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(54) **STRUCTURAL PROTECTION SYSTEM FOR BUILDINGS**

STRUKTURELLES GEBÄUDESCHUTZSYSTEM

SYSTÈME STRUCTUREL DE PROTECTION DE BÂTIMENTS

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EP 2 475 829 B1

Description

[0001] The present patent application for industrial invention relates to a structural system for seismic protection of buildings. The structural system according to the invention is especially suitable for seismic protection of existing buildings, with special reference to buildings that play an important social role, classified as strategic buildings (hospitals, schools, barracks, etc.) and also of new buildings.

[0002] Fig. 1 illustrates a structural system for seismic protection of buildings according to the prior art.

[0003] A plurality of dissipation devices (1) are installed in building (E) to be protected, being designed to dissipate the energy generated by the oscillations of the building due to earth tremor. According to the different techniques, said dissipation devices (1) are installed inside the building (E) or outside it on the walls.

[0004] The building (E) comprises a framework of the bearing structure. By framework we mean a frame composed of multiple floors (S) and vertical elements (P), such as pillars or bearing walls, in order to generate a plurality of spaces (M).

[0005] At least one dissipation device (1) is installed in each space (M) of said framework, in bracing configuration, preferably with diagonal direction with respect to the space (M).

[0006] Each dissipation device comprises a dissipation means (1 c) disposed between two rigid rods.

[0007] A first end (1 a) of the first rod of the dissipation device is tied to a portion of angle between the lower floor (S) of the space and a first lateral wall of the building.

[0008] A second end (1 a) of the second rod of the dissipation device is tied to a portion of angle between the upper floor (S) of the space and a second intermediate wall of the building.

[0009] Therefore each dissipation device (1) works autonomously and contributes to compensate wall deformations of each space (M) of the framework.

[0010] Such a structural system is impaired by a series of drawbacks due to the fact that the dissipation devices (1) must be disposed inside the building.

[0011] JP 09 235890 (Kajima Corp.) discloses a reinforcement and vibration-damping structure for existing buildings. It discloses a structural protection system having the features of the preamble of claim 1.

[0012] The purpose of the present invention is to eliminate the drawbacks of the prior art by disclosing a structural system that is able to oppose the oscillations of buildings due to earth tremor in an efficient and efficacious way.

[0013] Another purpose of the present invention is to provide such a structural system for seismic protection of buildings that is versatile and at the same time easy to make, install and maintain.

[0014] These purposes are achieved according to the present invention with the features claimed in independent claim 1.

[0015] Advantageous embodiments are disclosed in the dependent claims.

[0016] The building to be seismically protected is combined with a specialized structure designed to oppose seismic actions by dissipating energy.

[0017] In case of existing buildings, the specialized structures can be simply installed in external position, without having to carry out any works inside the building.

[0018] The specialized structure can consist in a tower or frame or column with suitably rigidity, connected to the building by means of rigid rods with two hinges normally disposed at each floor level.

[0019] Hereinafter, for the sake of simplicity, reference will be always made to a specialized structure that consists in a tower.

[0020] The tower is tied at the base with a spherical joint or hinge. Therefore, the tower is free to oscillate in any direction around the spherical joint, rotating and pivoting on the joint (centre of rotation).

[0021] Dissipation devices or dampers are applied around the base of the tower, which strongly oppose the rotation and oscillation of the tower, thus suffering movements and dissipating energy by means of hysteresis cycles.

[0022] To amplify displacements (travel: elongation and shortening) of the dissipation devices, suitable mechanisms that operate by means of crank gears can be provided.

[0023] The global dissipation system, which is concentrated at the base of the tower, can be of any type.

[0024] Therefore, the main function of the tower is to oppose the effects produced by earth tremor by dissipating energy in the specialized area where dissipation devices of generic type (dampers) are installed.

[0025] The re-centering (balancing) of the tower is guaranteed by the elasticity of the building structure and also by elastic elements that can be connected in parallel to the energy dissipation means.

[0026] In new buildings the tower that acts as seismic-resistant-dissipation element can be inserted inside the building (for example in the stairwell-elevator area). The structural system of the invention has several advantages compared to the known systems.

[0027] Considerable cost reduction is obtained compared to traditional systems that are made inside the buildings and require additional works in addition to structural works.

[0028] If the external seismic-resistant-dissipation structure is of spatial type (tower), it can provide additional usable volume (enlargement), no longer being an end in itself (of structural type only) and with lower incidence of the seismic adaptation cost.

[0029] Such a seismic-resistant-dissipation structure can be, for example, a vertical connection element (stairs, elevator) or emergency staircase. Reference is made to the frequent installation of steel emergency staircases outside public buildings, which can also represent a seismic protection element if designed with the struc-

tural system of the invention.

[0030] Maintenance of dissipation devices can be carried out without interrupting the use of the building during maintenance works, consequently reducing the costs caused by the temporary lack of use.

[0031] The installation of the specialized structure can be carried out without interrupting the ordinary use of the building to be protected.

[0032] Dissipation devices are concentrated in a single specialized area with limited dimensions (tower base), which is consequently easy to inspect and maintain. For very high buildings the specialized dissipation area can be also positioned at higher levels, not only at the base of the tower.

[0033] The dissipation system guarantees high efficiency, taking full advantage of the devices, and high efficacy of the seismic-resistant devices that are concentrated in a single specialized area compared to the known methods with devices disseminated on the building, the operation of which is affected by the uncertain seismic reaction of the building as a whole, especially due to the presence of non-structural elements (walls in general, etc.).

[0034] The rigidity of external seismic-resistant structures with vertical development (tower, frame, column) connected by means of rigid rods to the building is such that it regularizes the deformation (horizontal floor displacements) of the building that is subject to earth tremor, which is generally irregular.

[0035] Complete reversibility of the system is guaranteed because no alterations are made to the building, as in case of internal works.

[0036] In case of hospital or school buildings, if the structural system of the invention has been correctly studied from an architectural viewpoint, it can provide improved design and improved operation with the use of additional structures (new spaces, services, etc.). This is made possible also because of the high formal flexibility of additional structures (for example, the tower can have a square, rectangular, polygonal, circular, etc. shape, can have a constant height or can be tapered vertically).

[0037] Additional characteristics of the invention will appear evident from the detailed description below, which refers to merely illustrative, not limiting embodiments, illustrated in the enclosed drawings, wherein:

Fig. 1 is a diagrammatic cross-sectional view along a vertical plane that shows a structural system for seismic protection of buildings according to the prior art;

Fig. 2 is a diagrammatic cross-sectional view along a vertical plane that shows a first embodiment of the structural system for seismic protection of buildings **which is not part of** the present invention that provides for a specialized structure with distributed energy dissipation system;

Fig. 3 is the same view as Fig. 2, except for it shows an embodiment of the structural system of the invention, with specialized structure with energy dissipation system concentrated at the base;

Fig. 4 is a plan view of the structural system of Fig. 3;

Fig. 5 is a perspective view of the structural system of Fig. 3;

Fig. 6 is the same view as Fig. 3, except for it shows a different version of the energy dissipation system of Fig. 3, which provides for a lever mechanism that multiplies the travel of the energy dissipation device;

Fig. 6A is an enlarged view of the detail contained in circle (A) of Fig. 6.

Fig. 7 is the same view as Fig. 6, except for it shows the oscillation of the structural system of Fig. 6 during earth tremor;

Fig. 7A is an enlarged view of the details contained in circles (A) and (A') of Fig. 7;

Figs. 8 and 9 are two side elevation views that show a different version of the structural system of the invention, wherein the specialized structure consists in a planar frame;

Fig. 10 is a plan view of the structural systems of Figs. 8 and 9;

Fig. 11 is a cross-sectional view along a vertical plane that shows the specialized structure disposed as nucleus inside the building;

Figs. 12 and 12A are two side elevation views that show a different version of the structural system of the invention, wherein the specialized structure consists in a column;

Fig. 13 is a plan view of the structural system of Fig. 12; and

Fig. 14 is a perspective view of the structural system of Fig. 12.

[0038] Now referring to Fig. 2 a first embodiment of the structural system for seismic protection of buildings **which is not part of** the present invention is disclosed.

[0039] The building (E) to be protected comprises a plurality of levels defined by floors (S) disposed according to horizontal planes. The structural system of the invention comprises at least one bearing structure (2) rigidly connected to the building (E).

[0040] The bearing structure (2) has basically the same height as the building (E) and is rigidly connected to the building by means of a plurality of rigid rods (3). The rod (3) is provided with a first end (3a) tied to a wall of the building (E) and a second end (3b) tied to the bearing structure (2).

[0041] Advantageously, the bearing structure (2) is provided with a plurality of horizontal reinforcement elements (S') disposed at the same height as the floors (S) of the building (E). Advantageously, the rigid rods (3) are disposed according to horizontal straight lines on the floors (S) of the building and the corresponding reinforcement elements (S') of the bearing structure.

[0042] The bearing structure (2) is a specialized structure that comprises an energy dissipation system adapted to dissipate the energy of the oscillations suffered by

the bearing structure (2) due to earth tremor.

[0043] It must be noted that the specialized structure (2) is rigidly connected to the building (E). Therefore the energy dissipation system of the specialized structure is able to compensate and damp also the oscillations suffered by the building (E) during the shocks.

[0044] According to the embodiment of Fig. 2, which is not part of the invention, the specialized structure (2) is a tower disposed outside the building (E) and the horizontal reinforcement elements are floors (S') of the tower disposed between a first vertical wall (2a) facing the building (E) and a second vertical wall (2b) opposite the first vertical wall (2a). In this way a vertical row of parallelepiped spaces (V) is defined in the tower (2).

[0045] One dissipation device (1) is disposed in each space (V) of the tower (2), in bracing configuration, diagonally, in such a way to generate an energy dissipation system of the specialized structure (2) distributed along the entire height of the specialized structure.

[0046] The dissipation device comprises an energy dissipation means (1 c) disposed between two rigid rods. The energy dissipation means (1 c) can be, for example, a chamber with fluid. A shock-absorbing element, such as elastic means, spring means or damper can be disposed in parallel position to the energy dissipation means (1 c).

[0047] In each space (V) the dissipation device (1) comprises:

- a first end (1a) tied to a portion of angle between the lower floor (S') of the space (V) and the first lateral wall (2a) of the tower, and
- a second end (1 a) tied to a portion of angle between the upper floor (S') of the space (V) and the second lateral wall (2a) of the tower.

