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(54) Construction system with anti-seismic behaviour

(57) The present invention concerns a complete new construction system, intended for building ordinary buildings, especially for housing and services, with an excellent level of anti-seismic and, by extension, anti-vibration behaviour, characterised in that it basically uses three constituent subsystems, foundations, masonry; and connections, which present, when working together, good multidirectional elasticity, a great capacity to absorb/dissipate multidirectionally-induced energies or stresses and repositional stability.

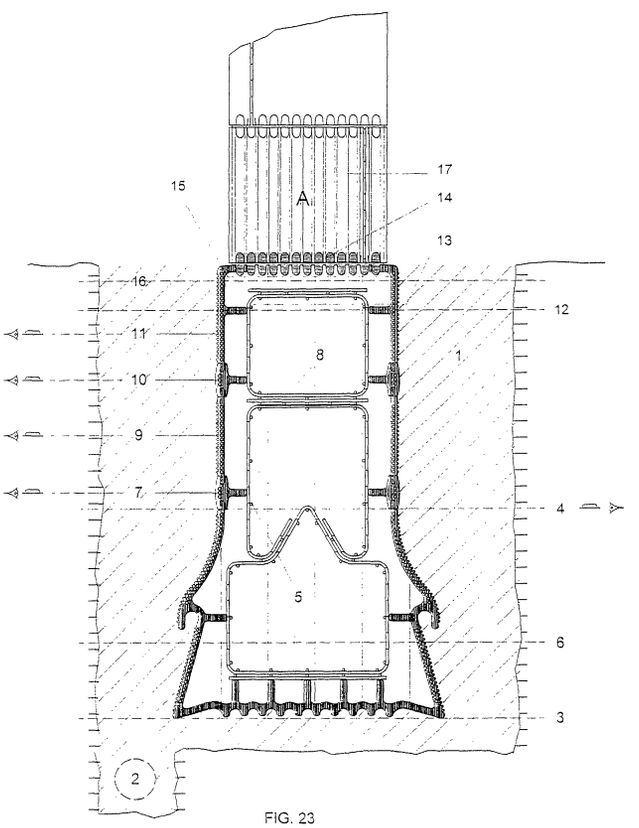

FIG. 23

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Description

[0001] The present invention concerns a complete new construction system, intended for building ordinary buildings, especially for housing and services, with an excellent level of anti-seismic and, by extension, anti-vibration behaviour.

[0002] It results from detailed reflections on theories, and also from action/reflection on building practices.

[0003] Its design is based on a vision which is different, perhaps even contrary, to that which is usually applied for the same ends.

[0004] Its general principles are:

- Multidirectional elasticity, among three constituent subsystems, clearly differentiated but working together as a balanced whole: **foundations, supporting structures/masonry and links/connections** between them;
- Organically flexible geometries, whose particular repositional stability results from the intelligent and controlled acceptance of the evident and inevitable general tendency for dispositional instability;
- Great capacity to absorb/dissipate multidirectionally-induced energies/stress through the whole the system, which, when applied fully, is constituted over an extensive network of combined dispersion;
- The whole construction - structural and substructural elements: partition walls, double ceilings, floating floors and frameworks - should be able to oscillate/twist, resisting and re-establishing, with the minimum of potential easily and economically reparable damages;
- Good mechanical organic adaptability versus rigidity.

[0005] Strategically, the system is based on the design of the three subsystems described above, which can be coordinated between each other and also with other usual elements, designed to accomplish specific and group functions, progressively providing more answers to growing requirements, within a predefined vital framework; its axis are the connectors and the formwork boxes of the foundations.

[0006] The objective is to obtain a new type of constructions which are much safer, both for their users and for third parties, economically viable and ecologically, culturally and aesthetically versatile.

Background to the invention

[0007] Several anti-seismic construction systems exist, which focus particularly on the design of parts to be assembled in the structures and which bestow better properties on them.

[0008] Among them, the following can be mentioned: patent EP 1 122 372, "Hidden connector", which relates to a connector for making a connection between a first element and a second element and which includes a fixing element, a plurality of fasteners received by the fixing element and an anchoring element also received by the fixing element; patent EP 1 170 429, "Earthquake-proofing reinforcement metal fitting", relates to anti-vibration reinforcement part assembled in the connecting parts of structural elements such as foundations, pillars, beams, etc., for reinforcing in such a way that a wooden building does not collapse as a result of strong vibrations caused by earthquakes, typhoons, etc.; patent application WO 00/53352 relates to a metallic foil connector having a fold with a small radius of curvature which is deformed by the opening of its flaps in order to minimise the stress that is transmitted to the structure.

[0009] Anti-seismic structures are also known, such as the one described in patent application WO 01/73212, which uses the concept of sliding among its component parts.

[0010] The applicant does not know of any integrated system for minimising the problems caused by earthquakes to buildings structures.

Summary of the invention

[0011] The construction system with anti-seismic behaviour which is the subject of this invention is characterised essentially in that it fundamentally uses three constituent subsystems: foundations, masonry and connections, which present, when working together, good multidirectional elasticity, a great capacity to absorb/dissipate multidirectionally-induced energies or stress and great repositional stability.

[0012] It is therefore an integrated system which, taking into account its global application, presents the following:

Behavioural advantages:

- very low incidence/perception of vibrations;
- better thermal and acoustic isolation coming from the system itself;
- reduction of the structural and substructural fatigue of the constructions;
- less basic maintenance, for a minimum durability of 25 years;
- better general quality of inhabitation.

Constructional advantages:

- better integration of industrially finished and semi-finished products;
- greater assembly speed/productivity during construction work, no mortar required to hold brickwork together, no drying time for mortar

and faster and more accurate alignments.

[0013] On the other hand, the use of this system requires a change of established habits and interests, in spite of the expected gains in terms of labour, which is easier to qualify, as it does not require as much skill or a long period of training. More planning is also necessary, from the project stage to the construction work, and greater discipline in operative sequences.

[0014] The use of this new system also increases the development of emerging upstream markets, such as markets for the industrial production of all the components, tools and machinery needed for preparing, finishing and assembling components, and markets for training, projects and technical assistance.

Brief description of the drawings

[0015] The following description is based on the attached drawings, which make it easier to understand the invention, though they are not restrictive in any way. In the drawings:

Figures 1 and 3 represent the standard profile of the base of the foundation formwork box, shown as a main elevation and a perspective view respectively;

Figure 2 represents the detail of the wall of the formwork box;

Figures 4 and 5 represent the standard profile of the ambidextrous part for extending the height of the foundation formwork box, shown as a main elevation and a perspective view respectively;

Figures 6 and 7 represent the standard profile of the ambidextrous part for the ending of the foundation formwork box, shown as a main elevation and a perspective view respectively;

Figures 8 and 9 represent the standard profile of the ambidextrous horizontal connecting part, among all the component parts of the foundation formwork box, shown as a main elevation and a perspective view respectively;

Figures 10 and 11 represent the standard profile of the framework relating to the first seat, shown as a main elevation and a perspective view respectively;

Figures 12 and 13 represent the standard profile of the framework relating to the second/third seats, shown as a main elevation and in perspective respectively;

Figure 14 represents the general pattern for the pins, the connector and, from top to bottom respectively, applications with a longitudinal axis, three longitudinal axes, five longitudinal axes and n longitudinal axes, irrespective of the specific form that the plan of the connector has to follow;

Figure 15 represents the connector in three views;

Figure 16 represents a perspective view of the connector;

Figures 17 and 18 represent the connector in detail and linking mortars to the designed masonry or other preprepared elements;

Figures 19, 20 and 21 represent assemblies of the constituent subsystems for buildings with 1 to 2 floors, 3 to 4 floors and 5 to 6 floors respectively;

Figure 22 represents the complete range of designed masonry in single volumes (seven related volumes A, B, C, D, E, F and G) and in some of the volumetric combinations between them (duly marked);

Figure 23 shows coordinated representations of all the drilled planes of the designed masonry;

Figure 24 represents, by way of example, three views of the volumes of masonry (B) shown in figure 22 and three perspective views of its production;

Figure 25 represents an assembly of the complete system; and

Figures 26 and 27 represent assemblies of the masonry designed using connectors.

Detailed description of the invention

[0016] As has already been mentioned, there are three constituent subsystems from which it is possible to design the various assemblies in order to meet a very wide range of requirements. Each one of the subsystems will be analysed hereunder.

FOUNDATIONS

[0017] This subsystem is represented in figures 1 to 13. It is a complete and autonomous subsystem, which means that it can be integrated into the system or used as a part of hybrid options, for example to reinforce existing walls to be restored. As can be observed, it consists of a closed ring generically represented by the reference (10), moulded *in situ*, a homogeneous and continuous base, shoe or annular beam, working together as a shock absorber, with a basically rectangular section heightwise; it combines dispersion, by seating, with friction. Said profiles (10) of figures 1 to 3 have a hole (1) in the wall which means: lower mass, less material,

greater energy absorption, by deformation/reconfiguration; surface corrugation (2) for enlargement of the seating by friction; blades (3) for spacing/marking the framework, with a recombinant elastic effect with the mortars/frameworks; first rows for supporting/levelling the parts (4); second support/seating rows (4a) for progressive levelling; manual/mechanical handle (5) for manual/mechanical positioning, for instance of groups of parts that are already joined. We can also observe in figure 3 the periodic sectioning (S) which is standard in industrial processing.

