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Schweitzer et al.

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[54] **COMPOSITE PANEL STRUCTURE**

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[73] Assignee: **H. E. Schweitzer AG,** Wettingen, Switzerland

[*] Notice: The portion of the term of this patent subsequent to Jan. 18, 1989, has been disclaimed.

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July 1, 1969 Switzerland 10048/69

[52] **U.S. Cl.** **52/663,** 35/52

[51] **Int. Cl.** **E04c 2/42**

[58] **Field of Search** ..... 52/263, 126, 489, 52/58, 663, 659, 581, 81, 645; 40/140, 142; 35/7, 52, 54; 61/61, 62; 94/4; 287/189.36 C, 189.36 H

[56] **References Cited**

UNITED STATES PATENTS

3,014,564	12/1961	Thomsen	52/484 X
1,294,115	2/1919	Knight	52/586
2,392,551	1/1946	Roe	52/586
2,900,495	8/1959	Zwick	52/473 X
3,086,629	4/1963	Blitzer	52/663
3,125,196	3/1964	Fenner	52/656
2,867,301	1/1959	Benton	52/263
3,298,153	1/1967	Rolland	52/663

OTHER PUBLICATIONS

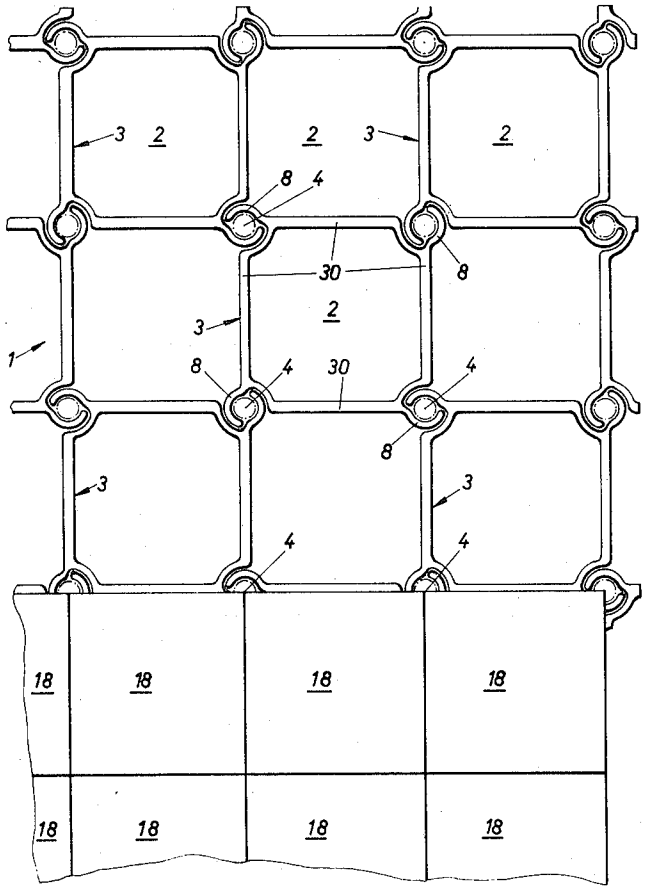
Germany Printed Application Das 1,140,329 to Schokbeton 11-1962

Primary Examiner—John E. Murtagh
Attorney—Michael S. Striker

[57] **ABSTRACT**

A frame of individual square elements, of which only diagonally opposite elements meet at their corners to form openings in which are held bolts having at their heads spring members that enter, and releasably lock in, recesses provided in the corners of square panels that register with the square elements.

