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(21) International Application Number: PCT/YU98/00017 (22) International Filing Date: 22 July 1998 (22.07.98) (30) Priority Data: P-322/97 25 July 1997 (25.07.97) YU (71)(72) Applicants and Inventors: KEKANOVIĆ, Milan [YU/YU]; Zetska 15/18, YU-24000 Subotica (YU). KASAŠ, Karolj [YU/YU]; Tvornička B.B., YU-24420 Kanjiža (YU). (74) Common Representative: KEKANOVIĆ, Milan; Zetska 15/18, YU-24000 Subotica (YU).		(81) Designated States: AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GE, GH, GM, HR, HU, ID, IL, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG). Published <i>Without international search report and to be republished upon receipt of that report.</i>
(54) Title: A GREAT-SPAN INTERMEDIATE FLOOR CONSTRUCTION, PARTICULARLY FOR BUILDING OF PUBLIC AND RESIDENCE STRUCTURES (57) Abstract This invention refers to Great Span Intermediate Floor Construction particularly designed for construction of public and residential buildings. This is a solution for construction of light-carrying floors based on the static system of a single span beam or continual beam, where the length of the field can be more or less than 10 meters, using semi prefabricated system of construction, that results in complete adaptability of space. The essence of the invention is in prefabrication of longitudinal girders (5) fixed to the supports (2 and 3) of the intermediate floor (1) and to the intermediate column (4a) of the continual intermediate floor (1a). The girder (5) consists of diagonal and triangular and spiral steel reinforcement filling which has in its corners flat steel profiles that are "welded" by fine grain concrete inside of the upper hollow tile (10) and lower hollow tile (11). Girders (5) may be not only straight but also horizontally or vertically curved, ring shaped or twisted. Between girders (5) that are evenly moved apart, on the lower hollow tiles, are placed the lower hollow tile blocks (6) and above them are placed at least two rows of light upper non-carrying hollow tile blocks (7). The hollow tile blocks (6 and 7) are made of burned ceramics. In the case of continual intermediate floor (1a), close to the intermediate columns (4a) instead of the blocks (6) between girders (5) are twice as short lower hollow tile blocks (20) enabling concrete to fill above (20) and into hollow tile blocks (19), forming this way, the lower pressurized zone.		

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A Great-Span Intermediate Floor Construction, Particularly for Building of Public and Residence Structures

Technical Field

The subject of this invention belongs to the field of Building Construction, to be more precise, to intermediate floor constructions, and it specifically refers to large span (10 meters and more) intermediate floor constructions, that are recommended in construction of public and residence buildings, and can even be applied in construction of bridges.

In accordance to international classification of patents (MKP), the subject of the invention is signed by a basic classification symbol E 04 B 5/08 that refers to bearing intermediate floor construction, accomplished by adjoining prefabricated hollow tile blocks, and secondary classification symbols E 04 C 1/24 and E 04 C 5/065 that refer to filling elements and light steel lattice trusses for construction of intermediate floors, and floors.

- The technical problem

The technical problem that is to be solved by this invention is: how to construct a simple and light bearing intermediate floor construction of large span (ten and more meters) by the means of a static system using a single span beam or continual beam with the ability of bearing bigger freight, while using prefabricated building approach, to enable the accomplishment of completely adaptable spaces under the intermediate floor.

Current state of technology /Background Art

It is well known that intermediate floor constructions are being constructed from wooden, cast and mounted reinforced concrete panels, as well as other mounted elements capable of bearing useful freight. In practice there are many different systems that use such bearing elements.

Nowadays similar solutions are used for light intermediate floor constructions such as: Monta Floor, Fert Floor, Omnia Floor, concrete floor that has been made lighter by implanted cardboard, polystyrene, and similar light materials. The Fert intermediate floor construction is the most similar to our solution, but with an important difference, which is that the Fert has a maximum span of 6,10 meters without the capability of continual construction.

In Yugoslav patent paper (number 31900) a light building construction is described, made from prefabricated elements for construction of floors. The innovative solution is an improved floor construction, which includes more parallel I-girders that carry prefabricated light panels filled with light concrete. Each of the panels have bottom side corner channels which are connected to the top ends of the nearby I-girders, while on the sides of panels are created semi-circular channels. Holders, placed on top side in the middle of I-girders connect the panels to each other, while the neighbor

panels are slightly apart. Fixing is carried out by glue that is being filled between panels and the bearer. Glues used for this purpose are either made on the basis of cement mortar or on the basis of organic polymers, such as acrylic or epoxy resin.

5 The prefabricated panel combined with a suitable bearing construction for manufacturing double floors, intermediate floors or attics is described in the paper of Yugoslav Patent Bureau under classification code 34215. The panel is a sheet metal container of thin walls and large surface. The filling material such as concrete is cast or poured into it forming a constructive entirety with the container. The container is in fact a reinforcement that is positioned on the outside of the prefabricated panel. The
10 container is produced of sheet by procedure of pressing metal sheets to moulds, and in the same time the connection elements for binding the panel to the bearing construction are also being made. Panels manufactured this way can be compared to the standardized building elements made from steel and light metals, which enable the transfer of forces between the bearing construction and prefabricated panels. The prefabricated panel can
15 be made of a huge variety of materials such as: concrete made from mineral substances with cement binding, from plaster or mineral substances with plaster binding, from mixtures based on artificial resins combined with common filling materials as for instance concrete, perlite concrete, mixture made of wooden fibers and cement, asbestos cement and similar materials.

