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(54) **Modular demountable and remountable parking system, including multi-storey**

(57) The modular demountable and remountable parking system for motor vehicles is composed of a determined number of modular structural units (10.1; 10.2) and adequate bracing elements (43, 44). Each modular structural unit comprises: a square or rectangular floor system including main steel beams (12, 14); four steel nodal elements (30.1; 30.2) on which the floor system rests at its four corners; four steel vertical support elements (18), at the top of which a nodal element (30.1; 30.2) is provided; and four steel bases (36). The joint between each base (36) and the lower end of the relative vertical support element (18) comprises a ball joint end (70). By providing a suitable type of node (30.2), multi-storey parking systems (100) can be obtained with the modular units (10.2).

EP 2 093 352 A1

Description

[0001] The present invention relates to a modular demountable and remountable vehicle parking system, including multi-storey.

[0002] As is well known to the expert of the art, various types of modular parking structures for motor vehicles exist, having at least one storey in addition to the ground floor, to be able to increase the number of motor cars parkable in a determined area. These structures are normally of fixed type, either of steel or reinforced concrete, or mixed. More recent modular parking structures are made mountable and demountable, these being increasingly used where parking areas are only temporarily required in a zone in which they are not sufficiently available. This need arises in particular in the case of determined sporting events, displays or fairs attracting crowds, or if building work is to be carried out in a determined zone to the extent of temporarily reducing the number of parking spaces available.

[0003] EP0364414B1 describes a modular demountable and remountable parking structure, usable to form temporary parking areas consisting of a first transit and parking storey, accessible via one or more ramps, and a ground floor (covered by the first storey) also used for transit and parking. The relative structure is obtained by assembling a determined number (depending on the required availability of parking places) of modular structural units, each of which comprises: a square or rectangular floor panel made of ribbed steel sheet completed upperly by a filling and finishing material, to hence obtain a drivable surface accessible to motor vehicles; four steel beams, one for each edge of the floor panel; four steel nodal elements at the corners of the floor panel; four vertical steel support elements each disposed below one of the nodal elements; and four steel bases each disposed below one of the vertical support elements. Each base comprises a baseplate from which there upwardly extends a coaxial cylindrical collar rigidly fixed to the baseplate. A first hinge element, in the form of a spherical cap with its convexity facing upwards, rests on the baseplate within said cylindrical collar. To enable the length of the vertical support elements to be adjusted, these latter comprise an externally threaded lower cylindrical pin of diameter less than the inner diameter of said cylindrical collar, so that said pin can be inserted fairly loosely into the collar. At its lower end the threaded cylindrical pin presents a second hinge element also of spherical cup shape but complementary to said first hinge element, so that the convex surface of this latter is received in the concave surface of the second hinge element, to form in practice a structural hinge at the lower end of each of the vertical support elements. The adjustment device for the length of these latter is completed by an internally threaded sleeve which can be inserted into and locked in the lower end of a tubular element forming the upper part of each vertical support element, the sleeve being intended to be screwed into said cylindrical pin.

[0004] The presence of bracing rods disposed in suitable vertical planes of the structure, together with the aforedescribed structural hinges at the lower end of each of the vertical support elements, means that these latter are subjected only to axial load.

[0005] It should also be noted that the nodal element typical of this structure comprises: a first tubular part insertable coaxially a certain distance into the upper end of said upper tubular part of the relative vertical support element, said first part externally presenting angularly equidistant plates for connection to said bracing rods; a horizontal plate for supporting said edge beams fixed to the outer end of the first tubular part; and a second tubular part above the first tubular part and in one piece and coaxial therewith. The second tubular part presents four vertical plates for connection to said edge beams, these plates being angularly equidistant and slightly offset from the axial vertical plane through the relative edge beam, this plane also passing through the axis of the relative vertical support element.

[0006] EP 1 165 909 B1 describes a floor system for demountable modular parking lots of the type described in EP 0 364 414 B1. Specifically, the floor system of the modular structural unit comprises a floor panel, which is provided with rain water collection and disposal channels and is formed of panels of ribbed sheet steel cooperating with an overlying casting of suitably reinforced concrete.

[0007] It should be noted that in those demountable modular parking lots in accordance with EP 1165909B1 and EP 0364414B1 which have been effectively constructed, in addition to the four perimetral steel beams provided in the modular structural unit of EP 0364414B1 there is also always present a secondary steel beam which rests between the centres of two parallel edge beams (so that in reality the unit uses five beams), this enabling the span of the relative floor panel to be significantly reduced.

[0008] From the aforegoing it is evident that the aforedescribed modular structural unit is decidedly complicated to construct and assemble, and consequently costly.

[0009] EP 1736616A1 describes a modular multi-storey parking system for motor vehicles, of the demountable and remountable type, the structure of which is decidedly more simple and less costly that that of EP 1165909B1 and EP 0364414B1. In particular, each modular structural unit comprises: a square or rectangular floor system including steel main beams which carry a single floor panel or several side by side floor panels; four nodal elements, also of steel, on which the floor system rests at its four corners; four steel vertical support elements, at the top of each of which a nodal element is provided; and four steel bases, each comprising a baseplate from which a tubular collar extends coaxially upwards to receive fairly loosely the lower end of the relative vertical support element.

[0010] The structural unit of EP 1736616A1 differs from EP 1165909B1 and EP 0364414B1 in particular by the fact that: the floor system comprises only two steel

edge beams parallel to each other; each vertical support element is formed in one piece of fixed length, the lower end of which is directly insertable loosely into the tubular collar of the relative base. It should be noted that a thickener element can be inserted into the tubular collar to vary by the required quantity (obviously within determined limits) the distance between the base and the nodal element. The vertical support elements of this structure have the advantage of being able to be formed from a single profile bar and are extremely simple to construct. Again in this case suitable bracing rods are obviously provided for the parking structure.

[0011] The modular structural unit of EP 1736616A1 is therefore considerably simpler and less costly than that of EP 1165909B1 and EP 0364414B1. However it does not ensure (in contrast to the structure of EP 036441B1) that the load on its vertical support elements are axial. In the description of EP 1736616A1 it is however stated that the cross-section of the vertical support elements of these parking systems cannot be less than determined dimensions as they are conditioned by other requirements which impose the use of dimensions decidedly greater than those necessary to carry only the axial load. Hence any load misaligment which can occur in the vertical support elements of EP 1736616A1 (for example if the baseplate is not perfectly horizontal) does not constitute a problem, because it gives rise to additional stresses (additional to just the axial load) in the vertical support elements, which can be easily supported by these latter (as stated, over-dimensioned for other reasons).

