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

(11) **EP 2 538 017 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
**26.12.2012 Bulletin 2012/52**

(51) Int Cl.:
***E06C 1/38*** *(2006.01)* ***E06C 7/08*** *(2006.01)*
***E06C 9/02*** *(2006.01)*

(21) Application number: **12171167.5**

(22) Date of filing: **07.06.2012**

(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: **22.06.2011 IT BS20110091**

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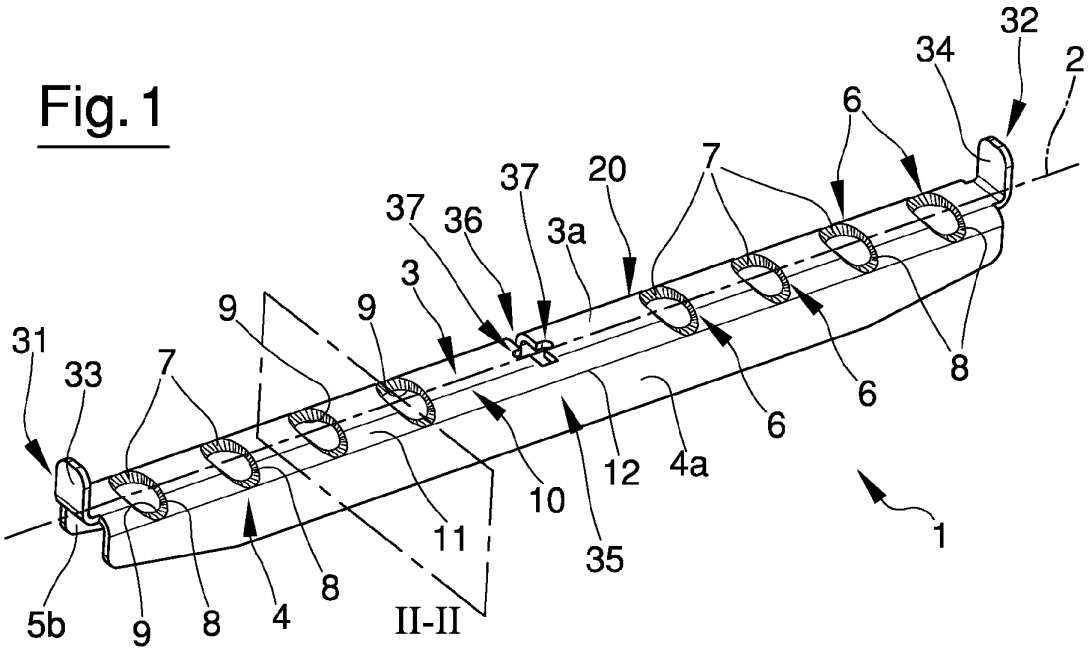
# (54) Fall prevention ladder and related method of production

(57) A fall-prevention ladder (100) comprising:
a single central stile (40) or a pair of lateral stiles, parallel to one another, destined to be fixed rigidly to a building structure;
a plurality of rungs (1) rigidly fixed to the central stile or lateral stiles, each rung having a substantially plate-shaped conformation and a longitudinal axis (2), the rung comprising a central wall (3), at least a first lateral wall (4) and a first bend (10) substantially parallel to the longitudinal axis interposed between, conjoining and demarcating, the central wall and the first lateral wall, where the rung is fixed to the stile or stiles by means of a respective weld (38) developing on at least a face of the two faces of the rung along at least a portion of the edge of the rung adjacent to the respective stile, and where each rung exhibits a pair of drain holes (37) passing through the central wall, the minimum distance of the edge of each drain hole from the stile that is closest being less than or equal to 3 cm.

Fig. 1




EP 2 538 017 A1

## Description

**[0001]** The present invention relates to the sector of safety fall-prevention systems destined for building structures. The present invention in particular relates to a rung for a fall-prevention ladder, the fall-prevention ladder comprising the rung, and a fall-prevention safety method and a production method of the ladder.

**[0002]** Fall-prevention ladders are known, suitable for being mounted permanently on building structures, which allow an operator to go up or down typically vertical routes safely, for example to gain access to roofs, towers, frames, poles, parts of buildings, pylons, chimneys, scaffolding and industrial equipment, or for access to depths, such as wells, pipelines, cisterns.

**[0003]** These fall-prevention ladders typically comprise a central fixed bar, to which the rungs are attached so that they protrude laterally from the bar, or a pair of side bars which extend between the rungs, and also comprise a fall-prevention rail typically associated with or coinciding with the central bar or one of the side bars. A fall-prevention carriage is associated to the fall-prevention rail, which rail comprises stop notches at regular intervals; in use, the operator anchors his individual safety cable (usually provided with a winder) or another suitable device connected to his harness, to his own safety carriage. The carriage is capable of sliding internally of the rail during the normal use of the ladder and stopping, should the operator fall, for example at one of said stop notches, thus preventing impact of the operator on the underlying structures or the ground. In this way the operator can proceed and work safely on the ladder, either when moving up or down it.

**[0004]** The Applicant has found that the rungs at present used for fall-prevention ladders, and the fall-prevention ladders too, are not free from drawbacks and can be improved in several respects.

**[0005]** In particular, the Applicant has found that the rungs for known fall-prevention ladders can exhibit rest surfaces that are slippery and not able, during the use of a ladder equipped with them, to effectively prevent operator slippage (typically the loss of adhesion between the operator's footwear and the rung) and prevent the operator from falling from the ladder.

**[0006]** The Applicant has also found that the known-type rungs for fall-prevention ladders may not be able to efficiently remove the dirt (e.g. earth, mud or other similar matter) typically clinging to the soles of an operator's shoes.

**[0007]** In general, the Applicant has found that rungs for fall-prevention ladders are characterized by a complexity of realization and/or installation and/or by a high implementation cost and/or by being large and/or heavy.

**[0008]** In this situation, the aim underpinning the present invention, in its various aspects and/or embodiments, is to provide a rung for fall-prevention ladders, a fall-prevention ladder comprising one or more of the said rungs and a fall-prevention safety method able to obviate one or more of the mentioned drawbacks.

**[0009]** In particular, one of the aims of the present invention is to provide a rung for fall-prevention ladders and a relative fall-prevention ladder that can increase the operator's foothold on the rung and effectively safeguard the operator from slipping and falling from the fall-prevention ladder, and at the same time is characterized by a simple structure and/or is easy to manufacture.

**[0010]** A further possible aim of the present invention is to provide a rung for fall-prevention ladders and a relative fall-prevention ladder that are sufficiently robust to operate in all operating conditions.

**[0011]** A further possible aim of the present invention in one or more of its various aspects is to disclose a rung for fall-prevention ladders, a fall-prevention ladder and a fall-prevention safety method that are more reliable and/or guarantee an operator a greater degree of safety during ascent or descent of building structures.

