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

(11) **EP 2 942 448 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
11.11.2015 Bulletin 2015/46

(21) Application number: **14193221.0**

(22) Date of filing: **14.11.2014**

(51) Int Cl.:
E04C 5/18 *(2006.01)* ***E04C 5/065*** *(2006.01)*
B21F 27/20 *(2006.01)*

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME

(30) Priority: **08.05.2014 BE 201400333**

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(54) **Spacer for concrete reinforcements**

(57) The present invention relates to spacers for concrete reinforcements, comprising three parallel longitudinal rods, connected to each other by transverse rods which run perpendicular to and are laterally connected to the longitudinal rods; characterized in that the transverse rods do not project, or at most project 1 mm, beyond the outer longitudinal rods. The invention furthermore relates to methods of producing such spacers.

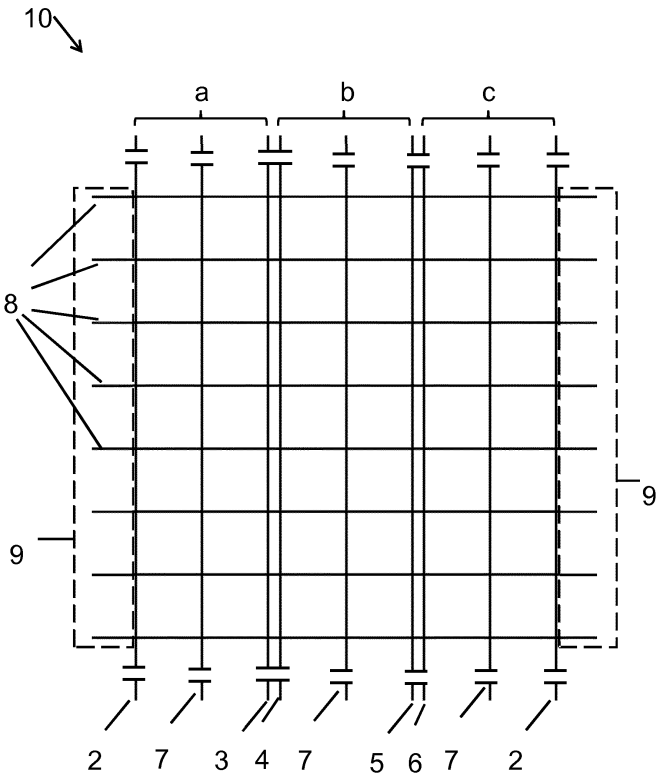

Fig. 1

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Description

TECHNICAL FIELD

[0001] The present invention relates to spacers for concrete reinforcements and concrete structures, methods of producing such spacers, and use thereof.

BACKGROUND

[0002] Reinforcements for flat structures in reinforced concrete are usually made from steel reinforcement mats. Often, one or more reinforcement mats are provided both at the top and bottom in the flat structure, so that both tensile and compressive forces can be absorbed in an optimum manner.

[0003] During building, the reinforcement mats are usually kept at the desired distance from one another by means of spacers. Various types of spacers are known.

[0004] A type of spacer which is often used is a (lattice) girder with a triangular or trapezoidal cross section. Such spacers are also known as A-shaped or U-shaped spacers and have a high strength while requiring very little material. However, such spacers have the drawback that they are difficult to drag across the bottom reinforcement mat. There is therefore a need for new spacers. There is also a need for new methods of producing spacers.

SUMMARY

[0005] The present invention relates to spacers for concrete reinforcements and/or concrete structures, methods of producing such spacers, and use thereof.

[0006] In a first aspect, the present invention provides a method of producing spacers for concrete reinforcements and/or concrete structures. This method comprises:

(a) providing at least six parallel longitudinal rods in a plane, comprising

- two peripheral longitudinal rods;
- at least one punching groove consisting of a pair of mutually adjacent longitudinal rods;
- a central longitudinal rod between each peripheral longitudinal rod and the adjacent punching groove;
- if the longitudinal rods form two or more punching grooves, a central longitudinal rod situated between each pair of adjacent punching grooves; and
- optionally, one or more additional longitudinal rods situated between the peripheral longitudinal rods and outside the punching grooves;

(b) placing transverse rods perpendicular to the longitudinal rods on top of and/or under the latter, and fastening the transverse rods to the longitudinal rods, thus producing a lattice structure;

(c) optionally, cutting parts of transverse rods overhanging the peripheral longitudinal rods;

(d) punching out or cutting through the transverse rod portions between the adjacent longitudinal rods of the punching groove, thus producing two or more elongate lattices, each comprising three parallel longitudinal rods which are connected to each other by transverse rods which run perpendicular to and are laterally connected to the longitudinal rods; the transverse rods preferably not projecting or at most projecting 0.5 mm beyond the outer longitudinal rods; and

(e) bending the two or more elongate lattices, thus producing two or more spacers, each comprising three parallel straight longitudinal rods including two bottom longitudinal rods and a top longitudinal rod, connected to each other by U-shaped transverse rods which run perpendicular to and are laterally connected to the longitudinal rods; the transverse rods preferably not projecting or at most projecting 0.5 mm beyond the bottom longitudinal rods.

[0007] In specific embodiments of the method, step (a) comprises unrolling and aligning at least six longitudinal rods in a plane; in which the peripheral longitudinal rods; the longitudinal rods forming part of a punching groove; and the additional longitudinal rods (if present) are cut to the desired length before performing step (e). In further embodiments, a separate roll is provided for each longitudinal rod.

[0008] In specific embodiments, the central longitudinal rods are cut to a desired length before performing step (e). In other embodiments, the method furthermore comprises, after step (e): (f) cutting the central longitudinal rods to a desired length.

[0009] In specific embodiments, step (e) furthermore comprises turning each even or odd lattice produced in step (d).

[0010] In certain embodiments, step (e) comprises bending the transverse rods of the two or more elongate lattices in two locations, thus producing two or more spacers having a trapezoidal cross section.

[0011] In specific embodiments, step (b) comprises unrolling, aligning and cutting the transverse rods from one or more rolls.

[0012] In certain embodiments of the method, the transverse rods of the spacers project at most 0.2 mm beyond bottom longitudinal rods.

[0013] In specific embodiments of the method, the longitudinal rods form at least two strips which each contain three or more longitudinal rods, in which each pair of adjacent strips is separated by a punching groove; and at least two of the strips are of a different width.

[0014] In certain embodiments of the method, the distance between the adjacent longitudinal rods of the punching groove is at most 10 mm.

[0015] The present invention furthermore provides a

spacer obtainable by means of the method described herein. More specifically, the invention provides a spacer for concrete reinforcements and/or concrete structures comprising three parallel straight longitudinal rods, including two bottom longitudinal rods and a top longitudinal rod, connected to each other by U-shaped transverse rods which run perpendicular to and are laterally connected to the longitudinal rods; characterized in that the transverse rods do not project, or at most project 0.5 mm, beyond the bottom longitudinal rods.