20 Paper number 41269 of Yugoslav Patent Bureau, describes the Honeycomb Construction Element for intermediate floors and facade construction, with the characteristics of multipurpose application, simple in construction, and able to sustain heavy loads. The element consists of sheet metal containers, with honeycomb structures in between them while a rectangular frame surrounds both containers. The honeycomb
25 cells are built from more perforated steel ribbons bent in zigzag manner which are connected to the lower container by the binding metal sheets. The inside of the construction element is filled with self-burned polyurethane foam, which penetrates through the perforations of the honeycomb cells. Using building elements like these is one of the reasons for the significant increase of the size of the span of intermediate
30 floors, in comparison to traditional building systems and constructions.

The reinforced girder is made from ceramic elements bind by concrete, as shown in the paper of Yugoslav Patent Bureau, (number 22622), used for manufacturing building constructions with reinforcement, more precisely with pre-stressed reinforcement like girders. It is consisted of a lower part with depressions of different
35 shape for reception of the reinforcement, and an upper part, which has a depression of the opposite orientation. The lower depression is filled with the ends of reinforcement, around the concrete, after that both parts are glued together with cement mortar on the adjoining surfaces.

40 All the solutions mentioned above used for construction of intermediate floors are limited to small spans, from 3 to 6 meters, and are not appropriate for constructing continual floors of larger span. On the other hand the complexity of these traditional constructions require highly qualified work force that results in high production costs.

The Essence of the Invention

The semi-prefabricated system for intermediate floor construction, as a combination of traditional and prefabricated methods of building, has a number of advantages, and as a matter of fact it utilizes the best characteristics of these methods. Large spans are, in Yugoslavia, mostly used in industrial and some public buildings.

5 The inventors, according to this invention, solved the problem of large span intermediate floor construction (10 meters and more) in public, industrial as well as in residential buildings, acquiring completely adaptable spaces that can be easily rearranged. Despite the fact that residential buildings do not have public character, there is often a need for adoption of space that brings us to the reasoning that distance
10 between fixed walls should go up to 10 meters.

The essence of the invention is that newly constructed light lattice girders are manufactured and then delivered to building sites and then assembled with specific ceiling filling. The light lattice girders, made of appropriate steel wire are placed into ceramic hollow tiles with the necessary reinforcement and cast with cement based fine-
15 grain concrete. Girders are directly mounted on fixed walls and on supporting scaffolding, situated every 2,5 meters and additionally raised in accordance to the size of the deflection of the joint.

Between light girders, leaned against the lower hollow tile, are mounted lower, carrying blocks made of lightened burned ceramics. Over them are placed the upper
20 non-carrying blocks, also made from lightened burned ceramics. Depending on desired rigidity, load and span ($10m < l < 10m$) of the intermediate floor, its height is defined simply by addition of new rows of non-carrying blocks.

According to this invention, it is possible to build a continual intermediate floor in a similar way, with minor adjustments and changes on the spots of intermediate
25 columns. In this case lower blocks are shorter and pushed aside to enable fresh concrete to fill the spaces within the blocks thus forming the lower pressurized zone. The distance between lower carrying blocks is filled with thin tile blocks that represent the lower carrying frame for fresh concrete.

Taking care in assembly phase and during concrete casting with vibrations, due
30 to which fresh concrete is getting the characteristics of heavy fluid with tendency of increased side pressure, and with increased effect of uplift forces, the invention has provided simple and efficient way of stiffening. Stiffening is based on mounting a wooden grill made of small wooden cross beams over upper non-carrying blocks. The small crossbeams are fixed with steel wire tied to the upper profile of the light lattice
35 girder. The force used to tighten the steel wire controls the level of stiffness.

Corresponding to this invention, the construction of large-span intermediate floors has a number of advantages. The most important are the following:

- it enables the design and building of adaptable spaces in a wide range of different types of buildings, with different number of floors, and it is also applicable in
40 individual buildings
- it enables the building of continual floor constructions with quite better tension state in certain cross sections
- it can be easily transported and mounted without using heavy machinery and highly skilled work force.

- the semi-prefabricated system of building results in faster, safer, and in a significantly cheaper building.
- the construction of paneling and highly complex reinforcement is unnecessary, so there is no need to employ highly skilled work force.
- 5 • longevity of the building is increased (especially in chemically aggressive environments as well as in bridge building)
- this building construction is environment friendly - using burned ceramics decreases human contact with concrete

10 Short description of schematic figures

To understand the essence of the invention, as well as to realize its practical value detailed schemes are provided by the inventors, where:

- Figure 1 is showing an axonometric projection scheme of the part of the building construction - intermediate floor with one field and two supports
- 15 • Figure 1a is showing an axonometric projection scheme of the part of the building construction - continual intermediate floor realized in two fields with an intermediate column
- Figure 2 is showing the cross section of II-II floor girder (from figures 1 and 1a) carried out in the field between supports, shown in a profile projection
- 20 • Figure 3 is showing a cross section of III-III floor girder from figure 1a placed by the intermediate column, shown in profile projection.
- Figure 4 is showing a cross section of IV-IV floor girder from figure 1a placed by the intermediate column, shown in a vertical projection.
- Figure (5) is showing a scheme of a part of the prefabricated light lattice girder shown in longitudinal direction, vertical projection
- 25 • Figure 6 is showing an enlarged detail A from figure (5).
- Figure (7) is showing the lattice girder from figure (5) in cross section VII-VII, shown in side profile projection, and significantly enlarged
- Figure 8 is showing a cross section of VIII-VIII from figure 6 shown in a profile projection
- 30 • Figure 9 is showing an axonometric projection of the prefabricated hollow tile of the lattice girder
- Figure 10 is showing an axonometric projection of the prefabricated lower hollow tile of the lattice girder
- 35 • Figure 11 is showing an axonometric projection of the diagonal triangular and spirally shaped steel reinforcement hollow tile of the prefabricated light steel lattice girder
- Figure 12 is showing an axonometric projection of the prefabricated tile lid of the upper non-carrying block filling.
- 40 • Figure 13 is showing an axonometric projection of the prefabricated spring steel wire for fixing the tile lid to the side of the hollow tile

- Figure (14) is showing an axonometric projection of the prefabricated lower carrying hollow tile block.
- Figure (15) is showing an axonometric projection of the prefabricated upper non-carrying hollow tile block.
- 5 • Figure 16 is showing an axonometric projection of the prefabricated lower plate hollow tile block which is placed on the intermediate column
- Figure 1(7) is showing an axonometric projection of the prefabricated lower carrying hollow tile block(half the width of the block shown in figure 14) which is placed on the intermediate column

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Detailed Description of the Invention

Observing figure 1 it is visible that the intermediate floor construction - light carrying floor (1) is supported by two bearing supports (2 and 3) on the principle of a single span beam. It is already pointed out that the length of the floor field l_0 can be more or less of 10 meters. Figure 1a is showing a continual intermediate floor on two fields, with an intermediate column 4a, where the length l_0 of each field is more or less than 10 meters.

From the cross section of II-II part of the intermediate floor 1 and 1a, shown in figure 2, is visible that the building construction - intermediate floor 1 and 1a is consisted of more prefabricated girders (5), lower carrying hollow tile blocks 6 two rows of upper non-carrying hollow tile blocks (7) and a helping construction, a grill made of 8 wooden beams for fixing the intermediate floor elements 1 and 1a during the casting of concrete.

Girders (5), that serve to carry the lower carrying hollow tile blocks (6), are made of diagonal, triangular and spiral steel reinforcement filling of the prefabricated light steel lattice girder (9), upper hollow tile blocks (10) and lower hollow tile blocks (11) (see figures 5, 6, 7). Inside of the triangular and spirally shaped steel reinforcement lattice (9) are placed flat steel profiles which are "welded" by fine grain concrete that is cast into the ceramic upper hollow tile blocks (10) and lower hollow tile blocks (11). Girders (5) may be not only strait but also horizontally or vertically curved, ring shaped or twisted

This way the prefabricated girders are shipped to the building site and placed onto walls, or intermediate columns 2 and 3 and on supporting scaffolding 4 where the distance between girders(5) is appropriate to the width of the lower carrying hollow tile blocks 6. Figure 10 shows us that the lower hollow tile blocks are made in a such way that their sides 11' are oblique in an upward direction while its upper horizontal surface 11'' is flat and wider, so that the hollow tile blocks 6 are "sitting" on a considerably bigger area and that increases safety coefficient and bearing capacity during the assembly process.

The lower carrying hollow tiles blocks (6) are mounted on the top side, between two girders (5) on their lower hollow tiles blocks (11), next to each other. Over the lower carrying hollow tile blocks (6) are mounted the upper non-carrying hollow tiles blocks (on top of each other)(7), which width and depth is equal to the to the width and depth of the blocks (6), as shown in figure 2.

The lower carrying hollow tile blocks 6, in contrast to the known Fert hollow tile blocks "Y" have a horizontal wall 12 which considerably increases their strength and bearing capacity. The parallelepiped shaped hollow tiles 6 above the partition 12 have (5) ribs in a row 13, shaped as letter "Y", and below the partition are 12 four vertical plate-shaped ribs (14) which are forming (5) prismatic tunnels. As shown in figure 14

The upper non-carrying hollow tile blocks (7), are parallelepiped-shaped hollow blocks, adjusted with their lower part to fit to the lower hollow tiles blocks (7). Three vertical partition walls (15) divide the interior of hollow tile blocks into two broader and two narrower tunnels (7). Between side walls and broader tunnels, the block (7) has narrow cuts 16 which are divided into two identical parts with a horizontal partition, as shown in figure (15).

In the phase of concrete casting it is necessary to reinforce elements in order to prevent them from sliding and to avoid the effect of side pressure caused by fresh concrete.