**[0012]** One or more of these aims, and possibly others besides, which will emerge from the following description, are substantially achieved by a rung for fall-prevention ladders, a fall-prevention ladder and a fall-prevention safety method, having the technical characteristics contained in one or more of the appended claims, each of which can be taken alone (without the relative dependent claims) or in any combination with the other claims, as well as according to the following aspects and/or example embodiments, variously combined, also with the above claims.

**[0013]** In an aspect the invention relates to a rung for fall-prevention ladders having a substantially plate shape and developing mainly along a longitudinal development axis, the rung comprising a central wall, at least a first lateral wall and a first bend, substantially parallel to said longitudinal development axis interposed between, conjoining and demarcating the central wall and the first lateral wall, the central wall and the first lateral wall being each provided with a respective external surface and a respective internal surface. In an aspect the rung comprises at least a through-hole passing through at least said central wall and defining an annular surface of the hole provided with an external edge on the side of the external surface and an internal edge on the side of the internal surface.

**[0014]** In an aspect said external edge of the hole extends up to the first bend and preferably not beyond the first bend.

**[0015]** In an aspect, the first bend comprises a respective curved external surface which connects the external surface of the central wall and the first lateral wall, said external edge extending up to a demarcating line of the external surfaces of the first bend and the first lateral wall, and preferably not beyond the demarcating line.

**[0016]** The Applicant believes that the combination of the above technical characteristics, in particular the presence of at least a hole passing through the central wall and defining an annular surface of the hole provided with an external edge that extends onto the first bend, enables

a rung for fall-prevention ladders to be obtained that is characterized by a tread surface (substantially coinciding with the external surface of the central wall and the first bend) having a greater adhesion and better grip for the shoes of an operator standing on the rung, such as effectively to prevent the operator from slipping and/or falling from the rung, and characterized, at the same time, by a structure that is simple, rational and easy and inexpensive to manufacture, for example by means of suitable cutting and bending of a single sheet-shaped element (e.g. a portion of sheet metal).

**[0017]** In fact, the external edge that extends onto the first bend necessarily creates a local sharp edge (i.e. with a subtended angle of less than 90°, preferably less than 60°) on which the sole of the shoe easily finds purchase. Moreover, the sharp edge does not involve any risk of cutting for the operator, as it is locally confined and at a lower height compared to the adjacent portions.

**[0018]** Further, the Applicant has observed how the external edge of the hole lying on the first bend realizes a dirt-scraper edge for the dirt clinging onto the soles of footwear, advantageously preventing dirt from accumulating on the tread surface, which can reduce the purchase of the footwear on the rungs.

**[0019]** In addition, the Applicant believes that the technical characteristics of the rung of the present invention enable an overall reduction in the size of the rest surface while maintaining the purchase offered by the rung to the operator's footwear; a rung and a relative fall-prevention ladder are obtained which are characterised by a smaller size and/or less use of material in the manufacturing thereof.

**[0020]** In an aspect said at least a through-hole exhibits a respective axis of the hole and at least a portion of the annular surface which is located in correspondence of the bend exhibits a line, on a section perpendicular to the longitudinal development axis, which line is inclined with respect to the hole axis. Preferably, the minor angle formed between the hole axis and said section line, taken on the section on which the external edge of the hole has the largest size among all the perpendicular sections (hereinafter referred to as "maximum cross-section of the hole"), is greater than or equal to 15°, preferably greater than or equal to 30°, more preferably greater than or equal to 45°, for example about 65°.

**[0021]** In an aspect, with reference to the maximum cross-section of the hole, the external edge of the hole lies in the space comprised between the (substantial) lie planes of the internal and external surface of the first wall, and preferably lies on the lie plane of the external surface of the first wall.

**[0022]** In an aspect the external edge has a size, in any section perpendicular to said longitudinal development axis, that is greater than the respective size of the internal edge.

**[0023]** In an aspect the maximum size (e.g. diameter) of the internal edge of the through-hole is greater than or equal to 2cm, preferably greater than or equal to 3 cm, and/or less than or equal to 5cm, preferably less than or equal to 4cm.

**[0024]** In an aspect the rung includes a second lateral wall and a second bend substantially parallel to said longitudinal development axis, on the opposite side to said first bend with respect to the central wall, interposed between, conjoining and demarcating the central wall and the second lateral wall, the second lateral wall being provided with a respective external surface and a respective internal surface facing the internal surface of the first wall.

**[0025]** In an aspect the second lateral wall, the second bend and the annular surface of the hole at the second bend have the same technical characteristics as specified above for, respectively, the first lateral wall, the first bend and the annular surface of the hole at the first bend.

**[0026]** In an aspect said external edge of said at least a through-hole extends up to the second bend and, preferably, not beyond it. The Applicant believes that the presence of the first and second lateral walls at the sides of the central wall advantageously enables a structurally sturdy rung to be obtained for fall-prevention ladders, able to withstand high static weights and also to withstand the high-intensity dynamic stresses connected to different conditions of use of a fall-prevention ladder. In fact, a U-shaped transversal section is able to effectively withstand traction stress, torsion stress, shear stress and bend stress. Further, a rung structured having the said walls enables a reduction in the thickness and the use of material used while obtaining the necessary level of mechanical resistance. Also, the technical characteristic according to which the external edge extends also onto the second bend leads to obtaining a further local sharp edge (in addition to the previously mentioned sharp edge on the first bend) on which the sole of the shoe can easily gain purchase and and on which adherence and/or cleaning by scraping of the operator's shoes on the rung can be performed.

**[0027]** In an aspect the annular surface of said hole, with reference to the maximum cross-section, forms, with the tangent to the external surface of the first and/or the second bend, or with the external surface of the first and/or second lateral wall, a respective minor angle of less than or equal to 90°, preferably less than or equal to 60°.

**[0028]** In an aspect, the central wall and/or the first and/or the second wall are substantially flat.

**[0029]** In an aspect said second bend is substantially identical to said first bend. In an aspect the first and second lateral walls extend in a parallel fashion. In an aspect said first and second lateral walls are substantially identical.

**[0030]** In an aspect, the rung has a longitudinal plane of symmetry lying on the longitudinal development axis and on the axis of said at least a hole and/or a plane of symmetry perpendicular to the longitudinal development axis arranged in a median position along said longitudinal axis.

**[0031]** In an aspect (the external edge of the annular

surface of) the through-hole is substantially symmetrical with respect to said longitudinal plane of symmetry.

**[0032]** In an aspect the rung comprises a plurality of said through holes, each having the technical characteristics specified above for said at least a hole. In an aspect, the rung comprises at least four through-holes, preferably at least six, for example at least eight. Preferably the holes are aligned along said longitudinal development axis.