17 Claims, 10 Drawing Figures



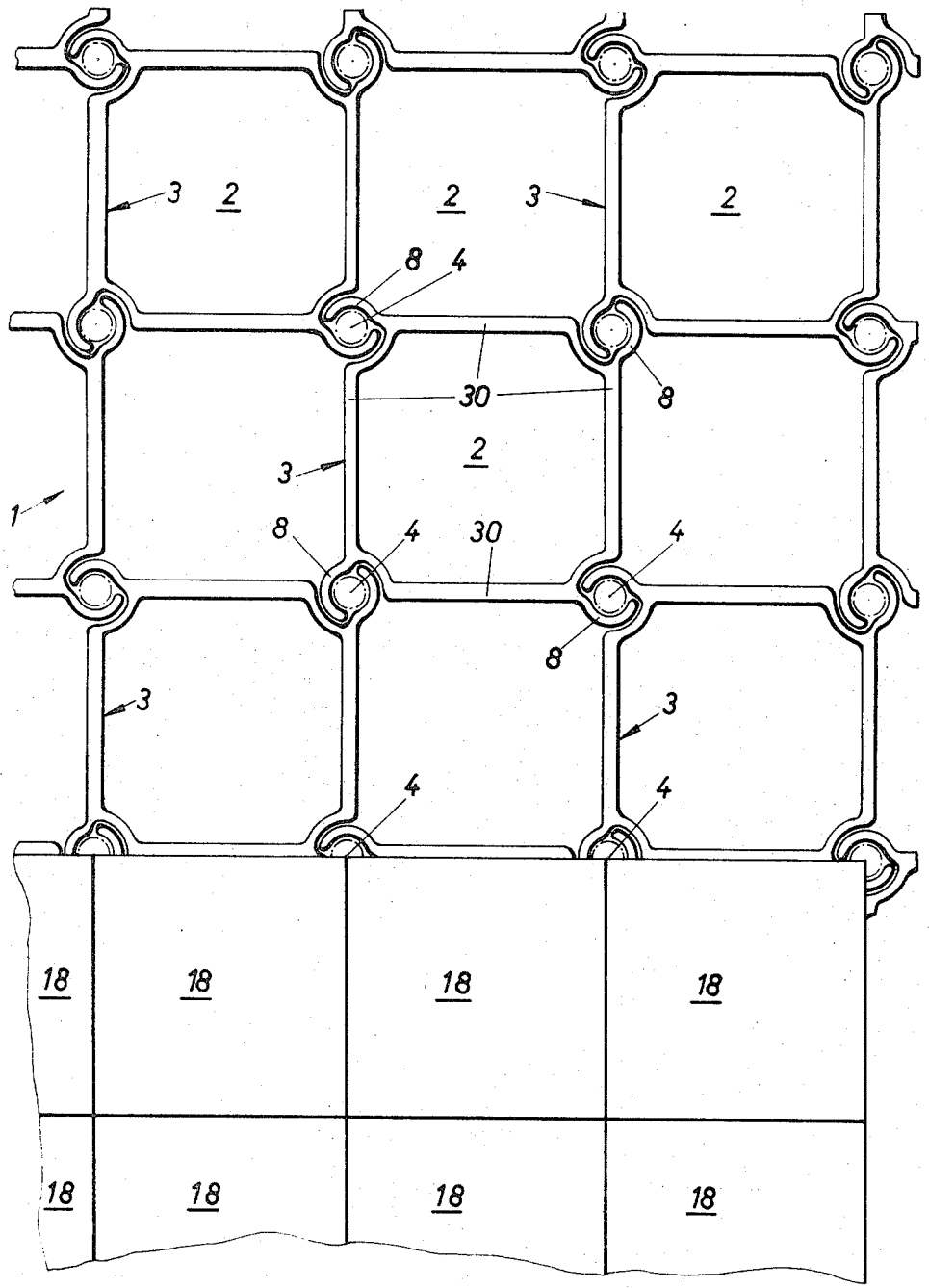


Fig. 1

Fig. 2

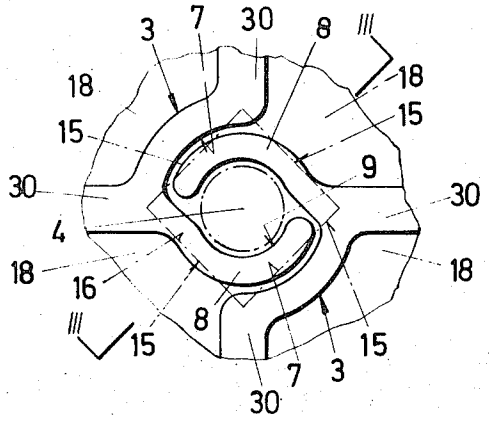
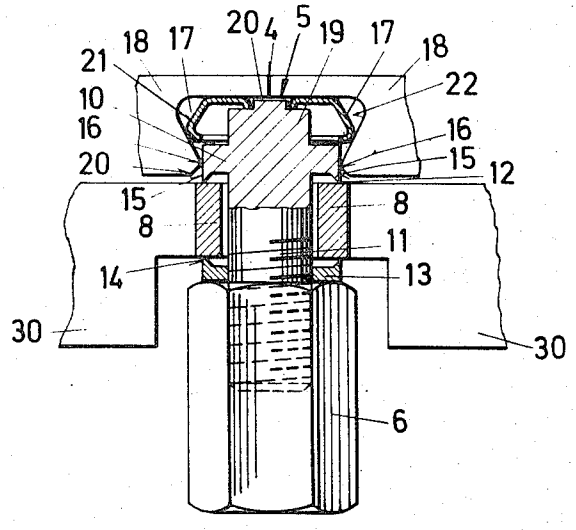

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Fig. 3


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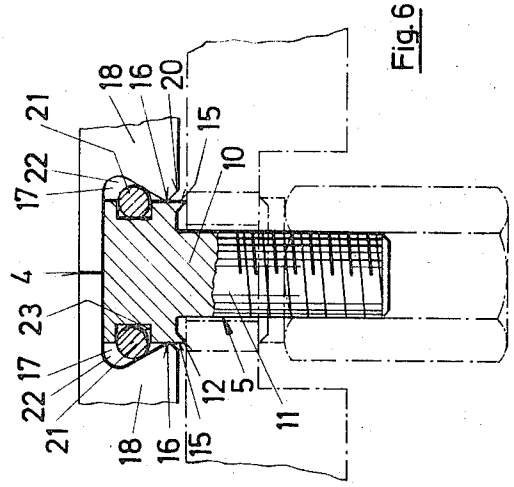