[0048] In the following description identical elements or elements corresponding to elements that have already been described are indicated with the same reference numerals, omitting their detailed description.

[0049] Figs. 3 - 5 describe an embodiment of the structural system of the invention, wherein the dissipation system is concentrated at the base of the tower (2).

[0050] The base of the tower (2) is tied to a spherical joint or hinge (4) mounted on a base (B) fixed to the ground. The vertical axis of the tower (2) passes through the centre of the spherical joint (4).

[0051] A plurality of dissipation devices (1) is disposed in peripheral position around the spherical joint (4). Each dissipation device (1) is provided with a first end (1 a) tied to the base (B) and a second end (1 b) tied at the base of the tower. Advantageously, the tower (2) has a base (20) shaped as overturned pyramid, wherein the vertex of the pyramid is tied to the spherical joint (4). As shown in Fig. 4, to protect the rectangular building (E), two specialized structures (2) are sufficient, being disposed in the long opposite sides of the building, near the opposite angles of the building.

[0052] The connection system of the tower (2) to the building (E) comprises four rigid rods (3) in each floor, disposed in W-configuration with three connection hinges (3a) on the building (E) and two connection hinges (3b) on the tower. As shown in Fig. 5, each tower (2) is damped by eight dissipation devices (1) disposed at the four angles of the tower base and along the central lines of the four sides of the tower base.

[0053] Referring to Figs. 6, 6A, 7 and 7A, a different version of the energy dissipation system is described.

[0054] As shown in Fig. 6A, according to this version, each dissipation device (1) is connected to a lever mechanism (5) to multiply the travel of the dissipation device (1), i.e. elongation/shortening of the dissipation device (1) to compensate the oscillation of the tower (2).

[0055] The lever mechanism (5) comprises two levers (L1, L2). The first lever (L1) is pivoted in the central point (F1) to a projection (51) of a flange (50) tied to the base (B). The second lever (L2) has a first end (La) pivoted at a projection of a flange (52) tied to the base (20) of the tower and a second end (Lb) pivoted at one end of the first lever (L1).

[0056] The dissipation device (1) has a first end (1 a) pivoted at a projection of the flange (52) tied to the base (20) of the tower and a second end (1 b) pivoted at the other end of the first lever (L1).

[0057] In idle state the dissipation device (1) is basically as long as the second lever (L2) and parallel to the second lever (L2) in such a way that first lever (L1), second lever (L2), flange (52) and dissipation device (1) form an articulated quadrilateral that can oscillate around the fulcrum (F1).

[0058] Referring to Figs. 7 and 7A, when the building (E) suffers oscillation due to earth tremor, also the tower (2) that is rigidly tied to the building (E) suffers oscillation with horizontal displacement (δ_o) of the top of the tower. Consequently, the base (20) of the tower suffers a vertical displacement (δ_v) that must be damped and compensated by the dissipation devices (1).

[0059] If Li is the length of the dissipation device in idle state and Lf is the length of the dissipation device after compression or elongation due to oscillation of the tower, the travel of the dissipation device is determined by the relationship:

$$\delta_D = | Li - Lf$$

[0060] The travel (δ_D) of the dissipation device is related to the lever mechanism (5) and vertical displacement (δ_v) of the tower base.

(b1) is the distance between the fulcrum (F1) of the first lever (L1) and the fulcrum (Lb) of the second lever (L2) with the first lever (L1).

(b2) is the distance between the fulcrum (F1) of the first lever (L1) and the fulcrum (1 Lb) of the dissipa-

tion device (1) with the first lever (L1).

[0061] As shown in Fig. 7A, the travel of the dissipation device is determined by the relationship:

$$\delta_D = | Li - Lf | = \delta_v * (1 + b2/b1)$$

[0062] If the fulcrum (F1) is in the centre of the first lever (L1), i.e. (b1 = b2), the travel of the dissipation device is:

$$\delta_D = 2 * \delta_v$$

[0063] The elongation or shortening of the dissipation device (1) will be twice as the vertical displacement (δ_v) of the base (20) of the tower.

[0064] Referring to Figs. 8, 9 and 10, a different version of the structural system of the invention is disclosed, wherein the specialized structure is a planar frame (102) composed, for example, of a reticular framework.

[0065] Also in this case, the dissipation devices (1) can be disposed at the base of the frame (102). The frame (102) is tied to the ground by means of a planar hinge (104) instead of a spherical joint.

[0066] As shown in Fig. 10, to protect a rectangular building, four frameworks (102) are necessary, being disposed in the four sides of the building.

[0067] Figs. 3, 5, 6, 7, 8 and 9 show five-storey buildings and specialized structures (2; 102) provided with energy dissipation system concentrated only at the base of the structure.

[0068] However, in case of taller buildings, each specialized structure can be made of multiple overlapped parts that are mutually tied by means of a central hinge around which the dissipation devices are disposed. The connection between the various parts of the bearing structure is exactly made as the connection of the base of the bearing structure to the ground.

[0069] Referring to Fig. 11, if a new building (E) is built, the specialized structure (202) can be the nucleus of the building, that is to say a tower inside the building that is rigidly connected to the internal walls of the building.

[0070] In such a case, the tower (202) is provided with a specialized energy dissipation system, such as the systems described in the aforementioned embodiments.

[0071] Referring to Figs. 12 12A, 13 and 14, a different version of the structural system of the invention is described, wherein the specialized structure is a column (302).

[0072] Also in this case, the dissipation devices (1) can be disposed at the base of the column (302). The column (302) is anchored to the ground by means of a spherical joint (4).

[0073] Fig. 12A shows an embodiment of the present invention in which the base of the column (302) is a horizontal plane under which the dissipation devices (1) and relevant multiplier lever mechanisms (5) are mounted.

[0074] As shown in Figs. 13 and 14, to protect a rectangular building, five columns (302) are necessary, being disposed in a row on the two long sides of the building. The columns (302) are mutually connected by means of rigid rods (303).

[0075] Numerous variations and modifications can be made to the present embodiments of the invention by an expert of the field, while still falling within the scope of the invention as claimed in the enclosed claims.

Claims

1. Structural protection system of buildings comprising at least one bearing structure (2, 102, 202, 302) to be connected with at least one wall of said building (E),
   wherein
   said bearing structure (2, 102, 202, 302) is suitable to be rigidly connected with the wall of said building (E), and
   said bearing structure (2, 102, 202, 302) is a specialized structure comprising an energy dissipation system adapted to dissipate the energy generated by the oscillations of the bearing structure due to earth tremor,
   characterized in that
   the bearing structure (2, 102, 202, 302) has a base (20) and said energy dissipation system is arranged between the ground and the base (20) of said bearing structure, the base (20) of the bearing structure being tied to the ground by means of one spherical joint (4) or hinge (104);
   wherein said spherical joint (4) or hinge (104) is arranged on the vertical axis of the bearing structure and said energy dissipation system is arranged in peripheral position with respect to said spherical joint (4) or hinge (104).

2. Structural system as claimed in claim 1, **characterized in that** said bearing structure (2, 102, 202, 302) is rigidly connected to the wall of said building (E) by means of rigid rods (3) having a first end (3a) connected to the wall of the building and a second end (3b) connected to said bearing structure.

3. Structural system as claimed in claim 2, **characterized in that** said rigid rods (3) are arranged according to horizontal planes in correspondence with the floors (S) of the building and the bearing structure (2, 102) provides for reinforcement elements (S') arranged according to horizontal planes in correspondence with the floors (S) of said building.

4. Structural system as claimed in any one of the preceding claims, **characterized in that** the energy dis-

sipation system is composed of a plurality of energy dissipation devices (1), each comprising an energy dissipation means (1 c) arranged between two rigid rods.

5. Structural system as claimed in claim 4, **characterized in that** said energy dissipation device (1) comprises a shock-absorbing element arranged in parallel position with respect to the energy dissipation means (1 c).

6. Structural system as claimed in claims 4 or 5, **characterized in that** said energy dissipation devices (1) have a first end (1 a) tied to the ground and a second end (1 b) tied to the base (20) of said bearing structure.

7. Structural system as claimed in claims 4 or 5, **characterized in that** said energy dissipation device (1) comprises a lever mechanism (5) adapted to multiply the travel of said energy dissipation device (1) during the oscillation of the bearing structure.

8. Structural system as claimed in claim 7, **characterized in that** said lever mechanism (5) comprises a first lever (L1) pivoted at a flange tied to the ground and a second lever (L2) having an end (La) pivoted at the base of the bearing structure and a second end (Lb) pivoted at the first lever (L1), in which the energy dissipation device (1) has a first end (1a) pivoted at the base of the bearing structure and a second end (1 b) pivoted at the first lever (L1).

9. Structural system as claimed in any one of the preceding claims, **characterized in that** the bearing structure (2) is a tower external to the building (E).

10. Structural system as claimed in any one of claims 1 to 8, **characterized in that** the bearing structure (102) is a planar frame external to the building (E).

11. Structural system as claimed in any one of claims 1 to 8, **characterized in that** the bearing structure (202) is a tower situated inside the building (E).

12. Structural system as claimed in any one of claims 1 to 8, **characterized in that** the bearing structure (302) is a column.

13. Structural system as claimed in claims 4 to 12, **characterized in that** said bearing structure (2; 102; 202; 302) is composed of multiple overlapped parts tied by a central hinge around which said energy dissipation devices (1) are arranged.

Patentansprüche

1. Strukturelles System für den Schutz von Gebäuden, umfassend mindestens eine Trägerkonstruktion (2, 102, 202, 302), die mit mindestens einer Wand des Gebäudes (E) verbunden wird,
wobei
die Trägerkonstruktion (2, 102, 202, 302) dazu geeignet ist, starr mit der Wand des Gebäudes (T) verbunden zu werden und
die Trägerkonstruktion (2, 102, 202, 302) eine Spezialkonstruktion ist, umfassend ein System zur Energiedissipation, dass dazu geeignet ist, die durch die Schwingungen der Trägerkonstruktion infolge von Erderschütterungen erzeugte Energie abzubauen,
dadurch gekennzeichnet, dass
die Trägerkonstruktion (2, 102, 202, 302) eine Basis (20) besitzt und das System zur Energiedissipation zwischen dem Boden und der Basis (20) der Trägerkonstruktion angeordnet ist, wobei die Basis (20) der Trägerkonstruktion mittels eines Kugelgelenks (4) oder eines Scharniers (104) mit dem Boden verbunden ist;
wobei das Kugelgelenk (4) oder das Scharnier (104) an der vertikalen Achse der Trägerkonstruktion angeordnet ist und das System zur Energiedissipation peripher zum Kugelgelenk (4) oder zum Scharnier (104) angeordnet ist.

