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(54) Connecting device and node for buildings with prefabricated elements

(57) A connection device (1,1') for connecting a first pillar (21) to a structural element (31) of a building, the first pillar (21) including first fixing elements (23-25), characterised in that:

the connection device (1,1') includes a first winged section (2), a distinctly separate second winged section (3) and further includes at least one spacer element (4) connected between the first and the second winged sections, the first winged section (2) including first fixing means (9,10) suitable to cooperate with the first fixing elements (23-25) of the first pillar (21) and the second winged section (3) being fixable to said structural element (31).

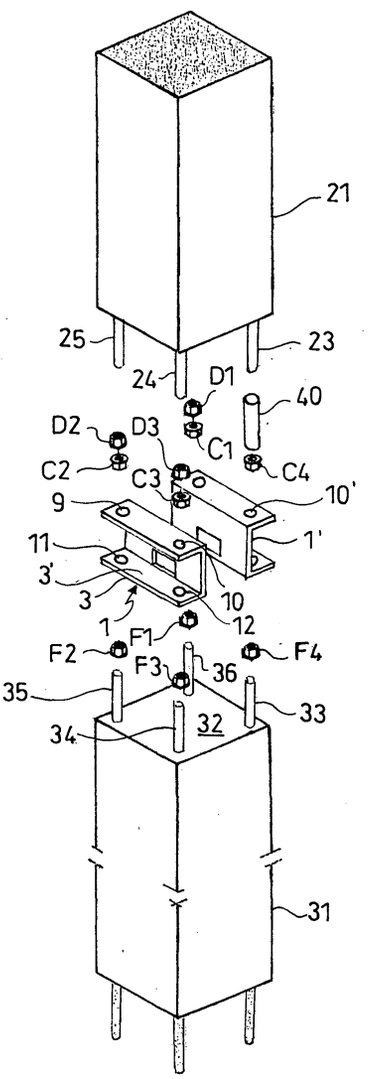

FIG. 4

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Description

[0001] The present invention relates to the technical sector of buildings with prefabricated elements, and in particular relates to a connecting device and a node usable in such buildings.

[0002] Within the construction sector, both in the civil and industrial spheres, the use of prefabricated construction elements, such as beams, pillars, floors, landings, staircases etc. is known and ever more widespread.

[0003] With respect to traditional construction techniques, providing the manufacture of such construction elements directly within the construction yard, the use of prefabricated elements offers undoubted advantages, which are well known to the expert in the field, such as the lowering of construction times, cost savings, less use of specialised manpower and greater precision in the work carried out.

[0004] A delicate step in the construction of buildings using prefabricated elements is the making of connections between the various elements. Particularly, in the prior art, the step of making connections between the elements which define the load bearing structure of a building, i.e. connections between foundations and pillars, between one pillar and another, between pillars and beams is still delicate and costly.

[0005] In greater detail, in the specific case of connections between pillars and other pillars and/or between pillars and beams, the making of load bearing structural nodes, i.e. the points in which, for example in a building with many storeys, two pillars vertically overlap one another, with an upper pillar and a lower pillar respectively, and in which one or more horizontal beams, useful for supporting the floor, is inserted, is particularly delicate.

[0006] A prior art method, in the event that the two overlapping pillars (made of concrete for example) comprise longitudinal reinforcing rods projecting from the corresponding heads to be connected, exemplificatively provides the following operations:

- raising the upper pillar and aligning it vertically with respect to the lower pillar (for example, resting and solidly fixed onto a foundation);
- connecting the two pillars through a two by two welding operation of the corresponding projecting longitudinal reinforcing rods;
- positioning and supporting the beams to be connected to the pillars using temporary supports;
- preparing temporary concrete shuttering around the joint;
- performing a concrete casting, in order to fix and make the structure formed by the connection between the pillars and the beams stable;
- following appropriate lengths of time, removing the shuttering and temporary supporting structures for the beams.

[0007] This method has a number of drawbacks, for example due to the requirement of aligning the longitudinal reinforcing rods, to the welding operation and to the installation/removal of the temporary supports for the beams.

[0008] In order to partially overcome the drawbacks of the aforementioned method, a prior art alternative construction system has been provided, which provides:

- the production of a pillar, for example the lower one, comprising a metallic tube projecting from an area which is arranged substantially in the middle of the surface of the head;
- the production of a pillar, for example the upper one, comprising an open cavity on the head and suitable to at least partially house said projecting metallic tube.

[0009] In such a system, during the step of connecting the two pillars, with the upper pillar coming down onto the lower one such that the metallic tube slides inside the cavity, one can take advantage of the guiding effect provided by the cooperation between the projecting tube and the cavity. However, due to the size tolerances required for the insertion of the metallic tube into the cavity, vertical alignment between the upper and lower pillars is not ensured. Furthermore, temporary structures for supporting the horizontal beams which support the floor are however required.

[0010] Similar considerations and drawbacks apply when connecting a pillar to a foundation.

[0011] The object of the present invention is to provide a connection device which allows to simplify the making of the load bearing structure of a building made from prefabricated elements, whilst obviating the above mentioned prior art drawbacks.

[0012] This object is achieved by a connection device such as described in the attached first claim. Preferred embodiments of the connection device in accordance with the invention are set out in the appended claims 2-18.

[0013] A node for a prefabricated element-structure, such as described in the appended claims 19 and 20, also forms an additional object of the present invention.

[0014] Further characteristics and the advantages of the invention will be better understood from the following detailed description of a preferred embodiment, which is given as an illustrative and non-limiting example, in relation to the enclosed figures, in which:

- figure 1 shows a perspective view of a first embodiment of a connection device according to the present invention;
- figure 2 shows a perspective view of a second embodiment of a connection device according to the present invention;
- figure 3 shows a perspective view of a first and a second pillar to be connected through the device of

figure 1 or of figure 2;

- figure 4 shows the connection plan of the pillars of figure 3 using the device of figure 1;
- figure 5 shows a side view of a first and a second pillar connected using the device of figure 1;
- figure 6 shows a first type of tapering to be made using a connection device of the type represented in figure 1;
- figure 7 shows a second type of tapering to be made by a connection device of the type represented in figure 1;
- figure 8 shows a partial plan view of a first example of a supporting plate for a prefabricated beam, to be used in a connection node comprising a connection device of the type represented in figure 1;
- figure 9 shows a partial plan view of two supporting plates of figure 8 coupled to a lower pillar;
- figure 10 shows a partial plan view of a second example of a supporting plate for a prefabricated beam, to be used in a connection node comprising a connection device of the type represented in figure 1;
- figure 11 shows a partial side view of a connection node comprising two connection devices of figure 1;
- figure 12 shows a partial side view of a prefabricated pillar fixed to a foundation through a connection device in a slightly different embodiment than that represented in figure 1; and
- figure 13 shows a connection node made in accordance with a connection plan alternative to that represented in figure 4.

[0015] Figure 1 shows a perspective view of a particularly preferred embodiment of a connection device 1 in accordance with the present invention.

[0016] The connection device 1, is for example to be used to connect two pillars to one another (not shown in figure 1), and particularly to connect a first pillar, or upper pillar, and a second pillar, or lower pillar, such as to allow the vertical overlapping of such pillars.

[0017] Advantageously, as will be explained in further detail below, the connection device 1 can also be used to connect a pillar to a foundation such as, for example, a plinth, a foundation pit or a ground beam and column foundation.

[0018] More generally, a connection device 1 in accordance with the present invention can be used to connect a pillar to a structural element of a building.

[0019] The connection device 1 in accordance with the present invention may be used in the construction of residential buildings, office blocks, hotels, public and service sector buildings in general.

[0020] The connection device 1 may be used, furthermore, in order to construct multi-storey car parks, school buildings, hospitals, areas used in the pursuit of sporting activities, industrial buildings etc.

[0021] Advantageously, the connection device 1 comprises a first winged section 2, or more simply a first wing 2, and further comprises a second winged section 3, or second wing 3, distinct from said first winged section 2.

[0022] The first winged section 2 is connected to the second winged section 3 through at least one spacer element 4, for example arranged transversally with respect to such winged sections.

[0023] In the particular example of figure 1, the first winged section 2 includes a main body comprising a first substantially flat face turned towards the outside of the connection device. For clarity purposes, such face will be indicated by the expression "upper face" of the connection device.

[0024] Preferably, the main body of the first winged section 2 is substantially shaped in the form of a plate. For this reason, in the following, the first winged section 2 will be referred to as the "upper plate 2", without despite this introducing any limitations.