**[0033]** In an aspect the rung is provided with a first end and a second end, opposite the first end along said longitudinal development axis.

**[0034]** In an aspect said first and second ends are destined to be fixed, for example by means of a respective welding or respective fastening means, to a respective stile of a fall-prevention ladder.

**[0035]** In an alternative aspect, the rung comprises a fastening portion, longitudinally interposed between said first and second end (preferably in an equidistant position from said first and second end), destined to be fastened, e.g. by a respective welding or the respective fastening means, to a central stile of a fall-prevention ladder, said first and second end preferably being free.

**[0036]** In an aspect the rung (preferably the fastening portion) comprises a notch passing through the entire thickness of the rung, preferably extending perpendicularly to the longitudinal axis. The notch preferably extends up to a perimeter edge of the rung (being continuous with it). Preferably the notch extends along the entire central wall and/or the entire first lateral wall.

**[0037]** In an aspect the invention relates to a fall-prevention ladder comprising:

- at least a stile having a main development along a vertical development axis and destined to be rigidly fixed to a portion of a building structure,
- a plurality of rungs according to one or more of the embodiments described and/or claimed herein,

where the rungs of said plurality are rigidly fixed to said at least a stile such as to be made mutually solidly constrained thereto, each rung having the respective longitudinal development axis thereof arranged transversally (preferably perpendicular) to the vertical development axis of the stile.

**[0038]** In an aspect the ladder comprises said at least a stile and a further stile as lateral stiles and each of said first and second ends of the rung is fixed to a respective lateral stile. In an alternative aspect the ladder comprises said at least a stile as a single central stile and said fixing portion is fastened to the central stile.

**[0039]** In an aspect the central stile is a T-shaped beam.

**[0040]** In an aspect the rung and/or the central stile or the two lateral stiles are made of metal, for example an alloy containing aluminium (preferably oxidized) or iron (preferably galvanised), including steel (stainless steel).

**[0041]** In an aspect the rung is secured to said central stile or the said lateral stiles by means of a respective welding extending on at least one of the two faces of the rung along at least a respective edge portion of the rung adjacent to (in contact with) said central stile or said respective lateral stile.

**[0042]** In an aspect each rung exhibits a pair of drain holes, preferably circular, passing through (only) the central wall. Preferably each hole of the pair of drain holes has a maximum dimension (e.g. diameter) of less than 2cm, more preferably less than or equal to 1 cm and/or greater than or equal to 2mm, more preferably greater than or equal to 4mm. Preferably the minimum distance of the edge of each drain hole from the nearest stile is less than or equal to 3 cm, more preferably less than or equal to 2cm, even more preferably less than or equal to 1.5cm.

**[0043]** In an aspect each rung comprises said notch which is engaged by a portion of said central stile, preferably a portion of the stile having a flat sheet conformation the rung being fixed to said central stile by a weld (between rung and stile) extending on at least one of the two faces of the rung along at least a portion of the edge of the notch, preferably along at least two portions of the edge of the notch arranged on opposite sides of the stile portion. In an aspect the drain holes are arranged on opposite sides of the notch. Preferably the minimum distance of the edge of each drain hole from the edge of the said notch is less than, or equal to 3 cm, preferably 2cm.

**[0044]** In an aspect the above first and second ends are welded to the respective lateral stile and the drain holes are arranged respectively at the first and second ends. Preferably the minimum distance of the edge of each drain hole from the edge of the respective proximal end is less than or equal to 3 cm, preferably 2cm.

**[0045]** In an aspect the said minimum distance is strictly greater than zero, preferably greater than or equal to 0.5cm, more preferably greater than or equal to 0.8cm.

**[0046]** In this case the ladder lends itself effectively to a galvanizing process (e.g. in the case of iron) or oxidation (e.g. in the case of aluminium) in an electrolytic bath, in that the liquid used in the electrolytic bath is sufficiently fluid to be able also to wet, thanks to the presence of the pair of holes, even the space (relatively closed), in proximity of the internal surface of the central wall and the stile (which is typically free of through-openings) and/or able to flow out of the space.

**[0047]** In particular when the rung and the stile/s are made of iron (or an alloy based on iron), the welding between the rung and the central stile, or lateral stiles, is preferably continued on both faces of the rung and along the whole edge of the notch or, respectively, along the entire contact edge between the respective end of the rung and the respective stile.

**[0048]** In this case the ladder can effectively be subjected to a process of electrolytic galvanising, since the continuous weld (made possible by the above-mentioned distance of the drain holes) closes all the interstices between the rung and the stile (which interstices would

prove difficult to be penetrated by the electrolytic galvanising bath).

**[0049]** In an aspect the said minimum distance is zero, i.e. in other words, the hole is continuous with the notch or with the end edge of the rung.

**[0050]** In an aspect the distance between the axis (centre of gravity) of each drain hole and the nearest beam is smaller than a radius of the hole. Preferably the distance between the axis and the stile is strictly greater than zero (i.e. the axis does not fall on the stile), more preferably greater than or equal to one third of the radius of the hole, still more preferably greater than or equal to half the radius of the hole. The weld between the rung and the stile is preferably not exhibited at each drain hole (and thus develops discontinuously at the sides of each hole). The welding is preferably developed on a single face of the rung, for example the face that is the external surface of the central wall and first lateral wall. In this case the ladder can effectively be subjected to a hot-dip galvanizing bath process or, in this case too, oxidation in an electrolytic bath, since the interstices existing between the rung and the stile are penetrated (and/or sealed) by the hot-dip galvanizing bath or electrolytic oxidation. At the same time, the liquid used in the hot-dip galvanizing bath, despite its viscosity (generally greater than that of the liquid of the electrolytic galvanizing bath), is also able, thanks to the pair of through-holes located adjacent to the stile/s, to wet the above-mentioned space in proximity of the internal surface of the central wall and the stile and/or drain from the space. In the case of electrolytic oxidation, which typically has a lower viscosity than the bath of hot-dip galvanizing, the drain holes allow the desired draining of the liquid.

**[0051]** In an aspect the invention relates to the above building structure provided with one or more of the fall-prevention ladders.

**[0052]** In a further aspect the invention relates to an fall-prevention safety method comprising steps of:

- providing the fall-prevention ladder of the present invention,
- installing said ladder on a building structure, such that said at least a stile is attached to said building structure and said rungs protrude from the building structure and are accessible to an operator.

**[0053]** In a further aspect the invention relates to a use of the rung in accordance with the present invention in a fall-prevention ladder.

