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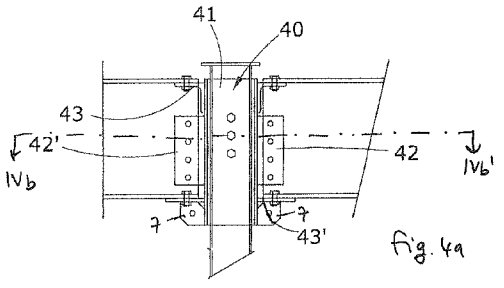


fig. 4a

(57) Abstract: The present invention relates to a device (1) for connecting two beam elements (2) in correspondence of a column (3; 4; 3'; 4'), said beam elements (2) comprising a central portion, an upper portion and a lower portion, said column (3; 4; 3'; 4') comprising an upper portion, said device (1) being characterized in that it comprises a first connection element (41) suitable to allow the passage of the upper portion of a column (3; 4; 3'; 4'), two second connecting elements (42, 42'), each one of said two second elements (42, 42') being coupled to said first element (41) and being suitable to couple to the central portion of a respective beam element (2), two third connection elements (43, 43'), each of said two third elements (43, 43') being coupled to said first element (41) and being suitable to couple to the upper or lower portion of said beam elements (2), said device (1) being configured, during the use, so as to assume a first configuration, in which said second elements (42, 42') are coupled to the central portion of the respective beam elements (2) and said third elements (43, 43') are respectively coupled to the upper and lower portions of both said beam elements (2) so as to allow the passage of the stresses between the two beam elements (2) and possibly allow the passage of said column (3; 4; 3'; 4') passing through said first coupling element (41) without receiving the load by said beam elements (2).

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DEVICE FOR CONNECTING TWO BEAMS AND STRUCTURE COMPRISING SAID DEVICE

The present invention relates to a device for connecting two beam elements and a structure comprising said device.

More precisely, the present invention relates to a device able to connect two beam elements each other so as to allow the transfer of the continuity of the stress characteristics from one element to the other.

At present, as shown by way of example in figures 1a and 1b, a parking structure without foundation having two floors or levels above ground can present both lane columns A superimposed one above the other, in correspondence of both overhead levels. The floor element in such cases generally is in concrete.

This implies that each lane column A is loaded with the loads on each level relative to a structure portion 20% larger than that which is sustained by the secondary column B placed side by side to it and joined in an inner position with respect to the same. Altogether, therefore, the column lane A will be loaded 40% more than the secondary column B.

Such an arrangement is not optimal, especially in situations where the floor of the existing flush car park, where it should be installed the parking structure without foundations, has a not optimal lift. In such conditions, the base plate of lane column A may not be verified, making it necessary to employ a conventional foundation.

A second problem of the known technique of figures 1a and 1b is the presence of the St. Andrew's cross braces, making it difficult opening the doors of parked cars, and entry/exit from the same.

Further, another example of a known parking structure is shown in figures 2a and 2b. In this case, the parking structure has only one floor above ground and has a pair of columns A and B, one lane column A and a secondary column B, every three parking spaces in the lane direction. In such a structure, usually it is employed a bracing "X" such as the one shown in figure 2a.

However, if this structure is realized with a light floor, rather than a heavy floor, i.e. made of wood or steel instead of concrete, then the bracing of Fig. 2a no longer would work, because, for horizontal actions, even not very strong actions (such as wind or earthquake), the lifting caused by bracing on one of the two lane columns A, would be higher than their own weights, and the anchoring of this column A to the ground would

be too onerous, and therefore not compatible for parking facilities without foundation.

The object of the present invention is therefore to overcome the problems of the known parking structures, by means of devices that are able to reduce or to completely eliminate the loading of the beams on some columns and possibly restore it.

It is object of the present invention a device for connecting two beam elements in correspondence of a column, said beam elements comprising a central portion, an upper portion and a lower portion, said column comprising an upper portion, said device being characterized in that it comprises a first connection element suitable to allow the passage of the upper portion of a column, two second connecting elements, each one of said two second elements being coupled to said first element and being suitable to couple to the central portion of a respective beam element, two third connection elements, each of said two third elements being coupled to said first element and being suitable to couple to the upper or lower portion of said beam elements, said device being configured, during the use, so as to assume a first configuration, in which said second elements are coupled to the central portion of the respective beam elements and said third elements are respectively coupled to the upper and lower portions of both said beam elements so as to allow the passage of the stresses between the two beam elements and possibly allow the passage of said column passing through said first coupling element without receiving the load by said beam elements.

Further, said device may be configured, during use, so as to assume either said first configuration or said second configuration, in which said second elements are coupled to the central portion of the respective beam element and said first connection element is coupled to said column so as to distribute the load also on said column.

Still according to the invention, said first connection element can be a hollow tubular sleeve suitable for the axial passage of a column.

Always according to the invention, said second connection elements can be two opposite side flanges radially developed from the outer lateral surface of said first connection element.

Furthermore according to the invention, said third connection elements can be an upper flange and a lower flange suitable to couple to the upper and lower end portions of said beam elements.

Preferably according to the invention, said beam elements can have an "H" or double "T" section, in which the central portion is the core beam element and the upper and lower portions may correspond to the wings of the beam element.

In particular, according to the invention, the couplings between elements are realised by means of bolting and/or welding.

Still according to the invention, said device may comprise fourth connection elements, in particular connection flanges, coupled to said third connection elements, suitable to be coupled to possible bracing between the columns.

Always according to the invention, said device may further comprise an abutment element, preferably a collar, coupled to said column below said third connection elements to support the load of the beam elements in any emergency situations.

Preferably according to the invention, said device may comprise at least a further fifth connection element, particularly a flange, coupled to the first connection element and suitable to permit the connection to the central portion of a possible further beam.

Further, it is an object of the present invention a structure comprising at least one column, having an upper portion, and at least two beam elements, said structure being characterized in that it comprises the device described in the above and in that said device connects said beam elements each other in correspondence of the upper portion of said column passing through said device.

Still according to the invention, said structure may comprise a further column having a top portion, one of said beam elements can be coupled to said upper portion of said column and between said columns a bracing may be provided, coupled to said device.

In particular, according to the invention, said bracing can be an "X" or double "X" bracing.

Finally, according to the invention, said bracing can be a rod coupled to said device and at the base of the further column.

The invention will be now described, for illustrative but not limitative purposes, with particular reference to the figures of the enclosed drawings, wherein:

figure 1a shows a front elevation view of a two-floor parking structure without foundations, according to the known technique;

figure 1b shows a plan view of the first or of the second floor above ground of the carpentry of the parking structure of figure 1a;

figure 2a shows a front elevation view of a one floor parking structure without foundations, according to the known technique;

figure 2b shows a plan view of the floor above ground of the carpentry of the parking structure of figure 2a;

figure 3a shows a front view of the connection device between columns according to a first embodiment of the invention in a first arrangement or active column arrangement;

figure 3b shows a sectional view taken along line IIIb-IIIb' of the device of figure 3a;

figure 4a shows a front view of the device of figure 3a in a second arrangement or an inactive column arrangement;

figure 4b shows a section view taken along line IVb-IVb' of the device of figure 4a;

figure 5 shows a plan view of the first deck of a parking structure with an above ground level (G+1), arranged to super elevation two levels above ground (G+2);

figure 6 shows a plan view of a structure of the second deck of the parking structure of figure 5 after super elevation to G+2;

figure 7 shows a front view of the device of figure 3a applied to a lane column of the parking structure of figure 5;

figure 8 shows a front view of the device of figure 3a applied to a lane column of the parking structure of figure 6;

figure 9a shows a front view of the device according to the invention in a second embodiment;

figure 9b shows a top section view taken along the line IXb-IXb' of the device of figure 9a;

figure 10 shows a front elevation view of a two floors parking structure above the ground without foundations, according to a first arrangement according to the invention;

figures 11a and 11b show a plan view of the second and of the first floor above the ground of the carpentry of the parking structure of figure 10;

figure 12 shows a front view of a two floors parking structure above the ground without foundations, according to a second arrangement according to the invention;

figure 13 shows a front view of a two floors parking structure above the ground without foundations, according to a third arrangement according to the invention;

figure 14 shows a front view of the device according to the invention in a third embodiment;

figures 15a and 15b show a front view of the second and of the first floor above ground of a parking structure according to a fourth arrangement according to the invention;

figure 16 shows a front view of the device according to the invention in a fourth embodiment;

figure 17a shows a front view of a parking structure according to a fifth arrangement;

figure 17b shows a top view of the carpentry of the first floor above ground of the parking structure of figure 17a;

figures 18a and 18b show a front view of the connection device between beams according to the invention in a fifth embodiment, respectively in a first configuration or active column configuration and in a second configuration or inactive column configuration; and

figure 19 shows a front view of the connection device between beams according to the invention in a sixth embodiment.

Referring to figures 3a and 3b and 4a and 4b, there is shown a first embodiment of the connection device between beams according to the invention, indicated by the reference number 1.

Said device 1 is suitable to connect the first two structural elements or beam elements 2, preferably double "T" or "H" section beam elements 2, between them and, if necessary, to allow the passage of a second structural element or column or pillar 3 through, in such a way that said column 3 can receive or not the load on by the beam 2 elements.

