(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 1 507 938 B1**

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention of the grant of the patent:
24.03.2010 Bulletin 2010/12

(21) Application number: **03725251.7**

(22) Date of filing: **23.05.2003**

(51) Int Cl.:
E04C 3/293 *(2006.01)* ***E04C 3/07*** *(2006.01)*
E04B 5/29 *(2006.01)*

(86) International application number:
PCT/FI2003/000398

(87) International publication number:
WO 2003/100186 (04.12.2003 Gazette 2003/49)

(54) **METHOD FOR MANUFACTURING STEEL BEAM AND STEEL BEAM**

VERFAHREN ZUR HERSTELLUNG EINES STAHLTRÄGERS UND STAHLTRÄGER

PROCEDE FABRICATION D'UNE POUTRE D'ACIER ET POUTRE D'ACIER

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IT LI LU MC NL PT RO SE SI SK TR

(30) Priority: **29.05.2002 FI 20021009**

(43) Date of publication of application:
23.02.2005 Bulletin 2005/08

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Description

[0001] The invention relates to a method for manufacturing a steel beam, the steel beam serving together with concrete as a bearing composite structure for various slab systems, and in the method, the base plate, web parts and top plate of the beam are cut from a plate material, the above-mentioned parts are assembled in such a manner that between the parts, a space is formed for concrete fed through openings in the web part, and the parts are welded together. Further, the invention relates to a steel beam.

[0002] The invention relates to a beam, on which the bearing structures of a building, such as hollow-core slabs, composite slabs, shell slabs and cast-in-situ, can be supported, During seam grouting or other concreting, the beam is filled with concrete, and after the concrete has hardened, the beam serves as a composite structure. Beams of this type are today quite well known in the field of element structures. Examples of solutions known in the field are those described in Finnish publications 85745 and 92089. The use of a composite structure provides a steel beam that is lighter than the earlier ones and the beam can be used at longer bearings than the earlier beams.

[0003] The solutions described in the above-mentioned publications serve as structures without problems. The drawback in the solutions is, however, their manufacturing method. The used manufacturing methods are relatively arduous and quite complex. Owing to the arduousness and complexity of manufacture, the costs are high and consequently, the price of the beam is high, which means that the end result is not the best possible.

[0004] It is an object of the invention to provide a method and for manufacturing a steel beam and a steel beam, by means of which the drawbacks of the prior art can be eliminated. This is achieved by the present invention. The method of the invention is **characterized in that** the web parts are cut to a curved shape according to pre-cambering, that side supports determining the position of the web parts and centre supports determining the location of the top plate are fastened to the base plate at regular intervals in the longitudinal direction of the beam, that a force is directed to the base plate that forces the base plate to the curvature determined by the web parts, whereby the side supports determine the position of the web parts and the centre supports determine the curvature of the top plate to be set in place. The means of the invention is, in turn, **characterized in that** the web parts have been cut to a curved shape according to pre-cambering, side supports determining the position of the web parts and centre supports determining the location of the top plate are fastened to the base plate at regular intervals in the longitudinal direction of the beam, that the base plate has been forced to the curvature defined by the web parts, whereby the side supports have been arranged to determine the position of the web parts and the centre supports have been arranged to determine the curvature of the top plate.

[0005] The advantage of the invention over the prior art is above all the fact that the manufacture of the beam is essentially simpler than before, whereby the costs are substantially lower. The implementation of the method of the invention is also simple in practice, whereby the introduction and use of the invention are advantageous. The method of the invention is also very flexible, because the invention can be applied in an advantageous manner to the manufacture of very different beams.

[0006] In the following, the invention will be described in more detail by means of a preferred embodiment described in the attached drawing, in which

Figures 1 to 5 are general stepwise views of the method of the invention,
Figure 6 is a longitudinal view of the beam manufactured with the method of the invention, and
Figure 7 is a perspective view of the beam manufactured with the method of the invention.

[0007] Figures 1 to 5 show the method of the invention in a set of figures shown in steps. In the figures, reference numeral 1 marks the base plate of the beam, reference numeral 2 marks the web parts and reference numeral 3 marks the top plate. Figures 1 to 5 only show one web plate. However, a finished beam has two web plates, as shown in Figure 6, for instance.

