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(54) Method and arrangement for moving a bridge

(57) A transfer track (4) is built and a bridge (2) is moved sideways from beside its final location along the transfer track (4) to its final location. A support beam (8) is arranged on top of the transfer track (4) and the bridge (2) is arranged on top of the support beam (8). The support beam (8) is made such that lifting jacks (9) are arrangeable at specific points under its top part. The support beam (8) is lifted upward with the lifting jacks (9) in such a manner that during the move of the bridge (2) the load caused by the bridge (2) is at least partly directed to the lifting jacks (9).

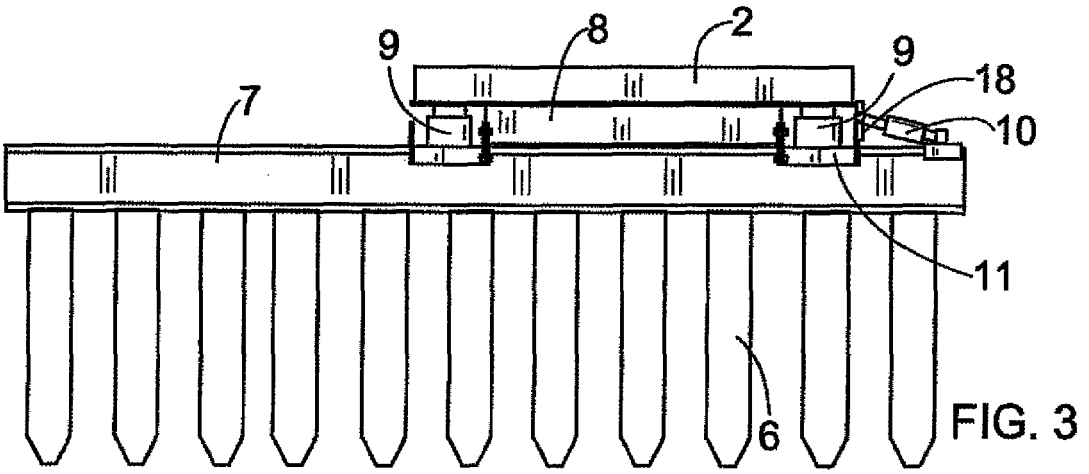

FIG. 3

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Description

BACKGROUND OF THE INVENTION

[0001] The invention relates to a method for moving a bridge, the method comprising forming a transfer track, arranging transfer fittings on the transfer track, and moving the bridge sideways from beside its final location along the transfer track to its final utilization location.

[0002] The invention further relates to an arrangement for moving a bridge, the arrangement comprising a transfer track and transfer fittings, whereby the bridge is movable sideways from beside its final location along the transfer track to its final utilization location.

[0003] FI patent 96,231 discloses a solution, in which a bridge cast beside its final location is moved in place. In the solution, lifting jacks are mounted between the bridge and a beam on the transfer track to support the bridge during the move. The lifting jacks are positioned on a support rail and the thrust of thrusting jacks is directed to the support rails when the bridge is moved in place along the beam on the transfer track. After the bridge is moved in place, it is lowered to rest by its ends on support structures. The location of these support structures differs from that of the transfer track. The solution is very reliable and the bridge can be moved in quite a short time. The transfer fittings are mounted on the beam of the transfer track and at the same time below the bridge to be moved just before the move. To mount the transfer fittings, the bridge needs to be lifted from beside the transfer track. Therefore, both this lifting location and the transfer track need to be well supported with support structures. It is also possible that the bridge is before the move supported on a support line, whose location differs from that of the transfer track, and the transfer fittings are arranged under the transfer track without lifting the bridge. The load is then moved to the transfer track by lifting it with the lifting jacks of the transfer fittings. In this case, too, support structures need to be arranged in a wide area, i.e. at the transfer track and the support line whose location differs from that of the transfer track. If piling is used to form the support structures, it should be made quite dense both at the transfer track and beside it.

[0004] FI patent 97,073 discloses a solution for supporting a bridge being moved along transfer beams. In this solution, pipe piles are driven in the location where the bridge is supported. A beam serving as the transfer track is fastened on top of the pipe pipes. The bridge is moved along the beam and lowered to its final position on auxiliary supports mounted on the pipe piles. In the publication, the bridge is shown supported on auxiliary legs during the move. The bridge, its elevation and straightness are then not completely under control during the move, and therefore, the move is not secure.

