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(54) **Anti-seismic structure for roofs**

Erdbebensichere Dachstruktur

Structure anti-sismique pour toits

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Description

[0001] The present invention relates to buildings, both for civil and for industrial use, and in particular relates to a roof structure for buildings having notable anti-seismic properties.

[0002] The construction of a pitched roof, in traditional building practice, comprises the positioning of a central beam along the ridge of the roof structure which is to be formed, said beam being supported by one or more pillars which may also form part of the load-bearing structure of the building and which in turn rest directly on the last floor slab of the latter.

[0003] In the document EP-A-0357273 is described a connector for securing a rafter to a wall plate thereof comprises a first component of U-shaped form for mounting on the rafter, a pair of identical second components of L-shaped form mounting on the wall plate, and rivets for interconnecting the components in an articulated manner. Moreover in D1 is described a roof structure comprising roof structure members, such as hip beams and ridge beams, secured together by a plurality of connectors, according to either, or both, forms of connectors.

[0004] This connectors and structure described in EP-A-0357273 results in a substantial saving in time and effort in building a roof structure.

[0005] Similar roof structures, comprising ridge beams and hip beams connected together and to a load bearing structure of a building, such as a floor slab or a wall plate, are described in the documents US-A-1787167 and FR-A-2194858.

[0006] These types of known roof structures are open and static and present an arrangement of the loads which may create numerous problems as regards the stability and solidity of the building, the load of the roof is in fact distributed in a non-uniform manner on the load-bearing structure of the building and any deformations or damage affecting the floor slab on which the roof pillars rest may result in the collapse of said building towards the inside thereof.

[0007] In the document WO 94/115039, which is considered to be the closest prior art, is described a roof structure formed with first and second Y-shaped modular construction members. The first construction is comprised of first, second and third branches of substantially equal length. The second construction members are comprised of fourth, fifth, and sixth branches of substantially equal length. The first and fourth branches are coupled together along a common axis to define an apex or ridge of the roof structure. The second, third, fifth and sixth branches are coupled between the apex and respective first, second, third and fourth corners of a rectangular base frame.

[0008] This type of roof structure described in WO 94/115039 is closed, but equally is a static structure and presents an arrangement of the loads which may create various problems as regards the stability and solidity of the building, the load of the roof is in fact distributed in a

non-uniform manner on the load-bearing structure of the building and any deformations or damage affecting the floor slab on which the roof pillars rest may result in the collapse of said building towards the inside thereof. Moreover, the loads and the oscillations of the roof structure often have components which act in directions different from that associated with simple compression of the load-bearing structure of the building and which generally are not easily withstood by the latter.

[0009] In particular, the roof structure of WO 94/115039 is formed by a base frame, a plurality of upright beams and a ridge which are fastened together in every jointing corner in a fixed and blocked way. In other words, relative movements between the base frame, the upright beams and the ridge one in respect to another are not allowed. Therefore, in case of a movement of the building caused for example by a seism, it is not allowed the self-settling movement of the said roof structure and all the components of the loads, namely compressive load, transverse load and torsional load are disadvantageously transferred onto the load-bearing structure of the building.

[0010] The object of the present invention, therefore, is to provide a support structure for roofs which presents a more rational and safe distribution of the load represented by the said roof, in particular intended to transfer the load onto the load-bearing walls of the building only in the form of axial compression, while the transverse and torsional components are absorbed by the perimetral frame, and the capacity, thanks to a dynamic self-settling movement, to adapt to the static and dynamic conditions, assisting the movements caused by any natural or non-natural events, such as tremors, atmospheric phenomena, shock waves from explosions and the like

[0011] The present invention therefore relates to a structure for roofs of buildings according to claim 1.

[0012] In one embodiment, the support structure of the invention is completed by a plurality of lattice members which are arranged in the plane of each pitch of the structure in a direction perpendicular to the respective base beam.

[0013] The support structure of the invention comprises base beams, hip beams and ridge beams which are preferably formed as continuous box-shaped bodies which are made of metallic material and preferably steel; said box-shaped bodies may have a substantially trapezoidal cross-section, and in particular a cross-section substantially corresponding to an isosceles trapezium. The walls corresponding to the larger base and to the smaller base may be made of sheet metal, while those walls corresponding to the inclined sides may consist of a latticework.

[0014] In another embodiment, said box-shaped bodies may have a substantially rectangular cross-section, two opposite walls consisting of a latticework, and the other opposite walls consisting of tubular metal section, rectangularly shaped. Preferably, each latticework wall is provided with two tubular metal sections, perpendicular

to its plane, the tubular metal sections of the said lattice-work walls being welded together, or connected one to the other by means of at least another one tubular metal section.

[0015] In one constructional variant of the present invention, the roof structure is connected to the load-bearing structure of the building by means of the connecting members arranged at least in each corner of the perimetral frame. In this constructional variant, the base beams, depending on their length, may envisage means for connection to the load-bearing structure of the building.

[0016] In another constructional variant, the roof structure is connected to the load-bearing structure of the building by means of connecting members which are joined to each of the hip beams, in the vicinity of the end thereof connected to the perimetral frame.

[0017] The present invention also relates to a method for assembling a support structure for roofs, comprising the steps of: fixing members for supporting the roof structure to the load-bearing structure of the building; assembling the perimetral frame; positioning the header member of the hip beams by means of suitable means and joining the hip beams to said header member; joining the hip beams to the perimetral frame. In one embodiment, the perimetral frame is secured to the support members before positioning of the hip beams; alternatively, the hip beams which are secured to the support members may be positioned and then the perimetral frame is joined to said hip beams.

[0018] Further advantages and characteristic features of the device according to the present invention will emerge from the following detailed description of some embodiments of the present invention, provided, by way of a non-limiting example, with reference to the accompanying plates of drawings in which:

Figure 1 is a perspective schematic diagram showing a first embodiment of the device according to the present invention;

Figure 2 is a perspective schematic diagram showing a second embodiment of the device according to the present invention;

Figure 3 is a perspective view showing a constructional variant of the device according to the present invention;

Figure 4 is a side elevation view with parts, shown in cross-section, of a detail relating to the embodiment of Figure 2;

Figure 5 shows a cross-sectional view along the line V-V of Figure 4;

Figure 6 is an enlarged detail, shown in a plan view from above, of the embodiment according to Figure 1;

Figure 7 is an enlarged detail, shown in a plan view from above, of the embodiment according to Figure 2;

Figure 8 is an enlarged detail, shown in plan view,

relating to the embodiment according to Figure 1; Figure 9 is a side elevation view of the detail according to Figure 8;

Figure 10 is a side elevation view which shows a step in the method for assembling the structure according to the present invention;

Figure 11 shows an elevation view of the tool used in the method for assembling the structure according to the present invention;

Figure 12 shows a cross-sectional view of a portion of the finished roof built with the structure according to the present invention;

Figure 13 shows a plan view of a component part of the structure according to the invention;

Figure 14 shows a cross-sectional view of another component part of the structure according to the invention;

Figure 15 is a cross sectional view of a constructional variant of a beam, as shown for example in Figure 4; and

Figure 16 is a cross sectional view of another embodiment similar to that shown in Figure 15.

[0019] Figure 1 shows in schematic form a first embodiment of the roof structure according to the present invention; 10 denotes the said structure. The load-bearing structure of the building is formed by the piers 41 on which the support members 3 are arranged, the latter being connected to the hip beams 201. The said hip beams 201 are joined to the base beams 101 in the corners of the perimetral frame by means of the connecting members 601, while at the opposite end they are connected to the ridge beam 301 by means of the connecting members 701. The lattice members 801 are connected to the structure, being positioned in the pitch plane in a direction perpendicular to the respective base beam 101.

[0020] Figure 2 shows a roof structure 20 according to another embodiment of the present invention, connected by means of the support members 2 and 3 to the load-bearing structure 40 of the building on which the roof is to be formed. The said structure 20 comprises the base beams 101, connected together by means of the connecting members 501, which also connect one end of the hip beams 201 to the frame formed by the base beams 101. The opposite end of each of the hip beams 201 is connected to the ridge beam 301 by means of the connecting member 601.

[0021] Figure 3 is a perspective view of a constructional variant 30 of the roof structure according to the present invention; the same numbers are used to indicate the same parts. As can be noted, a structure which could be that shown in Figure 1 or Figure 2 has, added to it, at both ends of the structure, the additional hip beams 911 which are connected to the perimetral frame by means of the connecting members 601 and the additional ridge beam 921 connected at one end to the connecting member 701 and at the other end to the connecting member 901.

[0022] Figure 4 shows a support member 3 of the roof structure according to the present invention, in this case used in the manner illustrated in the embodiment of Figure 1. The hip beam 201, which is formed by the upper and lower sheet-metal walls 211 and 221, respectively, and by the latticework side walls 231, is inserted and clamped inside the bracket 103 of the support member 3. The bracket 103 is provided with a cover 203 which is secured to the said bracket by means of the bolts 213 and to the wall 211 of the beam 201 by means of the bolts 223. On the opposite side, the bracket 103 is provided with a lug 303 having a through-hole 313 which receives the bolt 423 (see Figure 5) supported by the flanges 413 projecting axially from the plate 403 and stably connected thereto. The plate 403 is fixed by means of the bolts 433 to the pier 41.

[0023] As can be noted from Figure 5, in which the same numbers are used to indicate the same parts, the flanges 413 are welded to the plate 403, and the bolt 423 locks the bracket 103 in a given position with respect to the pier 41. Moreover, the cross-section of the beam 201, which is also the cross-section of all the base beams, the hip beams and the ridge beams preferably used in the roof structure according to the present invention, is substantially trapezoidal, with the larger base consisting of a sheet-metal section 211, the side portions of which are folded inwards so as to seat the latticework walls formed by a plurality of profiled metal parts 231, preferably having a square cross-section, arranged in a zigzag manner and inclined at about 45° with respect to the planes of the sheet-metal walls 211 and 221, as can be seen from Figure 4, the two latticework walls 231 are made so that the parts 231 of one wall are staggered with respect to those of the other wall. The smaller base is formed by a sheet-metal section 221, the side portions 251 of which are folded inwards at an angle substantially complementing that of the portions 241 of the section 211 of the larger base, while the ends 261 of said side portions 251 are folded outwards.

[0024] Figure 6 shows a detail of the embodiment shown in Figure 2; the plate 2 is fixed, by means of the pins 102, to the load-bearing structure 40 of the building. A hub 202 is secured to one corner of the base 2, and in particular the corner directed towards the inside of the load-bearing structure 40, said hub having, arranged thereon, the triangular plate 501 which has in the two corners directed along the sides of the structure 40 two pins 511 having, connected thereto, the lugs 521 mounted on the threaded pins 531 which are inserted and locked by means of the nuts 541 inside the end parts, not defined more fully here, of the base beams 101. The corner of the plate 501 directed towards the inside of the structure 40 supports a hinging bracket 551 having, mounted therein, a pin which is joined to the lug 521 secured to the threaded pin 531 inserted and locked inside the end part of the hip beam 201 by means of the nut 541.

