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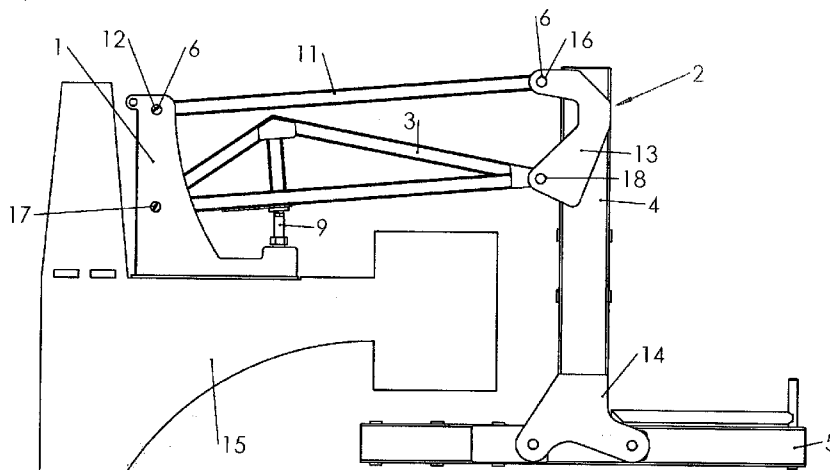


Fig. 1

(57) Abstract: Scaffolding unit to be attached to the deck structure of a bridge or similar comprises a set of arms (2) for carrying working levels and the support structures needed in work and an attachment frame (1) for attaching the set of arms to the upper surface of the deck structure. The set of arms (2) is connected to the attachment frame by means of a pivoted parallelogram (3, 6, 11, 12).



## Scaffold

### Field of the invention

5

The present invention relates to scaffolding unit intended to form working stages and the support structures required in work for use in connection with repair, installation, and maintenance work on bridges and other structures with a  
10 deck.

In particular, the invention relates to the creation of repair scaffolding for bridges.

### 15 Background to the invention

Publication WO2008132277 discloses one scaffolding arrangement suitable for repair work on a bridge deck. The arrangement consists of a number of scaffolding supports to  
20 be installed on the deck of the bridge, which are supported from the bridge by bolting the support to the upper surface of the deck of the bridge and then carrying the support on rotatable support elements on the undersurface of the deck.

25 Publication WO2012062968 discloses an attachment element for attaching a scaffolding support to the deck of a bridge. The scaffolding support to be attached is arranged to be carried on two support points to the upper side of the deck of the bridge. At least one of the support points  
30 is arranged to take the compressive force of the attachment elements attached to the deck of the bridge and at least one is arranged to take the tensile force. The attachment element is arranged to be detachably attached to the deck of the bridge with at least two attachment means and com-  
35 prises at least one attachment means for attaching the

attachment element to the support point taking the tensile force of the scaffolding support.

Because scaffolding supports must be able to carry quite a  
5 large load of repair tools, repair workers, and possibly casting formwork and similar, the supports easily become quite massive. Thus, lifting means are needed to handle them and heavy vehicles to transport them. In addition, the installation of the supports usually requires several people.  
10 ple. All these factors increase the repair costs.

Another factor slowing repair work and increasing costs is that the vertical adjustment margin of the supports relative to the bridge deck is quite small. In addition, in  
15 some cases the lifting of the support level relative to the bridge deck causes it to tilt, which either makes the work difficult or must be compensated for in some way. Due to the large loads, all the adjustment elements and operating devices must be dimensioned to be heavy, which increases  
20 the weight and costs of the structure.

The scaffolding also requires special attachment devices, such as bolts running through the bridge deck and possibly a flat surface in the deck for attachment. The formwork  
25 required for repairing and casting the edge of the bridge must be moved with jacks and continuous casting in the longitudinal direction of the bridge or deck is not possible. Work is also hindered by the support required by the scaffolding against the undersurface of the bridge.

30

The present invention is intended to create a solution, in which the position of the support level formed by the scaffolding can be easily altered in the height direction.