This reinforcement, already referred to, is a wooden grill made of 8 small wooden beams (with cross section of 48 mm x 48 mm). The longitudinal beams are placed in the middle of the upper hollow tile blocks (7), while 8 beams are placed in a cross direction. They are fixed by a steel wire turnbuckle (18) which lower end is tied to the upper part of the girder (5), more precisely to its upper hollow tile 10. The stiffness of the structure is controlled by the steel wire turnbuckle (18). If necessary, additional reinforcement of lower and upper parts of the intermediate floor can be built in during the production of the girder, or at the building site. It is also necessary to implant a reinforcing cage, made of the lightest wire-mesh reinforcement, banded into the shape of the Greek letter "II". Reinforcing the upper part of the continual intermediate floor with the lightest wire mash is compulsory. This reinforcement will insure the stiffness of the other direction and transform the intermediate floor (1) and (1a) into a stiff disc, which is able to take over possible horizontal forces and transfer them to supporting walls (2, 3 and 4a) in proportion to their stiffness. The other reason for installation of this reinforcement is the reinforcement of concrete above the upper hollow tile blocks (7) to enable the installation of partition walls.

In case of building continual intermediate floors (1a), minor adjustments and changes are necessary on the spots of intermediate columns (4a). The lower carrying hollow tile blocks (19) are half of the length of blocks 6 and are placed on the lower hollow tiles with gaps in between (e.g. 12,5 cm) to enable fresh concrete to fill the spaces within the hollow tile blocks (19) forming that way the pressurized lower area. The construction of the lower carrying hollow tile blocks (19) is shown in figure (17) and it is identical to lower carrying hollow tile blocks (6) from figure 14, which width is 25 cm.. The gap between lower carrying blocks (19) is filled with thin bearing plate-shaped blocks (20) (see its sides 11' and flat areas 11'') and those are the lower bearing surface of the fresh concrete. Above the lower carrying hollow tile bearing blocks (19) are placed the upper non-carrying hollow tiles blocks (7) in the same manner as shown in figure 1.

Prefabricated cone hollow tile blocks (21) are cemented in around the intermediate columns (4a) of the intermediate floor (1a) and around scaffolding supports (4) (there are three for $l_0 = 10$ m) on the girders (5), more precisely on

diagonals of their space lattice. This is done in order to increase the stiffness. This operation is carried out outside of the building site. These hollow tile blocks (21) are shown in figure 11, as well as in figure 6 where they are presented together with the girder (5). Its cross section is shown in figure 8, and it has at the end of the inner
5 broader end a prismatic cavity (22), which has the function of supporting the possible reinforcement. Front sides of hollow tile blocks (7) need to be closed with a plate lid (23) on the ends as well as in places for cross girders. This closing is done to prevent concrete from getting into hollow tile blocks (7). The plate (23) is fixed to the front of
10 the hollow tile blocks (7) (see figure 12), by a spring steel wire hook (24) shown in figure 13. Each plate lid (23) is fixed by three hooks (24) which are also holding the hollow tile blocks (7), (see figures 3 and 4).

The upper area of the intermediate floor (1a), also needs to be reinforced in (concrete above hollow tile blocks (7) with the lightest lattice. Static and construction check is carried out by theory of marginal state method. The deflections are calculated
15 by approximate or accurate formulae taking in consideration only concrete and its reinforcement, although the stiffness is far bigger because it is increased by space girders (5) and hollow tile blocks (6) and (7), that also contribute to increased overall security.

