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(54) **A GUTTER MOUNTING ASSEMBLY**

RINNENMONTAGEANORDNUNG

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Description

[0001] The object of the invention is an assembly for mounting a gutter used to discharge rainwater, in a working position, in particular to the front board of the roof truss of a building.

[0002] There are known gutters having a front bead curved to the outside of the gutter trough, used to stiffen the gutter and to seat mounting elements therein. There are known solutions and methods for mounting gutters in gutter hooks made of metals and plastics, using the resilient properties of these materials, where the gutter hook has a nose or a front protrusion directed outside the hook, and a rear clip sloping down towards the inside of the hook trough, while the gutter is mounted in the hook in such a manner that its front bead is introduced onto the hook nose and remains locked on top of it, and subsequently it is guided along a curve relative to the nose, until its working position in the hook trough becomes fixed, the rear edge of the gutter in the final phase of this operation becoming bent towards the hook face for enabling its introduction under the rear clip, and the grip of the gutter is subsequently released, which results in locking the gutter in this clip. In these known solutions, gutters are mounted in the working position using mounting elements, in particular hooks, tangential to the outer plane of the gutter and visible for an observer looking at the gutter mounted in the working position, in particular from below, at a certain angle, in a typical situation of using the gutter as a roof gutter.

[0003] There are known gutters with a symmetrical transverse cross-section of the trough, at each edge of the trough having identical clips directed towards the inside of the trough, also able to serve the function of drips directing rainwater towards the inside of the gutter trough and preventing its splashout. Such a gutter is removable, which in particular facilitates its assembly, taking into account the descent vector of the gutter and the type of connection between the segments of the gutter, and its design facilitates placing the gutter face flush with the wall of a building, and hiding the gutter in the roof eaves. There are known methods for mounting such a gutter using bearing hooks, into which the gutter is slid, and subsequently their position is fixed, and for mounting it by resting it against a cornice, or a soffit reinforced for this purpose. These solutions include the use of mounting elements tangential to the outer surface of the gutter, which is related to increased complexity of the assembly of elements used to mount the gutter, as well as to revealing these mounting elements on the gutter in a manner visible for a model observer.

[0004] An example of a mounting assembly for a gutter is known from US 2 635 841 A.

[0005] The purpose of the solution according to the invention is an assembly of elements used to mount a gutter in a working position, possibly hidden from an observer looking at the gutter placed in the working position, at a certain angle from the bottom, in a typical

situation of using the gutter as a roof gutter, with at least unchanged functional parameters of the mounted gutter, in particular in terms of its resistance to temperature deformations and impact resistance. In the solution according to the invention, elements of the gutter mounting assembly are invisible for a model observer almost in their entirety, excluding the ending of a clip tongue pulled over the gutter and the ending of a hook foot, and in the area of a hook base they are additionally concealed by the gutter. The solution stands out due to its minimalist external appearance of the mounted gutter assembly, which makes it acceptable from the point of view of certain trends in modern architecture, in particular inspired by the Scandinavian architects.

[0006] This purpose is achieved by a mounting assembly according to claim 1. The invention is defined by the appended claims.

[0007] The gutter mounting assembly according to the invention is intended for mounting a gutter having on its front edge a front clip directed towards the inside of the gutter trough, which can also serve the function of a drip directing rainwater towards the inside of the gutter trough, including for a gutter ending like this on both sides, in particular a square gutter. The gutter mounting assembly comprises a hook having an arm and a base, mounted to the front plane, in particular a front/eaves board of the roof truss, using mounting openings in the hook base, the hook arm A constituting a flat bar preferably 3.5-6 mm in thickness and preferably 10-45 mm in width having a rod, cut perpendicularly on the free end, in the working position extending from the hook base transversely to the gutter, and with its free end tangential to the inner edge of the pocket of the front clip, as well as a foot, in the working position overlapped by the gutter to a depth of at least 15 mm beyond the gutter trough curvature. The rod has a clip tongue seated thereon adjacently to it, constituting a flat bar with certain deformability, preferably 0.6-1.8 mm in thickness, in the working position extending above the outer bending edge of the front clip, adjacently to the gutter face, at a depth of at least 5 mm beyond the bending edge of the front clip. In a preferable embodiment, the rod can abut with its upper plane on the inner plane of the front clip, and it can also be chamfered correspondingly to the shape of the pocket curvature of the front clip.

[0008] In an embodiment of the solution, the hook arm in the area of the gutter trough, in its central part, is bent towards the gutter bottom, forming a back gutter edge pocket, additionally used to fix the position of the rear gutter edge, transfer loads from the gutter onto the hook when in use, and prevent sliding of the gutter on the hook foot. In a preferable embodiment, this bend has the form of a single turn of the hook arm, which simplifies the process of manufacturing the hook, enables bringing the hook arm far away from the outer contour of the gutter, in order to conceal it this more fully from a model observer, at the same time maintaining the capacity of the gutter, also making it easier to place the upper plane of

the rod flush with the inner plane of the front clip. Such a shape of the hook arm also enables deep overlapping of the free edge of the gutter strip inside the gutter trough, which noticeably improves the functional properties of the water discharge assembly according to the invention, hindering the flow of water under the eaves and protecting the front board against the splashout of water from the gutter, and against rain. The gutter strip placed in this manner also constitutes an additional cover of the hook, reducing its visibility for a model observer.

[0009] The clip tongue can be mounted to the hook rod in points, with a mounting element, in a manner known from prior art, in particular using bolts, rivets, gluing, brazing or welding. The clip tongue can be mounted fixedly, in which case, in the mounting process, it is bent upwards in order to slide the front gutter clip between it and the hook arm rod, and the clip tongue is subsequently released and its position can be fixed using mounting elements, in particular a clip tongue clamp or a free clip tongue clamp, so that the clip tongue overlaps the edge of the front clip, and further adjacently to the gutter face. In another embodiment of the solution, the clip tongue is mounted to the rod hook with a connector element, in particular a single rivet or bolt, in a manner enabling rotation of the clip tongue by a certain angle, preferably $30^\circ < \alpha < 90^\circ$ relative to the hook arm rod, and in the mounting process the clip tongue initially remains brought away to the side of the hook rod, and subsequently, after locking the hook rod on the inner bending edge of the front clip, it is brought close to the rod via rotation on the rivet/bolt, and its position can be fixed using the mounting elements, and the clip tongue is subsequently bent by the edge of the front clip, and further adjacently to the gutter face. In an embodiment of the solution, the clip tongue has mounting tongues extending transversely to its longitudinal axis, which, after bringing the clip tongue close to the rod, are bent on the sides of the rod, and further adjacently to its bottom side.