[0016] In specific embodiments, the transverse rods of the spacer project at most 0.2 mm beyond bottom longitudinal rods. In certain embodiments, the spacer comprises two or more transverse rods of different diameters.

[0017] In a further aspect, the present invention provides the use of the spacer described herein as a construction element.

[0018] The methods described herein make it possible to produce spacers in a simple and quick manner, in which case there is no or hardly any overhang of the transverse rods beyond the bottom longitudinal rods. The spacers which have thus been produced are easier to drag across reinforcement mats than similar existing spacers and, in specific embodiments, are also easier to stack.

DESCRIPTION OF THE FIGURES

[0019] The following description of the figures of specific embodiments of the invention is only given by way of example and is not intended to limit the present description, its application or use. In the drawings, identical reference numerals refer to the same or similar parts and features.

Fig. 1 Illustration of a lattice (10) obtained as an intermediate product according to a specific embodiment of the method described herein.

Fig. 2 Perspective view of a spacer (1) according to specific embodiments of the present invention (A), and of a prior-art spacer (11) (B).

Fig. 3 A, B: cross section of spacers (1, 11) according to specific embodiments of the present invention.

[0020] The following reference numerals are used in the description and figures:

1, 11, 12 - spacer; 2-7 - longitudinal rod; 8 - transverse rod; 9 - overhang; 10 - lattice.

DESCRIPTION OF THE INVENTION

[0021] As used below in this text, the singular forms "a", "an", "the" include both the singular and the plural, unless the context clearly indicates otherwise.

[0022] The terms "comprise", "comprises" as used below are synonymous with "including", "include" or "contain", "contains" and are inclusive or open and do not exclude additional unmentioned parts, elements or method steps. Where this description refers to a product or process which "comprises" specific features, parts or steps, this refers to the possibility that other features, parts or steps may also be present, but may also refer to embodiments which only contain the listed features, parts or steps.

[0023] The enumeration of numeric values by means of ranges of figures comprises all values and fractions in these ranges, as well as the cited end points.

[0024] The term "approximately" as used when referring to a measurable value, such as a parameter, an amount, a time period, and the like, is intended to include variations of +/- 10% or less, preferably +/-5% or less, more preferably +/-1% or less, and still more preferably +/-0.1% or less, of and from the specified value, in so far as the variations apply to the invention disclosed herein. It should be understood that the value to which the term "approximately" refers per se has also been disclosed.

[0025] All references cited in this description are hereby deemed to be incorporated in their entirety by way of reference.

[0026] Unless defined otherwise, all terms disclosed in the invention, including technical and scientific terms, have the meaning which a person skilled in the art usually gives them. For further guidance, definitions are included to further explain terms which are used in the description of the invention.

[0027] As intended herein, an object is "elongate" when the length of said object is greater than two times the width of said object; preferably the length is greater than three, four or five times the width of the object.

[0028] The term "perpendicular" as used herein may comprise a deviation from an exactly perpendicular orientation. More particularly, a first rod is considered to be positioned perpendicularly with respect to a plane or second rod if the angle between the longitudinal axis of the first rod and the plane, or the angle between the longitudinal axes of the first and second rod, is between 89° and 91°; preferably between 89.5° and 90.5°; and most preferably 90°.

[0029] The present invention relates to spacers for concrete reinforcements and/or concrete structures. The spacers are in particular intended to space two or more parallel concrete reinforcements, for example reinforcement mats for a flat structure, a desired distance apart. The flat structure may be a horizontal structure, such as a floor, or a vertical structure, such as a wall. The spacers may be used, for example, for spacing reinforcement mats in prefabricated (prefab) hollow walls apart. Such walls typically comprise two prefab concrete shells, each concrete shell comprising a reinforcement mat. These reinforcement mats are spaced a distance apart by one or more spacers. In this case, a hollow wall is produced which can be filled with concrete on the building site.

[0030] More specifically, the present invention provides a U-shaped spacer for concrete reinforcements

and/or concrete structures comprising three or more parallel longitudinal rods, including two bottom longitudinal rods and a top longitudinal rod. The longitudinal rods are connected to each other by bent transverse rods which run perpendicular to and are laterally connected to the longitudinal rods. The spacer is furthermore characterized in that the transverse rods do not project beyond the bottom longitudinal rods, or hardly at all. As a result thereof, the spacers according to the present invention can be dragged across reinforcement mats in a simple and virtually unimpeded manner. These characterizing features will be explained further below.

[0031] The spacer described herein comprises three or more straight longitudinal rods, including two bottom longitudinal rods and a top longitudinal rod. In specific embodiments, there may be one or more longitudinal rods between the bottom longitudinal rods and the top longitudinal rod. In specific embodiments, the spacer comprises more than one top longitudinal rod.

[0032] The longitudinal rods are placed a certain distance apart and parallel to one another. If the spacer comprises only one top longitudinal rod, the top longitudinal rod and the bottom longitudinal rods form the ribs of a triangular prism. If the spacer comprises two top longitudinal rods, the top longitudinal rods and the bottom longitudinal rods typically form the ribs of a trapezoidal prism. Typically, the large base of the trapezium is in this case formed by the bottom longitudinal rods.

[0033] The longitudinal rods are connected to each other by means of transverse rods, thus producing a grid structure or lattice structure. The term "lattice structure" as used herein denotes an open frame formed by laterally touching or overlapping wires, rods or the like, preferably in a regular pattern.

[0034] The transverse rods are typically identical in shape and bent to form a U shape or V shape. More specifically, the transverse rods are bent in one or two locations in the centre. In specific embodiments, the transverse rods are not bent at the location where they are attached to the longitudinal rods, for example a welding spot. In this way, it is possible to prevent transverse rods from detaching from the longitudinal rods after (excessive) bending. Preferably, the transverse rods are bent in two locations, more specifically on either side of the top longitudinal rod. In this case, a spacer having a trapezoidal cross section can be produced. The curvature radius of the bend(s) of the transverse rods is not critical, as long as a U shape or V shape is obtained. Preferably, a small curvature radius is avoided if the transverse rods are bent at the location of a welding spot.

[0035] The transverse rods are placed perpendicular to the longitudinal rods. More specifically, the longitudinal rods and the transverse rods, in the unbent state, form a lattice structure with rectangular or square openings. The lattice structure may be regarded as a mesh-shaped structure.

[0036] In a simple form, the spacer comprises only three parallel longitudinal rods, more specifically two bottom longitudinal rods and one top longitudinal rod. Such a spacer is mainly suitable for spacing concrete reinforcements a small distance apart, for example a distance of up to 200 mm. However, it is not impossible to use spacers comprising only three longitudinal rods to bridge distances greater than 200 mm.