In figures 3a and 3b, the device 1 is set according to a first arrangement in such a way that the column 3 corresponding to the same is loaded by the connection with the device 1 (connection between device 1 and column 3 active). In this way, each beam element 2 rests on the column 3 and the device 1 works as a normal hinge node.

By setting the device in the second arrangement of figures 4a and 4b (connection between device 1 and column 3 inactive) it is obtained the passage of the stress between the beam elements 2. The beams of a possible second floor (not visible here) will shift the load on column 3

passing through the device 1. Said device 1 then acts as a joint allowing only the transmission of the stresses between the beams.

Connection of device 1 to surrounding elements 2 and 3 will be set as in figs. 4a and 4b (active bending connections, inactive pillar connection). In this way, the device 1 restores the continuity between the beams 2, allowing it to discharge "beyond" the through column 3.

Said connections can be made in a modifiable manner, such as by bolting, or permanently, for example by welding, as shown in Fig 9a and Fig. 9b. While the bolted connection between the beam elements 2 and the device 1 allows the conversion between the two settings described above, the welded connection allows the realization of a more ductile coupling and can allow the passage of the highest stresses, with the same overall dimensions. It may therefore be more appropriate for certain uses.

More particularly, said device 1 comprises a connection element 40 defined by a tubular sleeve 41, from the outer side surface of which two opposed flanges 42 and 42' develop in the radial direction, for a fastening, with respect to a central core of two adjacent beams 2 (taking into account the fact that beams 2 have typically a double "T" or "H" section), said sleeve 41 being also provided with opposed upper end 43 and lower end 43' flanges suitable to permit a connection, respectively, with the upper and lower flanges of the same beams 2.

The column or pillar 3 is arranged internally and coaxially to the sleeve 41 of the connection element 40 as shown schematically in Figures 3a, 3b, 4a and 4b, wherein said connection element 40 is shown in a front view and from above.

Figures 3a and 3b represent the condition in which, in a one or more levels above the ground parking structure, the level represented **discharge** the vertical loads on column 3; this is obtained by screws 44 passing through the sleeve 41 according to a direction perpendicular with respect to the axis of the column 3 and by ensuring that the flexion connection of the beam elements 2 is inactive while the connection between the sleeve 41 and the pillar 3 is active.

Figures 4a and 4b represent, instead, the condition in which the discharge of the single levels is selective and therefore, the condition in which the column 3 receives the load only from some levels (and in particular not by the level shown in the figure).

This condition is obtained without the interposition of the transverse screws 44, so that the flexion connections are active while the connection sleeve 41 – column 3 is inactive; in this way the load of the upper level is discharged to the ground without affecting the underlying level.

Moreover, the connection element 40 is connected to the beams 2 not only in correspondence of the central core but also at the opposite wings of the beam 2 wings, so that the sleeve 41 defines a connection element between two adjacent beams 2.

By the device 1 and the connection element 40 it is possible to realize different configurations and, more particularly, to combine two or more columns 3 in correspondence with the edge lane or of the peripheral edge, on the basis of overlaying levels and of the distribution of the loads.

For example, it is possible providing two columns 3 on the lane edge, aligned orthogonally to the axis of the lane, arranged so that at least one of them is the bearing while the other is passing through by the connection element 40 and, therefore, able to receive the load from one or more higher parking levels.

In accordance with another arrangement, it is possible combining three columns in correspondence with the lane edge in which, as in the previous case, at least one column is of bearing type while the other column of the group is passing through by the described connection element; the three columns can be combined in function of the specific needing of the load distributions.

The use of the connection element described above allows to obtain combinations of columns arranged along the peripheral edge of the parking structure, said combinations which preferably comprising two - four columns and in which such columns can be load-bearing or they can be passing through in function of specific manufacturing requirements.

In some applications where it is advantageous that the structures can be modified after the entry into service, or it is advantageous that the same components can fulfil different structural features, the device 1 arrangement shown in Figures 3a, 3b, 4a and 4b, as described in the above with reference to the activation/deactivation of the connection between the connection element and the pillar, can be realized in a modifiable manner after the manufacturing, for example by means of bolted joints. This is useful for example, in case it is first realized a

structure G+1 (with only one level above ground) expandable (carpentry of Fig. 5), to add then a higher level (carpentry of Fig. 6), possibly after having changed the setting of device 1, from the one shown in figure 3a to the one shown in figure 4a.

As shown in fig.7, a "collateral" but absolutely significant advantage of having two columns 3 and 4 close the lane, is the possibility to brace the structure (bracings 46) in a direction orthogonal to the lane between these two close columns 3 and 4. This to the advantage of ease of use since car door openings is no longer hampered by braces 46. In order to bring this advantage even at the top level, it is possible deciding to continue the lane column 3 which is loaded at the intermediate level up to the second level, as shown in Fig. 8 (bracings column). Such column 3 will be connected to the overlying beam 5 by a connection schematized by a vertical axis carriage, operating only along with the braces 46. In Fig. 6, column 3 bracings are schematically shown by an "X".

In figures 9a and 9b it is shown a second embodiment of the device 1 according to the invention, which, as in the previous embodiment provides a connection element 40 comprising a first element 41 for the passage of column 3, two opposite second elements 42 and 42' for the shearing stresses integral to said first element 41 and suitable to be coupled to the central body, preferably a central core, of the respective beam element 2, two thirds elements 43 and 43', respectively upper 43 and bottom 43', for the restoration of the continuity of the bending moment between the beam elements 2, said third elements 43 and 43' being integral with said first element 41 and suitable to be coupled respectively to the upper and lower portion of each beam element 2, preferably to the upper and lower wings of the beam elements 2.

Considering to use the device 1 of figures 9a and 9b in the structure shown in figures 1a and 1b, in correspondence of the first level of the parking structure and of the lane column A. By the device 1 according to the invention, the lane column A will now only pass through the first level. If it also stops the secondary column B at the first level, it will have the configuration shown in figures 10, 11a and 11b, where the lane columns 3 are exclusively loaded with the vertical loads of the second level, the secondary columns 4 are loaded exclusively with the vertical loads of the first level.

This configuration reduces the differential between the vertical loads imposed on the columns A and B from 40% for structure shown in figures 1a and 1b to few percentage points, thus solving a problem of the prior art.

Advantageously, the device according to the invention allows the crossing of a beam by a column without that the stress state of the beam is influenced by the passage of the column, which is therefore statically neutral.

In Fig. 12 there is shown a bracing alternative to that of figure 1a, made possible by the presence of the device 1 according to the invention in correspondence with the lane column 3.

Such bracing provides that the braces 6 of the two levels converge in correspondence with intermediate deck in correspondence of the device 1 applied to the lane column 3, where it is placed the device 1. Particularly, a first brace 6 is provided between the base of the secondary column 4 of the first level and the device 1 according to the invention applied to the upper portion of the lane column 3. While a second brace 6' is applied between the device 1 and the upper portion of the secondary column 4' disposed in the upper floor. This generates a typical "K" shape of the bracing.

Such a configuration is clearly more advantageous than the one shown in Fig. 10 by the parking use comfort point of view. The St. Andrew cross bracings of Fig. 10 are in fact replaced by "K" shaped bracing described above, which, by virtue of its position, does not interfere with the opening of the door and the entrance/exit from the vehicle.

For a no foundations parking, "K" configuration shown in figure 12 is made possible by the presence of the device 1 in correspondence of the "K" apex.

The presence of the device 1, in the setting of Fig. 4, involves the fact that the beam elements 2 are involved in the response of the structure to horizontal actions. The involvement of the beam elements 2, prevents that, in consequence of the application of the horizontal actions, lifting or compression actions are generate at the base of columns 3 and 4, incompatible with the system without foundations.

If the device 1 is positioned in correspondence of the secondary column 4, then the similar configuration of Fig. 13 occurs.

In these last two cases, the employed device 1 according to the invention is the one shown according to the embodiment of figure 14, so as to allow the connection of the bracings 6 and 6 '.

The device 1 of figure 14 differs from that described with reference to figures 9a and 9b, in that it further comprises a fourth connection element 7 to the bracings 6 or 6'. Said fourth connection 7 can be coupled to the third element 43 or 43' on the basis of the position of the braces 6, 6' to which it must be coupled. In particular, said fourth element is a connection flange 7. Said connection flange 7 is also shown for the embodiment of figures 3a and 3b for connection to the "X" shaped bracing 46.

In figure 12 it is also shown a secondary column 4' in correspondence of the second level which, as noted, is not affected by the vertical loads of the second level, and therefore can also not be present (for this reason it is represented dashed).

The function of this secondary column 4' is dual: on one hand it can act as a spare column, if, for an exceptional action, such as a shock as to bring down it, the lane column 3 or 3' fails.

Secondary column 4' also solves the problem of the potential walking user's accidental collision with the brace 6'. The diagonal brace 6' entails a risk that users can strike the head against the high part of the brace 6', since the actual rod dimensions is not adequately reported starting from the ground level.

Therefore, the presence of the secondary column 4' in correspondence of the second level and its reserve function, justifies the presence of the device 1 according to the invention also in correspondence of its upper portion, within the second level carpentry. However, the feature of the device 1 to allow the possible crossing by a passing through column is not used and the bending connections will obviously be active (the device 1 is therefore in the configuration inactive column).

The same reasoning can be applied to the arrangement of figure 13, where it is possible to provide a lane column 3' to the upper floor and the device 1 is also applied in correspondence of its upper portion, with active bending connections (the device 1 in the configuration is therefore in an inactive column configuration).