[0018] This subsystem dynamically correlates the construction with the adjacent ground, responding to the induced loads, by means of the following:

- the impervious box, leave-in-place formwork - functioning additionally as water and heat insulation, saving these extra tasks and materials - and the first horizontal row of connectors, around the whole perimeter of the foundations, to the structural masonry;

- the box and connectors will be made of specific materials of a similar or identical quality designed to absorb shocks and torsions, with progressive adaptation to the supported loads, through all its useful life;

- the geometry of this subgroup and its organic cohesion with the mortar and the framework thereof; for this reason, any structural elements which may be loose will be anchored through the extensions of the foundations box to the closed rings thereof.

[0019] This subsystem, evidencing a clear and physically well defined relationship both with the ground and with the structures built upwards, should function with a high level of absorption/dissipation of induced energies, whether they result from the ground or from the construction; it should "float".

[0020] The first reception/dissipation will be made in the subgroup consisting of the box plus the first row of connectors, thus drastically reducing the direct stress on the armed mortar.

[0021] Subsequently, the armed mortar will be subjected to stresses of all types and in all directions, although less intense; it will respond by twisting, becoming deformed and progressively returning to the initial geometry, without collapsing, meaning that it will have to be more elastic than usual.

[0022] At the most, even if the construction becomes partially unsupported or if it tilts or slides, it should resist intrinsically, thus guaranteeing a high level of safety for its users or third parties as well as technical and economical viability in terms of restoration / recuperation.

If necessary or required, this foundation can be combined with additional seatings, subshoes underneath or beddings, provided that they are placed immediately beneath the ring and are physically disconnected from it.

[0023] For uneven foundations, there will be several ways of resolving the problem, following the same principle of closed rings, to be considered case by case.

[0024] In general terms, three standard versions are presented, as can be seen in figures 19, 20 and 21, intended for constructions of: up to 2 floors (figure 19), from 2 to 4 floors (figure 20) and from 4 to 6 floors (figure 21); as will be obvious to persons skilled in the art, other versions can be developed. The integrated logic behind this subsystem covers, in correlated standards, boxes, accessories and frameworks. As can be observed, these standard base structures are composed of the profiles (10) and the parts (6, 7 and 8) represented in figures 4 to 9, respectively the ambidextrous profile (7), for increasing the height of the foundation formwork box; the ambidextrous profile (6) for the ending of the foundation formwork box; and the ambidextrous horizontal connection profile (8), among other component parts of the formwork box of the foundations. The profile (6), being an ending part, has a hole (5a) for fitting the first row of connectors (13).

[0025] The height-extending parts consist of an ambidextrous profile (7) with a hole (1) to reduce its weight and to increase the energy absorption and a surface corrugate (2) to allow the enlargement of the seating by friction of the walls; the ending parts consist of an ambidextrous profile (6) that has in the middle a blade (9) which is turned inwards, on top another blade (9) turned inwards which has vertical holes (5a) along all its length to receive the connectors (13) mentioned in the claim 1; and the connection parts are constituted by a profile (8) with an upper and a lower slot and a blade (9) turned inwards for marking out the framework; both profiles (6) and (8) have a hole (1) and identical corrugation (2) with identical functions to the profiles (10) and (7).

[0026] All of the box's parts, previously described, are designed to be produced by extrusion or by similar methods; the assembly of these parts will be canted out by mechanical connection and gluing, or similar techniques, which guarantee the relative imperviousness of the box and the relative homogeneity of its functioning; the material(s) to be used for this purpose will be homogeneous; even though some existing materials can be used, the objective is to achieve others with qualities specified above.

[0027] The frameworks (20, 21 and 22) represented in figures 10 to 13 are traditionally designed as being metallic, though they can be made in other more suitable materials, their mass is lower in percentage than that which is usually applied for the same purposes, they present a more balanced distribution in the interior of the beam and are produced industrially, without any variations, with the exception of the adjustment cuts made; these cuts and the ring connections will also be automated and technically warrantable operations, to be carried out during the course of the work.

[0028] The assembly of all the whole subsystem requires very clear rules and stringent discipline. This covers:

- general and specific design of the foundations and opening of foundation pits, foreseeing and positioning all of the substructures *ab initio*, since the ring should not be broken after being filled;
- preparation of the assembly of the box and its positioning in the foundation pit, entry of the framework, connections thereof and balanced filling, with the refilling of the free space between the foundation pit and the box;
- positioning/closing of the first row of connectors and conclusion of the filling of the ring.

CONNECTOR / CONNECTION

[0029] It is a component (13), essentially a board (14) with pins (15) on both sides, designed according to a three-dimensional mesh represented in figure 14, which works in perfectly arranged two-dimensional connections, especially horizontal and vertically, both with the masonry that constitutes the other subsystem of this invention and in other combined options: concrete, other mortars, glues or similar, emptied / moulded in situ, classic masonry, wood, metals, or other materials preprepared with holes according to the same pattern.

[0030] Functioning in absolute three-dimensional connections requires three-dimensional connectors, which, although possible, does not seem to us to be necessary; in the non-connected plans, this component - a flat board with the same thickness - closes the joints and does not have any pins.

[0031] This part, in view of its drawing and intrinsic nature, constitutes the key to the whole system designed.

[0032] Although materials available on the market can be used, it might be necessary to achieve a new material, with common application to the formwork box of foundations.

[0033] Of the required qualities, some of them already mentioned in the description of the formwork box, include the following:

- relative physicochemical homogeneity;
- identification of the actions/progressive stresses and appropriate responses;
- good physicochemical behaviour in relation to the agents present: air and its variations, direct fire, cleaning products, treatment and recovering;
- relative identity and cohesion, with the surfaces that it unites;
- relative durability with good behaviour in relation to disassembly and repositioning, which will require intrinsic reversibility extended in the time.

[0034] The use of these components dispenses with the need for mortars for laying masonry/connecting structures.

[0035] The basic commercial presentation will be the following:

[0036] In unison pattern plates, adjusted in order to maximise productivity in terms of assembly and with variable widths, according to the number of pins/entrances to be coordinated; these plates will be easily adaptable to the circumstances, allowing adjustment cuts, extraction of pins, opening of holes, for instance, among other operations; if necessary, the perimeter of the board can take any form (figure 16).

[0037] Possibly in rolls, if the manufacturing materials are suitable for presentation/use in this form, which is more practical and quicker for the assembly purposes.

[0038] Figure 14 represents the general pattern for the pins, the connection connector, with the combination a = 2b1, on both sides of the connector, stipulating the ratios to be maintained, irrespective of the scale of industrial production to be adopted: part by part, in continuous band, or with a random perimetrical geometry plan.

[0039] The subsequent representations of figure 14 (A to C) present from top to bottom a rectangular standard - the current form - with a longitudinal axis; a standardwith three longitudinal axes; a standard with five longitudinal axes. Representation D presents the principle applied to the parts b1 x b1 + n a x n a + b1 x b1, or n a x n a, showing the range/flexibility of the system, irrespective of the specific form that the plan of the connection connector has to follow.

MASONRY

[0040] A complete range of parts (A to G) is represented in figure 22, with holes, taking into account the following main circumstances:

- dimension/weigh: commercially acceptable, with a view to maximising the profitability of labour during construction work;
- holes: lower mass/weight; less material and energy expenses in industrial production; mechanical use, since the holes are coordinated mathematically with the mesh of the connectors according to the formula

$$a = b + e/2 = 2b1$$

  where e means the constant thickness of the boards;
- optional versatility, especially bearing in mind the inconvenience of making cuts for adjustment of parts during construction work; loss of material and more manual work - and the need to meet to aesthetic demands; constructions without plasters - more demanding.

[0041] Volumes A to C have three hole plans; volumes D to F have two hole plans; and volume G has one hole plan.

[0042] All the volumes can have a pattern of holes all over or holes partially covering the outer walls, as shown in figures 5, 8, 9 and 10, which permits the universal use of the connector without any cuts in the pins, thereby enhancing the aesthetic variations of the masonry.

[0043] Various materials can be used: ceramics, mortars or other "plastics" that can be shaped by moulds.

[0044] The same applies to the techniques used: extrusion, drying, baking; cold or hot moulding.

[0045] Commercial presentation should also take account of colour and textural control, in order to meet the current demands of the market, with finished parts and without the need for recovering.

[0046] Connection in the three planes, by means of the connectors and the seals of joints without any holes is perfect, whatever the range and sequences of this selected masonry; also, it does not need to be applied in "counterthread", since connection is independent of the mass/disarrangement ratios of the joints.

[0047] The developed geometry ensures a good balance between the apparent and real volumes and the resulting specific mass, as regards the aforementioned behavioural functions and the handling of the parts used in the construction work.

[0048] Easy assembly/alignment is evident.

[0049] Application goes from the supporting wall/pillar to the substructures.

[0050] Figure 23 shows the coordinated representations of all the singular plans with holes of the above mentioned designed masonry.

ASSEMBLY SEQUENCE

[0051] Having described in detail the three subsystems that make up the invention, we will now describe the assembly of the complete system as represented by way of example in figure 25, which shows all the subsystems duly assembled and perfectly integrated so as to form a whole.

1. Opening of the foundation pit

2. Laying of rainwater drainage.

3. First refilling of the ditch for laying the base (10) of the formwork box

4. First levelling, after total assembly of each horizontal crossbar of the base (10), together with its alignment; the vertical connections between all the parts are made by partial mechanical coupling between the holes of the walls and gluing or a similar technique, continuous and on the inside.

