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(54) **Beam and block floor**

Träger und Blockboden

Poutre et plancher du bloc

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Description

[0001] The present invention relates to a beam and block floor. The invention, further relates to a method of producing such a floor.

[0002] Beam and block floors are typically formed by an array of equidistantly arranged horizontal beams provided with substantially horizontal support surfaces, a plurality of blocks between the beams resting on the support surfaces and concrete covering the beams and the blocks. The blocks are generally made of a thermo-isolating material, such as Expanded Polystyrene (EPS), or any other suitable material, such as ceramic, clay or concrete. These blocks serve as a mould for the concrete. The blocks can for example be mainly rectangular blocks, with or without chamfered sections, or they can be plates or shells, e.g. curved shells, or they can have any other suitable shape. A metallic reinforcement mesh can be arranged on top of the beams. Concrete is poured over the beams and blocks. After hardening the different components of the floor cooperate as a coherent composed structure. Such floors show good structural and isolating performance, can be constructed relatively quick and involve low expenses. Such floors are typically used in residential buildings.

[0003] Hitherto, the beams used in such Floors are usually beams of pretensioned or reinforced concrete, which have inverted T-shape cross sections. Such concrete beams are heavy and difficult to handle. Moreover, such concrete beams are relatively fragile, so during assembly of the floor such concrete beams may need additional temporary supports to avoid downward bending of the floor caused by its own weight, which would substantially deteriorate the structural performance of the resulting floor.

[0004] FR 1 127 798 discloses a floor according to the preamble of claim 1 with metal beams provided with support surfaces for supporting hollow wooden units covered by a concrete layer.

[0005] NL 1012339 discloses a block and beam floor using light weight beams of a fibre reinforced polymeric material. It has been found that such beams have limited load capacity and need additional support during building of the floor.

[0006] WO 2009/109893 discloses a floor using beams made of two sheet metal parts with L-shaped cross section, e.g. of galvanised steel, arranged back to back to form an inverted T-shape. The two parts can be connected, e.g., by welding. Such beams have a relatively low load capacity and need additional temporary supports during assembly of the floor. Moreover, the welding connections and the ends of such beams are easily exposed to corrosion.

[0007] It is an object of the invention to provide a floor which overcomes the aforementioned problems.

[0008] The object of the invention is achieved with a floor comprising blocks, beams provided with support surfaces for supporting the blocks and a layer of concrete structurally connecting the beams and covering the blocks, wherein at least a part of the beams are formed from a metal sheet folded to form a beam with the desired cross section, wherein the cross sectional ends of the metal sheet overlap each other and are connected to each other. The connected overlapping ends are embedded in the concrete.

[0009] By embedding the sheet ends, it becomes possible to attach these ends to each other without enhancing the risk of local corrosion. This way, beams can be folded from a single metal sheet with a cross section combining low weight with high load capacities. Since the sheet ends are embedded in the concrete and protected against corrosion, a wide range of connections can be used to attach the sheet end to each other. Suitable connection means are for instance a weld, spot welds, dowels, rivets and/or clinch connections, e.g., clinch connections of the type provided by the German company Tox Pressotechnik. Preferably, the sheet ends overlap each other.

[0010] Preferably, also the outer ends of the beams are embedded in the concrete. These outer ends form typical spots for corrosion. By embedding these spots in the concrete layer these outer beam ends can effectively be protected against corrosion.

[0011] The metal sheet can for instance be a steel sheet. Preferably the steel is galvanized or provided in any other suitable way with a protective layer, such as a zinc layer. The steel can for instance be cold rolled galvanized steel.

[0012] To enhance the structural cooperation between the concrete layer and the beams and to optimize load transfer between the floor components, the beam parts which are embedded in the concrete layer can be provided with local deformations, such as impressions.

[0013] The beams can be dimensioned in such a way that in use the top sides of the beams protrude above the blocks. This way one or more reinforcement meshes can be placed on the top sides of the beams, at a distance above the blocks. Such meshes may considerably enhance the load capacity of the floor as a constructional unit.

[0014] The beams will generally have a symmetrical cross-section, although non-symmetrical configurations can also be used, if so desired.