[0025] Figure 7 shows a detail similar to that of Figure

6 and relating to the embodiment according to Figure 1. In this case, the hip beam 201 is fixed by means of the support member 3 to the pier 41 of the building, substantially in the manner shown in Figures 4 and 5. The end of the beam 201 has, mounted thereon, the end-piece 271 to which a plate 621 is connected by means of the bolts 631; said plate 621 has, axially projecting therefrom, a block 641 which is rigidly joined, by means of the pins 651, to the circular plate 601. Two blocks 611 are also connected to this plate 601 in a manner directionally adjustable in the plane of the said plate, owing to said pins 651; the blocks 611 have at the other end a system for connection, by means of the pins 661 having an axis perpendicular to that of the pins 651, to the lugs 671 arranged at the ends of the threaded pins 681 locked by means of the bolts 691 in the end-pieces 171 of the base beam 101. The said base beams 101 are made in a manner identical to that of the hip beams described above.

[0026] Figure 8 shows the member 701 performing connection between the ridge beam 301 and the hip beams 201; this member comprises the double circular plate 701 (see Figure 9) to which the hip beam 301 is rigidly connected by means of the block 741 welded to the plate 721 fixed to the end-piece of the said beam, not shown in the figure; the block 741 is coupled with the pins 751 of the plate 701. The hip beams 201 are instead connected in an oscillating manner with respect to the plane of the plate by means of the connection established between the block 711 and the pin 751 of the plate; the block is provided, at its end opposite to that connected to the plate 701, with a pin 781 having an axis perpendicular to that of the pin 751 and coupled with the hinging flanges 771 fixed to the plate 761 which is in turn connected by means of the fixing means 731 to the end part of the beam 201. As can be seen more clearly in Figure 9, in which the same numbers are used to indicate the same parts, the hip beams 201 are able to oscillate with respect to the ridge beam 301 about two axes which are perpendicular to each other and correspond to the axes of the pins 751 and 781.

[0027] Figure 10 shows one of the main stages during assembly of the roof structure according to the invention; both in the case where the structure is formed according to the embodiment shown in Figure 1 and where it is formed as schematically shown in Figure 2, it is of fundamental importance to arrange the ridge beam 301 in the correct manner so as to obtain the correct slope of the pitches and balance the structure as a whole. Since the roof structure according to the invention does not envisage the use of piers, the ridge beam 301 is positioned on at least two temporary supports 5 which each comprise a stem 105 supported by two legs 405 which rest on the floor slab 50 and are hinged at one end with the two flanges 115 projecting radially from said stem and at the opposite end are connected to the said stem by means of two hinged arms 415. The stem 105 has, telescopically inserted inside it, a shaft 205 having, arranged at its free end, a bush 215 co-operating with a

hub 315 on which a support table 305 is mounted. Figure 11 shows the support 5 in more detail; it can be seen how the shaft 205 is provided with a plurality of radial holes 225 which are equally spaced from each other and which allow, in co-operation with the holes 125 formed on the stem, a first heightwise adjustment of the support to be performed. The bush 215, which is internally threaded, ensures on the other hand, together with the hub 315 which is also threaded, the fine adjustment of the position of the table 305.

[0028] Figure 12 shows by way of example the formation of a finished roof constructed on a structure according to the present invention; the beam 101 is supported by the support member 3, where the bracket 103 is connected in a directionally adjustable manner to the plate 403 fixed to the load-bearing structure 40 of the building. The beam 101 receives, inserted inside it, the latticework 801 comprising the box-shaped section 811 and the box-shaped section 821 between which sections the members 831 are arranged (see Fig. 14), said members being arranged in a zigzag manner with an inclination of about 45° relative to the sections; the section 811 is then positioned above the upper wall 111 of the beam 101, while the section 821 is inserted inside the latticework side wall of the said beam. The insulating material 42 on which the cover tiling 43 is arranged may be positioned on the upper side of the roof structure; the cross-piece 44, to which the wood finishes 45 and the guttering 47 are connected, may then be connected to the beam 101 by means of the support 46 which is arranged on the end portion 161 of its bottom wall 121. It must be noted that in this case the lug 503 of the bracket 103 is directed perpendicularly with respect to the longitudinal axis of the said bracket 103, since the base beam 101 must be able to oscillate laterally, and not in the manner envisaged for the hip beams 201 shown in Figures 4 and 5.

[0029] Figure 13, shows a front plan view of an end-piece used for the beams of the roof structure according to the invention; in the figure the numbers relating to the end-piece 271 used for the hip beam 201 are shown, although the base beams 101 and the ridge beam 301 have end-pieces which have an identical configuration. The end-piece has a substantially trapezoidal shape and has a series of three circular holes 281 along its larger axis as well as two elliptical eyelets 291 positioned symmetrically with respect to the said holes 281.

[0030] In Figure 15 is illustrated another constructional variant of the roof structure according to the present invention. Instead of beams as shown in Figures 4 and 5, the base beams, hip beams and ridge beams can be constructed as the beam 206; each latticework 226 is mounted between two box-shaped sections 216, which are welded together by the welding 236. In the other embodiment shown in Figure 16, the box-shaped sections 316 of the latticework 326 are welded to an intermediate box-shaped section 346.

[0031] The operating principle and assembly of the roof structure according to the present invention will

emerge more clearly from the following description. Depending on the type of load-bearing structure which is available, and depending on the type of roof which is to be constructed, namely with a greater or smaller projection of the pitched surfaces with respect to the perimetral walls, one or other of the embodiments shown in Figures 1 and 2 will be chosen. In both cases, the first operation which is performed during construction of the structure is positioning of the support members; with reference therefore to the embodiment shown in Figure 1, the support members 3 are connected to the piers 41 in the manner which can be seen from that shown in Figures 4 and 5. The plate 403 of each support member 3 is secured to the respective pier 41 and the respective bracket 103 is arranged so as to receive the respective hip beam 201. Once the supports for all four hip beams 201 have been prepared, it is necessary to perform that which may be regarded as one of the main steps for construction of the roof structure according to the invention, namely positioning of the ridge beam. The temporary supports 5 are arranged, as shown in Figure 10, on the floor slab 50, and the ridge beam 301, at the ends of which the hip beams 201 may be fastened, is arranged on them. From that shown in Figures 8 and 9, the connecting member 701 allows the oscillation with respect to two axes which are perpendicular to each other, thus ensuring a decidedly precise adjustment of the position of the hip beams 201; after performing this adjustment and fixing the connection, the base beams must now be connected to the hip beams 201, as can be seen from Figure 7. In this case also, the connecting means 601, namely the plate 601 and all the component parts which are used to form the connection, allow various degrees of adjustment, thereby ensuring the stability of the structure thus obtained. Between the steps involving positioning of the hip beams 201 and positioning of the base beams 101, it is necessary to arrange the lattice members 801 which form the support for the roof finishing elements to be arranged on the structure, in accordance with that shown in Figure 12.

[0032] In the embodiment shown in Figure 2, the assembly is performed using a different sequence; in this case, the first operating step is still that of positioning the support members 3 and 2, this being followed, however, by positioning of the base beams 101 on the said support members 3 and 2. The support members 3 are the same ones used in the embodiment in Figure 1, while the support members 2, shown in Figure 6, comprise a base 2 which has, joined thereto, the connecting member 501, namely the plate 501, to which both the base beams 101 and the hip beams 201 will be connected in an adjustable manner. After positioning of the base beams, the connection between the ridge beam 301 and the hip beams 201 is performed in the same manner described above, but only after arranging the lattice members 801 in the various pitch planes; the roof structure 20 then undergoes a final check as to the adjustments and is made suitably rigid.

[0033] The roof structures thus assembled have in both cases a perimetral frame, which is closed and integral with the hip beams and which allows a better distribution of the loads from the roof to the building. In particular, only the compressive load component is transferred onto the load-bearing structure of the building, whether it be the load-bearing wall 40 or the piers 41, while the transverse and torsional components are absorbed by the perimetral frame. This solution improves considerably the statics of the entire structure, since the load-bearing members of the building poorly withstand loads which are not applied by means of compression; in addition to this, the elimination of the piers inside the roof structure substantially eliminates the load intended to be supported by the last floor slab and allows the maximum accessibility to the area underneath the roof.

[0034] In the embodiment illustrated in Figure 3 it is shown how it is possible to obtain, using the roof structure according to the present invention, a two-pitch roof. The structure is formed from a roof structure constructed equally well according to the embodiment of Figure 1 or the embodiment of Figure 2; the additional hip beams 911 and the additional ridge beams 921 are joined to this structure. The connection between each pair of additional hip beams 911 and the respective additional ridge beam 921 is performed by means of the connecting member 901; with this type of structure it is possible to achieve the same type of results as the embodiments described above, also in the case of a building where a two-pitch roof is used.

[0035] Another significant aspect, in the roof structure according to the present invention, consists in the specific characteristics of the structural parts used. All the base, hip and ridge beams are made using the same prefabricated component made of metallic material and consisting of a metallic box-shaped beam with a polygonal - preferably trapezoidal - cross-section, and in particular having a cross-section in the form of an isosceles trapezium; the two bases are metal sections which are preferably made of sheet steel or a similar material. As can be seen from the cross-section in Figure 5, the wall 211 is arranged towards the outside of the roof structure and encloses, between its two side portions 241, the latticework walls formed by the parts 231 with a polygonal and preferably square cross-section arranged in a zigzag manner with an inclination of about 45° relative to the plane of the said wall 211. The other sheet-metal wall, namely the wall 221, has outwardly projecting portions which ensure the rigid fixing inside the bracket 103 of the support member 3. The sheet-metal walls and the latticework walls may be made with different thicknesses of materials, depending on the type of load which the beam must support.

[0036] The beam is made in the form of modules with a standard length, between 10 and 15 metres, and in particular 12 metres; these modules are provided at each end with an end-piece of the type shown in Figure 13. The end-piece is provided with holes 281 and 291 on the

side which is transverse to the beam, so as to allow the connection thereto of the various connecting members used. The beam may be cut to size and the end which has been cut may be fitted with an end-piece. Moreover, it is possible to add beam segments to a module, or two modules may be joined together, using the said end-pieces.

[0037] In the alternative embodiments shown in Figures 15 and 16, the beam is obtained in a much more simple way; starting from a lattice member very similar to that indicated with the numeral 801, the beam 206 or 306 can be realised according to the particular requirements of the roof structure that has to be built. The structural properties of this kind of beams are quite comparable with that of the beams as above described. The clear advantage is represented by the modularity of the structure of this latter kind of beam, in which the side walls formed with the box-shaped sections can be constructed in a number of different ways. Particularly, the intermediate box-shaped section 346 of the beam 306 shown in Figure 16 will have not necessarily the same width of the box-shaped sections 316 of the latticework 326, but its width can be chosen according to the specific structural requirements that the beam have to fulfill.