One of the drawbacks of the parking structure according to the arrangements of figures 12 and 13 is that the carpentry of the first and second levels are different each other.

This is a disadvantage since it would be preferable, for prefabricated structures, to standardize as much as possible the production, and thus be able to use the same type of modules.

In figures 12 and 13, the devices 1 are arranged symmetrically with respect to the lane axis, therefore to the lane column 3 (Fig. 12), or to the secondary column 4 (Fig. 13).

If, instead of symmetrically, the devices 1 are provided in the lane column 3 and in the secondary column 4, the advantage is obtained of being able to use an identical structural module for both the first and the second level, as shown in figures 15a and 15b , where it is well evident that a module can be superimposed to itself after a rotation of 180° about a vertical axis passing through the centre of the lane.

Therefore, in case each level is used in a single-level parking structure above ground, connections of the bending device 1 according to the invention are active and its respective column is not necessary (therefore shown dashed). In case the layers are stacked one (figure 15a) on the other (figure 15b), spare columns 3 and 4 of the first level will be replaced with about double length columns, so as to be passing through the device 1 and to connect to the second deck, with a load-bearing function. The spare columns 4' and 3' of the second level will instead be installed as such in correspondence of the head of bearing columns 4 and 3 of the first level.

Preferably, as shown in the embodiment of figure 16, the device 1 according to the invention may further comprise an abutment element 8, particularly a collar, provided in the head of the passing through column 3. Said abutment element 8 allows the passing through column 3 to act as a spare column, as seen in the above, for the deck with respect to which it is passing through, if it fails, for an exceptional action, such as a shock as to bring down it, the supporting column 4.

In fact, if the load-bearing column 4 is no longer present, the lowering of the first deck would mean that it loads on the collar 8 shown in figure 16 and therefore on the passing through column 3. In other words, collar 8 allows, in case of exceptional lowering of the deck through the

column, to transfer to the same column the weight of the deck, preventing further lowering.

As mentioned in the above, the first level of figure 12 or of figure 13 or even better indifferently the first and the second level of figures 15a and 15b, may be used for a single level "comfort" structure with lightweight floor, as shown in figure 17a.

It is then well evident that, if the device 1 which in figures 17a and 17b is installed in the lane column 3 and in the secondary column 4, is realized as in the embodiments of figures 18 and 19, it would be possible to convert figure 2a in the structure of figure 17a and vice versa.

In particular, the device of figures 18a and 18b is adapted to pass from a first configuration or active column configuration (figure 18a) to a second configuration or inactive column configuration (figure 18b). The device 1 in fact has fixing means 9, in particular a bolt, able to connect the sleeve 41 to column 3 in said active configuration, so that also the column 3 can participate to the floor support. In addition, second elements 42 and 42' in this configuration, in particular lateral flanges 42 and 42', are integrally connected to the central portion, in particular the core, of the respective beams 2, while third elements 43 and 43', in particular the lower 43' and upper 43 flanges, are not active, or are not connected to the lower and to the upper portion, especially to the wings, of both of the beam elements 2.

On the contrary, in said inactive column configuration of figure 18b, the sleeve 41 is disconnected from the column 3, while the upper and lower flanges 43 and 43' are connected by means of further fixing means 10, in particular bolting 10, to both the beam elements 2, to restore the continuity, without loading on passing through column 3.

Moreover, as shown for the embodiment of figure 19, the device 1 according to the invention may further comprise an additional fifth element 11 coupled to the sleeve 41 of the device 1 and able to allow the connection of a beam orthogonal with respect to the two beam elements 2 that are connected to each other.

For example, the steps to move from the structure of figure 2a to the structure of figure 17a are:

a) elimination of the lightweight floor and relative secondary beam frame;

b) resetting the device 1 consisting in:

b1) elimination of bolting 10 between the wings of the beam members 2 and the device 1, in order to interrupt the continuity of the beam elements 2;

b2) introduction of bolting 9 between the spare column 3 and the device 1;

c) possible doubling of the beam in the lane beam, exploiting the flange 11 provided on the device 1 as shown in figure 19;

d) installation of heavy floor.

In particular, the resetting of the device 1 is necessary, because the greater weights of the concrete structure entail that, even if realized of a single layer, this structure has the need to bear on both lane columns 3.

In the above preferred embodiments have been described and variations of the present invention have been suggested, but it is to be understood that those skilled in the art can make modifications and changes, without departing from the relevant scope, as defined by the claims have been described attached.

CLAIMS

1. Device (1) for connecting two beam elements (2) in correspondence of a column (3; 4; 3'; 4'), said beam elements (2) comprising a central portion, an upper portion and a lower portion, said column (3; 4; 3'; 4') comprising an upper portion, said device (1) being characterized in that it comprises a first connection element (41) suitable to allow the passage of the upper portion of a column (3; 4; 3'; 4'), two second connecting elements (42, 42'), each one of said two second elements (42, 42') being coupled to said first element (41) and being suitable to couple to the central portion of a respective beam element (2), two third connection elements (43, 43'), each of said two third elements (43, 43') being coupled to said first element (41) and being suitable to couple to the upper or lower portion of said beam elements (2),

said device (1) being configured, during the use, so as to assume a first configuration, in which said second elements (42, 42') are coupled to the central portion of the respective beam elements (2) and said third elements (43, 43') are respectively coupled to the upper and lower portions of both said beam elements (2) so as to allow the passage of the stresses between the two beam elements (2) and possibly allow the passage of said column (3; 4; 3'; 4') passing through said first coupling element (41) without receiving the load by said beam elements (2).

2. Device (1) according to the preceding claim, characterised in that it is configured, during use, so as to assume either said first configuration or said second configuration, in which said second elements (42, 42') are coupled to the central portion of the respective beam element (2) and said first connection element (41) is coupled to said column (3) so as to distribute the load also on said column (3, 4).

3. Device (1) according to one of the preceding claim, characterised in that said first connection element (41) is a hollow tubular sleeve suitable for the axial passage of a column (3; 4; 3'; 4').

4. Device (1) according to one of the preceding claim, characterised in that said second connection elements are two opposite side flanges (42, 42') radially developed from the outer lateral surface of said first connection element (41).

5. Device (1) according to one of the preceding claim, characterised in that said third connection elements are an upper flange (43) and a lower flange (43') suitable to couple to the upper and lower end portions of said beam elements (2).

6. Device (1) according to one of the preceding claim, characterised in that said beam elements (2) have an "H" or double "T" section, in which the central portion is the core beam element (2) and the upper and lower portions correspond to the wings of the beam element (2).

7. Device (1) according to one of the preceding claim, characterised in that the couplings between elements are realised by means of bolting (9; 10) and/or welding.

8. Device (1) according to one of the preceding claim, characterised in that it comprises fourth connection elements (7), in particular connection flanges (7), coupled to said third connection elements (43, 43'), suitable to be coupled to possible bracing (46; 6; 6') between the columns (3; 4; 3'; 4').

9. Device (1) according to one of the preceding claim, characterised in that it further comprises an abutment element (8), preferably a collar, coupled to said column (3; 4; 3'; 4') below said third connection elements (43, 43') to support the load of the beam elements (2) in any emergency situations.

10. Device (1) according to one of the preceding claim, characterised in that it comprises at least a further fifth connection element (11), particularly a flange (11), coupled to the first connection element (41) and suitable to permit the connection to the central portion of a possible further beam.

11. Structure comprising at least one column (3; 4; 3'; 4'), having an upper portion, and at least two beam elements (2), said structure being characterized in that it comprises the device (1) according to one of the preceding claims and in that said device (1) connects said beam elements (2) each other in correspondence of the upper portion of said column (3; 4; 3'; 4') passing through said device (1).

12. Structure according to the preceding claim, when depending on claim 8, characterised in that it comprises a further column (4; 3; 4'; 3') having a top portion, in that one of said beam elements (2) is coupled to said upper portion of said column (4; 3; 4'; 3') and in that between said

columns (3; 4; 3'; 4') a bracing (46; 6; 6') is provided, coupled to said device (1).

13. Structure according to the preceding claim, characterised in that said bracing is an "X" or double "X" bracing.

14. Structure according to the preceding claim 12, characterised in that said bracing is a rod (6; 6') coupled to said device (1) and at the base of the further column (4; 3).