[0008] According to the essential idea of the invention, the base plate 1 of the beam is first placed on a platform, as shown in Figure 1. In the next step, side supports 4 determining the position of the web parts 2, i.e. the web plates and centre supports 5 determining the location of the top plate are fastened to the base plate at regular intervals in the longitudinal direction. The side supports 4 and centre supports 5 are clearly shown in Figure 6. The fastening of the side supports 4 and centre supports 5 to the base plate is shown generally in Figure 2. In this step, the top plate 3 can also be set in place on the centre supports 5, as shown in Figure 2.

[0009] In the next step, the web plates 2 are placed on the side supports 4. According to the essential idea of the invention, the web plates 2 are cut to a curved shape according to the pre-cambering of the beam. For the sake of clarity, the curved shape of the web plate is shown exaggerated. Setting the web plates 2 on the base plate 1 is shown in Figure 3. During the cutting step, openings 6 are also made to the web plates 2, through which concrete can be fed inside the beam.

[0010] In the next step of the method of the invention, a force is directed to the base plate that forces the base plate 1 to the curvature determined by the web plates 2, whereby the side supports 4 determine the position of the web plates 2 and, because the centre supports move with the base plate to the position according to the curvature of the web plates, the centre supports 5 determine the curvature of the top plate 3. The above-mentioned force is marked with arrows F in Figure 4.

[0011] The base plate 1, web plates 2 and top plate 3 are fastened together by welding to obtain the beam shown in Figure 5. The beam can also be equipped with end plates to close the ends of the beam. The end plates are not shown in Figures 1 to 5. The end plates are fastened to the beam by welding. The end plates are shown by way of example in Figure 7 and marked with reference numeral 7.

[0012] The method of the invention described above is particularly advantageous in that the manufacture of the beam is done without expensive jigs that were earlier used in the manufacture of beams.

[0013] Concreting the beams made in the above-mentioned manner in connection with different structures is known to a person skilled in the art and is thus not described in greater detail herein. Reference is merely made to Finnish publication 85745, in which this is described in more detail.

[0014] The above-mentioned side supports 4 are formed in such a manner that they comprise a part to be fastened to the base plate and having a first end 4a arranged to determine the location of the low edge of the web plate and a second end 4b arranged to determine the location of the top edge of the web plate. The side supports 4 can in principle be made in any shape. A particularly advantageous solution is one in which the part to be fastened to the base plate is substantially L-shaped and the free ends 4a, 4b of its branches are arranged to form the ends determining the locations of the edges of the web plate 2. In this type of solution, the outer surface of one branch is arranged to serve as the fastening surface between the part and the base plate 1. This type of application is shown in Figure 6. The side supports 4 can be fastened to the base plate 1 by welding, for instance.

[0015] The side supports 4 can be cut from a plate-like material, such as steel plate. For example, the L-shaped side supports used in the embodiment of Figure 6 are made in this manner. The centre supports 5 can be made in the same manner as the side supports 4. The shape of the centre supports 5 can also vary; in the embodiment of Figure 6, the centre supports are separate, substantially rectangular pieces. It is, however, possible to make the supports in such a manner that the side support and centre support are made up of one and the same element, if this is considered necessary.

[0016] The side supports and/or centre supports can also be made of a bar-like material, etc.

Claims

1. A method for manufacturing a steel beam, the steel beam serving together with concrete as a bearing composite structure for various slab systems, and in the method, base plate (1), web parts (2) and top plate (3) of the beam are cut from a plate material, the above-mentioned parts are assembled in a such manner that between the parts, a space is formed for concrete fed through openings (6) in the web part (2), and the parts are welded together, **characterized in that** the web parts (2) are cut to a curved shape according to pre-cambering, that side supports (4) determining the position of the web parts (2) and centre supports (5) determining the location of the top plate (3) are fastened to the base plate (1) at regular intervals in the longitudinal direction of the beam, that a force (F) is directed to the base plate (1) that forces the base plate (1) to the curvature defined by the web parts (2), so that the side supports (4) determine the position of the web parts (2) and the centre supports (5) determine the curvature of the top plate (3) to be set in place.