[0037] In specific embodiments, the spacer comprises four or more parallel longitudinal rods, more specifically, two bottom longitudinal rods, a top longitudinal rod, and one or more intermediate longitudinal rods. This increases the strength of the spacer and is particularly important for spacers of considerable height, for example having a height greater than 200 mm. The distances between an intermediate longitudinal rod and each of the two adjacent longitudinal rods may be equal or different. In specific embodiments, the distance between two adjacent longitudinal rods, measured along the transverse rods, is always between 20 mm and 200 mm, preferably between 50 mm and 200 mm.

[0038] In the spacer described herein, the transverse rods do not project, or hardly at all, beyond the bottom longitudinal rods. There is therefore hardly or no overhang by the ends of the transverse rods beyond the bottom longitudinal rods. More specifically, the transverse rods project at most 1.0 mm beyond the bottom longitudinal rods; preferably at most 0.5 mm; still more preferably at most 0.2 mm; or at most 0.1 mm; or at most 0.05 mm.

[0039] The overhang of a transverse rod beyond a longitudinal rod can be measured as the distance of the end of the transverse rod (on the side of the respective longitudinal rod) with respect to a plane which is perpendicular (90°) to the longitudinal axis of the respective transverse rod in an unbent position, and touches the respective longitudinal rod at the outer side of the spacer. An overhang of 0.5 mm thus means that when the spacer is positioned on a plane, there is at most a distance of 0.5 mm from the bottom longitudinal rod and the plane.

[0040] The transverse rods may have straight and/or oblique ends.

[0041] In specific embodiments, one or more transverse rods have straight ends. This means that the transverse rods have been cut according to a plane perpendicular to their longitudinal axis (in the unbent position).

[0042] In specific embodiments, one or more transverse rods have oblique ends. This means that the transverse rods have been cut at an angle, preferably according to a plane which runs parallel to the longitudinal rods and forms an angle with the transverse rods of 30° to 50°. Thus, the overhang of the transverse rods can be minimized further. In further embodiments, all transverse rods have oblique ends.

[0043] In specific embodiments, one or more transverse rods may have a straight and an oblique end.

[0044] The longitudinal rods and the transverse rods typically run along the entire length and the entire width of the spacer. The height of the spacer is determined by the distance between the top longitudinal rod and the

plane defined by the bottom longitudinal rods, and is usually between 20 mm and 400 mm. For a large number of applications, a height of at most 200 mm is sufficient. In a preferred embodiment, the spacer described herein thus has a height of between 20 mm and 200 mm, more preferably of between 50 mm and 200 mm.

[0045] However, the spacers described herein are not limited to such a height. In specific embodiments, the height is between 50 mm and 400 mm, preferably between 200 mm and 400 mm, more preferably between 200 mm and 360 mm, for example 300 mm.

[0046] The length of the spacers is usually between 100 cm and 400 cm, preferably between 100 cm and 300 cm, more preferably between 150 cm and 250 cm, for example 200 cm.

[0047] The width of the spacers is not critical and may depend on the angle at which the transverse rods have been bent and the height of the spacer. In specific embodiments, the width of the spacers is between 5 cm and 20 cm, although another width is not ruled out.

[0048] In the spacers described herein, the transverse rods (in the unbent position) are positioned perpendicular to the longitudinal rods, with the transverse rods laterally touching the longitudinal rods. Preferably, each transverse rod touches each of the longitudinal rods of the spacer. In the unbent position of the transverse rods, the spacer thus forms a lattice structure comprising three or more parallel longitudinal rods with a series of parallel transverse rods running perpendicular thereto.

[0049] The distance between two adjacent transverse rods is usually between 50 and 300 mm, preferably between 50 and 200 mm, more preferably between 100 and 150 mm. In a preferred embodiment, the transverse rods are placed at regular intervals. However, it is provided that in specific embodiments, two or more adjacent transverse rods are placed closer together or further apart than other transverse rods.

[0050] The longitudinal rods and transverse rods are preferably made of steel. In specific embodiments, the rods are not smooth, but provided, for example, with spiral-shaped ridges. This increases the surface of the rods, as a result of which the steel attaches better to the concrete. However, this is not a requirement, so that the rods may be smooth in specific embodiments.

[0051] The diameter of the longitudinal and transverse rods is typically between 2.0 and 10.0 mm. In specific embodiments, the diameter of the longitudinal and transverse rods is between 3.0 and 5.0 mm. The diameter of the longitudinal rods may be identical to or different from the diameter of the transverse rods.

[0052] The diameter of the transverse rods may be adapted to the height of the spacer. More specifically, for a higher spacer, transverse rods of a greater strength and therefore with a larger diameter are used. In specific embodiments, the spacer typically has a height of approximately 100 mm, with the transverse rods having a diameter of approximately 3.0 mm. In certain embodiments, the spacer has a height of approximately 120 mm, with the transverse rods having a diameter of approximately 3.2 mm.

[0053] The bottom longitudinal rods preferably are of equal diameter, which may be equal to or differ from the diameter of the top longitudinal rod. Any intermediate longitudinal rods as described above may have a diameter which may be equal to or differ from the diameter of the top and/or bottom longitudinal rods.

[0054] Usually, all the transverse rods of the spacer are of an equal diameter or thickness. However, it is not impossible for two or more transverse rods to have a different diameter or thickness in specific embodiments.

[0055] The present invention furthermore provides a method for producing spacers, including the spacers described herein, said method comprising:

(a) providing at least six parallel longitudinal rods in a plane, comprising

- two peripheral longitudinal rods;
- at least one punching groove consisting of a pair of adjacent longitudinal rods;
- a central longitudinal rod between each peripheral longitudinal rod and the adjacent punching groove;
- if the longitudinal rods form two or more punching grooves, a central longitudinal rod situated between each pair of adjacent punching grooves; and
- optionally, one or more additional longitudinal rods situated between the peripheral longitudinal rods and outside the punching grooves;

(b) placing transverse rods perpendicular to the longitudinal rods on top of and/or under the latter, and fastening the transverse rods to the longitudinal rods to produce a lattice structure;

(c) optionally, cutting parts of transverse rods overhanging the peripheral longitudinal rods;

(d) punching out or cutting the transverse rod portions between the adjacent longitudinal rods of the punching groove, thus producing two or more elongate lattices, each comprising three parallel longitudinal rods which are connected to each other by transverse rods which run perpendicular to and are laterally connected to the longitudinal rods; the transverse rods preferably not projecting or at most projecting 0.5mm beyond the outer longitudinal rods; and

(e) bending the (transverse rods of the) two or more elongate lattices, thus producing two or more spacers, preferably spacers as described herein.

[0056] This method makes it possible to produce spacers in an efficient and material-saving way. In a preferred embodiment, there is no overhang of the transverse rods beyond the outer longitudinal rods, as a result of which the resulting spacers can be dragged across reinforce-

ment mats in a simple and virtually unimpeded manner. These steps will be explained further below.

[0057] In a first step, the method described herein comprises (a) providing at least six parallel longitudinal rods, usually in a plane. The six or more longitudinal rods comprise:

- two peripheral longitudinal rods; and
- at least one punching groove consisting of a pair of adjacent longitudinal rods;

with in each case one central longitudinal rod being provided between each pair of adjacent punching grooves, and between each peripheral longitudinal rod and the adjacent punching groove.