[0005] FI patent 106,810 discloses a solution for moving a bridge, wherein transfer tracks are arranged on both sides of the final location of the bridge. A beam is arranged to the bridge in such a manner that the bridge can be arranged to the beam. Said beam is arranged to extend across the final location of the bridge from the first transfer track to the second. Said beam and the bridge are then lifted up and the beam and bridge moved along the transfer tracks to the final location, and the bridge is lowered in place. This solution is well suited for moving extremely heavy bridges. The transfer tracks on both sides of the final location of the bridge need then be built quite long. Further, the jacks lifting the bridge need to be arranged on different transfer tracks, in which case taking into account the horizontal forces directed to them is very challenging.

BRIEF DESCRIPTION OF THE INVENTION

[0006] It is an object of the present invention to provide a novel method and arrangement for moving a bridge.

[0007] The method of the invention is characterized by arranging a support beam on a transfer track, arranging the bridge on the support beam that is made such that lifting jacks are arrangeable at specific points under its top part, arranging lifting jacks to said points, and lifting the support beam upward with the jacks such that the load caused by the bridge during the move is at least partly directed to the jacks.

[0008] Further, the arrangement of the invention is characterized in that the arrangement comprises a support beam arranged on the transfer track under the bridge and made such that lifting jacks are arrangeable at specific points under its top part, and said lifting jacks that are arranged to lift the support beam upward during the move of the bridge such that the load caused by the bridge during the move is at least partly directed to the jacks.

[0009] In the present solution, the bridge is formed on the support beam and rests on it during the move. The support beam is made such that lifting jacks are arrangeable under its top part to lift the support beam upward for the move of the bridge, whereby the load caused by the bridge is at least partly directed to the lifting jacks during the move.

[0010] Because the bridge is formed on the support beam and moved on the support beam to its final location, the bridge is thus, when located beside its final location and resting by its ends on the base, only supported at the transfer track. Therefore, strong support structures only need to be built for the bridge beside the final location at the transfer track. When the support beam is shaped such that lifting jacks can be arranged under it and the load of the bridge is during the move directed at least partly to the lifting jacks, the move of the bridge is well controlled, i.e. the move is secure and, consequently, the time required for the move can be determined fairly accurately and very reliably. Sliding blocks can be arranged under the lifting jacks for the move, or the support beam can be lifted with the lifting jacks just before the move to install sliding blocks under it. This way, there is no need

to have sliding blocks under the support beam before the move, which would make the structure unstable. The bridge also does not have to be supported by the lifting jacks for a long time, because the jacks can be installed in place just before the move.

[0011] The idea of an embodiment is that plates are arranged rigidly to the ends of the support beam in the longitudinal direction of the beam, and the position of the plates is adjustable in the vertical direction of the beam, whereby the jacks are placed on the plates for the move. Owing to this solution, the bottom parts of the lifting jacks are rigidly connected to each other in the longitudinal direction of the support beam to avoid the harmful effect of horizontal loads directed to the lifting jacks during the move of the bridge. This way, the move is fast and secure.

BRIEF DESCRIPTION OF THE FIGURES

[0012] The invention is described in more detail in the attached drawings, in which

Figure 1 is a schematic top view of a bridge located beside its final location,
Figure 2 is a schematic view of a bridge located beside its final location as seen from the direction of the railway,
Figure 3 is a schematic view of a bridge being moved as seen from the direction of the railway,
Figure 4 is a schematic view of a bridge in its final location as seen from the direction of the railway,
Figure 5 is a schematic view of a support beam used in moving a bridge,
Figure 6 shows the support beam of Figure 5 in cross-section along line A-A of Figure 5, and
Figure 7 shows the support beam of Figure 5 in cross-section along line B-B of Figure 5.

[0013] The figures show some embodiments of the invention in a simplified manner for the sake of clarity. Similar parts are marked with the same reference numbers in the figures.

DETAILED DESCRIPTION OF SOME EMBODIMENTS OF THE INVENTION

[0014] Figure 1 shows a railway 1 and, beside it, a bridge 2. The bridge 2 is thus beside its final location.

[0015] When a new underbridge is made under an existing railway 1, the bridge 2 is built next to the railway 1 at the intended location of the bridge. When the bridge 2 is ready, a section of the railway 1 equal to the length of the new bridge 2 is removed. After this, the bridge is moved in place along a transfer track 4.