Prior Art

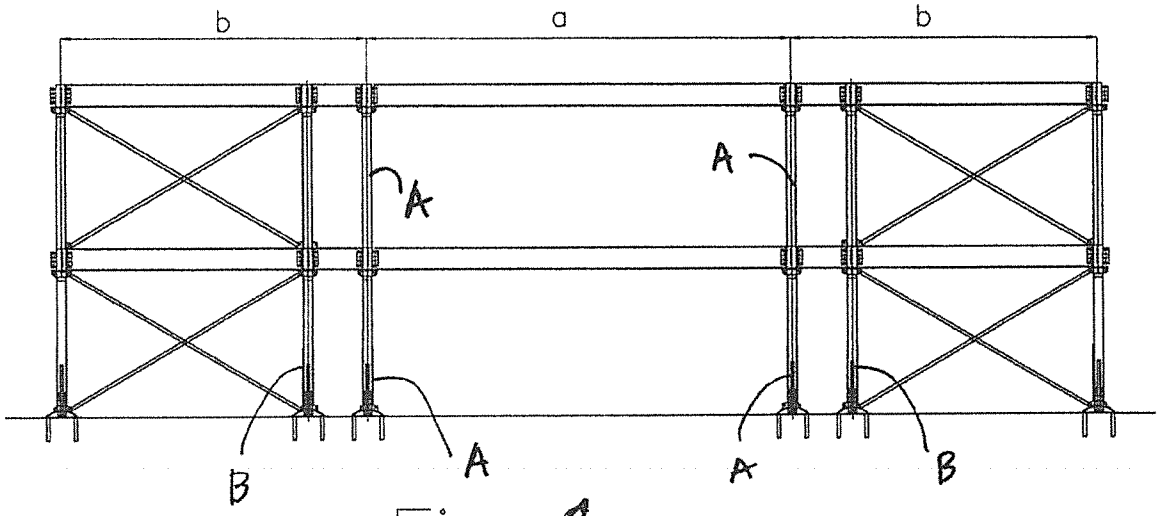


Fig 1a

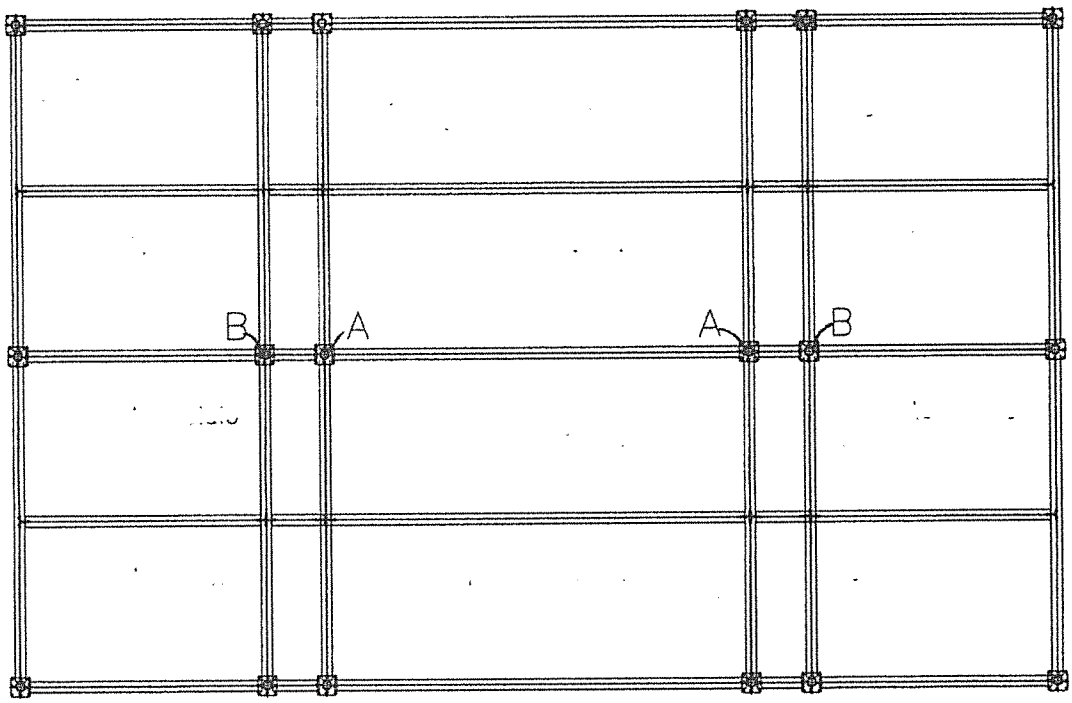


Fig 1b

Prior Art

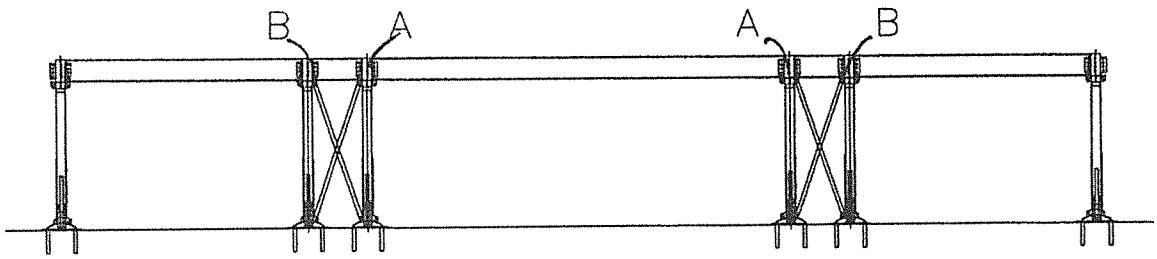


Fig 2a

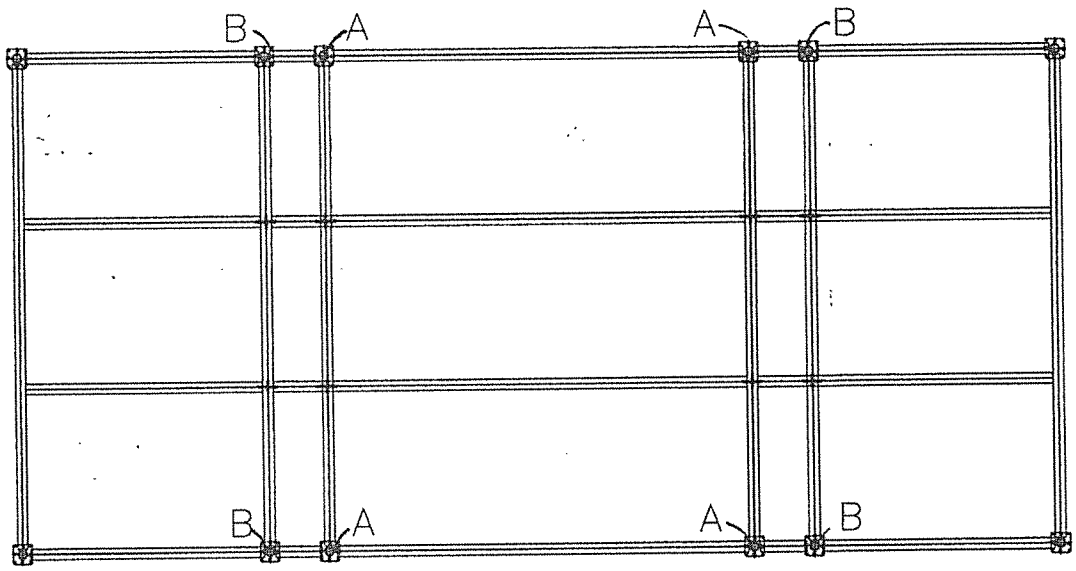


Fig 2b

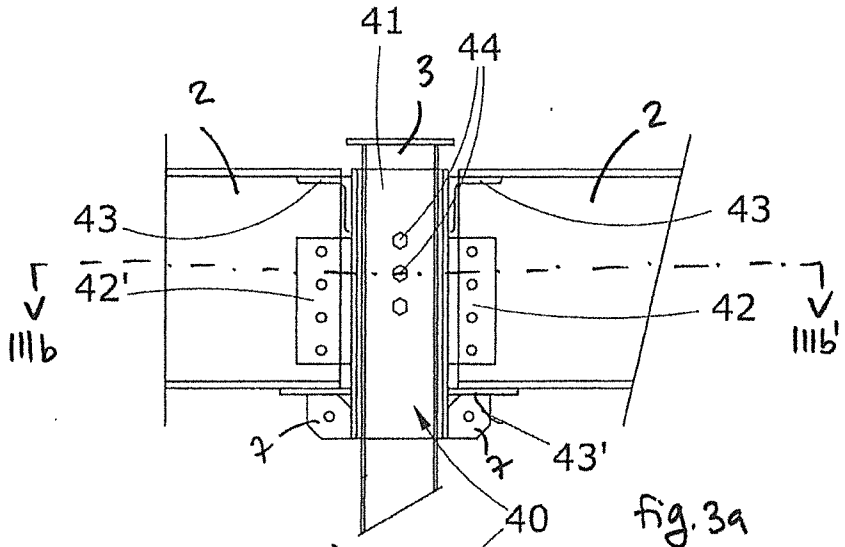


fig. 3a

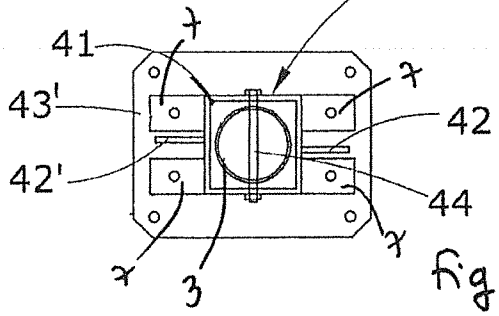


fig. 3b

