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

(11) **EP 3 812 525 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
28.04.2021 Bulletin 2021/17

(51) Int Cl.:
E04B 1/41 *(2006.01)*

(21) Application number: **20203233.0**

(22) Date of filing: **22.10.2020**

(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
Designated Validation States:
KH MA MD TN

(30) Priority: **22.10.2019 IT 201900019502**

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(54) **FIXING SYSTEM FOR BUILDING CONSTRUCTIONS AND PROCESS FOR MANUFACTURING IT**

(57) The fixing system according to the invention for building constructions comprising a fixing profile (1**0, 10', 10", 10"'**) having C-shaped cross sections. The fixing profile (**10, 10', 10", 10"'**) forms an internal channel (**12**), an external back (**14**) and at least two engagement edges (**15, 15', 15"**). The fixing section is obtained by substantially cold forming a metal sheet (LM) forming two major faces (FM**1**, FM**2**). At least one of the two major faces (FM**1**, FM**2**) of the metal sheet (LM) at or near at least one of the two engagement edges (**15, 15', 15"**) forms a first toothing (**17**). The internal channel (**12**), the external back (**14**), the at least two engagement edges (**15, 15', 15"**) and the at least one first toothing (**17**) extend longitudinally with respect to the fixing profile (**10**). The first toothing (**17**) is obtained by plastic cold forming.

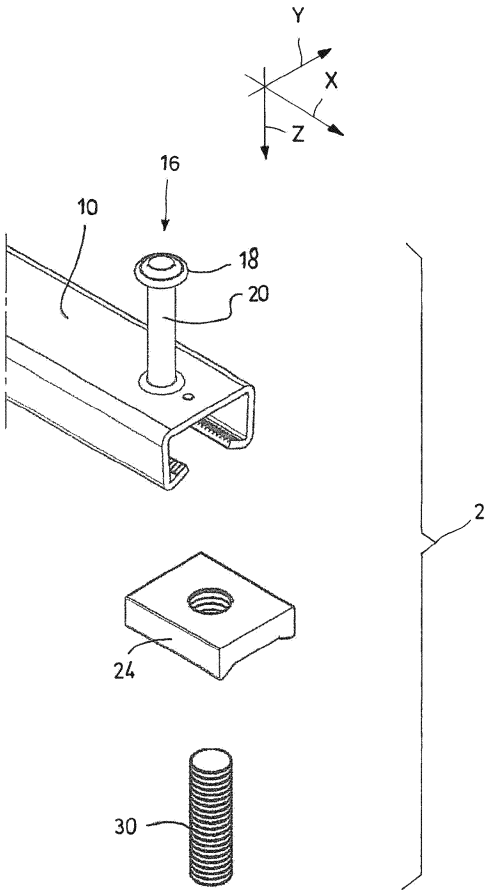

Fig.1

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Description

Field of the invention

[0001] The present invention relates to a fixing system for cement building constructions, in particular on a fixing system of the type that can be pre-assembled to concrete items.

[0002] The present invention further relates to a process for making said fixing system.

Background

[0003] Fixing systems are known, which can be pre-assembled to concrete items.

[0004] These fixing systems typically comprise profiles or channels that have C-shaped cross-sections.

[0005] Such fixing profiles are usually made of steel or aluminium and comprise, on their back - i.e. the opposite surface to the C-shaped opening - a plurality of integral or dummy tie-rods forming the part anchoring the profiles themselves to the concrete.

[0006] The C-shaped fixing profile and the respective anchoring part are put into the formworks, as well as the reinforcement rods.

[0007] In particular, the tie rods of the fixing profile will be near the steel bars forming the reinforcement of the concrete structures before the concrete is cast.

[0008] The open part of the C-shaped fixing profile remains adherent to the formwork so that, after the concrete item has been produced, the C-shaped cavity is accessible for carrying out and completing the fixing; such completion also requires one or more connectors be inserted in the C-shaped sections of the profile .