[0010] In an embodiment of the solution, along a certain segment, including in the bending zone, the clip tongue can have at least one outer rib, preferably two, running parallel to the longitudinal axis of the clip tongue, symmetrically on both sides, in order to increase its rigidity.

[0011] According to the invention, the clip tongue additionally has a clamp having mounting tongues extending transversely to its longitudinal axis. In another embodiment, the clip tongue additionally has a free clamp mounted on the mounting tongue with an additional mounting element between the mounting of the clip tongue with the mounting element and the free end of the hook arm rod, having mounting tongues extending transversely to its longitudinal axis. In the mounting process, these mounting tongues are bent on the sides of the rod, and further adjacently to its bottom side.

[0012] The gutter mounting assembly according to the invention can be made of steel, aluminium, copper, titanium or alloys thereof. The clip tongue D can be made of

the same material as the gutter, similarly protected against corrosion and likewise coloured in order to reduce its visibility for a model observer. It can also be made of powder-coated sheet steel.

[0013] The object of the invention is illustrated in embodiments in the attached drawing, in which the individual figures present:

- Fig. 1a the gutter in a lateral cross-section
- 10 Fig. 1b detail A of Fig. 1a - the front gutter clip in a lateral cross-section
- Fig. 1c the hook base in a general view
- Fig. 1d the hook arm in a general view
- Fig. 2a the hook with the clip tongue in version I in a general view
- 15 Fig. 2b the hook with the clip tongue in version I after mounting with the gutter in a lateral cross-section
- Fig. 3a the hook arm rod with the clip tongue in version I with the clamp in a general view
- 20 Fig. 3b the hook arm rod with the clip tongue in version I with the clamp in a bottom view
- Fig. 3c the clip tongue in version I with the clamp in a bottom view
- 25 Fig. 4a the hook arm rod with the clip tongue in version II in a general view
- Fig. 4b the hook arm rod with the clip tongue in version II in a bottom view
- Fig. 4c the clip tongue in version II in a bottom view
- 30 Fig. 5a the hook arm rod with the clip tongue in version III in a general view
- Fig. 5b the hook arm rod with the clip tongue in version III in a bottom view
- Fig. 5c the clip tongue in version II in a bottom view
- 35 Fig. 6a the hook arm rod with the clip tongue in version IV in a general view
- Fig. 6b the hook arm rod with the clip tongue in version IV in a bottom view
- Fig. 6c the clip tongue in version IV in a bottom view
- 40 Fig. 7 the gutter mounting assembly with the clip tongue in version I with the clamp after mounting with the gutter in a general view

Embodiment I

[0014] In the first embodiment of the solution according to the invention, the gutter mounting assembly is used to mount a square gutter, having on its front edge a front clip directed towards the inside of the gutter trough, with a width of 23 mm. The assembly comprises a hook, in which the gutter is seated, having an arm and a base, mounted to the front plane using mounting openings 19 in the hook base, such that the hook arm A constitutes a steel flat bar, 4 mm in thickness and 25 mm in width, having a rod 2 cut perpendicularly on its free end 3, extending from the hook base B, in the working position perpendicularly to the gutter C, with its free end 3 tangential to the inner bending edge 5 of the front gutter clip

1, and on the rod 2 of the hook arm A a clip tongue D is seated adjacently to the rod 2 with a mounting element 11, constituting a steel flat bar 1.2 mm in thickness, in the working position extending above the outer bending edge of the front gutter clip 6, adjacently to the gutter face at a depth of 7 mm beyond the outer bending edge of the front gutter clip 6, and the hook arm A has a hook arm foot 4, in the working position overlapped by the gutter C to a depth of 20 mm beyond the gutter trough curvature 8. The hook arm A is bent in its central part, with a single bend towards the gutter bottom 9 at an inner angle of 78°, forming a back gutter edge pocket 10, and the hook arm rod 2 abuts with its upper plane on the inner plane of the front gutter clip 1. The free end of the hook arm rod 3 is chamfered correspondingly to the shape of the pocket curvature of the front gutter clip 7. In this embodiment, the clip tongue D in version I shown in Figs. 2a, 2b, 3a, 3b, 3c and 7 additionally has a clamp 12 mounted on the mounting tongue with a mounting element 11, having mounting tongues 13', 13" extending transversely to its longitudinal axis; the connector element 11 is a rivet, and the clip tongue D is mounted on this connector element 11 in a manner allowing it to bend upwards relative to the hook arm rod 2. The clamp 12 is made of the same material as the gutter C.

Embodiment II

[0015] An embodiment like above, except the clip tongue D like in version II shown in Figs. 4a, 4b and 4c is made of the same material as the gutter, and in its bending zone it has two outer ribs 14 running parallel to the longitudinal axis of the clip tongue D, symmetrically on both sides, as well as it additionally has mounting tongues 15', 15" constituting parts thereof, extending transversely to its longitudinal axis.

Embodiment III

[0016] An embodiment like in Embodiment I, except the clip tongue D like in version III shown in Figs. 5a, 5b and 5c additionally has a free clamp 16 mounted on the clip tongue D with an additional mounting element 17 constituting a ring rivet, having mounting tongues 18', 18" extending transversely to its longitudinal axis.

Embodiment IV

[0017] An embodiment like in Embodiment I, except the clip tongue D like in version IV shown in Figs. 6a, 6b and 6c is shorter and mounted to the hook arm rod 2 fixedly with a mounting element 11 constituting a single rivet.