[0058] The term "central longitudinal rod", as used herein, refers to a longitudinal rod which is positioned between a pair of adjacent punching grooves, or between a peripheral longitudinal rod and the adjacent punching groove, in such a manner that the central longitudinal rod forms a top longitudinal rod of a spacer produced by means of the method described herein. In this case, the central longitudinal rod does not necessarily have to be positioned exactly in the centre between two other longitudinal rods. In specific embodiments, the central longitudinal rods are positioned in the centre of the space between each pair of adjacent punching grooves, and between each peripheral longitudinal rod and the adjacent punching groove.

[0059] The peripheral longitudinal rods and the longitudinal rods which form part of the punching grooves form the bottom longitudinal rods of the spacers, produced by means of the method described herein. The central longitudinal rods form the top longitudinal rods of the spacers. The optional additional longitudinal rods form intermediate longitudinal rods of the spacers.

[0060] The longitudinal rods comprise at least one punching groove formed by a pair of adjacent longitudinal rods (different from the peripheral longitudinal rods). A punching groove forms a dividing line where the transverse rods are punched out or cut, so that the peripheral longitudinal rods and the longitudinal rods of the punching groove form the bottom longitudinal rods of the resulting spacers (see below). The punching grooves divide the parallel longitudinal rods into two or more strips which are separated from one another by punching grooves. Each strip comprises at least three longitudinal rods, so that each strip can be made into a separate spacer as described herein.

[0061] In specific embodiments, more than six parallel longitudinal rods are provided, preferably nine or more parallel longitudinal rods. In specific embodiments, at least nine parallel longitudinal rods are provided, with one or two pairs of adjacent longitudinal rods forming one or two punching grooves, respectively. In specific embodiments, 12 or more parallel longitudinal rods are provided, with at least three punching grooves being formed.

[0062] The longitudinal rods are typically positioned at a distance from one another, corresponding to the distance between the adjacent longitudinal rods (measured along the transverse rods) in the spacers described herein. However, each pair of adjacent longitudinal rods which forms a punching groove is preferably placed as close to each other as possible. This reduces the loss of material when separating the spacers (see below). In specific embodiments, the distance between a pair of adjacent longitudinal rods which form a punching groove - this distance is also referred to here as the width of the punching groove - is at most 20 mm. Preferably, each punching groove has a width of 0 mm to 20 mm, preferably of between 0 mm and 15 mm, more preferably of between 0 mm and 10 mm.

[0063] If the portions of the transverse rods within the punching groove are not cut, but punched out, a punching groove which is too narrow may cause accelerated wear of blades which are used for punching. Preferably, the distance between a pair of adjacent longitudinal rods which form a punching groove is at least 3 mm in such embodiments. In specific embodiments, this distance is approximately 15 mm. Such a distance may ensure minimal wear and low loss of material. Except between the adjacent longitudinal rods which form a punching groove as described above, the distance between two adjacent longitudinal rods is between 20 mm and 200 mm, preferably between 30 mm and 200 mm, more preferably between 50 mm and 200 mm in specific embodiments.

[0064] As described above, the parallel longitudinal rods together form two or more strips, with each pair of adjacent strips being separated from one another by a punching groove. Each strip contains at least three longitudinal rods. The distance between the outer pair of longitudinal rods of a strip is also referred to as the "width" of the respective strip herein. This width determines the length of the transverse rods of the spacer which can be obtained from the respective strip by means of the method described herein; and thus also the maximum width and height of the spacer.

[0065] In specific embodiments, two of the two or more strips have a different width. This makes it possible simultaneously to produce two or more types of spacers having a different height and/or width using one installation. As a result thereof, it is possible to prevent the installation from having to be completely converted for each new height and/or width. This saving in changeover time makes a more efficient and quicker production possible.

[0066] In specific embodiments, the longitudinal rods form at least three, at least five, at least eight, at least ten or at least twelve strips which are separated from one another by punching grooves, with at least two strips having a different width.

[0067] In specific embodiments of the method described herein, providing the at least six parallel longitudinal rods comprises unrolling and (straightening and) aligning these longitudinal rods in a plane.

[0068] In a preferred embodiment, each of the six or

more longitudinal rods comes from a separate roll. This may increase the speed of production and makes it possible, if desired, to combine different types of longitudinal rods, for example longitudinal rods of different diameters.

[0069] When the longitudinal rods are unrolled from one or more rolls, the method described herein furthermore also comprises cutting of the longitudinal rods to a desired length. The desired length depends on the desired length of the spacers, and is usually between 100 cm and 400 cm, preferably between 100 cm and 300 cm, more preferably between 150 cm and 250 cm, for example 200 cm.

[0070] Cutting the longitudinal rods to the desired length may take place immediately after unrolling or in a further stage of the production process, for example after welding a number of transverse rods onto the longitudinal rods.

[0071] In specific embodiments, all longitudinal rods are cut to the desired length in step (a), (b), (c) and/or (d). In specific embodiments, this is carried out after the fastening of the transverse rods in step (d) and before the bending of the lattices in step (e).

[0072] In specific embodiments, a number of longitudinal rods are cut before the bending of the lattices, while other longitudinal rods are cut after the bending of the lattices. More specifically, except for the central longitudinal rods, all longitudinal rods may be cut before step (e) is carried out. In other words, in such an embodiment, the peripheral longitudinal rods, the longitudinal rods forming part of a punching groove, and any additional longitudinal rods are cut before step (e) is carried out; more specifically, in step (a), (b), (c) and/or (d). The central longitudinal rods can then be cut after step (e), in an additional step:

> (f) cutting the central longitudinal rods to a desired length.

[0073] Leaving the central longitudinal rods intact may simplify transportation of the lattices on the production line and ensure that the lattices are conveyed through all stages of the production process at the same speed. On the other hand, the cutting of the other longitudinal rods makes it possible to bend the lattices separately.

[0074] The method described herein furthermore comprises (b) positioning transverse rods perpendicular to the longitudinal rods on top of and/or under the latter, and fastening the transverse rods to the longitudinal rods, so that a lattice structure is obtained. The order in which the transverse rods and the longitudinal rods are positioned is not critical to the method described herein. In specific embodiments, the longitudinal rods are first positioned over a specific length, following which one or more transverse rods are positioned on top of and/or below the longitudinal rods. In other embodiments, one or more transverse rods are positioned first, following which the longitudinal rods are positioned on top of and/or under the transverse rods.

[0075] The transverse rods run parallel to each other and are perpendicular to the longitudinal rods, and laterally touch the longitudinal rods, thus forming a lattice structure. In specific embodiments, all transverse rods are on the same side of the plane defined by the longitudinal rods. However, in specific embodiments, it is provided that transverse rods may be situated on both sides of this plane. Thus, it is for example possible to ensure that, during the bending in step (e) (see below), the transverse rods are situated below or above the longitudinal rods.