[0009] Such connectors, which are known in themselves, can comprise a screw with a shaped head or a fixing plate into which a threaded pin is screwed.

[0010] The head of the screw enters the C and turns by **90°** for carrying out the fixing.

[0011] The plate is pre-inserted into the C-shaped channel and houses the threaded bar for carrying out the fixing.

[0012] Other concrete structural elements - such as for example pillars, beams or prefabricated slabs- or steel structural elements - such as for example anchorages of ventilated façades or more simply glass doors, shelves and brackets of channels and other cable trays or various water or gas pipes are usually fixed to the threaded pins of the connectors and the screws -.

[0013] The threaded end of the screw and the threaded pin of the plate are fundamental fixing elements projecting from the concrete item.

[0014] A fixing system provided with a C-shaped profile is known, for example, from document EP 0 758 039 A1 filed in the name of Halfen.

[0015] Initially and for a long time the C-shaped fixing profiles were manufactured through hot drawing.

[0016] In fact such a process was deemed necessary for obtaining the desired shear and tensile strength, reinforcing the proximal edges to the C-shaped opening and increasing the mass of steel placed in adherence to the application point of the load.

[0017] However, it was later discovered that the fixing profiles could be successfully made by cold deformation obtaining tensile and shear strength at least comparable with those of the fixing profiles obtained by hot deformation.

[0018] The author of the present invention considers that anchoring profiles can be made through cold deformation obtaining mechanical resistance - at least tensile and shear resistance - even greater than that of hot deformed profiles.

[0019] Nevertheless the author of the present invention observed that it would be desirable to be able to produce fixing profiles obtained prevalently, or even exclusively, through cold deformation, and having a resistance to longitudinal sliding loads having a substantially similar value to the transverse tensile and shear load resistance - i.e. perpendicular to the profile itself.

[0020] An object of the present invention is therefore providing a fixing profile having an improved resistance to longitudinal sliding loads in comparison with known fixing profiles and which can be obtained through a less expensive and energy consuming process than the known ones.

Summary of the invention

[0021] In a first aspect of the present invention, such object is achieved with a fixing system for building constructions having the features according to claim **1.**

[0022] In a second aspect of the present invention, such object is achieved with a process having the features according to claim **9.**

[0023] The dependent claims are directed to further features of the invention.

[0024] The advantages attainable with the present invention shall become more readily apparent to the person skilled in the art by the following detailed description of some particular, non-limiting embodiments, described with reference to the following schematic figures.

List of Figures

[0025]

Figure **1** shows an exploded perspective view of a fixing system according to a first particular embodiment of the present invention;

Figure **2** shows a perspective view of a section of the fixing profile of the fixing system of Figure **1;**

Figure **2**A shows a perspective view of a portion of the toothing of the profile of Figure **2;**

Figure **2**B shows a partially sectioned view according to the section plane A-A, of a portion of the toothing of Figure **2**A coupled with the toothing of Figure **3;**

Figure **3** shows a perspective view of a connector of the fixing system of Figure **1;**

Figure **4** shows a perspective view of an instant of a production process in which, through a forming roller, the toothings of the profile of Figures **2, 2**A, **6-9** can be made, according to a particular embodiment of the invention;

Figure **4**A shows a detailed view of the toothing of the forming roller of Figure **4,** according to an observation direction parallel to the axis of rotation of the roller itself;

Figure **4**B shows a detailed view of the toothing of a forming roller according to a particular and alternative embodiment, according to an observation direction parallel to the axis of rotation of the roller itself;

Figure **5** shows a pair of bending rollers that can be used to bend a strip of sheet metal and form the profile of Figures **2, 2**A, **6-9** observed according to a parallel direction to the axes of rotation of the rollers themselves;