List of references

[0018]

A hook arm
B hook base
C gutter
D clip tongue

5
1 front clip
2 hook arm rod
3 free end of the hook arm rod
4 hook arm foot
10 5 inner bending edge of the front gutter clip
6 outer bending edge of the front gutter clip
7 pocket of the front gutter clip
8 gutter trough curvature
9 gutter bottom
15 10 back gutter edge pocket
11 clip tongue mounting element
12 clip tongue clamp
13', 13" mounting tongues of the clip tongue clamp
14 outer rib of the mounting tongue
20 15', 15" mounting tongues of the clip tongue
16 free clamp of the clip tongue
17 additional mounting element
18', 18" mounting tongues of the free clamp
19 mounting openings

Claims

1. A mounting assembly for a gutter having a front wall, a rear wall, a trough, a trough curvature (8) and on its front edge a bend forming a front clip (1) directed towards the inside of the gutter trough, in particular of a square gutter, the mounting assembly comprising

- a hook in which the gutter is to be seated, the hook having an arm (A), and
- a base (B), the base being configured to be mounted to the hook using mounting openings in the base,
wherein the hook arm (A), constituting a flat bar preferably 3.5-6 mm in thickness and preferably 10-45 mm in width, has

- a rod (2), cut perpendicularly on its free end (3), extending in the mounted position away from the hook base (A), and perpendicularly to the longitudinal direction of the gutter (C), with its free end (3) being tangential to the inner side (5) of the bend of the front gutter clip (1), and

- on the rod (2) of the hook arm (A) a clip tongue (D), seated adjacently to the rod (2) with a mounting element (11), constituting a flat bar with certain deformability, extending in the mounted position above the outer side (6) of the bend of the front gutter clip (6), adjacently to the outer side of the gutter, front wall at a depth of at least (5) mm beyond the bend of the front gutter clip

(6), and

- a hook arm foot (4) configured, in the mounted position to be overlapped by the gutter (C) to a depth of at least 15 mm beyond the gutter trough curvature (8),

wherein the clip tongue (D) additionally has a clamp (12, 16) having mounting tongues (13', 13'', 15', 15'', 18', 18'') extending transversely to its longitudinal axis..

2. The mounting assembly according to claim 1, **characterised in that** the hook arm rod (2) abuts with its upper plane on the inner plane of the front gutter clip (1). 5
3. The mounting assembly according to claim 1, **characterised in that** the free end of the hook arm rod (3) is chamfered correspondingly to the shape of the pocket curvature of the front gutter clip (7). 20
4. The mounting assembly according to claim 1, **characterised in that** the hook arm A is in its central part bent towards the gutter bottom (9), forming a back gutter edge pocket 10. 25
5. The mounting assembly according to claim 4, **characterised in that** the bend in the central part of the hook arm A is single. 30
6. The mounting assembly according to claim 1, **characterised in that** the mounting element (11) is in particular a rivet or a bolt, and the clip tongue (D) is mounted on the mounting element (11) in a manner enabling its rotation by a certain angle, preferably $30^\circ < \alpha < 90^\circ$, relative to the hook arm rod (2). 35
7. The mounting assembly according to claim 1, **characterised in that**, along a certain segment, including in the bending zone, the clip tongue has at least one outer rib (14), preferably two, running parallel to the longitudinal axis of the clip tongue (D), symmetrically on both sides. 40
8. The mounting assembly according to claim 1, **characterised in that** the clip tongue (D) additionally has mounting tongues (15', 15'') extending transversely to its longitudinal axis. 45
9. The mounting assembly according to claim 1, **characterised in that** the clip tongue (D) additionally has a free clamp (16) mounted on the mounting tongue with an additional mounting element (17), having mounting tongues (18', 18'') extending transversely to its longitudinal axis. 50
10. The mounting assembly according to claim 1, **characterised in that** it is made of steel, aluminium,

copper, titanium or alloys thereof.

11. The mounting assembly according to claim 1, **characterised in that** the clamp (12) is made of the same material as the gutter (C). 5

Patentansprüche

1. Montageanordnung für eine Dachrinne mit einer Vorderwand, einer Rückwand, einem Rinnentrog, einer Trogkrümmung (8) und an ihrer Vorderkante einer Biegung, die eine nach innen zum Rinnentrog gerichtete vordere Klammer (1) bildet, insbesondere für eine kastenförmige Dachrinne, die Montageanordnung umfasst:

- einen Haken, in dem die Dachrinne aufgenommen werden soll, wobei der Haken einen Arm (A) aufweist, und

- eine Basis (B), wobei die Basis dazu ausgelegt ist, mittels in der Basis vorgesehener Montageöffnungen am Haken befestigt zu werden, wobei der Hakenarm (A), der einen Flachstab mit vorzugsweise 3,5 bis 6 mm Dicke und vorzugsweise 10 bis 45 mm Breite bildet, aufweist:

- einen Stab (2), der an seinem freien Ende (3) rechtwinklig abgeschnitten ist und sich im montierten Zustand von der Hakenbasis (A) weg sowie senkrecht zur Längsrichtung der Dachrinne (C) erstreckt, wobei sein freies Ende (3) tangential zur Innenseite (5) der Biegung der vorderen Rinnenklammer (1) verläuft, und

- auf dem Stab (2) des Hakenarms (A) eine Klammerzunge (D), die benachbart zu dem Stab (2) mittels eines Befestigungselements (11) angeordnet ist, einen Flachstab mit einer gewissen Verformbarkeit bildet und sich im montierten Zustand über der Außenseite (6) der Biegung der vorderen Rinnenklammer (6) sowie benachbart zur Außenseite der Vorderwand der Dachrinne in einer Tiefe von mindestens (5) mm über die Biegung der vorderen Rinnenklammer (6) hinaus erstreckt, und

- einen Fuß (4) des Hakenarms, der im montierten Zustand dazu ausgelegt ist, von der Dachrinne (C) bis zu einer Tiefe von mindestens 15 mm über die Trogkrümmung (8) hinaus überdeckt zu werden,

wobei die Klammerzunge (D) ferner eine Klemme (12, 16) mit Befestigungsglaschen (13', 13'', 15', 15'', 18', 18'') aufweist, die sich quer zu ihrer Längsachse erstrecken.