[0016] When building a bridge of reinforced concrete, the weight of the bridge is during concreting evenly distributed along the mould of the bridge. When prestress wires are tightened, the bridge gets prestressed and its midsection lifts up from the mould. The weight of the bridge is then focused on its ends. When the bridge is in place, the weight is, thus, directed to support lines 3. The transfer track 4 is in the longitudinal direction of the bridge 2 very close to the support line 3 of the final location of the bridge. Therefore, before the bridge 2 is moved, its weight is directed to the transfer track 4.

[0017] In Figure 1, the transfer track 4 is illustrated with an area surrounded by a dashed line, and the support line 3 is illustrated with an area surrounded by a dash-and-dot line. The support structures at these locations thus serve as supports for the corresponding loads. Support piles 5 are illustrated at the support line 3. Arranging the support line 3 and transfer track 4 exactly at the same location in the longitudinal direction of the bridge 2 is also possible.

[0018] Figure 2 shows an arrangement for moving a bridge. Dashed lines in the figure also show a railway 1 that will be dismantled just before the bridge is moved in place. Support piles 5 that can be pipe piles, for instance, are mounted at the support line 3. It is also possible to use concrete or wood piles. The tops of the pipe piles can be filled with concrete grout. In addition to support piles 5, auxiliary piles 6 are mounted, and they can be similar to the support piles 5. A transfer track beam 7 is mounted on top of the auxiliary piles 6. Thus, the transfer track is made up of the transfer track beam 7 and its support structures, such as auxiliary piles 6. Piling is not always required, and the support structure can also be formed without auxiliary piles in any manner known per se to a person skilled in the art.

[0019] The bridge 2 is arranged on top of the transfer track beam 7 and is moved along it to its final location.

[0020] A support beam 8 is arranged on top of the transfer track beam 7. The support beam 8 can be mounted in place together with the transfer track beam 7 before the bridge is prestressed. The support beam 8 and transfer track beam 7 can be mounted in place for instance when the mould for the reinforced concrete bridge is made. The support beam 8 transfers the weight of the bridge to the transfer track when the bridge is prestressed.

[0021] The ends of the support beam 8 are shaped such that lifting jacks 9 can be arranged below the top flange of the support beam. During the move, the lifting jacks 9 lift the support beam 8 and thus also the bridge 2 on top of it upward, as shown in Figure 3.

[0022] The bridge 2 is moved in the direction of the transfer track 4 with a transfer jack 10. The transfer jack 10 is fastened with lugs to a vertical crossbeam 18. The crossbeam 18 is in turn fastened at its bottom end to a support plate 11 under the lifting jack 9. The top end of the crossbeam 18 rests against a top flange of the support beam 8, which can be slightly longer than the width of the bridge 2. The top end of the crossbeam 18 need not be supported to the support beam 8, if the fastening of the crossbeam 18 and support plate 11 can otherwise be made sufficiently rigid. With the present solution, the horizontal forces generated by the thrust jack 10 do not

harmfully affect the lifting jacks 9.

[0023] During the move, the support beam 8 can be free of the transfer track beam 7, in which case the weight of the bridge is directed to the lifting jacks 9. Sliding blocks are arranged under the lifting jacks 9 to reduce friction. If desired, the weight of the bridge can also be arranged to be directed on the transfer track beam 7 partly through the support beam 8. Sliding blocks should then also be arranged between the support beam 8 and transfer track beam 7.

[0024] If the load of the bridge is distributed between the sliding blocks under the lifting jacks 9 and the sliding blocks under the support beam 8, or if there are three or more lifting jacks 9, the load transmitted by each individual point can be changed during the move. For instance, one support location can be left unused for a while. This feature is required for instance when the sliding surface of the transfer beam is damaged during the move, and a discontinuity is formed therein that may at worst destroy the sliding block. This way it is possible to free from load the sliding block that is at the damaged point.

[0025] Further, during the move, the support beam 8 serves as a reserve support, if one of the lifting jacks due to a malfunction, for instance, cannot bear its load. The damaged lifting jack 9 can then easily be replaced.

[0026] Owing to the design of the support beam 8, the lifting jacks 9 do not need to be positioned under the support beam 8 when the bridge 2 is cast. The lifting jacks 9 only need to be set in place when the bridge 2 is finished and going to be moved.