[0038] The lattice members 801 are mounted on the structure in the manner shown in Figure 12, namely with the box-shaped section 811, which has a larger cross-section as can be seen in Figure 14, positioned on top of the wall 111 of the base beam 101 and the section 821 inserted between the spaces of the latticework side wall formed by the members 131. The lattice members 801 are arranged in the individual pitches in a direction perpendicular to the base beam 101 of each pitch and are preferably equally spaced from each other. The insulating material 42 and the cover tiling 43 may then be positioned on the lattice members 801 and, similarly, all the finishing parts which are considered necessary may be fixed to the sections 821 directed towards the inside of the roof structure.

[0039] The roof structures constructed according to the present invention therefore have the capacity to adapt to the static and dynamic conditions, assisting the movements caused by any natural or non-natural events, such as tremors, atmospheric phenomena, shock waves from explosions and the like. The structures will be able to adapt to movements of a vibrating, undulating or mixed nature and then settle again in their original position.

Claims

1. Structure (10, 20, 30) for roofs of buildings, comprises a plurality of upright beams, called hip beams (201) below, which are fastened at one end to a ridge beam (301), a polygonal perimetral frame able to be connected to a load-bearing structure (40, 41) of a building, arranged in a substantially horizontal plane and consisting of a plurality of beams, called base

- beams (101) below, which are fastened together, said hip beams (201) being fastened, at the opposite end in respect of said ridge beam (301), to said frame in each of its corner and being arranged, in adjacent pairs, in planes inclined with respect to the plane of said frame and converging towards each other, **characterized in that** said base beams (101) said hip beams (201) and said ridge beam (301) are fastened together in an adjustable manner by means of fastening means (501, 601, 701) provided with at least one degree of freedom, so as to allow the self-settling movement of the said roof structure and to allow that only the compressive load component is transferred onto the load-bearing structure (40, 41) of the building, while the transverse and torsional components are absorbed by the perimetral frame.
2. Structure according to Claim 1, in which said structure further comprises a plurality of lattice members (801) arranged in a plane of each pitch of the structure in a direction perpendicular to the respective base beams (101).
 3. Structure according to Claim 1 or 2, in which said structure is able to be connected to the load-bearing structure (40) of the building by means of support members (2) arranged at least in each corner of the perimetral frame.
 4. Structure according to Claim 3, in which support members (3) connected to said base beams and able to be arranged to said load-bearing (40) structure of the building are envisaged.
 5. Structure according to Claim 1 or 2, in which said structure (10) is able to be connected to the load-bearing structure (40) of the building by means of support members (3) which are joined to each of the hip beams (201), in the vicinity of the end thereof connected to the said perimetral frame.
 6. Structure according to any one of the preceding Claims 1 to 5, in which said base beams (101) are connected together by means of adjustable connecting members (501, 601), said hip beams being connected to the perimetral frame thus formed in the region of the said connecting members (501, 601).
 7. Structure according to any one of the preceding Claims 1 to 6, in which said hip beams (201) are connected to said ridge beam by means of adjustable connecting members (701).
 8. Structure according to any one of the preceding Claims 1 to 7, in which said base beams (101), said hip beams (201) and said ridge beam (301) are formed as continuous box-shaped bodies made of metallic material.
 9. Structure according to Claim 8, in which said box-shaped bodies (101, 201, 301) have a substantially trapezoidal cross-section.
 10. Structure according to Claim 9, in which said cross-section substantially corresponds to an isosceles trapezium.
 11. Structure according to Claim 10, in which the walls of said box-shaped body (101, 201, 301) corresponding to the larger base (111, 211, 311) and to the smaller base (121, 221, 321) are made of sheet metal, while the walls corresponding to the inclined sides (131, 231, 331) consist of a latticework.
 12. Structure according to Claim 8, in which said box-shaped bodies (206, 306) have a substantially rectangular cross-section, two opposite walls consisting of a latticework (226, 326), and the other opposite walls consisting of tubular metal section, rectangularly shaped (216, 316).
 13. Structure according to Claim 12, in which each latticework wall (226) is provided with two tubular metal sections (216), perpendicular to its plane, the tubular metal sections of the said latticework walls being welded together.
 14. Structure according to Claim 12, in which each latticework (326) wall is provided with two tubular metal sections (316), perpendicular to its plane, the tubular metal sections (316) of the said latticework walls (326) being connected one to the other by means of at least another one tubular metal section (346).
 15. Structure according to any one of the preceding Claims 1 to 14, in which said beams (101, 201, 301, 206, 306) are provided at each end with an end-piece (271) provided with a plurality of apertures (281, 291) for engagement with the said connecting members (501, 601, 701).
 16. Method for assembling a roof structure according to any one of the preceding Claims 1 to 15, comprising the steps of: fixing the support members (2, 3) of the anti-seismic roof structure to the load-bearing structure (40, 41) of the building; assembling the perimetral frame; positioning the ridge member (301) of the hip beams by means of suitable means (5) and joining the hip beams (201) to said ridge member (301); joining the hip beams (201) to the perimetral frame.
 17. Method according to Claim 16, in which the said perimetral frame is secured to the support members (2, 3) before positioning of the hip beams (201).
 18. Method according to Claim 16, in which the hip

beams (201) which are secured to the support members (3) are firstly positioned and then the perimetral frame is joined to said hip beams (201).

Patentansprüche

1. Struktur (10, 20, 30) für Dächer von Gebäuden, die eine Mehrzahl von aufrechten Balken aufweisen, nachfolgend Walmbalken (201) genannt, welche an einem Ende an einem Firstbalken (301) festgelegt sind, einen polygonalen perimetralen Rahmen, welcher verbindbar ist mit einer lasttragenden Struktur (40, 41) eines Gebäudes, die im Wesentlichen in einer horizontalen Ebene angeordnet ist und aus einer Mehrzahl von Balken, nachfolgend Grundbalken (101) genannt, welche aneinander festgelegt sind, aufweist, wobei die Walmbalken (201) an einem gegenüberliegenden Ende vom Firstbalken (301) in den Ecken des Rahmens festgelegt sind und in benachbarten Paaren in geneigten sich einander annähernden Ebenen mit Bezug zur Ebene des Rahmens angeordnet sind, **dadurch gekennzeichnet, dass** die Grundbalken (101), die Walmbalken (201) und der Firstbalken (301) miteinander in einer einstellbaren Weise durch Verbindungsmittel (501, 601, 701) verbunden sind, wobei sie über zumindest einen Freiheitsgrad verfügen, der eine eigenständige Absetzbewegung der Dachstruktur erlaubt und es ermöglicht, dass nur die Komponente des Verdichtungsdrucks auf die lasttragende Struktur (40, 41) des Gebäudes übertragen wird, während die Schräg- und Torsionskomponenten durch den perimetralen Rahmen absorbiert werden.
2. Struktur nach Anspruch 1, **dadurch gekennzeichnet, dass** die Struktur weiterhin eine Mehrzahl an Latten (801) aufweist, die in einer Ebene einer jeden Schräge der Struktur in senkrechter Richtung zu den Grundbalken (101) angeordnet sind.
3. Struktur nach Anspruch 1 oder 2, **dadurch gekennzeichnet, dass** die Struktur verbindbar ist mit der lasttragenden Struktur (40) des Gebäudes durch Tragmittel (2), welche zumindest in jeder Ecke des perimetralen Rahmens angeordnet sind.
4. Struktur nach Anspruch 3, **dadurch gekennzeichnet, dass** Tragmittel (3) vorgesehen sind, welche mit den Grundbalken verbunden sind und an der lasttragenden Struktur (40) anordbar sind.
5. Struktur nach Anspruch 1 oder 2, **dadurch gekennzeichnet, dass** die Struktur (10) verbindbar ist mit der lasttragenden Struktur (40) des Gebäudes durch Tragmittel (3) in der Nähe des Endes eines jeden Walmbalkens (201) angeordnet sind dabei mit dem perimetralen Rahmen verbunden ist.
6. Struktur nach einem der vorhergehenden Ansprüche 1 bis 5, **dadurch gekennzeichnet, dass** die Grundbalken (101) miteinander durch justierbare Verbindungsmittel (501, 601) verbunden sind, wobei die Walmbalken mit dem perimetralen Rahmen der Nähe der Verbindungsmittel (501, 601) verbunden sind.
7. Struktur nach einem der vorhergehenden Ansprüche 1 bis 6, **dadurch gekennzeichnet, dass** die Walmbalken (201) verbunden sind mit dem Firstbalken durch justierbare Verbindungsmittel (701).
8. Struktur nach einem der vorhergehenden Ansprüche 1 bis 7, **dadurch gekennzeichnet, dass** der Grundbalken (101) die Walmbalken (201) und der Firstbalken (301) als gleichmäßige kastenförmige Körper aus metallischem Material gebildet sind.
9. Struktur nach Anspruch 8, **dadurch gekennzeichnet, dass** die kastenförmigen Körper (101, 201, 301) einen im Wesentlichen trapezförmigen Querschnitt aufweisen.
10. Struktur nach Anspruch 9, **dadurch gekennzeichnet, dass** der Querschnitt im Wesentlichen einem im Wesentlichen gleichschenkligen Trapez entspricht.
11. Struktur nach Anspruch 10, **dadurch gekennzeichnet, dass** die Wände des kastenförmigen Körpers, welche die größere Basis (101, 201, 301) und die kleinere Basis (121, 221, 321) bilden, aus Metallblechen hergestellt sind, und die Wände, welche den geneigten Seiten (131, 231, 331) entsprechen, aus einem Gitterwerk bestehen.
12. Struktur nach Anspruch 8, **dadurch gekennzeichnet, dass** die kastenförmigen Körper (205, 306) einen im Wesentlichen rechteckigen Querschnitt aufweisen, wobei zwei gegenüberliegende Wände aus Gitterwerk (226, 326) bestehen und die anderen gegenüberliegenden Wände aus rohrförmigen metallischen Abschnitten (216, 316) bestehen, die rechteckig geformt sind.
13. Struktur nach Anspruch 12, **dadurch gekennzeichnet, dass** jede Wand aus Gitterwerk (226) senkrecht zu ihrer Ebene mit zwei röhrenförmigen metallischen Abschnitten (216) versehen ist, wobei die röhrenförmigen metallischen Abschnitte (216) der Wand aus Gitterwerk zusammengeschweißt sind.
14. Struktur nach Anspruch 12, **dadurch gekennzeichnet, dass** jede Wand aus Gitterwerk (326) senkrecht zu ihrer Ebene mit zwei röhrenförmigen metallischen Abschnitten (316) versehen ist, wobei die röhrenförmigen metallischen Abschnitte (316) der Wand aus

Gitterwerk (326) miteinander durch Mittel zumindest eines weiteren röhrenförmigen metallischen Abschnitts (346) verbunden sind.

15. Struktur nach einem der vorhergehenden Ansprüche 1 bis 14, **dadurch gekennzeichnet, dass** die Balken (101, 201, 301, 206, 306) an jedem Ende mit einem Endstück (271) versehen sind, welches eine Mehrzahl von Öffnungen (281, 291) zur Festlegung mit den Verbindungsmitteln (501, 601, 701) aufweist.