**[0054]** In an aspect the invention relates to a method of manufacturing a rung for fall-prevention ladders, for example in accordance with the present invention, comprising steps of:

- predisposing a flat sheet;
- cutting, for example by laser cutting, said flat sheet so as to obtain a blank of the rung having a longitudinal development axis, for example corresponding to said axis of development of the rung;
- making in the blank at least a through-hole or a plurality of through holes aligned along said longitudinal axis;
- bending the blank along at least a first bend line substantially parallel to said longitudinal development axis and intersecting said through-hole or plurality of through-holes along a line having a smaller of the two maximum distances from the edge of the hole comprised between zero and three times the thickness of the sheet, preferably between zero and twice, more preferably between zero and once, for example a half of once.

**[0055]** In this way the rung of the present invention can be obtained in a simple and economic way. Furthermore, this method is highly repeatable and lends itself advantageously to automation.

**[0056]** In an aspect the bending step comprises the step of bending along a second bend line, distinct and separate from the first bend, substantially parallel to said longitudinal development axis and intersecting said through-hole or plurality of through-holes along a line, diametrically opposite the line relating to the first bend and symmetrical thereto.

**[0057]** In an aspect the invention relates to a production method of a fall-prevention ladder, preferably in accordance with any embodiment described herein, comprising steps of:

- predisposing at least a stile (for example according to any embodiment described herein);
- providing a plurality of rungs in accordance with any embodiment described herein, each rung exhibiting said pair of drain holes in the various embodiments described herein;
- locating the rungs (preferably equally spaced) on the central stile so that a respective portion of said stile engages each notch, or locating the rungs between the two lateral stiles so that said first and second end of each rung is in abutment with a respective lateral stile, and securing the rung to said stile/s by means of a weld extending on at least one of the two faces of the rung along at least a portion of the edge of the rung adjacent to the respective stile;
- galvanizing the entire ladder thus-obtained by electrolytic galvanizing or hot-dip galvanizing or by electrolytic oxidation.

**[0058]** In an aspect, when the ladder is made of an iron-based material, the ladder is galvanized with electrolytic galvanizing and the said minimum distance is strictly greater than zero, preferably greater than or equal to 0.5cm, more preferably greater than or equal to 0.8 cm.

**[0059]** In an aspect, when the ladder is made of an iron-based material, the ladder is galvanized in a hot-dip galvanising bath and said minimum distance is zero.

**[0060]** In an aspect, when the ladder is made of an

aluminium-based material, the ladder is oxidized in an electrolytic bath and said minimum distance is zero.

**[0061]** Further characteristics and advantages will more fully emerge from the detailed description of some embodiments, including a preferred embodiment, made by way of non-exclusive example, of a rung for fall-prevention ladders and a fall-prevention ladder, according to the present invention. This description will be set out herein below with reference to the accompanying drawings, provided merely by way of non-limiting example and in which:

figure 1 is a perspective view of a possible embodiment of a rung in accordance with the present invention;
figure 2 is a section view of the rung of figure 1, sectioned along the maximum cross-section plane II-II;
figure 3 is a perspective view of a possible embodiment of a fall-prevention ladder, according to the present invention, comprising a plurality of the rungs of figure 1;
figure 4 shows an enlarged detail of figure 3 from a different view-point;
figure 5 shows a detail of a variant embodiment of a fall-prevention ladder, according to the present invention.

**[0062]** With reference to the attached figures, a rung for fall-prevention ladders according to the present invention is denoted in its entirety by reference number 1 and a fall-prevention ladder according to the present invention is generally denoted by reference number 100. In general, the same reference number is used for the same elements, including possibly in their different embodiments.

**[0063]** The rung 1 for fall-prevention ladders has a substantially plate-shaped conformation and a main longitudinal development along a longitudinal development axis 2, and includes a central wall 3, at least a first lateral wall 4 and a first bend 10, substantially parallel to the longitudinal development axis, interposed between the central wall and the first lateral wall. The bend conjoins and demarcates, i.e. separates, in the imaginary sense, the central wall from the first lateral wall. The central wall and the first lateral wall are each provided with a respective external surface 3a, 4a and a respective internal surface 3b, 4b. The rung further comprises at least a hole 6 passing at least through the central wall 3 and defining an annular surface 7 of the hole provided with an external edge 8 at the side of the external surface and an internal edge 9 at the side of the internal surface, and the external edge of the hole extends up to the first bend 10 and, preferably, not beyond it.

**[0064]** Note that the existence of the bend means that the central wall and the first lateral wall do not lie on a same plane.

**[0065]** The first bend preferably comprises a respective curved external surface 11 which connects the external surfaces of the central wall and the first lateral wall, and the external edge extends to said external surface 11, and preferably extends to a demarcation line 12 of the external surfaces of the first bend and the first lateral wall.

**[0066]** The through hole 6 preferably has a respective axis of the hole and at least a portion of the annular surface 7 which is located at the first bend 10 and has a line, on a section perpendicular to the longitudinal axis, that is inclined to the axis of the hole, as shown by way of example in the maximum section of figure 2. By way of example, the minor angle formed between the hole axis and the section line, taken on the section on which the external edge 8 of the hole has the largest size among all the perpendicular sections (hereinafter referred to as "maximum cross-section of the hole"), is about 65°.

**[0067]** With reference to the maximum cross-section of the hole, the external edge of the hole 8 preferably lies in the space comprised between the lie planes of the internal surface 4b and the external surface 4a of the first lateral wall 4, and preferably lies on the lie plane of the external surface of the first wall. By lie plane is meant the plane on which the respective surface substantially lies.

**[0068]** Preferably the external edge 8 has a dimension, in any section perpendicular to said longitudinal axis, that is greater than the respective size of the internal edge 9.

**[0069]** As shown by way of example in the figures, the rung 1 preferably comprises a second lateral wall 5 and a second bend 20 substantially parallel to the longitudinal development axis 2, on the opposite side to the first bend 10 with respect to the central wall 3, interposed between, conjoining and demarcating the central wall and the second lateral wall, the second lateral wall being provided with a respective external surface 5a and a respective internal surface 5b facing the internal surface 4b of the first wall. The external edge of the said at least one through-hole preferably extends up to the second bend 20 and, preferably, not beyond it.

**[0070]** The annular surface of the hole, with reference to the maximum cross-section, preferably forms, with the tangent to the external surface of the first and/or the second bend, or with the external surface of the first and/or second lateral wall, a respective minor angle having a size smaller than or equal to 90°, preferably smaller than or equal to 60°.

**[0071]** Preferably, as shown by way of example in the figures, the central wall and/or the first and/or the second wall are substantially flat.

**[0072]** When the rung comprises the central wall 3 and the first lateral wall 4, the transversal section thereof, i.e. on a plane perpendicular to the longitudinal development axis 2, is preferably in an "L" shape and, when the rung comprises the central wall and the first and the second lateral wall 5, the transversal section thereof is "U" shaped.

**[0073]** The second bend is preferably substantially identical to the first bend. The first 4 and the second lateral wall 5 preferably extend parallel to one another. The first

and second lateral walls are preferably substantially identical.