2. A method as claimed in claim 2, **characterized in that** the side supports (4) and centre supports (5) are welded to the base plate (1).

3. A steel beam which is arranged to serve together with concrete as a bearing composite structure for various slab systems the steel beam comprising base plate (1), web parts (2) and top plate (3) cut from a plate material, whereby the base plate (1), the web parts (2) and the top plate (3) have been assembled and welded together in such a manner that between the parts, a space is formed for concrete fed through openings (6) in the web part (2), **characterized in that** the web parts (2) have been cut to a curved shape according to pre-cambering, side supports (4) determining the position of the web parts (2) and centre supports (5) determining the location of the top plate (3) are fastened to the base plate (1) at regular intervals in the longitudinal direction of the beam, that the base plate (1) has been forced to the curvature defined by the web parts (2), wherein the side supports (4) have been arranged to determine the position of the web parts (2) and the centre supports (5) have been arranged to determine the curvature of the top plate (3).

4. A steel beam as claimed in claim 3, **characterized in that** the side support (4) comprise a part arranged to be fastened to the base plate and having a first end (4a) arranged to determine the location of the low edge of the web part (2) and a second end (4b) arranged to determine the location of the top edge of the web part (2).

5. A steel beam as claimed in claim 4, **characterized in that** the side support (4) is a substantially L-shaped part and the free ends (4a, 4b) of its branches have been arranged to form the ends determining the location of the edges of the web part (2) and that the outer surface of one end has been arranged to serve as the fastening surface between the side support (4) and the base plate (1).

Patentansprüche

1. Verfahren zur Herstellung eines Stahlträgers, der zusammen mit Beton als eine stützende Verbundkonstruktion für unterschiedliche Plattensysteme fungiert, bei welchem Verfahren eine Grundplatte (1), Stegteile (2) und eine Oberplatte (3) des Trägers aus einem Plattenmaterial geschnitten werden, die oben erwähnten Teile derart montiert werden, dass zwischen den Teilen ein Raum für durch Öffnungen (6) im Stegteil (2) zuzuführenden Beton ausgebildet wird, und die Teile zusammengeschweisst werden, **dadurch gekennzeichnet, dass** die Stegteile (2) in eine gekrümmte Form gemäß einer Vorwölbung geschnitten werden, dass die Position der Stegteile (2) bestimmende Seitenstützen (4) und die Lage der Oberplatte (3) bestimmende Mittelstützen (5) an die Grundplatte (1) in regelmäßigen Abständen in Längsrichtung des Trägers befestigt werden, dass eine Kraft (F) auf die Grundplatte (1) gerichtet wird, die die Grundplatte (1) zur von den Stegteilen (2) bestimmten Krümmung zwingt, so dass die Seitenstützen (4) die Position der Stegteile (2) bestimmen und die Mittelstützen (5) die Krümmung der an ihren Platz zu stellenden Oberplatte (3) bestimmen.

2. Verfahren nach Anspruch 2, **dadurch gekennzeichnet, dass** die Seitenstützen (4) und die Mittelstützen (5) an die Grundplatte (1) geschweisst werden.

3. Stahlträger, der vorgesehen ist, zusammen mit Beton als eine stützende Verbundkonstruktion für unterschiedliche Plattensysteme zu fungieren, welcher Stahlträger eine Grundplatte (1), Stegteile (2) und eine Oberplatte (3) ausweist, die aus einem Plattenmaterial geschnitten sind, wobei die Grundplatte (1), die Stegteile (2) und die Oberplatte (3) derart montiert und zusammengeschweisst sind, dass zwischen den Teilen ein Raum für durch Öffnungen (6) im Stegteil (2) zuzuführenden Beton ausgebildet wird, **dadurch gekennzeichnet, dass** die Stegteile (2) in eine gekrümmte Form gemäß einer Vorwölbung geschnitten sind, die Position der Stegteile (2) bestimmende Seitenstützen (4) und die Lage der Oberplatte (3) bestimmende Mittelstützen (5) an die Grundplatte (1) in regelmäßigen Abständen in Längsrichtung des Trägers befestigt werden, dass die Grundplatte (1) zur von den Stegteilen (2) bestimmten Krümmung gezwungen ist, wobei die Seitenstützen (4) vorgesehen sind, die Position der Stegteile (2) zu bestimmen, und die Mittelstützen (5) vorgesehen sind, die Krümmung der Oberplatte (3) zu bestimmen.