2. Montageanordnung nach Anspruch 1, **dadurch gekennzeichnet, dass** der Stab (2) des Hakenarms mit seiner oberen Fläche an der Innenfläche der vorderen Rinnenklammer (1) anliegt. 5
3. Montageanordnung nach Anspruch 1, **dadurch gekennzeichnet, dass** das freie Ende (3) des Stabs (2) des Hakenarms entsprechend der Form der Taschenkrümmung der vorderen Rinnenklammer (7) abgeschrägt ist. 10
4. Montageanordnung nach Anspruch 1, **dadurch gekennzeichnet, dass** der Hakenarm (A) in seinem mittleren Bereich zum Rinnenboden (9) hin gebogen ist und eine hintere Rinnenrandtasche (10) bildet. 15
5. Montageanordnung nach Anspruch 4, **dadurch gekennzeichnet, dass** die Biegung im mittleren Bereich des Hakenarms (A) einzelne ist. 20
6. Montageanordnung nach Anspruch 1, **dadurch gekennzeichnet, dass** das Befestigungselement (11) insbesondere eine Niete oder eine Schraube ist und die Klammerzunge (D) auf dem Befestigungselement (11) so montiert ist, dass eine Drehung um einen bestimmten Winkel, vorzugsweise $30^\circ < \alpha < 90^\circ$, relativ zum Stab (2) des Hakenarms möglich ist. 25
7. Montageanordnung nach Anspruch 1, **dadurch gekennzeichnet, dass** die Klammerzunge entlang eines bestimmten Abschnitts, einschließlich im Biegebereich, mindestens eine äußere Rippe (14), vorzugsweise zwei, aufweist, die parallel zur Längsachse der Klammerzunge (D) und symmetrisch auf beiden Seiten verlaufen. 30 35
8. Montageanordnung nach Anspruch 1, **dadurch gekennzeichnet, dass** die Klammerzunge (D) ferner Befestigungsglaschen (15', 15'') aufweist, die sich quer zu ihrer Längsachse erstrecken. 40
9. Montageanordnung nach Anspruch 1, **dadurch gekennzeichnet, dass** die Klammerzunge (D) ferner eine freie Klemme (16) aufweist, die auf einer Befestigungsglasche mittels eines zusätzlichen Befestigungselements (17) montiert ist und Befestigungsglaschen (18', 18'') aufweist, die sich quer zu ihrer Längsachse erstrecken. 45 50
10. Montageanordnung nach Anspruch 1, **dadurch gekennzeichnet, dass** sie aus Stahl, Aluminium, Kupfer, Titan oder deren Legierungen hergestellt ist.
11. Montageanordnung nach Anspruch 1, **dadurch gekennzeichnet, dass** die Klemme (12) aus demselben Material wie die Dachrinne (C) hergestellt ist. 55

Revendications

1. Ensemble de montage pour une gouttière comportant une paroi avant, une paroi arrière, un fond de gouttière, une courbure du fond (8) et, sur son bord avant, un pli formant un clip avant (1) orienté vers l'intérieur du fond de la gouttière, en particulier d'une gouttière carrée, ledit ensemble de montage comprenant :

- un crochet dans lequel la gouttière est destinée à être logée, ledit crochet comportant un bras (A), et
- une base (B), ladite base étant configurée pour être fixée au crochet au moyen d'orifices de montage ménagés dans la base, dans lequel le bras de crochet (A), constituant une barre plate de préférence d'une épaisseur de 3,5 à 6 mm et d'une largeur de préférence de 10 à 45 mm, comprend :

- une tige (2), coupée perpendiculairement à son extrémité libre (3), s'étendant en position montée à partir de la base du crochet (A) et perpendiculairement à la direction longitudinale de la gouttière (C), son extrémité libre (3) étant tangente à la face interne (5) du pli du clip avant de gouttière (1), et
- sur la tige (2) du bras de crochet (A), une languette de clip (D), disposée de manière adjacente à ladite tige (2) au moyen d'un élément de fixation (11), constituant une barre plate présentant une certaine déformabilité, s'étendant en position montée au-dessus de la face externe (6) du pli du clip avant de gouttière (6), de manière adjacente à la face externe de la paroi avant de la gouttière, à une profondeur d'au moins (5) mm au-delà du pli du clip avant de gouttière (6), et
- un pied (4) du bras de crochet, configuré pour être recouvert, en position montée, par la gouttière (C) à une profondeur d'au moins 15 mm au-delà de la courbure du fond de gouttière (8),

dans lequel la languette de clip (D) comporte en outre un serre-joint (12, 16) muni de languettes de montage (13', 13'', 15', 15'', 18', 18'') s'étendant transversalement à son axe longitudinal.

2. Ensemble de montage selon la revendication 1, **caractérisé en ce que** la tige (2) du bras de crochet vient en appui, par son plan supérieur, contre le plan interne du clip avant de gouttière (1).
3. Ensemble de montage selon la revendication 1, **caractérisé en ce que** l'extrémité libre (3) de la tige

(2) du bras de crochet est chanfreinée conformément à la forme de la courbure de la cavité du clip avant de gouttière (7).