5. Positioning of the first level of the framework (20); possible insertion of passages, creation of negatives for future passages, or discharges of "ground rings".

6. Second refilling, without tightening, for securing the base (10) and tightening/fastening thereto, by friction, of the first row of the framework (20);

7. Positioning/securing, by gluing or a similar technique, of the first row of parts (8) for horizontal connection; verification of alignment and levelling.

8. Positioning/securing of the second/third levels of the framework (21, 22); *idem*, *idem*, passages, negatives and congeners.

9. Positioning/securing of the first row of height extension, part (7) of the formwork box; verification of alignment and levelling; *idem*, *idem*, phase 4 (vertical connections).

10. Positioning/securing of the second row of horizontal connection parts (8); *idem, idem,* alignment and levelling and vertical connections, phase 4.

11. Positioning/securing of the ending part (6) of the formwork box; *idem, idem,* alignment and levelling and phase 4 (vertical connections).

12. Third refilling of the ditch, without tightening or with slight tightening.

13. Maximum level of the first filling with self-compacting mortar; the ending part (6) will be semi-fastened by fitted portions of the first row of connectors (13).

14. Positioning/securing of the first row of connectors (13).

15. Conclusion of the filling with the self-compacting mortar, until the spaces between the inside pins (15) of the connectors have been completely filled, through a series of holes in the board (14) thereof.

16. Conclusion of the refilling of the ditch and the compacting thereof.

17. Beginning of the lifting of the masonry or other structural, substructural or finishing elements.

HYBRID COMBINATIONS

[0052] These are the cases where the system is used in combination with other solutions.

[0053] The most common case will be the use of concrete flagstones; in other situations, systems of pillars and beams will be used - or even supporting walls - in

concrete, wood, iron, stonemasonry, among the most common materials.

[0054] In some cases, only the foundations and connectors will be used, in other cases, the herein designed masonry will become used in conjunction with other materials.

[0055] The foundations, in particular, can be used to underpin old walls.

[0056] The connectors will be a good option when it is necessary to assemble concrete flagstones or to fasten other supporting elements in old constructions, since they will relieve the stress induced on the supporting structures, in general with good resistance to compression, but with low resistance to bending/torsion/cuts, which has a tendency to lower with age and the inevitable degradation of the connection mortars and of the constituent structural elements themselves.

[0057] Finally, figures 26 and 27 represent various assemblies of the designed masonry, by means of connectors, exemplifying the progressive positioning thereof with view to a more effective joining.

[0058] As will be obvious to those skilled in the art, there are several possible types of plans for the foundation, evidencing the adaptability of the box formwork in the closed ring, i.e. with a square, rectangular, trapezoidal or mixed configuration including rectilinear sections and curved sections. It is also possible to proceed with the "fastening" of supporting elements placed outside the perimetrical line of the ring.

[0059] The seats can be levelled or unlevelled, simply resorting to a distribution of the shoe in contiguous rings and by levels. It is possible, if necessary or desirable, to use reinforcements for the subshoes and the subbeddings by means of additional elements, which will be built resting underneath but detached from the ring, so that if they suffer very severe blows, they can fracture without damaging it.

[0060] With this system the following assemblies are possible: of flat concrete flagstones with a classic arch; enlargement of vertical supports; in combination with beams made of wood, steel or other materials; succession of differentiated materials, always with the joints linked by connectors (masonry, pillars made of concrete, steel or wood, stones, armed concrete vaulting).

Claims

1. Construction system with anti-seismic behaviour, **characterised in that** it basically uses three constituent subsystems:

   foundations;
   masonry; and
   connections,
   which present, when working together, good multidirectional elasticity, a great capacity to absorb/dissipate multidirectionally-induced energies or stresses and repositional stability.

2. Construction system with anti-seismic behaviour, according to the previous claim, **characterised in that** the foundation subsystem consists of a closed ring based on the homogeneous and continuous profile (10), moulded *in situ*, functioning coherently and as a shock absorber, with a basically upright rectangular section, consisting of a leave-in-place formwork like impervious box inside of which the framework is placed (20, 21), this box having, at the base and internally, blades (3) for spacing and marking out the framework and, externally, supporting points for levelling the parts, its vertical walls having a hole (1) to reduce its weight and the amount of raw material and to increase energy absorption, and a surface corrugate (2) to allow the enlargement of the seating by friction, these parts being extendible in height by other complementary parts for extension (7), ending (6) and connection (8).

3. Construction system with anti-seismic behaviour, according to claim 2, **characterised in that**:

   the height-extending parts for extension are constituted by an ambidextrous profile (7) with a hole (1) to reduce its weight and to increase energy absorption and a surface corrugate (2) to allow the enlargement of the seating by friction;

   the ending parts are constituted by an ambidextrous profile (6) that has a blade (9) in the middle turned inwards, for marking out the framework, and another blade (9) on top turned inwards which has vertical holes (5a) along all its length in order to receive the connectors (13) mentioned in claim 1;

   the connection parts are constituted by a profile (8) with an upper and a lower fitting and a blade (9) turned inwards for marking out the framework;

   both profiles (6) and (8) have an identical hole (1) and corrugate (2) with the same functions as the profiles (10) and (7).

4. Construction system with anti-seismic behaviour, according to claims 2 and 3, **characterised in that** the foundations box as well as its complementary parts are obtained by extrusion or by another industrial means making it possible to obtain the same standard sections, its assembly being carried out by mechanical connection and gluing in order to guarantee the relative imperviousness of the box and relative homogeneity of operation.

5. Construction system with anti-seismic behaviour, according to claim 2, **characterised in that** the frameworks (20, 21 and 22) are traditionally metallic but can be made of other materials, being produced industrially without any variations, with the exception of the cuts required in accordance with the work to be carried out.

6. Construction system with anti-seismic behaviour, according to claim 1, **characterised in that** the connection subsystem connection is essentially constituted by a connector (13) with the configuration of a board (14) with pins (15) on both sides designed according to a three-dimensional mesh that works with two-dimensional connections with a perfectly horizontal and vertical layout, whether with other the subsystem, masonry, or with other combined options such as concrete, mortar, glues, cast or moulded *in situ*, wood, metal or other masonry prepared by means of holes according to the same mould.

7. Construction system with anti-seismic behaviour, according to claim 6, **characterised in that** in the non-connected plans this component is presented as a flat board with the same thickness and closes the joints without pins.

8. Construction system with anti-seismic behaviour, according to claim 6, **characterised in that** the relationship between the centres of the adjacent (a) pins (15) and the perpendicular distance between the centres of the peripheral pins (15) and the boards of the board (bl) is defined as a = 2b1.

9. Construction system with anti-seismic behaviour, according to claim 1, **characterised in that** the masonry subsystem consists of a group of parallelepipedal parts (A to G), with holes, the holes being made "at the bottom", "at the top" and "along the edge", following a mathematical moulding relating to that of the connectors, defined as a = b + e/2 = 2b1.

10. Construction system with anti-seismic behaviour, according to claim 9, **characterised in that** each of the masonry parts can be associated to others, in such a way as to form connected volumes.

11. Construction system with anti-seismic behaviour, according to claim 1, **characterised in that** it follows an assembly sequence defined by the following phases:

1. opening of the foundation pit;

2. laying of rainwater drainage;

3. first refilling of the ditch for laying the base (10);

4. first levelling, after total assembly of each horizontal crossbar of the base (10), together with its alignment; the vertical connections between all the parts are made by partial mechanical coupling between the holes of the walls and gluing or a similar technique, continuous and on the inside;

5. positioning of the first level of the framework (20); possible insertion of passages, creation of negatives for future passages, or discharges of "ground rings";

6. second refilling, without tightening, for securing the base (10) and tightening/fastening thereto, by friction, of the first row of the framework (20);

7. positioning/securing, by gluing or a similar technique, of the first row of parts for horizontal connection (8); verification of alignment and levelling;

8. positioning/securing of the second/third levels of the framework (21, 22); *idem*, *idem* passages, negative and congeners;

9. positioning/securing of the first row of height extension, part (7); verification of alignment and levelling; *idem*, *idem*, phase 4 (vertical connections);

10. positioning/securing of the second row of horizontal connection parts (8); *idem*, *idem*, alignment and levelling and vertical connections, phase 4;

11. positioning/securing of the ending part (6) of the formwork box, *idem*, *idem*, alignment and levelling and phase 4 (vertical connections);

12. third refilling of the ditch, without tightening or with slight tightening;

13. maximum level of the first filling with self-compacting mortar; the ending part (6) will be semi-fastened by fitted portions of the first row of connectors (13);

14. positioning/securing of the first row of connectors (13);

15. conclusion of the filling with the self-compacting mortar, until the spaces between the inside pins (15) of the connectors have been

completely filled, through a series of holes in the board (14) thereof;

16. conclusion of the refilling of the ditch and the compacting thereof;

17. beginning of the lifting of the masonry or other structural, substructural or finishing elements.