**[0074]** The rung preferably has a longitudinal plane of symmetry lying on the axis of the longitudinal development axis 2 and on the axis of the at least a hole and/or a plane of symmetry perpendicular to the longitudinal development axis arranged in a median position along the longitudinal development axis.

**[0075]** The external edge 8 of the annular surface 7 of the through-hole 6 is preferably substantially symmetrical with respect to said longitudinal plane of symmetry.

**[0076]** The rung is preferably made by cutting and bending a metal sheet.

**[0077]** The rung 1 preferably comprises a plurality of through-holes 6, each having the technical characteristics specified above for the said at least a hole. The rung preferably includes at least four through-holes, preferably at least six, for example at least eight.

**[0078]** The rung preferably has a thickness, preferably constant, comprised between 1mm and 10mm, by way of example approximately 3mm for a rung made of iron and about 5 mm for a rung made of aluminium.

**[0079]** The rung preferably has a total length, in a parallel direction to the longitudinal development axis, greater than or equal to 15cm, preferably greater than or equal to 30cm, still more preferably greater than or equal to 50cm. The rung preferably has a width in the perpendicular direction to the longitudinal axis (e.g. corresponding to the width of the central wall) greater than or equal to 3 cm, more preferably greater than or equal to 4cm, and/or less than or equal to 10cm, more preferably less than or equal to 7cm.

**[0080]** The first bend 10 is preferably shaped such that the external surface (respectively the internal surface) of the central wall is perpendicular to the external surface (respectively the internal surface) of the first and/or the second lateral wall. The rung preferably has a first end 31 and a second end 32, opposite the first end along the longitudinal development axis 2.

**[0081]** In an embodiment that is not illustrated, the first and second ends are preferably destined to be fixed, for example by means of a respective weld or the respective fastening means, to a respective lateral stile of a fall-prevention ladder. Alternatively, as shown in the embodiments of the figures, the rung comprises a fixing portion 35, longitudinally interposed between the first 31 and the second end 32 (preferably in an equidistant position from the first and second end), destined to be fixed, for example by a respective weld or the respective fastening means, to a central stile 40 of a fall-prevention ladder, said first and second ends being free.

**[0082]** The fastening portion preferably includes a notch 36 (for example obtained by cutting the sheet) passing through the entire thickness of the rung, with development that is perpendicular to the longitudinal axis. The notch preferably extends up to a perimeter edge of the rung and is continuous with it. In an alternative embodiment (not shown), the notch may develop completely within the perimeter of the rung without points of continuity with its perimeter edge. In the example of the figures the notch 36 extends along the entire second lateral wall 5 and is continuous with the peripheral edge of the second lateral wall opposite the bend. However, in an embodiment (not shown) in which the rung comprises only the first lateral wall, the notch can only develop on the central wall (possibly also on the bend) and is continuous with the peripheral edge of the central wall.

**[0083]** As shown by way of example in the figures, the rungs comprise four holes in the portion between the first end and the fastening portion, and similarly, four holes in the portion between the fastening portion and the second end.

**[0084]** The first 31 and/or the second end 32 preferably comprise a respective stop element 33, 34. The stop element is structured such as to prevent, in use, the operator's shoe resting on the rung from lateral separation from the rung itself (e.g. by sliding on the tread surface). In fact, in a case where the operator's shoe is slipping laterally (i.e. along a direction parallel to the longitudinal development axis), this stop element blocks the lateral movement of the shoe, keeping it on the rung.

**[0085]** The respective stop element preferably comprises a stop wall extending from the external surface 3a of the central wall 3 and arranged perpendicular to the longitudinal development axis 2. The stop wall preferably extends from the external surface of the central wall to a height of greater than or equal to 10mm, preferably greater than or equal to 20mm.

**[0086]** The rung and the stile or stiles can be made for example of oxidized aluminium or galvanized iron.

**[0087]** Figure 3 shows a possible embodiment of a fall-prevention ladder 100 in accordance with the present invention. The ladder 100 comprises a stile 40 (for example a T beam), having a main development along a vertical development axis 41 and destined to be rigidly constrained to a portion of a building structure, and a plurality of rungs 1 rigidly constrained to the stile so as to be mutually solidly constrained. Each rung 1 preferably has the respective longitudinal development axis 2 arranged transversally (preferably at right angles) to the vertical development axis 41 of the stile.

**[0088]** The rungs 1 are preferably fixed to the said stile 40 at said fixing portion 35, for example by welding or by means of suitable fastening means. In this way the fall-prevention ladder assumes a "double rung" conformation i.e. each of said rungs extending from both sides of the stile at a respective height in the development of the ladder. In a possible alternative embodiment (not shown), the ladder comprises a further stile arranged parallel to said stile and the rungs are fixed with the respective first end to the stile and with the respective second end to the further stile, for example by a respective weld or by means of respective fastening means. In this case the fall-prevention ladder assumes a "double stile" configuration.

**[0089]** As shown by way of example in figure 3, the

rungs of the plurality of rungs are preferably fixed to said stile with the respective longitudinal development axes all parallel to one another. The rungs of the plurality of rungs are preferably fixed to the stile with a constant distance between two successive rungs, for example between 10cm and 40cm, along the vertical development axis 2.

**[0090]** A portion 43 (such as a portion having a flat sheet conformation) of the stile preferably engages the notch 36 of each rung, which is fixed to the stile by a weld 38 (shown by way of example in figures 4 and 5) extending on at least one of two faces of the rung (corresponding to the internal and external surfaces), along at least two portions of the edge of the notch arranged on opposite sides of the portion 43 of stile.

**[0091]** Each rung preferably has a pair of drain holes 37, preferably circular (but they can have any shape), passing (preferably only) through the central wall and arranged on opposite sides of the notch. Each hole has, for example, a maximum size (e.g. diameter) of 6mm.

**[0092]** In an embodiment (as shown by way of example in figure 5) the minimum distance of the edge of each drain hole from the edge of the notch is strictly greater than zero (hole 37 noncontinuous with the notch), for example about 1cm. The weld 38 between the rung and the stile preferably develops continuously along the whole edge of the notch on both the faces of the rung. Note that the rung shown in figure 5 is entirely similar to the rung shown in figures 1 and 4, with the exception of the drain holes 37.

**[0093]** In an alternative embodiment (as shown by way of example in figures 1 and 4) the said minimum distance is zero, i.e. in other words, the hole is continuous with the notch. By way of example the (minimum) distance between the axis (centre of gravity) of each drain hole and the stile is smaller than a radius of the hole, for example between about two-thirds and three quarters of the radius of the hole. The weld 38 between the rung and the stile is preferably not present at the pair of holes (thus it develops discontinuously at the sides of each hole). The welding preferably extends on a single face of the rung, such as the face corresponding to the external surface of the central wall and the first lateral wall.