2. Strukturelles System nach Anspruch 1, **dadurch gekennzeichnet, dass** die Trägerkonstruktion (2, 102, 202, 302) starr mit der Wand des Gebäudes (E) mittels starrer Stangen (3) verbunden ist, die ein erstes, mit der Wand des Gebäudes verbundenes Ende (3a) und ein zweites, mit der Trägerkonstruktion verbundenes Ende (3b) besitzen.

3. Strukturelles System nach Anspruch 2, **dadurch gekennzeichnet, dass** die starren Stangen (3) nach horizontalen Ebenen auf den Stockwerken (S) des Gebäudes angeordnet sind und dass die Trägerkonstruktion (2, 102) Verstärkungselemente (S') vorsieht, die nach horizontalen Ebenen auf den Stockwerken (S) des Gebäudes angeordnet sind.

4. Strukturelles System nach einem beliebigen der vorstehenden Ansprüche, **dadurch gekennzeichnet, dass** das System zur Energiedissipation eine Vielzahl von Vorrichtungen zur Energiedissipation (1) umfasst, umfassend ein Mittel zur Energiedissipation (1 c), das zwischen zwei starren Stangen angeordnet ist.

5. Strukturelles System nach Anspruch 4, **dadurch gekennzeichnet, dass** die Vorrichtung zur Energiedissipation (1) ein stoßdämpfendes Element umfasst, das parallel zum Mittel zur Energiedissipation (1 c)

angeordnet ist.

6. Strukturelles System nach Anspruch 4 oder 5, **dadurch gekennzeichnet, dass** die Vorrichtungen zur Energiedissipation (1) ein erstes, mit dem Boden verbundenes Ende (1 a) und ein zweites, mit der Basis (20) der Trägerkonstruktion verbundenes Ende (1 b) besitzen.

7. Strukturelles System nach Anspruch 4 oder 5, **dadurch gekennzeichnet, dass** die Vorrichtung zur Energiedissipation (1) einen Hebelmechanismus (5) umfasst, der geeignet ist, den Hub der Vorrichtungen zur Energiedissipation (1) während der Schwingungen der Trägerkonstruktion zu vervielfachen.

8. Strukturelles System nach Anspruch 7, **dadurch gekennzeichnet, dass** der Hebelmechanismus (5) einen ersten Hebel (L1) umfasst, der an einen fest mit dem Boden verbundenen Flansch angelenkt ist, und einen zweiten Hebel (L2), von dem ein Ende (La) an der Basis der Trägerkonstruktion angelenkt ist, während das zweite Ende (Lb) an dem ersten Hebel (L1) angelenkt ist, wobei die Vorrichtung zur Energiedissipation (1) ein erstes, an der Basis der Trägerkonstruktion angelenktes Ende (1 a) und ein zweites, an dem ersten Hebel (L1) angelenktes Ende (1 b) besitzt.

9. Strukturelles System nach einem beliebigen der vorstehenden Ansprüche, **dadurch gekennzeichnet, dass** die Trägerkonstruktion (2) ein Turm außerhalb des Gebäudes (E) ist.

10. Strukturelles System nach einem beliebigen Anspruch 1 - 8, **dadurch gekennzeichnet, dass** die Trägerkonstruktion (102) ein Planarrahmen außerhalb des Gebäudes (E) ist.

11. Strukturelles System nach einem beliebigen Anspruch 1 - 8, **dadurch gekennzeichnet, dass** die Trägerkonstruktion (202) ein Turm innerhalb des Gebäudes (E) ist.

12. Strukturelles System nach einem beliebigen Anspruch 1 - 8, **dadurch gekennzeichnet, dass** die Trägerkonstruktion (302) eine Säule ist.

13. Strukturelles System nach einem beliebigen Anspruch 4 - 12, **dadurch gekennzeichnet, dass** die Trägerkonstruktion (2; 102; 202; 302) aus mehreren, übereinander liegenden Teilen besteht, die durch ein mittleres Gelenk miteinander verbunden sind, um welches die Dissipationsvorrichtungen (1) angeordnet sind.

Revendications

1. Système structurel pour la protection de bâtiments comprenant au moins une structure portante (2, 102, 202, 302) devant être reliée à au moins une paroi dudit bâtiment (E),
où
ladite structure portante (2, 102, 202, 302) est apte à être reliée de manière rigide à la paroi dudit bâtiment (E), et
ladite structure portante (2, 102, 202, 302) est une structure spécialisée comprenant un système de dissipation de l'énergie apte à dissiper l'énergie générée par les oscillations de la structure portante suite à des tremblements de terre,
caractérisé en ce que
ladite structure portante (2, 102, 202, 302) a une base (20) et ledit système de dissipation de l'énergie est disposé entre le sol et la base (20) de ladite structure portante, la base (20) de la structure portante étant fixée au sol moyennant un joint à rotule (4) ou une charnière (104) ;
où ledit joint à rotule (4), ou ladite charnière (104), est disposé en correspondance de l'axe vertical de la structure portante et ledit système de dissipation de l'énergie est disposé de manière périphérique par rapport au dit joint à rotule (4) ou à ladite charnière (104).

2. Système structurel selon la revendication 1, **caractérisé en ce que** ladite structure portante (2, 102, 202, 302) est reliée de manière rigide à la paroi du ledit bâtiment (E) moyennant des tiges rigides (3) qui présentent une première extrémité (3a) reliée à la paroi du bâtiment et une seconde extrémité (3b) reliée à ladite structure portante.

3. Système structurel selon la revendication 2, **caractérisé en ce que** lesdites tiges rigides (3) sont disposées selon des plans horizontaux en correspondance des étages (S) dudit bâtiment et ladite structure portante (2, 102) prévoit des éléments de renforcement (S') disposés selon des plans horizontaux, en correspondance des étages (S) dudit bâtiment.

4. Système structurel selon l'une quelconque des revendications précédentes, **caractérisé en ce que** ledit système de dissipation de l'énergie est composé d'une pluralité de dispositifs de dissipation de l'énergie (1) qui comprennent un moyen de dissipation de l'énergie (1c) disposé entre deux tiges rigides.

5. Système structurel selon la revendication 4, **caractérisé en ce que** ledit dispositif de dissipation de l'énergie (1) comprend un élément d'amortissement disposé en parallèle au dit moyen de dissipation de

l'énergie (1 c).

6. Système structurel selon la revendication 4 ou 5, **caractérisé en ce que** lesdits dispositifs de dissipation de l'énergie (1) ont une première extrémité (1 a) fixée au sol et une seconde extrémité (1 b) fixée à la base (20) de ladite structure portante.

7. Système structurel selon la revendication 4 ou 5, **caractérisé en ce que** ledit dispositif de dissipation de l'énergie (1) comprend un mécanisme de levier (5) apte à multiplier la course dudit dispositif de dissipation de l'énergie (1) pendant l'oscillation de ladite structure portante.

8. Système structurel selon la revendication 7, **caractérisé en ce que** ledit mécanisme de levier (5) comprend un premier levier (L1) qui est monté pivotant sur une bride solidaire au sol et un second levier (L2) ayant une extrémité (La) qui est montée pivotante sur la base de la structure portante et une seconde extrémité (Lb) qui est montée pivotante sur ledit premier levier (L1), où le dispositif de dissipation de l'énergie (1) a une première extrémité (1 a) qui est montée pivotante sur la base de la structure portante et une seconde extrémité (1 b) qui est montée pivotante sur ledit premier levier (L1).

9. Système structurel selon l'une quelconque des revendications précédentes, **caractérisé en ce que** ladite structure portante (2) est une tour externe au bâtiment (E).

10. Système structurel selon l'une quelconque des revendications de 1 à 8, **caractérisé en ce que** ladite structure portante (102) est un châssis planaire externe au bâtiment (E).

11. Système structurel selon l'une quelconque des revendications de 1 à 8, **caractérisé en ce que** ladite structure portante (202) est une tour disposée à l'intérieur du bâtiment (E).

12. Système structurel selon l'une quelconque des revendications de 1 à 8, **caractérisé en ce que** ladite structure portante (302) est une colonne.

13. Système structurel selon l'une quelconque des revendications de 4 à 12, **caractérisé en ce que** ladite structure portante (2; 102; 202; 302) est réalisée en plusieurs parties superposées et fixées entre elles par une charnière centrale autour de laquelle sont disposés lesdits dispositifs de dissipation (1).