[0012] In spite of this, some tender specifications still set a priori the condition that only axial loads must be present in the vertical support elements of the structural units which form this type of parking system.

[0013] An object of the present invention is therefore to provide a modular demountable and remountable parking system for motor vehicles, which combines the simplicity of the modular structural unit used, with the fact of having vertical support elements subjected only to axial loads.

[0014] Another object is to provide a modular parking system of the aforestated type, in which the modular unit also enables multi-storey parking systems to be obtained.

[0015] The first aforestated object is attained by a modular demountable and remountable parking system for motor vehicles, according to the present invention, comprising a determined number of modular structural units, characterised in that the joint between each support base and the lower end of the relative vertical support element comprises a ball joint end.

[0016] Ball joint ends are widely used in mechanics, in particular to transmit rotary movement between two shafts forming an angle (for example in power take-offs for tractors or in motor vehicle torsion bars), or to transmit traction or compression loads the line of action of which can vary within a certain angle (for example in trailer connectors or hydraulic cylinder ends).

[0017] In this respect the inventor of the present invention has realized that this type of end can be usefully used to form the structural hinge between the support base and the lower end of a vertical support element of the aforesaid modular units, even in the case of the higher loads which occur in the vertical support elements of the lower floor of multi-storey parking systems. From the vast range of such commercially available ends, it is easy to find at low cost one which is able to withstand the axial load acting on a vertical support element. They have the further advantage of being very compact.

[0018] According to one embodiment of the invention, the ball joint end is provided with a threaded shank on which a nut is screwed on which the lower end of the vertical support element rests, that part of the threaded shank above the nut being inserted into a coaxial vertical guide provide in the lower end of the vertical support element. Consequently, by adjusting the nut the distance between the baseplate and the relative lower end of the vertical support element can be varied within determined limits.

[0019] The floor system of the modular unit for the parking system of the present invention can be formed from one or more side-by-side panels, which form the drivable surface and rest on beams which themselves rest on the unit nodal elements. These panels can comprise a steel plate or a steel grid. The plate can also be of ribbed type, in which case an upper completion is provided with filling and finishing material (preferably concrete, possibly reinforced) to allow access to the motor vehicles. For this purpose wood-based panels can also be used, possibly adequately waterproofed, or fibreglass panels.

[0020] The nodal elements can be of the type already used ini EP 1736616A1 (to which reference should be made), i.e. comprising a first plate fixed in the manner of a capital to the top of the vertical support element, this first plate carrying, via vertical threaded bars and relative nuts and locking nuts, an overlying second plate parallel to and spaced from the first plate, an end of the relative main (edge) beam of the floor system resting on and being removably fixed to the second plate.

[0021] Alternatively, the nodal elements can be of a second type, comprising a bracket for each end of the main beam of the floor system which involves the node, this bracket being fixed laterally to the relative vertical support element, said end of the relative main beam of the floor system resting on and being removably fixed to this bracket.

[0022] If provided with nodal elements of the aforedescribed second type, a modular unit also attains the second aforesaid object, i.e. of providing a multi-storey parking system. In this respect, on the top of the vertical support elements of such a modular unit the bases of a similar modular unit can be rested, to form the upper storey of the parking system, and so on.

[0023] The invention will be more apparent from the ensuing description of some embodiments thereof. In this

description reference is made to the accompanying drawings, in which:

Figure 1 is a side elevation of a modular unit for parking systems according to the present invention, with its floor system formed using ribbed sheet steel panels;
Figure 2 is an elevation thereof taken in the direction of the arrow 2 of Figure 1;
Figure 2 is an isometric view thereof;
Figure 4 is an isometric view of a single floor system panel;
Figure 5 is an elevation of a different embodiment of the modular unit for parking systems according to the present invention, provided with a different node and with its floor system comprising grid panels;
Figure 6 is an elevation thereof taken in the direction of the arrow 6 of Figure 5;
Figure 7 is an isometric view thereof in which a single grid panel can be seen;
Figure 8 is an enlargement of the detail 8 of Figure 7;
Figure 9 is an exploded isometric view of a vertical support element of the modular unit of Figures 1-3, including the relative base;
Figure 10 shows the vertical support element of Figure 9 alone, but mounted;
Figure 11 is an enlarged front elevation of the ball joint end forming part of the vertical support element of Figures 9 and 10;
Figure 12 is a side elevation thereof;
Figure 13 is an exploded isometric view of a variant of the vertical support element of Figure 9;
Figure 14 shows how a modular multi-storey parking system can be formed using nodal elements such as that of Figure 8;
Figure 15 is a partial vertical section through a multi-storey parking system formed using nodal elements such as that of Figure 14.

[0024] The modular structural unit 10.1 of Figures 1-3 is similar to that shown in Figures 3-5 of EP 1736616A1 (to which reference should be made) and described therein, but with the difference that instead of the lower end of the vertical support element being simply inserted into the collar of the base (indicated respectively by 18 and 40 in Figures 9, 10 and 14 of EP 1736616A1), the lower end of the vertical support element 18 is here provided (see accompanying Figures 9 and 10) with a ball joint end 70, best seen in the accompanying Figures 11 and 12. Before continuing, it should be noted that for convenience, those elements shown in the accompanying figures which are identical or similar to those of the figures of EP 1736616A1 have been indicated by the same reference numerals.

[0025] As can be seen, the ball joint end 70 comprises a threaded shank 71, on the near end of which an annular head 72 is screwable presenting an annular seat 74 of spherical surface receiving an annular element 73 the spherical peripheral surface of which mates with that of the annular seat 74. The axis 75 of the annular element 73 can hence be inclined to the axis of the annular seat 74, the annular element 73 also being able to rotate about its axis.

On the free end of the threaded shank 71 a nut 82 can be screwed, on which the lower end of the vertical support element 18 rests coaxially. This resting on the nut 82 occurs via a plate 81 which closes the lower end of the tubular element 18 and is provided with an axial hole to enable the upper part of the shank 71 to pass. The plate 81 is welded into the lower end of the tubular element 18. The lower end of a coaxial sleeve 80 is welded to the upper face of the plate 81 to act as a guide for the shank 71.

[0026] It can also be seen from Figure 9 that a conventional protection sleeve 83 is provided consisting of a piece of square tube of suitable dimensions.