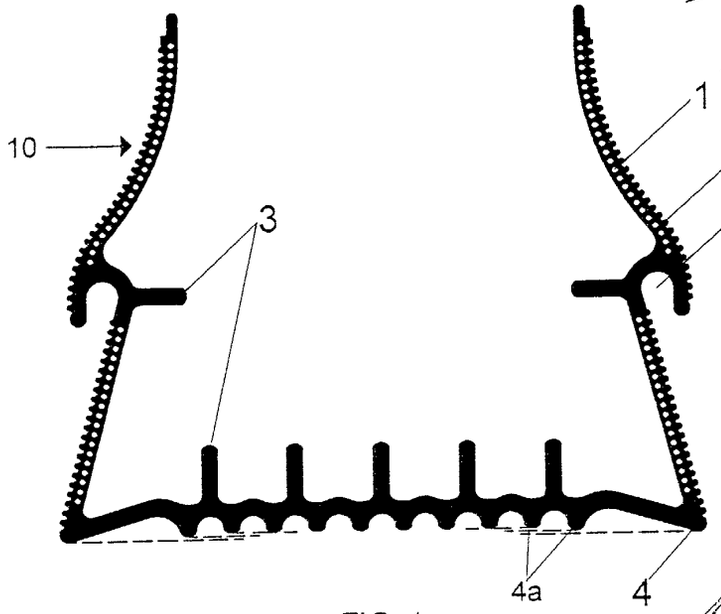

FIG. 1

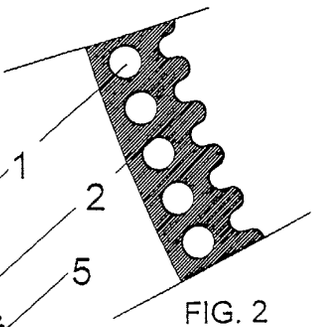

FIG. 2

FIG. 3

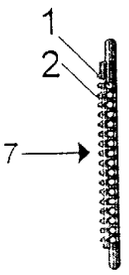

FIG. 4

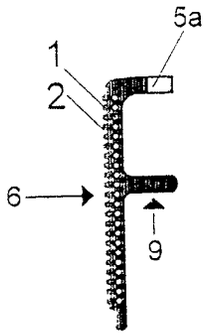

FIG. 6

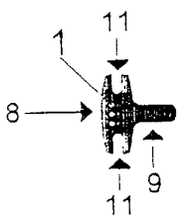

FIG.8

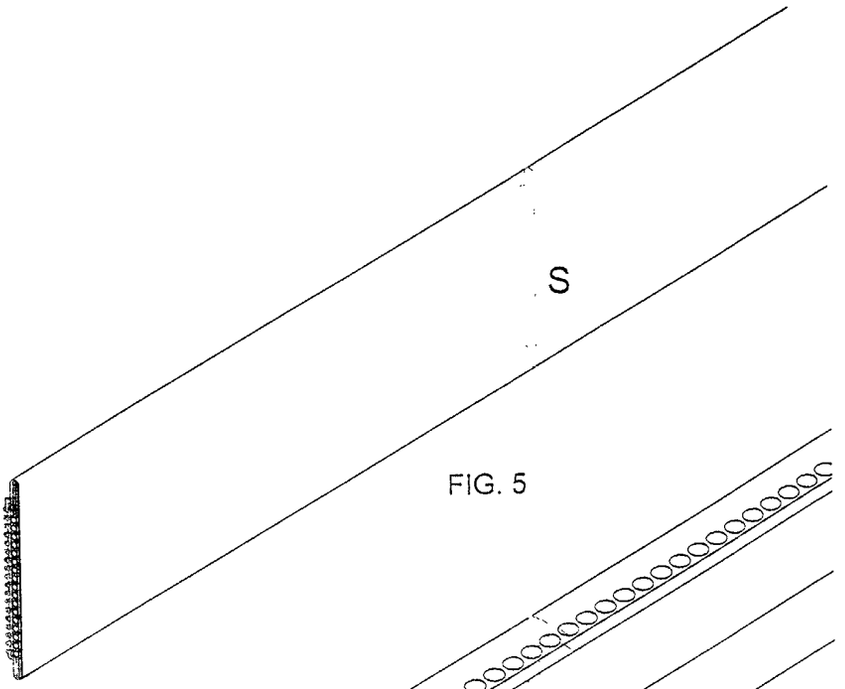

FIG. 5

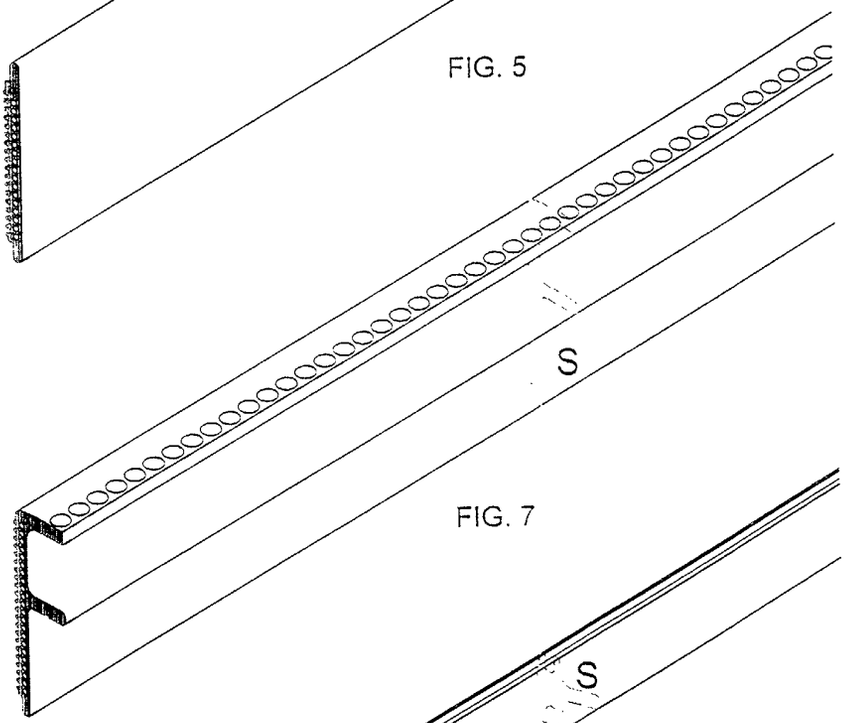

FIG. 7

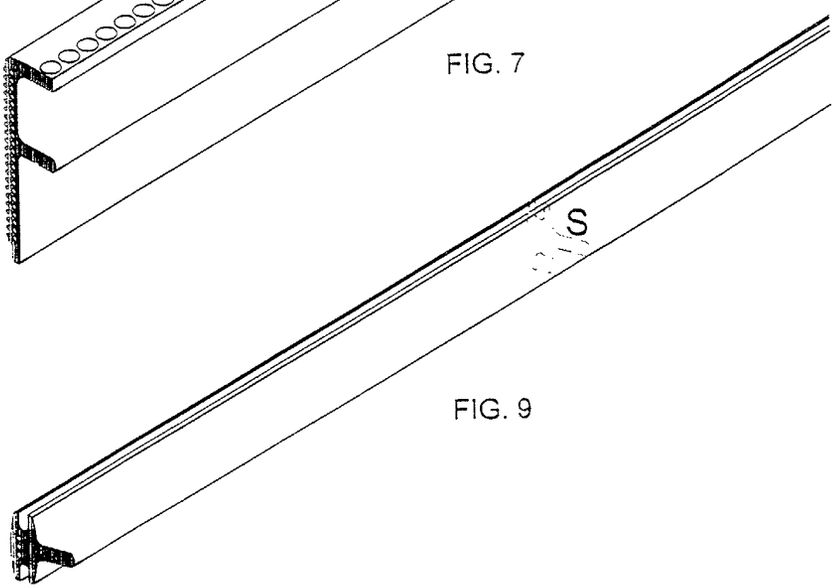