[0025] The second winged section 3 includes a main body comprising a substantially flat face (or "lower face") turned towards the outside of the connection device 1 and substantially parallel to the above described upper face.

[0026] Preferably, the second winged section 3 comprises a substantially plate-shaped main body which will be hereinafter indicated as lower plate 2 for clarity purposes. Preferably, though without any limitation, the two upper and lower plates 2 and 3 have substantially the same shapes and sizes.

[0027] Preferably, both lower and upper plates 2 and 3 are connected such as to lie on two substantially horizontal planes, parallel to one another. Furthermore, such plates are substantially aligned in plan with respect to one another and project outwards laterally with respect to the spacer element 4.

[0028] Preferably, the spacer element 4 is such as to connect to one another plates 2 and 3 lying on a vertical plane substantially perpendicular to the horizontal planes on which such plates lie.

[0029] In the particularly preferred embodiment of figure 1, the spacer element 4 comprises a wall or vertical plate 5 and further comprises a first edge 7 connected to the upper plate 2 and a second edge 8 connected to the lower plate 3.

[0030] Preferably, the upper plate 2, the lower plate 3 and the spacer element 4 are made as a single piece, for example from a metallic material.

[0031] In one particularly advantageous embodiment, the connection device includes an outflow opening 6, between the upper winged section 2 and the lower winged section 3, preferably located in close proximity to the lower plate 3. In the particular example of figure 2, the outflow opening 6 is a rectangular shaped opening formed within the wall 5 of the spacer element 4 and is arranged substantially in close proximity to the second winged section 3.

[0032] In one particular example, in the case of the construction of a building which does not have any particular requirements from the structural point of view,

such as for example a residential building, the connection device 1 is made of steel and comprises an upper plate 2, a lower plate 3 and a vertical plate 4 having an average thickness ranging between about 7 millimetres and 20 millimetres and more preferably substantially equal to about 10 millimetres.

[0033] In the same example embodiment, the distance between the upper plate 2 and the lower plate 3 is preferably of a value comprised within the interval [10,20] centimetres, and more preferably equal to about 14 centimetres.

[0034] In different types of buildings, the proportioning of the connection device 1 requires structural planning calculations easily derivable for any expert from the prior art, and hence not gone into any further in the present description. Briefly, such calculations take account of the stresses to which the connection device 1 is subjected both during the operational step and during the erection step, considering both compression and traction stresses on the node comprising the same .

[0035] It should be observed that, in the case in which the connection device 1 is used for the connection of pillars in a multi-storey building, the distance between the two upper 2 and lower 3 plates, is no greater than the thickness of the floor (or the thickness of the slab) located between the two plates.

[0036] It is furthermore observed that, in accordance with the particular example of the device of figure 1, the upper plate 2, the lower plate 3 and the spacer element 4 are arranged and connected to one another such as to confer upon the device 1 a conformation characterised by a substantially "clip" or substantially "C" shaped outline.

[0037] Advantageously, the connection device 1, and in particular the upper plate 2, comprises first fixing means, suitable to allow the connection device 1 to be fixed to a first pillar including fixing elements suitable to cooperate with said first fixing means.

[0038] The connection device 1 further comprises second fixing means suitable for the connection device 1 to be fixed to a second pillar or to a foundation element.

[0039] Preferably, the first fixing means are such as to allow the connection device 1 to be screw fixed to the first pillar.

[0040] Preferably, the second fixing means are such as to allow the connection device 1 to be screw fixed to the second pillar or alternatively to a foundation.

[0041] In particular, in this latter case of the connection to a foundation, the second fixing means are such as to be able to be connected to the foundation also through a type of fixing other than by screwing, for example they are connectable by direct welding to an appropriate metallic frame structure embedded within the foundation. This particular embodiment will be described in greater detail below.

[0042] In the embodiment of figure 1, the first fixing means comprise a plurality of fixing through holes. In the particular example, the first fixing means comprise a first pair of fixing holes 9, 10 and the second fixing means comprise an additional pair of fixing holes 11, 12.

[0043] Additional fixing holes, not shown in figure 1, may be provided in the first and/or in the second fixing means in order to allow a connection in accordance with a tapering along the axis or at the edge in the overlapping of an upper pillar and a lower pillar, and more generally, in order to ensure a multiplicity of variations in the overlapping of pillars with different cross sections.

[0044] With reference to the manufacture of the connection device 1 illustrated in figure 1, this is preferably obtained through a drilling operation of a starting plate and a subsequent bending operation along the edges 7 and 8.

[0045] In figure 2 is depicted a perspective view of a second embodiment of a connection device 1 in accordance with the present invention.

[0046] Differently from the embodiment depicted in figure 1, in the connection device 1 of figure 2 the upper plate 2 and the lower plate 3 are coupled to one another through two rod like spacer elements 4 or columns, for example with circular or square cross sections.

[0047] For example, each of such rods 4 is welded at a first end thereof to the upper plate 2 and at a second end thereof to the lower plate 3. Alternatively, in the connection device 1 of figure 2, the two plates 2 and 3 and the rods 4 are manufactured as a single piece by casting.

[0048] In the particular embodiment of figure 2, the connection device 1 has a substantially "frame-like" structure and the outflow opening is delimited between the two plates 2 and 3 and the rods 4.

[0049] Figure 3 shows a perspective view of two pillars and in particular of an upper pillar 21 and a lower pillar 31, which are shown as aligned vertically with one another and separated, connectable by overlapping with one another through a connection device of the type depicted in figure 1 or in figure 2.

[0050] The upper pillar 21, comprises a lower head 22 including fixing elements. The lower head 22 is the head of the pillar 21 intended to be connected to the lower pillar 31, and for this reason, it will hereinafter also be indicated as the upper pillar "connection head 22".

[0051] As shown in figure 3, in one particularly advantageous embodiment, the fixing elements of the connection head 22 are elements projecting from the head 22 of the pillar 21 and include four substantially circular cross sectioned projecting, and at least partially threaded, bars (for example, with threaded heads) three of which can be seen in the view of figure 3, respectively: the bars 23, 24 and 25 projecting from the head 22 of the upper pillar 21.

[0052] Preferably, such upper plate 21 fixing elements are metallic elements connected to the longitudinal reinforcing bars of such a pillar. More preferably, the four projecting bars are an extension, outside the upper pillar 21, of the corresponding longitudinal reinforcing bars embedded within the concrete of the pillar.

[0053] Similarly, the lower pillar 31, comprises an upper head 32, including fixing elements, which in this example is the connection head of such a pillar.

[0054] As shown in figure 3, in a particularly advantageous embodiment, the fixing elements include four projecting bars 33, 34, 35 and 36 at least partially threaded, e.g. threaded at the head, and projecting from the connection head 32 of the lower pillar 31. Preferably, the fixing elements are metallic elements connected to the longitudinal reinforcing bars of the lower pillar 31. More preferably, the four projecting bars 33, 34, 35 and 36 are an outwards extension of the corresponding longitudinal reinforcing bars of the lower pillar 31, embedded within the concrete of the pillar.

[0055] It should be observed, that the lower pillar 31 further comprises a lower head 32' including additional fixing elements 33', 34' 35' in order to allow the connection of the lower pillar 31 to an additional lower pillar or to a foundation.

[0056] Figure 4, in a perspective view, shows the connection plan of the lower pillar 31 to the upper pillar 21 using two connection devices 1 and 1' respectively, in a "C" configuration, of the type depicted in figure 1.

[0057] The connection device 1 can be fixed to the lower pillar 31 by fitting the device itself, through the connection holes 11 and 12 provided in the lower plate 3, over the corresponding projecting bars of the connection head 32 of the lower pillar 31 (or supporting pillar 31).

[0058] The use of a pair of nuts, F2 and F3 respectively, suitable to be screwed onto the corresponding threading on the outer surface of the projecting bars 34 and 35, allows the connection device 1 to be fixed to the head of the support pillar 31, by screwing.

[0059] It should be observed that, differently from that depicted in figure 4, the pair of nuts F2 and F3 are intended to be screwed inside the "C" shaped profile of the device 1 such as to tighten themselves against an inner face 3' of the lower plate 3. The different depiction used in figure 4 has been dictated by the need for greater comprehensibility of the description.

[0060] Similarly, the second connection device 1' can be fixed to the head of the lower pillar 31.