[0027] A pin 77 is inserted through the hole 76 of the annular element 73 (Figure 11) and also through two corresponding coaxial holes (of which only one can be seen, in Figure 9, indicated by 78) provided in opposing positions in the tubular collar 40 of the base 36. The fact that the pin 77 is provided with a head and that close to its other end an annular groove for a retaining ring 79 is provided means that the pin 77 is maintained in position once mounted.

[0028] Consequently, by virtue of the ball joint end 70 a connection is obtained between the base 36 and the vertical support element 18 which is a true spherical hinge, hence (as bracing is provided on the parking structure to support any horizontal loads) only axial loads exist in the vertical elements 18.

[0029] Figure 13 shows simply that instead of being formed from a square-tube profile bar (as in Figure 9), the vertical elements 18 can be formed with a round-tube profile bar (in the two cases the same reference numbers have been used for corresponding parts). As can be seen, the holed plate 81 is circular in this case, with a cylindrical protection sleeve 83 and a cylindrical collar 40 for the base 36.

[0030] Returning to the modular unit 10.1, it should be noted that Figure 4, for simplicity, does not show the filling (for example of lightweight and possibly reinforced concrete) above the ribbed sheet metal (visible however in Figures 1 and 2) which forms the drivable surface. It should also be noted that, instead of ribbed sheet metal panels, flat or expanded sheet metal panels, metal grid panels or even wood-based or fibreglass panels can be used to form the floor system. In all these cases it is however normally necessary to provide a larger number of secondary beams.

[0031] It should be noted that the modular unit 10.1 has nodal elements 30.1 such as those described in EP 1736616A1 (to which reference should be made), with particular reference to Figure 14 of this latter, from which it can be seen that they comprise a first plate fixed in the manner of a capital to the top of the vertical support el-

ement 18. The second plate 20 is carried by the first plate 28 via four threaded bars 22 and relative nuts and locking nuts. The relative main beams 12 rest on and are removably fixed to the second plate.

[0032] Figures 5-7 show a second type of modular unit indicated by 10.2, usable to form a parking system of the present invention. Elements identical or similar to those of Figures 1-3 are again indicated by the same reference numbers.

[0033] The modular unit 10.2, in addition to having a floor system in which the treadable surface is formed from metal grid panels 16G - and having consequently to provide several secondary beams 12 plus one intermediate beam 13 (or even more than one if necessary) - comprises in this specific case a zinc-plated metal sheet disposed between the secondary beams 12 and the grid 16G, to prevent rail water passing through the floor system (the secondary beams 14 and the intermediate beam 13 are shown by dashed lines in Figure 7 precisely because the metal sheet is provided). It is however apparent that such a floor system can also be replaced by other types of floor system and in particular by that already described with reference to Figures 1-3.

[0034] It should also be noted that, to avoid misunderstanding, the bracing has not been shown in Figures 5-7 for simplicity (visible however in Figures 1-3), but this must be provided in the parking system.

[0035] Furthermore the metal sheet could be dispensed with, so that, because of the presence of the grid, an "open" drivable surface is obtained, i.e. enabling the rain water to pass (an acceptable solution especially in those countries where it very rarely rains), with the advantage of having total aeration of the parking system and of facilitating the obtaining of building permission.

[0036] It should be especially noted that the unit 10.2 differs from the unit 10.1 by the different form of the nodal elements, here indicated by 30.2. As can be seen from Figure 8, these comprise, in addition to the upper end part of the vertical support element 18 (which is of through construction and therefore forms part of the nodal element), a lateral bracket 20.2 for each of the main beams 12 involved in the node. The main beams 12 are removably fixed to the relative bracket 20.2, for example by bolts. The brackets 20.2 are also fixed to the vertical element 18 by bolts or by welding. The advantage of having the vertical element 18 of through construction in the node 30.2 is that a plate 21 can be fixed on the top of the vertical element 18 on which, if a multi-storey parking system is to be formed, the base 36 of another modular unit can rest to contribute to the formation of the upper parking floor and that of the underlying modular unit, as shown in Figure 14. The multi-storey parking system 100 of Figure 15 can hence be obtained in this manner. It should be noted that in it (in contrast to Figures 5-7 and likewise Figures 1-3) the floor system comprises panels of ribbed sheet metal with an overlying filling of reinforced concrete.

[0037] As will be easily understood from the aforedescribed and illustrated embodiments of the modular parking system of the present invention, parking systems of this type can be demounted once their purpose has been fulfilled, to be remounted on another site, the relative foundations having merely to be adapted to new type of terrain. These foundations can conveniently be of prefabricated type.

Claims

1. A modular demountable and remountable parking system for motor vehicles which, in addition to one or more access ramps, is composed of a determined number of modular structural units (10.1; 10.2) and adequate bracing elements (43, 44), each modular structural unit comprising: a square or rectangular floor system including main steel beams (12, 14) carrying a single floor panel or several side-by-side floor panels (16A, 16B; 16G); four steel nodal elements (30.1; 30.2) on which the floor system rests at its four corners; four steel vertical support elements (18), at the top of each of which a nodal element (30.1; 30.2) is provided; and four steel bases (36);
characterised in that the joint between each base (36) and the lower end of the relative vertical support element (18) comprises a ball joint end (70).

2. A modular parking system as claimed in claim 1, wherein the ball joint end (70) is of the type which comprises: a threaded shank (71) projecting vertically upwards coaxial with the relative vertical support element (18), on the shank (71) a nut (72) being screwed on which the lower end of the vertical support element (18) rests.

3. A modular parking system as claimed in claim 2, wherein the vertical support elements (18) are tubular, the vertical support element (18) resting on the nut (82) via a plate (81) which closes the lower end of the relative tubular element (18), the lower end of a coaxial sleeve (80) being welded to the upper face of the plate (81) to act as a guide for the shank (71).

4. A modular parking system as claimed in claim 2, wherein on the other end of the threaded shank (71) an annular head (72) is screwable presenting a seat (74) of spherical surface receiving an annular element (73) the peripheral surface of which is also spherical to mate with that of the seat (74), a pin (77) being inserted through the annular element (73) and also through two relative coaxial holes (78) of horizontal axis provided in opposing positions in the base (36) to be able to insert the annular head (72) therebetween.