20 Potential application of the invention in industry and elsewhere.

The possibilities of the application of this invention are clearly described in the previous text and presented by the given schemes, so we thought that further description is not necessary. All constructional and functional characteristics are successfully checked and tested on the actual prototype of the intermediate floor.
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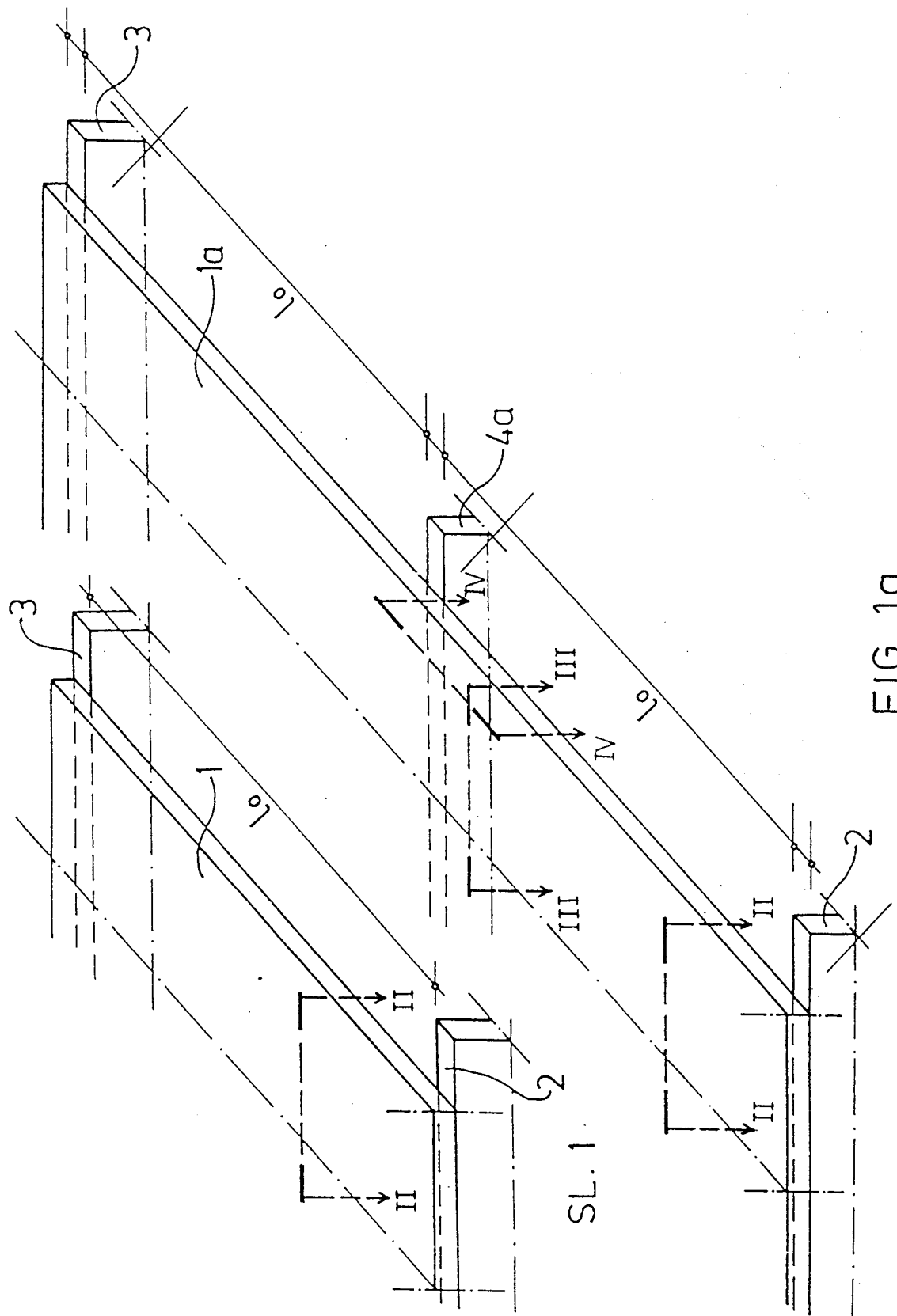
Claims

1. Great-span intermediate floor construction, designed particularly for construction of public and residential buildings, using the static system of a single span beam or continual beam with field span l_0 more or less than 10 meters, is also applicable in bridge construction, is characterized by a great span intermediate floor (1) with one field and continual beam (1a), consists of supports (2 and 3), intermediate column (4a) reinforced ends of longitudinal girders (5), where the girders (5) are parallel and placed on even distance. Between girders (5) are placed the lower carrying hollow tile blocks (6) and over them at least two rows of upper non-carrying hollow tile blocks (7). The front side of marginal upper non-carrying hollow tile blocks (7) of the intermediate floor (1 and 1a) are closed up with plate lids (23), while from the outside the plate lids (23) are fixed to the non-carrying hollow tile blocks (7) by spring hooks (24).
2. Construction of the intermediate floor, according to request 1 is characterized by the following: in case of the continual intermediate floor (1a) with intermediate column (4a) the shorter lower carrying hollow tile blocks (19) are placed between girders (5) with gaps in between; that between lower carrying hollow tile blocks (19) on the girders (5) are placed carrying plate-shaped hollow tile blocks (20), while above the lower carrying hollow tile blocks (19) are placed the upper non-carrying hollow tile blocks (7); and that before concrete casting, on the front side of the upper non-carrying hollow tile blocks (7) in the area of the intermediate column (4a) plate lids are placed (23) /best if made of concrete/, fixed by wire spring hooks (24).

The intermediate floor construction, according to request 1 and 2 is characterized by the fact that the prefabricated girder (5) consists of diagonal and triangular and spiral steel reinforcement filling which has in its corners flat steel profiles which are "welded" by fine grain concrete inside of the upper hollow tile (10) and lower hollow tile (11). Girders (5) may be not only strait but also horizontally or vertically curved, ring shaped or twisted

1. The broader hollow tile (11) has cone sides (11') and flat upper surface (11'') for landing the upper carrying hollow tile blocks (6 and 19) and plate hollow tile blocks (20) and girders (5) or lattice (9) above the wooden supporters scaffolds (4) are having cone hollow tile blocks (21) cast on diagonals of the lattice (9) and between upper and lower hollow tile block (10 and 11), and that cone hollow tile blocks are provided with a rectangular, hollow elevation (22) for the reinforcement.
2. The intermediate floor construction, in comparison to known Fert hollow tile "Y" according to request 1,2,3 is characterized by the fact that the lower carrying hollow tile blocks (6,19) have horizontal partition (12) which divides upper "Y" ribs (13) from the plate ribs (14) and that the hollow tile block (7) has three partitions (15), while longitudinally on the sides of the hollow tile blocks (7) are placed vertical cuts (16) symmetrically divided by the horizontal partition (17) into equal parts.