Fig. 6

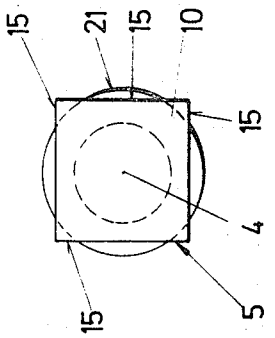


Fig. 7

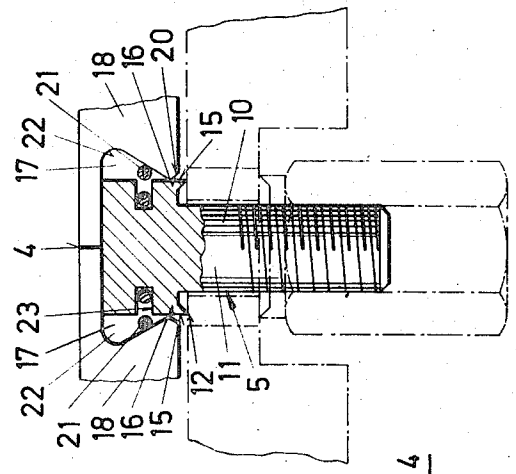


Fig. 4

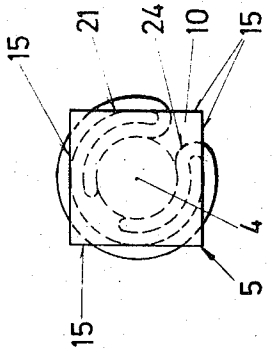


Fig. 5

Fig. 8

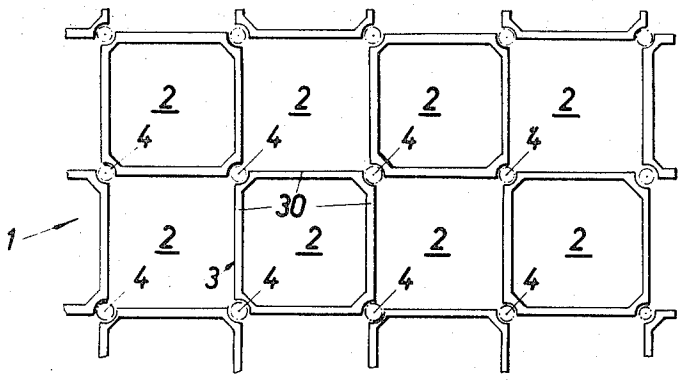


Fig. 9

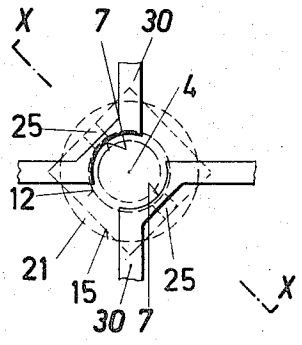
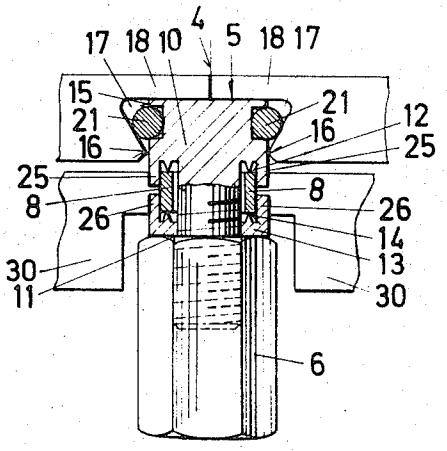


Fig. 10



COMPOSITE PANEL STRUCTURE

BACKGROUND OF THE INVENTION

The invention relates to a combination in a composite panel structure, comprising a lattice-like frame having similar polygonal frame elements.

The composite panel structure is particularly intended to be used in monitoring and control stations to monitor and control industrial processes or the power grid of a city, for example. The mosaic "stones," which are injection molded of a suitable synthetic plastic material, and are usually 25 to 50 mm. square, or else 25 × 50 mm., in size, have on their exposed surface the symbol of the element they represent. A complete panel therefore shows schematically an entire manufacturing process, for example, and composes a kind of mosaic circuit diagram. Moreover, switching units and indicators, such as control lamps and current and voltmeters, can be mounted in the panels to be visible to the personnel, who thereby can monitor and control that which is schematically represented on the panel.

Known structures of this kind, as used, for example, for mosaic circuit diagrams, comprise a mounting wall to which the mosaic stones are fixed. The mounting wall consists of a frame having therein metal plates with holes into which the mosaic stones are set. This known arrangement has the disadvantage that only surface areas of certain definite sizes can be fully covered by the mosaic stones. A further disadvantage are the relatively high construction expenses. Since the metal plates, which are the mounting wall proper, must be arranged in a frame, each circuit diagram is restricted to a definite kind of diagram, so that later changes or expansions are possible only at considerable expense. Moreover, a mosaic circuit diagram of this kind is very difficult to build convex or concave, since in this case both the frame and the metal plates must be constructed with very precise dimensions.

A honeycombed mounting wall has also been suggested for mosaic circuit diagrams. The lack of dimensional precision of the individual parts has the disadvantage that mosaic circuit diagrams of only limited size can be constructed. Since, however, a frame for accepting the individual parts is essential, the manufacturing and assembling costs are disproportionately high. This kind of construction is just as unsuitable for making concave or convex shapes as is the previous one.

There is known a still further mosaic circuit diagram, which comprises a rear wall and other wall parts, which latter build a mounting wall that consists of units. The mosaic stones are fixed to the mounting wall, which is assembled from cross-shaped or three-armed wall parts. All four or three arms of neighboring wall parts are joined together and screwed against supporting pins fixed to the rear wall by means of a single bolt or screw. This construction has the disadvantage that it takes a great deal of time, and is therefore expensive, to assemble the wall parts. A further disadvantage is that the wall parts are bolted or screwed against a rear wall, which makes more difficult the construction of convex or concave mosaic circuit diagrams. Finally, expansion or alteration of an existing mosaic circuit diagram is possible only to a limited degree.