FIG. 9

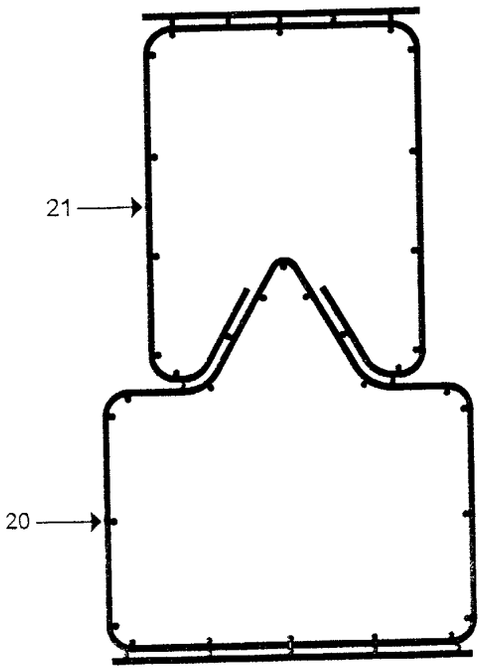

FIG. 10

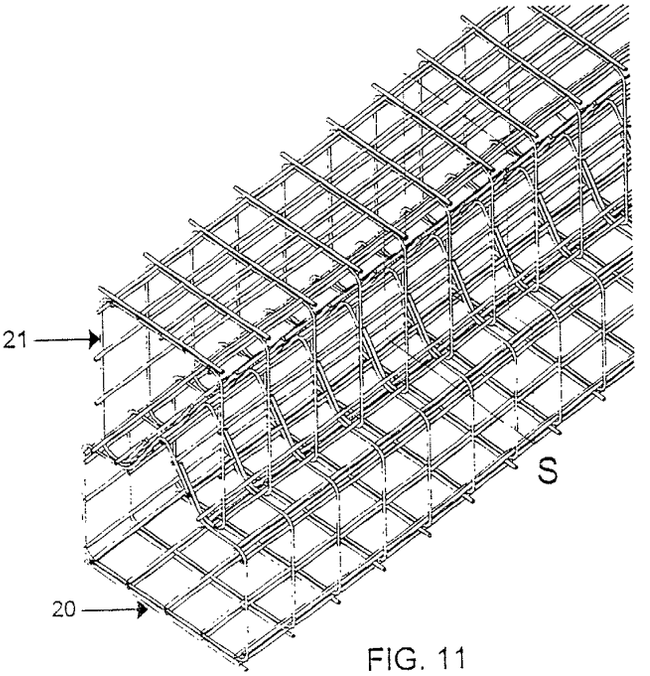

FIG. 11

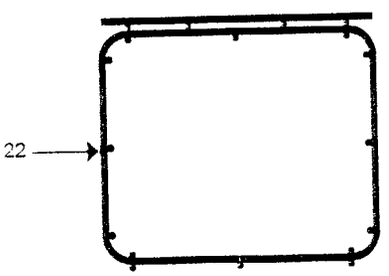

FIG. 12

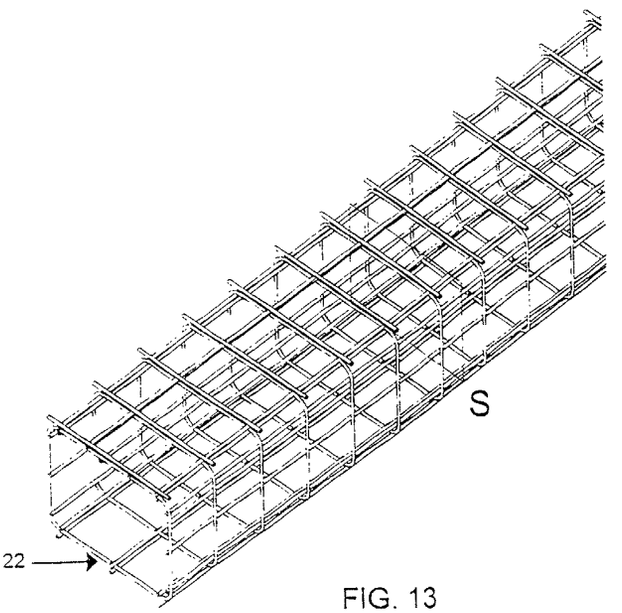

FIG. 13

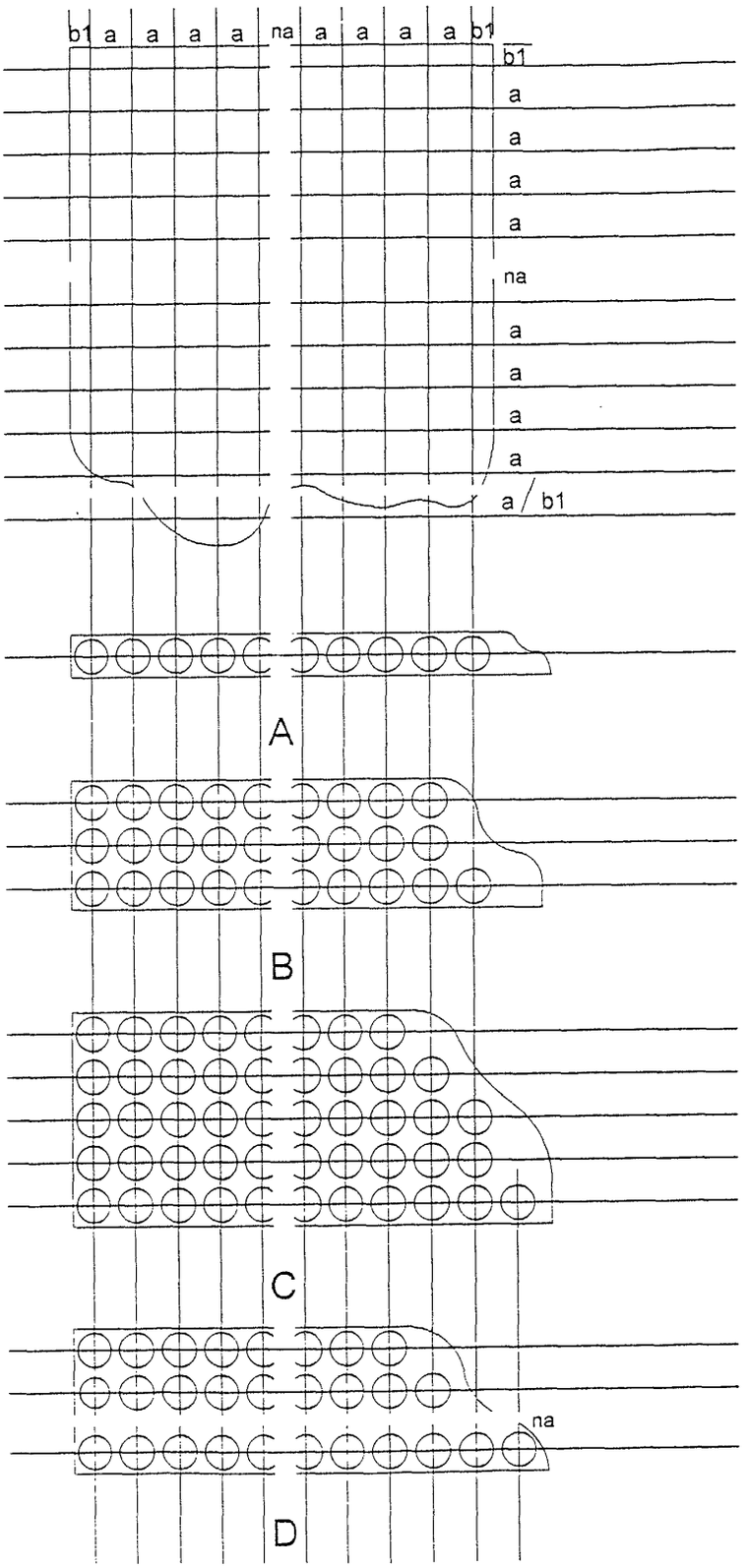

FIG. 14

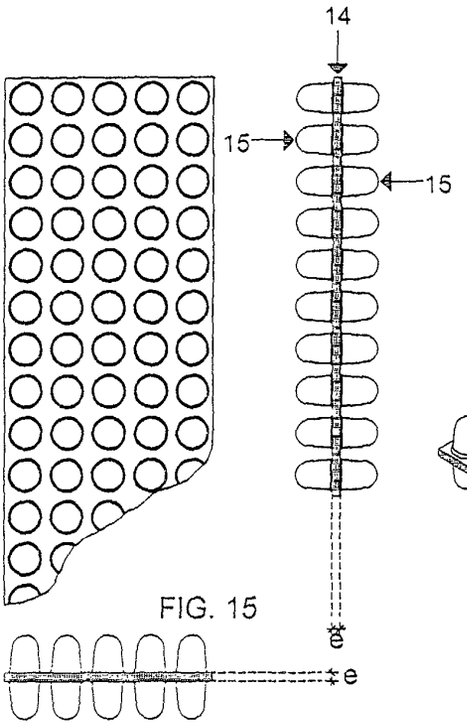

FIG. 15

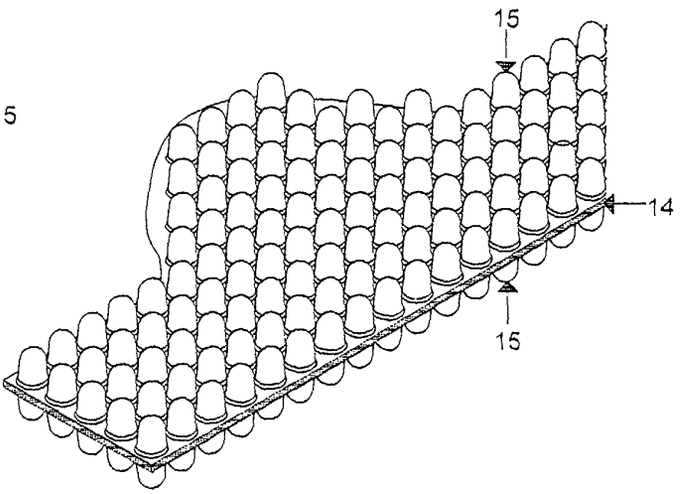

FIG. 16

