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(54) FRICTION DAMPING ASSEMBLY

REIBUNGSDÄMPFUNG MONTAGE

ASSEMBLAGE AMORTISSEUR DE FRICTION

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Description

Background of the invention

[0001] The invention relates to a friction damping assembly, in particular an assembly that is installable between at least two elements of a structure in which such elements are susceptible of performing reciprocal movements.

[0002] The assembly in question can be associated with a structure or construction in order to increase the dissipation properties thereof, for example to improve the capacity of the structure or construction to withstand seismic events or other potentially disastrous phenomena, strong winds, violent air movements, vibrations (for example caused by machinery), etc.

[0003] Specifically, but not exclusively, the damping assembly in question can be installed in a multi-storey building. Document WO2011/038742 A1 discloses the features of the preamble of claim 1.

Summary of the invention

[0004] One object of the invention is to make available a damping assembly that is able to ensure a high level of energy dissipation between two structural elements that can move reciprocally.

[0005] The damping assembly in question can be installed in a building (for example in a multi-storey building), in particular, merely by way of non-limiting example, in order to achieve one or more of the following objects and/or advantages:

a) limiting horizontal movements and accelerations in the event of a seismic event;
b) providing additional resistance to the bracing system in the event of a sizable seismic event;
c) reducing the seismic actions acting on the bracing system in the event of a minor seismic event.

[0006] One advantage is reducing movements, accelerations and forces associated with the action that induces a corresponding movement between the structural elements to which the damping assembly in question is connected.

[0007] One advantage is the possibility of modulating the damping effect induced by the present assembly on the structure in which it is installed.

[0008] One advantage is reducing the undesirable effect of potentially destructive actions, in particular horizontal actions, on various types of structure, owing to the dissipation contribution provided by the damping assembly.

[0009] One advantage is the ease and speed of installation of the damping assembly, both on existing buildings and on buildings being built.

[0010] The assembly in question can be advantageously used both in newly constructed structures (for example buildings), in particular for making building systems with zero damage, and in existing structures, in particular for mitigating or eliminating the seismic vulnerability thereof.

[0011] Such objects and advantages and still others are achieved by an assembly according to one or more of the claims set out below.

[0012] In one or more embodiments, the damping assembly comprises at least one first element extending longitudinally, at least one second element extending longitudinally and coupled rotatably with the first element around a first rotation axis, first friction means interposed between the first element and the second element and first prestressing means configured to prestress the first friction means between the first element and the second element.

[0013] In one or more embodiments, the damping assembly may be made in the form of a panel that is insertable into a building structure as a facade curtain wall element, or as an internal compartmentalization element, or a bracing and dissipation element in the floor plane.

Brief description of the drawings

[0014] The invention can be understood better and implemented with reference to the enclosed drawings that illustrate embodiments thereof by way of non-limiting examples:

Figure 1 is a vertical raised frontal view of a first embodiment of a damping assembly;
Figure 2 is a right side view of Figure 1;
Figure 3 is a vertical raised frontal view of a second embodiment of a damping assembly;
Figure 4 is a vertical raised frontal view of a third embodiment of a damping assembly applied to a building structure;
Figure 5 is section V-V of Figure 4;
Figure 6 is an enlarged detail of Figure 5;
Figure 7 is a vertical raised frontal view of a fourth embodiment of a damping assembly applied to a building structure;
Figure 8 is a section on a vertical plane of the assembly of Figure 6;
Figure 9 is an exploded view of a fifth embodiment of a damping assembly.

Detailed description

[0015] With reference to the aforesaid figures, analogous elements of difference embodiments have been indicated, for the sake of simplicity of exposition, by the same numbering. With 1, overall, a friction damping assembly has been indicated that is intended for being installed in a structure between at least two structural elements that can be subjected to moving reciprocally if stressed by external actions, for example actions caused by seismic events, strong winds, violent air movements,

vibrations (for example induced by machinery), etc. The damping assembly 1 may be associated with the structure to increase the dissipation properties thereof and thus improve the capacity thereof to withstand the aforesaid external actions.

[0016] The damping assembly 1 comprises at least one first element 2a extending along a first longitudinal axis k1.

[0017] The damping assembly 1 comprises at least one second element 3a extending along a second longitudinal axis k2.

[0018] The second element 3a is coupled with the first element 2a with the possibility of performing a rotation with respect to the first element 2a around a first rotation axis x1. In particular, the first element 2a and the second element 3a may be coupled with one another by a first hinge zone 4a (where hinge is defined as a constraint that suppresses two degrees of freedom and does not react to the mechanical torque, i.e. a constraint that permits the constrained object only rotations, eliminating translation), for example a first rotation pin, which defines the first rotation axis x1. The first rotation axis x1 is transverse to the first longitudinal axis k1 and to the second longitudinal axis k2.

[0019] The damping assembly 1 comprises first friction means 5a interposed between the first element 2a and the second element 3a. The first friction means 5a are arranged around the first rotation axis x1. The first friction means 5a may comprise, in particular, at least one pair of abrasive surfaces in mutual contact. A first abrasive surface may be arranged on one side of the first element 2a. A second abrasive surface may be arranged on one side of the second element 3a.

[0020] The damping assembly 1 comprises first prestressing means 6a configured to prestress with a compression force N the first friction means 5a between the first element 2a and the second element 3a. The first prestressing means 6a may comprise, in particular, screw means provided with a thread coupled with the first element 2a and pretensioned so as to prestress at least the first friction means 5a between the first element 2a and the second element 3a. The first screw means may comprise, for example, at least one bolt (for example a screw coupled with a nut or a counter-rivet) and/or at least one device against spontaneous loosening (for example a washer, a lock nut, a split pin, a Belleville washer, etc). The first prestressing means 6a may comprise, in particular, fastening means of another type, alternatively or in addition to the screw means, for example rivet and/or nail means.

[0021] The damping assembly 1 may comprise, in particular, a further first element 7a extending along a further first longitudinal axis j1. The further first element 7a may be coupled, as in these embodiments, with the second element 3a with the possibility of performing a rotation with respect to the second element 3a around the aforesaid first rotation axis x1. In particular, the further first element 7a and the second element 3a may be coupled with one another by the first hinge zone 4a.

[0022] The second element 3a may be, as in these embodiments, interposed between the first element 2a and the further first element 7a.

[0023] The damping assembly 1 may comprise, in particular, further first friction means 8a interposed between the further first element 7a and the second element 3a. The further first friction means 8a may be arranged, in particular, near the first rotation axis x1 and/or around the first rotation axis x1. The further first friction means 8a may comprise, in particular, at least one pair of abrasive surfaces in mutual contact, one first abrasive surface of which may be arranged on one side of the further first element 7a and a second abrasive surface may be arranged on one side of the second element 3a.

[0024] The first prestressing means 6a may be configured, in particular, to prestress the further first friction means 8a between the further first element 7a and the second element 3a.

[0025] With reference to the embodiments of figures 3, 4 and 6, the damping assembly 1 comprises a third element 2b extending along a third longitudinal axis k3 and coupled with the second element 3a with the possibility of performing a rotation with respect to the second element 3a around a second rotation axis x2. In particular, the second element 3a and the third element 2b may be coupled with one another by a second hinge zone 4b (for example a second rotation pin) that defines the second rotation axis x2. The second rotation axis x2 may be, in particular, transverse to the second longitudinal axis k2 and to the third longitudinal axis k3. The first rotation axis x1 and the second rotation axis x2 may be, as in these embodiments, parallel to and spaced apart from one another.

[0026] The damping assembly 1 comprises second friction means 5b interposed between the second element 3a and the third element 2b. The second friction means 5b are arranged around the second rotation axis x2.

[0027] The second friction means 5b may comprise, in particular, at least one pair of abrasive surfaces in mutual contact, one first abrasive surface of which may be arranged on one side of the second element 3a and a second abrasive surface may be arranged on one side of the third element 2b.

[0028] The damping assembly 1 comprises second prestressing means 6b configured to prestress the second friction means 5b between the second element 3a and the third element 2b.

[0029] The damping assembly 1 comprises a fourth element 3b extending along a fourth longitudinal axis k4 and coupled with the third element 2b with the possibility of performing a rotation with respect to the third element 2b around a third rotation axis x3 that is transverse to the third longitudinal axis k3 and to the fourth longitudinal axis k4. In particular, the fourth element 3b and the third element 2b may be coupled together by a third hinge zone 4c (for example a third rotation pin) that defines the

third rotation axis x3.

[0030] The fourth element 3b is coupled with the first element 2a with the possibility of performing a rotation with respect to the first element 2a around a fourth rotation axis x4 that is transverse to the first longitudinal axis k1 and to the fourth longitudinal axis k4. In particular, the fourth element 3b and the first element 2a may be coupled with one another by a fourth hinge zone 4d (for example a fourth rotation pin) that defines the fourth rotation axis x4.