**[0094]** The stile 40 (and/or the above further stile) preferably comprises a rail schematically denoted by number 42 (for example having a shape of a flat sheet portion of the stile 40 perpendicular to the said portion 43 inserted into the notches 36) structured such as to be able to accommodate a safety carriage, and to enable sliding of the carriage internally of the rail, the safety carriage being associated with an individual safety cable (typically equipped with a winder) of an operator, or another suitable device, typically connected to the operator's harness.

**[0095]** The said carriage and rail enable the operator to anchor himself to the fall-prevention ladder and at the same time to move up and down the ladder in ascent and descent. In this way the operator can proceed on the ladder in a state of safety. The stile 40 preferably has a preferably constant thickness of between 1mm and 10mm, for example of about 3mm.

**[0096]** The fall-prevention ladder 100(or the said stile 40) preferably has a total height, in a direction parallel to the axis of vertical development, of preferably between 50cm, preferably 100cm, and 700cm, preferably 500cm.

**[0097]** The fall-prevention ladder preferably includes two or more of the above stiles, each in a single piece, each bearing the respective rungs, fixed in succession with coinciding respective vertical development axes, in such a way as to form a single assembly stile. In the case of a double-stile ladder, the fall-prevention ladder includes two or more of the above stile and further stile, bearing the respective rungs, fixed in succession with coinciding respective vertical development axes, in such a way as to form a single stile and a single further stile of the assembly.

**[0098]** The stile is preferably complementarily shaped to a portion of the building structure, in such a way as to follow the development thereof. By way of example, the vertical development axis of the stile may be curved so as to follow the curvature of a building structure (e.g. a curved wall).

**[0099]** The fall-prevention ladder 100 preferably includes assembly organs 45 structured such as to rigidly secure the ladder to the building structure above. These bodies preferably comprise one or more fastening flanges 46 and screws or bolts structured such as to secure each flange to the building structure and the stile to each flange.

**[0100]** By way of example, as shown in figure 3, the assembly organs comprise a base 47 structured to fasten and support the ladder inferiorly to the building structure.

**[0101]** The ladder, for example, the rungs and/or the stiles and/or the assembly organs, are preferably made of metal, for example an alloy containing aluminium or iron, preferably steel, more preferably stainless steel or galvanized steel.

## Claims

**1.** A fall-prevention ladder (100) comprising:

a single central stile (40), destined to be fixed rigidly to a building structure;
a plurality of rungs (1) rigidly fixed to said central stile,
each rung having a substantially plate-shaped conformation and
a main development along a longitudinal axis (2), the rung comprising a central wall (3), at least a first lateral wall (4) and a first bend (10) substantially parallel to said longitudinal axis, the bend being interposed between,
conjoining and demarcating, the central wall and the first lateral wall, the central wall and the first

lateral wall being each provided with a respective external surface (3a, 4a) and a respective internal surface (3b, 4b),
where the rung is fixed to said stile by means of a respective weld (38) developing on at least a face of two faces of the rung along at least a portion of the edge of the rung adjacent to the central stile, and
where each rung comprises a notch (36) passing through a whole thickness of the rung, which notch is engaged to a portion (43) of said central stile.

**2.** The ladder according to claim 1, wherein each rung exhibits a pair of drain holes (37) passing through the central wall and where the drain holes are arranged on opposite sides of the notch.

**3.** The ladder of claim 2, where the minimum distance of the edge of each drain hole from the stile is less than or equal to 3 cm, preferably 2 cm.

**4.** The ladder according to any one of the preceding claims, where said minimum distance is strictly greater than zero, preferably greater than or equal to 0.5 cm.

**5.** The ladder according to the preceding claim, where the weld develops continuously on both faces of the rung along a whole contact edge between the rung and each stile.

**6.** The ladder according to any one of claims from 1 to 3, where said minimum distance is zero.

**7.** The ladder according to claim 6, where the weld is not present at the pair of holes and develops preferably on a single face of the rung.

**8.** A production method of a fall-prevention ladder according to any one of the preceding claims, comprising steps of:

predisposing said central stile (40);
predisposing said plurality of rungs;
locating the rungs on the central stile such that a portion (43) of said stile engages a notch of each rung, and welding each rung to the stile by means of the weld (38);
galvanising or oxidising the whole ladder thus obtained with an immersion process of the ladder in a bath.

**9.** The method according to claim 8, the ladder being according to claim 4 or 5, where the ladder is made of an iron-based material and is galvanised in an electrolytic bath.

**10.** The method according to claim 8, the ladder being according to claim 6 or 7, where the ladder is made of an iron-based material and is galvanised in a hot bath, or where the ladder is made of an aluminium-based material and is oxidised in an electrolytic bath.