Figure **6** shows a cross section of the fixing profile of Figure **2;**

Figure **6A** shows an enlarged detail of the view of Figure **6;**

Figure **7** shows a cross section of a fixing profile of a fixing system according to a second particular embodiment of the present invention;

Figure **8** shows a cross section of a fixing profile, having substantially omega shaped cross sections, of a fixing system according to a third particular embodiment of the present invention;

Figure **9** shows a cross section of a fixing profile of a fixing system according to a fourth particular embodiment of the present invention;

Figure **10** shows a perspective view of an anchor head screw that can be used as a connector in a fixing system according to the embodiments of the previous Figures;

Figure **11** shows an exploded perspective view of a fixing system according to a fifth particular embodiment of the present invention.

Detailed description

[0026] In the present description:

- tensile strain on a fixing profile **10** means strain in a parallel direction to an anchoring nail **16** and/or to the pins **30** that are fixed to a respective connector **24, 24';**
- shear strain means strain that pushes or pulls a connector **24, 24'** in a substantially perpendicular direction both to the longitudinal direction of the profile **10** and in the direction of the tensile strain, i.e. strain orthogonal to the tensile strain acting both transversally to the profile **10** and in the direction of the profile **10;**
- sliding strain means strain that tends to cause a connector **24** slide along a respective fixing profile **10,** i.e. strain in which the load has the same direction as the profile **10.**

[0027] By way of example, referring to Figure **1** a longitudinal sliding-, tensile- and shear strain, is parallel to the axis X, Z and Y respectively.

[0028] Figures **1, 2, 2A, 2B, 3, 4, 4A, 5, 6, 10** relate to a fixing system for fixing for example to concrete in building constructions according to a first particular embodiment that can be used for example for fixing another prefabricated concrete element to a concrete element - such as for example a pillar panel, or a glass-aluminium façade to the concrete slab of the building or even the guides of the lift to the concrete wall of the compartment in which the lift operates or even for example a pillar, beam, wall or slab.

[0029] Such fixing system, indicated with the overall reference **2,** comprises at least one fixing profile **10, 10', 10", 10'''** obtained by cold bending of a band, strip or other metal sheet so as to confer substantially C-shaped cross sections thereto.

[0030] A fixing profile **10, 10', 10", 10'''** according to the invention can also have substantially omega shaped cross sections; such cross sections can however be considered, in the present description, to be a particular type of C-shaped sections.

[0031] The sheet metal from which the profile **10, 10', 10", 10'''** is obtained preferably has a thickness comprised between **1-10** millimetres or between **2-5** millimetres and preferably **2-4** or **3** or **8** mm.

[0032] The sheet from which the profile **10, 10', 10", 10'''** is obtained can be made for example of steel.

[0033] The fixing profile **10** forms an external back **14, 14', 14"** and two side flaps **13, 13', 13"** which extend perpendicularly or however transversally to the external back **14, 14', 14"** (Figures **2, 6-9**).

[0034] The side flaps **13, 13', 13"** end in a respective engagement edge **15, 15', 15".**

[0035] As for example, in Figures **2, 6-9,** the external back **14, 14', 14",** the side flaps **13, 13', 13"** and the engagement edges **15, 15', 15"** can form substantially flat faces.

[0036] The external back **14, 14', 14",** the side flaps **13, 13', 13"** and the engagement edges **15, 15', 15"** define and delimit within them an internal channel **12.**

[0037] The profile **10, 10', 10", 10'''** is obtained by substantially cold deforming a band or strip of metal material that forms two major faces FM**1**, FM**2**.

[0038] In the present description hot and cold deformating a metal indicate processings in which the metal is plastically deformed respectively above and below the recrystallization temperature of the metal itself.

[0039] From the external surface of the external back **14** a plurality of anchoring nails **16** can extend, configured as anchoring elements of the fixing profile, i.e. to be fixed onto a first structural component, typically a concrete item.