3. The intermediate floor construction, according to request 1,2 is characterized by the fact that wooden cross I-beams of the grill (8), which is temporarily placed during concrete casting over the top row of the upper hollow tile blocks (7), are being pulled tight by the wire turn buckle (18), which lower end is fixed around the upper hollow tile (10) of the girder (5)



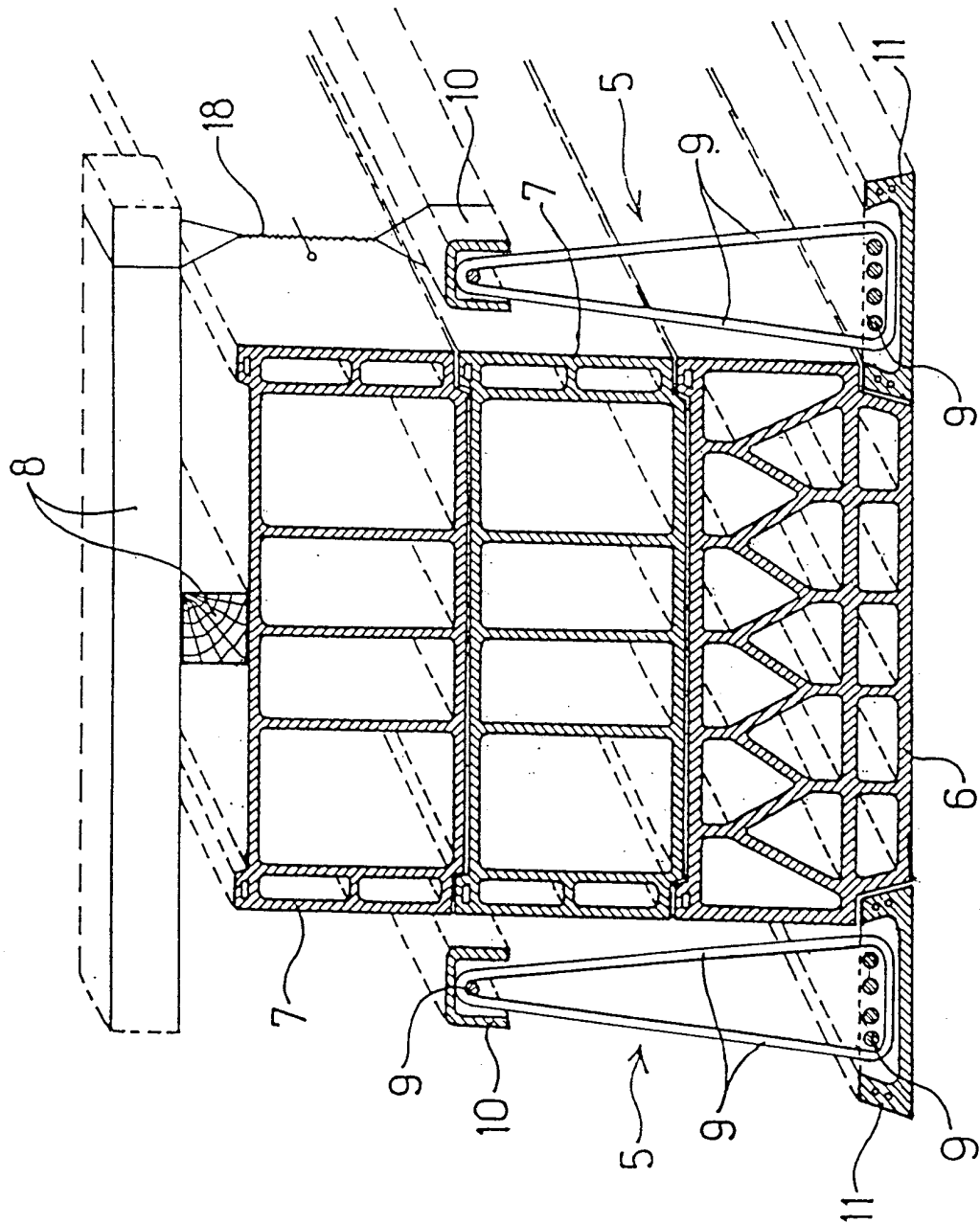


FIG. 2

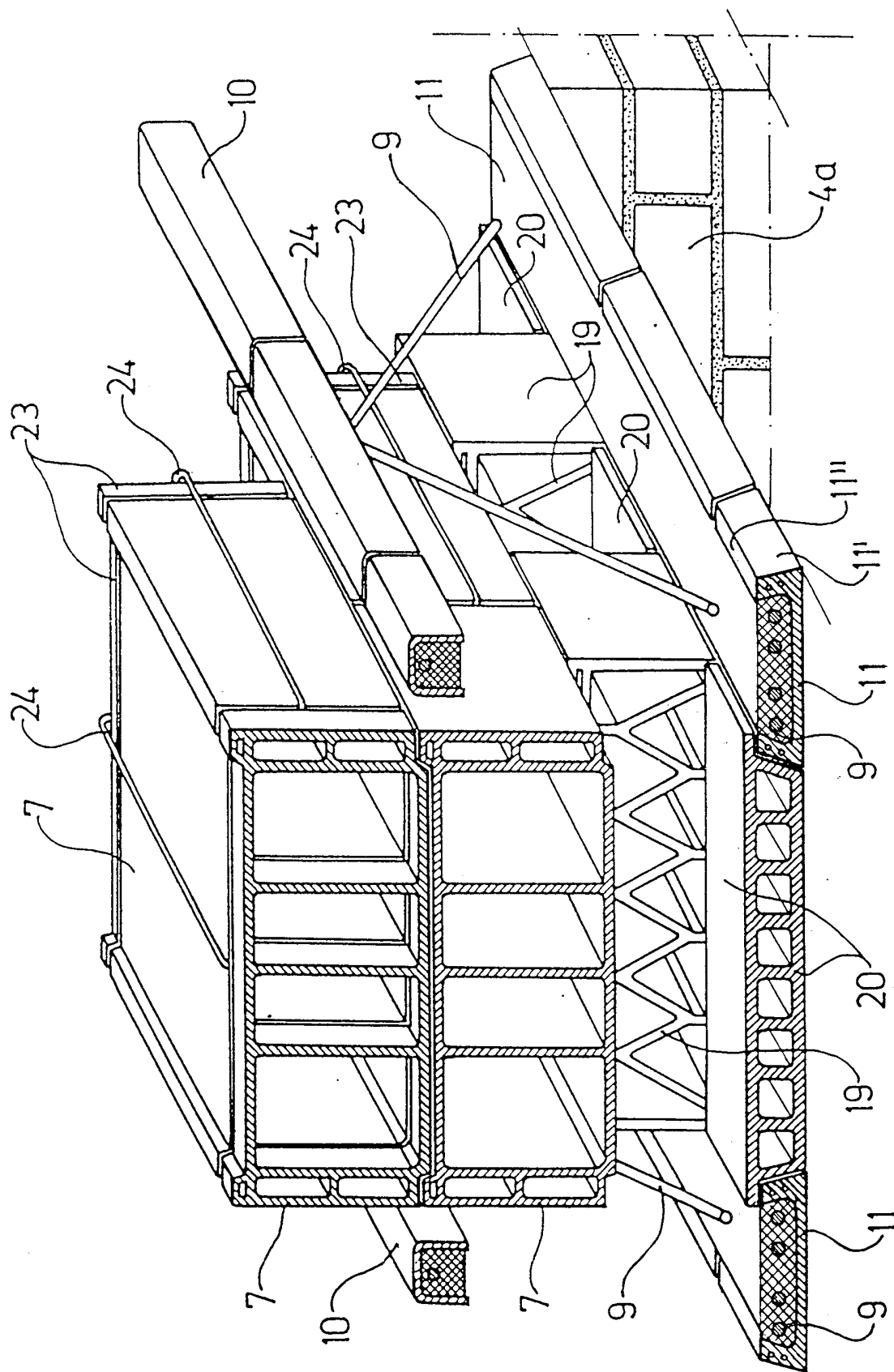


FIG. 3

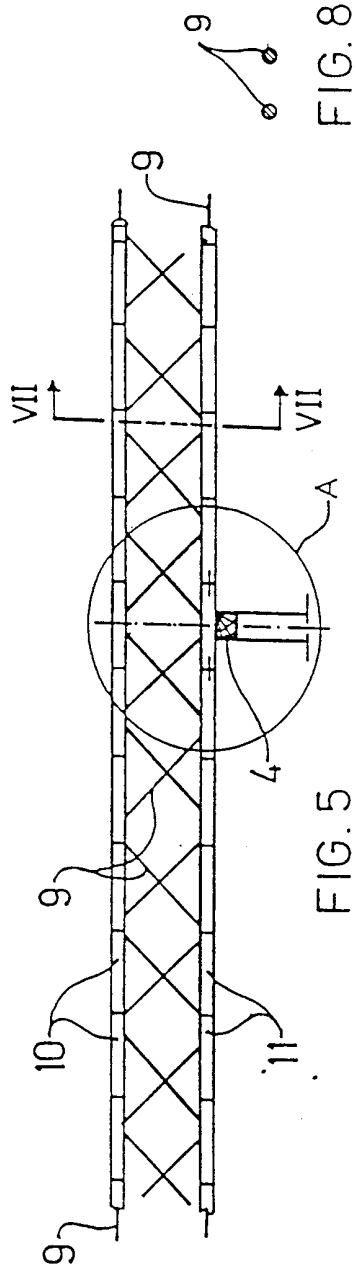


FIG. 8

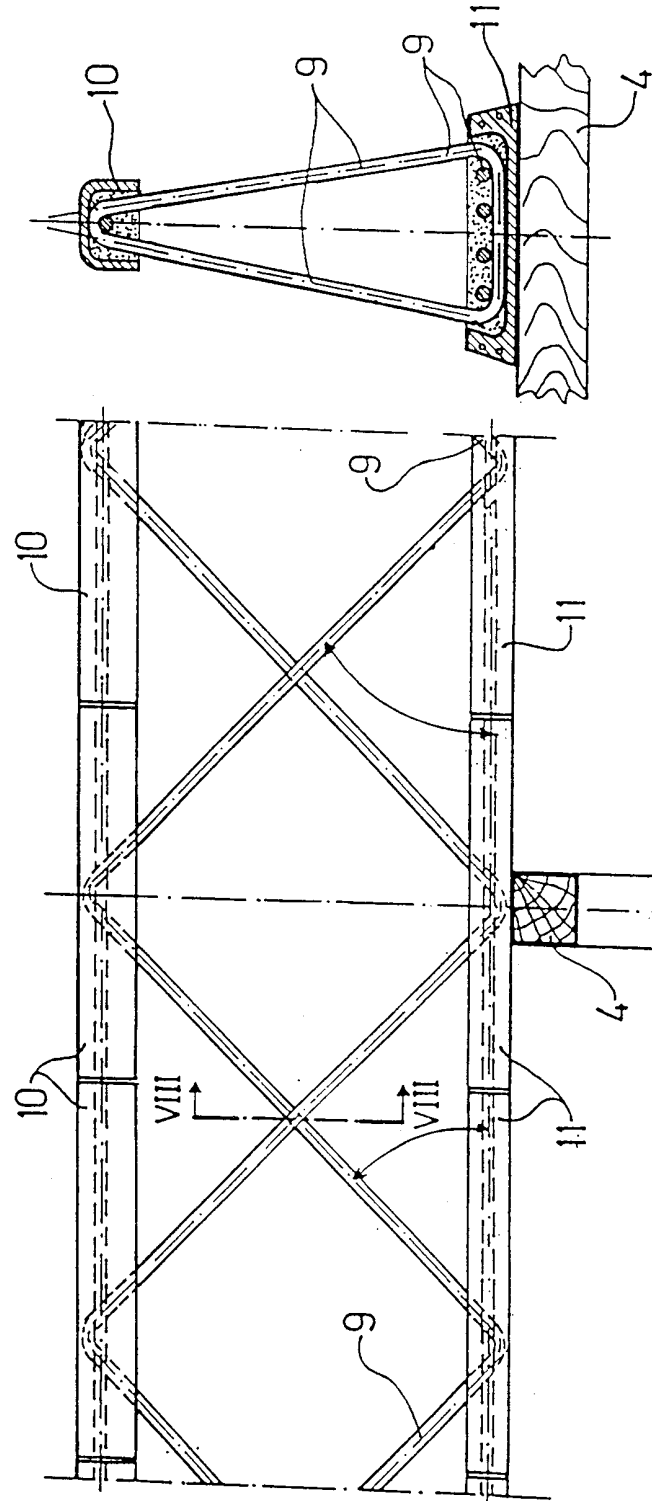
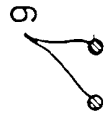