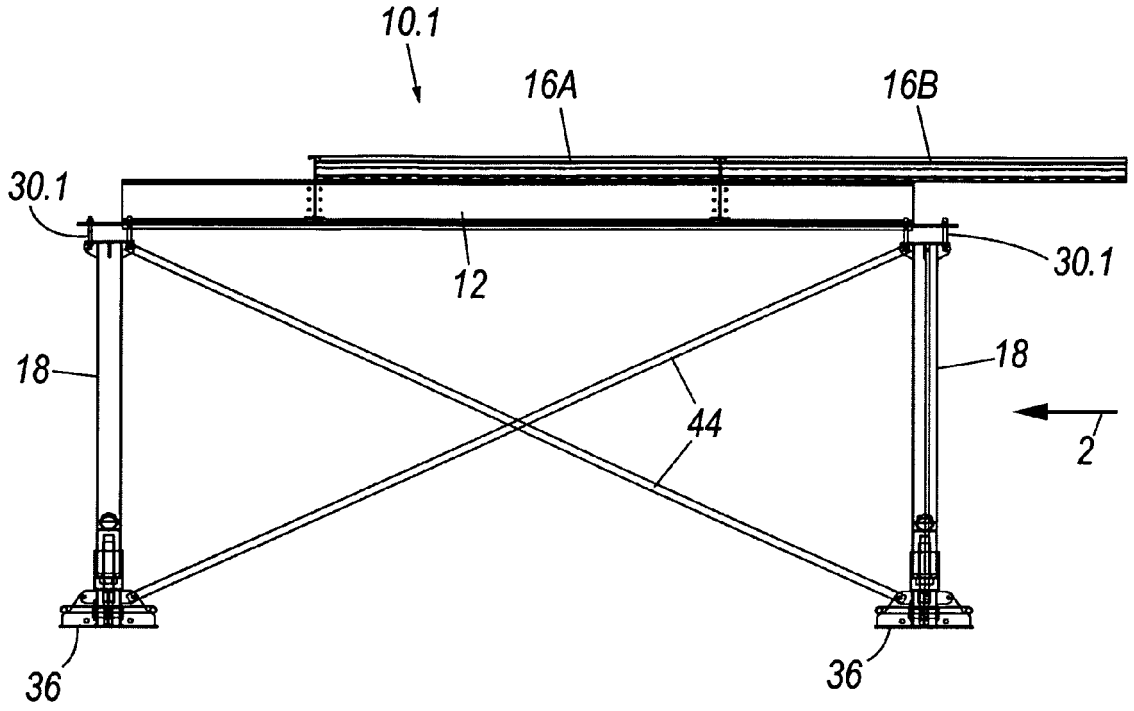
5. A modular parking system as claimed in claim 1, wherein the nodal element (30.2) comprises, in ad-

dition to the upper end part of the respective vertical support element (18), a lateral bracket (20.2) for each main beam (12) involved in the node (30.2), this beam (12) resting on the bracket (20.2) and being removably fixed thereto.

6. A modular parking system as claimed in claim 5, of multi-storey type, wherein on the upper end of the vertical support elements (18) of those modular units (10.2) forming a determined storey, a relative horizontal plate (21) is fixed on which there rests the base (36) of a corresponding vertical support element (18) forming part of one of the modular units (10.1; 10.2) intended to form the upper story of the parking system (100).

7. A modular parking system as claimed in claim 1, wherein the floor panel or panels comprise a grid (16G) forming the drivable surface.

8. A modular parking system as claimed in claim 7, wherein a metal closing sheet (84) is provided below the grid (16G).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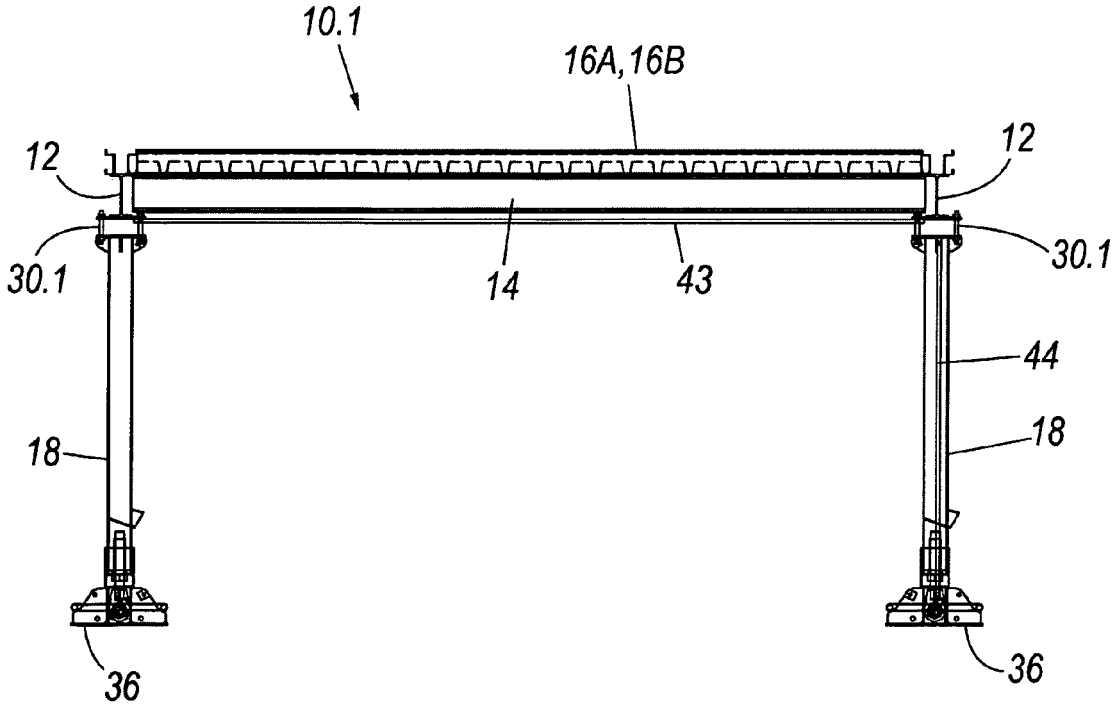
16A
16B
30.1
12
30.1
18
18
44
2
36
36

Fig. 1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16A,16B
12
12
30.1
30.1
14
43
44
18
18
36
36