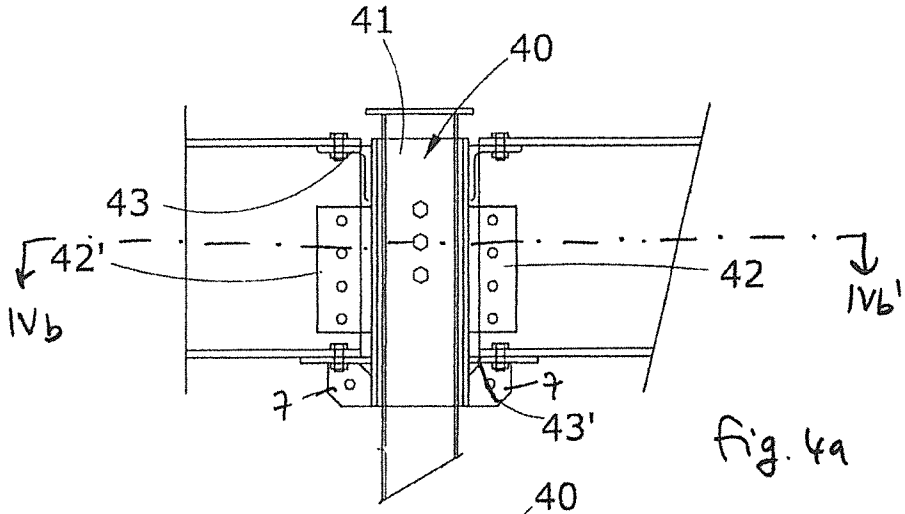


fig. 4a

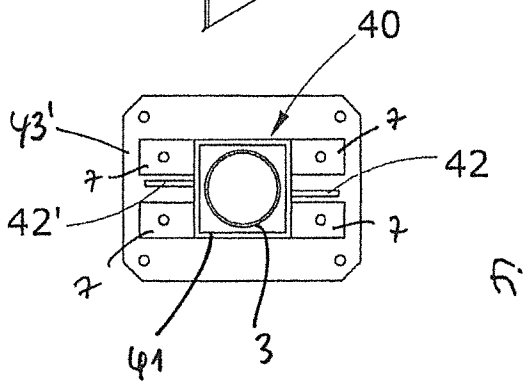


fig. 4b

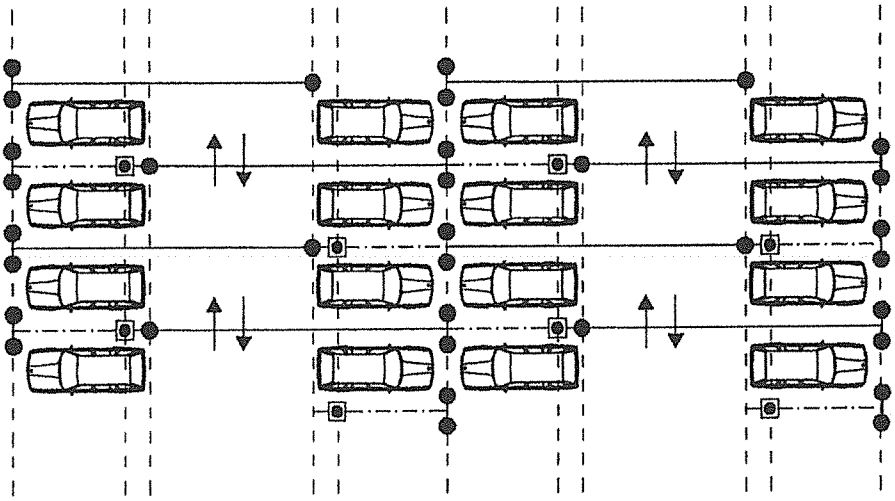


fig. 5

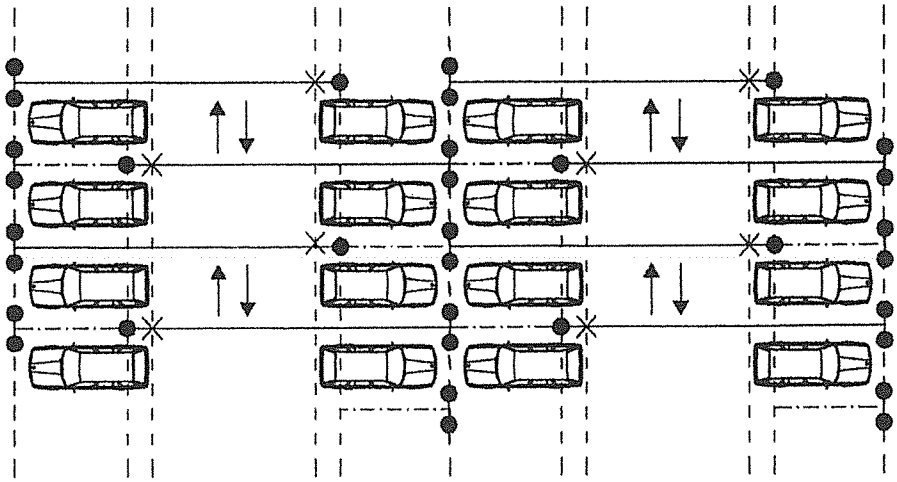


Fig. 6

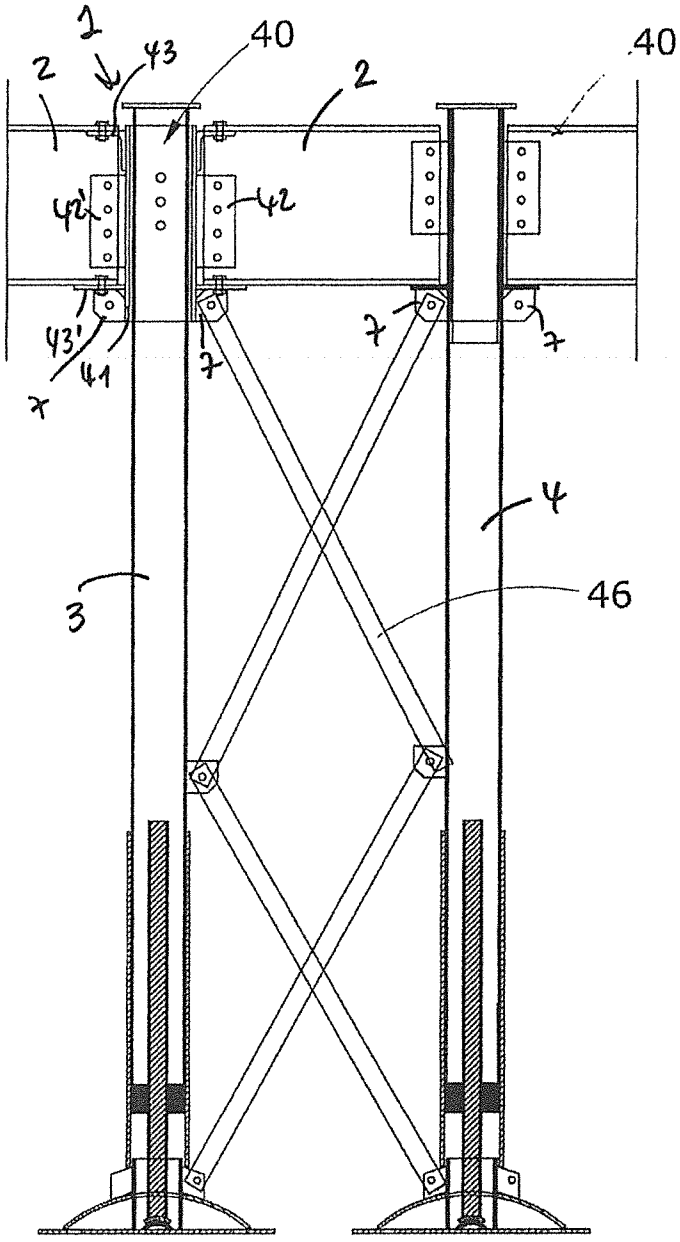


fig. 7

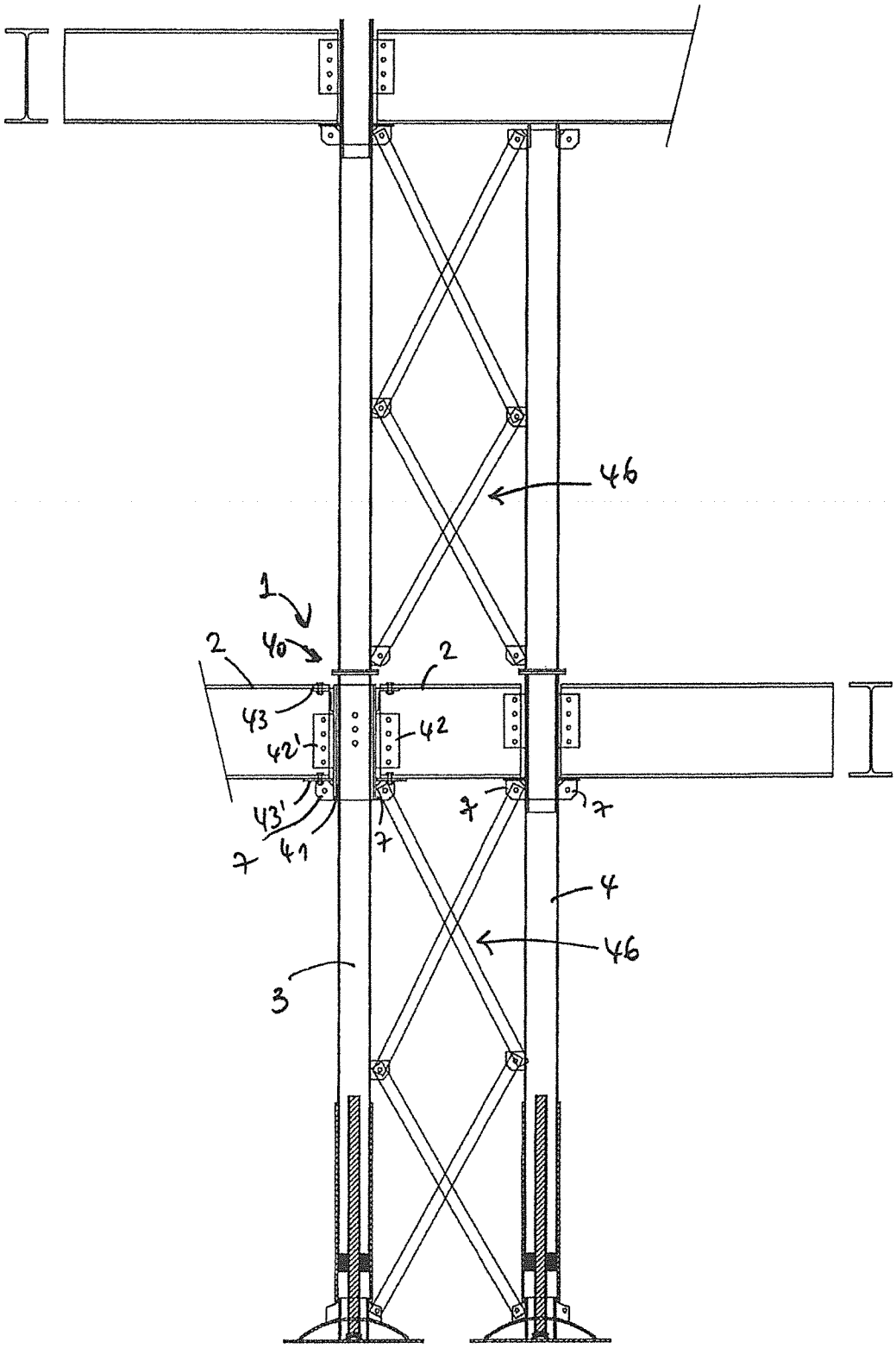
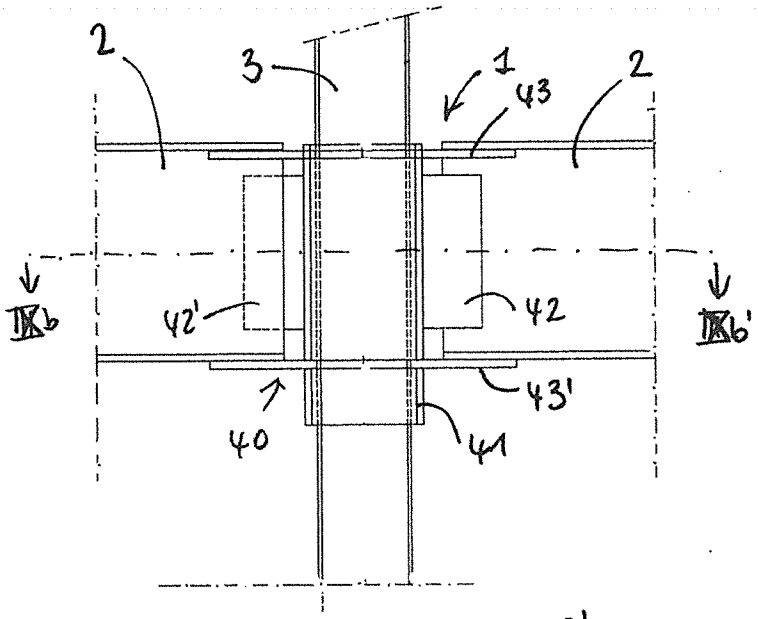