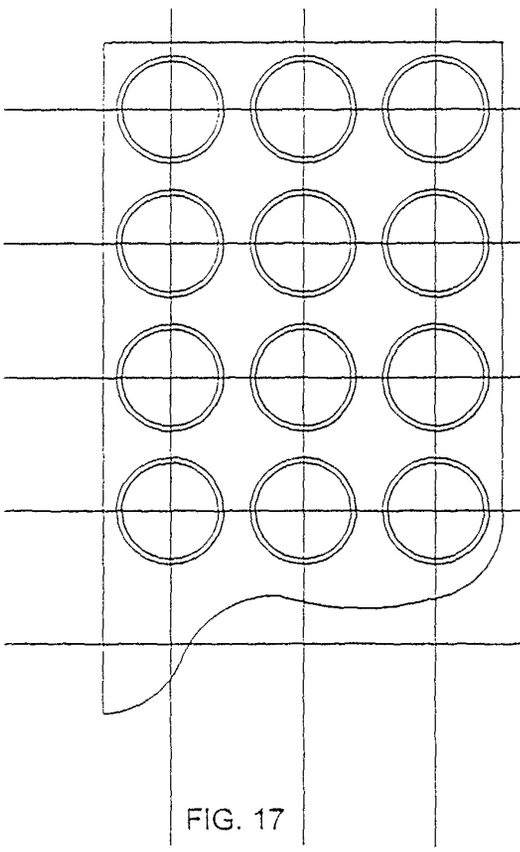

FIG. 17

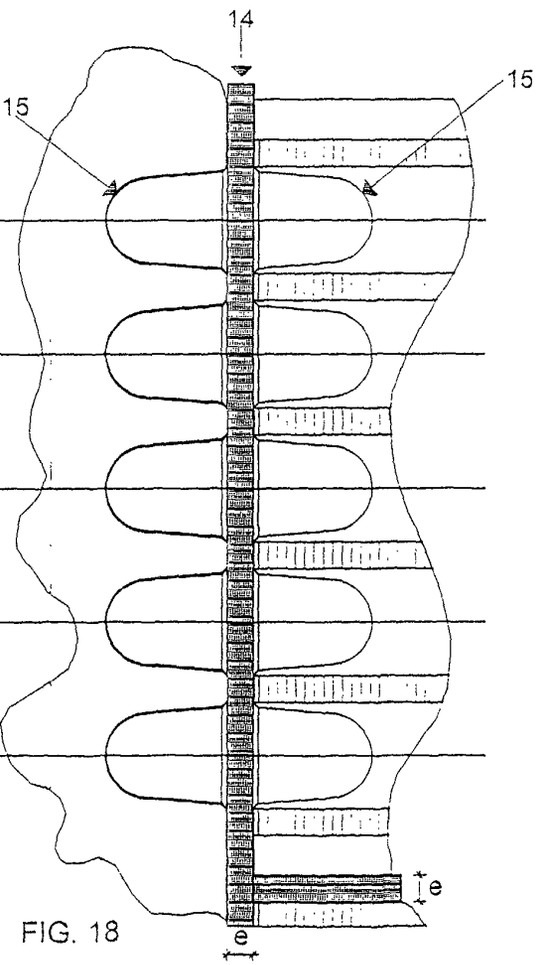

FIG. 18

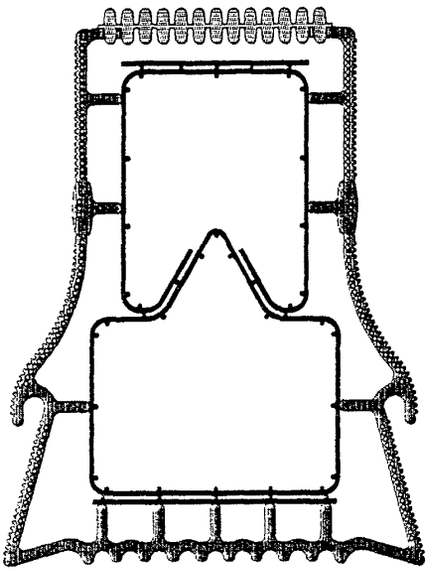

FIG. 19

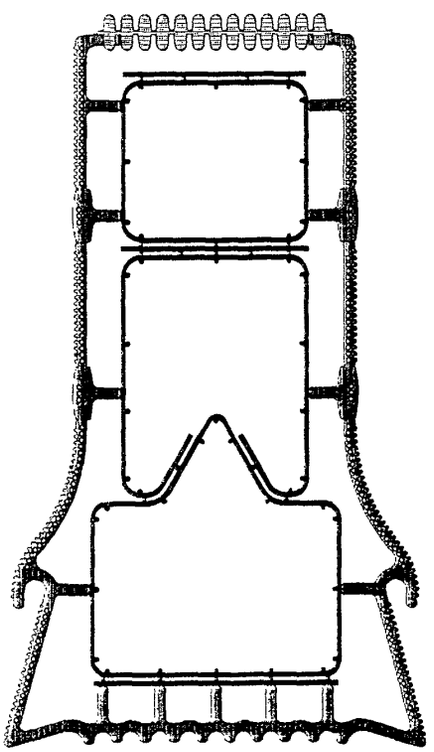

FIG. 20

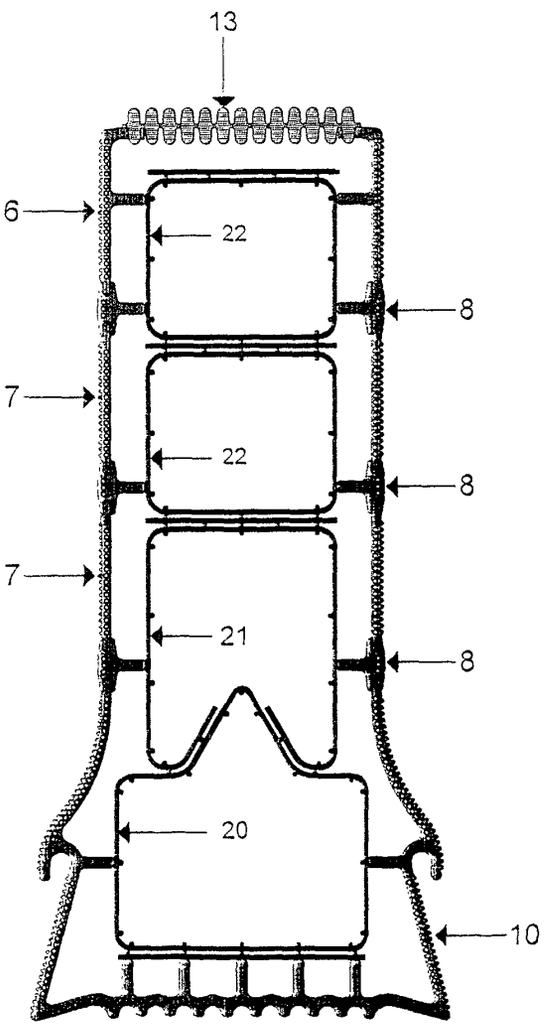

FIG. 21

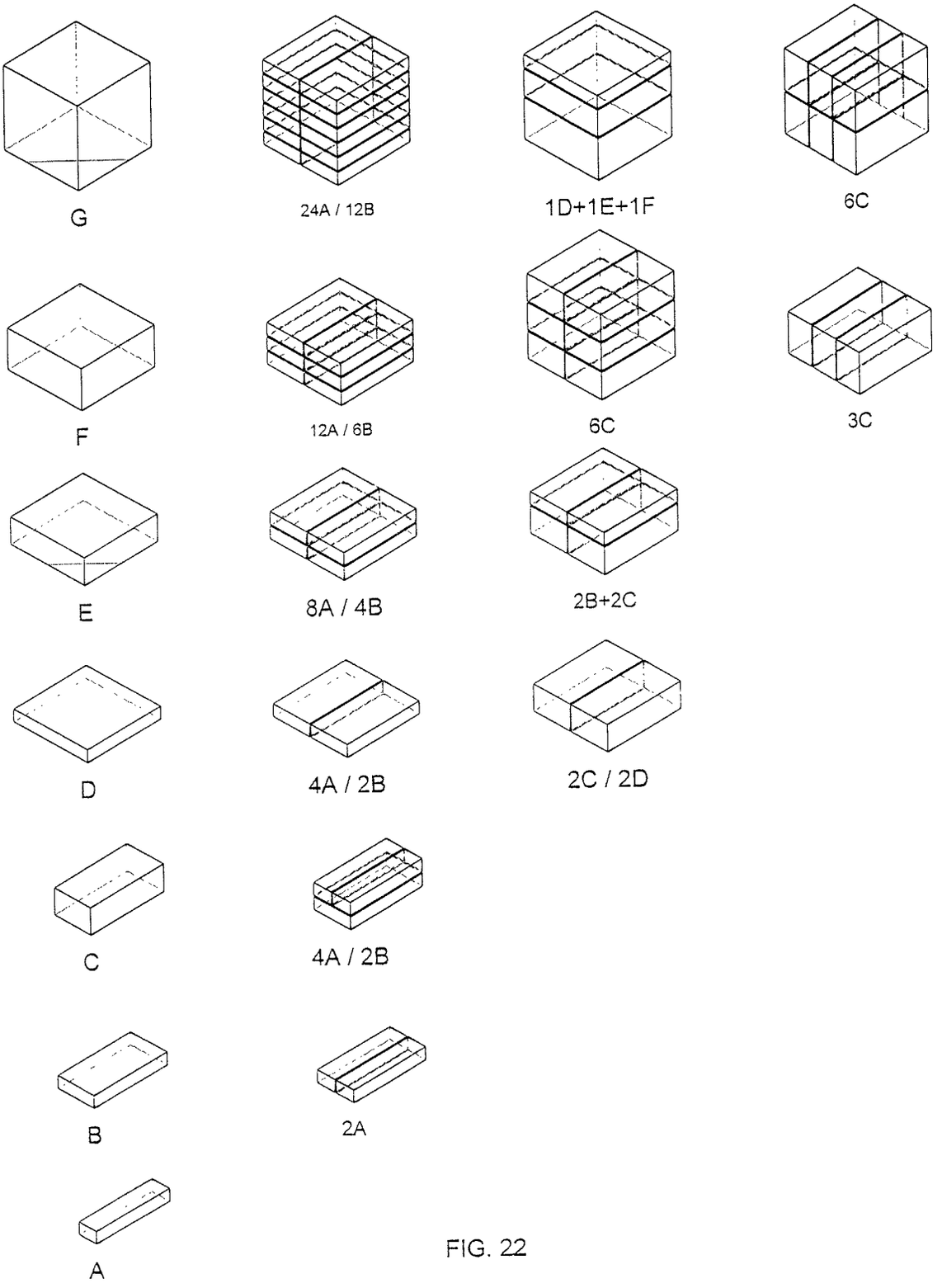
G
24A / 12B
1D+1E+1F
6C
F
12A / 6B
6C
3C
E
8A / 4B
2B+2C
D
4A / 2B
2C / 2D
C
4A / 2B
B
2A
A