Fig. 2

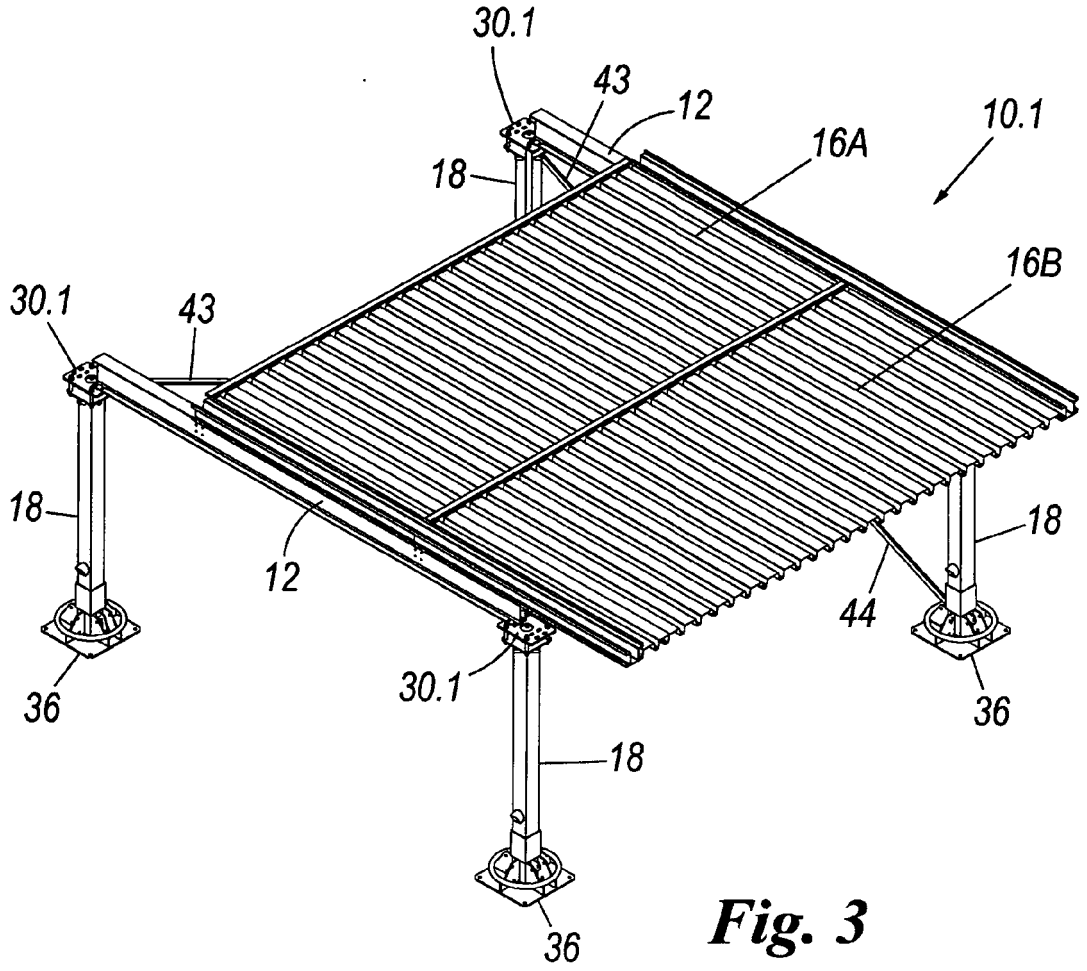

Fig. 3

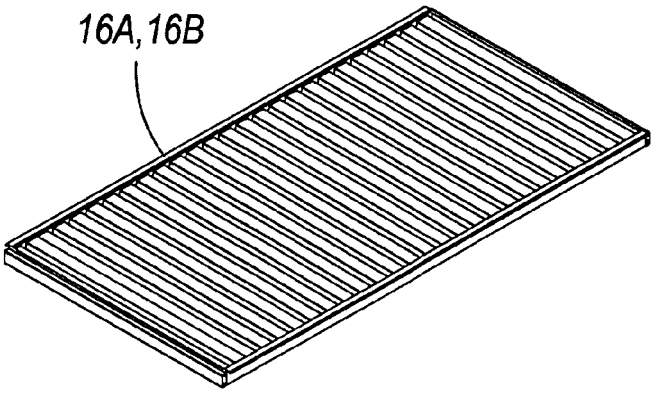

Fig. 4

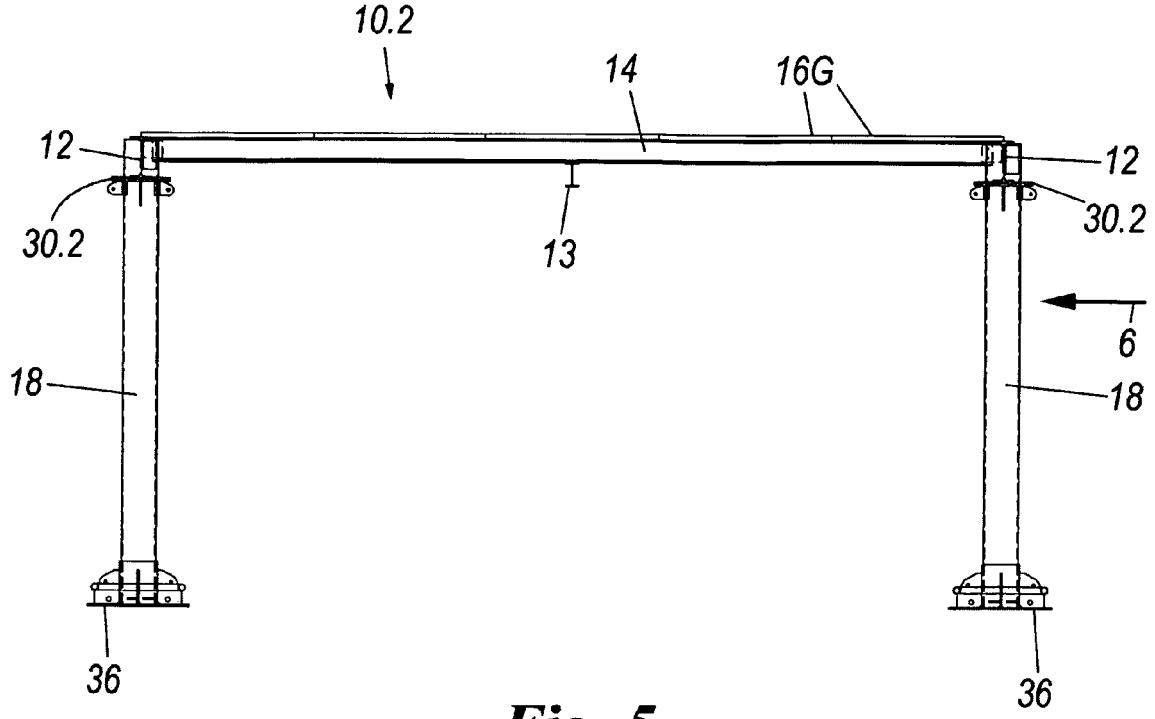
10.2
14
16G
12
12
30.2
30.2
13
6
18
18
36
36