4. Stahlträger nach Anspruch 3, **dadurch gekennzeichnet, dass** die Seitenstütze (4) einen an die Grundplatte zu befestigenden Teil aufweist und ein erstes Ende (4a) hat, das angeordnet ist, die Lage des unteren Rands des Stegteils (2) zu bestimmen, und ein zweites Ende (4b) hat, das angeordnet ist, die Lage des oberen Rands des Stegteils (2) zu bestimmen.

5. Stahlträger nach Anspruch 4, **dadurch gekennzeichnet, dass** die Seitenstütze (4) ein wesentlich L-förmiger Teil ist und die freien Enden (4a, 4b) seiner Schenkel vorgesehen sind, die Enden auszubilden, die die Lage der Ränder des Stegteils (2) bestimmen, und dass die Aussenfläche eines Endes vorgesehen ist, als Befestigungsfläche zwischen der Seitenstütze (4) und der Grundplatte (1) zu dienen.

Revendications

1. Procédé de fabrication d'une poutre d'acier, ladite poutre d'acier coopérant avec du béton pour former une structure porteuse composite pour différents systèmes de dallage, dans lequel la semelle (1), les éléments d'âme (2) et la plaque supérieure (3) de la poutre sont découpés dans une plaque de matériau, les éléments précités étant assemblés de manière à délimiter entre eux un espace destiné à recevoir du béton introduit par des ouvertures (6) ménagées dans l'élément d'âme (2) et lesdits éléments étant soudés entre eux, **caractérisé en ce que** les éléments d'âme (2) sont découpés avec une forme incurvée selon le précintrage, **en ce que** des supports latéraux (4) déterminant la position des éléments d'âme (2) et des supports centraux (5) déterminant l'emplacement de la plaque supérieure (3) sont fixés à la semelle (1) à des intervalles réguliers dans la direction longitudinale de la poutre, **en ce qu'**une force (F) est exercée sur la semelle (1) pour contraindre cette dernière à épouser la courbure définie par les éléments d'âme (2), de sorte que les supports latéraux (4) déterminent la position des éléments d'âme (2) et que les supports centraux (5) déterminent la courbure de la plaque supérieure (3) à mettre en place.

2. Procédé selon la revendication 2, **caractérisé en ce que** les supports latéraux (4) et les supports centraux (5) sont soudés à la semelle (1).

3. Poutre d'acier agencée pour coopérer avec du béton pour former une structure porteuse composite pour différents systèmes de dallage, ladite poutre d'acier comprenant une semelle (1), des éléments d'âme (2) et une plaque supérieure (3) découpés dans une plaque de matériau, la semelle (1), les éléments d'âme (2) et la plaque supérieure (3) ayant été assemblés et soudés entre eux de manière à délimiter entre eux un espace destiné à recevoir du béton introduit par les ouvertures (6) ménagées dans l'élé-

ment d'âme (2), **caractérisé en ce que** les éléments d'âme ont été découpés avec une forme incurvée selon le précintrage, **en ce que** des supports latéraux (4) déterminant la position des éléments d'âme (2) et des supports centraux (5) déterminant l'emplacement de la plaque supérieure (3) sont fixés à la semelle (1) à des intervalles réguliers dans la direction longitudinale de la poutre, et **en ce que** la semelle (1) a été contrainte d'épouser la courbure définie par les éléments d'âme (2), les supports latéraux (4) ayant été agencés pour déterminer la position des éléments d'âme (2) et les supports centraux (5) ayant été agencés pour déterminer la courbure de la plaque supérieure (3).

4. Poutre d'acier selon la revendication 3, **caractérisée en ce que** le support latéral (4) comprend une partie agencée pour être fixée à la semelle et présentant une première extrémité (4a) agencée pour déterminer l'emplacement du bord inférieur de l'élément d'âme (2) et une seconde extrémité (4b) agencée pour déterminer l'emplacement du bord supérieur de l'élément d'âme (2).