35 The invention is also intended to create a solution, in

which adjustment of the height direction does not alter the lateral positioning.

Further, the invention's embodiments are intended to create scaffolding, which can, when desired, be transported in parts and assembled at the point of use.

Further, the invention's embodiments are intended to create scaffolding, the structure of which is simple and easily manufactured.

The invention's embodiments are also intended to permit the adjustment within wide limits of the location of the scaffolding's work stages, formwork, and other structures at least in the height direction of the bridge deck, preferably also in the transverse direction relative to the longitudinal direction of the deck level.

The invention's embodiments are also intended to permit adjustment of the scaffolding's height-direction position relative to the deck of the bridge or other level at least partly from the top of the deck of the bridge or similar, most preferably from the side of the attachment frame of the scaffolding opposite to the edge of the deck.

The invention is based on the attachment elements connecting the scaffolding to the bridge deck being attached to the set of carrier arms by means of a pivoted rectangle, preferably a pivoted parallelogram.

According to one embodiment of the invention, the scaffolding can be dismantled into parts and assembled at the point of use.

According to one embodiment of the invention, one scaffold-

ing unit comprises only one operating device for altering the vertical position of the set of carrier arms.

Several advantages are gained with the aid of the invention.  
5 tion.

The structure of the scaffolding unit according to the invention is light, but can nevertheless be dimensioned to carry a large load, which is required for carrying the  
10 devices and materials to be used in bridge repair work. The scaffolding unit can be easily dismantled into parts for transportation and assembled at the point of use. Heavy lifting devices are not needed to move the parts and installation of the scaffolding can be done even by one work-  
15 man. One of the most important advantages of the invention is that the location of the carrier level formed with the aid of the scaffolding, relative to the undersurface of the bridge, can be easily altered within a large adjustment range without the angle of the carrier level or the dis-  
20 tance from the edge of the deck essentially changing. The components of the scaffolding are plate and beam structures, so that it is cheap to manufacture. In principle, the assembly of the scaffolding unit requires only the pivot pins to be set in place, so that installation work is  
25 easy and special tools are not required.

In the following, the invention is described in greater detail with the aid of the accompanying drawings.

30 Figure 1 shows a side view of the scaffolding unit according to the invention.

Figure 2 is an exploded view of the scaffolding unit of Figure 1.

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Figure 3 shows the scaffolding unit of Figures 1 and 2 in a first adjustment position.

Figure 4 shows the scaffolding unit of Figures 1 and 2 in a  
5 second adjustment position.

Figure 5 shows a second embodiment of the invention.

In the following, the downward direction is the direction  
10 from on top of the deck structure pointing towards its upper surface and the direction pointing upwards is the direction opposite to that.

In the embodiment of Figure 1, the scaffolding unit consists of a set of carrier arms 2 for forming work levels  
15 and for carrying the work machines and formwork required in the work and connecting the set of arms of the attachment frame 1 to the upper surface of the bridge or other deck structure 15 and for adjusting the attitude and location of  
20 the scaffolding. The set of arms 2 comprises a vertical arm 4, at the lower end of which is a transverse carrier beam 5, which forms a T-shaped structure at the end of the vertical arm. A second branch of the T is installed to point  
25 towards the bridge deck 15, so that the opposite branch points away from the deck. Walkways for the workers and the installations required for the work machines and formwork on the deck side of the bridge can be set on these branches.

30 At the opposite end of the vertical arm 4 there is a pivoted parallelogram formed by two beams, the upper beam 11 of which is a straight box-section beam and is attached at its end to the end of the vertical arm 4 at the pivot point 16 and extends from it in the direction of the attachment  
35 unit. Under the upper beam 11 is situated a lower parallel

beam 3. In this case, the lower beam 3 is a triangular beam or one that is otherwise reinforced at the location of the jack, which, when triangular, comprises a straight lower beam and a triangle formed on top of the lower beam, which  
5 consists of two sloping beams and a vertical support connecting the point of the triangle and the lower beam. The advantage of this beam construction is lightness and a good load-bearing capacity.