SUMMARY OF THE INVENTION

An object of the invention is a combination in a composite panel structure, and particularly in a mosaic circuit diagram, having no frame, in the sense that the first of the three kinds of prior-art constructions discussed has a frame, and no rear wall, and which can be assembled in any desired size; made flat, concave, or convex in shape; and altered as required after construction.

The invention consists broadly of a combination in a composite panel structure, such as a mosaic circuit diagram, comprising a lattice-like frame including a number of similar polygonal frame elements, which latter have a plurality of meeting corner portions, each one of these meeting corner portions meeting only with one corner portion of a single frame element, and discrete coupling means, which can be a nut and bolt, for releasably connecting together the meeting corner portions.

The novel features which are considered as characteristic for the invention are set forth in particular in the appended claims. The invention itself, however, both as to its construction and its method of operation, together with additional objects and advantages thereof, will be best understood from the following description of specific embodiments when read in connection with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a plan view, with some of the mosaic stones removed, of the invention as applied to a mosaic circuit diagram;

FIG. 2 is a detail view from FIG. 1 on expanded scale;

FIG. 3 is a view in section taken along line III—III of FIG. 2;

FIG. 4 is a view, corresponding to FIG. 3, of a third embodiment;

FIG. 5 is a plan view of the third embodiment, with the mosaic stones removed;

FIGS. 6 and 7 are views, respectively corresponding to FIGS. 4 and 5, of a fourth embodiment;

FIG. 8 is a plan view of a fifth embodiment, with the mosaic stones removed;

FIG. 9 is a detail view, on expanded scale, taken from FIG. 8; and

FIG. 10 is a sectional view, taken along line X—X of FIG. 9.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

FIG. 1 is a plan view of a composite, mosaic, panel structure having a mounting frame 1 composed of individual rectangular units 2 to form the lattice-like frame. These units are formed by rectangular frame elements 3, which are placed together so that their corner portions meet; and a design is formed like that of the squares of a chess board. The corners of the units 2 are adjacent the passages having axes 4, which extend perpendicular to the plane defined by the mounting frame 1. Only two frame elements 3 are adjacent each axis 4. Each element consists of four side walls 30 rigidly connected together. These walls are also perpendicular to the plane of the frame 1. The two elements 3 adjacent an axis 4 are securely held together by a screw or bolt 5 and a nut 6, as shown in FIGS. 2 and 3. Each corner of a frame element 3 incorporates a concave cavity 7 next to the axis 4. From one end of each cavity 7 projects a curved tongue 8 that partly surrounds the neighboring axis 4. As shown in the structure of FIGS. 1 and 2, the corner portions or tongues 8 project between the axis 4 and the concavity 7 of the diagonally

opposite frame element 3, so that the tongues of two frame elements form a socket, or an opening, 9 for a bolt 5. Between the cavity 7 and the surface of the neighboring tongue 8, on the one hand, and between the diameter of the bolt 5 and that of the opening 9, on the other, sufficient tolerance is provided to permit adjustment for imprecise dimensions of the frame elements 3 and/or of the mosaic stones 18. FIG. 1 shows that diagonally opposite tongues 8 of an element 3 are precisely symmetrical about the center of the element.