[0015] In cross section the beams can for example enclose one our more hollow spaces extending in longitudinal direction of the beam. In such a case a wall of at least one of the hollow spaces may border the lower side of the beam. This way, the lower side can be used for providing fastening means, e.g., to attach further constructional elements, such as piping, ceiling elements, etc..

[0016] In a particular embodiment the beam comprises two such hollow spaces, e.g., an upper hollow space and a lower hollow space. Optionally, the hollow spaces can be triangular in cross section. The triangular spaces can be configured to point towards each other. A web may

bridge the two triangular hollow spaces. In that case, the overlapping cross sectional ends of the metal sheet are preferably located at a section of the web which is embedded in the concrete layer. The support surfaces of the beam for carrying the blocks may extend from both lateral sides of the lower surface of the lower hollow space. The triangular hollow space may for instance be smaller than the upper hollow space.

[0017] Such a beam can be folded from a metal sheet in such a way that the web and the support surfaces are double walled while the walls of the hollow spaces are single walled.

[0018] This cross-sectional configuration of the beams makes it possible to provide beams combining light weight with high load capacity. The beams can for instance have a weight of 7,5 kg/m or less, e.g., 7 kg/m or less or even 6,5 or less and still have a load capacity which is sufficient to avoid the need for auxiliary supports during construction of the floor, even when people need to walk over the blocks resting on the support surfaces of the beams before the concrete is poured. For normal beam lengths the weight of the beams can be kept well below weights (presently 28 kg) for which present-day legislation in most European jurisdictions would prescribe the use of auxiliary lifting means.

[0019] The blocks will generally be thermal isolation blocks, e.g. of expanded polystyrene, although other block types can also be used if so desired, such as ceramic materials, clay, plastic or concrete or any other suitable formwork material. The blocks are typically provided with shoulders resting on the support surfaces provided by the beams. Optionally, the blocks can be provided with a lateral edge gripping around the lower surface of the beam and abutting the lower part of the side edge of an adjacent block. This way, an isolation layer can be obtained which is not interrupted by the beams and the formation of bridges can effectively be prevented. The beam material is better isolated from cold coming from below, so condensation on the beam surfaces is substantially reduced.

[0020] The present invention will be elucidated with reference to the figures wherein:

Figure 1: shows in cross section an embodiment of a floor according to the present invention;
Figure 2: shows in cross section a beam of the floor of Figure 1;
Figure 3: shows in cross section a detail of the floor of Figure 1 near an outer end of a beam;
Figure 4: shows in cross section a second exemplary embodiment of a floor according to the present invention.

[0021] Figure 1 shows in cross section a floor 1 made of blocks 2, equidistantly arranged horizontal beams 3 and a layer of concrete 4 which covers the blocks 2 and beams 3. At both lateral sides the beams 3 are provided with support surfaces 5 for supporting the blocks 2. The hardened concrete layer 4 structurally connects the beams 3 and cooperates with the beams 3 to function as a single structural unit. The ends of the beams 3 are supported by parts of the buildings construction or foundation (not shown).

[0022] As is particularly clear from Figure 2 the beams 3 are formed from a steel sheet material 31 folded to form a beam with the desired cross section. The steel sheet 31 is galvanized to form a protective zinc layer. The ends 32, 33 of the sheet metal 31 overlap and are connected, e.g., by welding, spot welding, rivet, dowel or clinch connections. In the final floor the connected ends 32, 33 of the metal sheet 31 are fully embedded within the concrete layer 4. This way, the connected ends 32, 33 are effectively protected against corrosion. Also the outer beam ends (not shown) of the beams 3 are fully embedded in the concrete layer 4. These ends are typically not or not fully protected by galvanization. The embedding concrete protects these beam ends against corrosion.

[0023] In cross section the beams 3 enclose an upper hollow space 34 and a lower hollow space 35. Both hollow spaces 34, 35 extend in longitudinal direction of the beam 3 over the full length of the beam 3.

[0024] The upper hollow space 34 is triangular in cross section and comprises an upper surface 36 which is substantially horizontal in use and two symmetrically arranged side walls 37, 38, both converging downwardly under an angle of about 45 degrees with the upper surface and under a 90 degrees angle with each other.