FIG. 7

FIG. 6

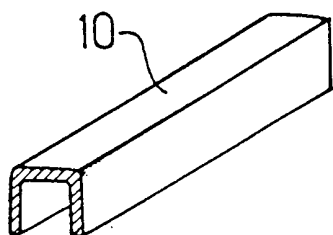


FIG. 9

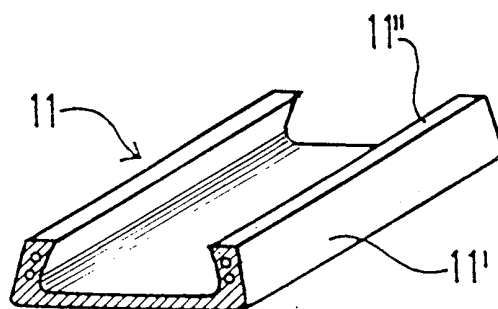


FIG. 10

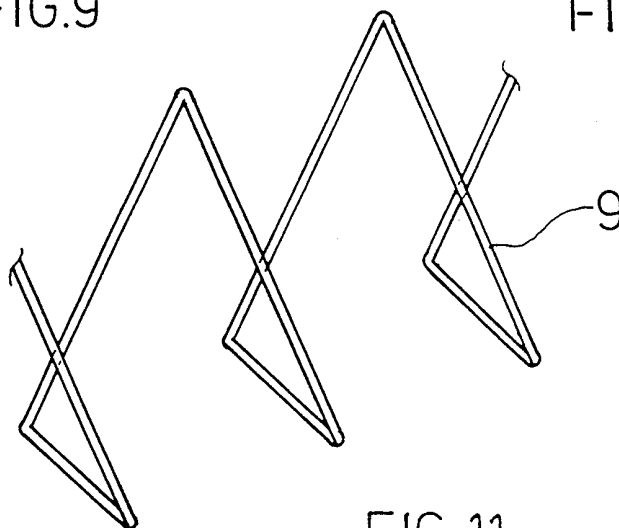


FIG. 11

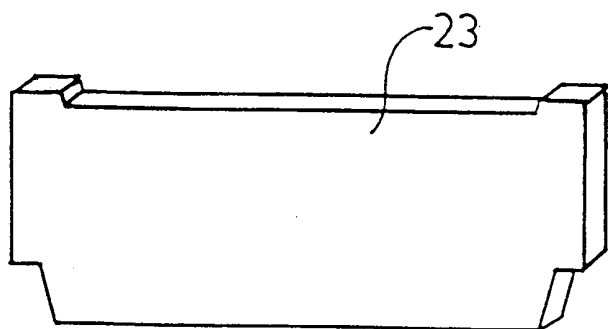


FIG. 12

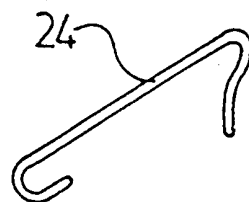


FIG. 13