4. Ensemble de montage selon la revendication 1, 5
caractérisé en ce que le bras de crochet (A) est, dans sa partie centrale, cintré vers le fond de la gouttière (9), formant une cavité (10) de bord arrière de la gouttière. 10
5. Ensemble de montage selon la revendication 4, 10
caractérisé en ce que le cintrage dans la partie centrale du bras de crochet (A) est simple.
6. Ensemble de montage selon la revendication 1, 15
caractérisé en ce que l'élément de fixation (11) est notamment un rivet ou un boulon, et **en ce que** la languette de clip (D) est montée sur ledit élément de fixation (11) de manière à permettre sa rotation selon un certain angle, de préférence $30^\circ < \alpha < 90^\circ$, par rapport à la tige (2) du bras de crochet. 20
7. Ensemble de montage selon la revendication 1, 25
caractérisé en ce que, sur un certain segment, y compris dans la zone de cintrage, la languette de clip comporte au moins une nervure externe (14), de préférence deux, s'étendant parallèlement à l'axe longitudinal de la languette de clip (D), de manière symétrique de part et d'autre. 30
8. Ensemble de montage selon la revendication 1, 35
caractérisé en ce que la languette de clip (D) comporte en outre des languettes de montage (15', 15'') s'étendant transversalement à son axe longitudinal.
9. Ensemble de montage selon la revendication 1, 40
caractérisé en ce que la languette de clip (D) comporte en outre un serre-joint libre (16) monté sur une languette de montage au moyen d'un élément de fixation supplémentaire (17), ledit serre-joint comportant des languettes de montage (18', 18'') s'étendant transversalement à son axe longitudinal. 45
10. Ensemble de montage selon la revendication 1, 50
caractérisé en ce qu'il est réalisé en acier, aluminium, cuivre, titane ou en leurs alliages.
11. Ensemble de montage selon la revendication 1, 50
caractérisé en ce que le serre-joint (12) est réalisé dans le même matériau que la gouttière (C). 55