[0031] The first element 2a and the third element 2b may be installed, as in these embodiments, so as to be transverse (for example orthogonal) to the second element 3a and to the fourth element 3b.

[0032] The damping assembly 1 comprises third friction means 5c interposed between the third element 2b and the fourth element 3b. The third friction means 5c are arranged around the third rotation axis x3.

[0033] The third friction means 5c may comprise, in particular, at least one pair of abrasive surfaces in mutual contact, one abrasive surface of which may be arranged on one side of the third element 2b and the other abrasive surface may be arranged on one side of the fourth element 3b.

[0034] The damping assembly 1 comprises fourth friction means 5d interposed between the fourth element 3b and the first element 2a. The fourth friction means 5d are arranged around the fourth rotation axis x4. The fourth friction means 5d may comprise, in particular, at least one pair of abrasive surfaces in mutual contact, one of which may be arranged on one side of the fourth element 3b and the other may be arranged on one side of the first element 2a.

[0035] The damping assembly 1 comprises third prestressing means 6c configured to prestress the third friction means 5c between the third element 2b and the fourth element 3b.

[0036] The damping assembly 1 comprises fourth prestressing means 6d configured to prestress the fourth friction means 5d between the first element 2a and the fourth element 3b.

[0037] The damping assembly 1 may comprise, in particular, a further third element 7b extending along a further third longitudinal axis j3. The further third element 7b may be coupled, as in these embodiments, with the second element 3a with the possibility of performing a rotation with respect to the second element 3a around the aforesaid second rotation axis x2. In particular, the further third element 7b and the second element 3a may be coupled with one another by the second hinge rotation zone 4b. The second element 3a may be, as in these embodiments, interposed between the third element 2b and the further third element 7b.

[0038] The damping assembly 1 may comprise, in particular, further second friction means 8b interposed between the further third element 7b and the second element 3a. The further second friction means 8b may be arranged, in particular, near the second rotation axis x2 and/or around the second rotation axis x2.

[0039] The second prestressing means 6b may be configured, in particular, to prestress the further second friction means 8b between the further third element 7b and the second element 3a.

[0040] The first, the second, the third and the fourth rotation axis x4 may be parallel to and spaced apart from one another. In particular, the first, the second, the third and the fourth rotation axis x4 may be arranged, as in these embodiments, so as to define overall a right prism with a square or rhombic base.

[0041] The damping assembly 1 comprises a fifth element 2c that is longitudinal, side by side, parallel to and coplanar with the third element 2b. The fifth element 2c is coupled with the second element 3a and with the fourth element 3b so as to define, on the whole together with the other elements, six rotation axes (defined by six hinge zones 4a, 4b, 4c, 4d, 4e, 4f) arranged in a lattice with square or rhombic links, at each of which the same number of friction means is arranged, respectively 5a, 5b, 5c, 5d, ..., etc, and the same number of prestressing means respectively 6a, 6b, 6c, 6d, ..., etc. It is possible to arrange further friction means 8a, 8b, 8c, 8d, ..., etc, in addition to the friction means 5a, 5b, 5c, 5d, ..., etc.

[0042] The damping assembly 1 comprises a sixth element 3c that is longitudinal, side by side, parallel to and coplanar with the fourth element 3b. The sixth element 3c is coupled with the first element 2a, with the third element 2b and with the fifth element 2c so as to define another three rotation axes (defined by three hinge zones) arranged in a lattice with square or rhombic links together with the other hinge zones, at each of which the same number of friction means is arranged and the same number of prestressing means. It is possible to arrange further friction means in addition to each of the aforesaid friction means.

[0043] It is possible to arrange a further fifth element that is longitudinal, side by side, parallel to and coplanar with the further third element 7b. The second element 3a and/or the fourth element 3b and/or the sixth element 3c may be, as in these embodiments, interposed between the fifth element 2c and the further fifth element.

[0044] Each longitudinal element 2a, 2b, 2c, ..., 3a, 3b, 3c, ..., 7a, 7b, ..., can comprise, in particular, a plate-like body (lamella, foil, lath, strip, shingle, stave, slab, etc), for example made of solid wood or of a material based on wood (laminate), or of other materials (metal, plastic, cement, composite, etc).

[0045] The various longitudinal elements may be arranged so as to form a panel in which the various elements 2a, 2b, 2c, ..., may be side by side, parallel to and coplanar with one another and/or in which the various elements 3a, 3, b, 3c, ..., may be side by side, parallel to and coplanar with one another and/or in which the various further elements 7a, 7b, ..., may be side by side, parallel to and coplanar with one another. The panel may comprise a layer with a desired number (one, two, three or more than three) parallel longitudinal elements in one

(for example vertical) direction and a layer with a desired number (one, two, three or more than three) of parallel longitudinal elements in another (for example horizontal) direction. The panel may comprise a further layer with a desired number (one, two, three or more than three) of further longitudinal elements. The panel may comprise a number of longitudinal elements greater than three.

[0046] Each of the friction means and possible further friction means may comprise a pair of contact abrasive surfaces arranged on two respective reciprocally facing longitudinal elements.

[0047] The aforesaid abrasive surfaces of the various friction means and/or of the further friction means may be, as in these embodiments, parallel to or coplanar with one another. Each abrasive surface may comprise, for example, at least one layer of abrasive material, for example of powder and/or granules, and/or at least one high roughness surface layer produced by surface processing. The various friction means may comprise, as in the illustrated embodiments, sheets of paper or abrasive cloth.

[0048] It is possible to provide, as in the embodiment of figure 7, for the first prestressing means to comprise at least one crosspiece 9a coupled with the first element 2a (and/or with the third element 2b and/or with the fifth element 2c, etc) by fastening means, for example of the screw or rivet type, that is pretensioned so as to prestress the various friction means. The first prestressing means may comprise at least one counter-crosspiece 9b opposed to the crosspiece 9a.

[0049] In particular, it is possible to provide a plurality of crosspieces 9a, for example arranged parallel to one another and/or a plurality of counter-crosspieces 9b each opposed to a respective crosspiece 9a. Each crosspiece 9a may extend in length in a direction that is transverse to the first element 2a. Each crosspiece 9a and/or each counter-crosspiece 9b may comprise, in particular, a beam (for example with a square or rectangular section) made of wood or of a material based on wood.

[0050] The damping assembly may be used, for example, to improve the capacity of a structure to withstand external stress. In one embodiment it is possible to install the first element 2a and/or the third element 2b and/or the fifth element 2c, etc, in a vertical position to connect together two floors of a structure, or horizontally to connect the exterior walls of a structure. In another embodiment it is possible to install the second element 3a and/or the fourth element 3b and/or the sixth element 3c, etc, in a vertical position to connect together two floors of a structure, or horizontally to connect the exterior walls of a structure.

[0051] The damping assembly 1 may be made, as has been seen, in the shape of a panel comprising two or more layers of longitudinal elements (in particular of flat shape, for example lamellas, laths, slabs, shingles, boards, etc) arranged transversely and coupled together by several hinge zones with rotation axes that are parallel to one another arranged in a lattice with square or rhombic links.

[0052] The high energy dissipation capacity is assured by the friction means that is set up between the various pairs of reciprocally facing longitudinal elements that are prestressed in an adjustable manner.

[0053] The friction means comprises contact surfaces that have surface roughness that is relatively high in the interfaces between the various layers of the panel. These contact surfaces may be surfaces of the various longitudinal elements (lamellas, laths, slabs, shingles, boards, etc) that are processed, for example, in one or more of the following modes: 1) gluing one or more sheets of abrasive paper; 2) application of one or more layers of abrasive powder (for example silicon glass) on a predistributed adhesive layer; 3) surface treatment for increasing the roughness of the surface.

[0054] The friction means may be pre-stressed, in particular, by a series of screw coupling means arranged in a lattice (with square or rhombic links) for assembling the layers of the panel. The screw means may be arranged at the hinge zones (rotation pins) that in this case may be an integral part of the screw means.

[0055] The panel may have, as has been seen, an arrangement of the hinge zones in the form of a lattice with square or rhombic links, so that the coupling means between the various layers of the resulting structure does not constitute a constraint that is such as to prevent the shearing deformation of the panel. In this case, the shearing deformation of the panel is conditioned mainly, or almost solely, by the friction generated by the friction means (surfaces with great roughness) arranged on the various (longitudinal) elements that form the layers of the panel.

[0056] The screw means, in addition to permitting the assembly between the various longitudinal elements and/or the various layers of the panel (and to providing the hinge zones), may also ensure the desired degree of axial preload between the various longitudinal elements and/or the various layers of the panel, so as to control the friction force that can be exerted between the various suitably prestressed (reciprocal rubbing surfaces).