16. Verfahren zur Montage einer Dachstruktur nach einem der vorhergehenden Ansprüche 1 bis 15, welches folgende Schritte aufweist:

- Fixieren der Tragmittel (2,3) der Anti-seismischen Dachstruktur auf die lasttragende Struktur (40, 41) des Gebäudes;
- Montage des perimetralen Rahmens,
- Positionieren des Firstteils (301) der Walmbalken durch geeignete Mittel (5) und Verbinden der Walmbalken (201) mit dem Firstteil (301);
- Verbinden der Walmbalken (201) mit dem perimetralen Rahmen.

17. Verfahren nach Anspruch 16, **dadurch gekennzeichnet, dass** der perimetrale Rahmen durch die Tragmittel (2, 3) gesichert wird, vor der Positionierung der Walmbalken (201).

18. Verfahren nach Anspruch 16, **dadurch gekennzeichnet, dass** die Walmbalken (201) welche durch die Tragmittel (3) gesichert werden zuerst positioniert werden und anschließend der perimetrale Rahmen mit den Walmbalken (201) verbunden wird.

Revendications

1. Charpente (10, 20, 30) pour les toits des bâtiments qui comporte une pluralité de poutres verticales, appelées arêtiers (201) ci-dessous, qui sont rattachées à une extrémité à une faîtière (301), un cadre polygonal périmétrique pouvant être relié à la structure porteuse (40, 41) d'un bâtiment, disposés sur un plan essentiellement horizontal et composé d'une pluralité de poutres, appelées sablières (101) ci-dessous, qui sont rattachées ensemble, les dits arêtiers (201) étant rattachés, à l'extrémité opposée par rapport à la faîtière (301), au dit cadre dans chacun de ses angles et disposés, par paires adjacentes, dans des plans inclinés par rapport au dit cadre et convergeant l'un vers l'autre, **caractérisé en ce que** les dites sablières (101) les dits arêtiers (201) et les dites faîtières (301) sont rattachés ensemble de façon réglable par des moyens d'attache (501, 601, 701) avec au moins un degré de liberté, afin de permettre un

mouvement d'auto-tassement de la dite charpente de toit et permettre qu'un seul composant de charge compressive soit transféré à la structure porteuse (40, 41) du bâtiment, alors que les composants transversaux et de torsion sont absorbés par le cadre périmétrique.

2. La charpente selon la revendication 1, dans laquelle la dite charpente comporte plusieurs poutres treillis (801) disposées dans le plan de chaque pente de la charpente selon une direction perpendiculaire aux sablières respectives (101).

3. La charpente selon la revendication 1 ou 2, dans laquelle ladite charpente peut être reliée à la structure porteuse (40) du bâtiment au moyen de supports (2) disposés au moins dans chaque angle du cadre périmétrique.

4. Une charpente selon la revendication 3, dans laquelle les supports (3) reliés aux dites sablières et pouvant être disposés par rapport au cadre porteur (40) du bâtiment sont envisagés.

5. Une charpente selon la revendication 1 ou 2, dans laquelle la dite charpente (10) peut être reliée à la structure porteuse (40) du bâtiment au moyen de supports (3) qui sont joints à chacun des arêtiers (201), à proximité de son extrémité reliée au dit cadre périmétrique.

6. Charpente selon une quelconque des revendications précédentes 1 à 5, dans lesquelles les dites sablières (101) sont reliées ensemble au moyen d'éléments réglables (501, 601), les dits arêtiers étant reliés au cadre périmétrique ainsi formé dans la région desdits membres réglables (501, 601).

7. Charpente selon une quelconque des revendications précédentes 1 à 6, dans lesquelles lesdits arêtiers (201) sont reliés à ladite faîtière au moyen d'éléments réglables (701).

8. Charpente selon une quelconque des revendications précédentes 1 à 7, dans lesquelles les dites sablières (101), dits arêtiers (201) et dite faîtière (301) forment un corps de caissons continus métalliques.

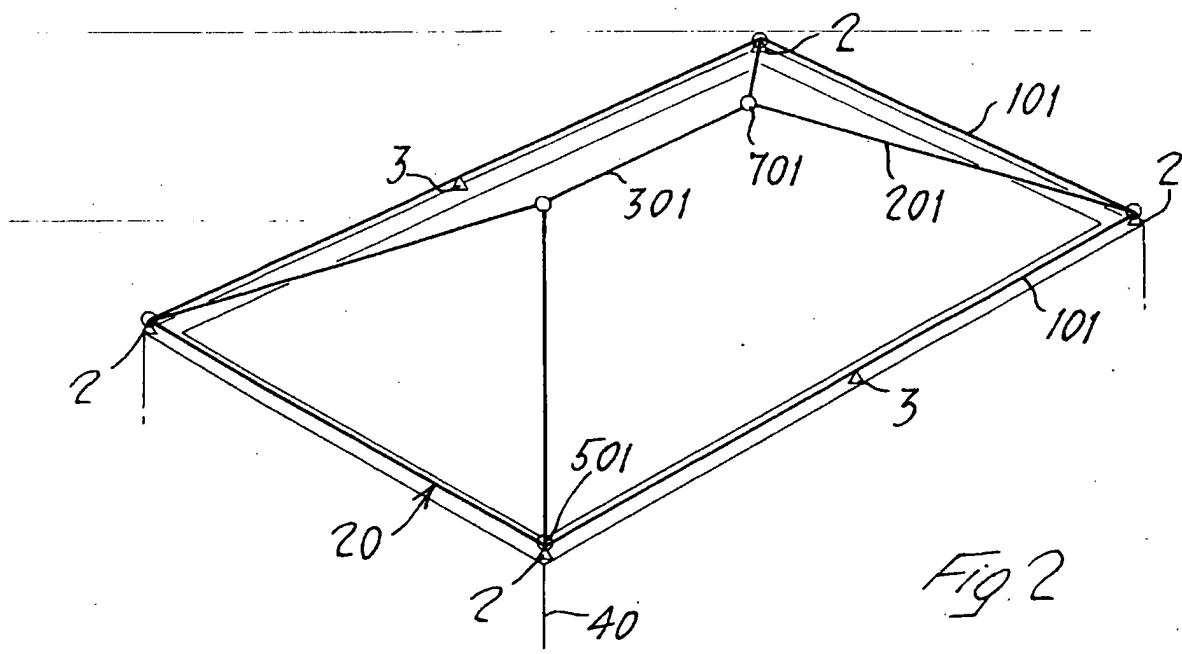
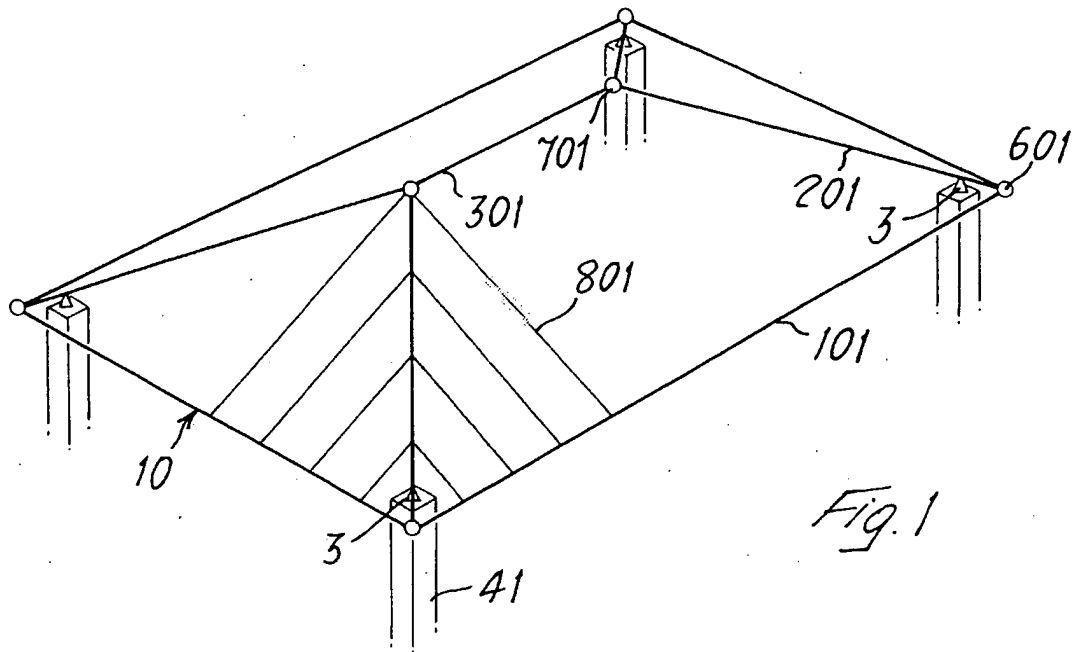
9. Charpente selon la revendication 8, dans laquelle lesdits corps caissons (101, 201, 301) ont une section transversale essentiellement trapézoïdale.

10. Charpente selon la revendication 9, dans laquelle ladite section transversale correspond sensiblement à un trapèze isocèle.

11. Charpente selon la revendication 10, dans laquelle

les parois dudit corps caisson (101, 201, 301) correspondant à la base la plus grande (111, 211, 311) et à la base la plus petite (121, 221, 321) sont faites de tôle, tandis que les parois correspondant aux côtes inclinés (131, 231, 331) se composent d'un treillis. 5

12. Charpente selon la revendication 8, dans laquelle lesdits corps caisson (206, 306) ont une section transversale essentiellement rectangulaire, deux parois opposées se composant d'un treillis (226, 326), et les autres parois opposées se composant de section tubulaire métallique, de forme rectangulaire (216, 316). 10
15
13. Charpente selon la revendication 12, dans laquelle chaque paroi en treillis (226) est équipée de deux sections tubulaires métalliques (216), perpendiculaires à son plan, les sections tubulaires métalliques des dites parois en treillis étant soudées ensemble. 20
14. Charpente selon la revendication 12, dans laquelle chaque paroi treillis (326) est équipée de deux sections tubulaires en métal (316), perpendiculaires à son plan, les sections tubulaires métalliques (316) des dites parois treillis (326) étant reliées l'une à l'autre au moyen d'au moins une autre section tubulaire métallique (346). 25
15. Charpente selon une quelconque des revendications précédentes 1 à 14, dans lesquelles les poutres (101, 201, 301, 206, 306) sont équipées à chaque extrémité d'un embout (271) avec une pluralité d'ouvertures (281, 291) pour l'engagement desdits éléments de liaison (501, 601, 701). 30
35
16. Méthode d'assemblage d'un charpente de toit selon une quelconque des revendications précédentes 1 à 15, comportant les étapes suivantes : fixation des éléments de support (2, 3) de la charpente de toit antisismique au cadre porteur (40, 41) du bâtiment ; assemblage du cadre périmétrique ; positionnement de la faîtière (301) des arêtières par des moyens appropriés (5) et attachement des arêtières (201) à ladite faîtière (301) ; rattachement des arêtières (201) au cadre périmétrique. 40
45
17. Méthode selon la revendication 16, dans laquelle ledit cadre périmétrique est fixé aux supports (2, 3) avant le positionnement des arêtières (201). 50
18. Méthode selon la revendication 16, dans laquelle les arêtières (201) qui sont fixés aux éléments de support (3) sont d'abord positionnés puis le cadre périmétrique est rattaché aux dits arêtières (201). 55