FIG. 22

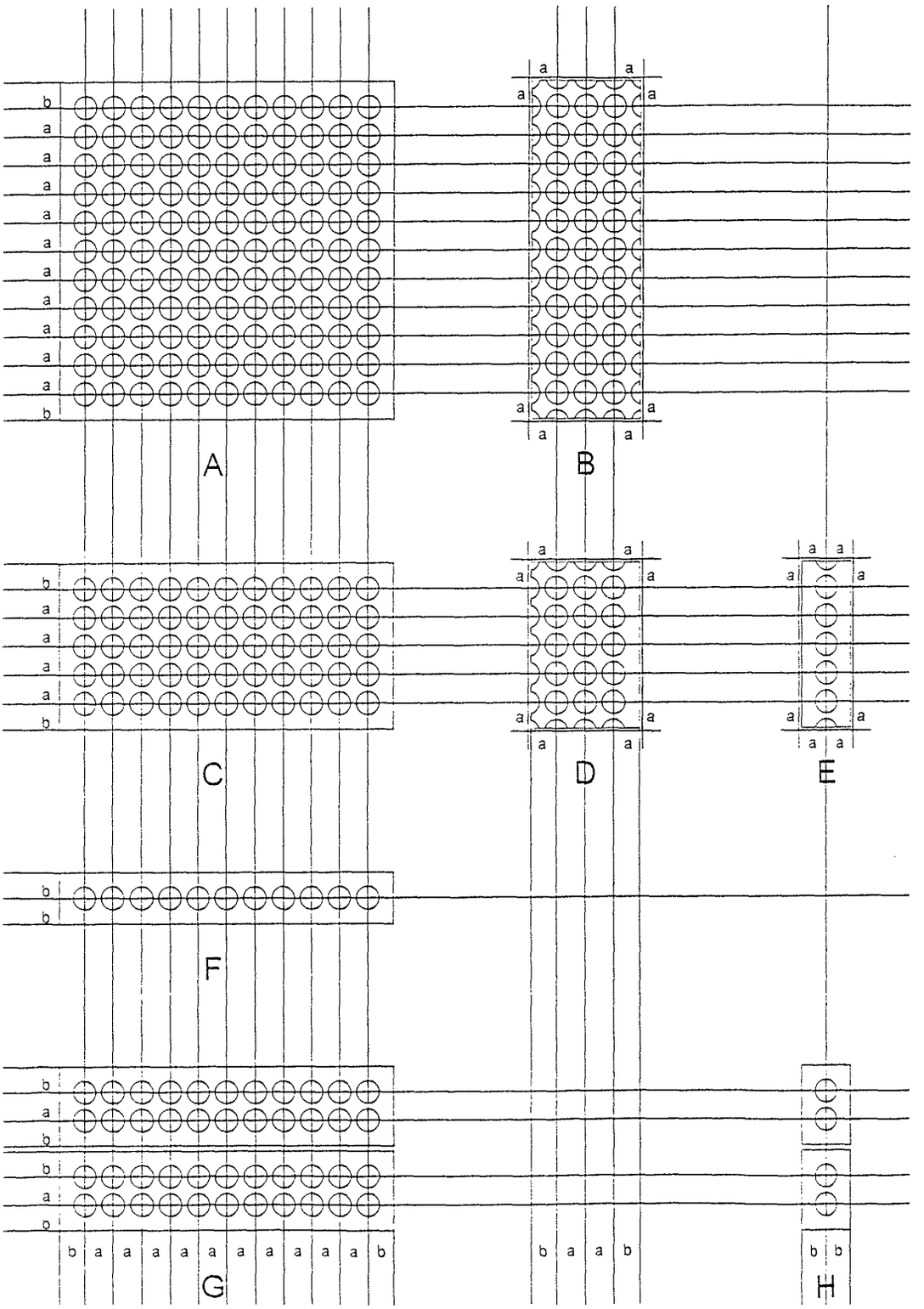

FIG. 23

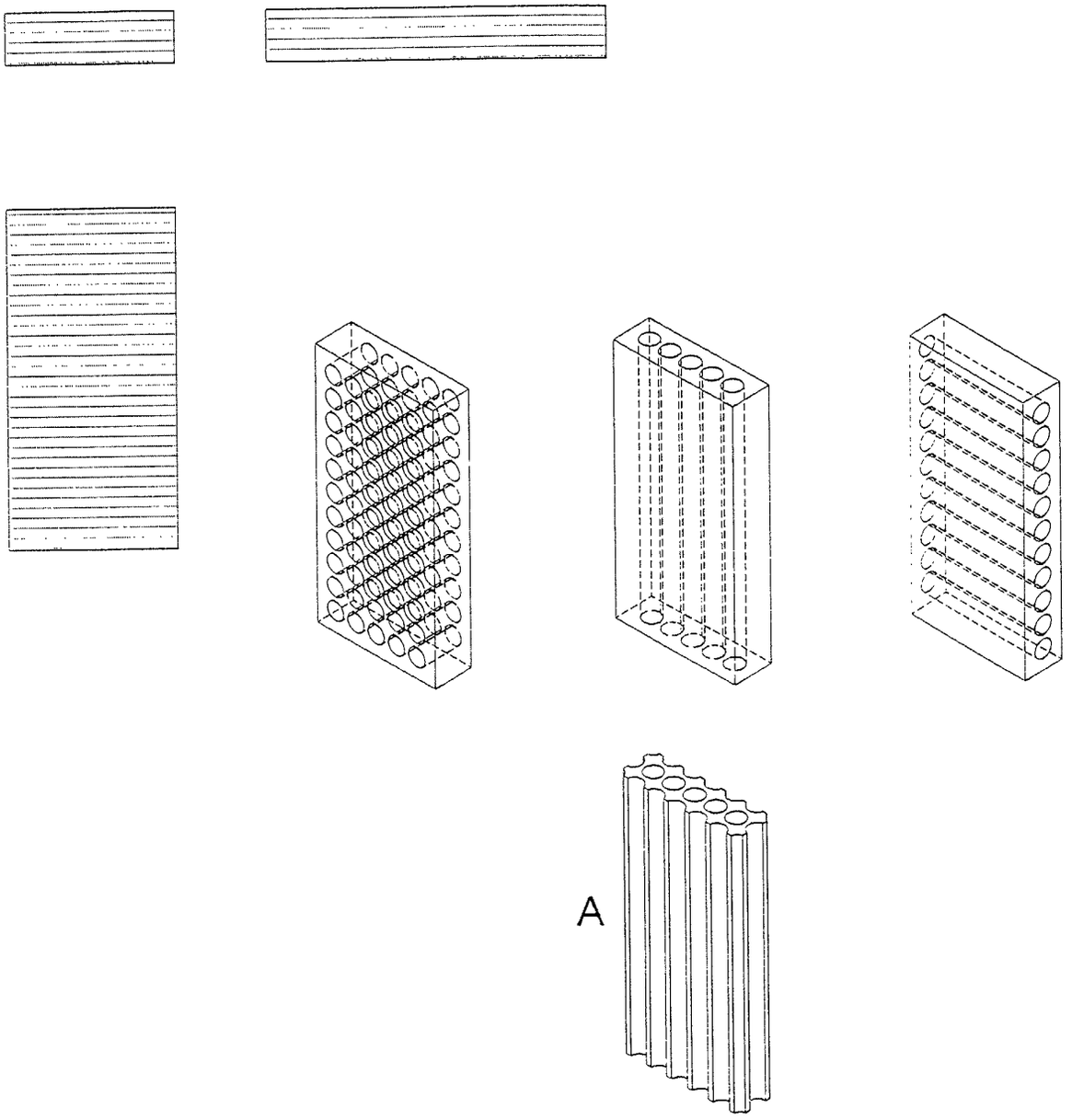

FIG. 24

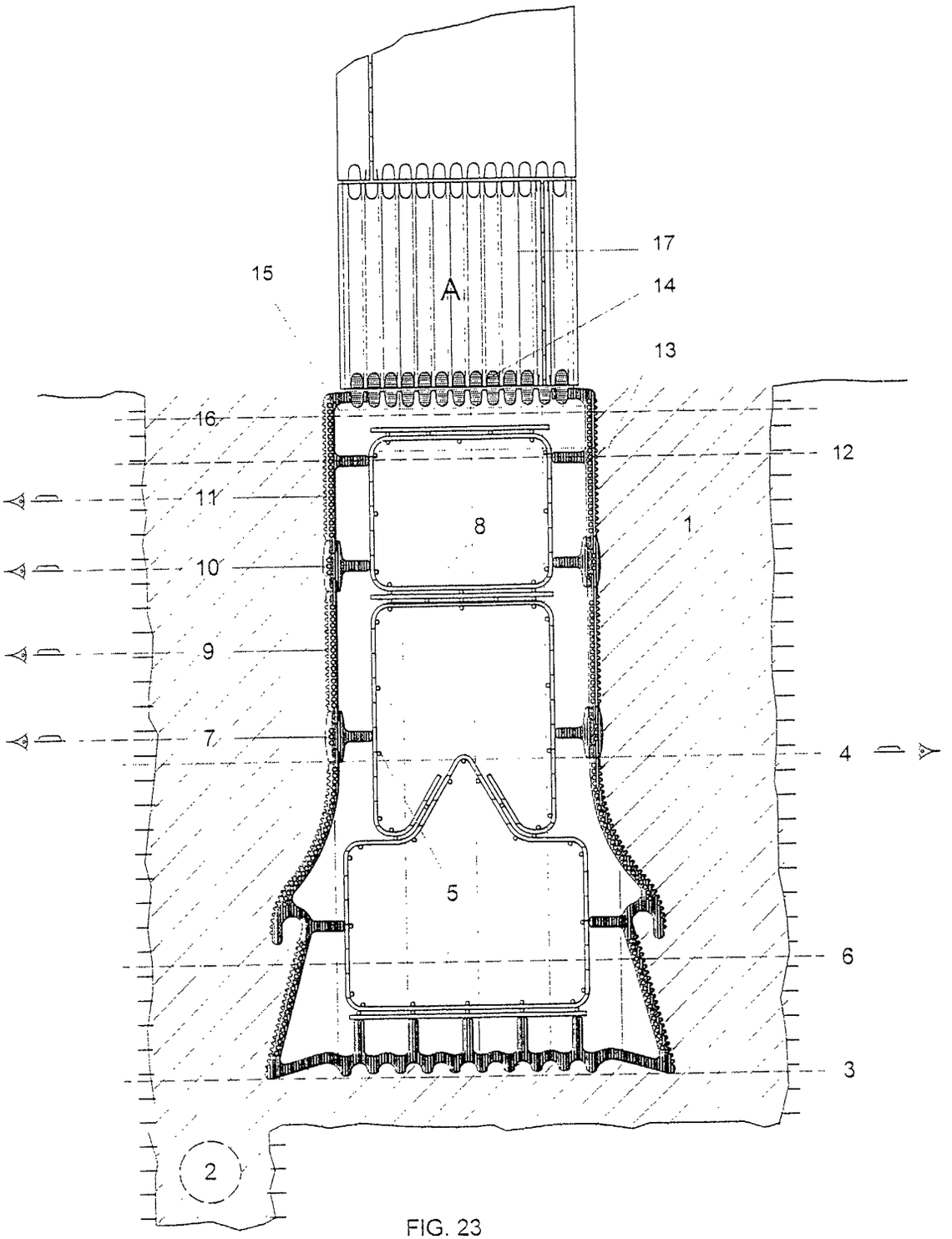

FIG. 23

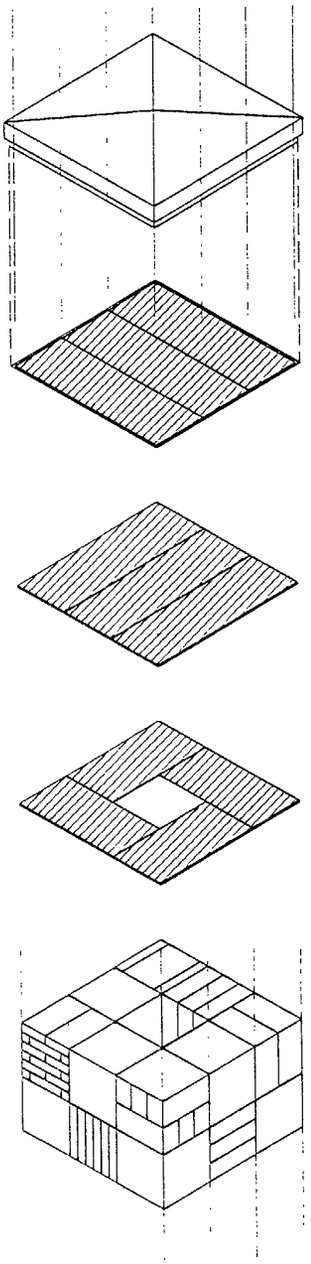

FIG. 26

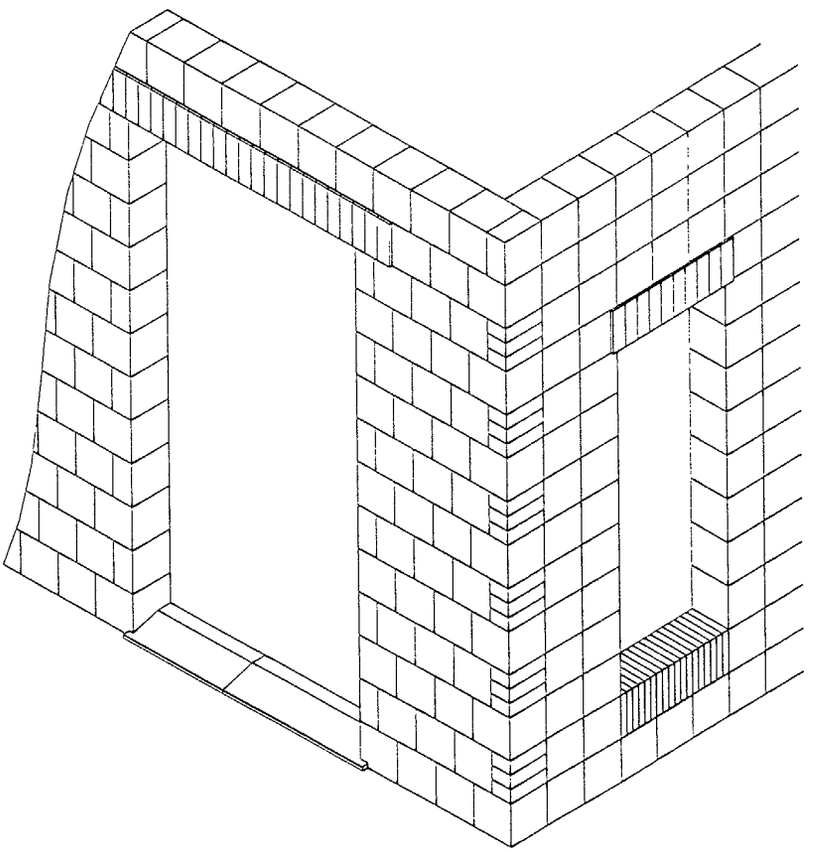

FIG. 27

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 02 39 8004

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
X	EP 0 462 042 A (FRANCOIS JACQUELINE ;FRANCOIS MICHEL (FR)) 18 December 1991 (1991-12-18) * the whole document *	1	E02D27/34 E04H9/02
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A	PATENT ABSTRACTS OF JAPAN vol. 1998, no. 12, 31 October 1998 (1998-10-31) & JP 10 182209 A (OBA SHINGO), 7 July 1998 (1998-07-07) * abstract *	1,2,6,11	
A	PATENT ABSTRACTS OF JAPAN vol. 009, no. 326 (M-441), 21 December 1985 (1985-12-21) & JP 60 159225 A (HITOSHI MORI), 20 August 1985 (1985-08-20) * abstract *	1,2,11	
A	DE 196 15 637 A (GEFINEX JACKON GMBH) 23 October 1997 (1997-10-23) * the whole document *	1,2,11	TECHNICAL FIELDS SEARCHED (Int.Cl.7) E02D E04H
X	US 5 802 792 A (FIELDING DAVID W ET AL) 8 September 1998 (1998-09-08) * the whole document *	1	
A		6-9	
X	DE 43 17 330 A (PHILIPP KLAUS ULRICH) 9 December 1993 (1993-12-09) * the whole document *	1	
A		6	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	13 January 2003	Delzor, F

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

European Patent Office

Application Number
EP 02 39 8004

CLAIMS INCURRING FEES

The present European patent application comprised at the time of filing more than ten claims.

☐ Only part of the claims have been paid within the prescribed time limit. The present European search report has been drawn up for the first ten claims and for those claims for which claims fees have been paid, namely claim(s):

☐ No claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for the first ten claims.

LACK OF UNITY OF INVENTION

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

see sheet B

☒ All further search fees have been paid within the fixed time limit. The present European search report has been drawn up for all claims.

☐ As all searchable claims could be searched without effort justifying an additional fee, the Search Division did not invite payment of any additional fee.

☐ Only part of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the inventions in respect of which search fees have been paid, namely claims:

☐ None of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims, namely claims:

European Patent Office

LACK OF UNITY OF INVENTION
SHEET B

Application Number
EP 02 39 8004

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

1. Claims: 1,2-5,11

   lost formwork for a reinforced concrete foundation diminishing stresses caused by earthquakes in the foudation.

2. Claims: 1,6-10,11

   connection for seismic uncoupling between a foundation and masonry walls or between the elements of said walls themselves, with a board-like connector having pins on both sides.

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 02 39 8004

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

13-01-2003

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82