The tongues 8 surround the axes 4 through an arc of nearly 180°. The concave cavity 7 and the corresponding tongue 8, of the same element 3, together surround the adjacent axis 4 through an arc of approximately 270°. When a bolt 5 is placed into the opening 9, the two tongues 8 of that opening surround the latter in such a manner that the two frame elements 3 thus connected together cannot be separated, irrespective of whether the nut 6 is threaded onto the bolt and tightened down. As a consequence, the frame 1 cannot collapse if the bolts 5 loosen. Each bolt, or male coupling element, has a head 10, and a threaded coupling member 11 with a nut, or female coupling element, 6. The latter preferably extends beyond the length of the shaft 11, so that switching or indicating units can be mounted in the exposed part of the threaded bore of the nut. The underside of the bolt head 10 has an annular knife edge 12, concentric to the axis 4, and which is forced into the two tongues 8 underneath. Between the nut 6 and the tongue 8 is arranged a ring, or annular disc 13, which has an annular knife edge 14 that is symmetrical to the knife edge 12 to a plane passing midway between these two knife edges. The knife edge 14 is forced from below into the two tongues 8 positioned above. In plan view the bolt head 10 is square, as shown in FIG. 2. Each side wall 15 of the bolt head extends parallel to the lower edge 16 of the recess 17 in a respective one of the four adjacent mosaic stones 18 meeting at their corners that coincide with the respective axis 4. The end walls of the recesses 17 are S-shaped in cross section, as can be seen in FIG. 3, which shows the end walls of two contiguous recesses. The lower edge 16 of a recess contacts the opposite side wall 15, which positions the edge 16, so that the bolt head 10 serves as a guide means. Since each mosaic stone has at each corner a recess 17 of which the end wall makes an angle of 45° with the adjacent sides of the mosaic stone, and since at each corner of a unit 2 there is provided a bolt 5 with side walls 15, each mosaic stone 18 is held in position at each of its four corners by a respective side wall 15.

The S-shaped end wall of each recess 17, and thus the edge 16, are rectilinear, as a consequence of which the milling of the recess 17 is simplified. Since the recess is straight, the diameter of the milling cutter is unimportant.

The S-shaped end wall of a recess forms a wedge-shaped surface 220 near the bottom of the recess, so that the mosaic stone presses relatively lightly on the spring 21.

The head 10 of the bolt 5 is elongated by a projection 19 that terminates in a short pin 20. The latter centers the spring 21, which is mounted on the projection and connected thereto in any suitable and known manner. The spring 21 consists of a dish-shaped, curved piece of spring steel and acts resiliently in directions extending radially from the corresponding axis 4.

In accordance with another embodiment, the spring 21 can be an annular, elastic, solid body of any suitable material, such as an elastomer.

A mosaic stone 18 is secured to a unit 2 by placing the stone over the unit, with the four corner recesses 17 of the stone in registry with the corresponding springs 21; whereupon the stone 18 is pressed against the frame 1, causing the respective lower edge 16 to compress the spring 21 until the latter is pushed behind the edge 16 and is releasably locked in the recess 17. When locked, the spring 21, as shown in FIG. 3, presses against the inclined end wall surface 22 of the recess 17. The mosaic stone 18 is removed simply by pulling on it, so that the end wall surface 22 compresses the spring 21 until the latter has been pulled free of the edge 16.

FIGS. 4 to 7 show third and fourth embodiments, wherein the same or equivalent parts are denoted by the same the same reference numerals and will not be further described.

In the embodiment shown in FIGS. 4 and 5, the bent, dish-shaped spring 21 is replaced by an annular spring 121. The bolt head 110 incorporates a peripheral groove 23 in which the spring 121 is held. The opening 24 in the spring 121 is positioned opposite one of the corners of the rectangular bolt head 110, so that a respective portion of the spring projects, and acts radially, beyond each side wall 15.

In the fourth embodiment, shown in FIGS. 6 and 7, the peripheral groove 23 is wider. The spring 221, an elastomeric annulus, round in cross section, is held in this groove and projects approximately one-half of its cross section beyond the middle of a side wall 15 of the bolt head 210. As a consequence, the spring 221 forms a radially acting spring in the neighborhood of the side walls 15.

The fifth embodiment, shown in FIGS. 8–10, comprises a mounting frame 101 for a mosaic circuit diagram having square units 2, which are formed by square frame elements 103 that are placed together at their corners to form a lattice-like frame 101. The corners of the units 2 border on respective axes 4, which are perpendicular to the plane defined by the frame 101. The elements 103 are composed of four side walls 130, which are rigidly connected together and normal to the plane of the frame 101. Only two, diagonally opposite, frame elements 103 are adjacent a respective axis 4; and they are fixedly connected together by a bolt 5 and nut 6, as shown in FIGS. 9 and 10. Each corner of an element 103 incorporates a concavity 107 that faces the respective axis 4.