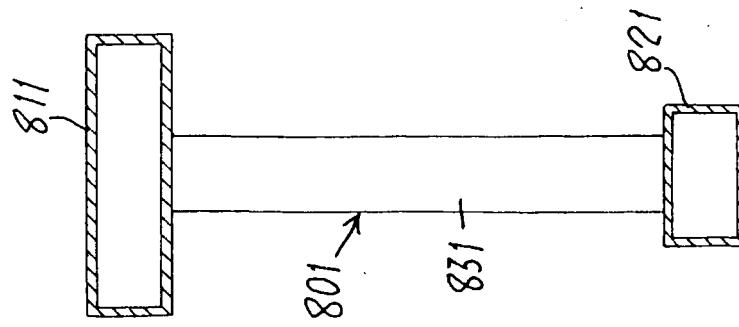


Fig. 14

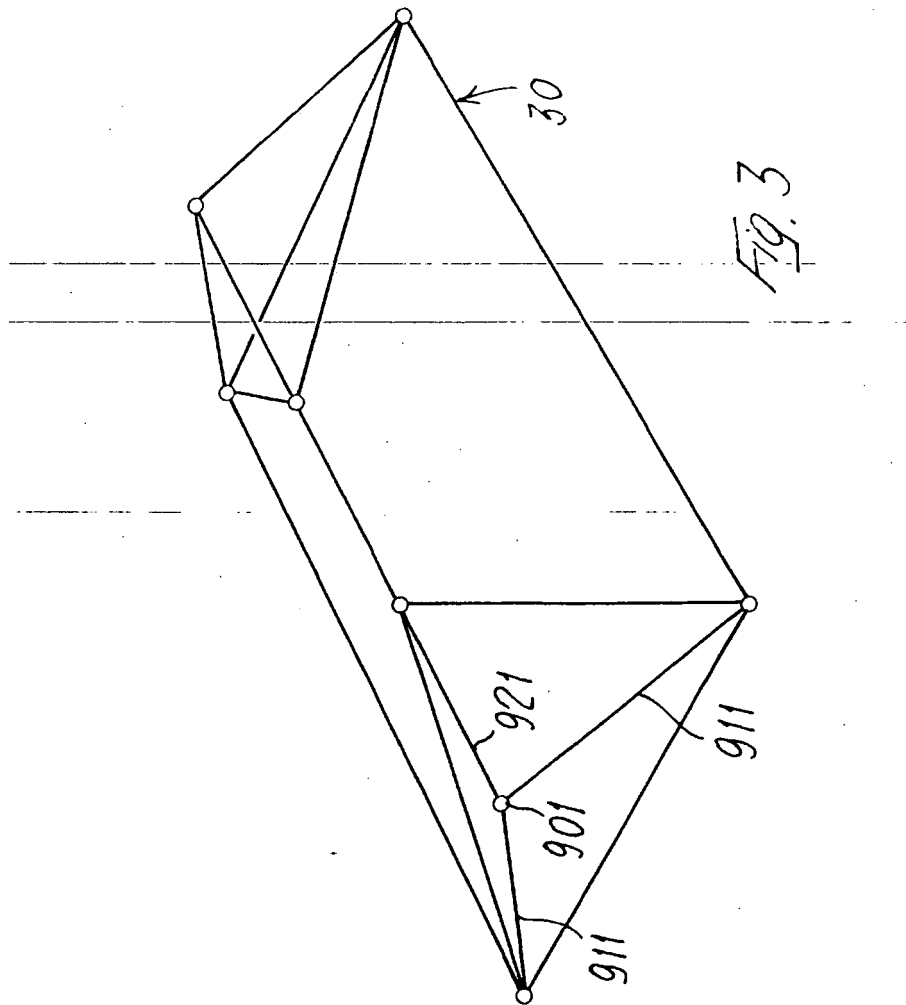


Fig. 3

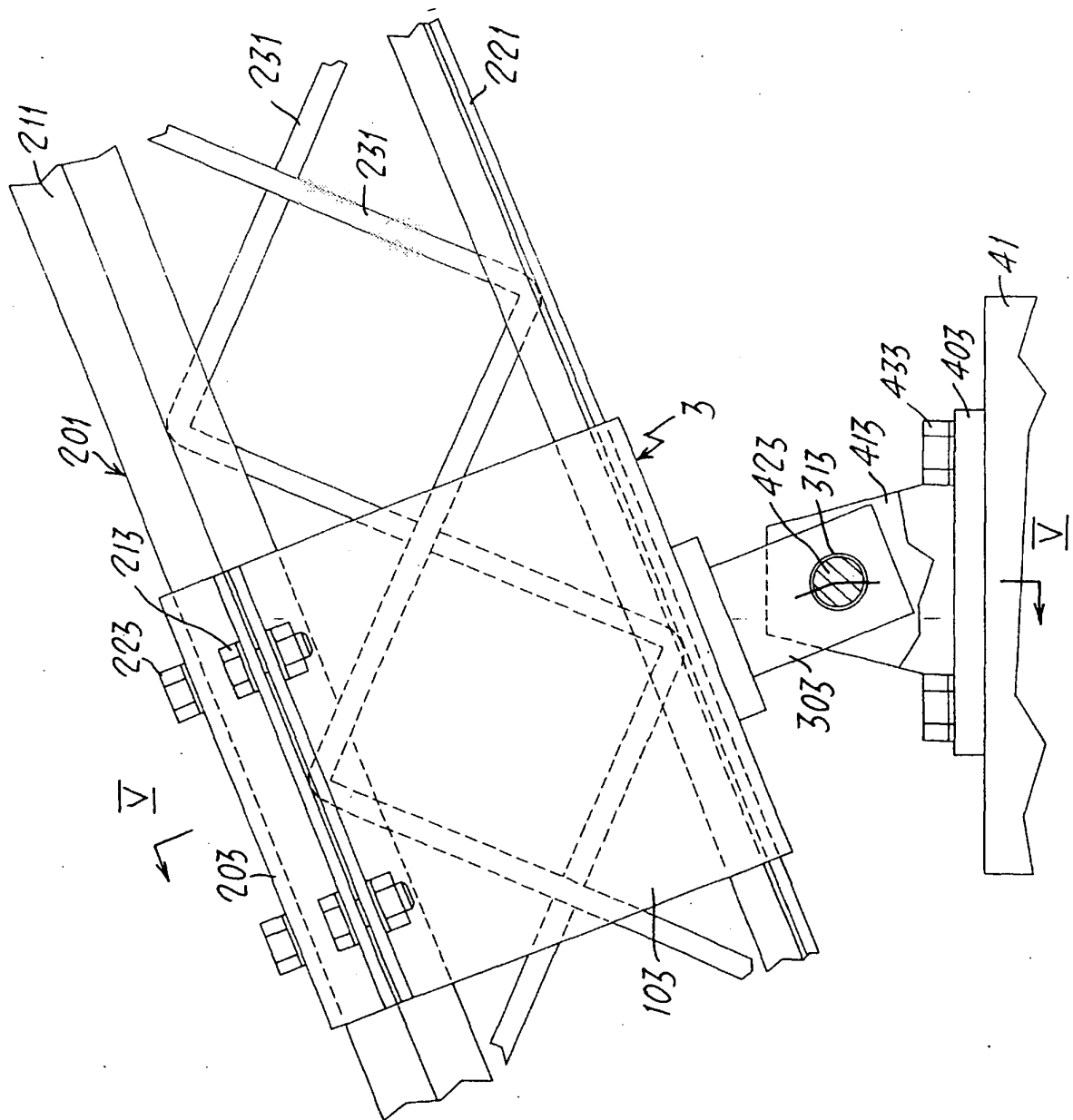
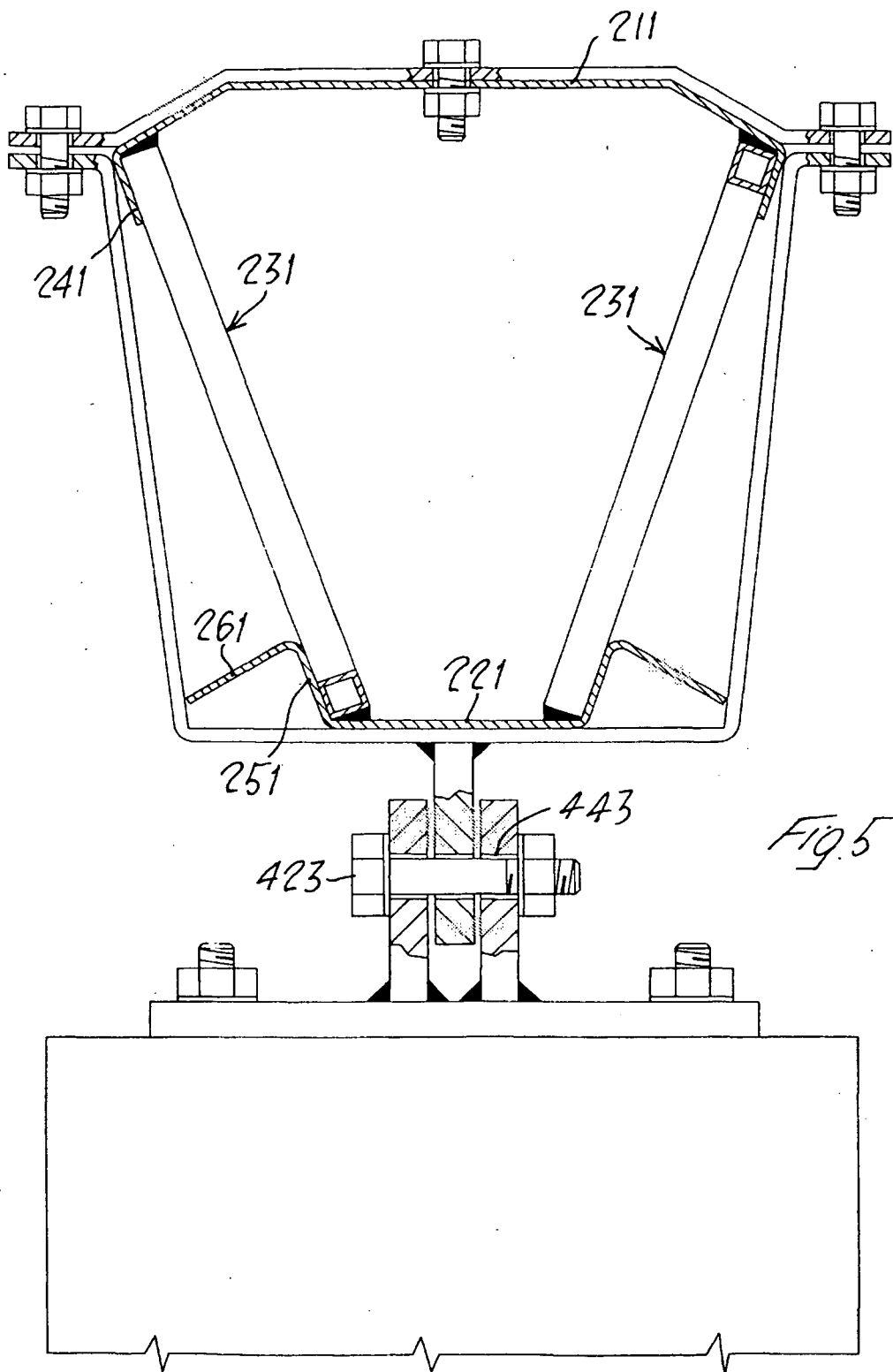
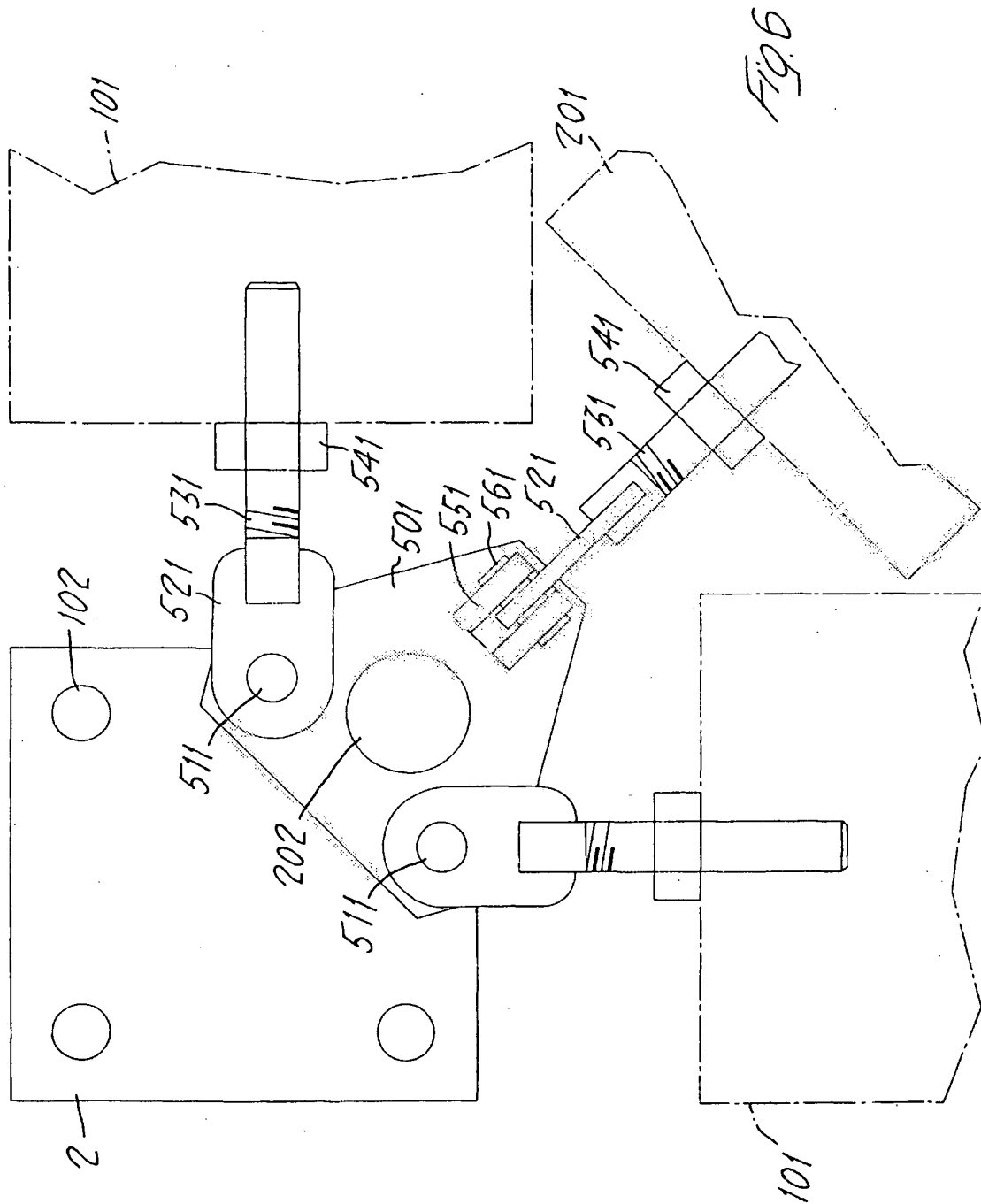