[0040] Each anchoring nail **16** is preferably provided with a fixing end **18** which preferably forms a head, a cylindrical leg **20** with a constant section, preferably circular, and a connecting portion **22** with the external back **14** of the fixing profile **10.**

[0041] Preferably, the fixing system comprises one or more connectors **24, 24'** described in more detail below and configured to be inserted into the internal channel **12** of the fixing profile **10** or however to be engaged with the first toothing(s) **17** of a related fixing profile **10, 10', 10" 10'''.**

[0042] The connectors **24** can advantageously have the shape of a generally and substantially flat plate (Figure **1, 3**), with an overall square, rectangular (Figure **1, 3**), polygonal shape, more or less oblong and a more or less rounded profile.

[0043] In combination or alternatively to such expedient, the fixing system can comprise one or more screws whose heads -which may for example be hammer or anchor heads (Figure **10**) **-** are inserted into the internal channel **12** of the fixing profile **10.**

[0044] The connectors **24** can be provided already inserted into profiles **10** by the installer of the profiles, or the purchaser of the profiles **10** can inserts the connectors **24** or the screws into the profiles themselves before having cemented or installed them.

[0045] Said fixing system can possibly further comprise a counter-plate **58** -which can have for example the shape of an L-shaped bracket; the aforementioned threaded pin **30,** a nut or another female screw **62** and possibly a washer **60** (Figure **11**).

[0046] According to an aspect of the invention, in the fixing profile **10, 10', 10", 10'''** at least one from among the two major faces FM**1**, FM**2** at or near at least one of the two engagement edges **15** forms at least a first toothing **17.**

[0047] Advantageously, at least one from among the two major faces FM**1**, FM**2** at or near both engagement edges **15** forms at least one toothing **17.**

[0048] Preferably, each first toothing **17** extends at least along half of the overall length of the profile **10,** more preferably along at least three quarters of such length, even more preferably along at least **0.9** times such length and even more preferably along the entire total length of the profile **10.**

[0049] The internal channel **12,** the external back **14,** the at least two engagement edges **15** and each toothing **17** extend parallel or more generally longitudinally to the fixing profile **10.**

[0050] Alternatively or in combination with what has been described up to now, each toothing **17** extends parallel or more generally longitudinally to the engagement edge on which it is obtained.

[0051] Still according to an aspect of the invention, the at least one toothing **17** -and more preferably each toothing **17-** is obtained by plastic deformation.

[0052] Advantageously each first toothing **17** and/or second toothing **41,** described in more detail below, is obtained by moulding, rolling, bending or more generally plastic deformation, cold.

[0053] Advantageously, the at least one toothing **17** is of the straight tooth type **170,** in the sense that each tooth extends in a direction substantially perpendicular to the line -or however to the row- formed by the various teeth **170** of the toothing (Figure **2A, 2B**).

[0054] In other embodiments not shown, however, the at least one toothing **17** can also be of the angled tooth type.

[0055] Advantageously both toothings **17** are obtained on a portion of one of the two major faces FM**1**, FM**2** turned towards the inside of the profile **10** (Figure **2, 2A, 4, 6, 7, 11**).

[0056] Furthermore, this makes it even more convenient to arrange the first toothings **17** and possibly the connector **24, 24'** inside the profile **10,** where they are more protected from splashes of liquid concrete that could otherwise filter between the toothings **41** and **17** reducing the adherence and resistance to longitudinal sliding.

[0057] Alternatively, as shown for example in Figure **8**, **9** both toothings **17** are obtained on a portion of one of the two major faces FM**1**, FM**2** turned towards the outside of the profile **10".**

[0058] Preferably the teeth **170** of each toothing **17** have substantially trapezium shaped cross sections (Figure **2**A) i.e. severed tip or triangular shaped.

[0059] Advantageously, the cross sections of the teeth **170** of each toothing **17** have a minimum height HD comprised between **0.8-4.0** millimetres, and more preferably comprised between **1-3** millimetres and for example equal to **1.5** millimetres, where such height HD means the difference in level between the top and the deepest point of the same cross section of the tooth in question (Fig.**2**A).