[0061] In figure 4 it may be observed that, once the two connection devices 1 and 1' are fixed to the lower pillar 31, the vertical plumb alignment and the fixing of the upper pillar 21 with respect to the lower pillar 31 can be obtained by an adjustment and fixing system comprising:

- three counter nuts D1 ,D2 and D3 suitable to be screwed onto the corresponding threadings on the projecting bars of the connection head 22 of the upper pillar 21;
- a metallic sleeve 40, suitable to be inserted over a bar 23 projecting from the upper pillar 21, the length of which is set such as to adapt the distance between the upper plate 21 and the lower plate 31 to the thickness of the floor located between such pillars;
- four locking nuts C1, C2, C3 and C4 suitable to be screwed onto the corresponding bars projecting from the upper pillar 21, which by locking against a surface located within the "C" shaped connection devices, allow the tight binding of the upper pillar 21 to the lower pillar 31. It is also noted that in this case, for clarity purposes, the positioning of the locking nuts C1, C2, C3 and C4 shown in figure 4 is different from their positioning, with respect to the connection devices 1 and 1', in the actual erection plan.

[0062] It should be observed that, once the two connection devices 1 and 1' have been fixed to the lower pillar 31 and once the upper pillar 21 has been connected, through such devices 1 and 1', to the lower pillar 31 (by inserting the bush 40 over the rod 23 and screwing the locking nut C4 to the rod 23 such as to lock it against the inner wall of the device 1'), the vertical plumb aligning of the upper pillar 21 with respect to the lower pillar 31 may be easily performed by adjusting the inclination of the upper pillar 21 by using the three counter nuts D1, D2 and D3.

[0063] Figure 5 shows a side section view of a building node N comprising the two pillars of figures 3 and 4 connected to one another through the two connection devices 1 and 1' and in accordance with the connection plan depicted in figure 4. To this node, at least one beam is generally connected between the two pillars, which beam is not depicted in figure 5 since connection with beams will be discussed in greater detail below.

[0064] In figure 5, the side section view shows that the projecting bars 23, 24, 33 and 34 are extensions of the corresponding longitudinal reinforcing rods indicated by 23', 24', 33' and 34'.

[0065] It should be observed that the pillars further include transverse reinforcing rods, visible in figure 5 only in the upper pillar 21 and indicated by the reference 50.

[0066] The node N comprises a supplementary casting GI of concrete which completes the connection between the two pillars.

[0067] Again, it should be observed that the connection devices 1 and 1' allow the creation of a vertical continuity between the corresponding longitudinal reinforcing rods of the upper pillar 21 and the lower pillar 31. Furthermore, it should be observed that the presence of outflow openings 6 (not shown in figure 5 but visible, for example, in figure 1) of the connection devices 1 and 1' allow, once the supplementary casting GI of concrete is made, conferring greater structural homogeneity to the connection node N.

[0068] It should be further observed that once the height h1 of the connection devices 1 and 1' is set, by appropriately selecting the length h2 of the sleeve 40 it is possible to obtain the connection of the two pillars in accordance with the slab thickness hs established in the

building design step.

[0069] In one particularly preferred embodiment, in the connection node N, the two connection devices 1 and 1' are appropriately proportioned and positioned such to define a gap I there between, which can advantageously be used for housing rods therein (for example, iron reinforcing rods, not shown in the figure) for the negative moment reinforcing, useful for ensuring the continuity of beam reinforcing.

[0070] As already previously stated generally, a connection device 1 in accordance with the present invention may include fixing means on the first winged section 2 and on the second winged section 3 suitable to allow a tapering in the axis and/or at the edge of two pillars to be connected.

[0071] As is indeed well known to any expert in the art, in buildings comprising a plurality of floors, the load that each pillar must bear reduces progressively with the increasing height of the building: the cross sectional area of the load bearing pillars may hence be reduced from a lower pillar to an upper pillar, whilst remaining adequate for the load to be borne.

[0072] This technique is called "tapering" and may generally be carried out in two ways.

[0073] The first method is known by the name of axis tapering and is depicted schematically in figure 6. In this method, a lower pillar 31 and an upper pillar 21 (depicted in plan in the figure) are connected to one another such as to ensure substantial alignment between the axes of symmetry A1, A2 of the cross sections of the two pillars.

[0074] Figure 6 further shows, in a front view, a connection device 1 of the same type as that shown in figure 1 but modified with respect to the latter such as to allow the connection between the two pillars in accordance with axis tapering.

[0075] In particular, the lower pillar 31 has a greater cross sectional area with respect to the upper pillar 21 and has fixing elements in the form of six projecting bars 33-38.

[0076] On the other hand, the upper pillar 21 has four projecting bars 23-26.

[0077] The connection device 1 (it should be noted that, in order to connect two pillars, two of these devices are required), is shown in its side view in figure 6 and comprises a lower winged section 3 including fixing means in the form of three through holes 60, suitable to fit over the corresponding projecting bars 34, 35, 37 of the lower pillar 31.

[0078] The connection device 1 further includes a second winged section 2, including fixing means in the form of two through holes 61, 61' suitable to cooperate with the corresponding projecting bars 24, 25 of the upper pillar 21 in order to allow the axial alignment of the upper pillar with respect to the lower pillar.

[0079] For example, in this case, the lower pillar 31 has a width W1 equal to 450 mm and a depth D1 equal to 250 mm whilst the upper pillar has a width W2 equal to 350 mm and a depth D2 equal to 250 mm.

[0080] It should be observed that in this particular example, the connection device 1 includes two outflow openings 6, substantially oval in shape.

[0081] As depicted in figure 6, advantageously, the connection device 1 further includes additional fixing means, in this example in the form of additional fixing holes 62, 62' on the second winged section 2, suitable to allow a connection between the two pillars in accordance with the tapering method, known by the name of edge tapering.

[0082] In greater detail, as shown in figure 7, the fixing holes 62, 62' allow tapering in alignment with the edge 70 of the lower pillar.

[0083] It should be observed that further holes 63, 63' may be provided in the connection device which are suitable to allow (together with through hole 62) the connection between an upper pillar and a lower pillar having substantially equal cross sectional areas.

[0084] Advantageously, since the dimensions of the pre-fabricated plates are substantially standardised, by means of the same connection device 1 it is possible to perform different types of tapering, or connect a lower pillar to an upper pillar having a cross sectional area selected from a (finite) plurality of different cross sectional areas.

[0085] Another advantageous aspect associated with the use of a connection device 1 in accordance with the present invention, in the creation of a building connection node, will be explained below.

[0086] In particular, in the case where the connection node forms a connection between two vertically overlapping pillars and a horizontal beam projecting laterally, a connection device in accordance with the present invention, allows either considerably reducing or completely eliminating, the temporary structures useful for shoring up the beam (in the event that prefabricated beams provided at opposite ends with appropriate support plates for resting on the lower pillar are used).

[0087] Preferably, such supporting plates are metallic plates suitable to interpose themselves and being held between the connection device 1 and the lower pillar 31, and in particular, held between the winged section 3 of the connection device 1 closest to the connection head of the lower pillar 31 and between the same head surface of the lower pillar 31 (the latter acting as a supporting surface).

[0088] Figure 8 shows a partial plan view of a first embodiment of a support plate 80 of the type described above. Preferably, the plate 80 is made from a metallic material, for example steel, and is shaped such as to allow it being placed on the connection head of the lower pillar 31 such that it does not interfere with the projecting bars of this head. In the particular example, the support plate 80 shown is provided with through holes 81 and 82 which are suitable to be fitted over a corresponding projecting bar such to allow it to pass through the plate 80.

[0089] Figure 9 shows a partial plan view of two sup-

port plates 80 and 90, each included at the end of a corresponding prefabricated beam, not shown in the figure. In the figure a lower pillar 31 can also be seen, from above, on the connection head 32 of which the two support plates 80 and 90 are resting.

[0090] The support plate 80 abuts on the connection head 32 thanks to through holes 81 and 82 on the plate 80 suitable to allow the passage of corresponding projecting bars 34 and 35. This similarly occurs for support plate 90, comprising through holes indicated by 91 and 92.

[0091] Figure 10 shows a partial plan view of a second embodiment of a support plate 100 for prefabricated beams. In this example, the support plate 100 comprises two side recesses 101 and 102 suitable to allow the passage of the corresponding connection head projecting bars of the pillar 31 on which such plate is intended to rest.

[0092] Figure 11 schematically shows a partial side view of a building connection node N including a lower pillar 31, an upper pillar 21, two connection devices 1 and 1' having an substantially "C" shaped profile, a first horizontal beam 105 and, in this particular example, also a second horizontal beam 105'. Furthermore, the node N further includes a supplementary casting of concrete GI.