[0076] In specific embodiments, the transverse rods are positioned and attached to the longitudinal rods one by one. In this case, a next transverse rod is only positioned after the previous transverse rod has been fastened. In other embodiments, several successive transverse rods are positioned before the transverse rods are fastened.

[0077] The transverse rods are preferably fastened to the longitudinal rods by welding. More specifically, rods are welded together at the points of contact between the rods.

[0078] In specific embodiments of the invention described herein, the positioning of the transverse rods comprises the unrolling, (straightening), aligning and cutting of the transverse rods from one or more rolls. In specific embodiments, the transverse rods come from the same roll. This is highly suitable for producing spacers which only use one type of transverse rod. When a single roll is used for the transverse rods, the positioning and fastening of the transverse rods takes place, for example, step by step, transverse rod per transverse rod.

[0079] In specific embodiments, the transverse rods come from two or more rolls. This has the advantage that different types of transverse rods can be used, for example transverse rods of different diameters. Accordingly, in specific embodiments of the method described herein, two or more transverse rods have a different diameter.

[0080] Adjacent transverse rods are usually placed at a distance of between 50 and 300 mm from one another, preferably between 50 and 200 mm, more preferably between 100 and 150 mm. In specific embodiments, the transverse rods are placed at regular distances apart. However, it is provided that in specific embodiments, specific adjacent transverse rods are placed closer together or further apart than other adjacent transverse rods.

[0081] The method described herein can be used for producing spacers in which the transverse rods do or do not project beyond the bottom longitudinal rods. In a preferred embodiment, the method is used to produce spacers in which the transverse rods do not project, or hardly at all. In specific embodiments, the transverse rods already have the desired length when they are being positioned, so that there is no overhang, or hardly any, of the transverse rods over the two peripheral longitudinal rods after the transverse rods have been fastened. In other embodiments, the transverse rods are longer, so that there is an overhang initially. In specific embodi-

ments, the method described herein thus furthermore comprises a step (c) which comprises cutting of transverse rod overhang over the peripheral longitudinal rods.

[0082] In a preferred embodiment, there is an initial overhang after the transverse rods have been positioned and the overhang is subsequently cut. This makes it possible to accelerate the production process, as the accurate positioning of an exactly dimensioned transverse rod usually requires more time than the accurate cutting of an overhang.

[0083] As has been described above, the longitudinal rods of the punching groove or punching grooves, together with the peripheral longitudinal rods, form the bottom longitudinal rods of the final spacers. In order to separate the spacers from one another, the transverse rods are cut and/or punched out between the adjacent horizontal longitudinal rods of each punching groove. In specific embodiments, the transverse rod portions within the punching grooves can be cut through or cut out. Cutting such a transverse rod portion may be effected by means of one or two cutting actions. Typically, a single cutting action is sufficient if the width of a punching groove is sufficiently small (at most 1 mm), so that the transverse rods project by less than 0.5 mm beyond the longitudinal rods after the cutting action. In the case of wider punching grooves, typically two cutting actions are required to prevent the transverse rods from projecting by more than 0.5 mm.

[0084] In specific embodiments, in the method described herein, the pieces of transverse rod between each pair of longitudinal rods forming a punching groove are punched out. The term "punch(ing) out" or "punch(ing)" is understood to mean that a transverse rod portion between two adjacent horizontal longitudinal rods of a punching groove is removed from the transverse rod by striking in a single operation. In that case, removal of a transverse rod portion does not comprise two separate cutting actions. This action may be regarded as being analogous to piercing or perforating, in which case an opening is produced in a panel.

[0085] The cutting and/or punching out is preferably carried out in such a manner that there is no overhang, or hardly any, after the cutting and/or punching-out operation of the transverse rods over the outer longitudinal rods of the resulting lattices and the spacers produced therefrom (see below). More specifically, the remaining overhang is at most 0.5 mm; preferably at most 0.2 mm; or at most 0.1 mm; or at most 0.05 mm. The cutting and/or punching out can be carried out in such a manner that transverse rods with straight ends and/or oblique ends are produced, as described above.

[0086] In specific embodiments, all transverse rod portions in the punching groove or punching grooves are cut or punched out. Cutting and/or punching results in two or more separate (flat) lattices which, in a subsequent step, are bent to form a spacer as described herein. In specific embodiments, each even or each odd lattice produced in step (d) is turned or turned over before bending, so that corresponding transverse rods of successive lattices are in each case situated on opposite sides of the lattices. As a result thereof, it is possible to stack the resulting spacers closer together on top of one another. Turning is usually effected by rotating the lattice about the transverse or longitudinal axis by 180°, but may also be effected by means of any desired combination of translational movements and/or rotations producing the same result. Preferably, the lattices are turned over after the longitudinal rods have been cut to the desired length.

[0087] In step (e), the lattices obtained in step (d) are bent. More specifically, the transverse rods of the (part) lattices are bent in an identical fashion, so that a U-shaped structure is produced. In a preferred embodiment, the transverse rods of each lattice are bent in two locations, more specifically, on either side of the central transverse rod of the respective lattice. Thus, it is possible to produce a spacer having a trapezoidal cross section.

[0088] As described above, the method described herein may comprise a further optional step (f), in which the central longitudinal rods are cut through at the desired length.

[0089] In an optional further step, the spacers can be stacked and tied together, preferably in packages of 10 to 50 spacers. Stacking and/or tying together may be carried out in a manual or mechanized manner.

[0090] In a subsequent aspect, the present invention provides the use of the spacer described herein as a construction element, more specifically, as a spacer for concrete reinforcements, such as reinforcement mats.

[0091] The present invention will be illustrated by means of the following non-limiting embodiments.

EXAMPLES

[0092] A production unit for carrying out a specific embodiment of the method described herein is configured to unroll six transverse rods from six rolls. By means of a guide station, the longitudinal rods are transported to an alignment station, where the rods are positioned parallel to each other in a plane.

[0093] The transverse rods are unrolled and cut off from a single roll and are positioned one by one perpendicular to the transverse rods and welded to the transverse rods in a welding station. This is typically carried out at a speed of approximately two transverse rods per second.

[0094] In this case, a continuous lattice (10) is obtained as illustrated in Fig. 1. The lattice (10) contains nine parallel longitudinal rods, including two peripheral longitudinal rods (2), and two pairs of adjacent longitudinal rods (3, 4, 5, 6), with each pair (3 and 4; 5 and 6) forming a punching groove. Central longitudinal rods (7) are provided between the punching grooves and between the peripheral longitudinal rods (2) and the adjacent longitudinal rods (3, 6) of the punching grooves. The distance between each pair of longitudinal rods which forms a punching groove is smaller than the other distances be-

tween the longitudinal rods. Thus, three strips (a, b, c) are created, with a spacer being created from each strip. The longitudinal rods (2, 3, 4, 5, 6, 7) are connected to each other by means of the transverse rods (8).