[0057] The preload may be obtained, as has been seen, by one or more threads of the screw means, in which each thread may couple with a sole longitudinal element (for example an element arranged on one side of the assembly). The preload may be maintained almost constant over time by using a split washer (installed on the side of the assembly opposite the side coupled with the thread) capable of compensating for possible shrinkage and transverse swelling phenomena of the longitudinal element (for example made of wood or of a material based on wood).

[0058] It is possible, as in the embodiment of Figure 7, to use "sandwich" closing means for closing the damping assembly, in which the "sandwich" closing means comprises a series of longitudinal bodies (beams or squared timber) that are parallel to one another that close the two

sides of the damping or dissipating assembly (panel) (with crosspiece elements) and are tightened by tightening (screw) means.

[0059] It is possible to adjust the resistance to shearing of the damping or dissipating assembly in various manners: for example, by modifying the number of layers of longitudinal elements (lamellas, slabs, foils, laths, shingles, boards, etc) that are coupled and/or crossed with one another, varying the dimension of the longitudinal elements, adjusting the preloading level of the prestressing means (tightening screws), adopting friction means with different friction coefficients, etc.

[0060] The damping assembly in question, that may comprise, in particular, a panel with two or more layers of longitudinal elements coupled together by hinge zones arranged in a lattice with square or rhombic links, is capable of ensuring a high level of energy dissipation of friction type and thus significantly increasing the damping capacity of the structure (for example of the building system) in which it is installed, for example as a curtain wall element and/or facade cladding, internal dividing wall or screed above the horizontal planes.

[0061] The assembly in question thus enables the damping capacity of (new or existing) constructions to be increased significantly, improving the ability thereof to withstand seismic events, even of considerable intensity.

Legend:

[0062]

1	damping assembly
2a, 2b, 2c	first element, third element, fifth element
3a, 3b, 3c	second element, fourth element, sixth element
4a, 4b, 4c	first hinge zone, second hinge zone, third hinge zone
4d, 4e, 4f	fourth hinge zone, fifth hinge zone, sixth hinge zone
5a, 5b	first friction means, second friction means
5c, 5d	third friction means, fourth friction means
6a, 6b	first prestressing means, second prestressing means
6c, 6d	third prestressing means, fourth prestressing means
7a, 7b	further first element, further third element
8a, 8b	further first friction means, further second friction means
8c, 8d	further third friction means, further fourth friction means
9a, 9b	crosspiece, counter-crosspiece
x1, x2	first rotation axis, second rotation axis
x3, x4	third rotation axis, fourth rotation axis
k1, k2	first longitudinal axis, second longitudinal axis
k3, k4	third longitudinal axis, fourth longitudinal axis
j1, j3	further first longitudinal axis, further third longitudinal axis

Claims

1. Friction damping assembly, comprising:

- a first element (2a) extending along a first longitudinal axis (k1);
- a second element (3a) extending along a second longitudinal axis (k2) and coupled with the first element (2a) with the possibility of performing a rotation with respect to the first element (2a) around a first rotation axis (x1) that is transverse to the first longitudinal axis (k1) and to the second longitudinal axis (k2);
- first friction means (5a) interposed between said first element (2a) and said second element (3a) around said first rotation axis (x1);
- first prestressing means (6a) configured to prestress said first friction means (5a) between said first element (2a) and said second element (3a);
- a third element (2b) extending along a third longitudinal axis (k3) and coupled with the second element (3a) with the possibility of performing a rotation with respect to the second element (3a) around a second rotation axis (x2) that is transverse to the second longitudinal axis (k2) and to the third longitudinal axis (k3), said first and second rotation axis (x1; x2) being parallel to and spaced apart from one another;
- second friction means (5b) interposed between said second element (3a) and said third element (2b) around said second rotation axis (x2);
- second prestressing means (6b) configured to prestress said second friction means (5b) between said second element (3a) and said third element (2b);
- a fourth element (3b) extending along a fourth longitudinal axis (k4) and coupled with the third element (2b) with the possibility of performing a rotation with respect to the third element (2b) around a third rotation axis (x3) that is transverse to the third longitudinal axis (k3) and to the fourth longitudinal axis (k4), said first, second and third rotation axis (x1; x2; x3) being parallel to and spaced apart from one another, said fourth element (3b) being coupled with the first element (2a) with the possibility of performing a rotation with respect to the first element (2a) around a fourth rotation axis (x4) that is transverse to the first longitudinal axis (k1) and to the fourth longitudinal axis (k4), said first, second, third and fourth rotation axis (x1; x2; x3; x4) being parallel to and spaced apart from one another, in which said elements (2a; 3a; 2b; 3b) are arranged so as to form a panel in which said first element

(2a) and third element (2b) are side by side, parallel to and coplanar with one another and said second element (3a) and fourth element (3b) are side by side, parallel to and coplanar with one another, said first element (2a) and third element (2b) being transverse to said second element (3a) and fourth element (3b);
- third friction means (5c) interposed between said third element (2b) and said fourth element (3b) around said third rotation axis (x3);
- fourth friction means (5d) interposed between said fourth element (3b) and said first element (2a) around said fourth rotation axis (x4);
- third prestressing means (6c) configured to prestress said third friction means (5c) between said third element (2b) and said fourth element (3b);
- fourth prestressing means (6d) configured to prestress said fourth friction means (5d) between said first element (2a) and said fourth element (3b);
- a fifth element (2c) side by side, parallel to and coplanar with said third element (2b), said fifth element (2c) being coupled with said second and fourth element (3a and 3b) so as to define, on the whole, six rotation axes with friction and prestressing means arranged in a lattice with square or rhombic links; **characterized by** comprising:
- a sixth element (3c) side by side, parallel to and coplanar with said fourth element (3b), said sixth element (3c) being coupled with said first, third and fifth element (2a, 2b and 2c) so as to define, on the whole, nine rotation axes with friction and prestressing means arranged in a lattice with square or rhombic links;

wherein each element (2a, 2b, 2c, 3a, 3b, 3c, 7a, 7b) comprises a plate-like body made of solid wood or of a material based on wood.

2. Assembly according to claim 1, wherein said first, second, third and fourth rotation axis (x1, x2, x3, x4) are arranged so as to define a right prism with a square or rhombic base.

3. Assembly according to claim 1 or 2, wherein:

- said first friction means (5a) comprises at least one pair of abrasive surfaces in mutual contact, one arranged on one side of the first element (2a) and the other arranged on one side of the second element (3a);
- said second friction means (5b) comprises at least one pair of abrasive surfaces in mutual contact, one arranged on one side of the second element (3a) and the other arranged on one side of the third element (2b);
- said third friction means (5c) comprises at least one pair of abrasive surfaces in mutual contact, one arranged on one side of the third element (2b) and the other arranged on one side of the fourth element (3b);
- said fourth friction means (5d) comprises at least one pair of abrasive surfaces in mutual contact, one arranged on one side of the fourth element (3b) and the other arranged on one side of the first element (2a).

4. Assembly according to claim 3, wherein said abrasive surfaces of the first, second, third and fourth friction means are parallel to or coplanar with one another.

5. Assembly according to claim 3 or 4, wherein one or more of said abrasive surfaces comprises at least one layer of abrasive material, for example of powder and/or granules.

6. Assembly according to any one of claims 3 to 5, wherein one or more of said abrasive surfaces comprises at least one high roughness surface layer produced by surface processing.

7. Assembly according to any preceding claim, comprising at least one first hinge zone (4a) around which said first and second element (2a and 3a) can rotate in relation to one another.

8. Assembly according to any preceding claim, wherein said first prestressing means (6a) comprises screw means provided with a thread coupled with said first element (2a) and pretensioned so as to prestress said first friction means (5a).

9. Assembly according to any preceding claim, wherein said first prestressing means (6a) comprises rivet means pretensioned so as to prestress said first friction means (5a).

10. Assembly according to any preceding claim, wherein said first prestressing means (6a) comprises at least one crosspiece (9a) coupled with said first element (2a) by fastening means, for example of the screw and/or rivet type, pretensioned so as to prestress said first and second friction means (5a and 5b), said at least one crosspiece (9a) extending in length in a direction that is transverse to said first element (2a).

11. Assembly according to claim 10, wherein said at least one crosspiece (9a) comprises a beam made of wood or of a material based on wood;

12. Assembly according to claim 10 or 11, wherein said first prestressing means (6a) comprises at least one counter-crosspiece (9b) opposed to said at least one

crosspiece (9a).

13. Assembly according to any preceding claim, comprising a further first element (7a) extending along a further first longitudinal axis (j1) and coupled with the second element (3a) with the possibility of performing a rotation with respect to the second element (3a) around said first rotation axis (x1), said second element (3a) being interposed between said first element (2a) and said further first element (7a).