[0027] Figure 4 shows the bridge in its final location. The lifting jacks 9 are then removed. The support beam 8 and transfer track beam 7 can be left under the bridge 2, or alternatively the bridge 2 can be supported in some other way and the support beam 8 and/or transfer track beam 7 can be removed.

[0028] As shown in Figure 5, the lifting jacks 9 can be arranged on top of a support plate 11. The support plate 11 has an end plate 12 that fastens the support plate 11 to an end plate 13 of the support beam with bolts 14, for instance. The support plate 11 is then rigidly arranged to the support beam 8 in the longitudinal direction of the support beam. For the sake of clarity, Figure 6 does not show a lifting jack.

[0029] The end plate 13 of the support beam has elongated openings 15 for the bolts 14, as shown in Figure 7. This makes it possible to adjust the position of the support plate 11 in the vertical direction of the support beam 8.

[0030] The support beam 8 is for instance an H-profile beam with a section of a bottom flange 8c and web 8b cut off at both ends. Thus, the lifting jacks 9 can be arranged at these points under a top flange 8a. The support beam 8 can also have some other shape as long as there is room for the lifting jack 9 under the top flange or top side, for instance at the ends of the support beam 8 and/or somewhere else. The lifting jack 9 and support plate 11 can thus be arranged not only at the ends of the support beam 8, but also elsewhere on the support beam 8. The length of the support beam 8 top flange 8a is typically the same as or longer than the width of the bridge 2. Further the support beam 8 is shaped such that at least two or even more lifting jacks 9 can be arranged under its top flange 8a.

[0031] When the bridge is moved, the support beam 8 is lifted upward with the lifting jacks 9, as shown in Figure 7, for instance. The bolts 14 then settle at the bottom of the elongated openings 15. The support plate 11 is, however, rigidly fastened to the support beam 8 in the longitudinal direction of the support beam, which helps avoid the harmful effect of horizontal loads directed to the lifting jacks during the move of the bridge. During the move, the bolts 14 can also be tightened such that the end plate 12 of the support plate and the end plate 13 of the support beam cannot move relative to each other even in the vertical direction. Instead of the bolts and elongated openings, the support plate 11 and support beam 8 can be arranged rigidly in the longitudinal direction of the support beam and adjustable in the vertical direction of the support beam by using a fastening structure, for instance, that has vertical rails that enable vertical movement but are horizontally locked to prevent the longitudinal movement of the support beam 8. Further, it is possible to use U-shaped steel beams, for instance, in such a manner that they receive tensile stress but at the same time enable vertical movement relative to each other, or another corresponding solution can be used.

[0032] The support plate 11 also has side guides 16 to ensure that the support beam 8 stays firmly on top of the transfer track beam 7 during the move. The sliding blocks 17 under the lifting jacks 9 are arranged between the support plate 11 and transfer track beam 7. The height of the support beam 8 is by at least the size of its top flange 8a higher than the summed height of the sliding block 17, support plate 11 and lifting jack 9 when the lifting jack 9 is in its low position. This makes placing the lifting jack 9 under the bottom flange of the support beam 8 and removing it easy.

[0033] In some cases, the features presented in this application can be used as such regardless of other features. On the other hand, the features presented in this application can also be combined as necessary to form various combinations.

[0034] The drawings and the related description are only intended to illustrate the idea of the invention. The invention may vary in detail within the scope of the claims. Thus, the use of the present solution is not only limited to moving railway bridges, but it can also be utilised in moving road bridges, for instance.

Claims

1. A method for moving a bridge, the method comprising forming a transfer track (4), arranging transfer fittings on the transfer track (4), and moving the

bridge (2) sideways from beside its final location along the transfer track (4) to its final location, **characterised by** arranging a support beam (8) on the transfer track (4), arranging the bridge (2) on the support beam (8) that is made such that lifting jacks (9) are arrangeable at specific points under its top part, arranging the lifting jacks (9) to said points, and lifting the support beam (8) upward with the jacks (9) such that the load caused by the bridge (2) during the move is at least partly directed to the jacks (9).

2. A method as claimed in claim 1, **characterised in that** support plates (11) are arranged to the support beam (8) in such a manner that they are rigidly fastened to the support beam (8) in its longitudinal direction, and their position in the vertical direction of the support beam (8) is adjustable, and the lifting jacks (9) are positioned on top of the support plates (11).