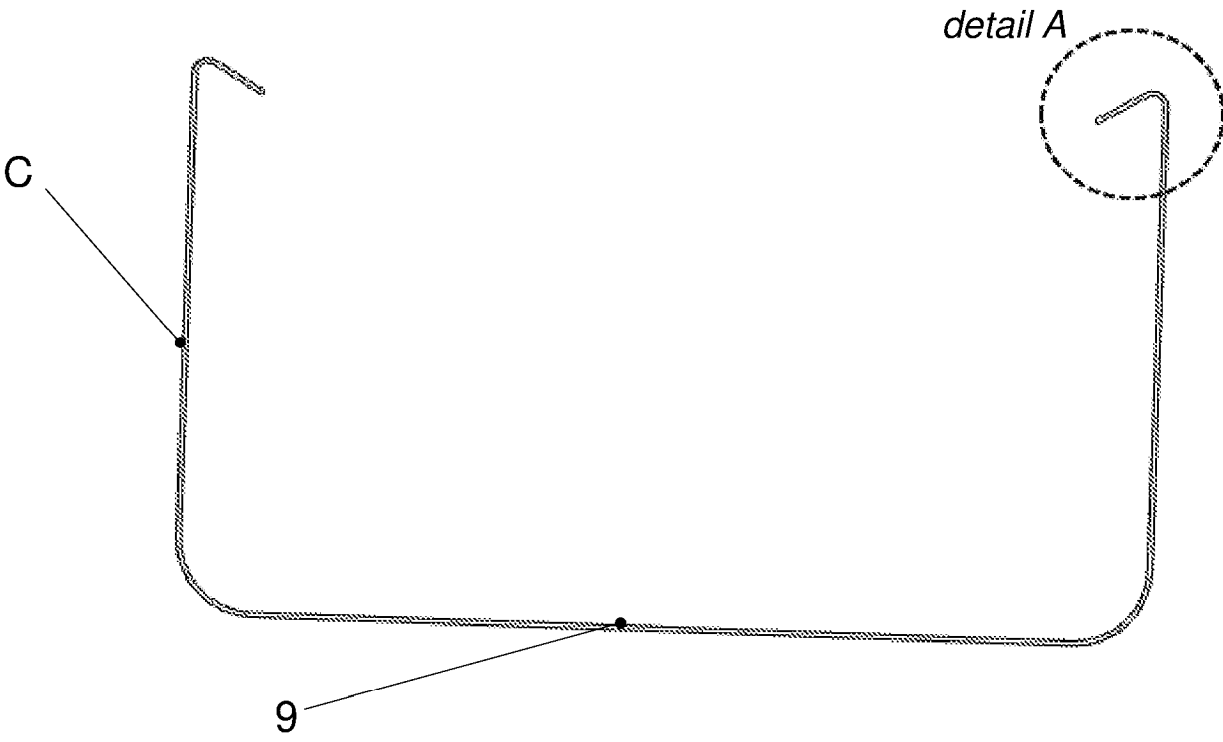


Fig. 1a

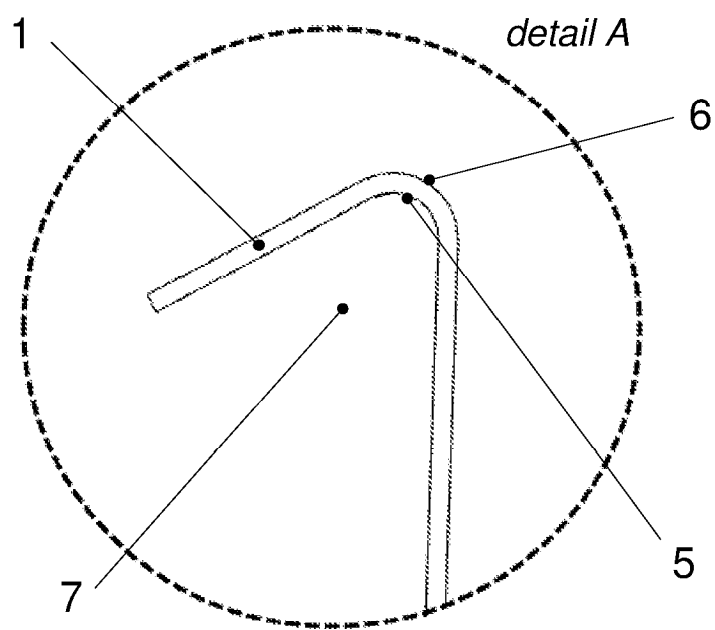


Fig. 1b

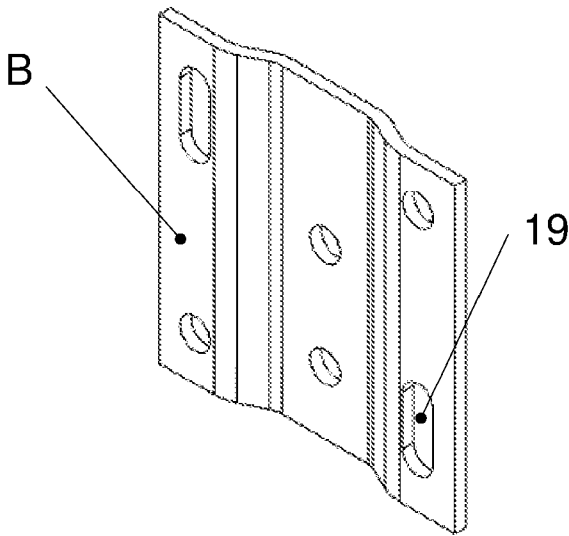


Fig. 1c

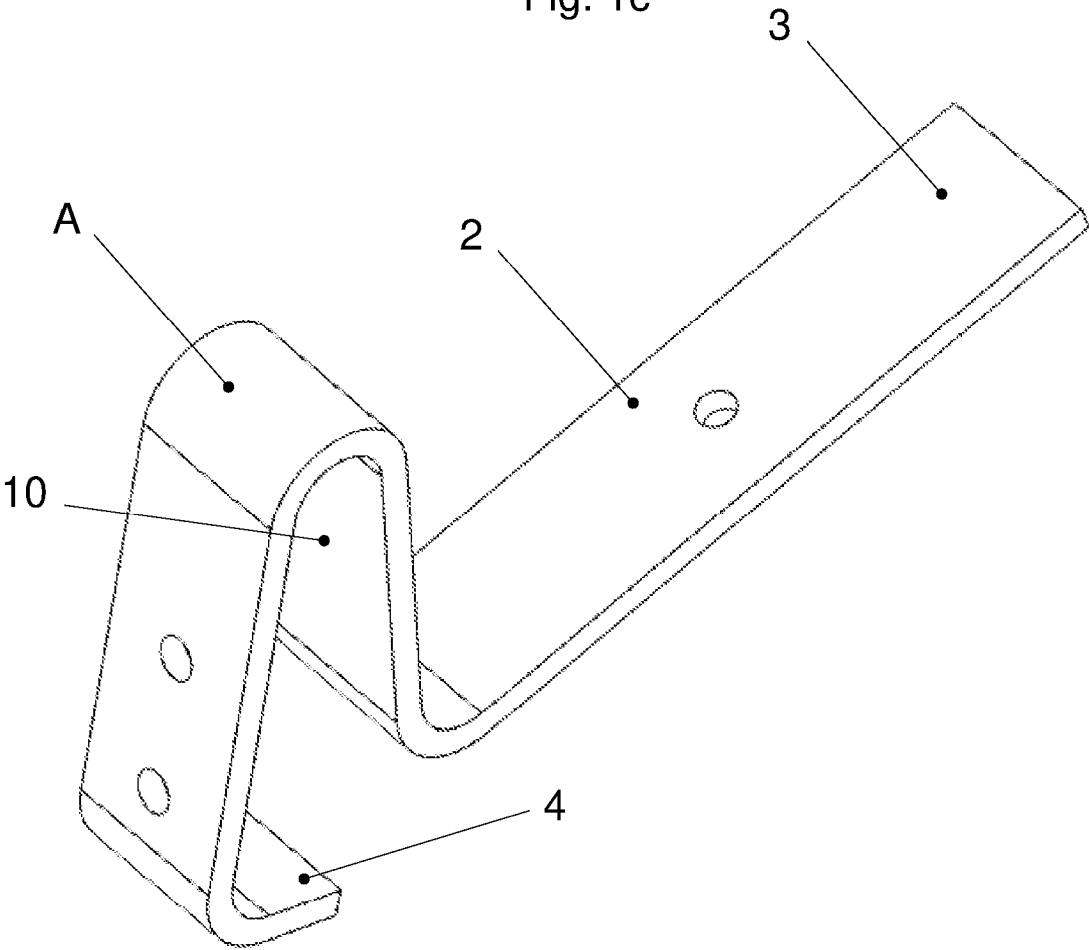


Fig. 1d

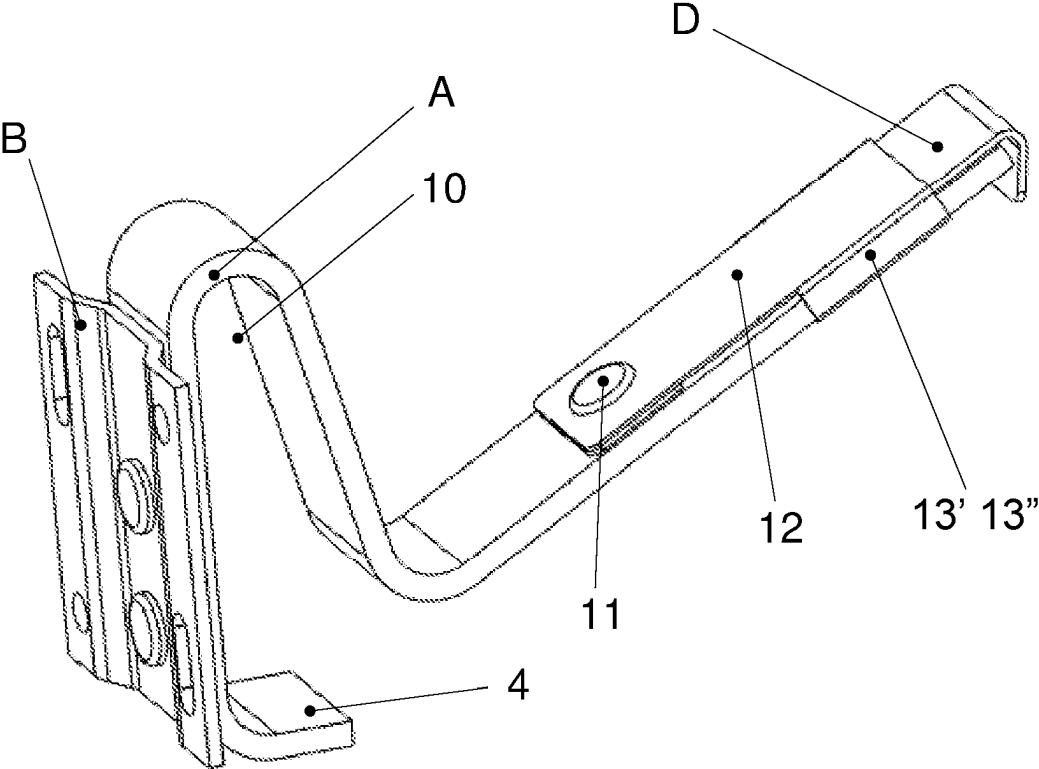


Fig. 2a

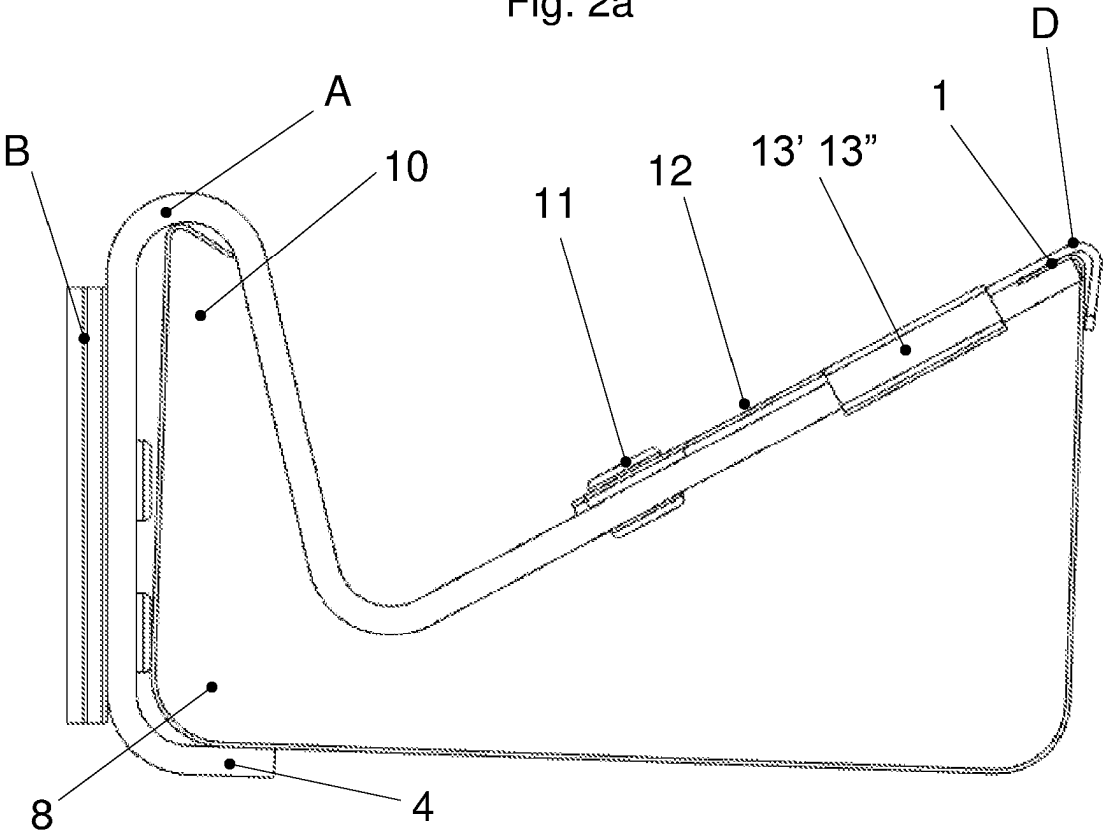


Fig. 2b

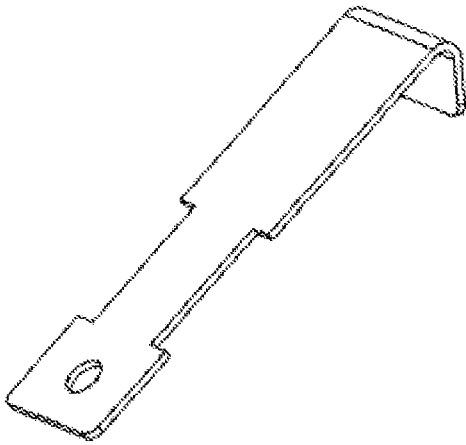