10 The upper and lower beams 3, 11 are attached to the attachment frame 1 by means of pivot pins 6 to pivot point 12 and 17 located at a distance from each other vertically, in such a way that the upper beam 11 is attached to pivot  
15 point 12 in the upper part of the attachment frame 1 and the lower beam 3 to pivot point 17 beneath it in the lower part of the attachment frame 1. In this example, the pivot points 12 and 17 of the attachment frame are on the same vertical straight line, but by altering the locations of the pivot points the paths of motion of the set of arms  
20 can, if necessary, be altered. At the opposite end, the upper and lower beam 3, 11 are attached by pivot pins 6 to lugs 13 in the end of the vertical arm 4, in which are also formed on top of each other on the same straight line in the vertical direction the pivot points 16, 18 to the upper  
25 beam 11 and the lower beam 3. Thus, the pivot points 12, 16, 17, and 18 form, together with the upper and lower beams 3, 11 a pivoted parallelogram, with the aid of which the vertical arm 4 and the transverse carrier beam 5 at its lower end can be moved vertically. The transverse carrier  
30 beam 5 is attached by pivot pins 6 to lugs 14 at the lower end of the vertical arm 14. In this attachment method, the transverse carrier beam 5 is locked to the horizontal attitude and the pin attachment is intended to create an easily assembled joint.

35

The attachment frame 1 can comprise attachment plates, which form a stand arrangement, which preferably includes attachment bolts that can be adjusted vertically, to attach the scaffolding to the bridge deck. The attachment bolts  
5 can be fitted into holes drilled in the bridge deck and secured with a chemical binding agent, thus making the attachment strong and reliable.

With the aid of the pivoted parallelogram, the vertical arm  
10 4 and the transverse carrier beam 5 attached to it can be raised and lowered. In this embodiment, the operating device is a jack 9, which is installed on top of the attachment frame 1 between the attachment frame 1 and the pivoted parallelogram's triangularly shaped lower beam 3. The jack  
15 9 is located at the vertical support under the point of the beam triangle, so that a strong working point is obtained for the jack 9. The jack 9 can be a simple screw jack, a hydraulic jack, or some similar lifting device. Because continuous adjustment of the vertical position is not need-  
20 ed, the jack can be a simple and strong device.

In Figure 3, the scaffolding is in the upper position and in Figure 4 in the lower position. As can be seen from the figures, even in the extreme positions the vertical arm 4  
25 of the scaffolding remains precisely vertical and the carrier beam 5 horizontal. In addition, it can be seen that the margin of movement of the height adjustment is quite large. This is an extremely important advantage compared to previously known solutions, because in these the adjustment  
30 margins have been quite limited and the adjustments difficult to make.

The scaffolding of Figure 5 differs slightly from that described above. First of all, the scaffolding's lower beam  
35 3 is unified, not necessarily straight, and continues to

the opposite side of the pivot point between the attachment frame 1 and the lower beam 3 relative to the vertical arm 4. The lower beam 3 thus forms a lever extending to both sides of the lower pivot point 17 of the attachment frame 1. A hydraulic jack 21 and a screw jack 22 is fitted to the end of this lever, also on the opposite side of the pivot point between the attachment frame 1 and the lower beam 3, relative to the vertical arm 4. The shafts of the jacks 21, 22 are supported on the stand 20 of the attachment frame 1. Both jacks can be used independently to adjust the position of the vertical arm 4 and the carrier beam 5 with the arm of the lever formed by the lower beam 3, but the adjustment is preferably made with the aid of the hydraulic jack while the position of the scaffolding is locked with the screw jack 22. Here, the terms hydraulic jack and screw jack refer to any hydraulic or screw-operated operating device whatever, by changing the length of which compression, or tractive force, or locking in position are achieved. The adjustment of position and locking can be done with only a screw jack if desired, but a hydraulic jack can be used as an aid in adjusting the height, or in parallel with the screw jack. Other operating devices or power tools are not required here. The adjustment can be made easily and safely on the opposite side of the attachment frame to the bridge deck. The lever can also be formed in a corresponding manner in the upper beam 11 or in both beams 3, 11. It is then possible to optionally fit either of the jacks to the upper beam and the other to the lower beam or both in connection with either the lower beam or upper beam.