[0093] It should be observed that the beams 105 and 105' are provided with corresponding support plates 100 and 100' at their heads, for example as depicted and described with reference to figure 10. It should be noted that, advantageously, the beam support plates are each gripped between a corresponding connection device 1 and 1', and the head surface 32 of the lower pillar 31. In particular, each support plate is gripped between a corresponding winged section 3 and 3' of a corresponding connection device 1 and 1' and the head surface 32 of the lower pillar 31.

[0094] Still with reference to figure 11, the procedure for the formation of the node N depicted therein will be briefly and diagrammatically described below.

[0095] During the formation of the node N, once the pillar 31 is set down and made plumb, for example on a foundation, the placing operation of the horizontal beams 105 and 105' is carried out, such that these have the corresponding support plates 100 and 100' in abutment upon the head surface 32 of the lower pillar 31. Obviously, even if not visible in the figure, the second ends of the beams 105 and 105', not depicted, may be placed on corresponding lower pillars by the same system.

[0096] Once beams 105 and 105' are set down, the two connection devices 1 and 1' are connected to the lower pillar 31, by acting on the fixing means to the lower pillar. This operation allows the fixing of the beams to the lower pillar, and thus it is then possible to carry out the setting operation of the floor onto the beams in the absence of any temporary shoring up structures and without the risk of overturning the beams during the setting of the slabs which make up the chassis, even if during such setting, the beams are subjected to considerably unbalanced loads.

[0097] Subsequently, the upper pillar 21, is lowered from above onto the connection devices 1 and 1', is plumbed and is fixed to the connection devices in accordance with the erection plan depicted in figure 4.

[0098] A supplementary casting GI of concrete completes the formation of the node N.

[0099] Figure 12 shows a particular embodiment of a connection device 121 in accordance with the present invention, suitable to allow the connection of a pillar 122 to a foundation, which, in the specific example, is represented by a ground beam 130.

[0100] The connection device 121 in this case is entirely similar to the connection device 1 shown in figure 1, but differs from this substantially due to the fact that the lower winged section 128 is not directly fixed by screwing to the lower structural element, but is connected to a base element 124, which preferably includes a metal grid 124 provided with a fixing plate 131, preferably perforated.

[0101] In more detail, in the embodiment of figure 12 the lower winged section 128 of the connection device 121 is directly fixed by welding to the metal grid 124. The assembly composed of the two connection devices 121 and the metal grid 124 is preferably factory manufactured such as to avoid any welding operations in the construction yard.

[0102] To connect the pillar 122 to the ground beam 130 such as shown in figure 12, a method is used exemplificatively comprising the steps of:

- carrying out a casting 123 of lean concrete,
- fixing the assembly comprising the two connection devices 121 and the grid 124 to the casting 123, such as by nailing the fixing plate 131 of the metal grid 124 to the free surface of the casting 133,
- installing foundation shuttering 134, such as of a prefabricated type, around the metal grid 124,
- performing a first casting of concrete 125, in order to only partially fill the foundation shuttering 134, for example, such that the level 132 of concrete 125 is such as to basically cover the metallic grid 124 and such as to not cover, or only partly cover, the connection devices 121,
- setting the pillar 122 on the connection devices 121,
- plumbing and fixing the pillar 122 in a similar (or easily deducible by any expert in the art) way to that already described above for the connection between two pillars (it should be observed that, even in this case, advantageously, a sleeve 126 is used in order to set the fixing height of the pillar 122),
- performing a second casting of concrete such as to finish filling the foundation shuttering 134, bringing the level of concrete up to the extrados level 135 of the foundation 130,
- removing the foundation shuttering 134.

[0103] Furthermore, it should be observed that in this example (and also in the example of figure 11), the "C" shaped connection devices have a profile which, differently from the connection device of figure 1, is curved internally and not squared off. In this case, for the fixing of the locking nuts 136 a small square plate 127 for structural steel may be advantageously used.

[0104] In figure 13, two pillars 21 and 31 are shown as being connected to one another through a connection device 1 in accordance with an alternative connection plan with respect to the connection plan described above with reference to figure 4.

[0105] Indeed, in this case, the upper pillar 21 has fixing elements in the form of projecting bars connected to the longitudinal reinforcing rods of the pillar 21, whilst the lower pillar 31 has fixing elements comprising internally threaded bushes 141 having corresponding openings facing onto the connection head 32 of the lower pillar 31. For this reason, the connection device 1 is fixed using pins 140 suitable to be gripped within the corresponding bushes 141. The fixing of the upper pillar is substantially unchanged with respect to the examples described above.

[0106] As may be seen in the figure, the bushes 141 are preferably joined to the longitudinal reinforcing rods of the lower pillar 31.

[0107] It is understood from the above description that a connection device 1 in accordance with the present invention allows considerable simplification of the construction of load bearing building structures, and in particular the formation of connection nodes between the load bearing structural elements. This results in a significant reduction in the costs and times required for the setting up of the structure.

[0108] Obviously, to the connection device according to the present invention, those skilled in the art, with the aim of satisfying contingent and specific requirements, may carry out additional modifications and variations, which are all contained within the scope of protection of the invention, such as defined by the following claims.

Claims

1. A connection device (1;1';121) for connecting a first pillar (21) to a structural element (31;130) of a building, the first pillar (21) including first fixing elements (23-25), **characterised in that**:

   the connection device (1) includes a first winged section (2), a distinctly separate second winged section (3) and further includes at least one spacer element (4) connected between the first and the second winged sections, the first winged section (2) including first fixing means (9,10) which are suitable to cooperate with the first fixing elements (23-25) of the first pillar (21) and the second winged section (3) being fixable to said structural element (31,130).

2. The connection device (1) according to claim 1, wherein at least one of said winged sections (2;3) includes a substantially plate-shaped main body.

3. The connection device (1) according to claim 1, wherein the first winged section (2) and the second winged section (3) lie on respective planes substantially parallel with one another and wherein the spacer element (4) lies substantially on a plane perpendicular to such parallel planes.

4. The connection device (1) according to claim 1, wherein the first winged section (2), the second winged section (3) and the spacer device (4) are arranged and connected to one another such to confer onto the connection device (1) an substantially "C" shaped profile.

5. The connection device (1) according to claim 1, wherein the first winged section (2), the second winged section (3) and the spacer device (4) are arranged and connected to one another such to confer onto the connection device (1) a substantially frame-shaped profile.

6. The connection device (1) according to claim 1, further including an outflow opening (6), between the first winged section (2) and the second winged section (3).

7. The connection device (1) according to claim 1, wherein the first fixing means include a first plurality of fixing through holes (9,10).

8. The connection device (1) according to claim 7, wherein the first pillar (21) includes longitudinal reinforcing rods and wherein the fixing elements (23-25) include a plurality of bars at least partially threaded and projecting from one head (22) of the first pillar (21), each of said bars being joined to a corresponding longitudinal reinforcing rod and being such as to be able to be inserted into a corresponding hole of said plurality of through holes in order to fix, by screwing at least one corresponding nut to said bar, the first pillar (21) to the connection device (1).

9. The connection device (1) according to claim 1, wherein said structural element (31,130) includes a second pillar (31).

10. The connection device (1) according to claim 9, wherein the second pillar (31) includes second fixing elements (33-36;141) and wherein the second winged section (3) includes second fixing means (11,12;60) suitable to cooperate with the second fix-

ing elements in order to fix the connection device (1) to the second pillar (31).

11. The connection device (1) according to claim 10, wherein the second fixing means (11,12;60) include a second plurality of fixing holes.

12. The connection device (1) according to claim 11, wherein the second pillar (31) includes longitudinal reinforcing rods (33', 34') and wherein the second fixing elements (33-36) include a second plurality of bars at least partially threaded and projecting from one head (32) of the second pillar (31), each of them being joined to a corresponding longitudinal reinforcing rod and being such as to be able to be inserted into a corresponding hole of said second plurality of through holes in order to fix, by screwing at least one corresponding nut to said bar, the second pillar (31) to the connection device (1) .

13. The connection device (1) according to claim 11, wherein the second pillar (31) includes longitudinal reinforcing bars and wherein the second fixing elements include a plurality of internally threaded bushes (141) and comprising corresponding openings facing onto one head (32) of the second pillar (31), each of them being joined to a corresponding longitudinal reinforcing bar and being such as to be able to house a corresponding pin (140) passing into a corresponding through hole of the second plurality of through holes in order to fix, the second pillar (31) to the connection device (1) by screwing said pin (140) into said bush (141).

14. The connection device (1) according to claim 9, wherein said device (1) is such as to connect the first (21) and the second (31) pillars such as to vertically overlap the first pillar (21) to the second pillar (31) and wherein said device (1) further allows fixing between the second winged section (3) and the second pillar (31) a supporting plate (100) of a horizontal beam (105) to be connected to said pillars.