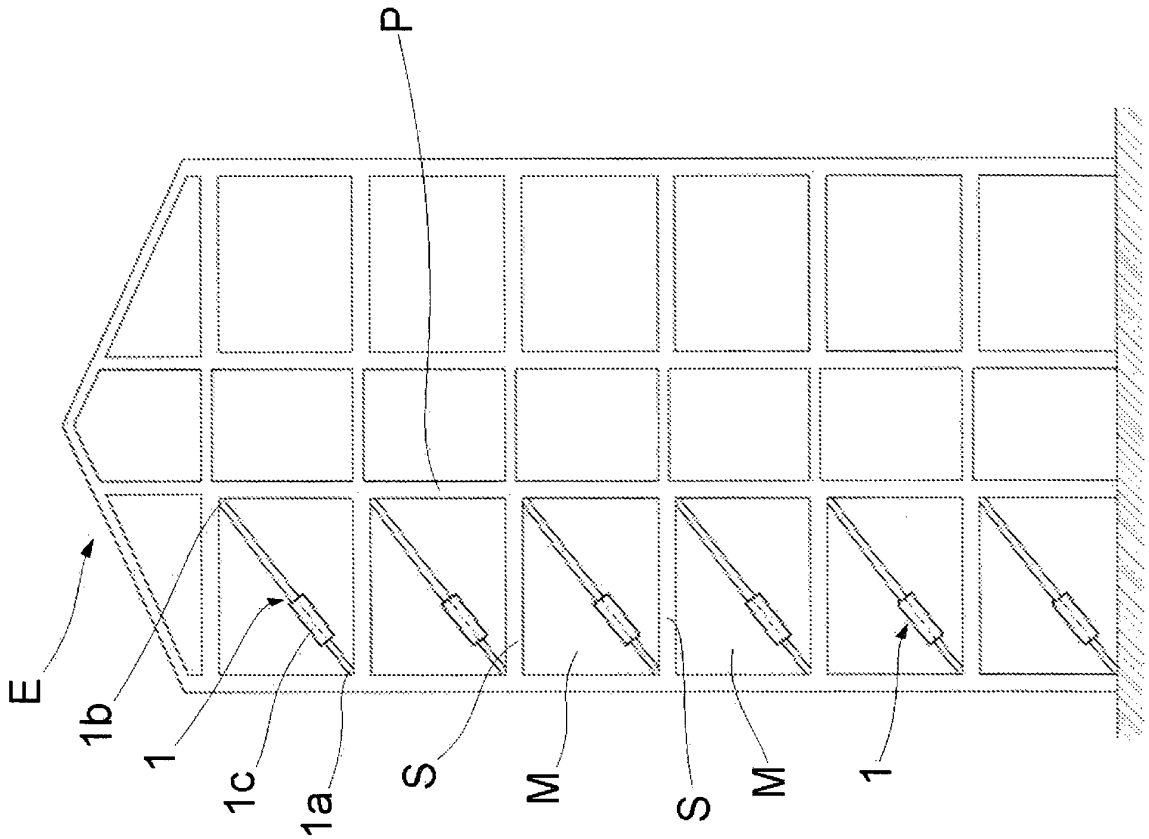


FIG. 1
PRIOR ART

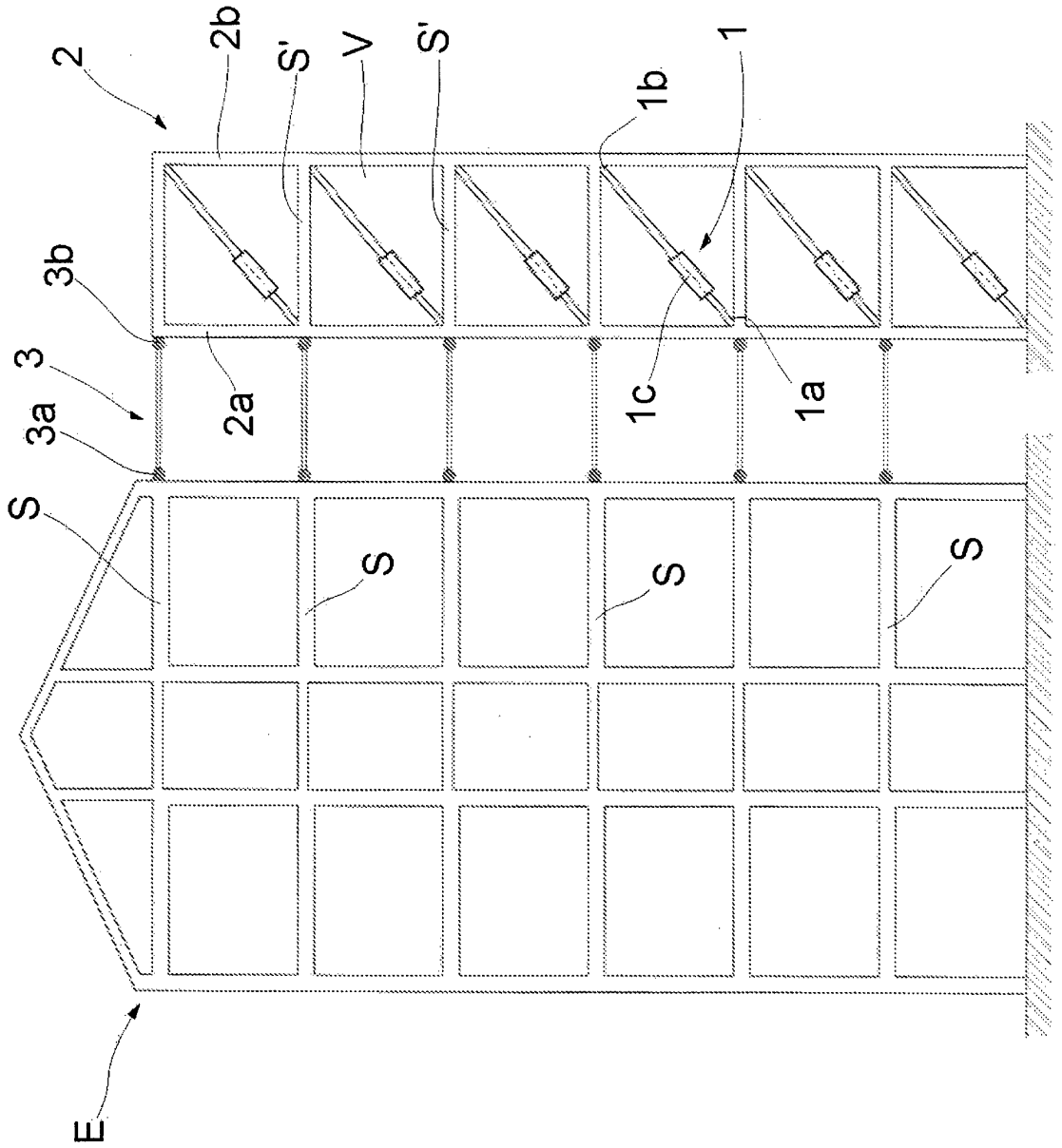


FIG. 2

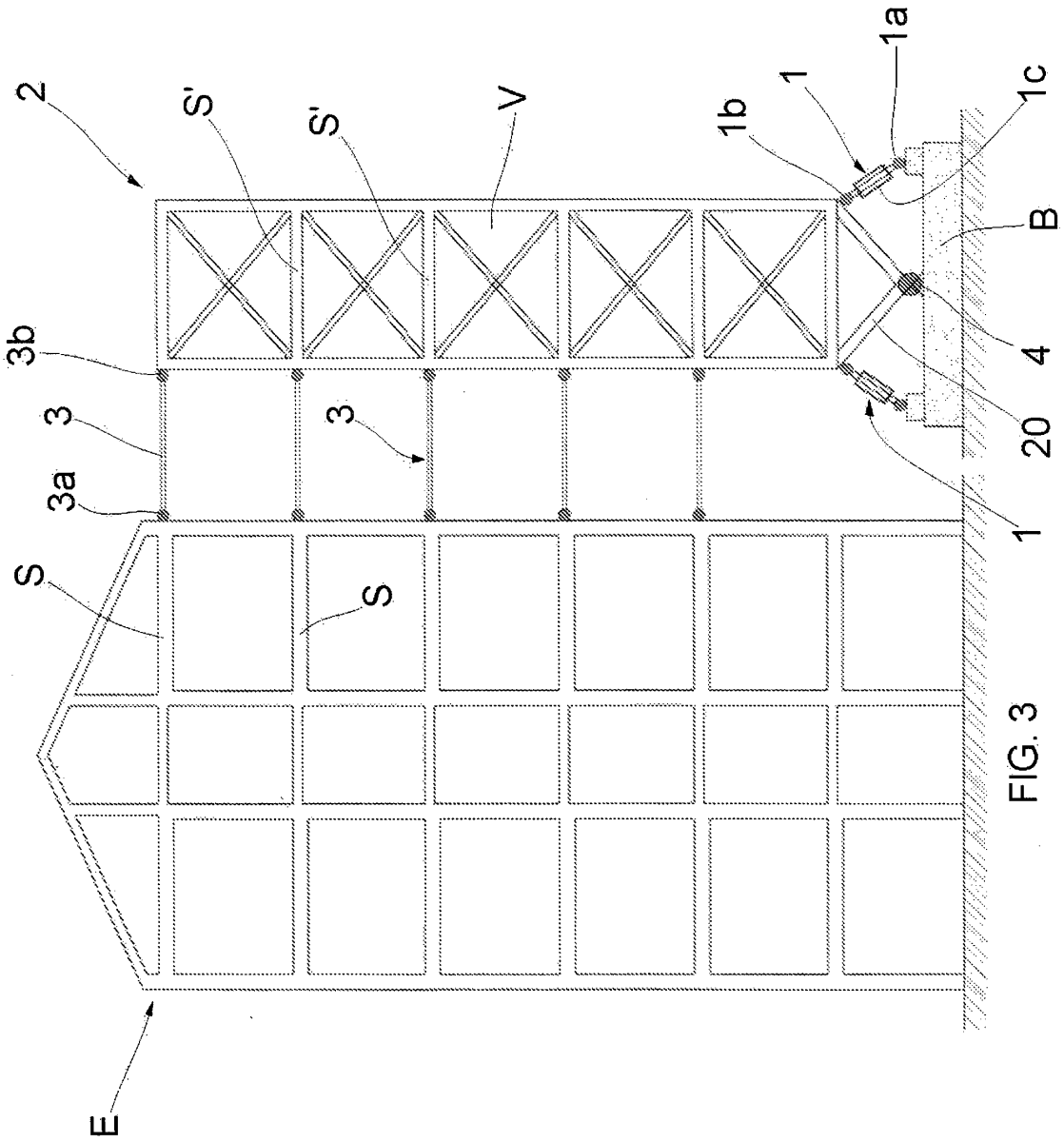


FIG. 3