[0025] The lower hollow space 35 comprises a lower surface 39 which is substantially horizontal in use and two symmetrically arranged side walls 40, 41, both converging upwardly under an angle of about 45 degrees with the lower surface 39 and under a 90 degrees angle with each other. The lower surface 39 of the lower hollow space 35 borders the lower side 42 of the beam 3.

[0026] The lower side 42 of the beam 3 extends at both lateral sides of the lower surface 39 of the lower hollow space 35 to form the support surfaces 5 for supporting the blocks 2. The lower surface 39 of the lower hollow space 35 forms the middle section of the lower side 42 of the beam 3 and spans about 10 - 50 %, e.g., about 25 - 40 %, e.g., about one third of the lower side 42.

[0027] The 90 degrees angular points 43, 44 of the upper and lower hollow spaces 34, 35 point towards each other. A web 45 connects these two points 43, 44. In use the web 45 is substantially vertical. The cross section of the beam 3 is substantially symmetrical, with a symmetry axis coinciding with the vertical axis of the web 45.

[0028] In the shown embodiment the upper hollow space 34 is larger than the lower hollow space 35. For instance, the width of the upper surface 36 of the upper hollow space 34 can be about 1,5 - 3 times, e.g. about 2 times the width of the lower surface 39 of the lower hollow space 35.

[0029] The web 45 comprises a lower section 46 and an upper section 47. In use the lower section 46 is located between two adjacent blocks 2, while the upper section

47 is embedded in the concrete layer 4. The overlapping ends 32, 33 of the metal sheet 31 are positioned in the upper section 47 of the web 45. To enhance structural cooperation between the concrete layer 4 and the beam 3, the upper section 47 of the web 45 is provided with local deformations, such as spherical impressions 48.

[0030] The top surfaces 36 of the beams 3 protrude above the blocks 2. A metallic reinforcement mesh 49 rests on the top surfaces 36 of the beams 3 (see Figure 1). The mesh 49 is fully embedded in the concrete layer 4.

[0031] The disclosed geometry makes it possible to use beams 3 weighing 7,5 kg/m or even less and still having sufficient load capacity avoiding the need to use auxiliary supports during assembly of the floor. The load capacity of the beams 3 can be sufficient to allow workmen to walk over the blocks 2 resting on the support surfaces 5 of the beams 3 before the concrete is poured. Hence, during assembly the beams 3 only need to be supported at positions where the final floor is supported after hardening.

[0032] The blocks 2 are made of an isolating material, such as expanded polystyrene, EPS. The blocks 2 comprises a middle section 21 with a rectangular cross section bordered by two downwardly slanting longitudinal edges 22, 23 both provided with a shoulder 24 resting on the support surfaces 5 of the beans 3. One longitudinal side 22 is provided with a lateral extension 25 extending below the shoulder 24, fully covering the lower side 42 of the beam 3 and abutting the lower side of the slanting edge 23 of and adjacent block 2. This way, the isolation layer formed by the blocks 2 is not interrupted by the beams 3 and the formation of thermal bridges can effectively be prevented.

[0033] The floor 1 is finished with a screed top layer 26.

[0034] As shown in Figure 3 the outer end 27 of the beam rests on a foundation 28 where it faces a wall section 29. A gap 30 between the outer end 27 and the wall section 29 ensures that the outer end 27 of the beam 3 is fully embedded in the concrete layer 4.

[0035] Figure 4 shows an alternative embodiment of a floor 50 according to the invention. Parts which are the same as in the embodiment of Figure 1 are indicated with the same referential numbers. Beams 3 comprise support surfaces 5 carrying blocks 51 formed by curved shells 51, e.g., of a concrete or plastic material. The shells 51 and beams 3 are covered by a concrete layer 4 finished by a screed top layer 25. As shown in more detail in Figure 5, the lower side surface 39 of the lower hollow space 35 of the beams 3 is provided with fastening elements 52 for a ceiling element 53. Optionally, the lower surface 39 can also be used for fastening other constructional elements, such as piping and the like. In the drawing of Figure 4 pipe lines 54 are arranged between the ceiling 53 and the shells 51.

