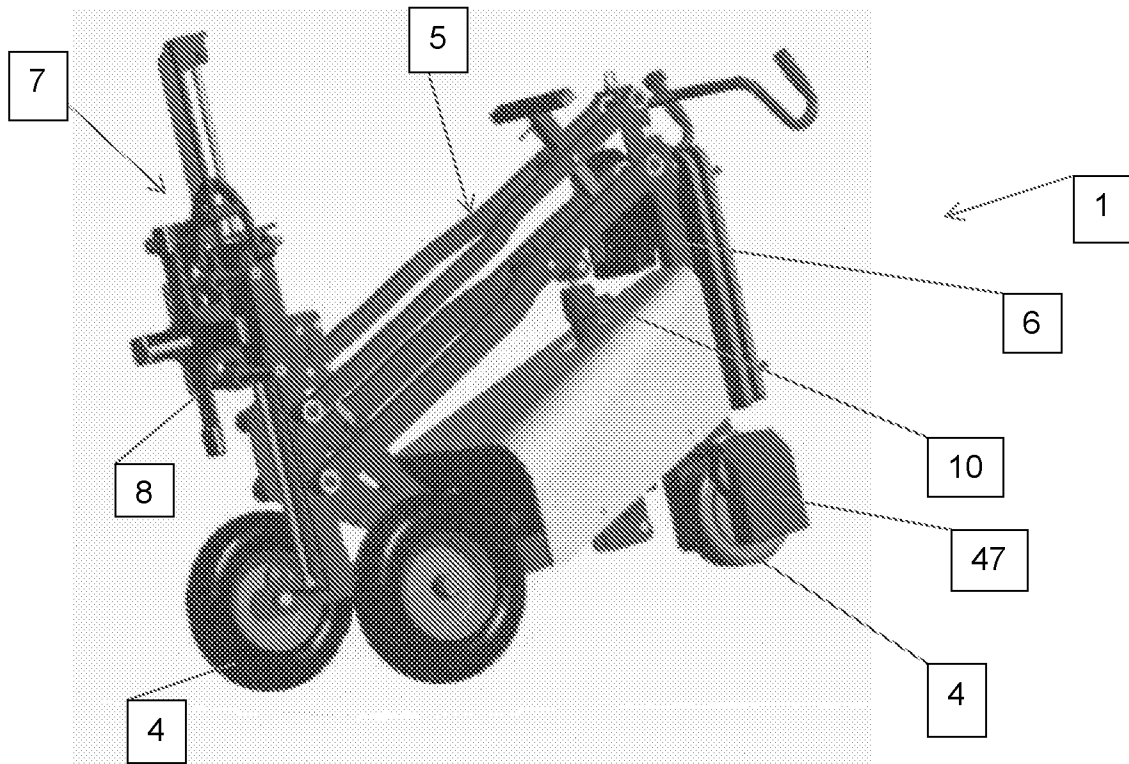


Fig. 5

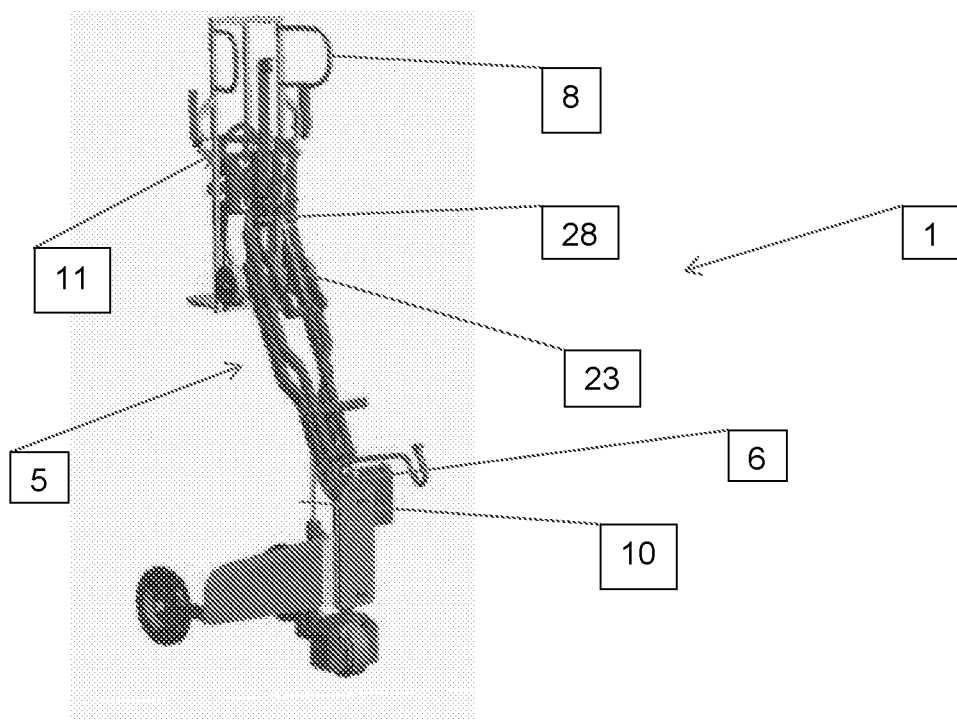


Fig. 6 a

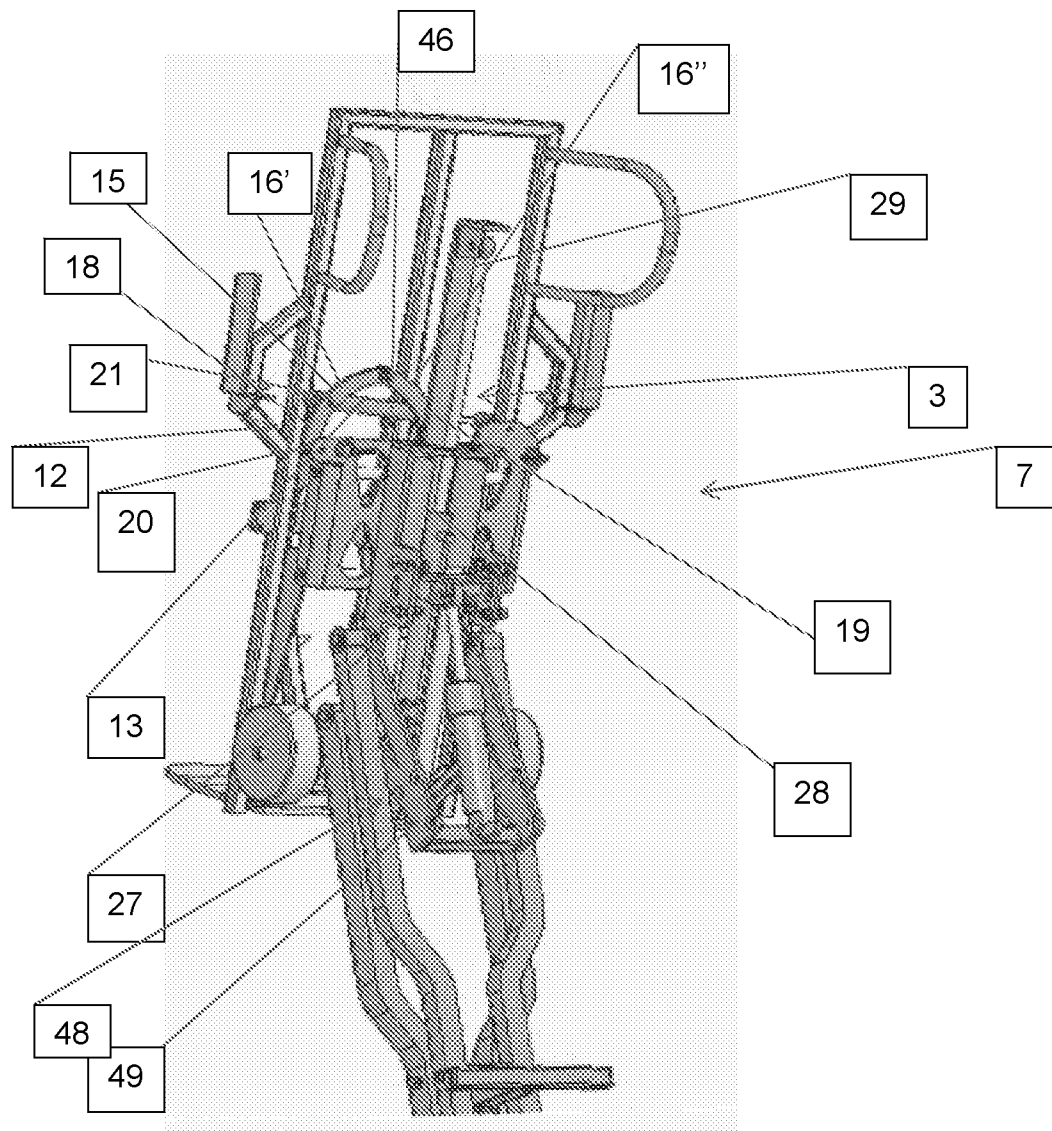


Fig. 6 b

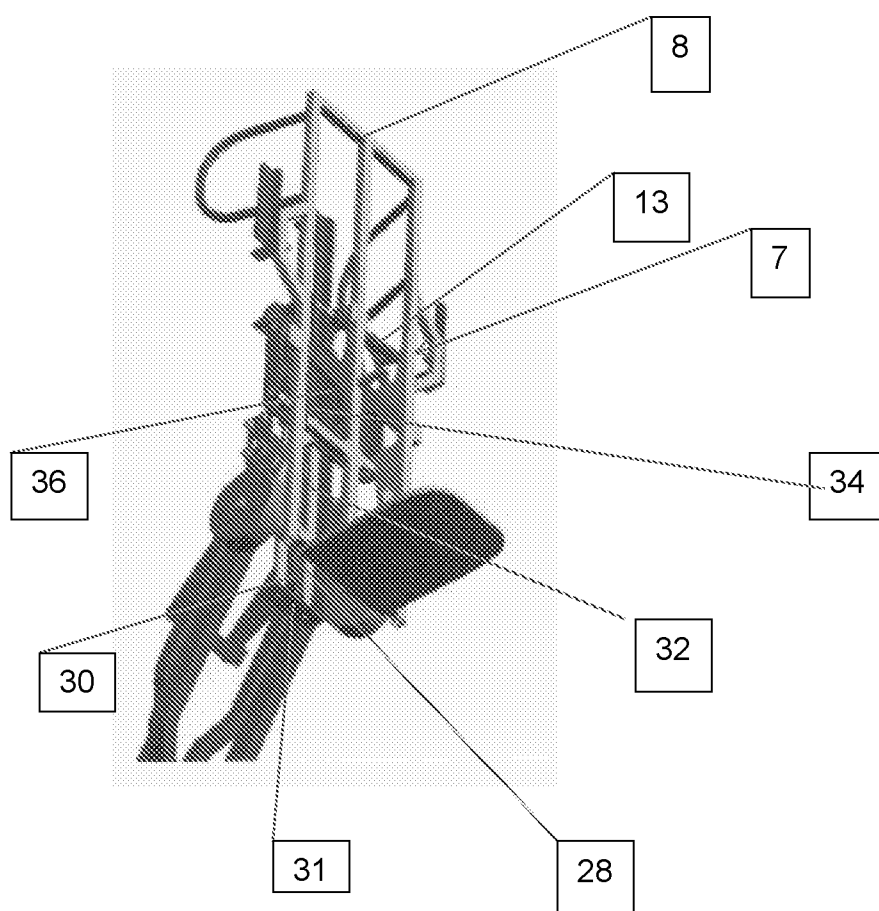


Fig. 6 c

INTERNATIONAL SEARCH REPORT

International application No.

PCT/DK2015/050006

A. CLASSIFICATION OF SUBJECT MATTER B62B 3/04 (2006.01), B62B 3/08 (2006.01) According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED Minimum documentation searched (classification system followed by classification symbols) IPC&CPC&FICLA: B62B		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched DK, NO, SE, FI: Classes as above.		
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) EPODOC, WPI, FULL TEXT: ENGLISH		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 1645484 A2 (MOUNTIT AS) 12 April 2006 (see abstract, sections [0015]-[0028] and figures 7, 10 and 12 in particular)	1-10