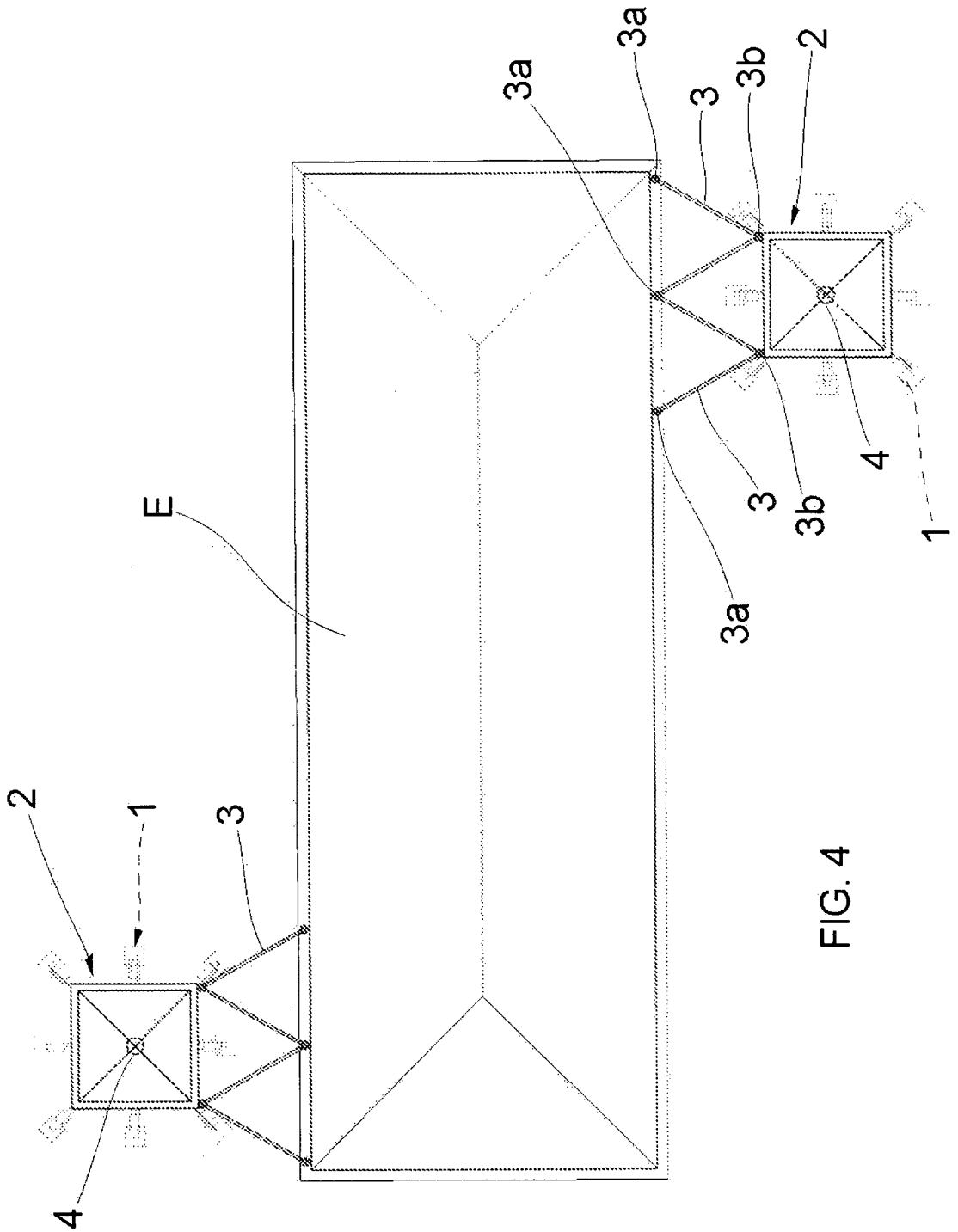


FIG. 4

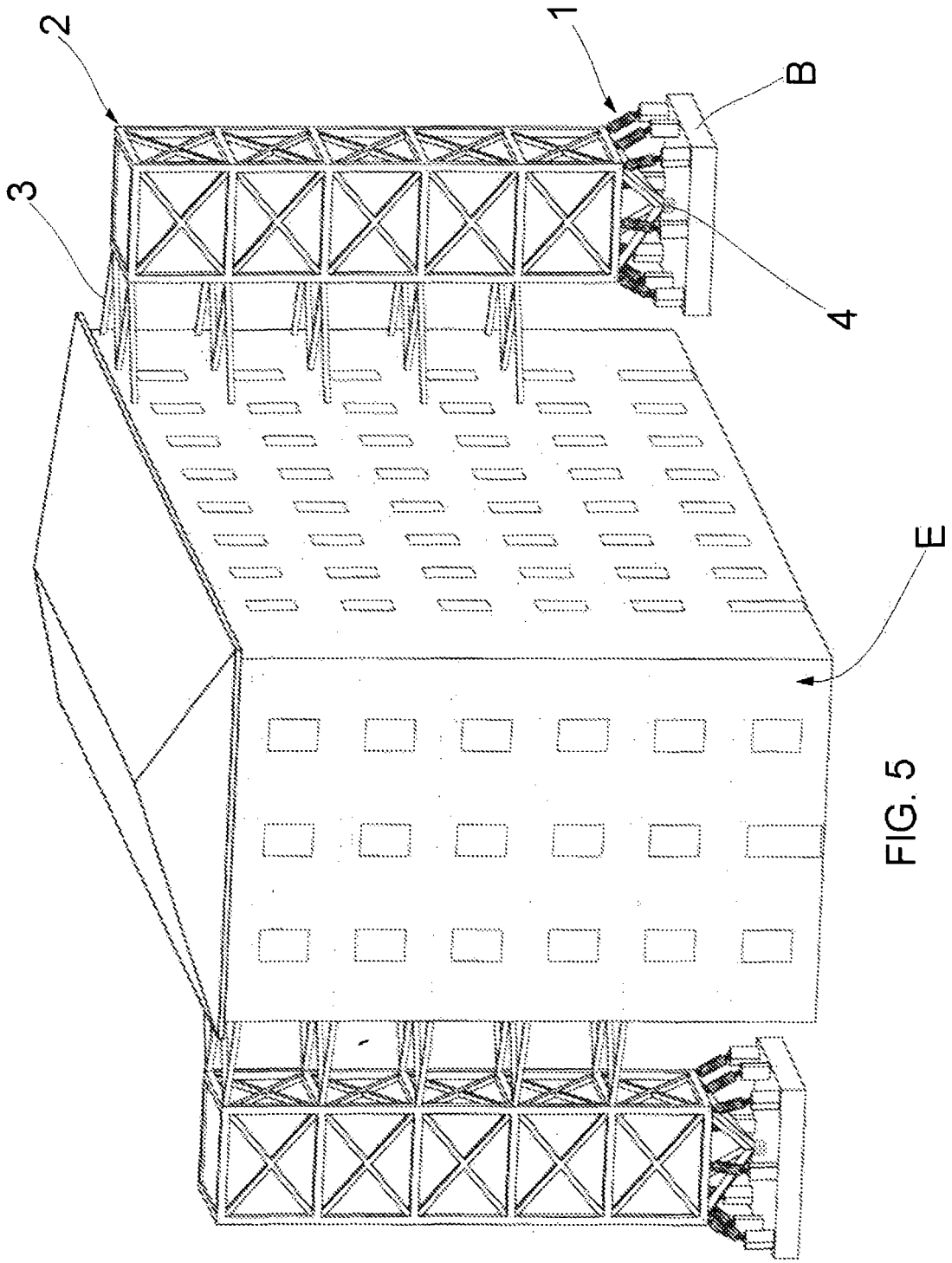


FIG. 5

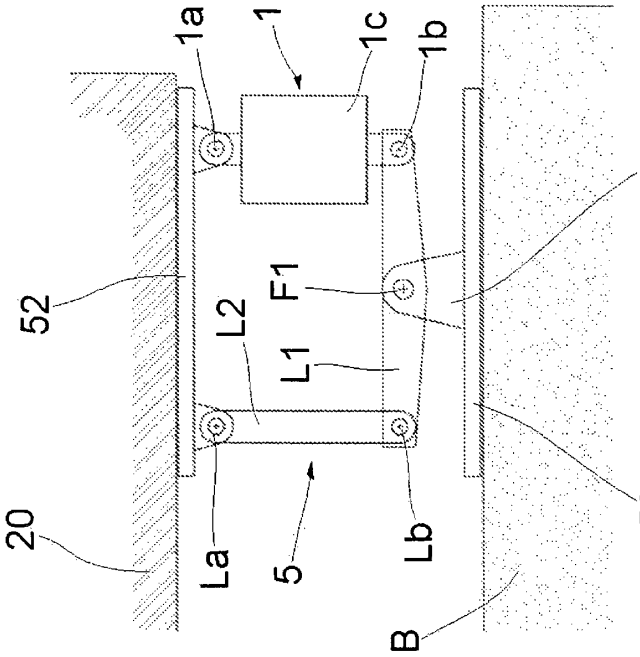


FIG. 6A