The concavities 107 of two diagonally opposite elements 103 form a socket, or an opening, for the bolt 5, which has a head 310 and a threaded shaft 11, on which latter the nut 6 is screwed. The nut preferably extends beyond the end of the threaded shaft 11, so that switching or indicating units can be mounted in the open part of the nut bore.

The underside of each bolt head 310 has an annular knife edge 112 that is centered on the respective axis 4 and pressed into the part of the frame element 103 immediately below it. A disc 113 is arranged between the nut 6 and the element 103. The disc has a knife edge 114, which is a mirror reflection of the knife edge 112 and is pressed into that part of the frame element 103 immediately above it. In plan view, the bolt head 310, as shown in FIG. 9, is square.

Each of its side walls **15** is parallel to the lower edge **16** of the recess **17** in a respective one of the four mosaic stones **18** meeting at their corners that coincide with the respective axis **4**. The side wall **15** engages the opposite lower edge **16** and acts as a guiding, or positioning, surface. Since each mosaic stone has at each os its corners a recess **17** of which the end wall makes an angle of 45° with the adjacent sides of the mosaic stone, and since at each corner of a unit **2** there is provided a bolt **5** with side walls **15**, each mosaic stone **18** is held in position at each of its four corners by a respective side wall **15**.

The underside of the bolt head **310** has two diametrically opposite legs **25**, which engage the inner face of the corner wall of a respective one of two diagonally opposite frame elements **103**.

The disc **113** also has two diagrammatically opposite legs **26**, which are aligned with the legs **25** and engage the same inner faces. Should the nut **6** loosen, the legs **25** and **26** prevent the mounting frame **101** from falling apart. Sufficient tolerance is provided between the legs **25** and **26**, on the one hand, and the corner walls of the frame elements **103** held by them. on the other hand, so as to permit compensation of dimensional inaccuracies in the elements **103** when large panel structures are built.

In the various embodiments, the assembly of frame elements **3** or **103** defines a plane that can be flat, concave or convex.

It will be understood that each of the elements described above, or two or more together, may also find a useful application in other types of composite panel structures differeing from the types described above.

Without further analysis, the foregoint will so fully reveal the gist of the present invention that others can be applying current knowledge readily adapt it for various applications without omitting features that, from the standpoint of prior art, fairly constitute essential characteristics of the generic or specific aspects of this invention and, therefore, such adaptations should and are intended to be comprehended within the meaning and range of equivalence of the following claims.

What is claimed as new and desired to be protected by Letters Patent is set forth in the appended claims.

We claim:

1. In a modular panel structure, a combination comprising a lattice-like frame including a plurality of similar polygonal frame elements each located in a general plane and each having a plurality of corner portions, the frame being so constructed that each corner portion of each of said frame elements adjoins a similar corner portion of at most one neighboring frame element, and each corner portion being so configurated that pairs of adjoining corner portions together define passages; and connecting means for preventing relative motion between neighboring ones of said frame elements in direction transverse to the general plane of such neighboring elements and including a plurality of discrete elongated coupling members each extending through a respective one of said passages in cirection transverse to the general plane of the respective neighboring elements; and further including a plurality of polygonal panels adjacent to one side of said frame and having corner portions that register with pairs of adjoining corner portions, the corner portions of said panels being provided with recesses extending substantially diagonally inwardly from the respective panel corner portions and each having a wider portion and a narrower portion disposed between the respective wider portion and said one side of said frame, said connecting means including substantially annular elastic retaining members mounted at the adjoining corner portions of said frame elements and received in the wider portions of the adjacent recesses of said panels, said panels being separable from the frame in response to deformation of said retaining members during passage through the narrower portions of the respective recesses.

2. A combination as defined in claim **1**, said connecting means further includes guide means mounted between each of said elastic retaining members and the adjoining corner portions of said frame, said guide means having four side walls that respectively engage along their lengths the narrow portion of a respective one of said recesses.

3. A combination as defined in claim **2**, wherein each said retaining member comprises a dish-shaped body consisting of spring steel.

4. A combination as defined in claim **1**, wherein each said retaining member comprises a solid, resilient, dish-shaped body.

5. A combination as defined in claim **2**, wherein said retaining members are annular springs, and said guide means has a continuous peripheral groove in said side walls thereof to hold a respective one of said annular springs.