Fig. 5

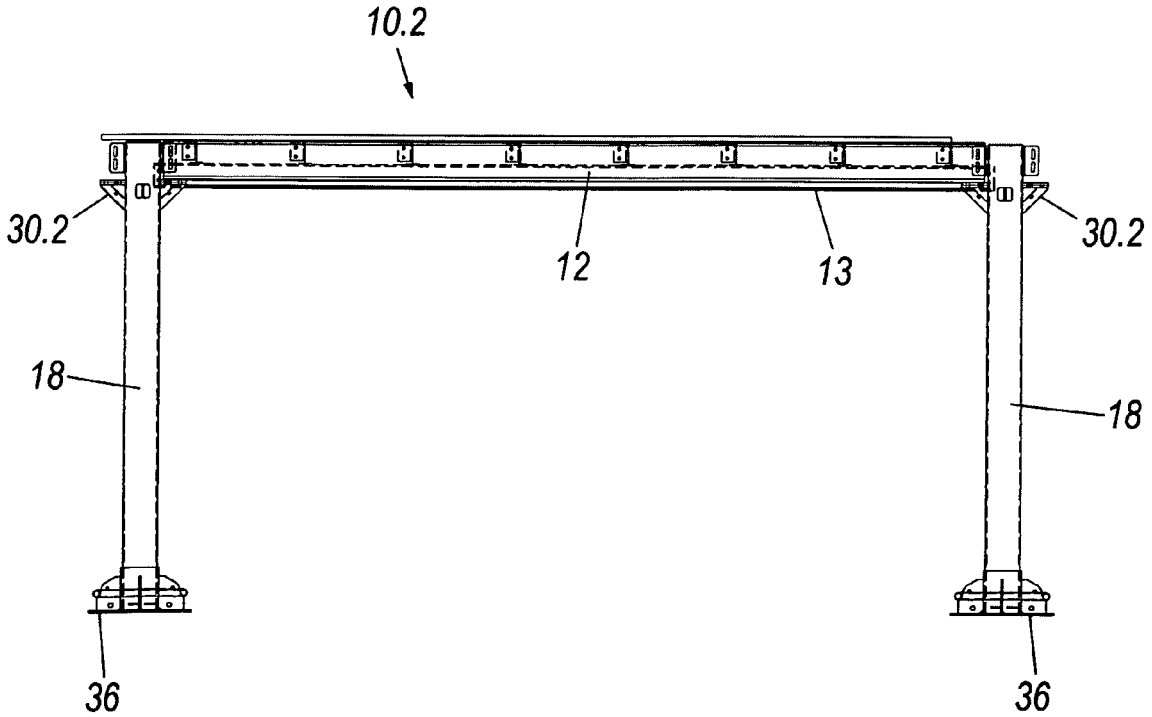
10.2
30.2
12
13
30.2
18
18
36
36

Fig. 6

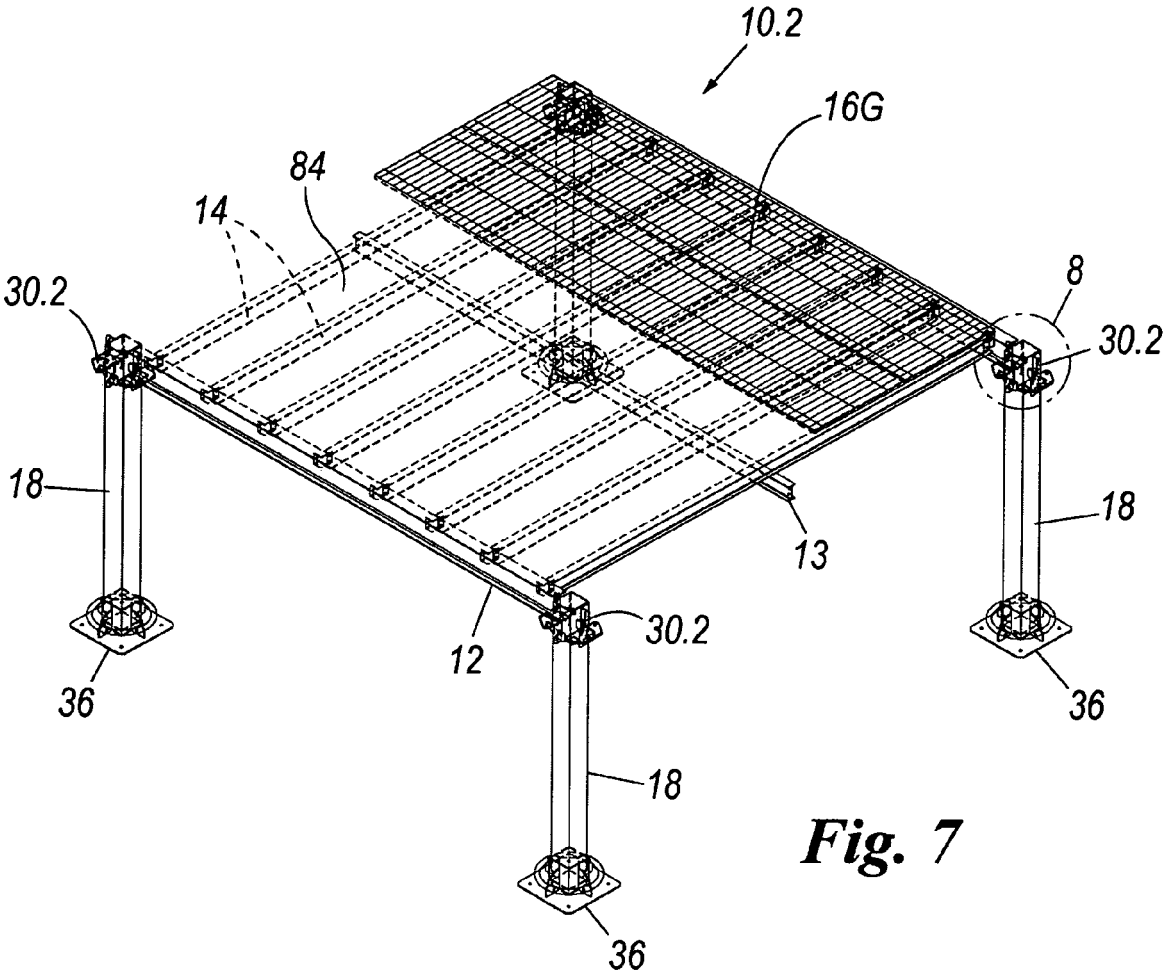
10.2
16G
84
14
30.2
8
30.2
18
18
13
12
30.2
36
36
18
36