Fig. 3a

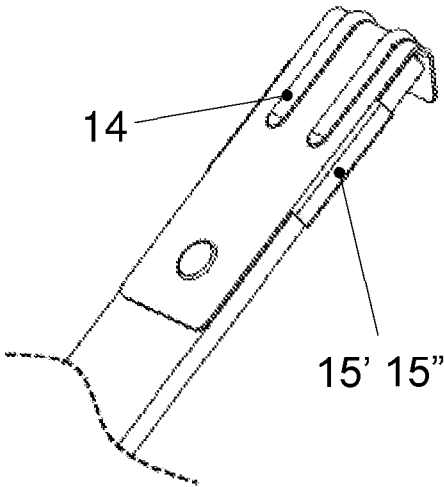


Fig. 4a

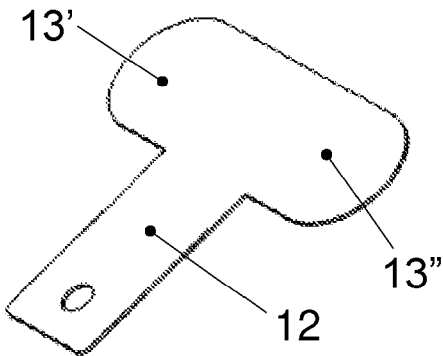


Fig. 3b

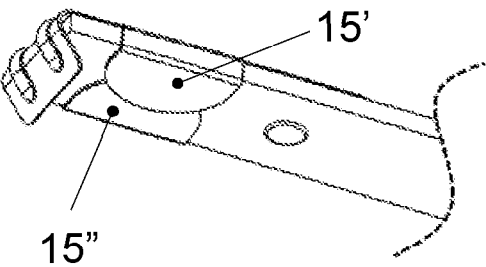


Fig. 4b

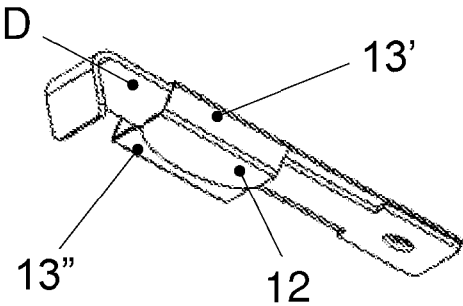


Fig. 3c

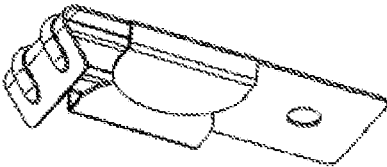


Fig. 4c

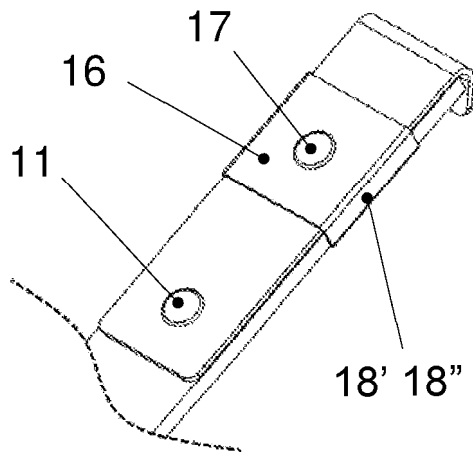


Fig. 5a

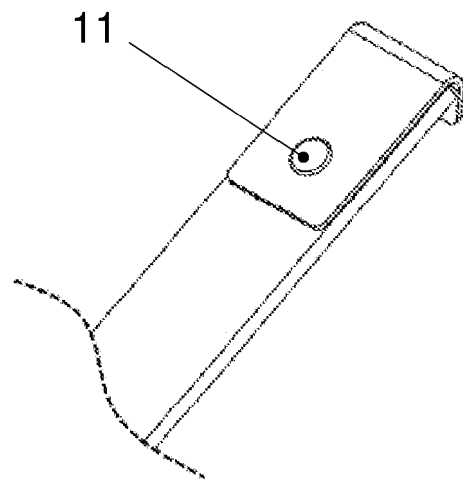