14. Assembly according to claim 13, comprising further first friction means (8a) interposed between said further first element (7a) and said second element (3a) around said first rotation axis (x1), said first prestressing means (6a) being configured to prestress said further first friction means (8a) between said further first element (7a) and said second element (3a).

15. Use of an assembly according to any preceding claim to improve the capacity of a structure to withstand external stress, in which one of said first and second element is installed vertically to connect two floors of a structure to each other, or horizontally to connect exterior walls of a structure.

Patentansprüche

1. Reibungsdämpfungsanordnung, die Folgendes aufweist:

- ein erstes Element (2a), das sich entlang einer ersten Längsachse (k1) erstreckt;
- ein zweites Element (3a), das sich entlang einer zweiten Längsachse (k2) erstreckt und mit dem ersten Element (2a) mit der Möglichkeit gekoppelt ist, eine Drehung in Bezug auf das erste Element (2a) um eine erste Rotationsachse (x1) auszuführen, die senkrecht zu der ersten Längsachse (k1) und der zweiten Längsachse (k2) ist;
- ein erstes Reibungsmittel (5a), das zwischen dem ersten Element (2a) und dem zweiten Element (3a) um die erste Drehachse (x1) angeordnet ist;
- ein erstes Vorspannmittel (6a), das ausgebildet ist, das erste Reibungsmittel (5a) zwischen dem ersten Element (2a) und dem zweiten Element (3a) vorzuspannen;
- ein drittes Element (2b), das sich entlang einer dritten Längsachse (k3) erstreckt und mit dem zweiten Element (3a) mit der Möglichkeit gekoppelt ist, eine Drehung in Bezug auf das zweite Element (3a) um eine zweite Drehachse (x2) auszuführen, die senkrecht zu der zweiten Längsachse (k2) und der dritten Längsachse (k3) ist, wobei die erste und die zweite Rotationsachse (x1; x2) parallel zueinander und voneinander beabstandet sind;
- ein zweites Reibungsmittel (5b), das zwischen dem zweiten Element (3a) und dem dritten Element (2b) um die zweite Drehachse (x2) drehbar angeordnet ist;
- ein zweites Vorspannmittel (6b), das dazu ausgebildet ist, das zweite Reibungsmittel (5b) zwischen dem zweiten Element (3a) und dem dritten Element (2b) vorzuspannen;
- ein viertes Element (3b), das sich entlang einer vierten Längsachse (k4) erstreckt und mit dem ersten Element (2b) mit der Möglichkeit gekoppelt ist, eine Drehung in Bezug auf das dritte Element (2b) um eine dritte Drehachse (x3) auszuführen, die senkrecht zu der dritten Längsachse (k3) und zu der vierten Längsachse (k4) ist, wobei die erste, zweite und dritte Drehachse (x1; x2; x3) parallel zueinander und voneinander beabstandet sind, wobei das vierte Element (3b) mit dem ersten Element (2a) mit der Möglichkeit gekoppelt ist, eine Drehung in Bezug auf das erste Element (2a) um eine vierte Drehachse (x4) auszuführen, die senkrecht zu der ersten Längsachse (k1) und zu der vierten Längsachse (k4) ist, wobei die erste, zweite, dritte und vierte Drehachse (x1; x2; x3; x4) zueinander parallel und voneinander beabstandet sind, wobei die Elemente (2a; 3a; 2b; 3b) angeordnet sind, um eine Tafel zu bilden, bei der das erste Element (2a) und das dritte Element (2b) zueinander parallel und koplanar miteinander sind, und wobei das zweite Element (3a) und das vierte Element (3b) nebeneinander parallel und koplanar miteinander sind, wobei das erste Element (2a) und das dritte Element (2b) quer zu dem zweiten Element (3a) und dem vierten Element (3b) sind;
- wobei ein drittes Reibungsmittel (5c) zwischen dem ersten Element (2b) und dem vierten Element (3b) um die dritte Rotationsachse (x3) angeordnet ist;
- wobei ein viertes Reibungsmittel (5d) zwischen dem vierten Element (3b) und dem ersten Element (2a) um die vierte Drehachse (x4) angeordnet ist;
- wobei ein drittes Vorspannmittel (6c) dazu ausgebildet ist, das dritte Reibungsmittel (5c) zwischen dem dritten Element (2b) und dem vierten Element (3b) vorzuspannen;
- wobei ein viertes Vorspannmittel (6d) dazu ausgebildet ist, das vierte Reibungsmittel (5d) zwischen dem ersten Element (2a) und dem vierten Element (3b) vorzuspannen;
- wobei ein fünftes Element (2c) Seite an Seite, parallel zu dem dritten Element (2b) und koplanar damit angeordnet ist, wobei das fünfte Element (2c) mit dem zweiten und vierten Element (3a und 3b) gekoppelt ist, um so insgesamt

sechs Rotationsachsen zu definieren, wobei das Reibungs- und Vorspannmittel in einem Gitter mit quadratischen oder rhombischen Verbindungsgliedern angeordnet ist; **dadurch gekennzeichnet, dass**:
- ein sechstes Element (3c) Seite an Seite, parallel zu und koplanar mit dem vierten Element (3b) angeordnet ist, wobei das sechste Element (3c) mit dem ersten, dritten und fünften Element (2a, 2b und 2c) gekoppelt ist, um so insgesamt neun Rotationsachsen mit Reibungs- und Vorspannmitteln in einem Gitter mit quadratischen oder rhombischen Verbindungsgliedern zu bilden;

wobei jedes Element (2a, 2b, 2c, 3a, 3b, 3c, 7a, 7b) einen plattenartigen Körper aufweist, der aus festem Holz oder aus einem Material auf der Basis von Holz hergestellt ist.

2. Anordnung nach Anspruch 1, bei der die erste, zweite, dritte und vierte Rotationsachse (x1, x2, x3, x4) angeordnet sind, um ein rechtes Prisma mit einer quadratischen oder rhombischen Basis zu definieren.

3. Anordnung nach Anspruch 1 oder 2, bei der:

- das erste Reibungsmittel (5a) wenigstens ein Paar von Reibungsflächen in gemeinsamem Kontakt aufweist, wobei eine auf einer Seite des ersten Elements (2a) und das andere auf einer Seite des zweiten Elements (3a) angeordnet ist;
- das zweite Reibungsmittel (5b) wenigstens ein erstes Paar von Reibungsflächen in gemeinsamem Kontakt aufweist, wobei eine auf einer Seite des zweiten Elements (3a) und die andere auf einer Seite des dritten Elements (2b) angeordnet ist;
- wobei das dritte Reibungsmittel (5c) wenigstens ein Paar von Reibungsflächen in gemeinsamem Kontakt aufweist, wobei eine auf einer Seite des dritten Elements (2b) und die andere auf einer Seite des vierten Elements (3b) angeordnet ist;
- wobei das vierte Reibungsmittel (5d) wenigstens ein Paar von Reibungsflächen in gemeinsamem Kontakt aufweist, wobei eine auf einer Seite des vierten Elements (3b) und die andere auf einer Seite des ersten Elements (2a) angeordnet ist.

4. Anordnung nach Anspruch 3, bei der die Reibungsflächen der ersten, zweiten, dritten und vierten Reibungsmittel parallel zueinander und koplanar miteinander sind.

5. Anordnung nach Anspruch 3 oder 4, bei der eine oder mehrere der Reibungsflächen wenigstens eine Schicht aus Abrasivmaterial aufweist, zum Beispiel aus Pulver und/oder Granulaten.

6. Anordnung nach irgendeinem der Ansprüche 3 bis 5, bei der eine oder mehrere der Reibungsflächen wenigstens eine stark raue Oberflächenschicht aufweist, die durch Oberflächenbearbeitung hergestellt ist.

7. Anordnung nach irgendeinem vorhergehenden Anspruch, die wenigstens eine erste Gelenkzone (4a) aufweist, um die das erste und das zweite Element (2a und 3a) sich relativ zueinander drehen können.

8. Anordnung nach irgendeinem vorhergehenden Anspruch, bei der das erste Vorspannmittel (6a) ein Schraubenmittel aufweist, das mit einem Gewinde versehen ist, das mit dem ersten Element (2a) gekoppelt ist und vorgespannt ist, um so das erste Reibungsmittel (5a) vorzuspannen.

9. Anordnung nach irgendeinem vorhergehenden Anspruch, bei der das erste Vorspannmittel (6a) ein Nietenmittel aufweist, das vorgespannt ist, um so das erste Reibungsmittel (5a) vorzuspannen.