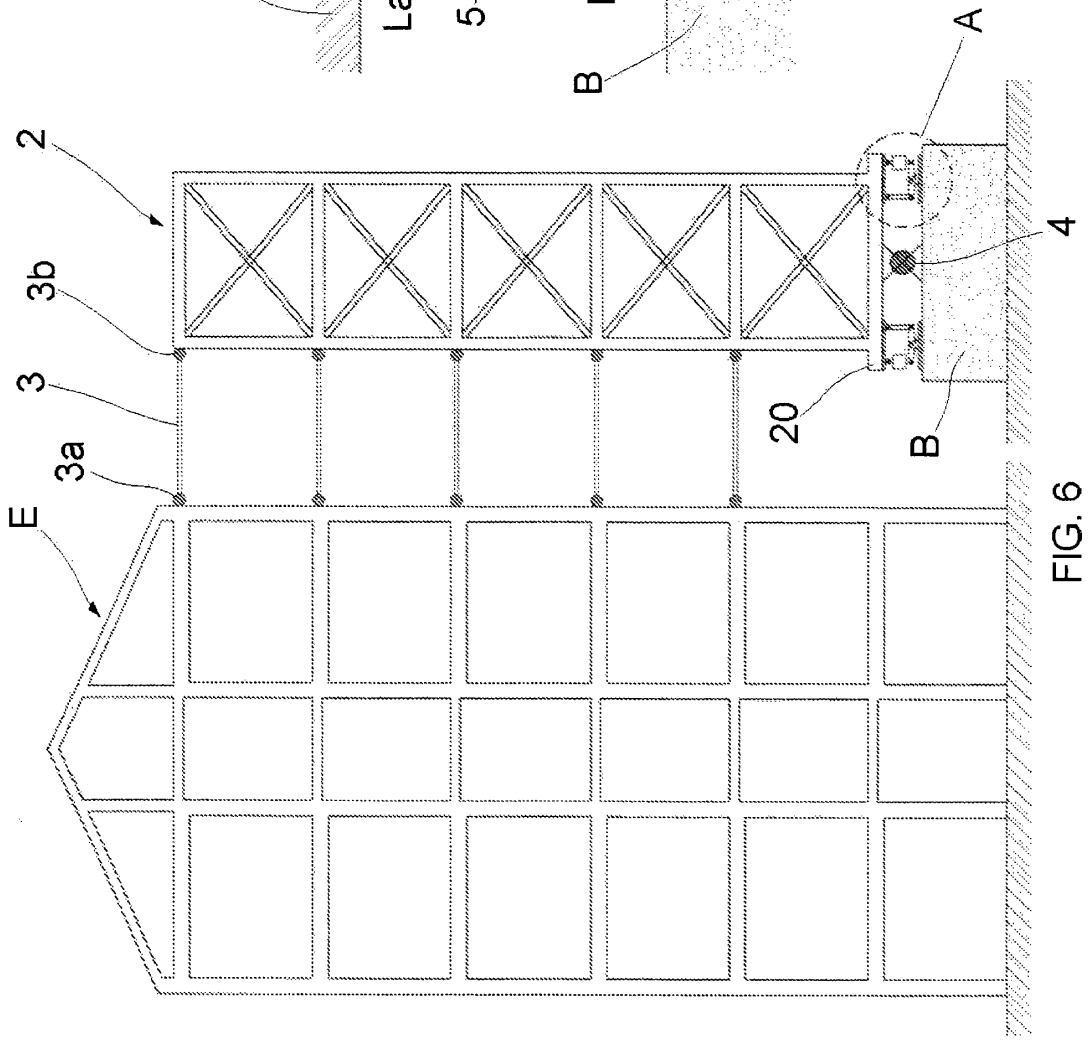


FIG. 6

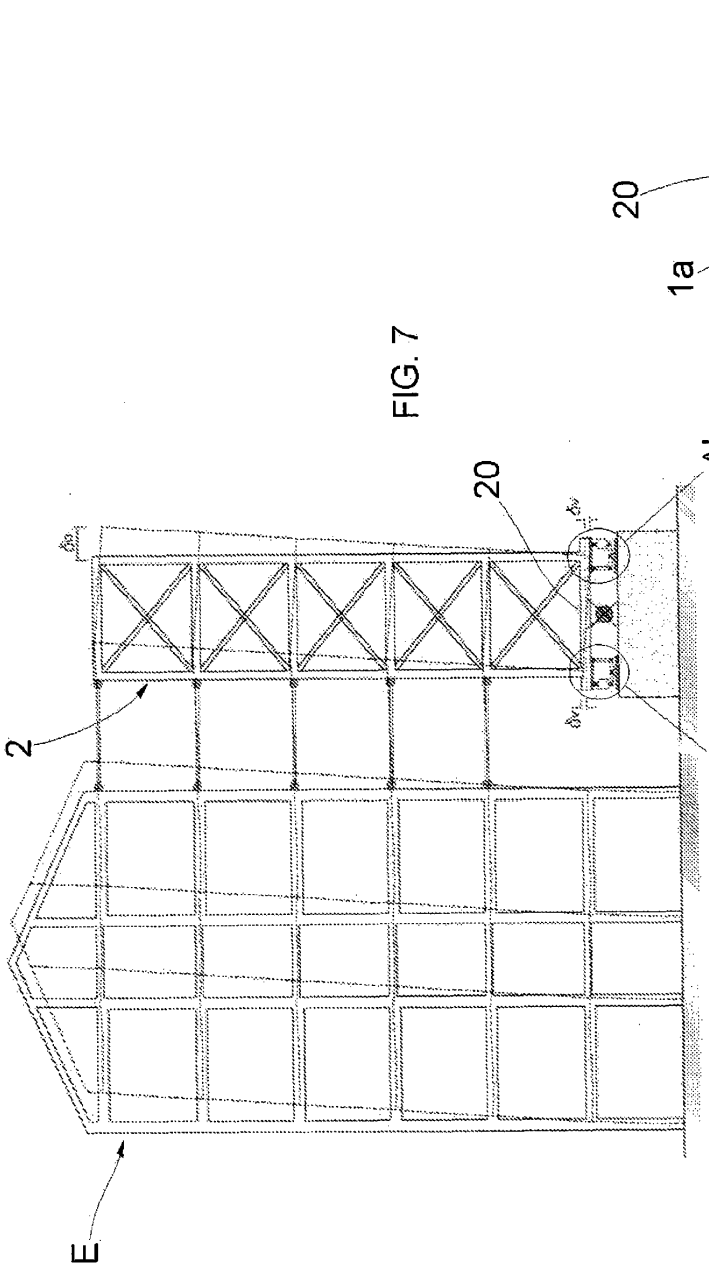


FIG. 7

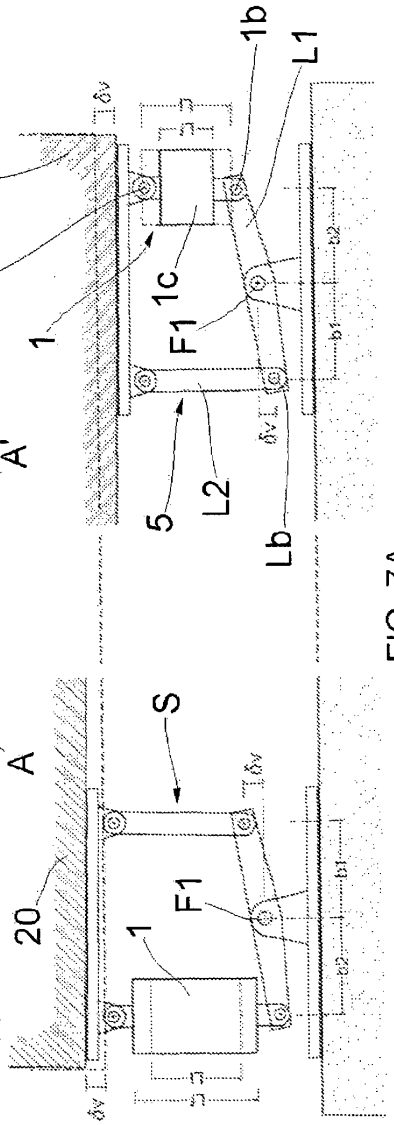


FIG. 7A

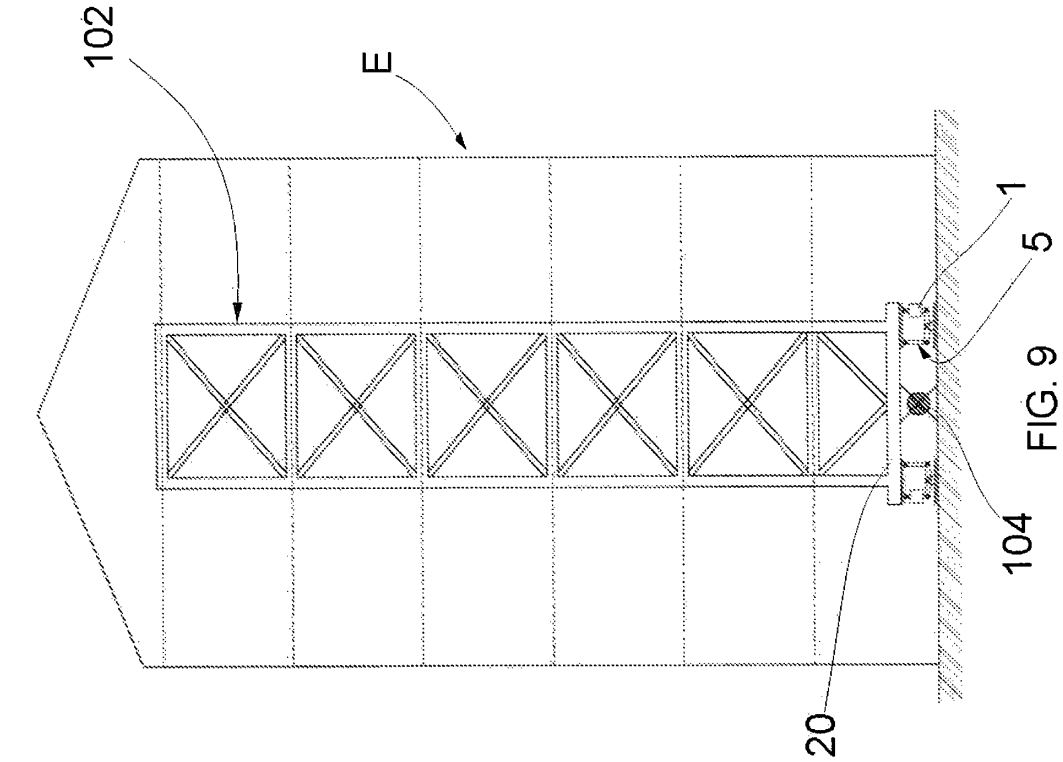