Fig. 4





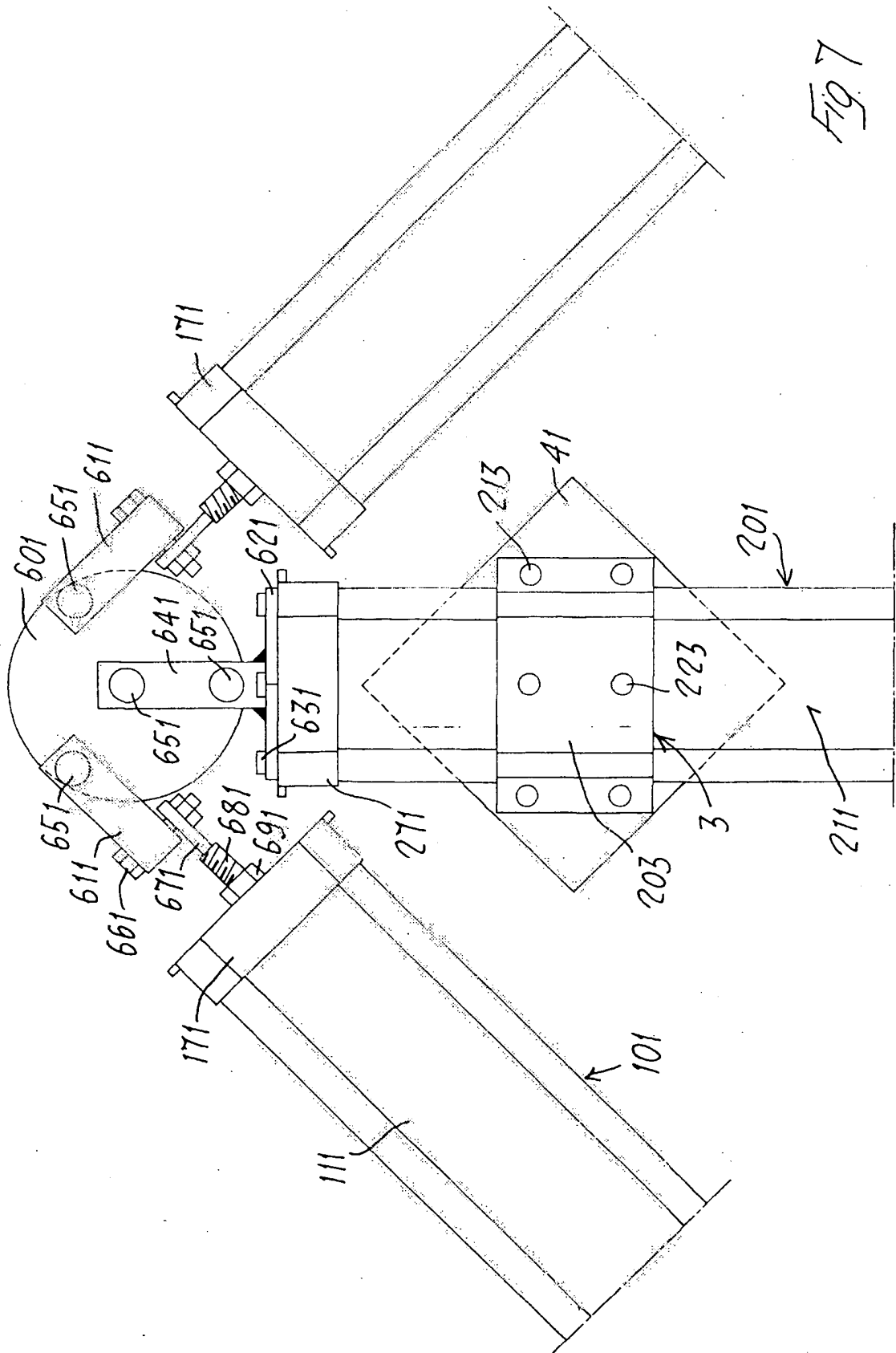
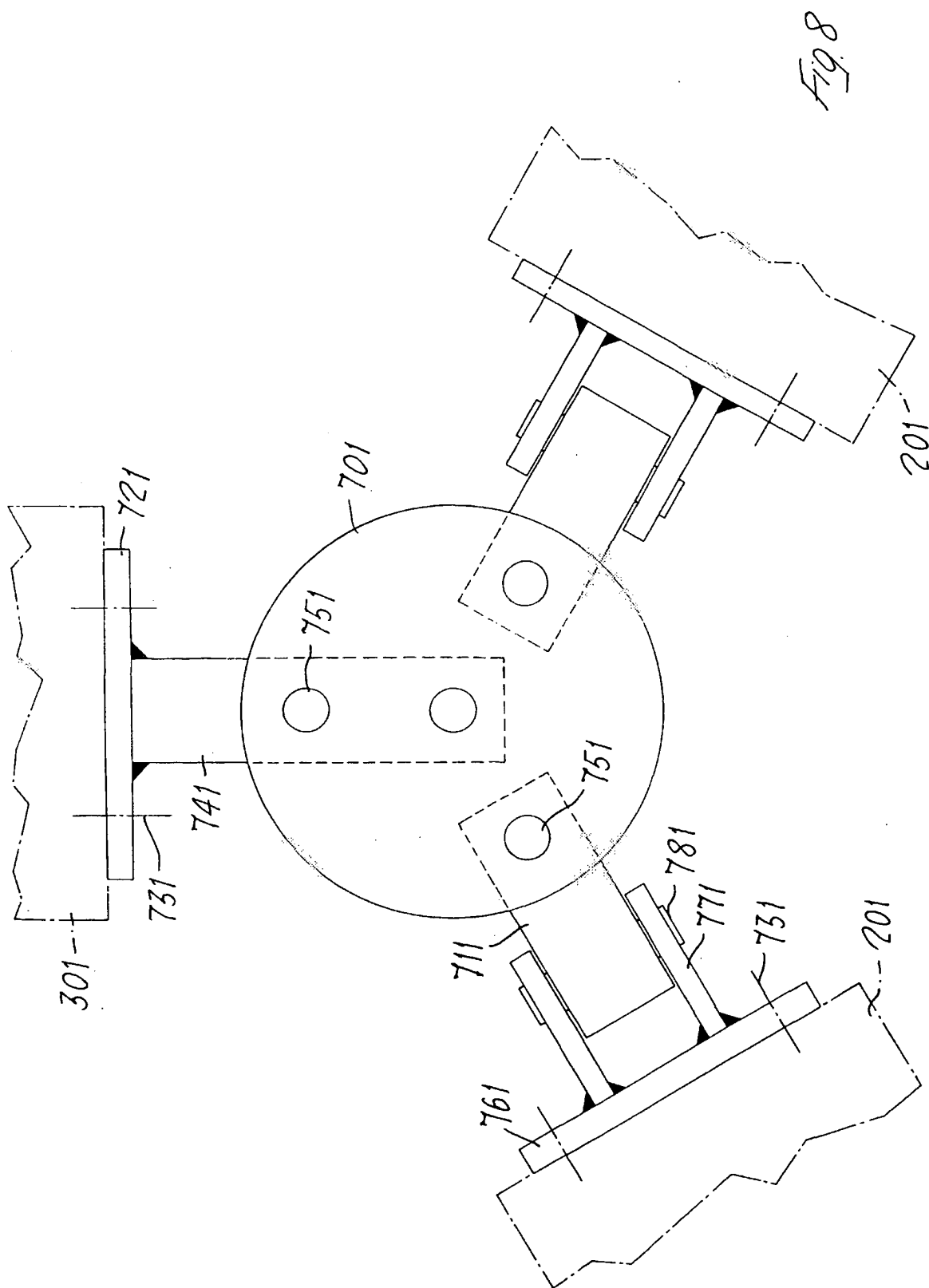