[0095] The lattice (10) is processed further in a first trimming line, in which the overhang of the transverse rods (8) over the peripheral longitudinal rods (2) is accurately cut off on both sides. The overhang of the transverse rods is indicated in Fig. 1 by the hatched rectangles (9). Subsequently, the transverse rod portions between the first pair of longitudinal rods (3, 4) which form a punching groove are punched out in a first punching station and the transverse rod portions between the second pair of longitudinal rods (5, 6) are punched out in a second punching station.

[0096] Subsequently, all longitudinal rods (2, 3, 4, 5, 6) except for the central longitudinal rods (7) are cut to the same distance in a cutting station. In this case, in each case three lattices are obtained, corresponding to the three strips (a, b, c), the lattices being connected to the continuous lattice (10) by means of continuous central longitudinal rods (7). The cutting of the longitudinal rods (2, 3, 4, 5, 6) makes it possible to bend the individual lattices in a press to form spacers (see below), while the continuous central longitudinal rods (7) ensure automatic transportation of the lattices at the production speed of the continuous lattice.

[0097] The lattices are transported to a press where they are bent to form a spacer (1), as illustrated in Fig. 2. The spacer (1) comprises a top longitudinal rod coming from one of the central longitudinal rods (7) of the continuous lattice (10); and two bottom longitudinal rods coming from the other longitudinal rods (2, 3, 4, 5, 6) of the continuous lattice (10). After bending, the central longitudinal rods (7) are cut to the desired length, so that the spacers (1) are separated from the continuous lattice (10).

[0098] Fig. 2A is a representation of a spacer (1) according to a specific embodiment of the present invention. The spacer (1) comprises three parallel longitudinal rods, more specifically a top longitudinal rod (7) and two bottom longitudinal rods (2, 3). The longitudinal rods (2, 3, 7) are connected by U-shaped transverse rods (8) which, in the unbent position, are arranged perpendicular to the longitudinal rods. There is no overlap of the transverse rods (8) beyond the bottom longitudinal rods (2, 3). Fig. 2B shows a spacer (11) known from the prior art, in which there is overlap of the transverse rods (8) beyond the bottom longitudinal rods (2, 3).

[0099] Fig. 3A shows a cross section of the spacer (1) illustrated in Fig. 2A. Fig. 3B shows a cross section of a similar spacer (12), which differs from the former in that the longitudinal rods in the spacer (12) in Fig. 3B are situated on the inside of the spacer (12), while the transverse rods in Fig. 3A are situated on the outer side of the spacer (1). The total angle α through which the transverse rods (8) are bent is preferably between 20° and 35°.

[0100] By alternately stacking the different spacers (1) and (12), the spacers (1, 12) can be stacked closer together than when spacers of the same type are stacked on top of one another.

[0101] The different spacers (1, 12) may be produced from the same lattice (10). In such embodiments, preferably all longitudinal rods (2, 3, 4, 5, 6, 7) are cut through. In this case, three lattices are produced, corresponding to the three strips (a, b, c), in which case the lattices are not connected to the continuous lattice (10). The lattices can then be bent to form spacers (1) as described herein. It is possible to turn over specific lattices before bending the lattices, for example all even or odd lattices, so that (alternately) spacers (1) are produced having the longitudinal wires on the outer side and spacers (12) having the longitudinal wires on the inner side, as described above.

[0102] In a last step, the spacers (1 and/or 12) are collected and tied together in a collecting station.

Claims

1. Method of producing spacers for concrete reinforcements and/or concrete structures, comprising:

(a) providing at least six parallel longitudinal rods in a plane, comprising

- two peripheral longitudinal rods;
- at least one punching groove consisting of a pair of mutually adjacent longitudinal rods;
- a central longitudinal rod between each peripheral longitudinal rod and the adjacent punching groove;
- if the longitudinal rods form two or more punching grooves, a central longitudinal rod situated between each pair of adjacent punching grooves; and
- optionally, one or more additional longitudinal rods situated between the peripheral longitudinal rods and outside the punching grooves;

(b) placing transverse rods perpendicular to the longitudinal rods on top of and/or under the latter, and fastening the transverse rods to the longitudinal rods, thus producing a lattice structure;
(c) optionally, cutting parts of transverse rods overhanging the peripheral longitudinal rods;
(d) punching out or cutting through the transverse rod portions between the adjacent longitudinal rods of the punching groove, thus producing two or more elongate lattices, each comprising three parallel longitudinal rods which are connected to each other by transverse rods which run perpendicular to and are laterally connected to the longitudinal rods; the transverse rods preferably not projecting or at most project-

ing 0.5 mm beyond the outer longitudinal rods; and

(e) bending the two or more elongate lattices, thus producing two or more spacers, each comprising three parallel straight longitudinal rods including two bottom longitudinal rods and a top longitudinal rod, connected to each other by U-shaped transverse rods which run perpendicular to and are laterally connected to the longitudinal rods; the transverse rods preferably not projecting or at most projecting 0.5 mm beyond the bottom longitudinal rods.

2. The method according to Claim 1, in which step (a) comprises unrolling and aligning at least six longitudinal rods in a plane; and in which

- the peripheral longitudinal rods;
- the longitudinal rods forming part of a punching groove; and
- if present, the additional longitudinal rods;

are cut to the desired length before performing step (e).

3. The method according to Claim 2, in which a separate roll is provided for each longitudinal rod.

4. The method according to Claim 2 or 3, in which the central longitudinal rods are cut to a desired length before performing step (e).

5. The method according to Claim 2 or 3, further comprising, after step (e):

(f) cutting the central longitudinal rods to a desired length.

6. The method according to one of Claims 1 to 4, in which step (e) further comprises turning each even or odd lattice produced in step (d).

7. The method according to one of Claims 1 to 6, in which step (e) comprises bending the transverse rods of the two or more elongate lattices in two locations, thus producing two or more spacers having a trapezoidal cross section.

8. The method according to one of Claims 1 to 7, in which step (b) comprises unrolling, aligning and cutting the transverse rods from one or more rolls.

9. The method according to one of Claims 1 to 8, in which the transverse rods of the spacers project at most 0.2 mm beyond bottom longitudinal rods.

10. The method according to one of Claims 1 to 9, in which the longitudinal rods form at least two strips which each contain three or more longitudinal rods, in which

- each pair of adjacent strips is separated by a punching groove; and
- at least two of the strips are of a different width.

11. The method according to one of Claims 1 to 10, in which the distance between the adjacent longitudinal rods of the punching groove is at most 10 mm.

12. Spacer for concrete reinforcements and/or concrete structures comprising three parallel straight longitudinal rods including two bottom longitudinal rods and a top longitudinal rod, connected to each other by U-shaped transverse rods which run perpendicular to and are laterally connected to the longitudinal rods; **characterized in that** the transverse rods do not project, or at most project 0.5 mm, beyond the bottom longitudinal rods.