15. The connection device (1) according to claims 10 and 14, wherein said supporting plate (100) is substantially such as to not interfere with said second fixing elements of the second pillar (31) when such supporting plate (100) is fixed between the connection device (1) and the second pillar (31).

16. The connection device (121) according to claim 1, wherein said structural element (31,130) includes a foundation (130) of said building structure.

17. The connection device (121) according to claim 16, wherein said foundation (130) includes one of the following elements: a plinth, a foundation pit, a ground beam and column foundation.

18. The connection device (121) according to claim 16, wherein the second winged section (128) is fixable through welding to a base element including a metal grid (124) embeddable within said foundation (130).

19. A connection node (N) for buildings comprising first (21) and second (31) pillars vertically overlapping one another, at least one horizontal beam (105,105') connected between the first and the second pillars, a supplementary casting of concrete (GI), **characterised in that**:

the first and the second pillars are connected to one another by means of at least one connection device (1,1') according to any of the claims 1 to 15.

20. A connection node (N) according to claim 19, wherein at least one connection device (1) is embedded within the supplementary casting of concrete (GI).

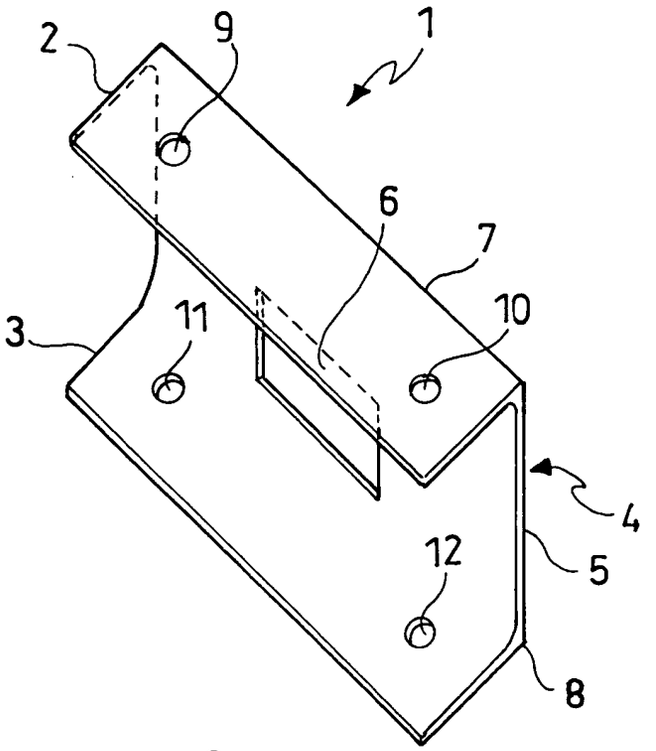


FIG. 1

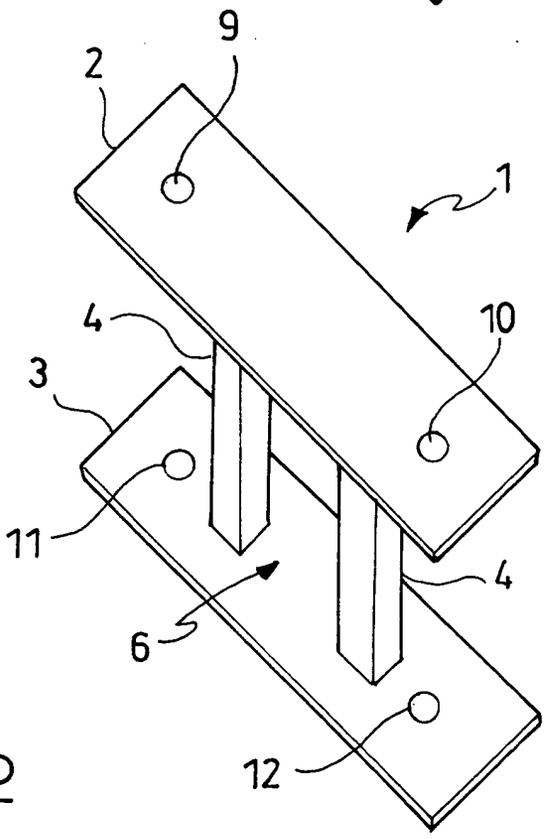


FIG. 2

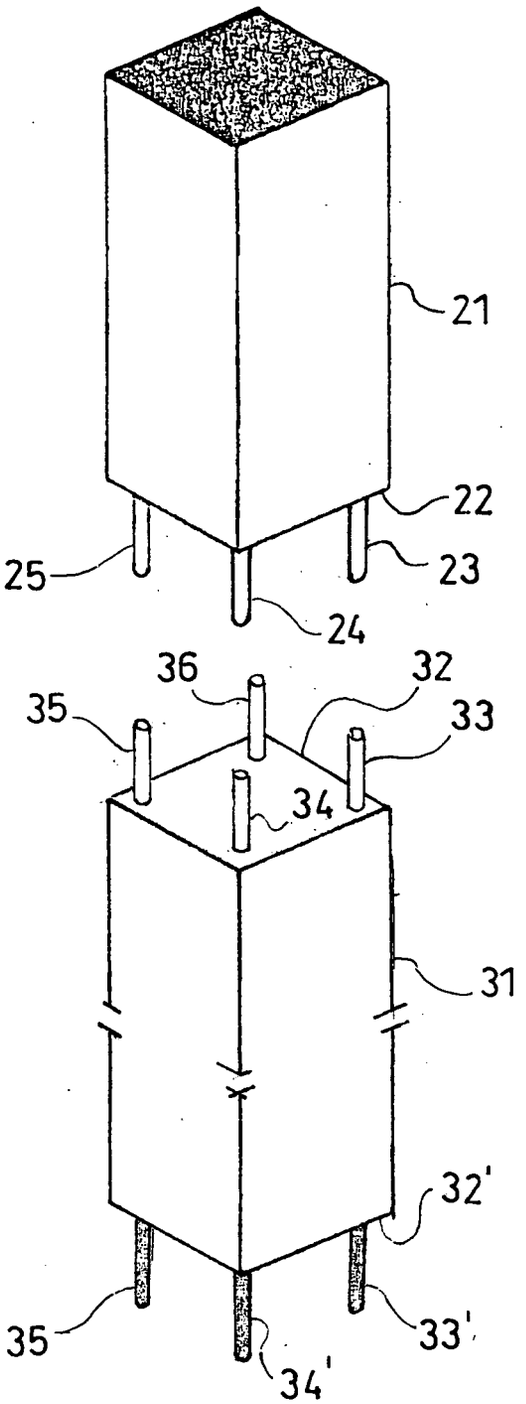


FIG. 3

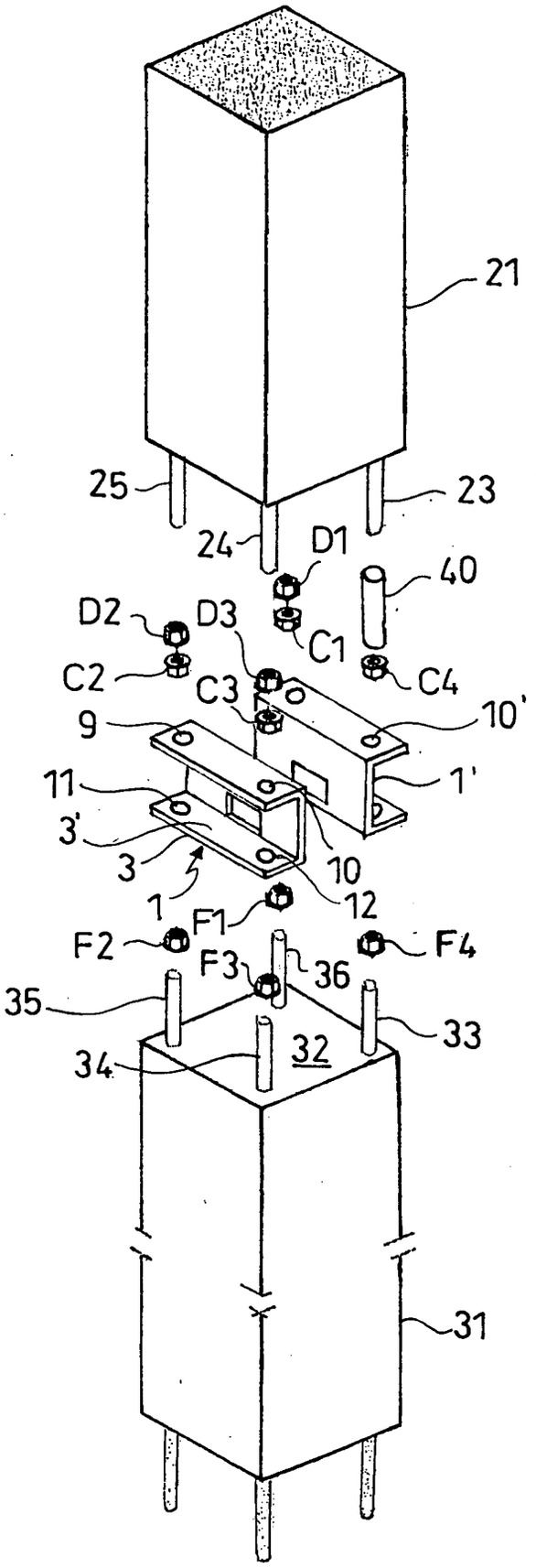

21
25
23
24
D1
40
D2
D3
C1
C2
C3
C4
9
10'
11
1'
3'
3
10
1
12
F1
F2
F3
F4
36
35
33
34
32
31

FIG. 4

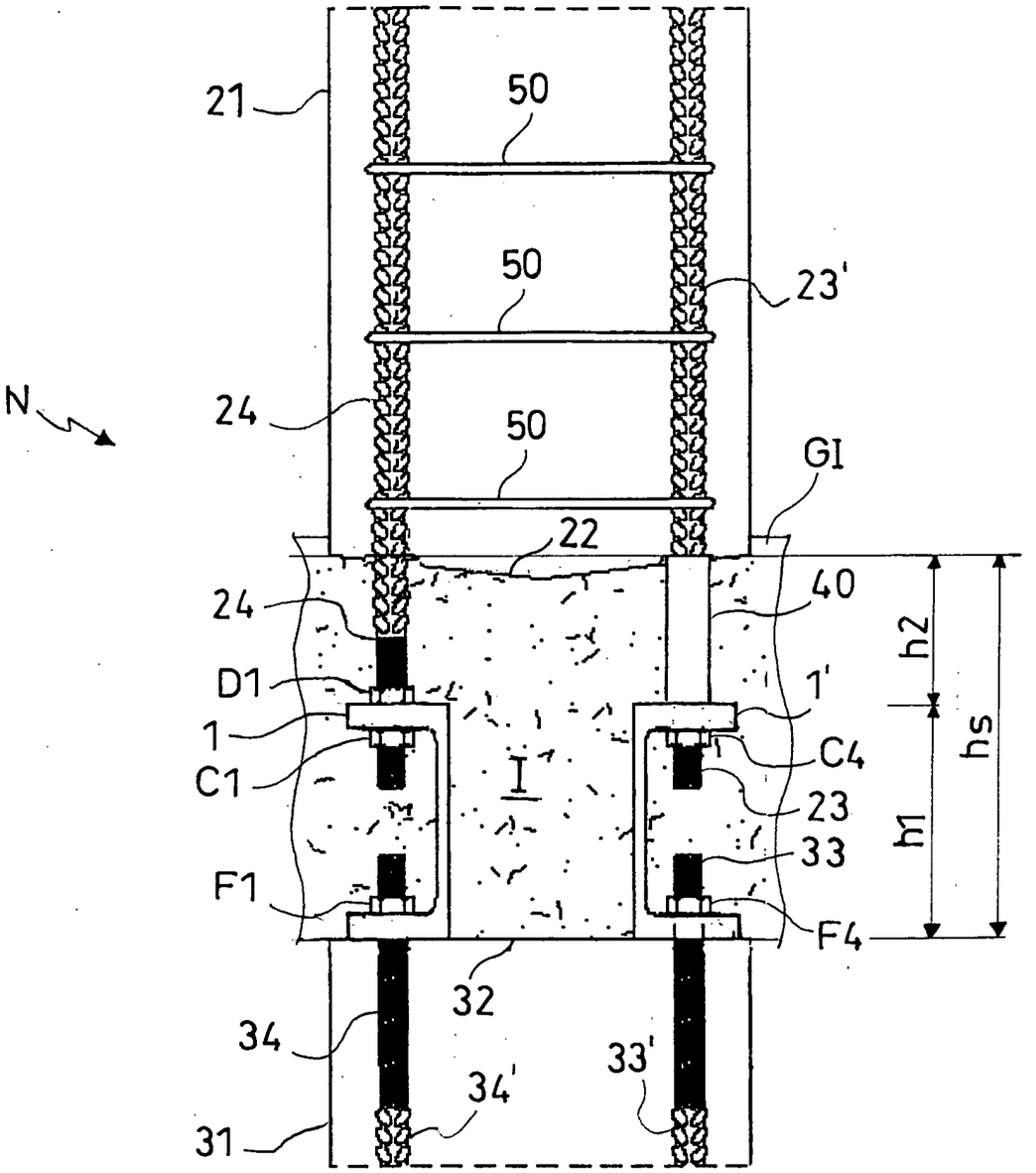
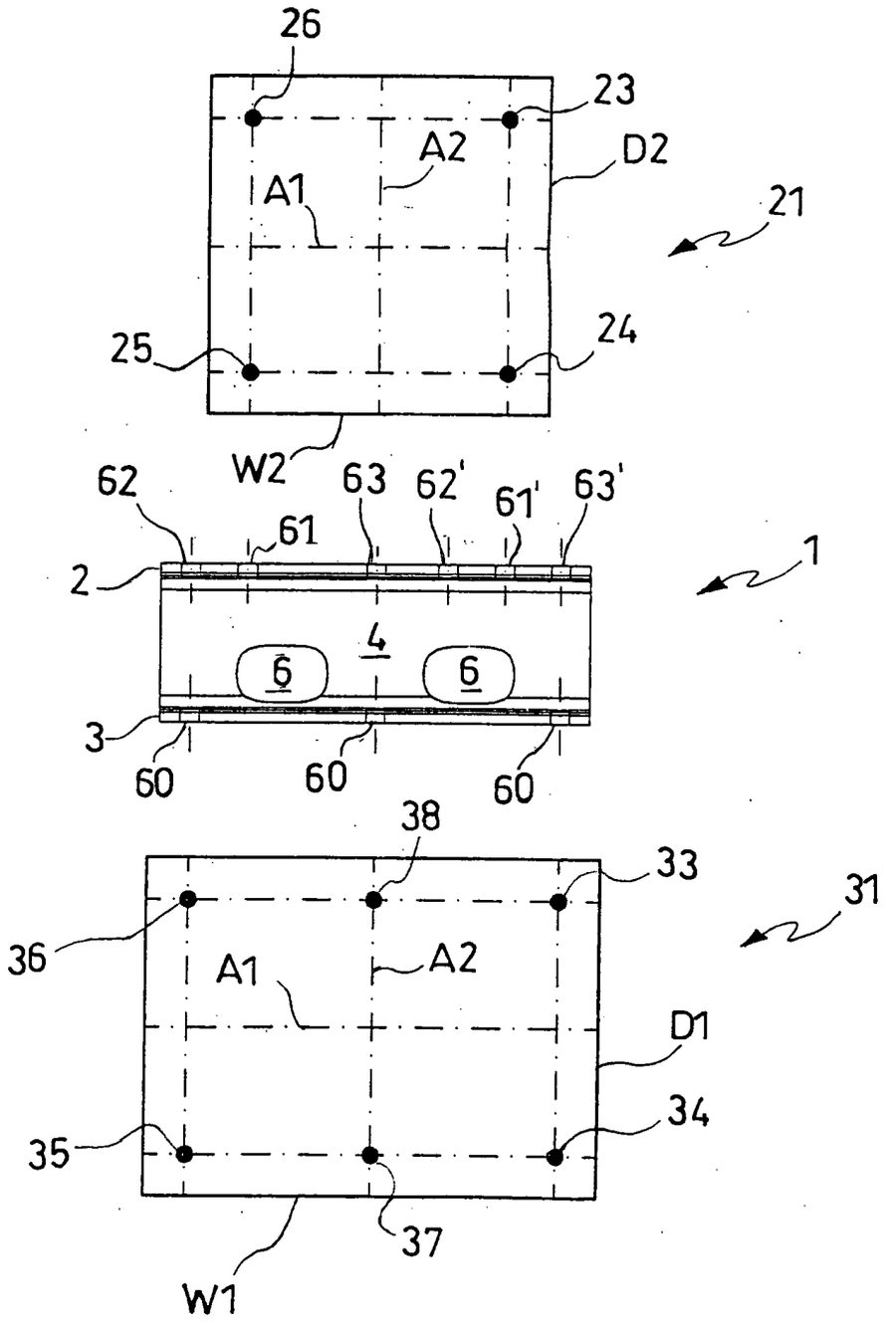