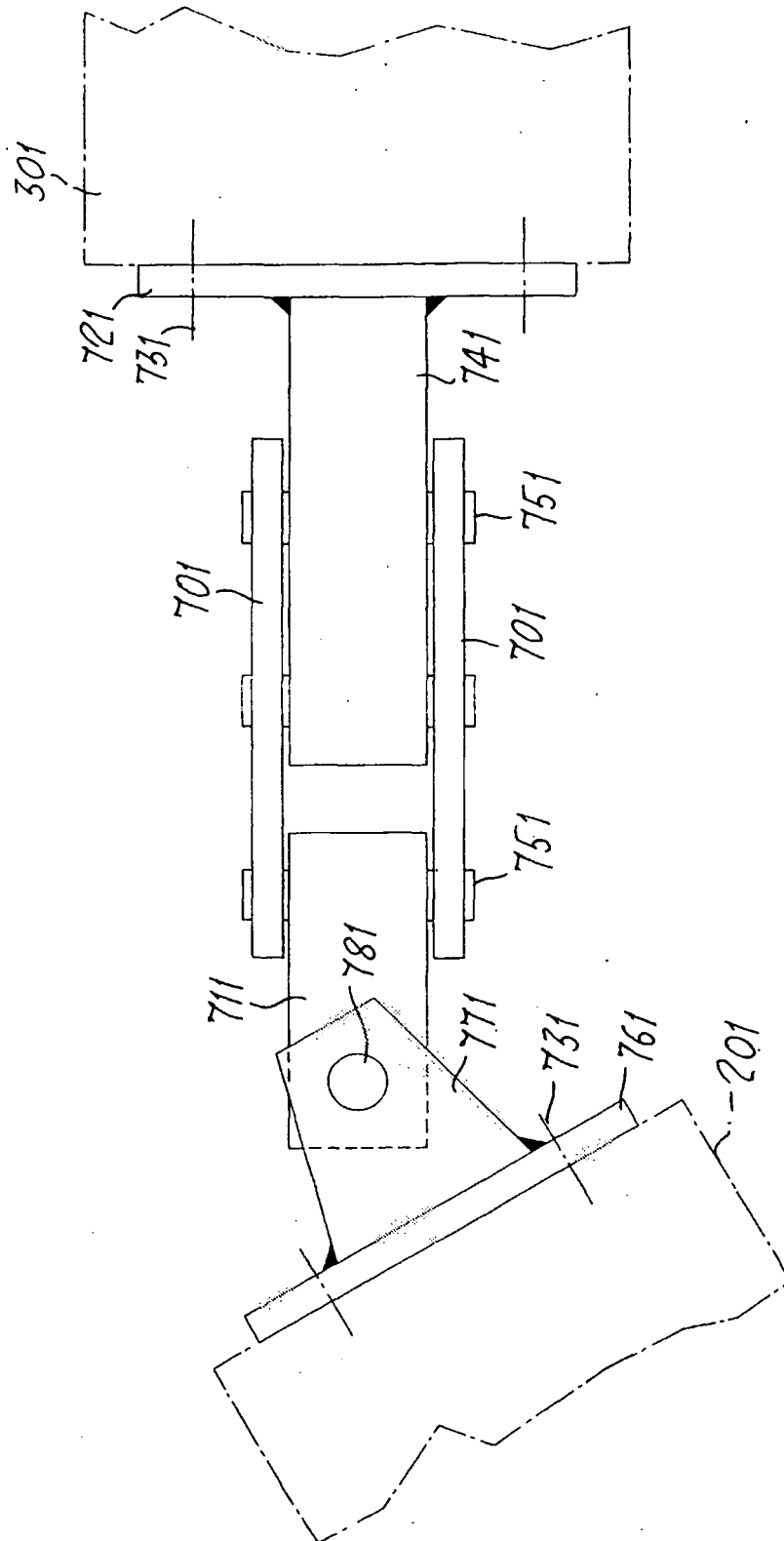
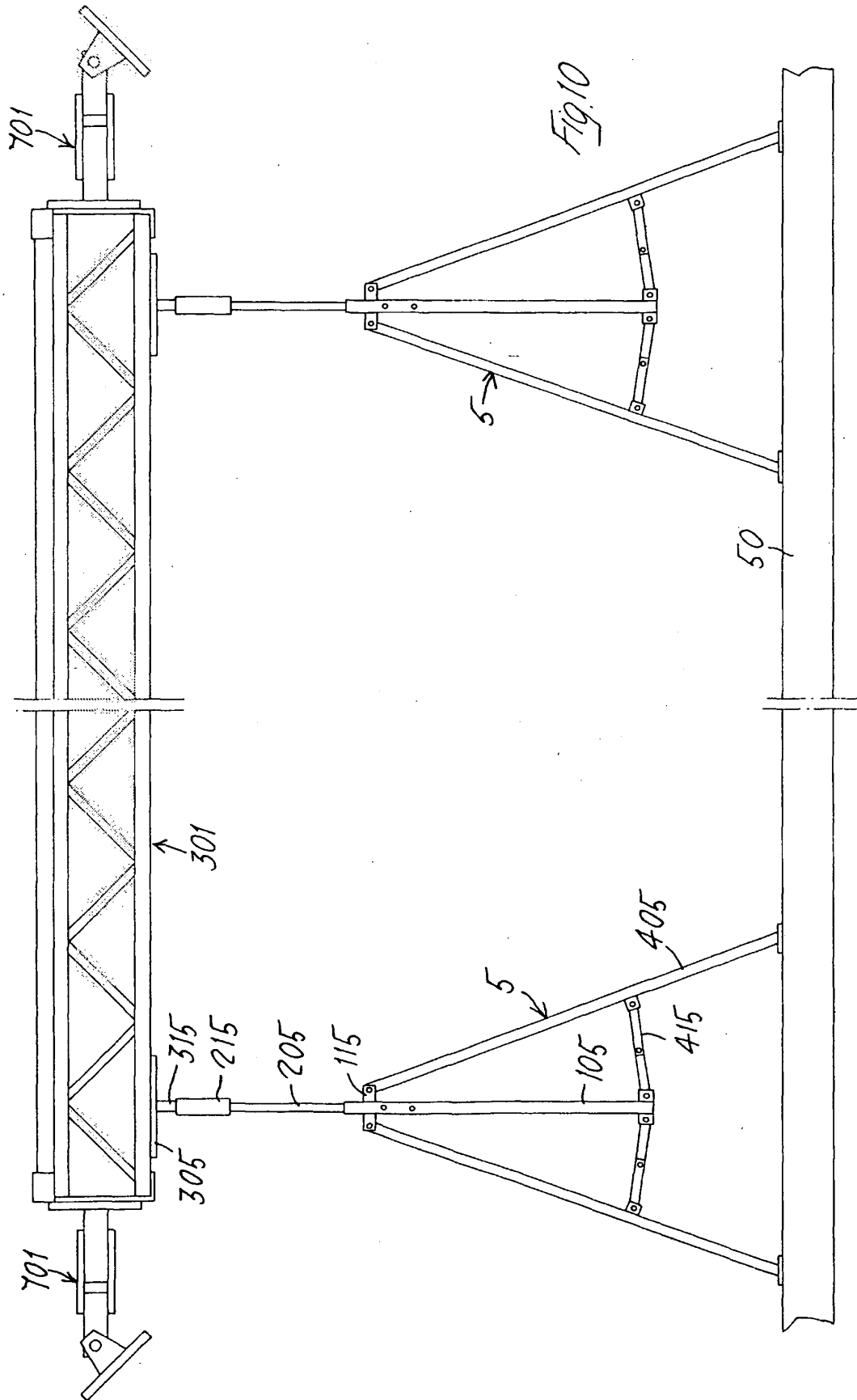
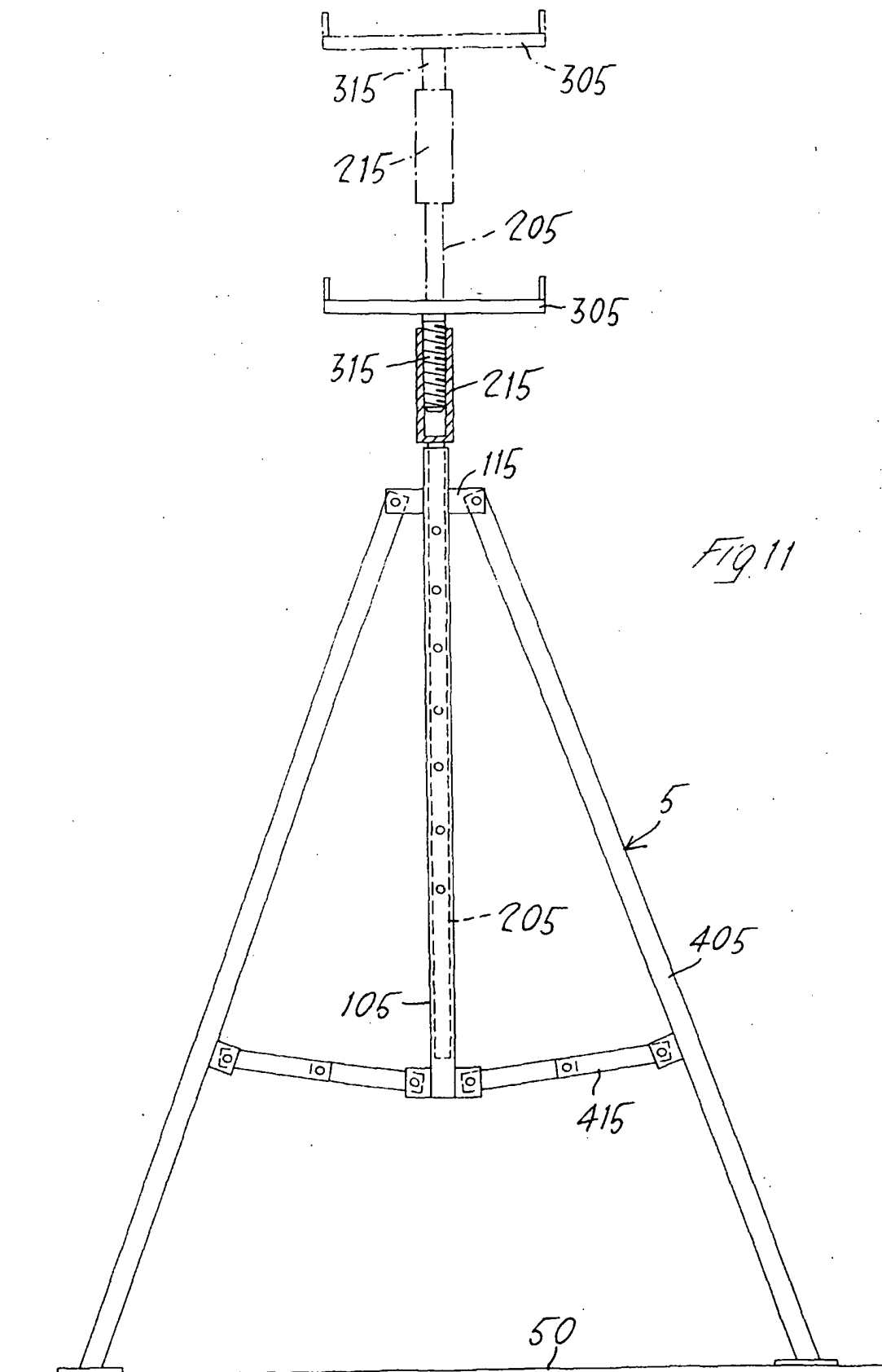