3. A method as claimed in claim 2, **characterised in that** the transfer fittings comprise a transfer jack (10) whose thrust force is directed at least partly to the support plate (11) to avoid harmful effects directed to the lifting jacks (9) by horizontal forces.

4. A method as claimed in claim 3, **characterised in that** the thrust force of the transfer jack (10) is directed partly at the support plate (11) under the lifting jack (9) and partly at the top part of the support beam (8) above the lifting jack (9).

5. A method as claimed in any one of the preceding claims, **characterised in that** the lifting jacks (9) are arranged at the ends of the support beam (8).

6. A method as claimed in any one of the preceding claims, **characterised in that** the bridge (2) is made of reinforced concrete that is prestressed before the bridge (2) is taken into use, and the support beam (8) is arranged in place when the mould of the bridge (2) is made.

7. An arrangement for moving a bridge, the arrangement comprising a transfer track (4) and transfer fittings, whereby the bridge (2) is movable sideways from beside its final location along the transfer track (4) to its final utilization location, **characterised in that** the arrangement further comprises a support beam (8) arranged on the transfer track (4) under the bridge (2) and made such that lifting jacks (9) are arrangeable at specific points under its top part, and the lifting jacks (9) are arranged to lift the support beam (8) upward during the move of the bridge (2) such that the load caused by the bridge (2) during the move is at least partly directed to the jacks (9).

8. An arrangement as claimed in claim 7, **characterised in that** support plates (11) are arranged to the support beam (8) in such a manner that they are rigidly fastened to the support beam (8) in its longitudinal direction, and their position in the vertical direction of the support beam (8) is adjustable, and the lifting jacks (9) are positioned on top of the support plates (11).

9. An arrangement as claimed in claim 8, **characterised in that** the transfer fittings comprise a transfer jack (10) that is arranged to direct its thrust force at least partly to the support plate (11).

10. An arrangement as claimed in claim 9, **characterised in that** the transfer jack (10) is connected to a crossbeam (18) that is from its bottom part connected to the support plate (11) under the lifting jack (9) and from its top part to the top part of the support beam (8) above the lifting jack (9), whereby the transfer jack (10) is arranged to direct its thrust force partly to the support plate (11) and partly to the top part of the support beam (8).

11. An arrangement as claimed in any one of claims 8 to 10, **characterised in that** the support plate (11) has side guides (16) to ensure that the support plate rests on the transfer track beam (7).

12. An arrangement as claimed in any one of claims 7 to 11, **characterised in that** the support beam (8) is an H-profile beam with a bottom flange (8c) and web (8b) removed from specific points, whereby the lifting jacks (9) are arrangeable at the points.

13. An arrangement as claimed in any one of claims 7 to 12, **characterised in that** the bridge (2) is made of reinforced concrete that is prestressed before the bridge (2) is taken into use, and the support beam (8) is arranged in place when the mould of the bridge (2) is made.