10. Anordnung nach irgendeinem vorhergehenden Anspruch, bei der das erste Vorspannmittel (6a) wenigstens ein Querstück (9a) aufweist, das mit dem ersten Element (2a) durch ein Befestigungsmittel gekoppelt ist, zum Beispiel von der Art einer Schraube und/oder eines Niets, das so vorgespannt ist, dass das erste und das zweite Reibungsmittel (5a und 5b) vorgespannt sind, wobei das wenigstens eine Querstück (9a) sich in der Länge in einer Richtung erstreckt, die quer zu dem ersten Element (2a) ist.

11. Anordnung nach Anspruch 10, bei der das wenigstens eine Querstück (9a) eine Strebe aufweist, die aus Holz oder aus einem Material auf der Basis von Holz besteht.

12. Anordnung nach Anspruch 10 oder 11, bei der das erste Vorspannmittel (6a) wenigstens ein Gegen-Querstück (9b) aufweist, das dem wenigstens einen Querstück (9a) gegenüberliegt.

13. Anordnung nach irgendeinem vorhergehenden Anspruch, die ein weiteres erstes Element (7a) aufweist, das sich entlang einer weiteren ersten Längsachse (j1) erstreckt und mit dem zweiten Element (3a) mit der Möglichkeit gekoppelt ist, eine Drehung in Bezug auf das zweite Element (3a) um die erste Drehachse (x1) auszuführen, wobei das zweite Element (3a) zwischen dem ersten Element (2a) und dem weiteren ersten Element (7a) angeordnet ist.

14. Anordnung nach Anspruch 13, bei der das erste Reibungsmittel (8a) zwischen dem ersten Element (7a) und dem zweiten Element (3a) um die erste Drehachse (x1) angeordnet ist, wobei das erste Vorspannmittel (6a) dazu ausgebildet ist, das weitere erste Reibungsmittel (8a) zwischen dem weiteren ersten Element (7a) und dem zweiten Element (3a) vorzuspannen.

15. Verwendung einer Anordnung nach irgendeinem vorhergehenden Anspruch, um die Kapazität einer Struktur zu verbessern, um äußerer Spannung zu widerstehen, wobei eines von dem ersten und zweiten Element vertikal angeordnet ist, um zwei Ebenen einer Struktur miteinander zu verbinden, oder horizontal, um die äußeren Wände einer Struktur zu verbinden.

Revendications

1. Assemblage d'amortissement de frottement, comprenant :

- un premier élément (2a) s'étendant le long d'un premier axe longitudinal (k1) ;
- un deuxième élément (3a) s'étendant le long d'un deuxième axe longitudinal (k2) et couplé au premier élément (2a) avec la possibilité de réaliser une rotation par rapport au premier élément (2a) autour d'un premier axe de rotation (x1) qui est transversal au premier axe longitudinal (k1) et au deuxième axe longitudinal (k2) ;
- un premier moyen de frottement (5a) interposé entre ledit premier élément (2a) et ledit deuxième élément (3a) autour dudit premier axe de rotation (x1) ;
- un premier moyen de précontrainte (6a) configuré pour précontraindre ledit premier moyen de frottement (5a) entre ledit premier élément (2a) et ledit deuxième élément (3a) ;
- un troisième élément (2b) s'étendant le long d'un troisième axe longitudinal (k3) et couplé au deuxième élément (3a) avec la possibilité de réaliser une rotation par rapport au deuxième élément (3a) autour d'un deuxième axe de rotation (x2) qui est transversal au deuxième axe longitudinal (k2) et au troisième axe longitudinal (k3), lesdits premier et deuxième axes de rotation (x1 ; x2) étant parallèles et espacés l'un de l'autre ;
- un deuxième moyen de frottement (5b) interposé entre ledit deuxième élément (3a) et ledit troisième élément (2b) autour dudit deuxième axe de rotation (x2) ;
- un deuxième moyen de précontrainte (6b) configuré pour précontraindre ledit deuxième moyen de frottement (5b) entre ledit deuxième élément (3a) et ledit troisième élément (2b) ;
- un quatrième élément (3b) s'étendant le long d'un quatrième axe longitudinal (k4) et couplé au troisième élément (2b) avec la possibilité de réaliser une rotation par rapport au troisième élément (2b) autour d'un troisième axe de rotation (x3) qui est transversal au troisième axe longitudinal (k3) et au quatrième axe longitudinal (k4), lesdits premier, deuxième et troisième axes de rotation (x1 ; x2 ; x3) étant parallèles et espacés l'un de l'autre, ledit quatrième élément (3b) étant couplé au premier élément (2a) avec la possibilité de réaliser une rotation par rapport au premier élément (2a) autour d'un quatrième axe de rotation (x4) qui est transversal au premier axe longitudinal (k1) et au quatrième axe longitudinal (k4), lesdits premier, deuxième, troisième et quatrième axes de rotation (x1 ; x2 ; x3 ; x4) étant parallèles et espacés l'un de l'autre, dans lequel lesdits éléments (2a ; 3a ; 2b ; 3b) sont agencés de manière à former un panneau dans lequel ledit premier élément (2a) et ledit troisième élément (2b) sont côte à côte, parallèles et coplanaires l'un à l'autre et ledit deuxième élément (3a) et ledit quatrième élément (3b) sont côte à côte, parallèles et coplanaires l'un à l'autre, ledit premier élément (2a) et ledit troisième élément (2b) étant transversaux audit deuxième élément (3a) et audit quatrième élément (3b) ;
- un troisième moyen de frottement (5c) interposé entre ledit troisième élément (2b) et ledit quatrième élément (3b) autour dudit troisième axe de rotation (x3) ;
- un quatrième moyen de frottement (5d) interposé entre ledit quatrième élément (3b) et ledit premier élément (2a) autour dudit quatrième axe de rotation (x4) ;
- un troisième moyen de précontrainte (6c) configuré pour précontraindre ledit troisième moyen de frottement (5c) entre ledit troisième élément (2b) et ledit quatrième élément (3b) ;
- un quatrième moyen de précontrainte (6d) configuré pour précontraindre ledit quatrième moyen de frottement (5d) entre ledit premier élément (2a) et ledit quatrième élément (3b) ;
- un cinquième élément (2c) côte à côte, parallèle et coplanaire audit troisième élément (2b), ledit cinquième élément (2c) étant couplé auxdits deuxième et quatrième éléments (3a et 3b) de manière à définir, dans l'ensemble, six axes de rotation avec des moyens de frottement et de précontrainte agencés dans un treillis avec des liaisons en carré ou en losange ;

caractérisé en ce qu'il comprend :

- un sixième élément (3c) côte à côte, parallèle

et coplanaire audit quatrième élément (3b), ledit sixième élément (3c) étant couplé auxdits premier, troisième et cinquième éléments (2a, 2b et 2c) de manière à définir, dans l'ensemble, neuf axes de rotation avec des moyens de frottement et de précontrainte agencés dans un treillis avec des liaisons en carré ou en losange ;

dans lequel chaque élément (2a, 2b, 2c, 3a, 3b, 3c, 7a, 7b) comprend un corps en forme de plaque constitué de bois plein ou d'un matériau à base de bois.

2. Ensemble selon la revendication 1, dans lequel lesdits premier, deuxième, troisième et quatrième axes de rotation (x1, x2, x3, x4) sont agencés de manière à définir un prisme droit avec une base en carré ou en losange.

3. Ensemble selon la revendication 1 ou 2, dans lequel :

- ledit premier moyen de frottement (5a) comprend au moins une paire de surfaces abrasives en contact mutuel, l'une agencée sur un côté du premier élément (2a) et l'autre agencée sur un côté du deuxième élément (3a) ;
- ledit deuxième moyen de frottement (5b) comprend au moins une paire de surfaces abrasives en contact mutuel, l'une agencée sur un côté du deuxième élément (3a) et l'autre agencée sur un côté du troisième élément (2b) ;
- ledit troisième moyen de frottement (5c) comprend au moins une paire de surfaces abrasives en contact mutuel, l'une agencée sur un côté du troisième élément (2b) et l'autre agencée sur un côté du quatrième élément (3b) ;
- ledit quatrième moyen de frottement (5d) comprend au moins une paire de surfaces abrasives en contact mutuel, l'une agencée sur un côté du quatrième élément (3b) et l'autre agencée sur un côté du premier élément (2a).

4. Ensemble selon la revendication 3, dans lequel lesdites surfaces abrasives des premier, deuxième, troisième et quatrième moyens de frottement sont parallèles ou coplanaires l'une à l'autre.

5. Ensemble selon la revendication 3 ou 4, dans lequel une ou plusieurs desdites surfaces abrasives comprend au moins une couche de matériau abrasif, par exemple de poudre et/ou de granules.

6. Ensemble selon l'une des revendications 3 à 5, dans lequel une ou plusieurs desdites surfaces abrasives comprend au moins une couche de surface de grande rugosité produite par un traitement de surface.

7. Ensemble selon l'une des revendications précédentes, comprenant au moins une première zone de charnière (4a) autour de laquelle lesdits premier et deuxième éléments (2a et 3a) peuvent tourner l'un par rapport à l'autre.