5. Poutre d'acier selon la revendication 4, **caractérisée en ce que** le support latéral (4) affecte la forme générale d'un L, dont les extrémités libres (4a, 4b) des branches ont été agencées pour former les extrémités déterminant l'emplacement des bords de l'élément d'âme (2) et **en ce que** la surface extérieure d'une extrémité a été agencée pour servir de surface de fixation du support latéral (4) sur la semelle (1).

Fig. 1

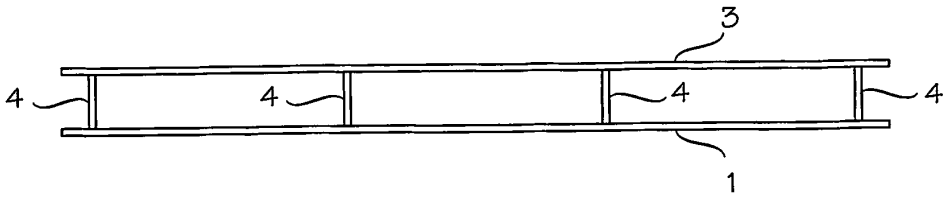


Fig. 2

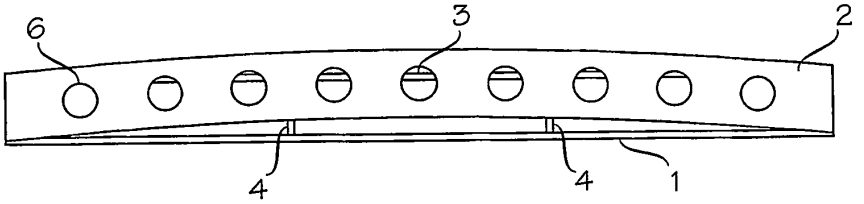


Fig. 3

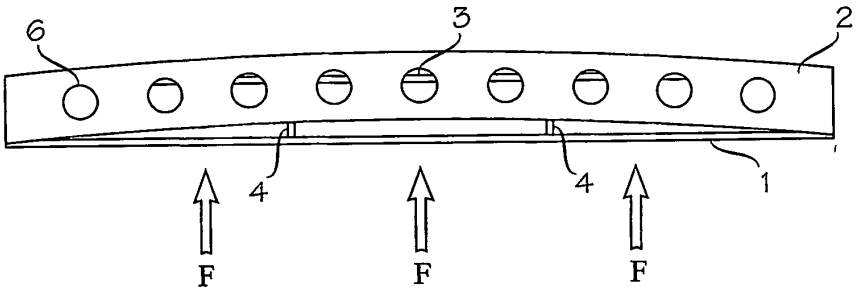


Fig. 4

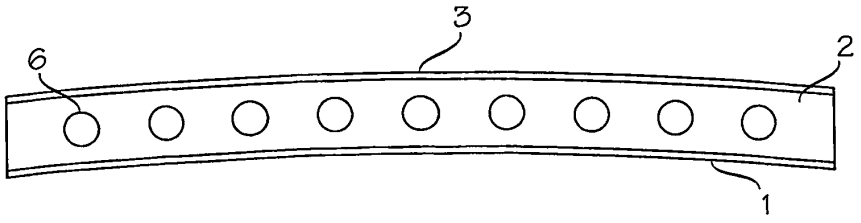


Fig. 5

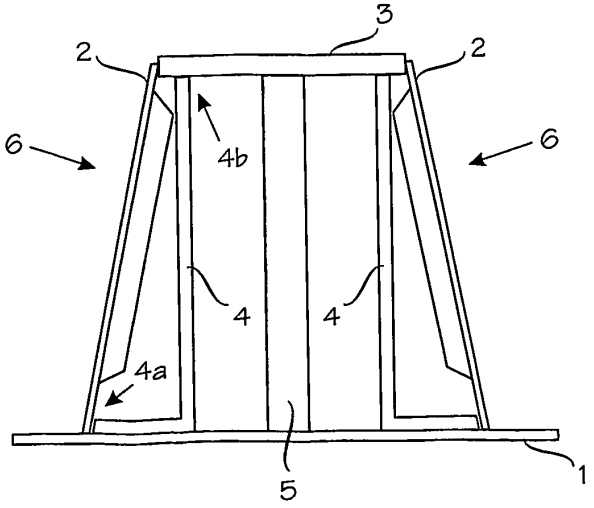
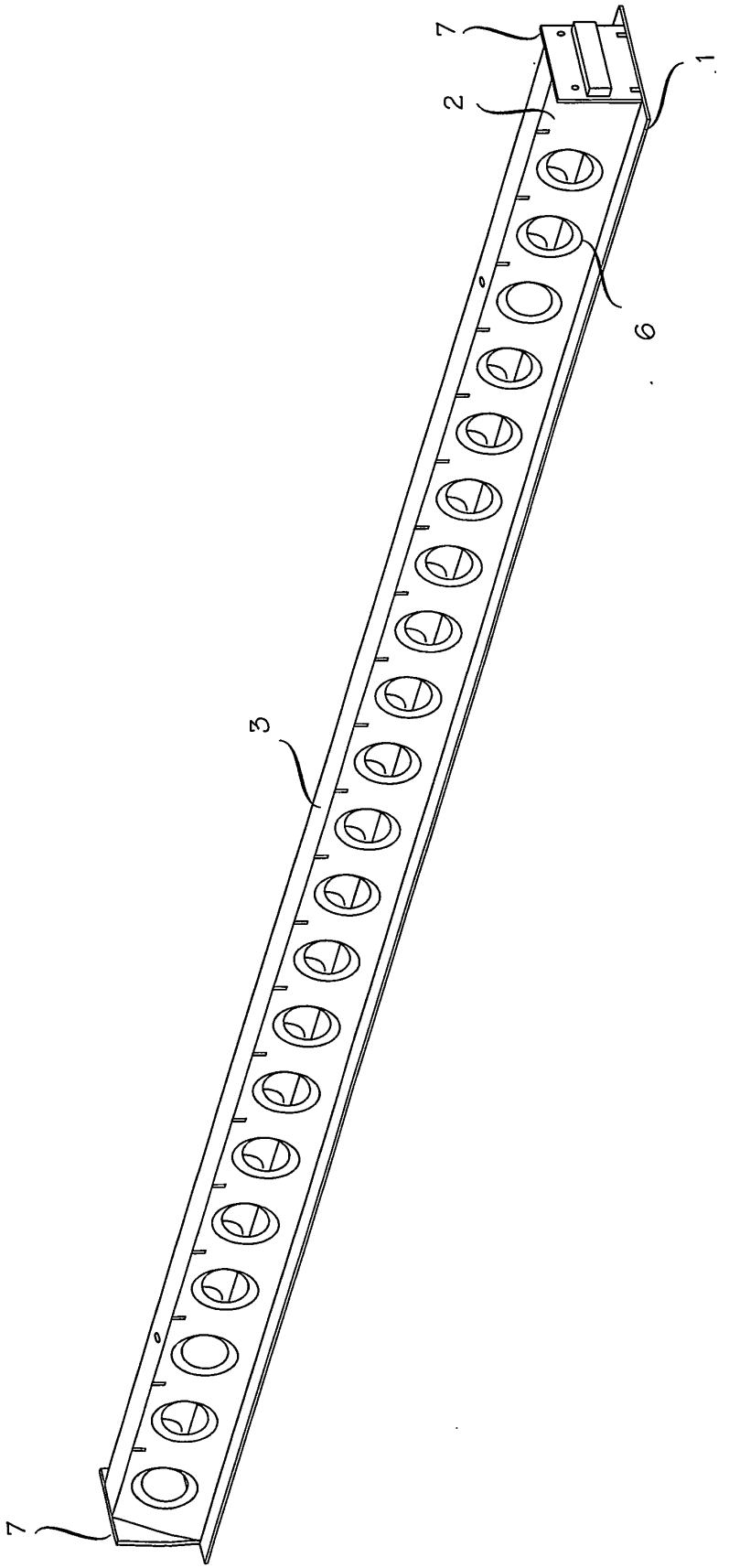


Fig. 6

Fig. 7



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Patent documents cited in the description

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- FI 92089 **[0002]**