Fig. 1

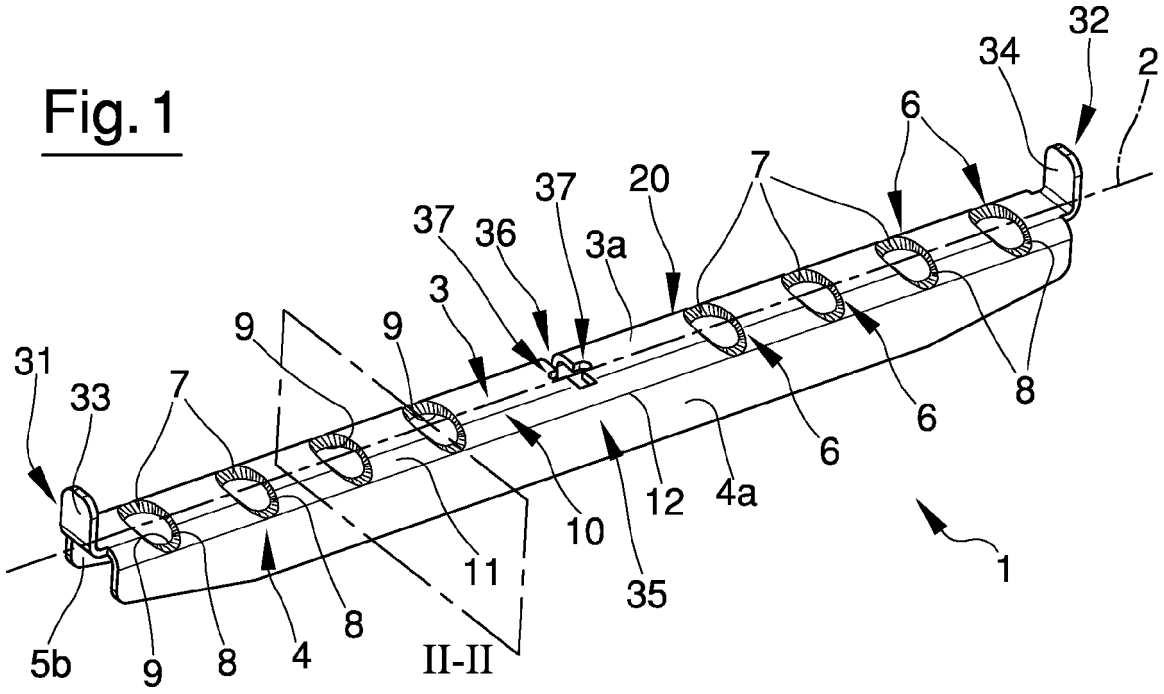

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Fig. 2

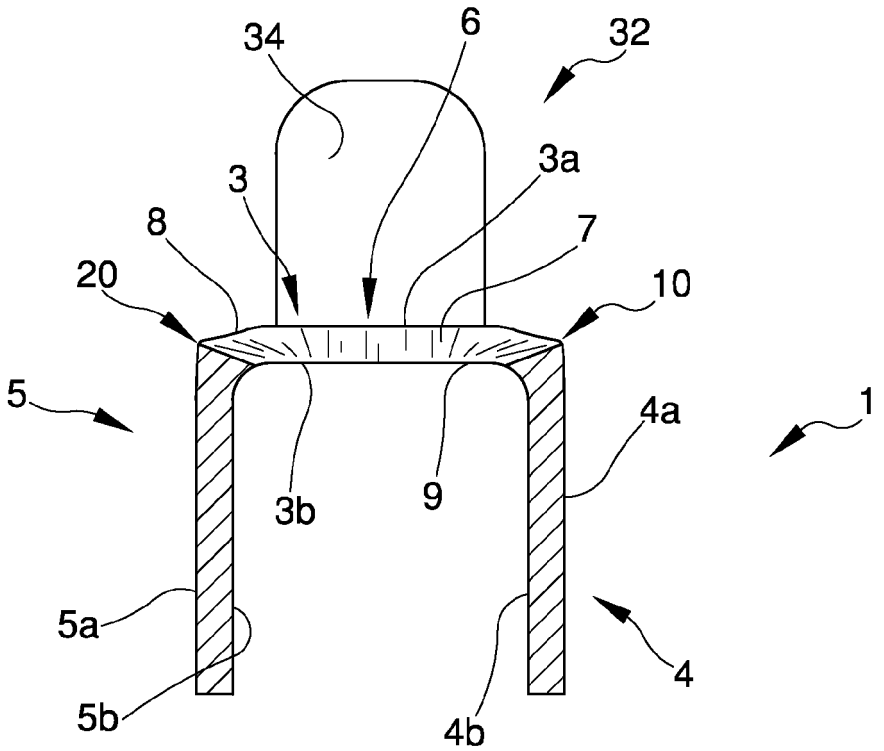
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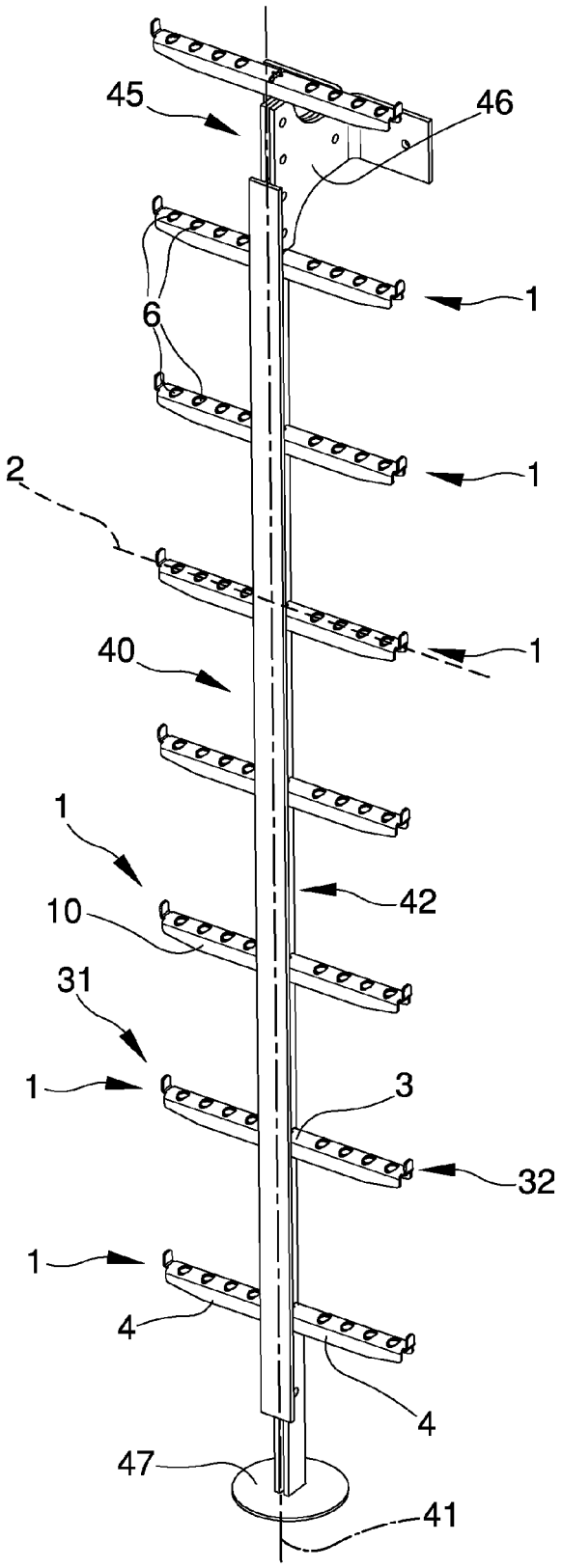
Fig. 3