The scaffolding unit (attachment frame 1) is preferably attached to the deck of the bridge or other structure with the aid of screwed bolts 23 from the stand 20. Attachment to the deck takes place by gluing or casting the bolts into blind holes made in the deck. The attachment is made from

two stands 20 at a distance from each other and with the aid of the screwed bolts the scaffolding can be raised from the deck, so that a gap 24 forms between the scaffolding and the deck. The deck surface can then be worked on and  
5 the surface cast with the scaffolding attached. There can be a spirit level or spirit levels ready in the attachment frame to facilitate the adjustment of its position.

In this embodiment, the positioning of the scaffolding unit  
10 in the height direction relative to the deck of the bridge or other structure takes place by altering, in addition to the pivoted parallelogram, the locations of the attachment points (pivot points) 16 and 18 between the vertical arm 4 and the pivoted parallelogram 12, 16, 17, 18. In the verti-  
15 cal arm 4 there are attachment holes 25 on top of each other, which have a predefined distance between them. At the ends of the upper and lower beams 11, 3 there are lugs 26, which are arranged on both sides of the vertical arm and in which there are also attachment holes 27 on top of  
20 each other, which have a predefined distance between them. The distances between the vertical arm's attachment holes 25 are greater than the distances between the lugs' 26 attachment holes 27. In this way, a large adjustment margin is obtained with the aid of the vertical arm's 4 attachment  
25 holes 25 and a smaller adjustment margin with the aid of the lugs' 26 attachment holes 27. When this manner of adjustment is combined with the adjustment taking place with the aid of the pivoted parallelogram, the position of the scaffolding unit can be set precisely as desired within  
30 quite large limits. This permits, among other things, easy and accurate placing of the bridge's edge casting 19.

The adjustment of the position of the carrier beam 5 relative to the edge of the bridge deck or other structure can  
35 be carried out with a corresponding hole distribution.

Figure 5 shows a dense hole distribution in the carrier beam 5 and four holes in the attachment lugs of the vertical arm. This hole distribution is also flexible and the number and distribution of the holes can be altered to create an adequate adjustment precision. Though a dense hole distribution can also be made in the long load-bearing components such as the vertical arm or the carrier beam, in these it is preferable to use a larger hole distribution, to minimize the number of holes and preserve strength.

10

In the invention, a pivoted parallelogram is preferably used, but the lengths of the sides and the location of the pivots can be altered as required, making it a pivoted rectangle.

15

The features of the embodiment described above can easily be combined and the corresponding components replaced with each other in order to create a structure more suitable for its purpose.

20

In the scaffolding, there can be integrated working stages and these can include rails or attachments for formwork, tools such as abrasive water jets, or handrails. The scaffolding can be attached to a rail in the bridge deck, so that it can be moved as work progresses parallel to the deck. In the attachment components there can be toolboxes for the safe storage of tools and other materials and lifting hooks or similar can be installed in the scaffolding so that it can be moved as an entire system.

30

The scaffolding unit according to the invention can be transported to the work site ready assembled or dismantled into its principal components. Assembly of the scaffolding unit takes place simply by installing the pivot pins 6 in place and locking them with cotters. Thus in principle, the

35

assembly of the scaffolding unit requires no tools at all. The scaffolding unit is easily dismantled into relatively light parts and can be moved to a new location after use. Because several scaffolding units are required for a bridge  
5 deck or similar work site, significant advantages are achieved with the aid of easy assembly, disassembly, and transportation. In place of pivot pins and cotters it is possible, of course, to use other corresponding attachment elements such as bolts and nuts.

10

It is obvious that the various parts of the example described above can be replaced with functional and structural equivalents within the scope defined by the Claims.