fig. 8

Fig.9a



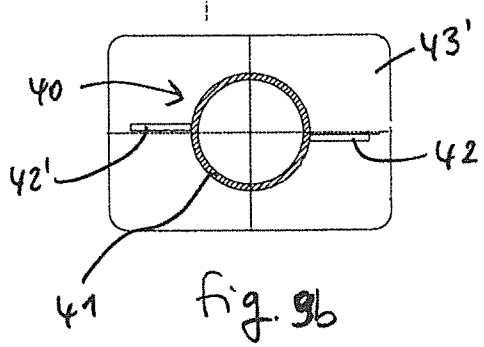


fig. 9b

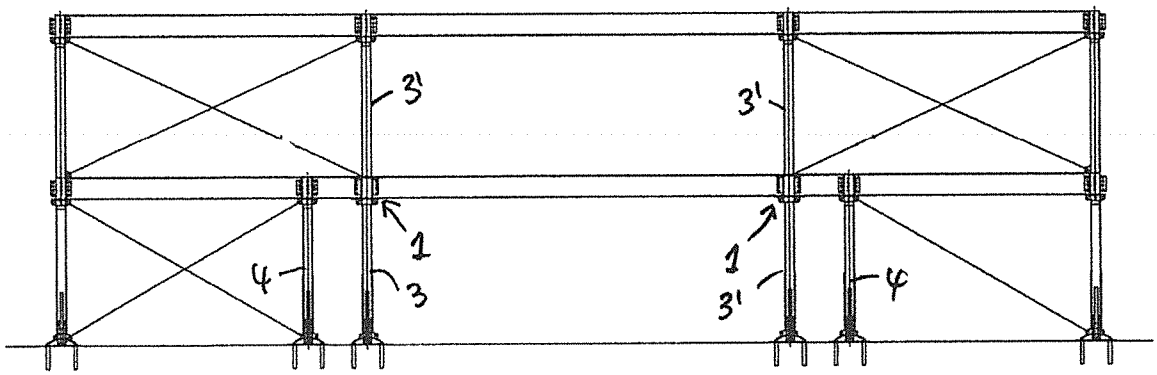


fig. 10

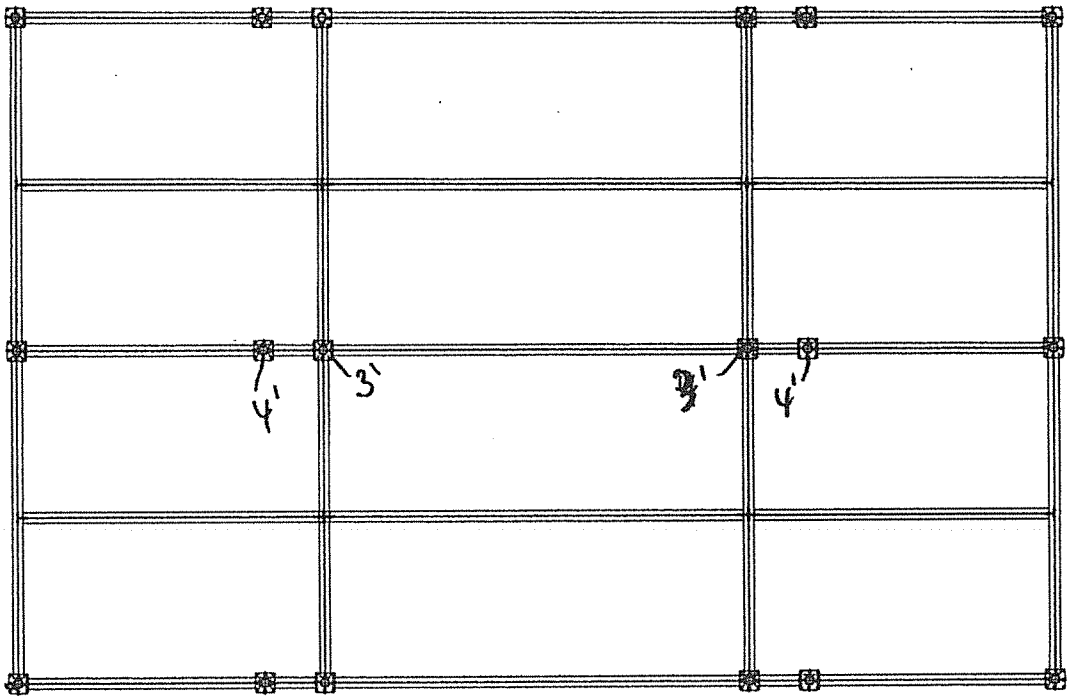


Fig. 11a

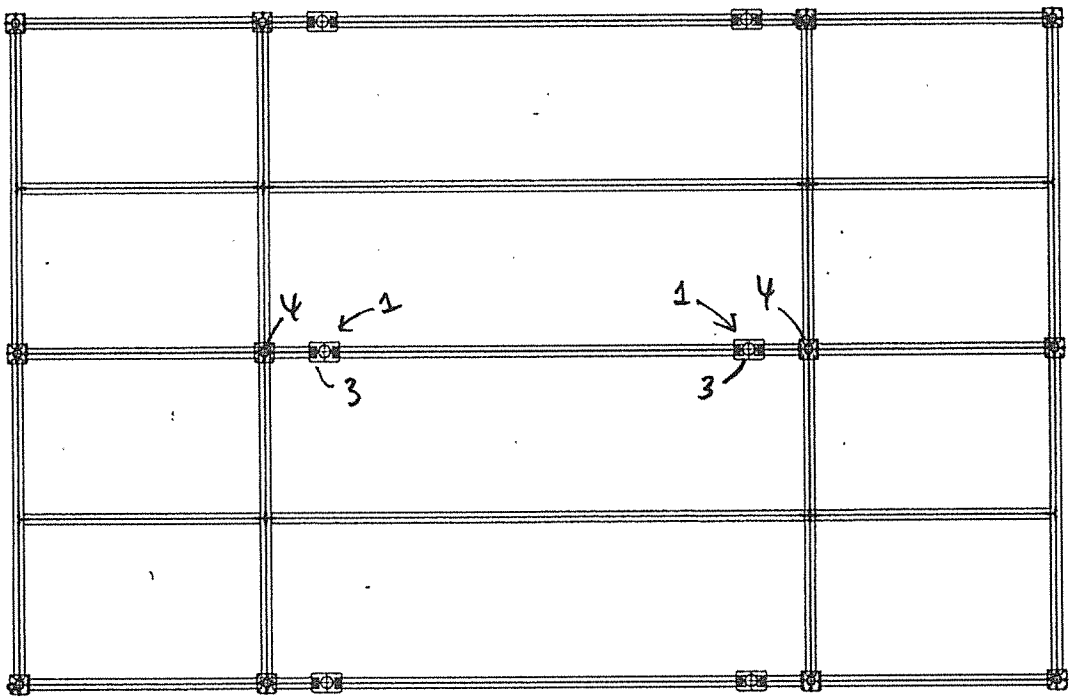


Fig. 11b

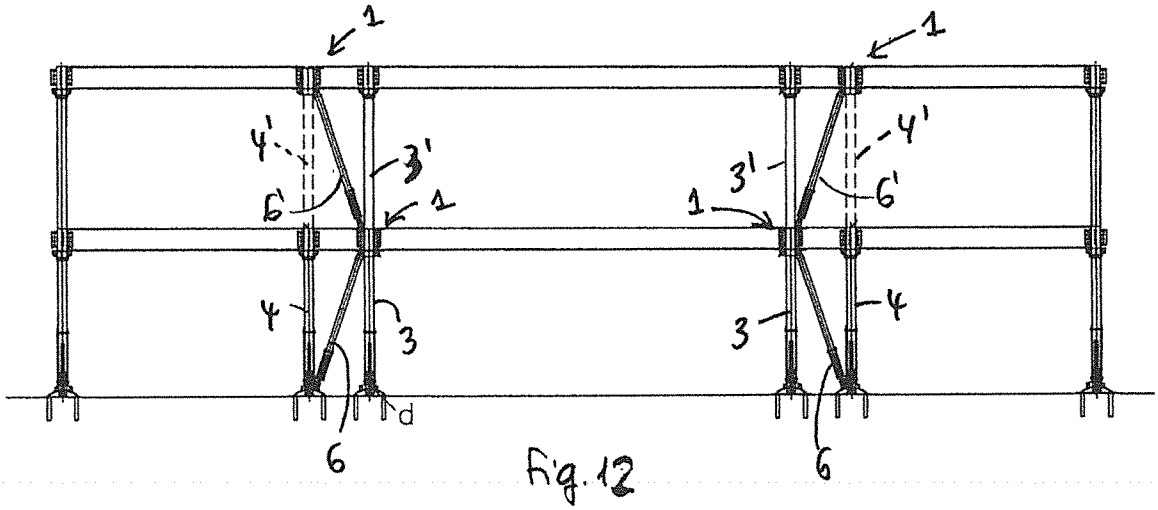


fig. 12

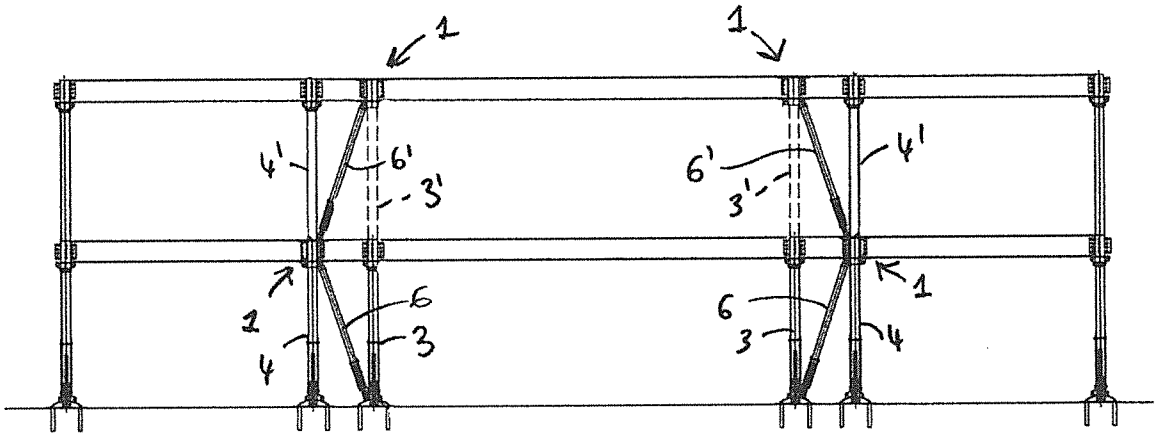


fig. 13

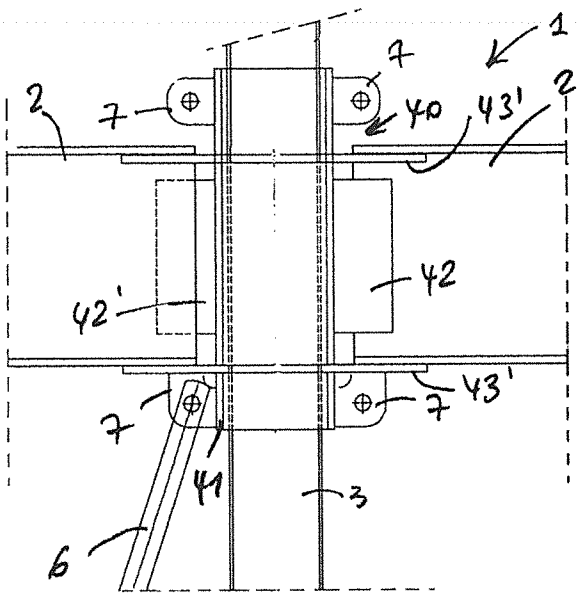


fig. 14

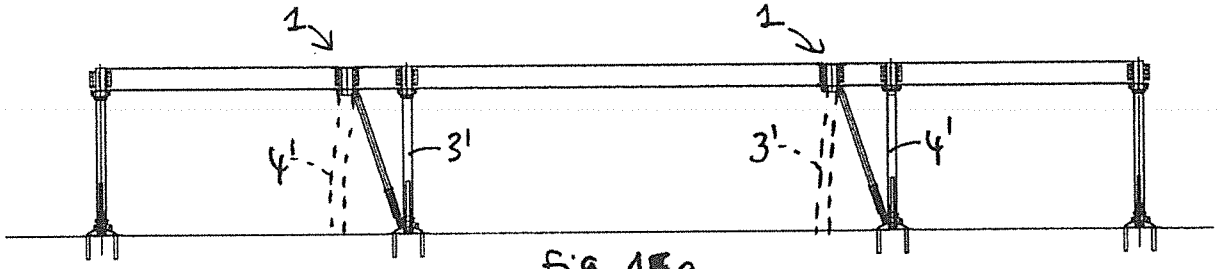


fig. 15a

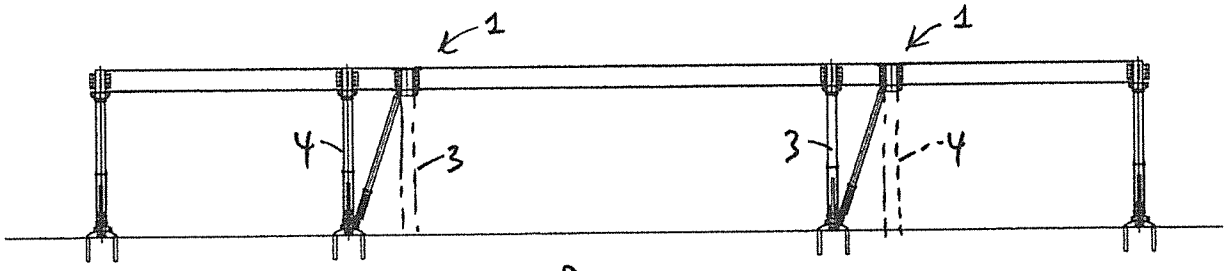


fig. 15b

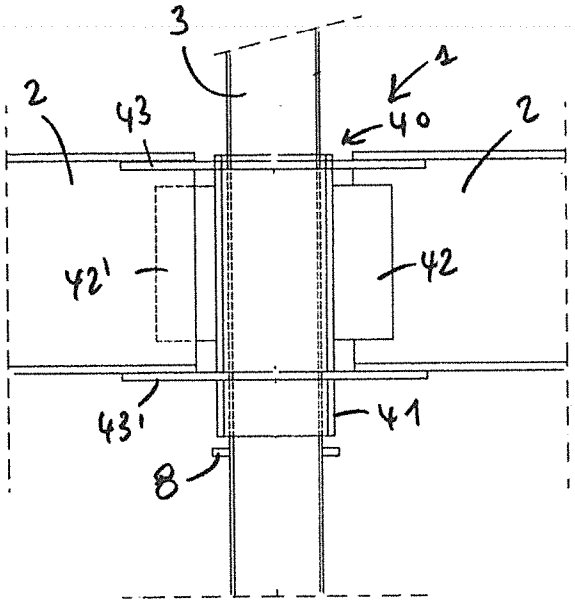


fig.16

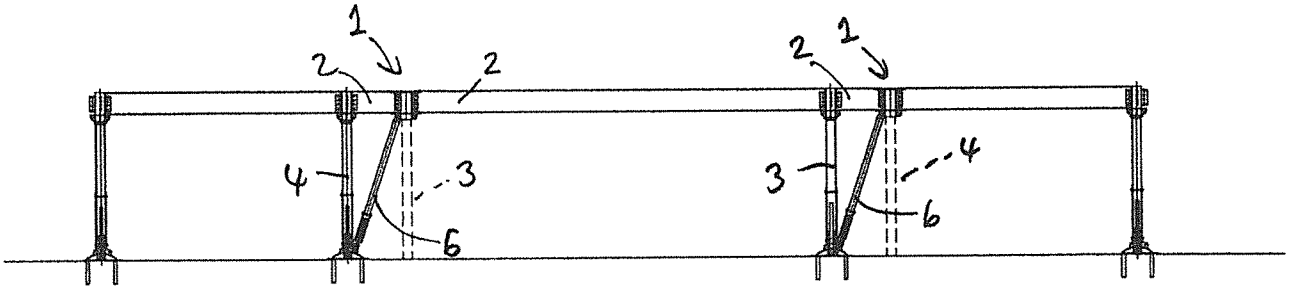


Fig. 17a

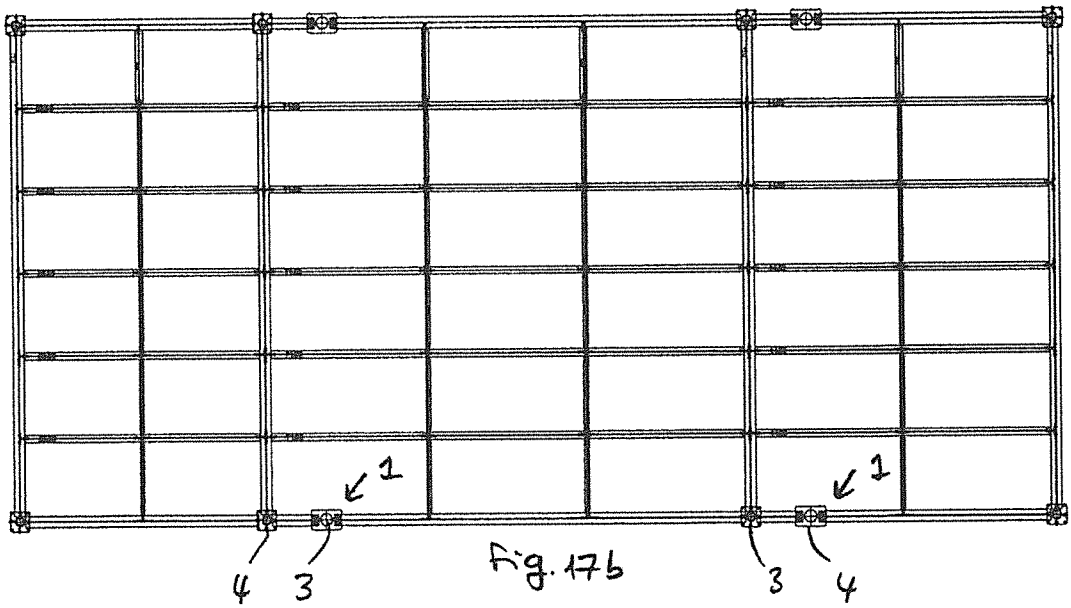


Fig. 17b

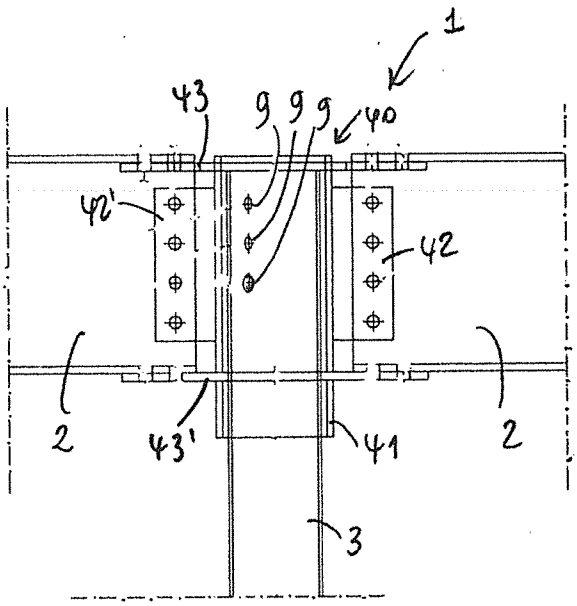


Fig. 18a

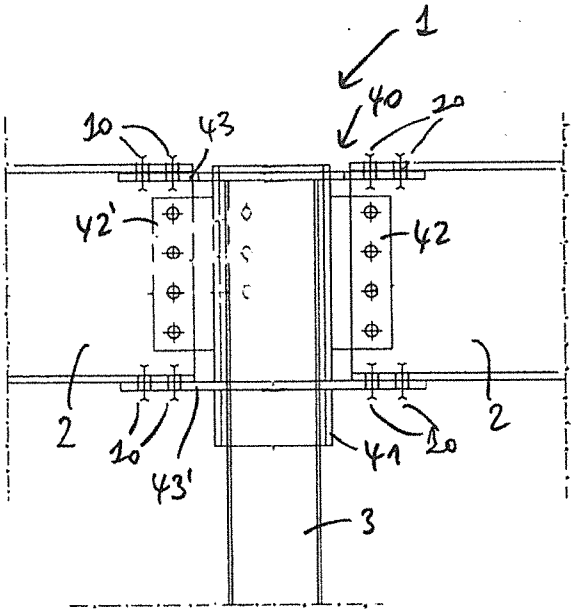
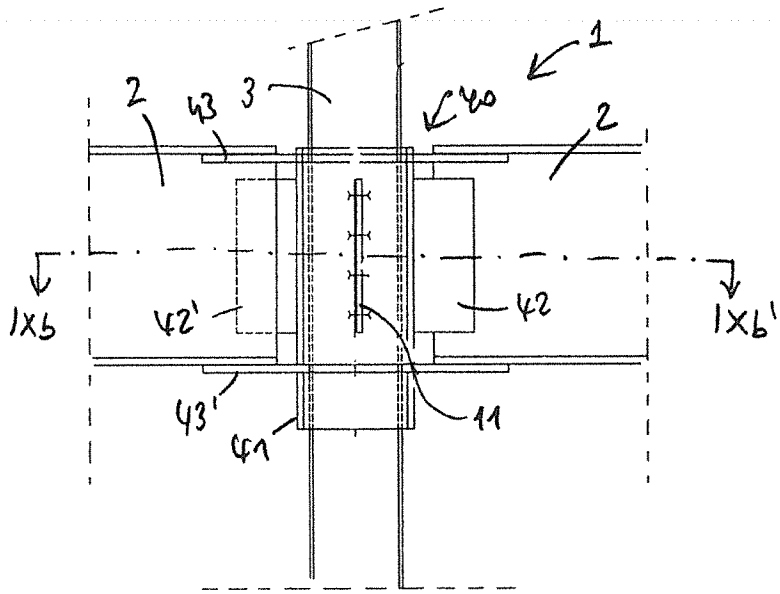