6. A combination as defined in claim **2**, wherein each of said annular springs defines in cross section a single round body.

7. In a modular panel structure, a combination comprising a lattice-like frame including a plurality of similar polygonal frame elements each located in a general plane and each having a plurality of corner portions, the frame being so constructed that each corner portion of each of said frame elements adjoins a similar corner portion of at most one neighboring frame element, and each corner portion comprising a claw-shaped extension, with the claw-shaped extensions of pairs of adjoining corner portions together defining passages; and connecting means for preventing relative motion between neighboring ones of said frame elements in direction transverse to the general planes of such neighboring elements and including a plurality of discrete elongated coupling members each extending through a respective one of said passages in direction transverse to the general planes of the respective neighboring elements.

8. A combination as defined in claim **7**, wherein each of said frame elements is rectangular and has a geometric center and has diagonally opposite claw-shaped extensions which are symmetrical with respect to said center.

9. A combination as defined in claim **7**, wherein each of said passages has an axis and wherein the interlocking claw-shaped extensions of adjoining corner portions each surround the respective axis by more than 90°.

10. A combination as defined in claim **9**, wherein said interlocking claw-shaped extensions of adjoining corner portions each surround the axis of the respective passage by approximately 270°.

11. A combination as defined in claim **7**, wherein each of said elongated coupling members has at least one sharp edge portion for engaging the two respective adjoining corner portions.

12. A combination as defined in claim 11, wherein said elongated coupling members are threaded bolts and wherein said connecting means further includes threaded nuts for said bolts, and wherein each of said threaded bolts has a head provided with a knife edge extending from said head in direction towards the leading end of the bolt.

13. In a modular panel structure, a combination comprising a lattice-like frame including a plurality of similar polygonal frame elements each located in a general plane and each having a plurality of corner portions, the frame being so constructed that each corner portion of each of said frame elements adjoins a similar corner portion of at most one neighboring frame element, and each corner portion being so configurated that pairs of adjoining corner portions together define pass-ages; and connecting means for preventing relative motion between neighboring ones of said frame elements in direction transverse to the general planes of such neighboring elements and including a plurality of discrete elongated coupling members in the form of threaded screws having heads and each extending through a respective one of said passages in direction transverse to the general planes of the respective neighboring elements, and said connecting means further comprising a plurality of threaded nuts for said threaded screws, the adjoining corner portions of neighboring frame elements being tightly held between the head of the respective threaded screw and the respective nut.

14. A combination as defined in claim 13, wherein said heads each have two substantially diametrically opposed legs, and each of two meeting corner portions has a respective wall partly surrounding the respective bolt on diametrically opposite sides thereof and located between the respective bolt and a respective leg by which it is engaged.

15. A combination as defined in claim 13, wherein each said connecting means includes an annular disc located between each nut and the respective meeting corner portions, said disc having two substantially diametrically opposed legs that engage respective ones of said meeting corner portion walls on the same surface thereof as the legs of said head.

16. A combination as defined in claim 13, wherein said frame elements are located in a predetermined plane, and two meeting corner portions define a passage normal to said plane, and the head of said bolt has an annular knife edge substantially centered on the axis of passage, and said connecting means includes an annular discs each substantially centered on said axis and having a knife edge, the knife edge of said bolt head and the knife edge of said disc each engaging both of the two meeting corner portions on respective sides thereof.

17. In a modular panel structure, a combination comprising a lattice-like frame including a plurality of similar polygonal frame elements each located in a general plane and each having a plurality of corner portions, the frame being so constructed that each corner portion of each of said frame elements adjoins a similar corner portion of at most one neighboring frame element, and each corner portion being so configurated that pairs of adjoining corner portions together define passages; and connecting means for preventing relative motion between neighboring ones of said frame elements in direction transverse to the general planes of such neighboring elements and including a plurality of discrete elongated coupling members each extending through a respective one of said passages in direction transverse to the general planes of the respective neighboring elements, and further including a plurality of circular members having knife edges engaging the adjoining corner portions of respective neighboring frame elements.

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