FIG. 9

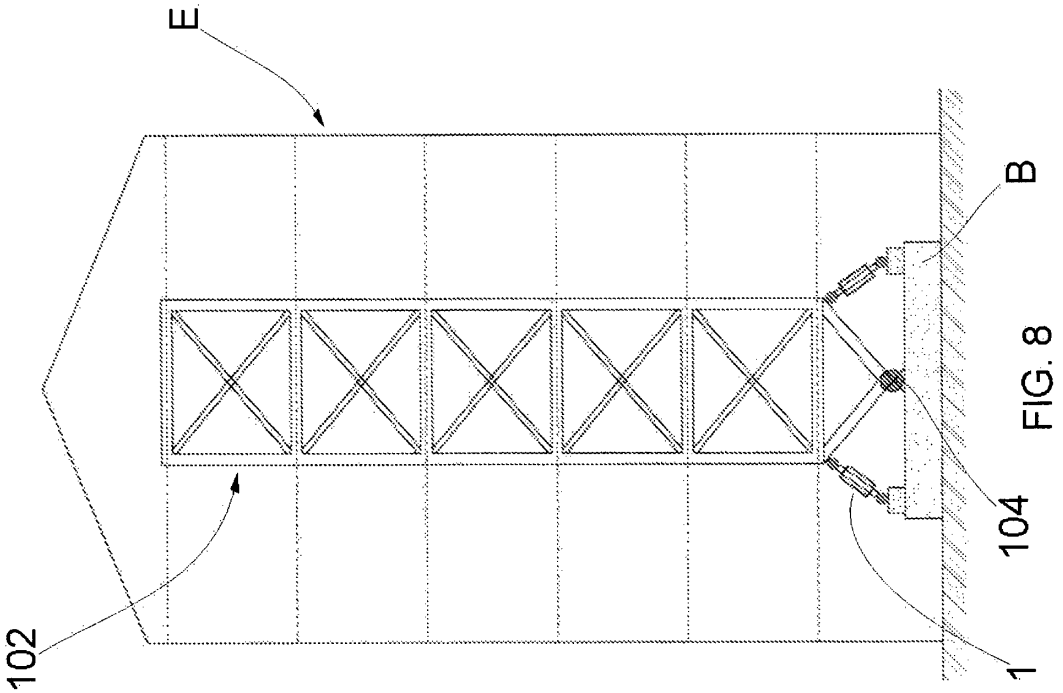


FIG. 8

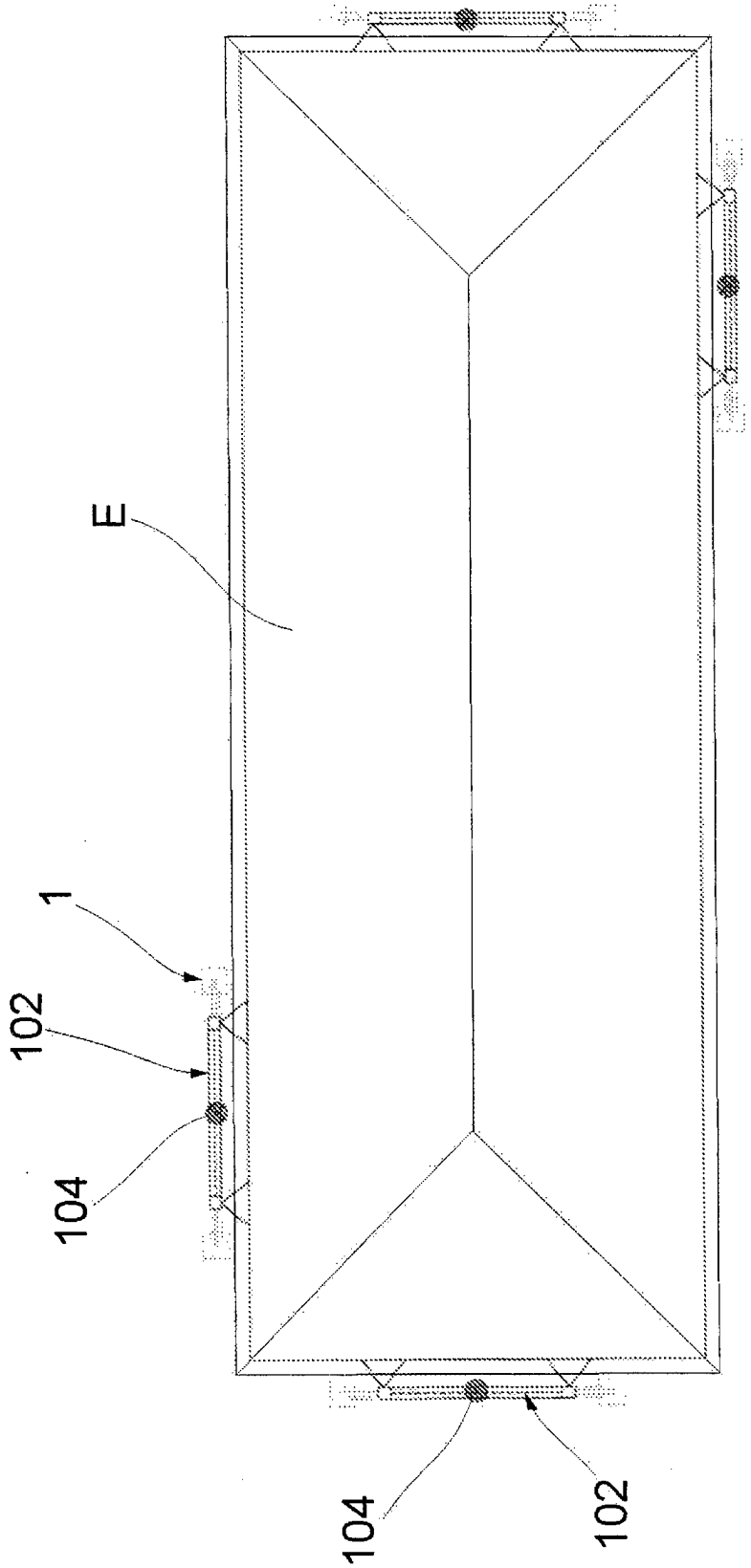
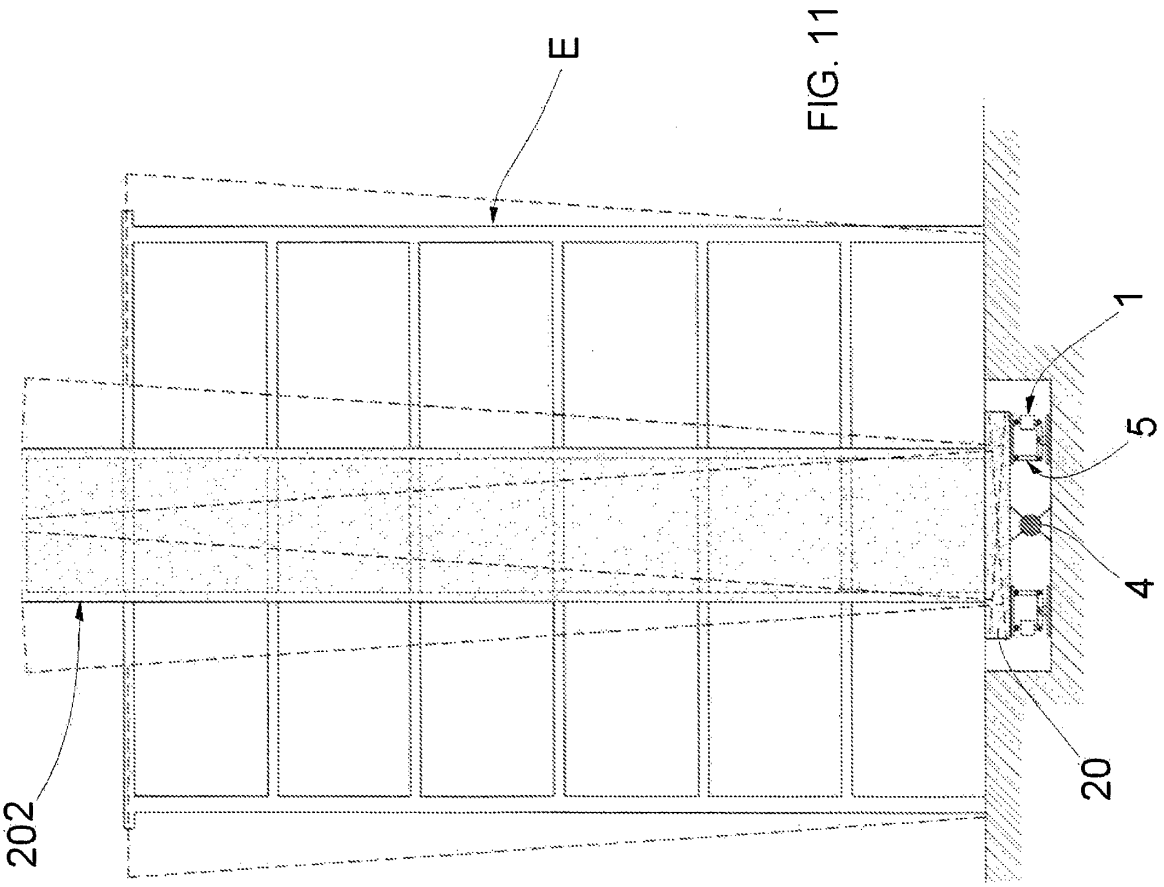