Fig. 18b

Fig 19a



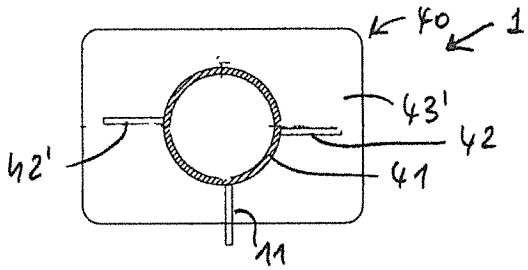


Fig. 19b

INTERNATIONAL SEARCH REPORT

International application No
PCT/IT2016/000105

A. CLASSIFICATION OF SUBJECT MATTER
INV. E04H6/10 E04B1/24
ADD.

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)
E04H E04B

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

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 2 441 903 A1 (FAST PARK SIST S R L [IT]) 18 April 2012 (2012-04-18) column 6, line 26 - column 10, line 22; figures 1A-10	1-9, 11-14
A	US 2006/265992 A1 (HIRAGAKI MINORU [JP]) 30 November 2006 (2006-11-30) page 3, right-hand column, paragraph 48 - page 5, left-hand column, paragraph 64; figures 1-8	1-4,7, 11,12
A	FR 2 526 890 A1 (PANTZ ERNEST ETS [FR]) 18 November 1983 (1983-11-18) page 4, line 14 - page 10, line 21; figures 1-4	1-8, 10-12

☐ 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

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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

"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	Date of mailing of the international search report
12 August 2016	30/08/2016

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Stefanescu, Radu

1

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/IT2016/000105

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 2441903 A1	18-04-2012	EP 2441903 A1	18-04-2012
		IT 1402343 B1	30-08-2013
US 2006265992 A1	30-11-2006	JP 3749250 B1	22-02-2006
		JP 2006328676 A	07-12-2006
		US 2006265992 A1	30-11-2006
FR 2526890 A1	18-11-1983	NONE	