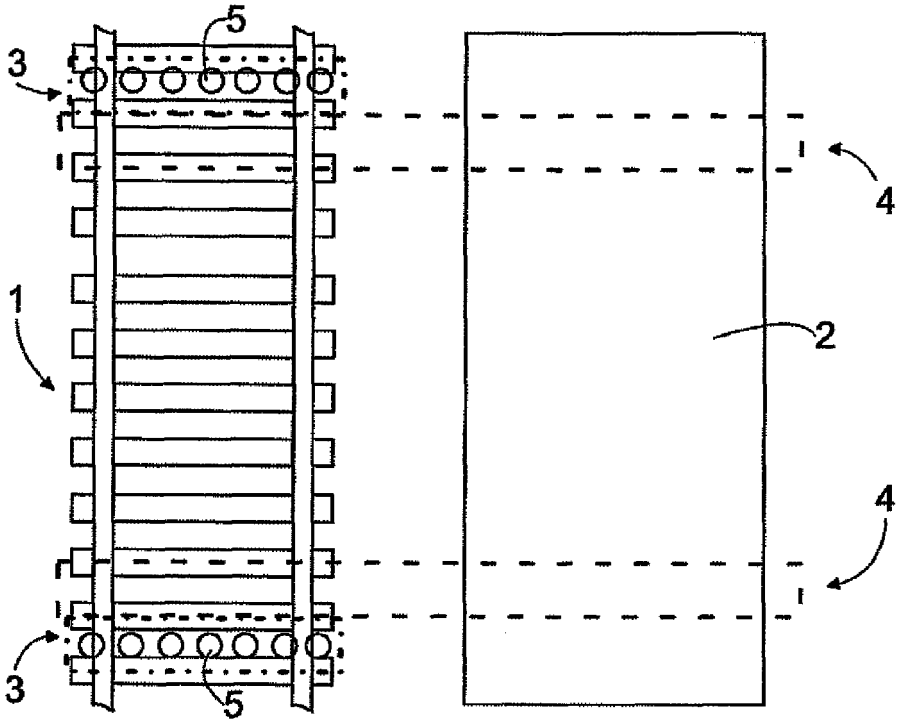

FIG. 1

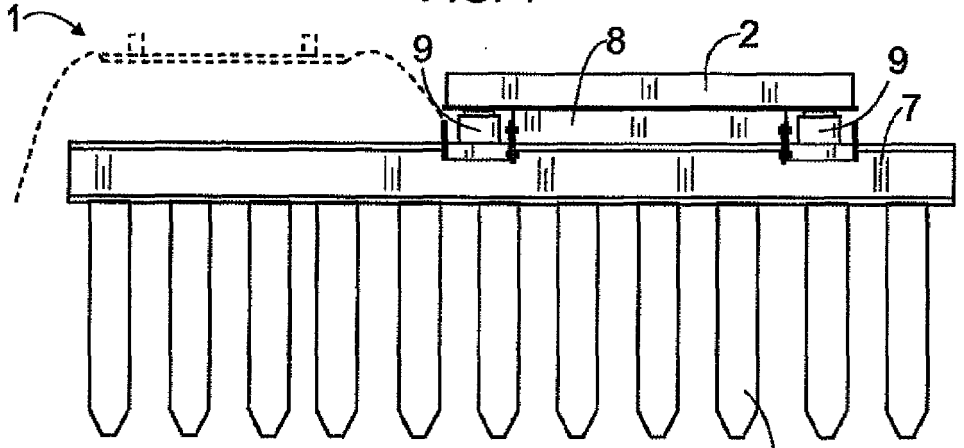

FIG. 2

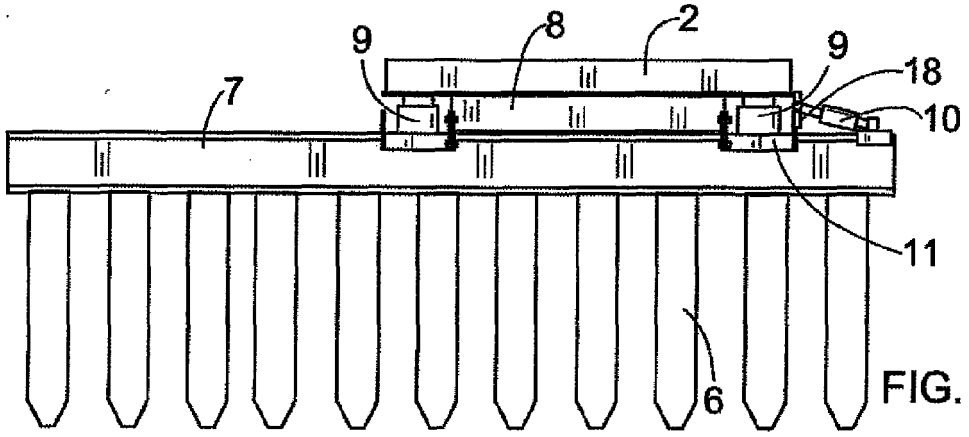

FIG. 3

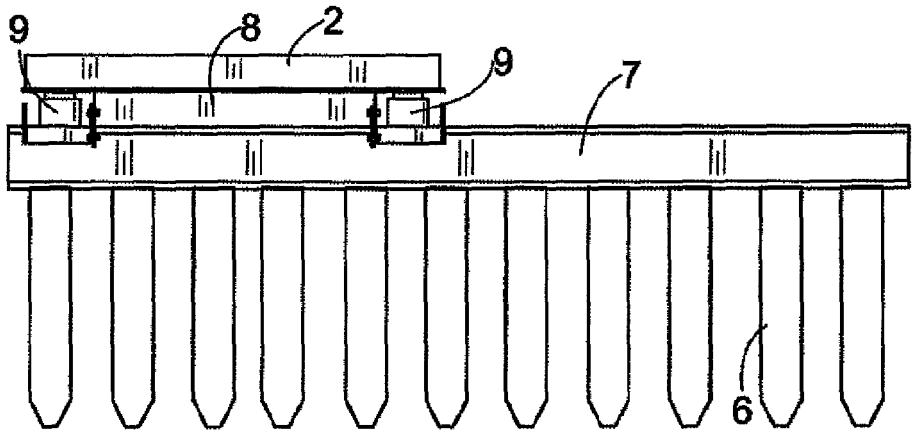

FIG. 4

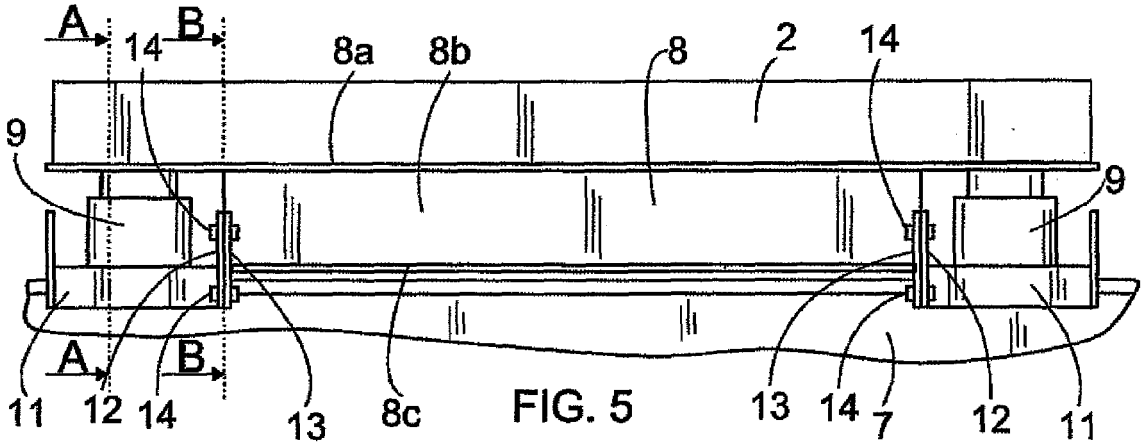

FIG. 5

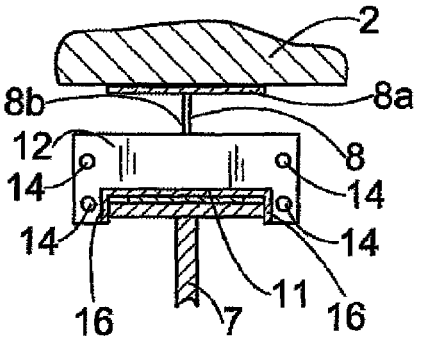

FIG. 6

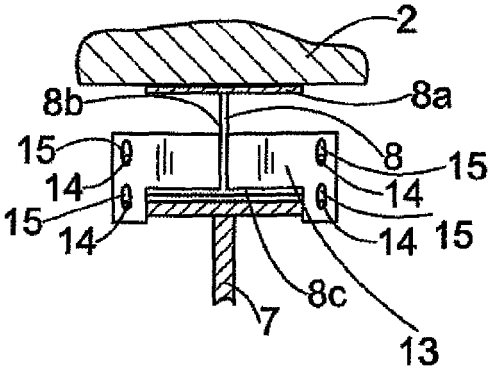

FIG. 7

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EUROPEAN SEARCH REPORT

Application Number
EP 07 10 4011

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	DE 25 54 112 A1 (HEITKAMP GMBH BAU) 16 June 1977 (1977-06-16) * the whole document *	1,7	INV. E01D21/06
A	DE 36 11 753 A1 (BILFINGER BERGER BAU [DE]) 19 March 1987 (1987-03-19) * column 4, lines 9-29; figures 1-4 *	1,7	

TECHNICAL FIELDS SEARCHED (IPC)

E01D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	13 July 2007	FLORES HOKKANEN, P

CATEGORY OF CITED DOCUMENTS

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE 2554112 A1	16-06-1977	NONE	
DE 3611753 A1	19-03-1987	NONE	

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

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- FI 97073 **[0004]**
- FI 106810 **[0005]**