FIG. 10

FIG. 11



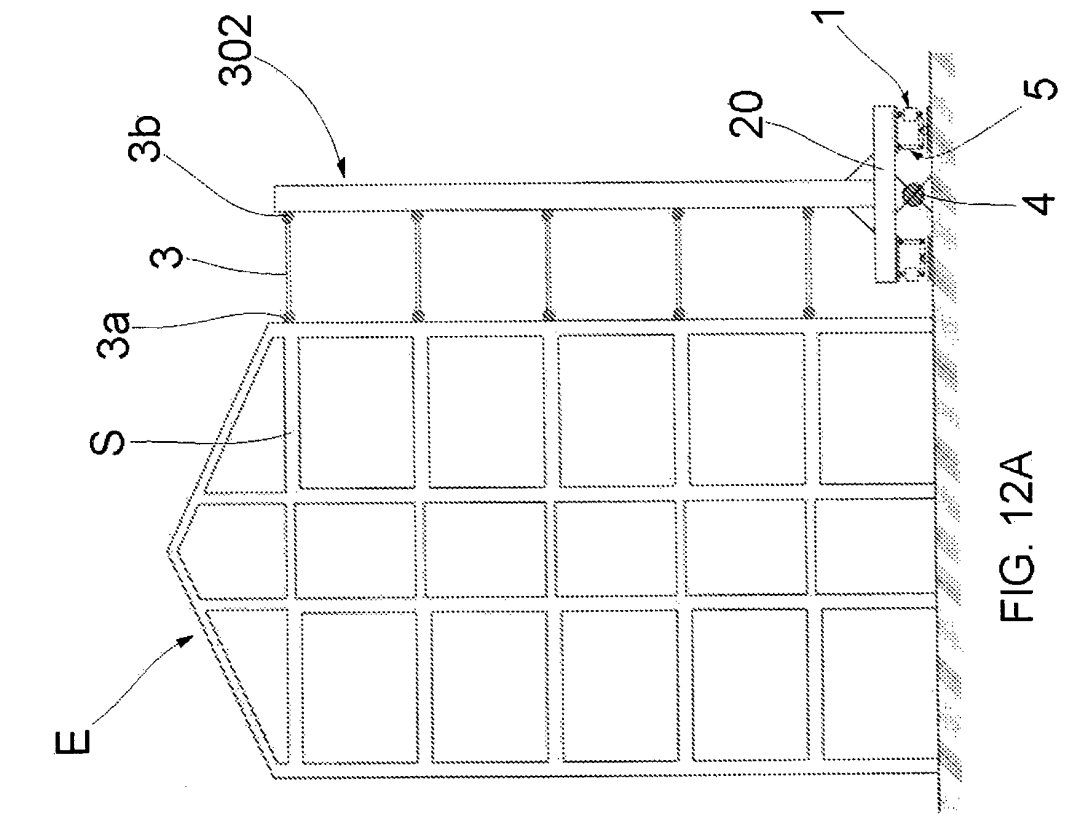


FIG. 12A

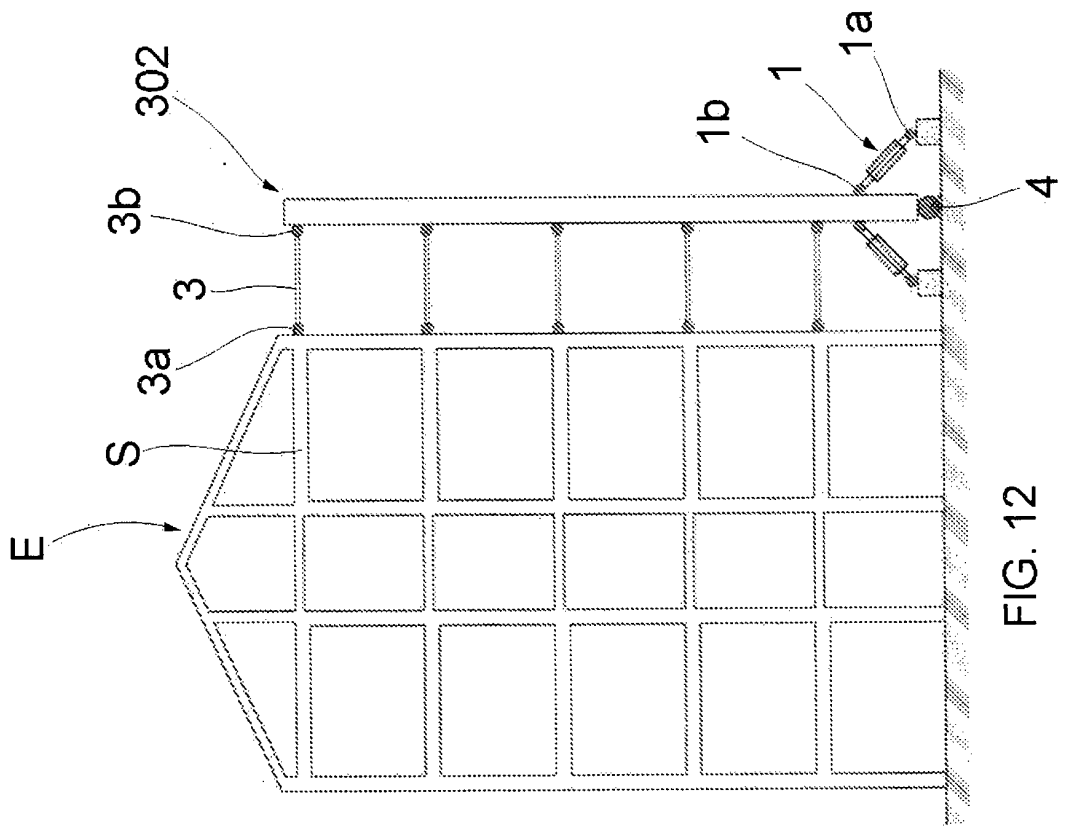


FIG. 12

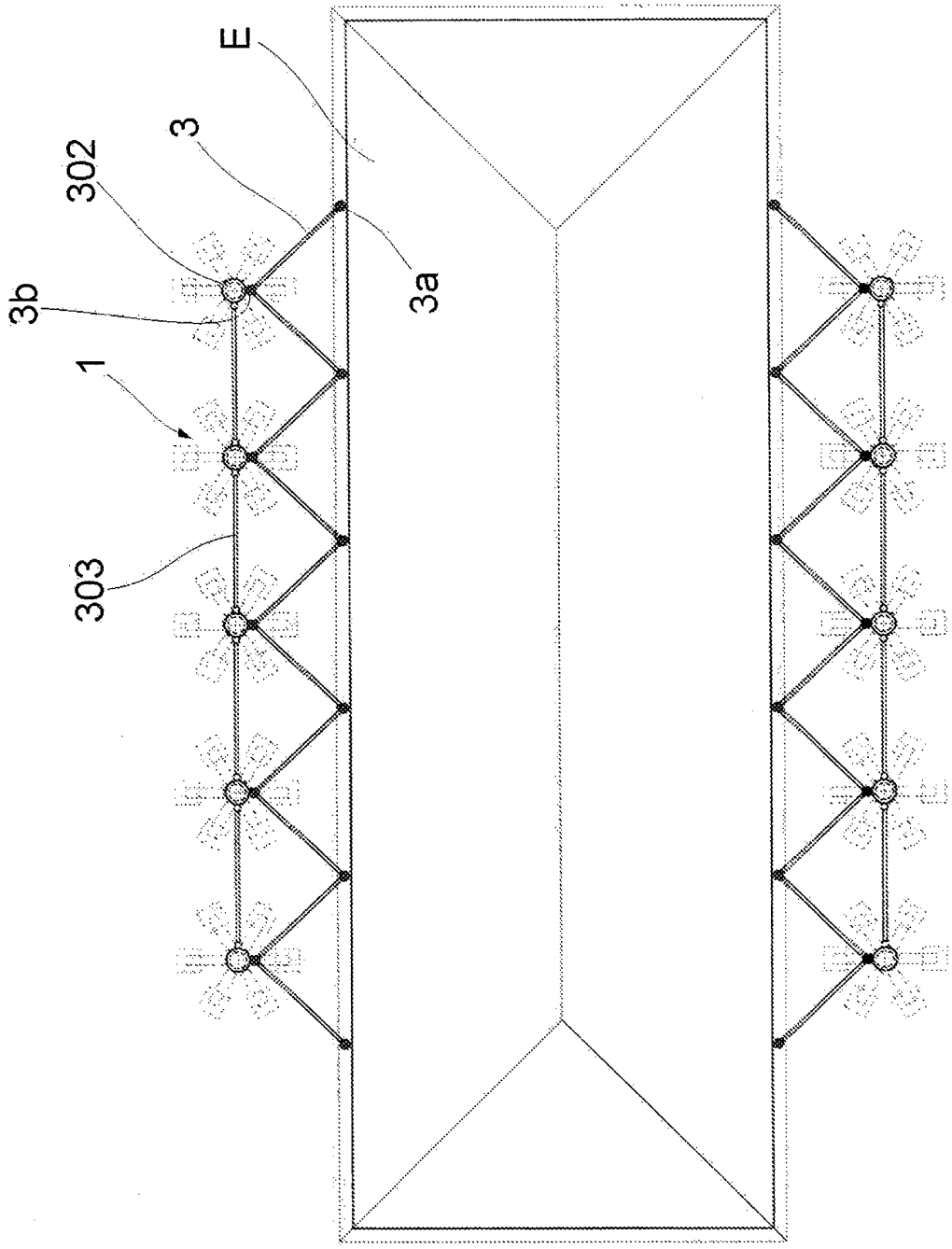


FIG. 13

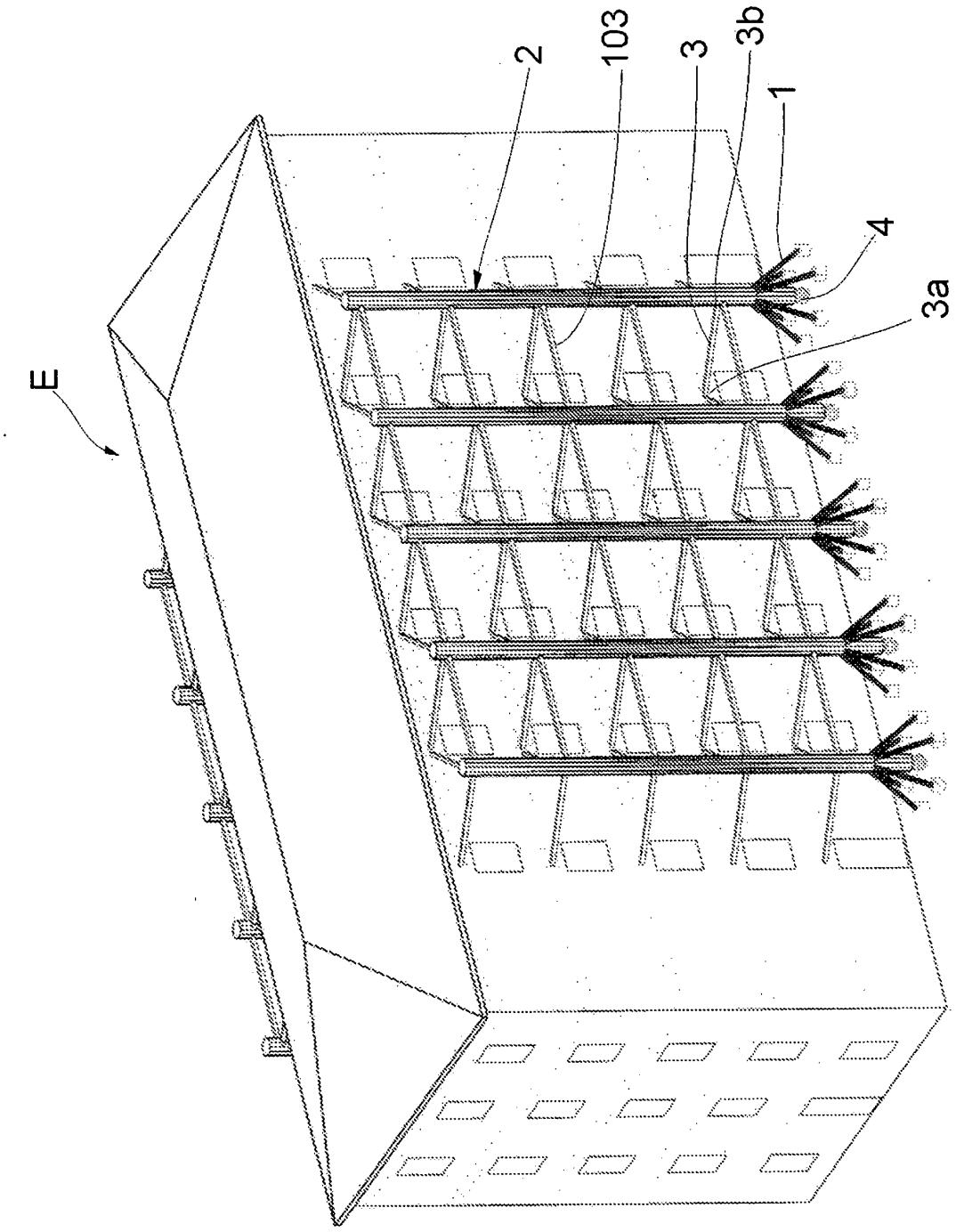


FIG. 14

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 9235890 A **[0011]**