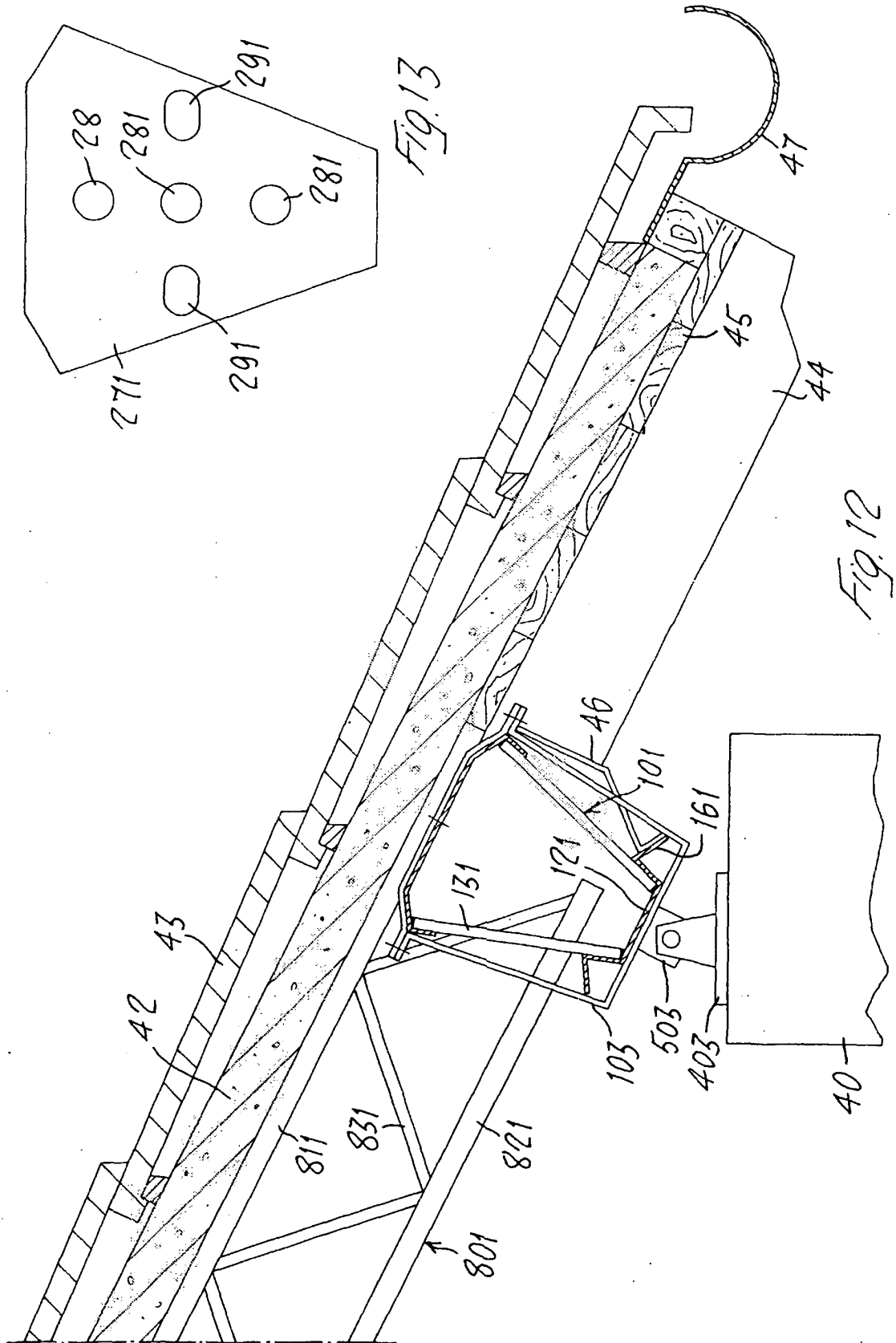
Fig. 7











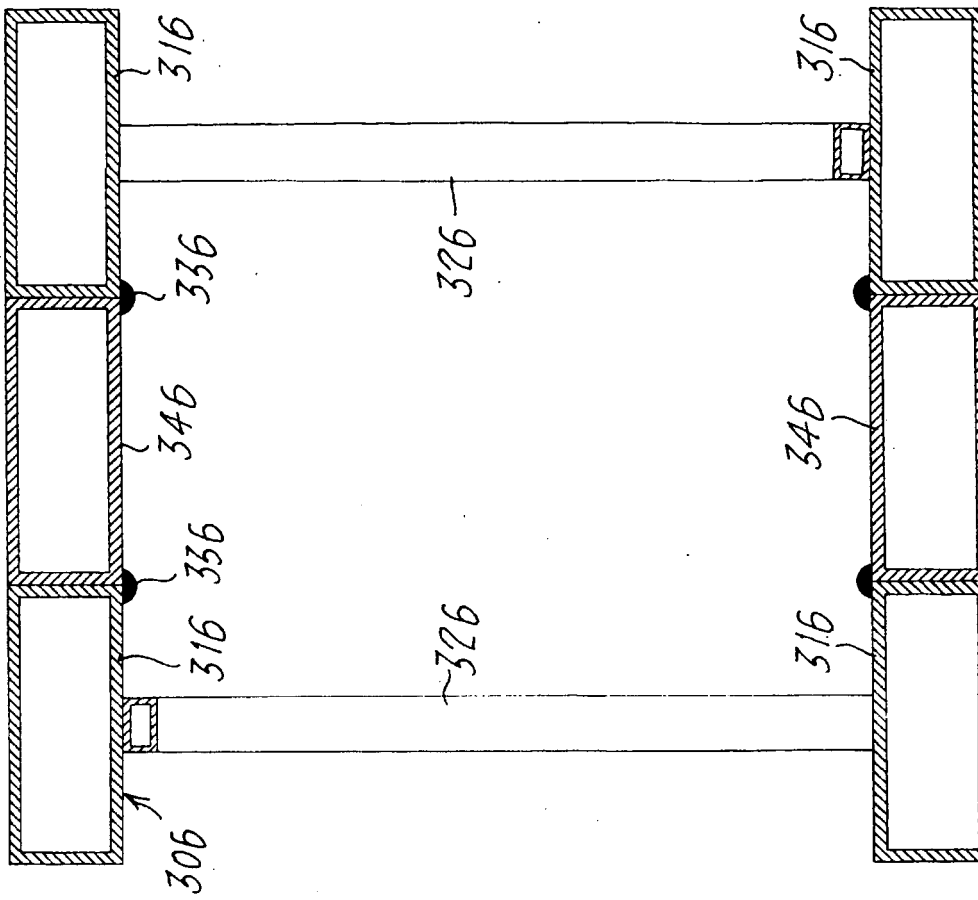


Fig. 15

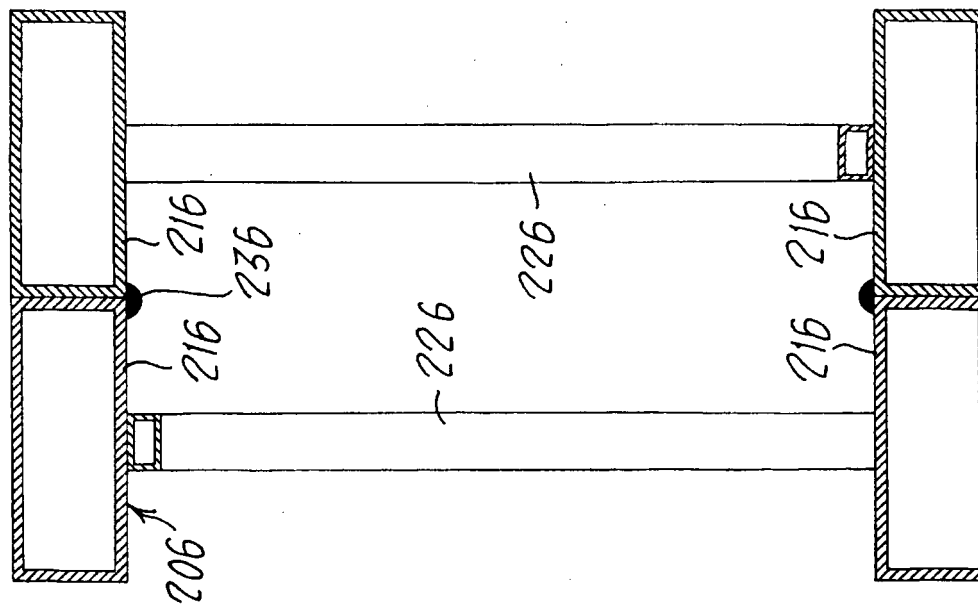


Fig. 16

REFERENCES CITED IN THE DESCRIPTION

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