## Claims:

- 5 1. Scaffolding unit to be attached to a bridge or similar  
deck structure, which comprises
- a set of arms (2) for carrying the working levels  
and support structures needed in work, and
  - a attachment frame (1) for attaching the set of arms
- 10 to the upper surface of the deck structure,  
**characterized** in that the set of arms (2) is connected to  
the attachment frame by means of a pivoted rectangle (12,  
16, 17, and 18).
- 15 2. Scaffolding unit according to Claim 1, **characterized** in  
that the pivoted rectangle is a pivoted parallelogram.
3. Scaffolding unit according to Claim 1 or 2, **character-**  
**ized** in that the pivoted rectangle comprise an upper and a
- 20 lower beam (11, 3) and pivot points (12, 16, 17, 18) for  
connecting the beams (3, 11) to the attachment frame (1)  
and the set of arms (2).
4. Scaffolding unit according to Claim 1, 2, or 3, **charac-**  
**terized** in that the pivot points (12, 17) of the attachment
- 25 frame (1) are on a straight line parallel to the pivot  
points (16, 18) of the set of arms (2), according to the  
definition of a pivoted parallelogram, and the straight  
lines are preferably vertical.
- 30
5. Scaffolding unit according to any of Claims 2 - 4, **char-**  
**acterized** in that the lower beam of the pivoted parallelo-  
gram is a triangular beam (3).
- 35 6. Scaffolding unit according to any of Claims 1 - 5, **char-**

**acterized** by at least one operating device (9) for adjusting the position of the pivoted rectangle (3, 6, 11, 12) and the set of arms (2) attached to it.

5 7. Scaffolding unit according to any of Claims 1 - 6, **characterized** in that at least the joints between the set of arms (2), the attachment frame (1), and the pivoted rectangle (3, 6, 11, 12) are implemented with detachable attachment elements (6).

10

8. Scaffolding unit according to Claim 7, **characterized** in that the attachment elements are pivot pins (6).

15 9. Scaffolding unit according to any of the above Claims, which comprises a vertical arm (4) and carrier beam (5) attached transversely to one end of it **characterized** in that the lower and upper beams (3, 11) are attached to the vertical arm (4) by means of lugs (26), in each of which is one row of holes, in which there is a first distance between the holes (27) and in which vertical arm there is a row of holes, in which there is a different distance between the holes (25) than between the lugs' holes (27).

20

10. Scaffolding unit according to Claim 9, **characterized** in that the distances between the holes (25) in the vertical arm (4) are greater than the distances between the holes (27 in the lugs (26).

25

11. Scaffolding unit according to any of the above Claims 8 - 10, **characterized** in that the vertical arm (4) and the carrier beam (5) are attached to each other by means of lugs at the end of the vertical arm (4), in each of which lugs there is a row of holes, in which there is a first distance between the holes and in which carrier beam (5) there is a row of holes, in which there is a different

30  
35

distance between the holes than between the lugs' holes.

12. Scaffolding unit according to Claim 11, **characterized**  
in that the distances between the holes in the carrier beam  
5 (5) are greater than the distances between the vertical  
arm's lugs.

13. Scaffolding unit according to any of the above Claims,  
**characterized** in that at least one of the upper or lower  
10 beams (3, 11) extends to the opposite side of the pivot  
point (17) between the attachment frame (1) and the lower  
beam (3) relative to the vertical arm (4) in such a way  
that the lower beam (3) forms a lever on both sides of the  
lower pivot point (17) of the attachment frame (1).

15

14. Scaffolding unit according to Claim 13, **characterized**  
in that at least one operating device from the group hy-  
draulic jack (21) and screw jack (22) is arranged at the  
end of the lever formed by at least one of the lower or  
20 upper beams, on the opposite side of the pivot point (17)  
between the attachment frame (1) and the lower beam (3)  
relative to the vertical arm (4).