21
50
50
23'
N
24
50
GI
22
24
40
h2
D1
1'
1
C4
C1
I
23
hs
h1
33
F1
F4
32
34
33'
34'
31

FIG.5


26
23
A2
D2
A1
21
25
24
W2
62
63
62'
61'
63'
61
2
1
4
6
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33
31
36
A1
A2
D1
35
34
37
W1

FIG. 6

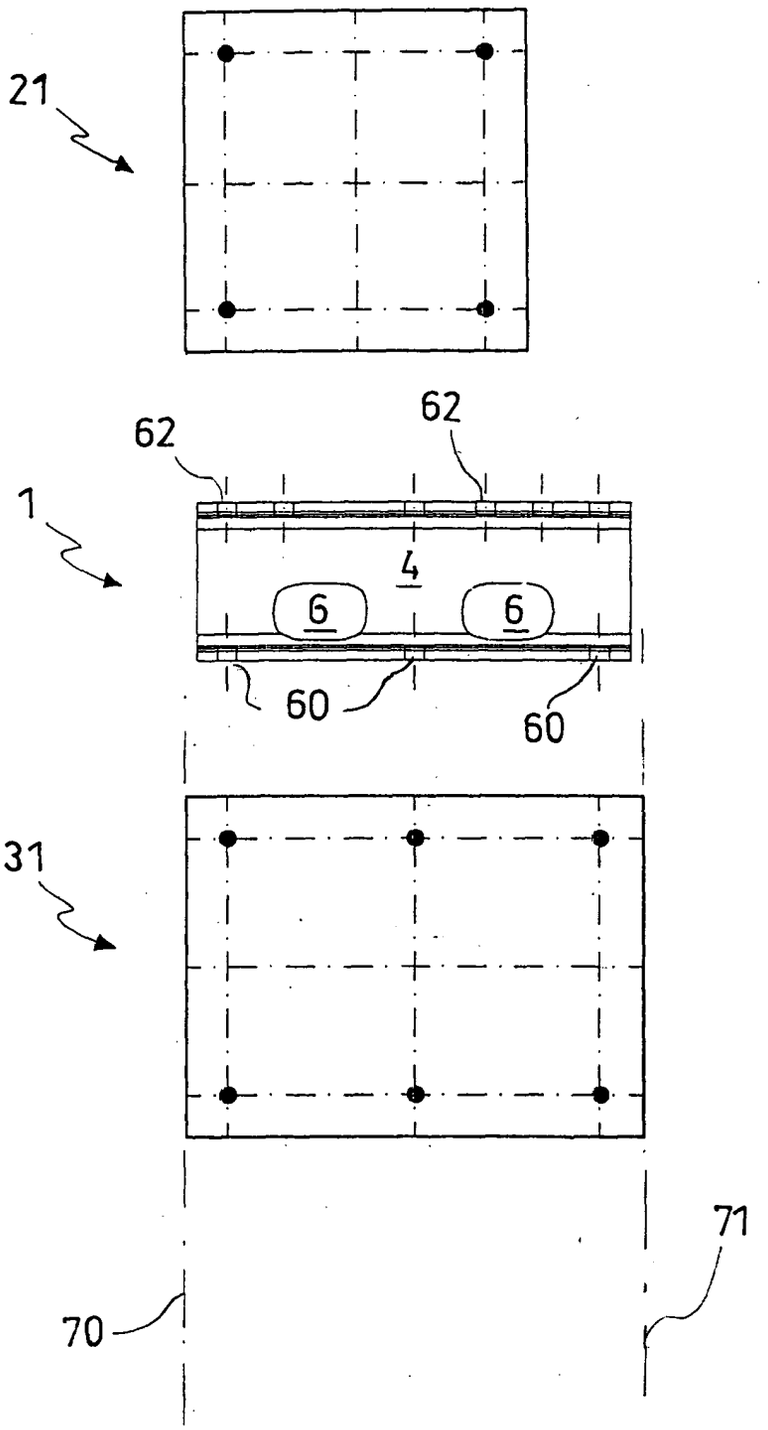

FIG. 7

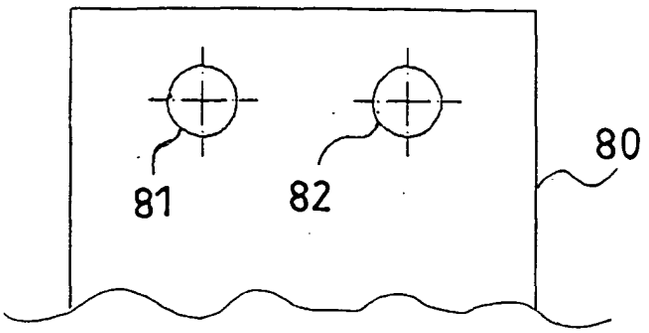

FIG. 8

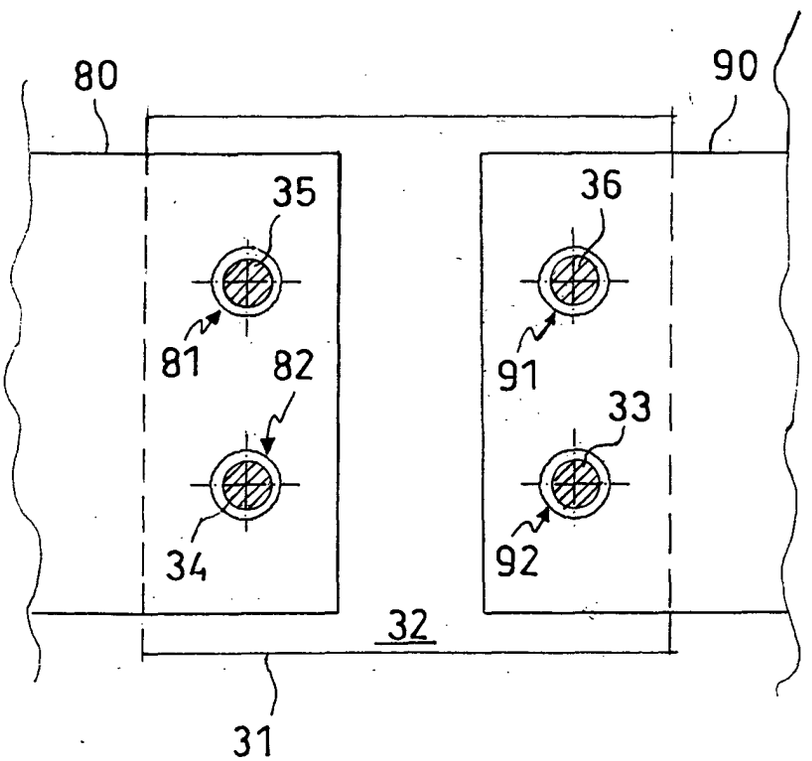

FIG. 9

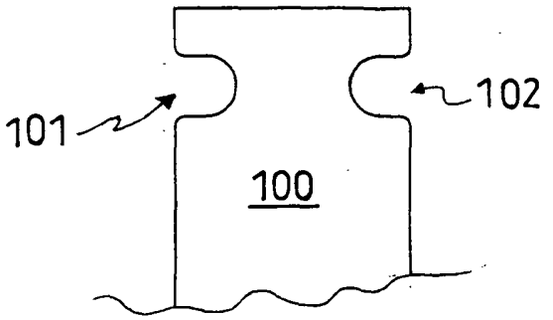

FIG.10

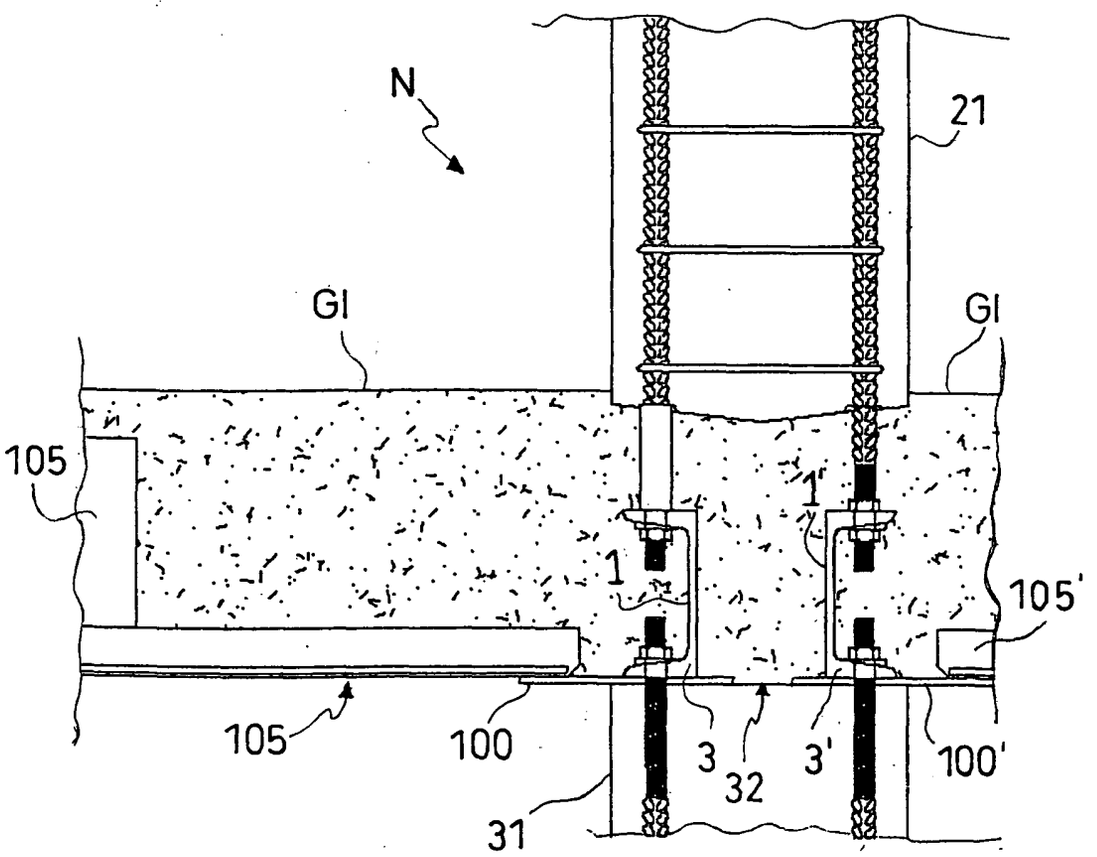

FIG.11

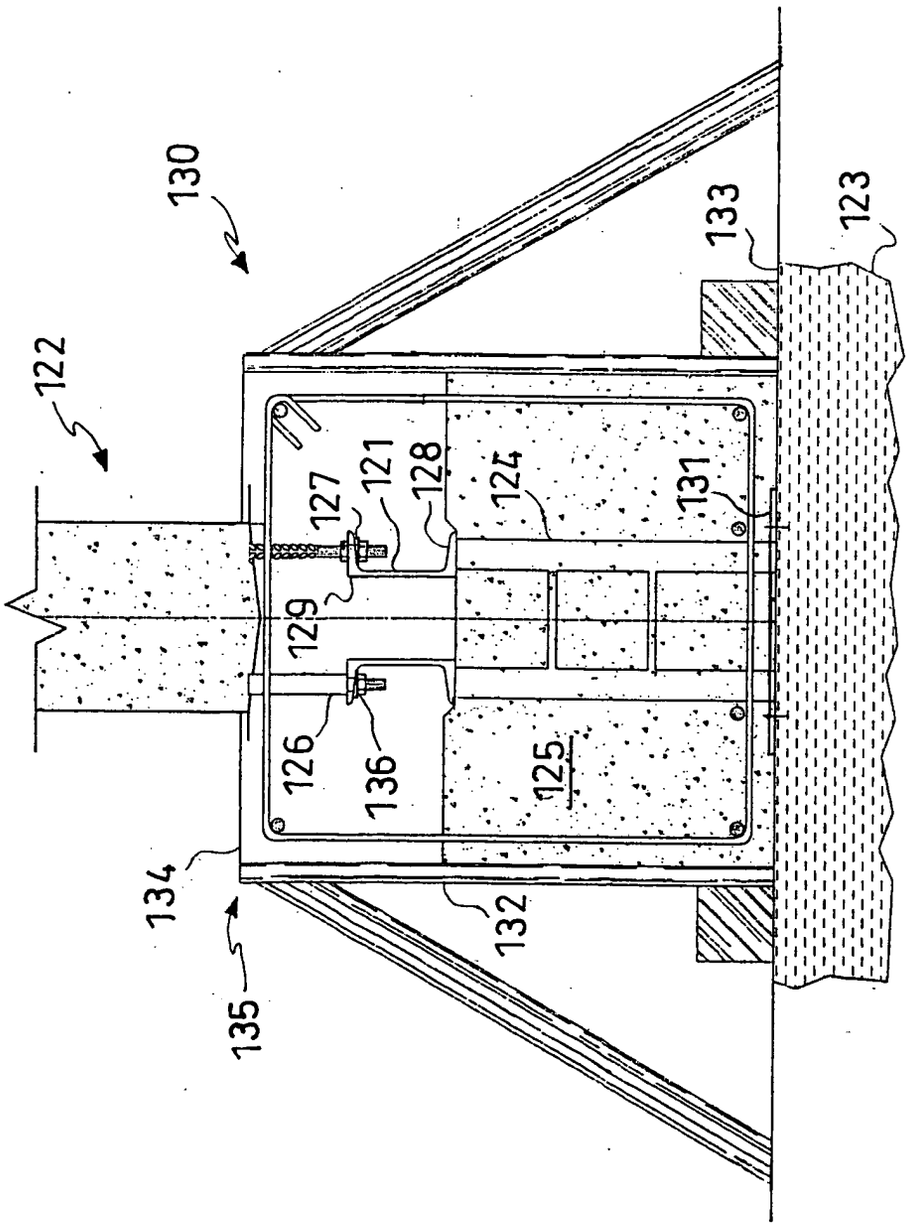