Claims

1. Floor (1) comprising blocks (2), beams (3) provided with support surfaces (5) for supporting the blocks and a layer (4) of concrete structurally connecting the beams and covering the blocks, **characterized in that** the beams are formed from a metal sheet (31) folded to form a beam with the desired cross section, wherein the cross sectional ends (32, 33) of the metal sheet overlap each other and are connected to each other, the ends being embedded in the concrete.

2. Floor according to claim 1 wherein the outer ends (27) of the beams are embedded in the concrete.

3. Floor according to claim 1 or 2 wherein the ends (32, 33) of the metal sheet are connected by means of a weld, spot welds, dowels, rivets and/or clinch connections.

4. Floor according to any one of the preceding claims wherein the metal sheet (31) is provided with a protective layer, e.g., a zinc layer.

5. Floor according to any one of the preceding claims wherein at least a part of the beams (3) enclose in cross section one or more hollow spaces (34, 35) extending in longitudinal direction of the beam, wherein a wall of at least one of the hollow spaces borders the lower side of the beam.

6. Floor according to claim 5 wherein the lower side of the beam (3) is provided with fastening means.

7. Floor according to any one of the preceding claims wherein one or more of the parts of the beams embedded in the concrete are provided with impressions (48).

8. Floor according to any one of the preceding claims wherein the top sides of the beams (36) protrude above the blocks and wherein one or more reinforcement meshes rest on the top sides of the beams.

9. Method of manufacturing a floor (1) according to any one of the preceding claims wherein beams (3) are used formed of a single metal sheet (31) folded to form a beam with a desired cross section, wherein the ends (34, 35) of the metal sheet overlap each other, the ends being embedded in the concrete.

10. Method according to claim 9 wherein beams (3) are used weighing at most 7,5 kg/m, preferably less than 7 kg/m, wherein during assembly of the floor (1) the beams are only supported at positions where the final floor is supported after hardening.

Patentansprüche

1. Boden (1) mit Blöcken (2), Trägern (3), die mit Auflageflächen (5) zum Tragen der Blöcke versehen sind, und einer Schicht (4) aus Beton, die die Träger strukturell verbindet und die Blöcke überzieht, **dadurch gekennzeichnet, dass** die Träger aus einem Metallblech (31) ausgebildet sind, das zu einem Träger mit dem gewünschten Querschnitt gefaltet ist, wobei die Querschnittsenden (32, 33) des Metallblechs einander überlappen und miteinander verbunden sind, wobei die Enden in den Beton eingebettet sind.

2. Boden nach Anspruch 1, wobei die äußeren Enden (27) der Träger in den Beton eingebettet sind.

3. Boden nach Anspruch 1 oder 2, wobei die Enden (32, 33) des Blechs durch eine Schweißnaht, Schweißpunkte, Dübel, Nieten und/oder Clinchverbindungen verbunden sind.

4. Boden nach einem der vorhergehenden Ansprüche, wobei das Metallblech (31) mit einer Schutzschicht, z. B. einer Zinkschicht, versehen ist.

5. Boden nach einem der vorhergehenden Ansprüche, wobei mindestens ein Teil der Träger (3) im Querschnitt einen oder mehrere Hohlräume (34, 35) umschließt, die sich in Längsrichtung des Trägers erstrecken, wobei eine Wand zumindest eines der Hohlräume die untere Seite des Trägers begrenzt.

6. Boden nach Anspruch 5, wobei die untere Seite des Trägers (3) mit Befestigungsmitteln versehen ist.

7. Boden nach einem der vorhergehenden Ansprüche, wobei einer oder mehrere der Teile der Träger, die in den Beton eingebettet sind, mit Vertiefungen (48) versehen sind.

8. Boden nach einem der vorhergehenden Ansprüche, wobei die Oberseiten der Träger (36) über die Blöcke vorstehen und wobei eine oder mehrere Bewehrungsmatten auf den Oberseiten der Träger liegen.

9. Verfahren zur Herstellung eines Bodens (1) nach einem der vorhergehenden Ansprüche, wobei Träger (3) verwendet werden, die aus einem einzelnen Metallblech (31) ausgebildet sind, das zu einem Träger mit einem gewünschten Querschnitt gefaltet ist, wobei die Enden (34, 35) des Metallblechs einander überlappen, wobei die Enden in den Beton eingebettet werden.