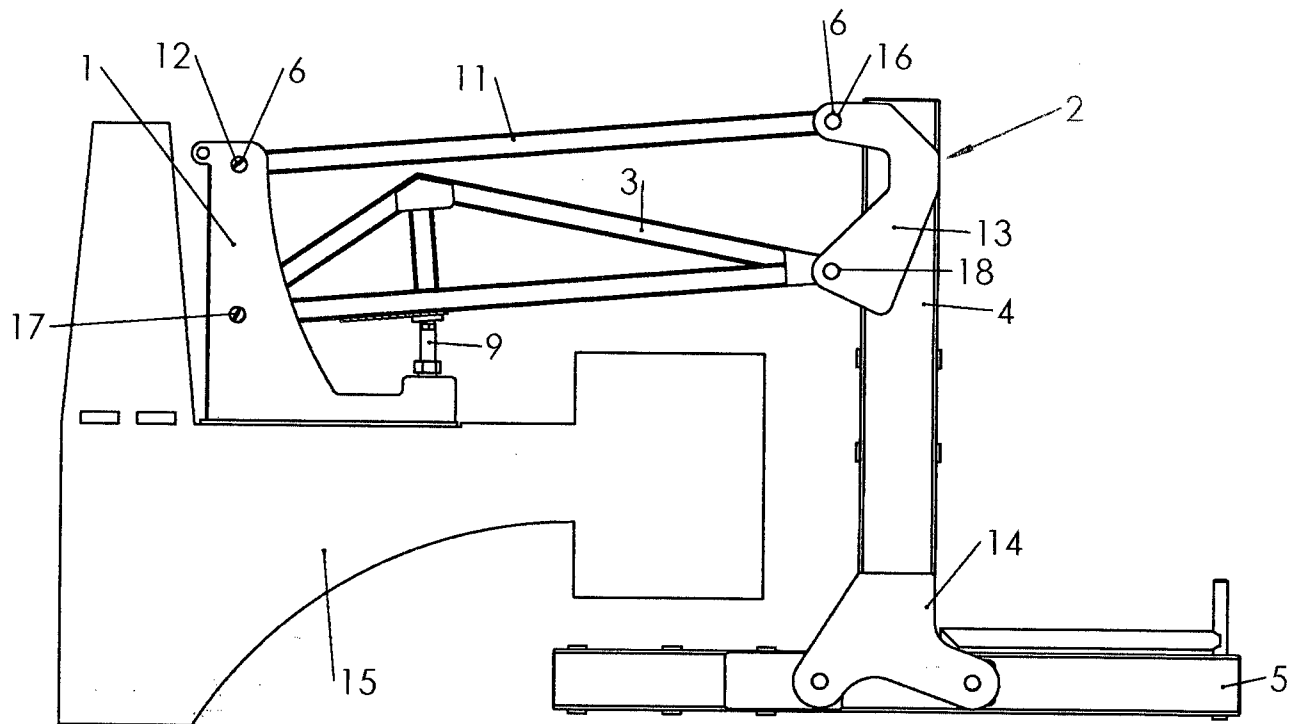


Fig. 1

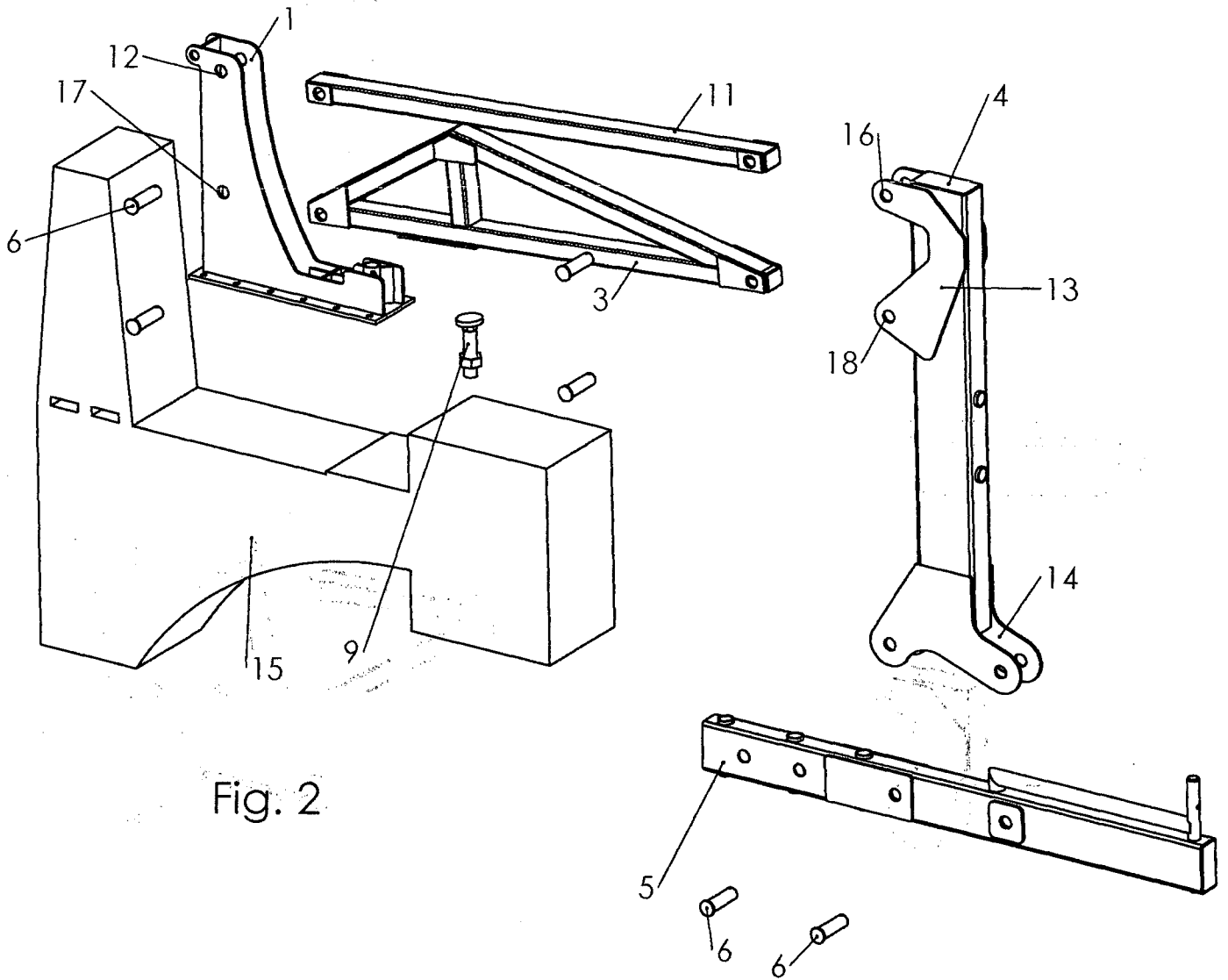