A	US 2001/0052708 A1 (SCHMALZ et al.) 20 December 2001 (see abstract, section [0079] and figure 6 in particular)	1-10
A	DE 202012104180 U1 (BOHLE AG) 29 November 2012 (see abstract and figures 9-10b in particular)	1-10
A	US 4810151 A (SHERN) 07 March 1989 (see abstract, description columns 4 and 6 and figures 9-10 in particular)	1-10
A	GB 2224263 A (KAJIMA CORP, KOMATSU MFG. CO. LTD.) 02 May 1990 (see abstract and figures 1-9 in particular)	1-10
☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.		
* Special categories of cited documents: "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier application or patent but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art "&" document member of the same patent family		
Date of the actual completion of the international search 12/05/2015		Date of mailing of the international search report 12/05/2015
Name and mailing address of the ISA Nordic Patent Institute Helgeshøj Allé 81 DK - 2630 Taastrup, Denmark. Facsimile No. + 45 43 50 80 08		Authorized officer Basel Hayatleh Telephone No. +45 43 50 83 66

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/DK2015/050006

Patent document cited in search report / Publication date	Patent family member(s) / Publication date
EP 1645484 A2 2006.04.12	None
US 2001052708 A1 2001.12.20	DE 19959285 A1 2001.06.21 DE 19959285 B4 2008.01.31 US 6652014 B2 2003.11.25
DE 202012104180U U1 2012.11.29	DE 102012110053 A1 2014.04.24 DE 102012110053 A9 2014.06.18 WO 2014064033 A1 2014.05.01
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