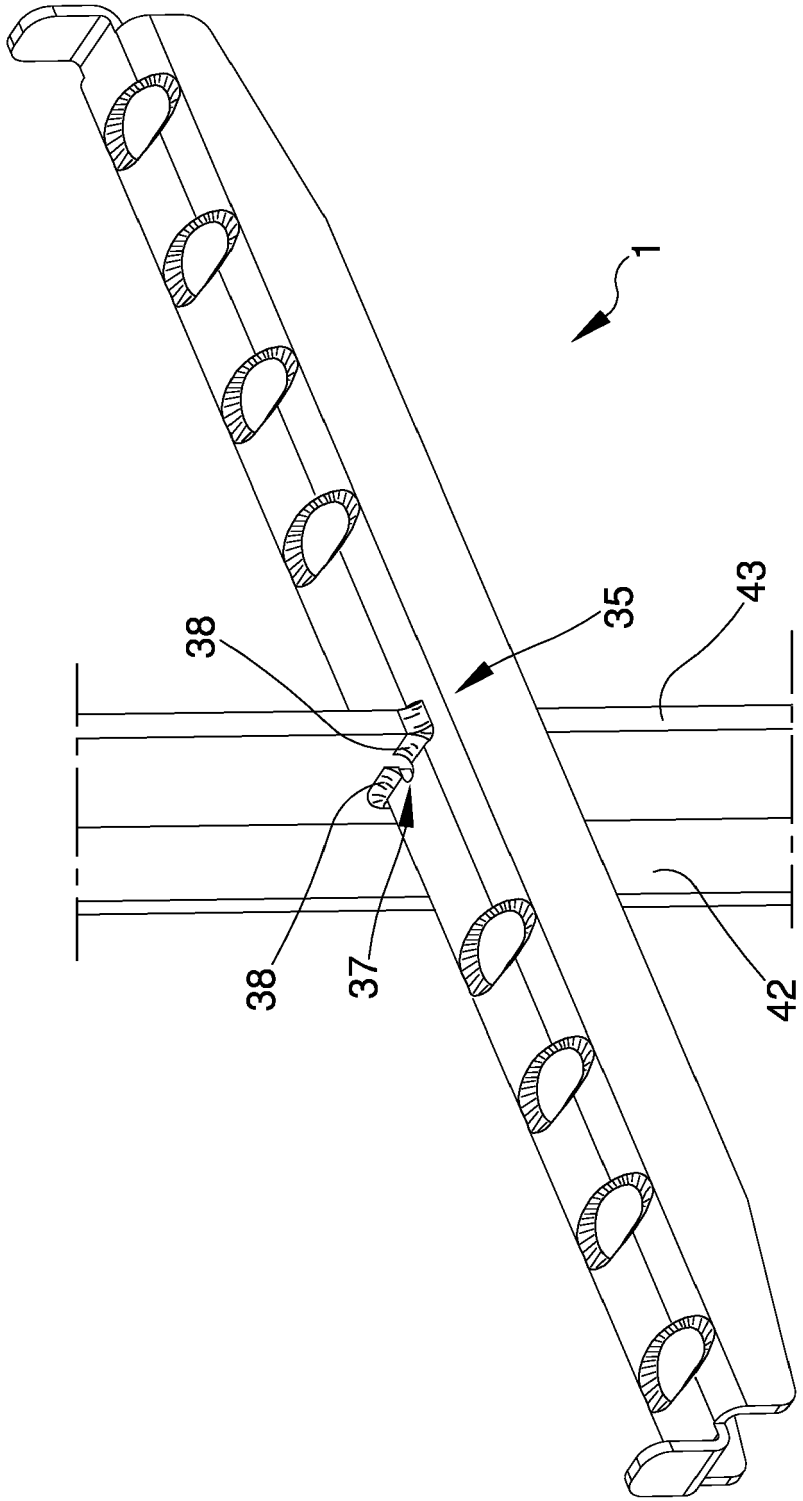



Fig. 4

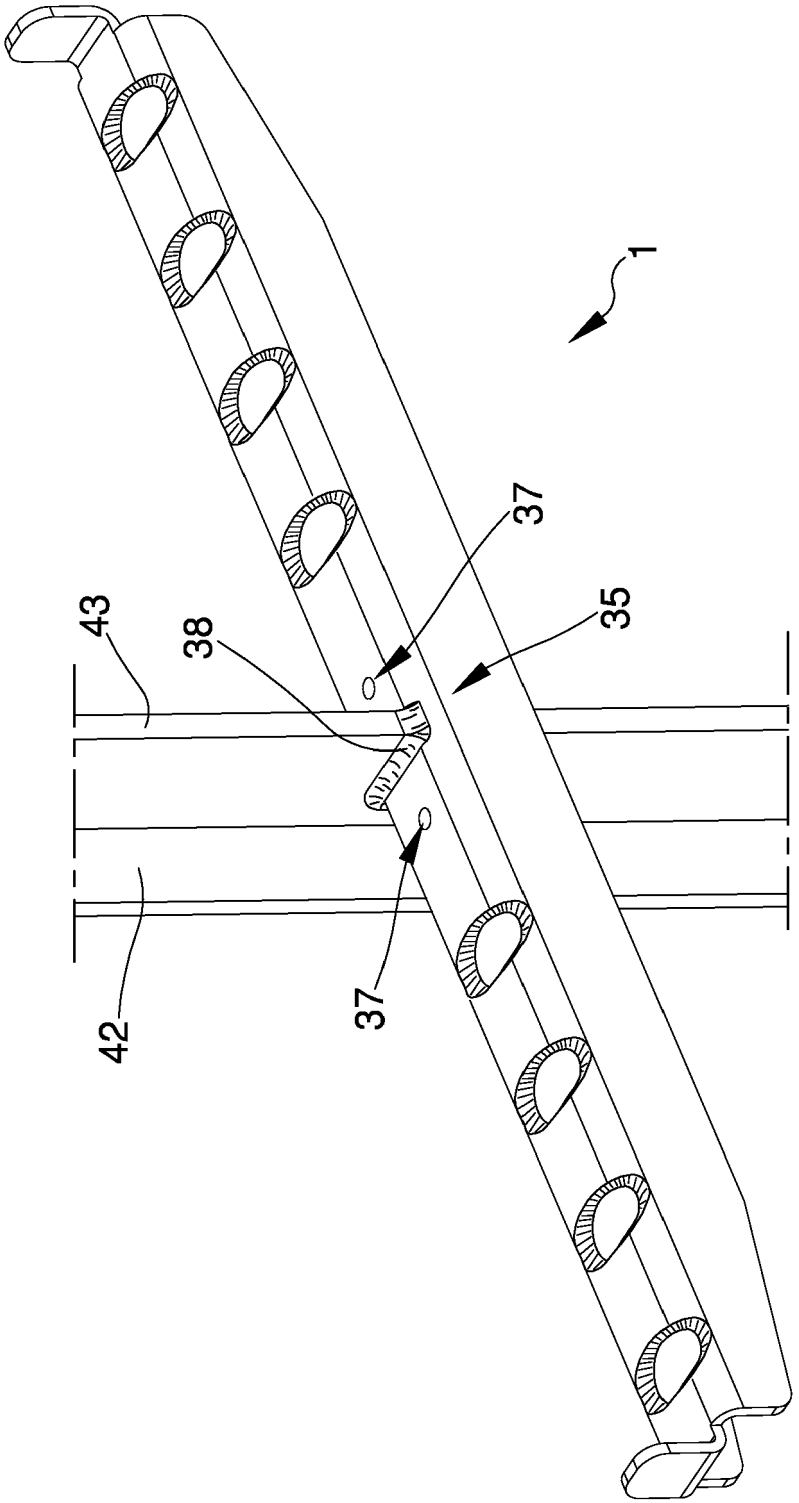



Fig. 5

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Application Number
EP 12 17 1167

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