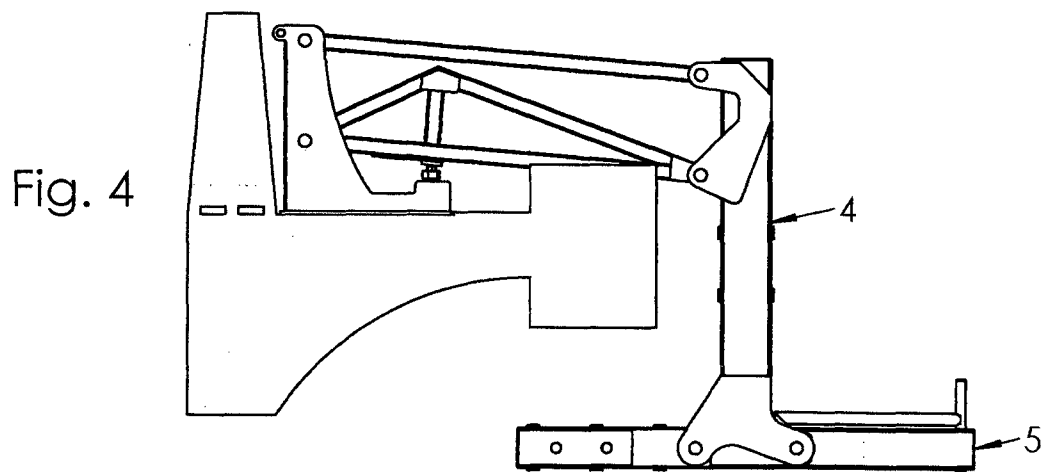
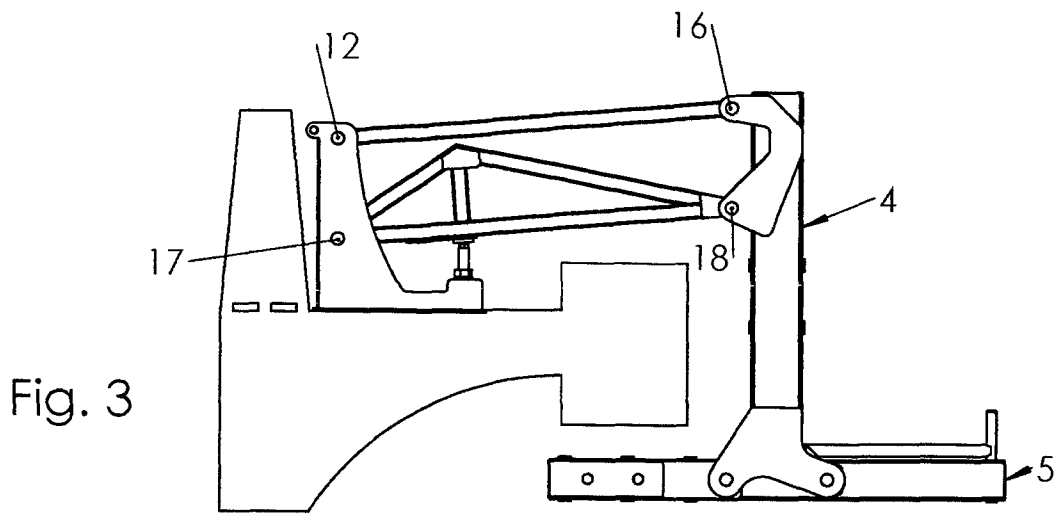