8. Ensemble selon l'une des revendications précédentes, dans lequel ledit premier moyen de précontrainte (6a) comprend un moyen de vis pourvu d'un filetage couplé audit premier élément (2a) et prétendu de manière à précontraindre ledit premier moyen de frottement (5a).

9. Ensemble selon l'une des revendications précédentes, dans lequel ledit premier moyen de précontrainte (6a) comprend un moyen de rivet prétendu de manière à précontraindre ledit premier moyen de frottement (5a).

10. Ensemble selon l'une des revendications précédentes, dans lequel ledit premier moyen de précontrainte (6a) comprend au moins une traverse (9a) couplée audit premier élément (2a) par un moyen de serrage, par exemple du type à vis et/ou à rivet, prétendu de manière à précontraindre lesdits premier et deuxième moyens de frottement (5a et 5b), ladite au moins une traverse (9a) s'étendant en longueur dans un sens qui est transversal audit premier élément (2a).

11. Ensemble selon la revendication 10, dans lequel ladite au moins une traverse (9a) comprend une poutre constituée de bois ou d'un matériau à base de bois.

12. Ensemble selon la revendication 10 ou 11, dans lequel ledit premier moyen de précontrainte (6a) comprend au moins une contre-traverse (9b) opposée à ladite au moins une traverse (9a).

13. Ensemble selon l'une des revendications précédentes, comprenant un premier élément supplémentaire (7a) s'étendant le long d'un premier axe longitudinal supplémentaire (j1) et couplé au deuxième élément (3a) avec la possibilité de réaliser une rotation par rapport au deuxième élément (3a) autour dudit premier axe de rotation (x1), ledit deuxième élément (3a) étant interposé entre ledit premier élément (2a) et ledit premier élément supplémentaire (7a).

14. Ensemble selon la revendication 13, comprenant un premier moyen de frottement supplémentaire (8a) interposé entre ledit premier élément supplémentaire (7a) et ledit deuxième élément (3a) autour dudit premier axe de rotation (x1), ledit premier moyen de précontrainte (6a) étant configuré pour précontraindre ledit premier moyen de frottement supplémentaire (8a) entre ledit premier élément supplémentaire (7a) et ledit deuxième élément (3a).

15. Utilisation d'un ensemble selon l'une des revendica-

tions précédentes pour améliorer la capacité d'une structure à résister à une contrainte externe, dans laquelle l'un desdits premier et deuxième éléments est installé verticalement pour raccorder deux étages d'une structure l'un à l'autre, ou horizontalement pour raccorder des parois extérieures d'une structure.