FIG. 12

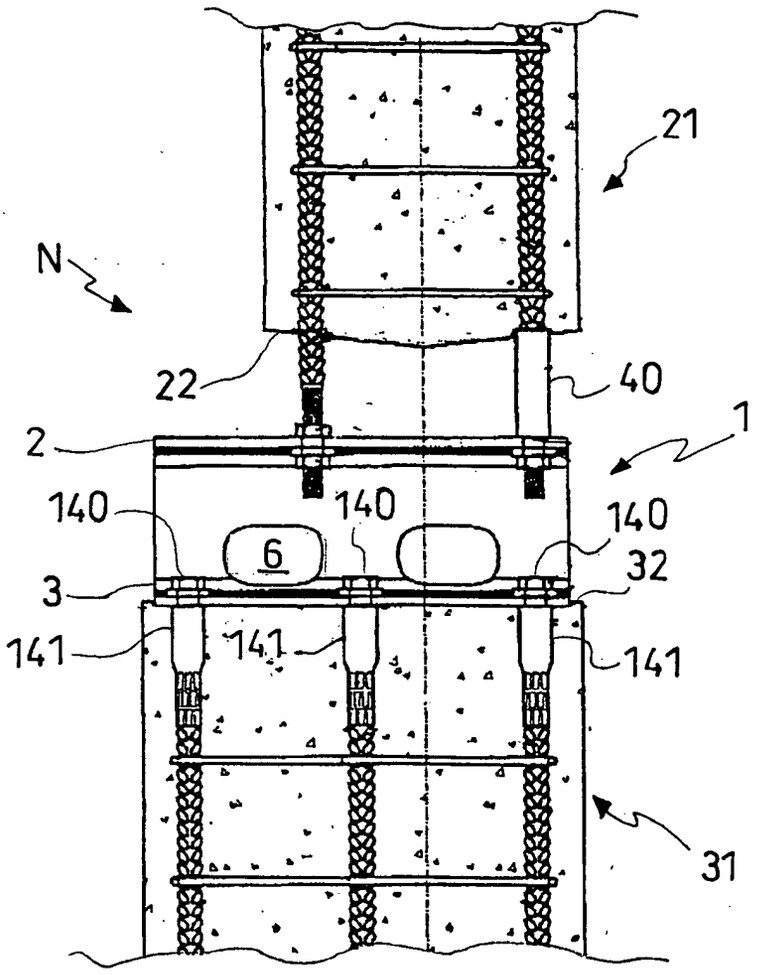

FIG. 13

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 04 42 5062

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X	US 3 261 135 A (KNABE MARTIN C) 19 July 1966 (1966-07-19) * figures 5,11,12 * ---	4	
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The present search report has been drawn up for all claims

1

Place of search	Date of completion of the search	Examiner
MUNICH	8 July 2004	Nilsson, L

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