Fig. 2





## INTERNATIONAL SEARCH REPORT

International application No.

PCT/FI2014/050610

**A. CLASSIFICATION OF SUBJECT MATTER**

See extra sheet

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: E01D, E04G

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

FI, SE, NO, DK

Electronic data base consulted during the international search (name of data base, and, where practicable, search terms used)

EPO-Internal, WPI

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4217971 A (RIVINIUS THEODORE [US]) 19 August 1980 (19.08.1980) abstract; column 2, lines 57-69; column 3, lines 48-54; figs. 1-4	1, 3, 6, 7-8
X	US 4168764 A (WALTERS TOM) 25 September 1979 (25.09.1979) abstract; claim 18; figs. 1-20	1-4, 6
X	US 2012006619 A1 (DUBOSE ADAM LEWIS [US] et al.) 12 January 2012 (12.01.2012) abstract; paragraphs [0033], [0037]; figs. 1-8	3, 6-8, 13
X	GB 2106074 B (GRAY MACKENZIE TECHNICAL SERVI [GB]) 30 May 1985 (30.05.1985)	1, 3, 6-8
Y	abstract; page 1, lines 99-105; fig. 1	5

 Further documents are listed in the continuation of Box C.
  See patent family annex.

* Special categories of cited documents:	"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
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"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	

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## INTERNATIONAL SEARCH REPORT

International application No.

PCT/FI2014/050610

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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Y	US 3043395 A (VOLKEL ELLIS W) 10 July 1962 (10.07.1962) abstract, figures 1-13	5
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**INTERNATIONAL SEARCH REPORT**  
**Information on Patent Family Members**

International application No.  
PCT/FI2014/050610

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US 4168764 A	25/09/1979	None	
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CLASSIFICATION OF SUBJECT MATTER

IPC  
**E01D 22/00** (2006.01)  
**E04G 3/00** (2006.01)  
**E06C 9/06** (2006.01)  
**B66F 11/04** (2006.01)