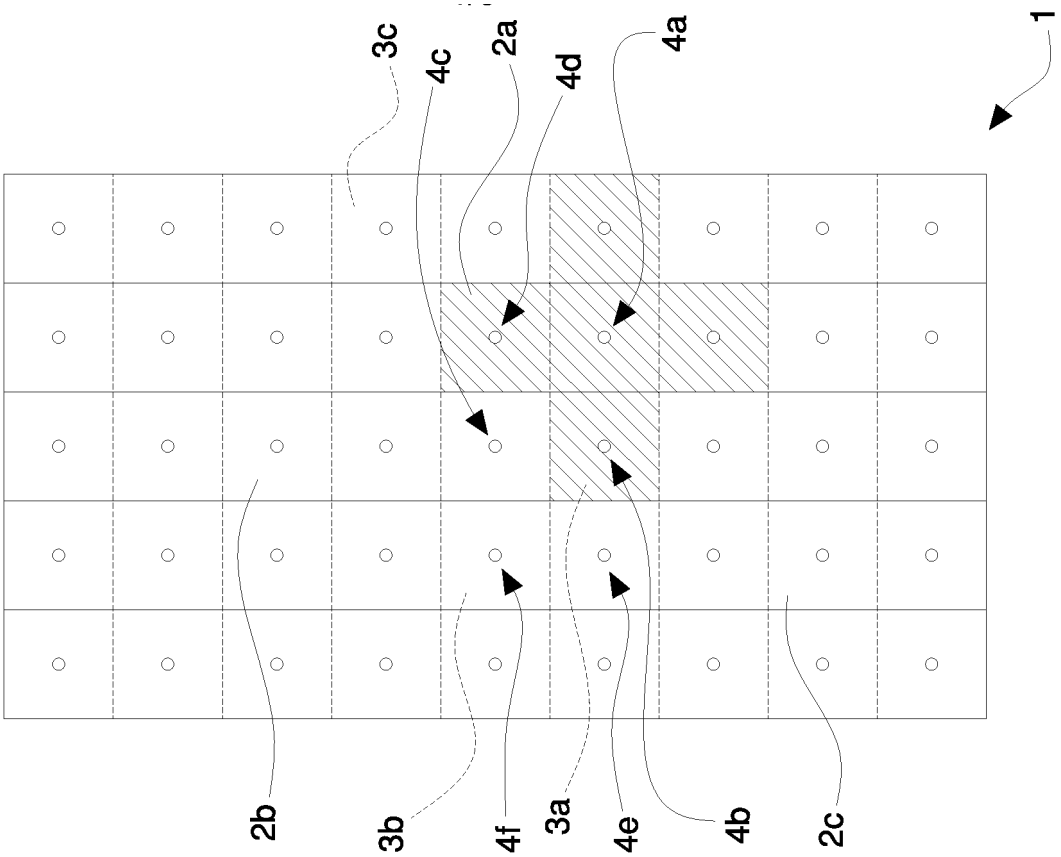

Fig. 3

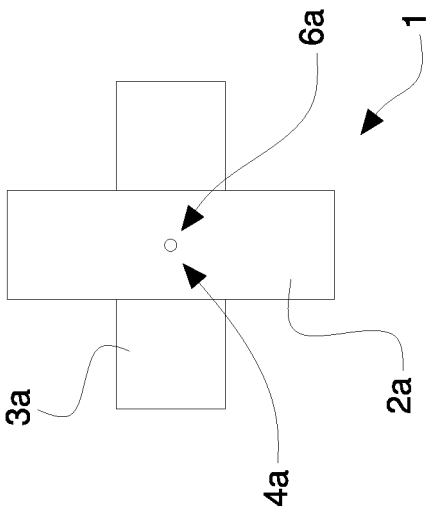

Fig. 1

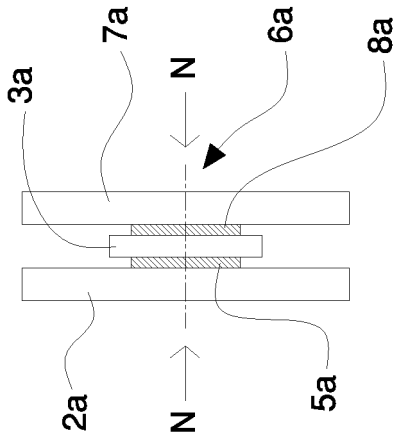

Fig. 2

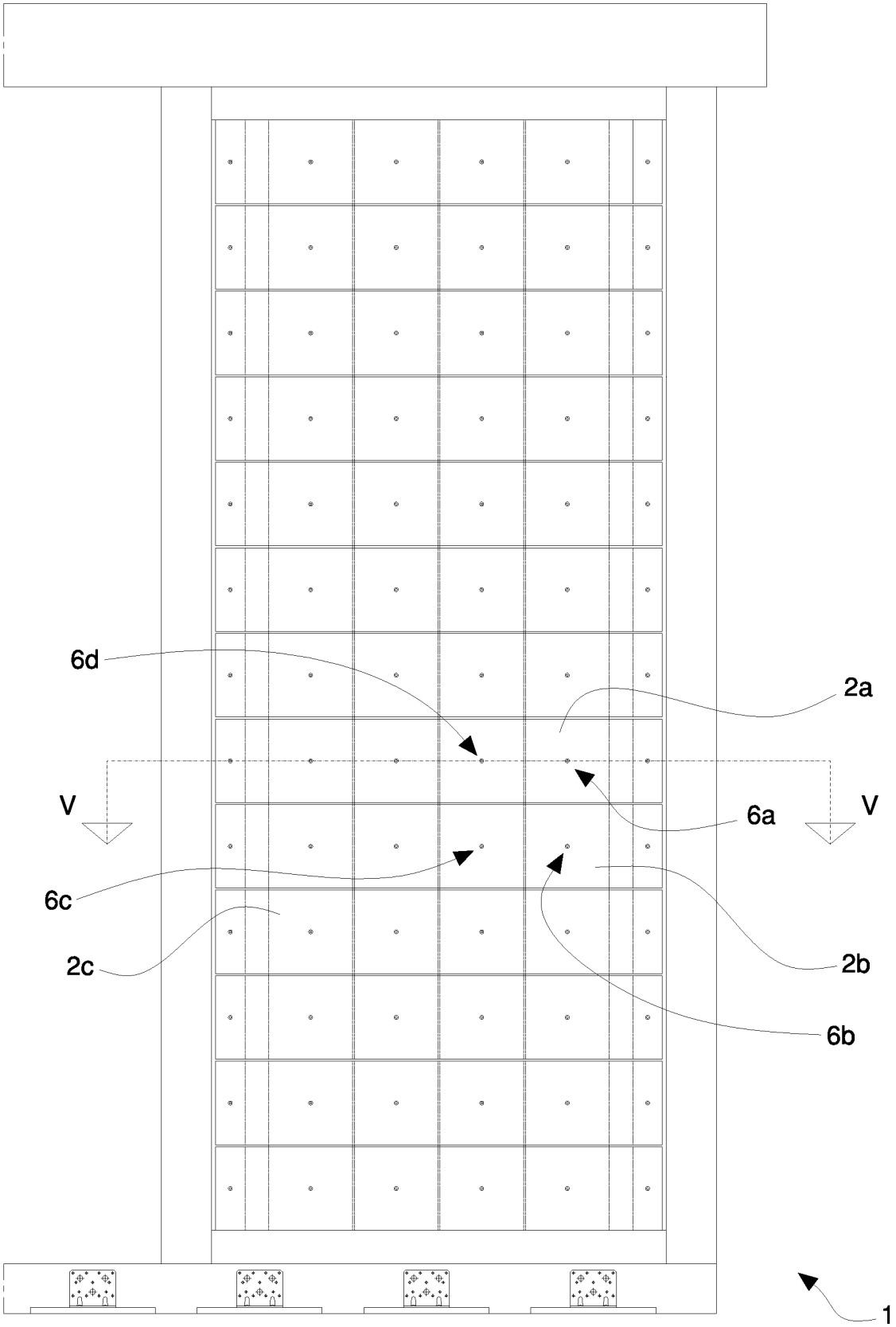

Fig. 4

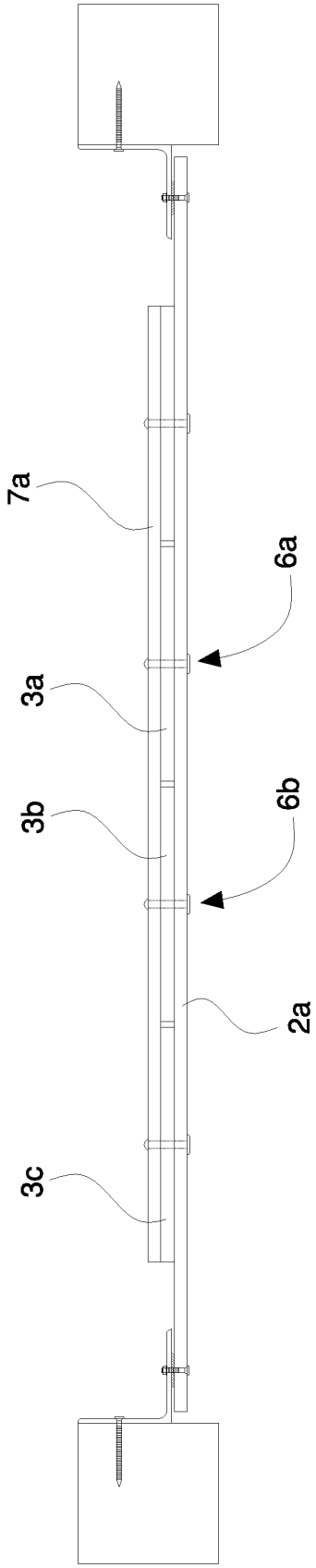

Fig. 5

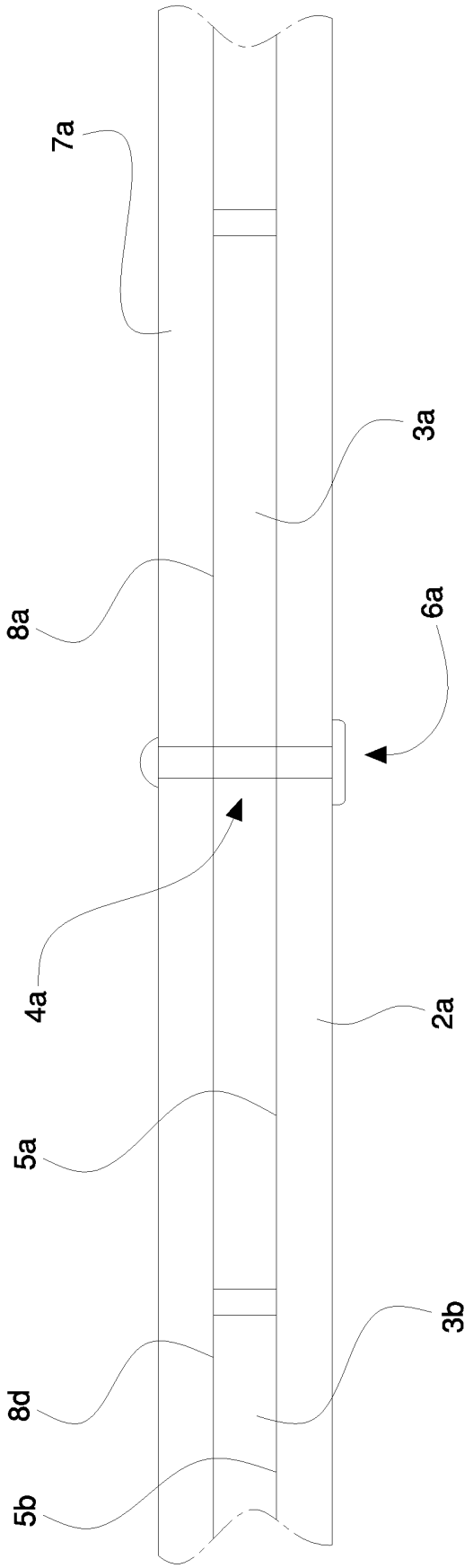