13. The spacer according to Claim 12, in which the transverse rods of the spacer project at most 0.2 mm beyond bottom longitudinal rods.

14. The spacer according to Claim 12 or 13, in which the spacer comprises two or more transverse rods of different diameters.

15. Use of a spacer according to one of Claims 12 to 14 as a construction element.

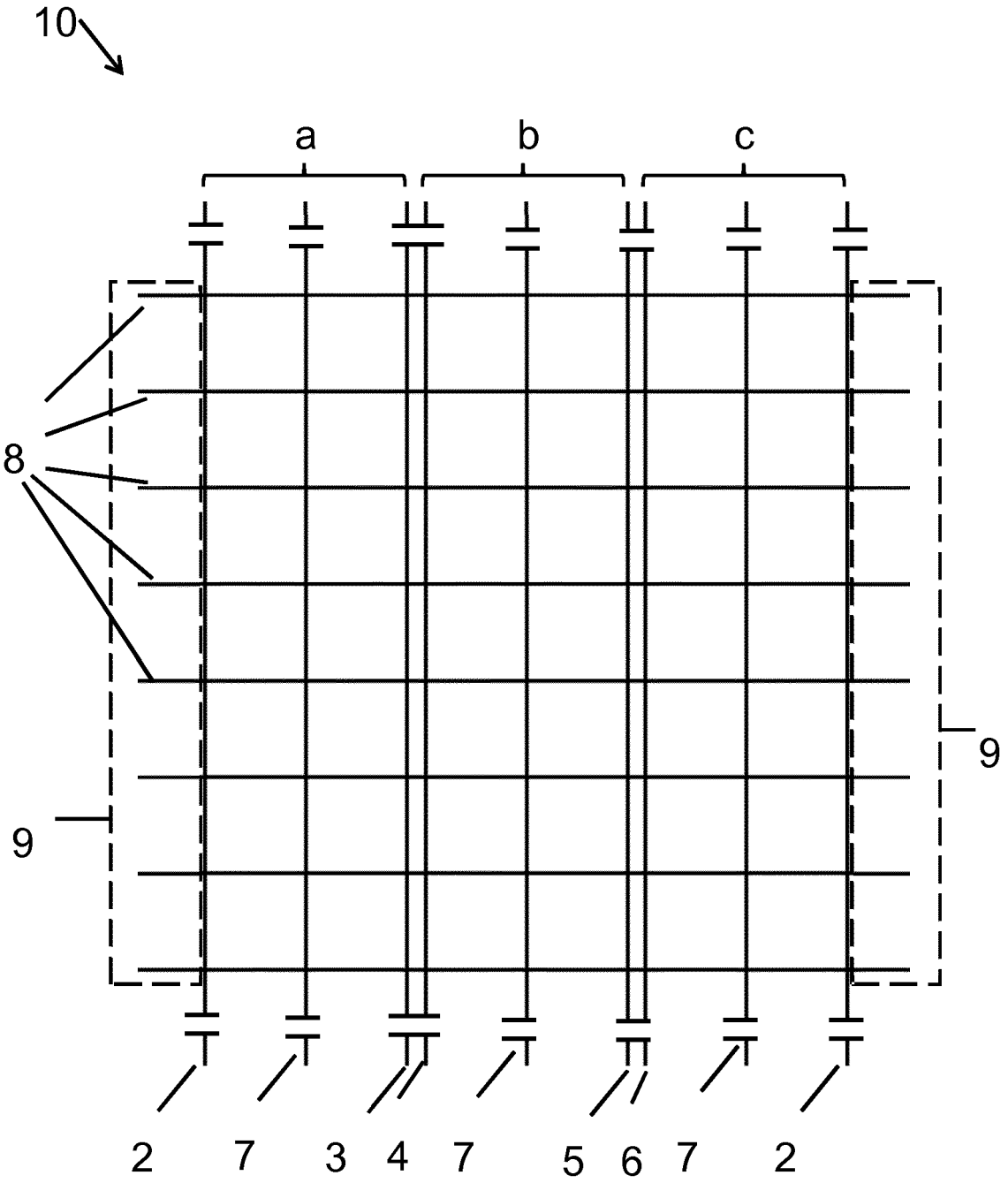

Fig. 1

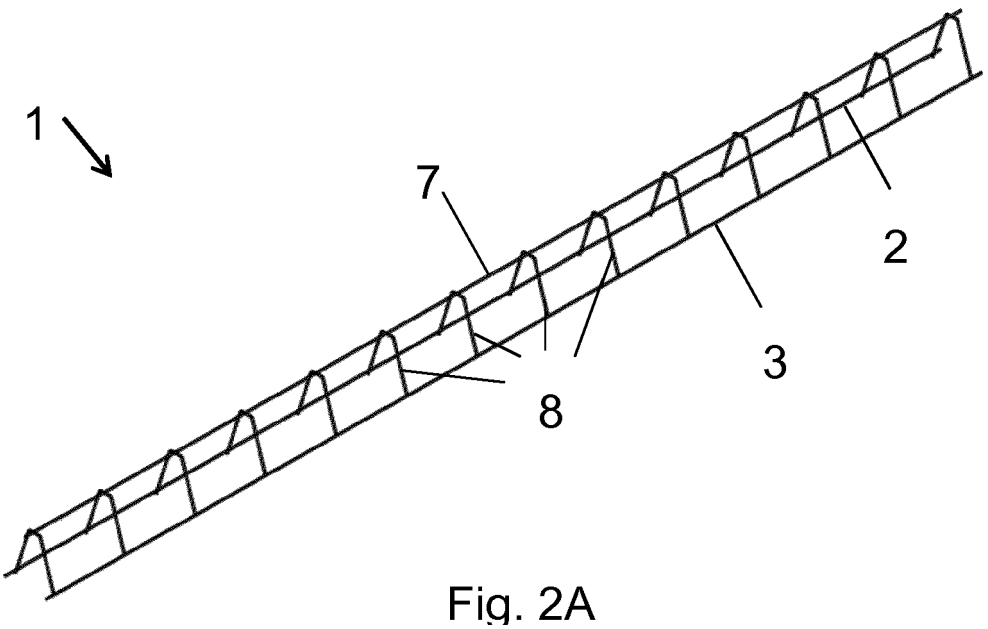

Fig. 2A

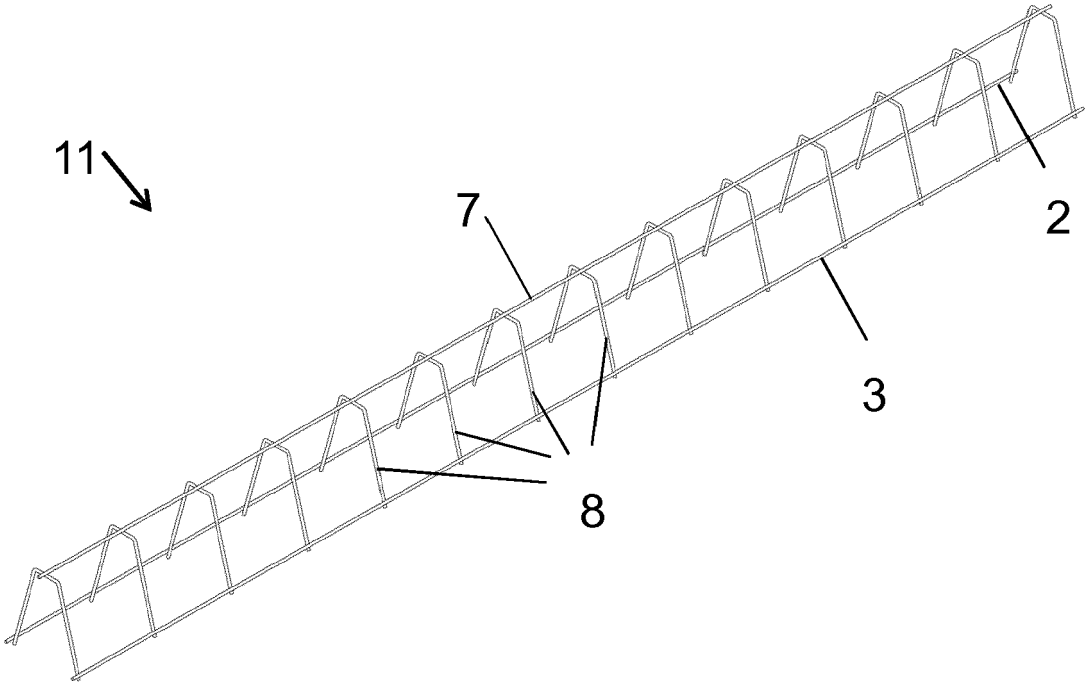

Fig. 2B

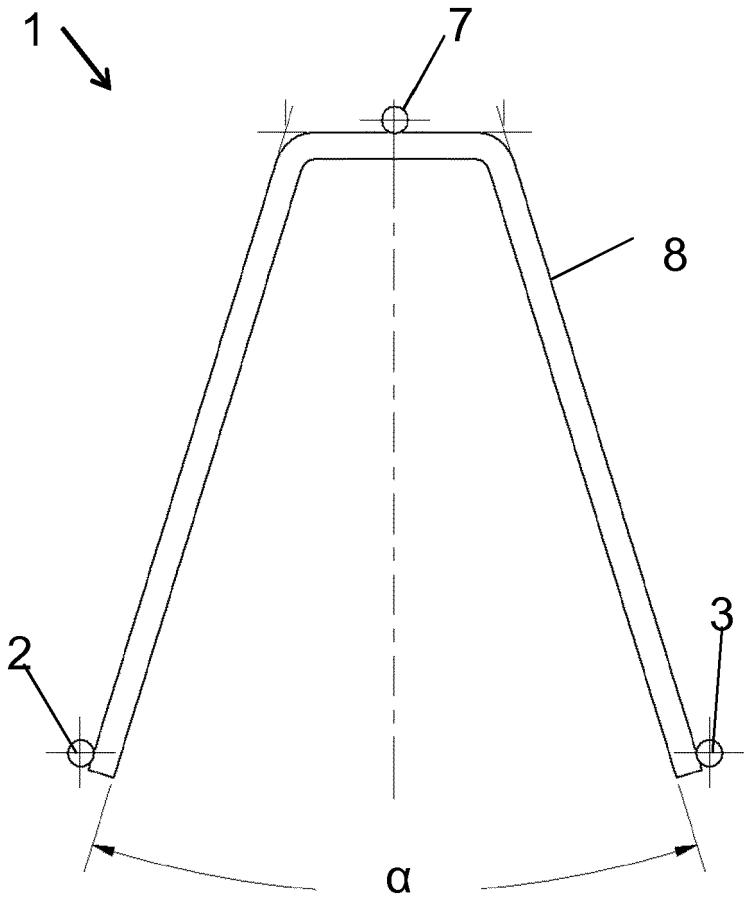

Fig. 3A

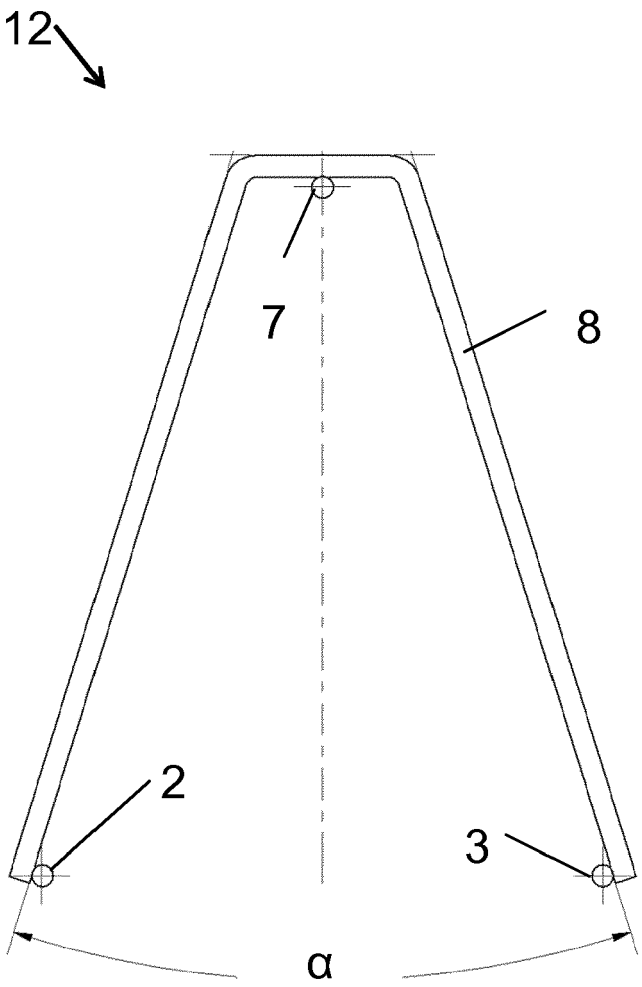

Fig. 3B

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EUROPEAN SEARCH REPORT

Application Number
EP 14 19 3221

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	FR 2 246 327 A1 (B. HERLIN) 2 May 1975 (1975-05-02)	12-15	INV. E04C5/18
A	* page 3, line 14 - line 24; figures *	1-11	E04C5/065 B21F27/20

X	DE 20 01 088 A1 (J. KRÜCKL.) 22 July 1971 (1971-07-22)	12-15	
A	* page 6, paragraph 1 - paragraph 2; figure 6 *	1-11	

A	AT 399 006 B (E. WENDL) 27 March 1995 (1995-03-27) * page 3, line 33 - line 40; figures 6,8 *	1-15	

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			E04C B21F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	29 May 2015	Righetti, Roberto

CATEGORY OF CITED DOCUMENTS

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29-05-2015

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