Fig. 7

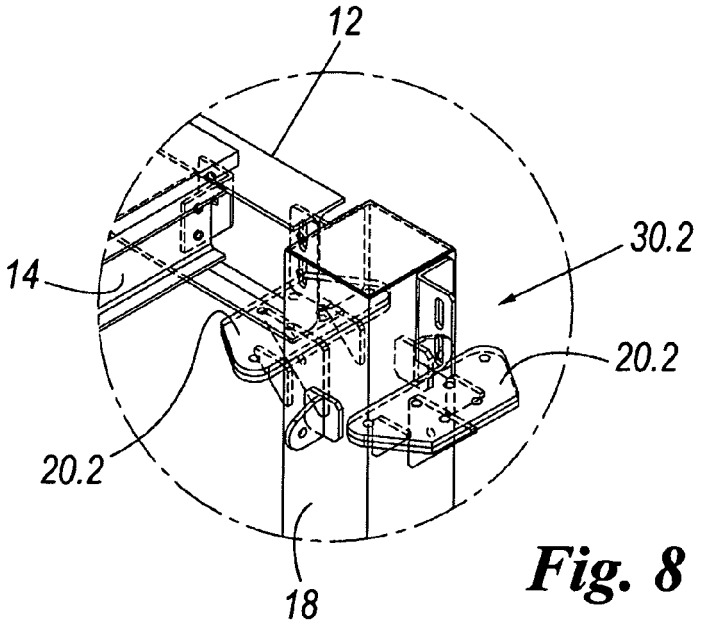
12
30.2
14
20.2
20.2
18

Fig. 8

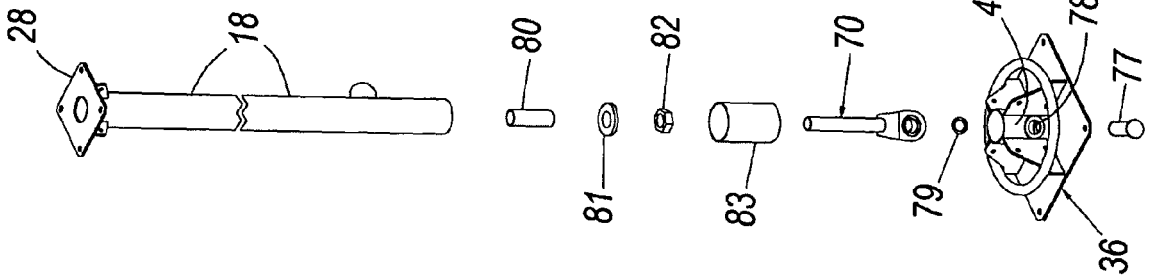

Fig. 13

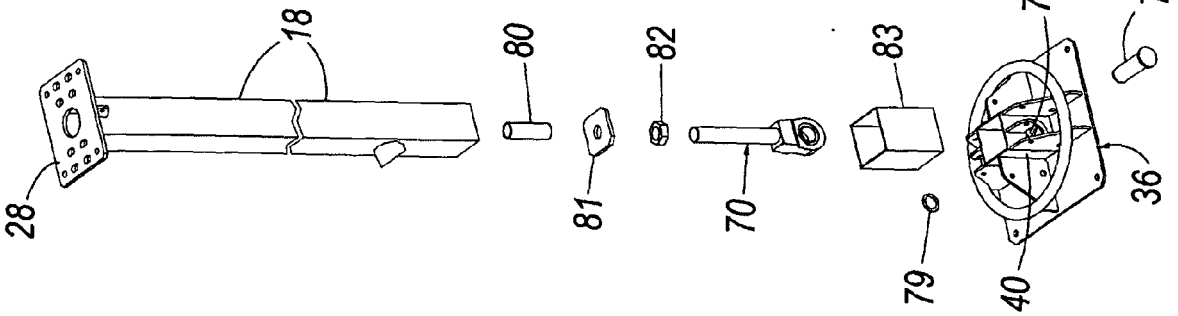

Fig. 9

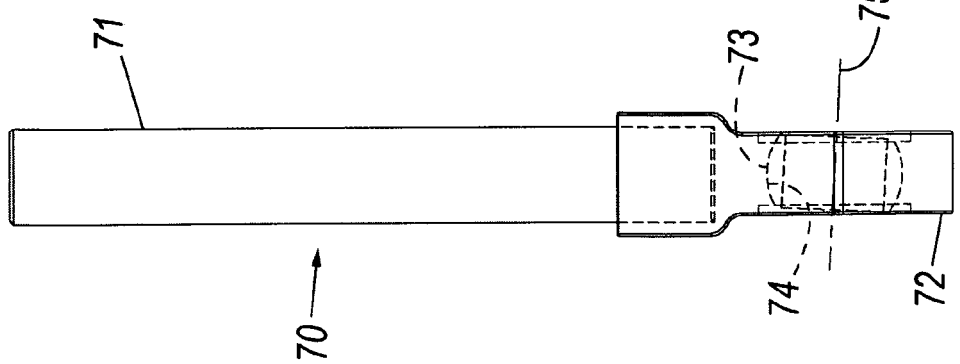

Fig. 12

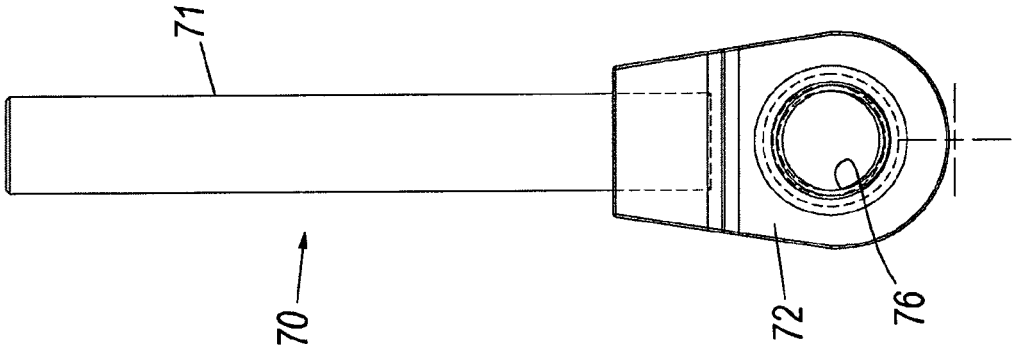

Fig. 11

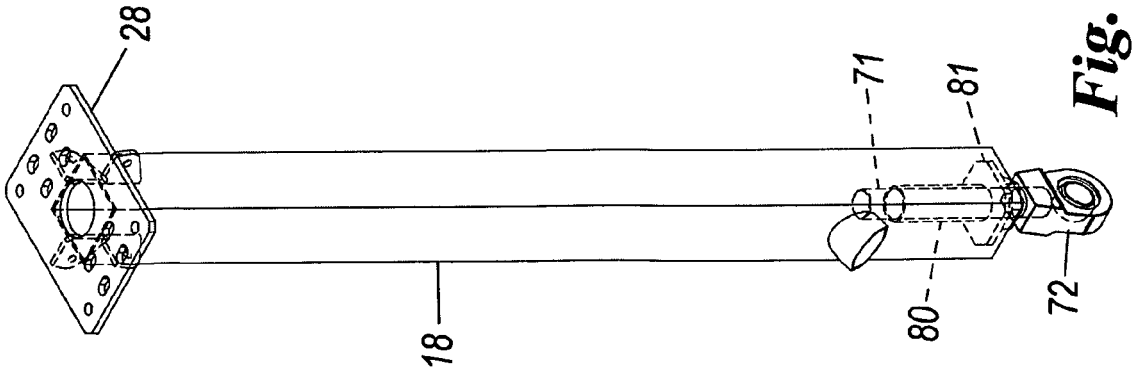

Fig. 10

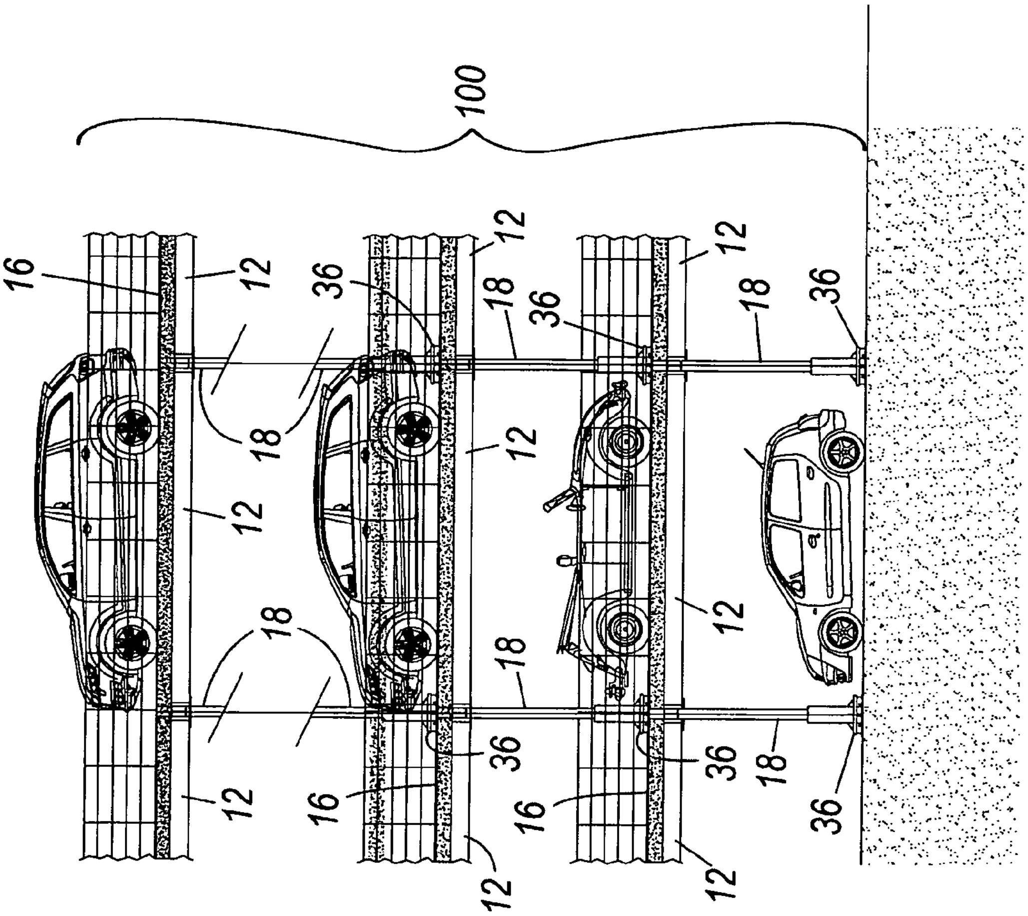

Fig. 15

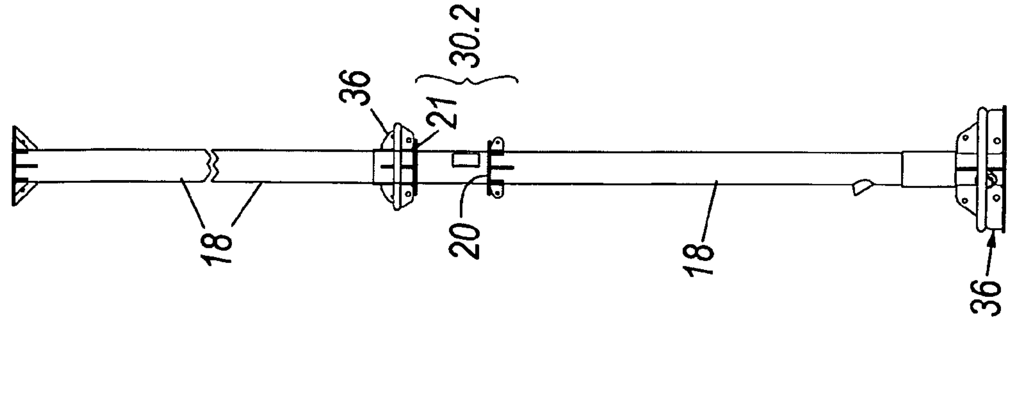

Fig. 14

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 08 10 1864

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
D,Y	EP 1 736 616 A (MUSSINI DANIELE [IT]) 27 December 2006 (2006-12-27) * column 5, line 21 - column 8, line 15; claim 1; figures 1-8,11,12,14,15 *	1,5-8	INV. E04H6/10
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	28 August 2008	Stefanescu, Radu

CATEGORY OF CITED DOCUMENTS

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