Fig. 6

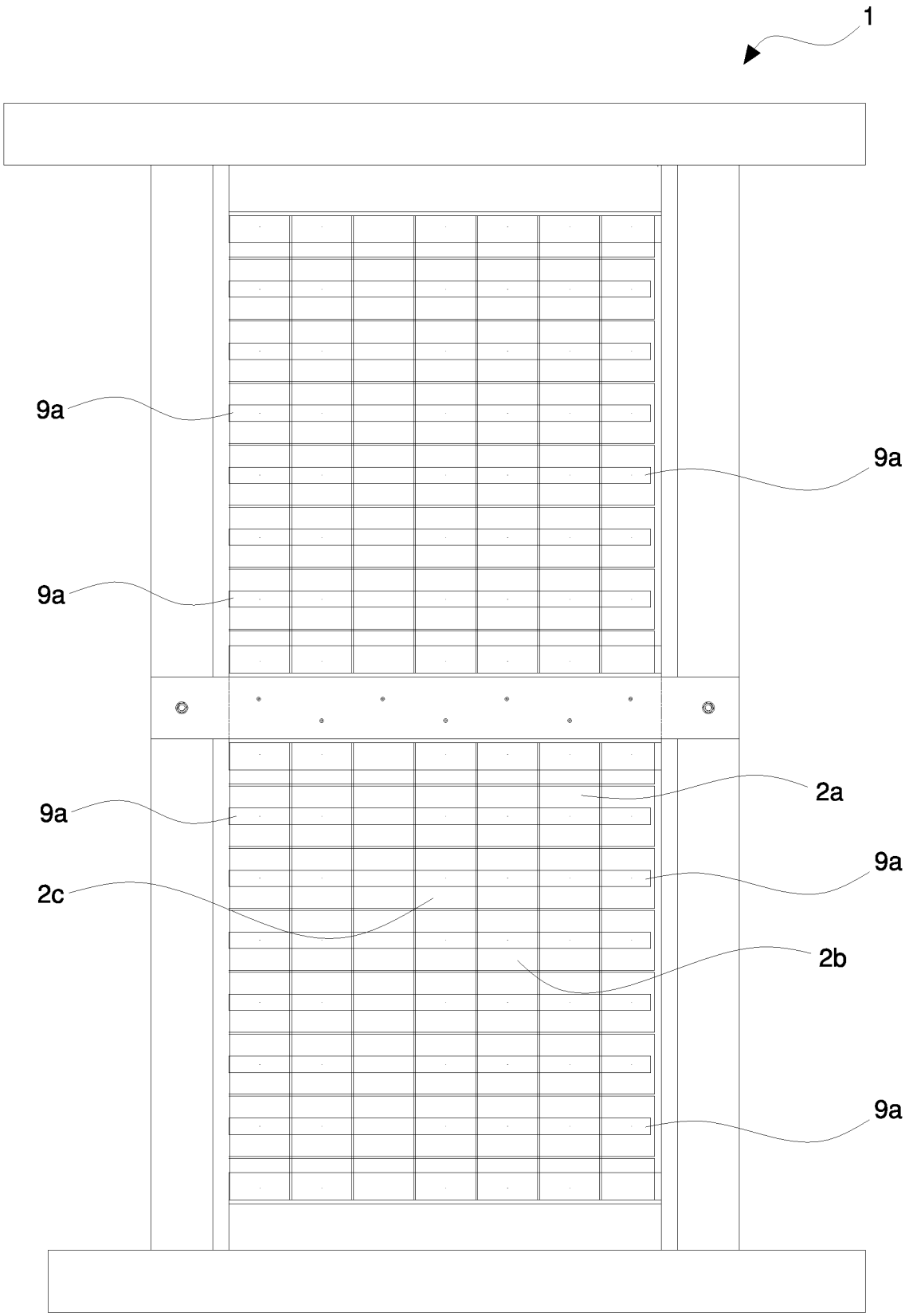

Fig. 7

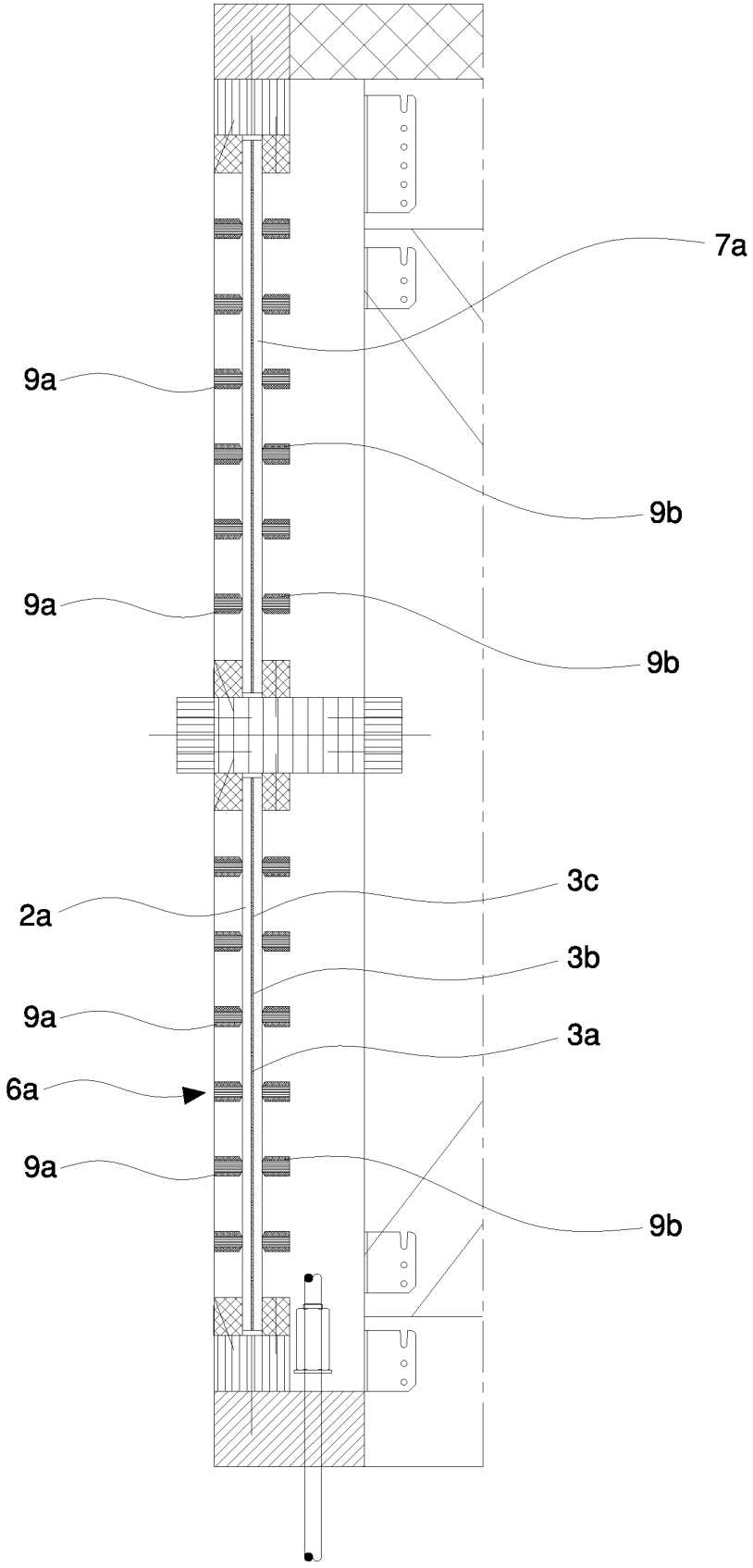

Fig. 8

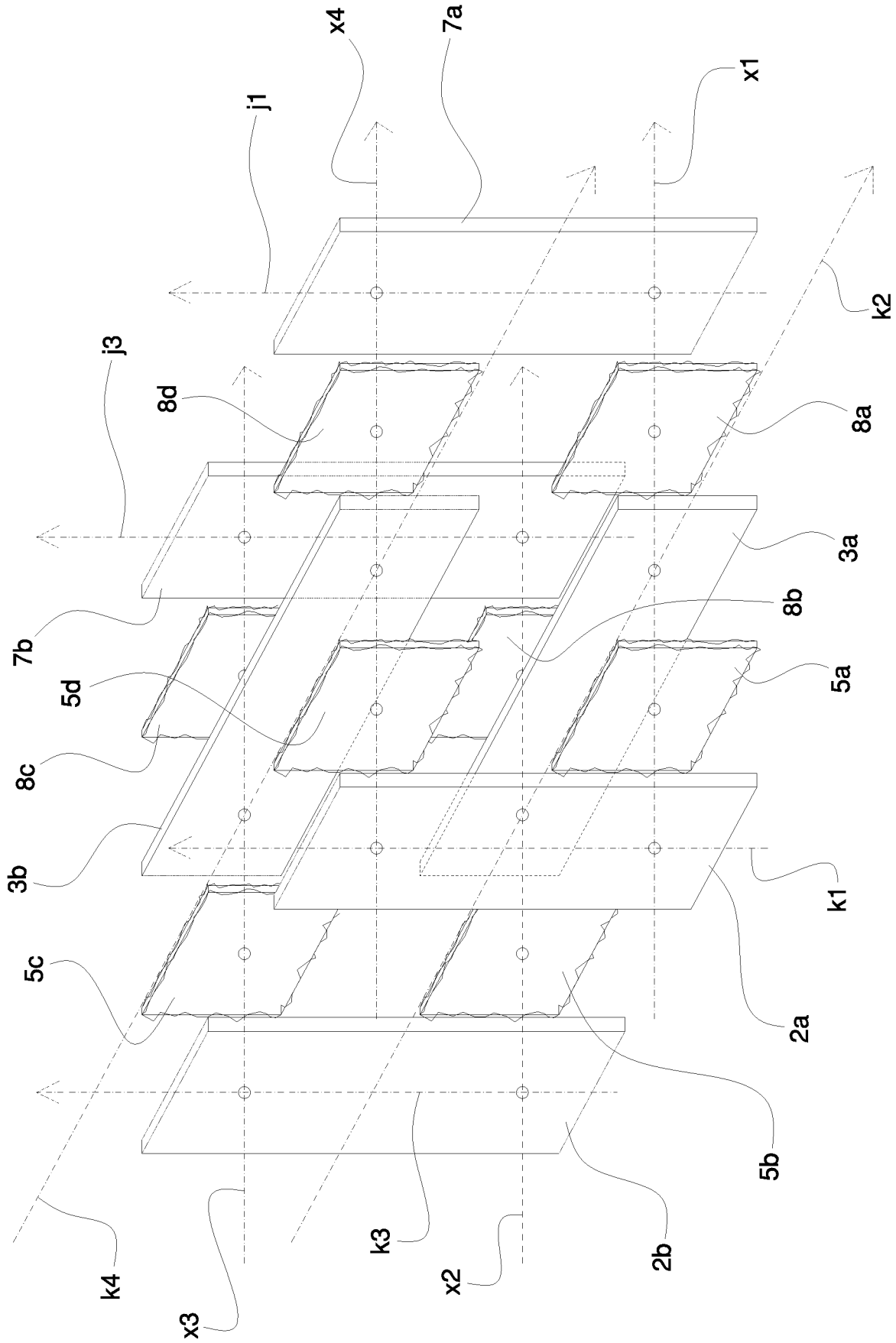

Fig. 9

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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