10. Verfahren nach Anspruch 9, wobei Träger (3) verwendet werden, die höchstens 7,5 kg/m wiegen, vorzugsweise weniger als 7 kg/m, wobei bei der Montage des Bodens (1) die Träger nur an Stellen gestützt sind, wo der endgültige Boden nach dem Aushärten gestützt ist.

Revendications

1. Plancher (1) comprenant des blocs (2), des poutres (3) dotées de surfaces porteuses (5) pour le support des blocs et une couche (4) de béton reliant structurellement les poutres et couvrant les blocs, **caractérisé en ce que** les poutres sont formées à partir d'une feuille métallique (31) pliée pour former une poutre avec la section transversale souhaitée, dans lequel les extrémités de section transversale (32, 33) de la feuille métallique se chevauchent et sont reliées l'une à l'autre, les extrémités étant intégrées dans le béton.

2. Plancher selon la revendication 1, dans lequel les extrémités extérieures (27) des poutres sont intégrées dans le béton.

3. Plancher selon la revendication 1 ou 2, dans lequel les extrémités (32, 33) de la feuille métallique sont reliées à l'aide d'une soudure, de points de soudure, de goujons, de rivets et/ou de rivetages.

4. Plancher selon l'une quelconque des revendications précédentes, dans lequel la feuille métallique (31) est dotée d'une couche de protection, par exemple d'une couche de zinc.

5. Plancher selon l'une quelconque des revendications précédentes, dans lequel au moins une partie des poutres (3) renferme en section transversale un ou plusieurs espaces creux (34, 35) s'étendant dans la direction longitudinale de la poutre, dans lequel une paroi d'au moins un des espaces creux borde le côté inférieur de la poutre.

6. Plancher selon la revendication 5, dans lequel le côté inférieur de la poutre (3) est doté de moyens de fixation.

7. Plancher selon l'une quelconque des revendications précédentes, dans lequel une ou plusieurs des parties des poutres intégrées dans le béton sont dotées d'impressions (48).

8. Plancher selon l'une quelconque des revendications précédentes, dans lequel les côtés supérieurs des poutres (36) font saillie au-dessus des blocs et dans lequel un ou plusieurs treillis d'armature reposent sur les côtés supérieurs des poutres.

9. Procédé de fabrication d'un plancher (1) selon l'une quelconque des revendications précédentes, dans

lequel des poutres (3) sont utilisées, formées d'une seule feuille métallique (31) pliée pour former une poutre avec une section transversale souhaitée, dans lequel les extrémités (34, 35) de la feuille métallique se chevauchent, les extrémités étant intégrées dans le béton.

10. Procédé selon la revendication 9, dans lequel des poutres (3) sont utilisées, pesant au plus 7,5 kg/m, de préférence moins de 7 kg/m, dans lequel, pendant l'assemblage du plancher (1), les poutres sont uniquement supportées en des positions où le plancher final est supporté après durcissement.