Fig. 6a

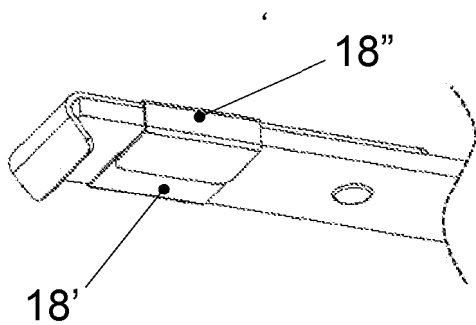


Fig. 5b

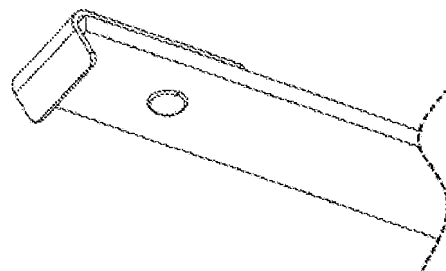


Fig. 6b

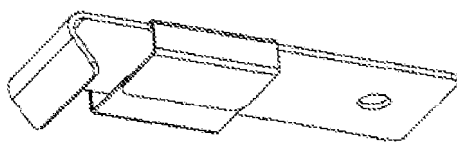


Fig. 5c



Fig. 6c

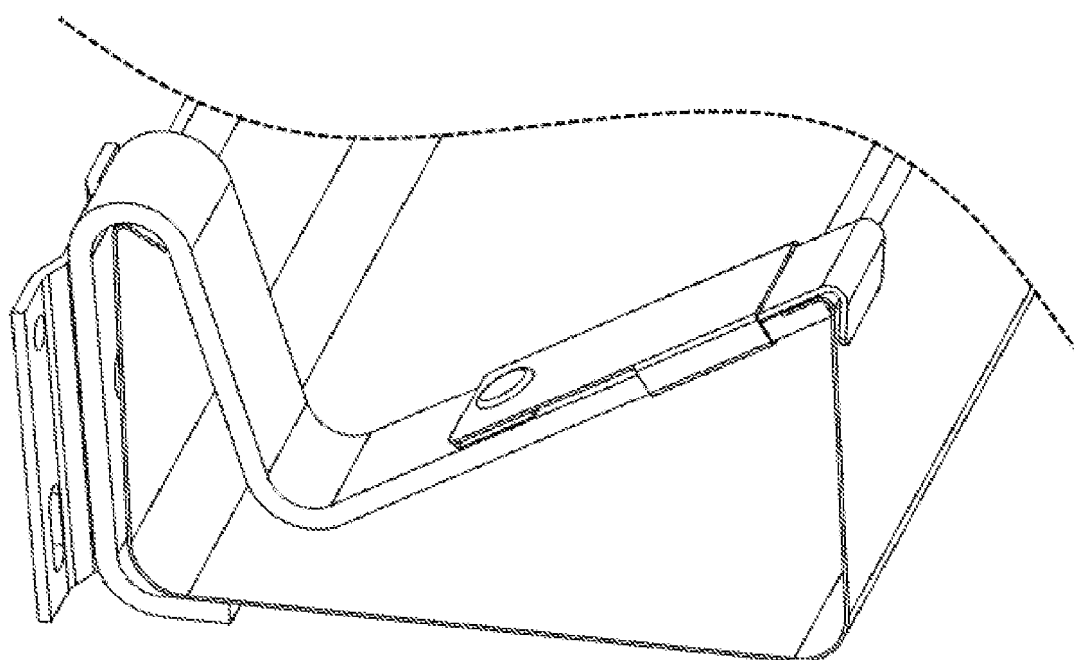


Fig. 7

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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