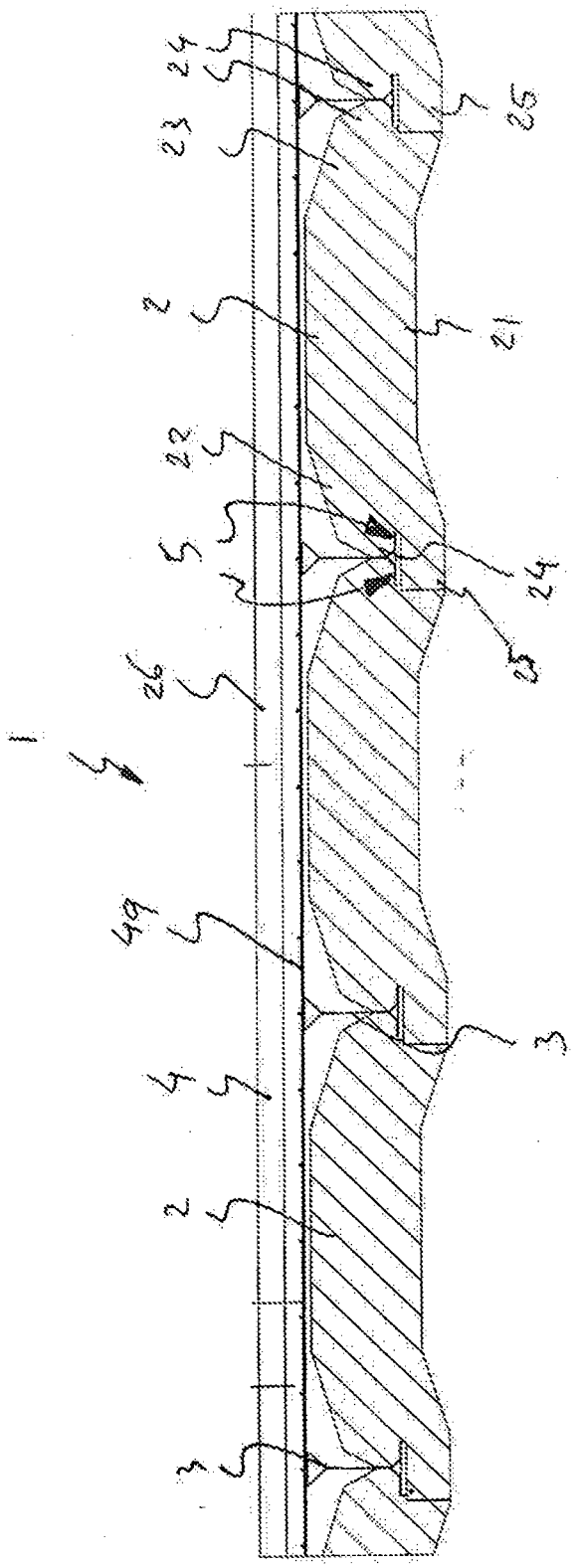
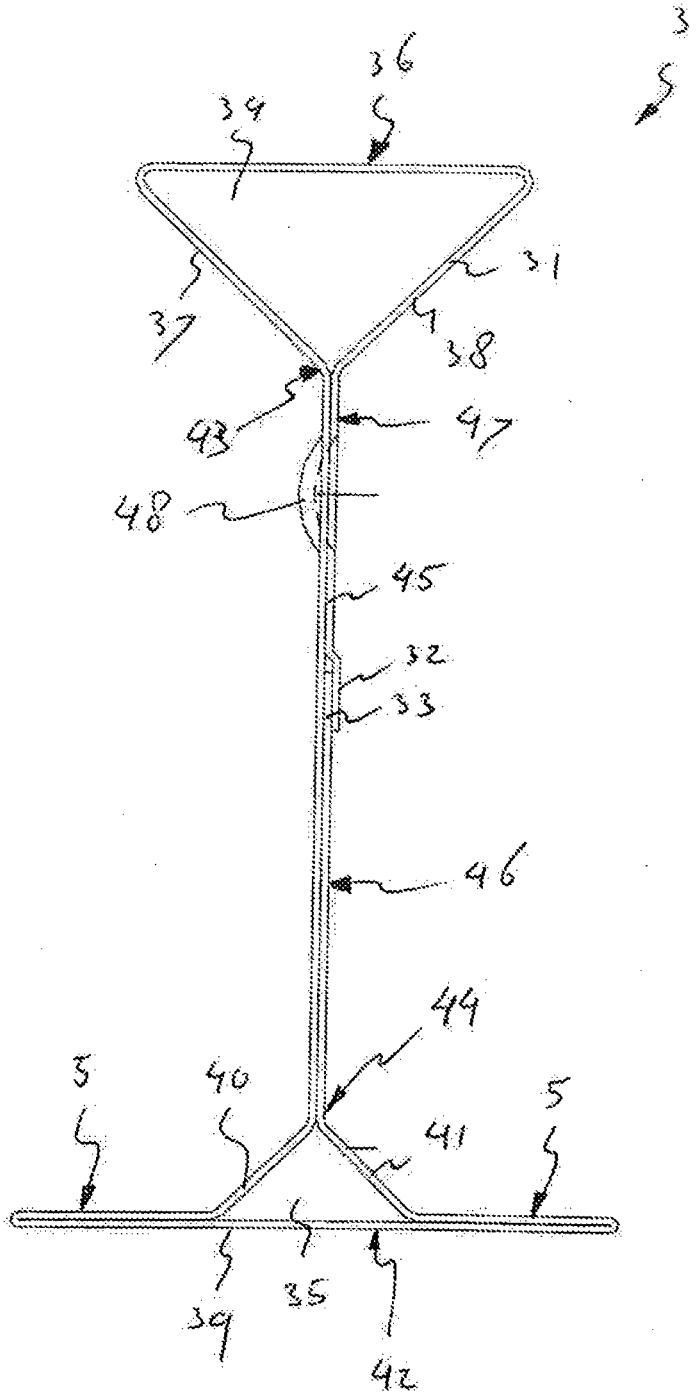
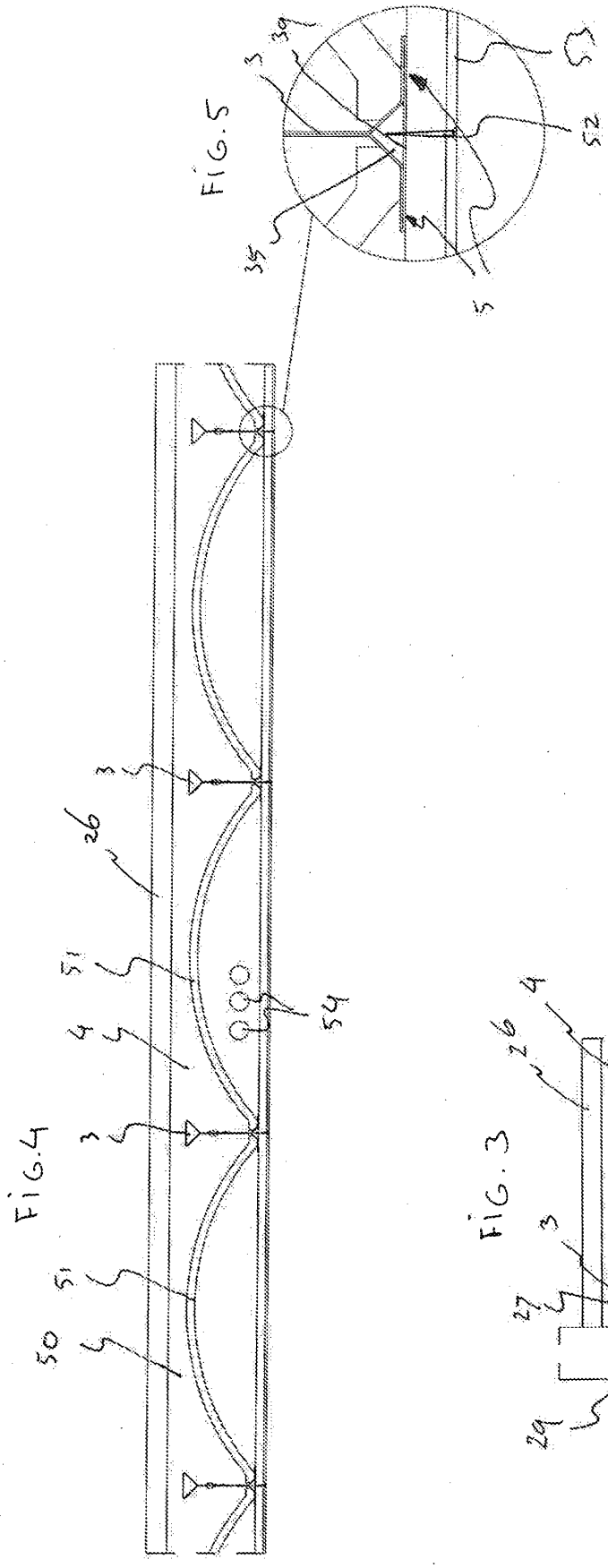


FIG. 1

FIG. 2




FIG. 5
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FIG. 4
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FIG. 3
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REFERENCES CITED IN THE DESCRIPTION

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