[0060] Advantageously, the cross sections of the teeth **170** of each toothing **17** form an angle at the vertex α [alpha] preferably comprised between **85°-135°** and, for example, equal to **90°.**

[0061] Preferably, the teeth **170** of the toothing **17** have a length WD comprised between **2-10** millimetres and more preferably between **3-6** millimetres (Figure **2**A).

[0062] Such dimensions, shapes and, in general, constructional features of the teeth of the toothings **17** enable or, however, make easier teeth themselves be produced through plastic cold forming .

[0063] Advantageously, as will be described in more detail below, the toothings **17** are made through a first step in which semi-processed teeth are made - belonging to the corresponding semi-processed toothings - through cold deformation; in this step, the top of each tooth may be flat, rounded or even form, for example, a substantially sharp or pointed crest; still in this first step two adjacent semi-processed teeth are separated by a preferably V-shaped notch.

[0064] Preferably, the teeth of the toothings **17** assume their final shape already -and only- with this first cold

deformation step.

[0065] With the subsequent bending process, which is preferably a dynamic process in which the metal sheet crosses a suitable series of forming rolls, the toothings **17** are generally subject to the stretching of the surface of the metal sheet.

[0066] The technique adopted can partly modify the shape of the hollow zone comprised between two adjacent teeth.

[0067] The toothing thus obtained has a shape repetitiveness consisting of flat, rounded or cusp shapes in the upper part of the tooth and the lower W-shaped part can acquire in the plan view a trapezoidal shape suitable for housing the teeth **410** of the toothings **41** of the connector **24.**

[0068] Each toothing **41** preferably comprises a row of teeth **410;** each of such rows is preferably arranged at a respective engagement surface **38** or **40,** and is preferably parallel or longitudinal to such respective engagement surface **38** or **40.**

[0069] The pitch and the dimensions of the teeth previously indicated enable a more uniform displacement of the material so that the toothed profile is regular both in the finished product and during processing.

[0070] The invention shows that the subsequent passages through the rollers do not compromise the quality of the toothing obtained, which remains sufficiently deep.

[0071] The toothing obtained from the process described enables the fixing to increase the sliding load performance increasing from **2** to **5** times the sliding load of the anchorage with respect to the load obtained without the toothings **17.**

[0072] The toothing enables the sliding load resistance to be made greater than or equal to the tensile load resistance.

[0073] Each connector **24** advantageously has a cross sectional shape and size that conform, for example substantially complementary, to the internal shape of the internal channel **12** of the related fixing profile **10.**

[0074] Each connector **24** advantageously has a length L, measured in the longitudinal direction of the fixing profile **10,** greater than the width W**1**, measured in the cross sectional direction of the fixing profile **10,** of the connector **24** itself (Figure **3**).

[0075] Advantageously, the length L of the connector **24** is greater than or equal to **1.15** times its width W**1**, and even more preferably greater than or equal to **1.6 or 2** times the width W**1**.

[0076] Advantageously, the length L of the connector **24** is greater than or equal to **24** millimetres, more preferably greater than or equal to **40** or **40** millimetres.

[0077] Significant lengths L increase the resistance of the fixing system, enabling it to reach high resistance values and fulfil the needs expressed in the structural calculations by European legislation, even if threaded bars **30** produced by third parties, which are not made by the same manufacturer as the profile **10,** are screwed thereto, and connectors **24,** with steels commonly found in the world.

[0078] Advantageously, the connector **24** is arranged in the profile **10** when the assembly is offered to the buyers by the fixing manufacturer, preferably enabling the connector **24** to move along the profile **10** for adjusting the anchorage before locking it and fixing it definitively.

[0079] The profile **10** and connectors **24** preferably form a single supply kit able to offer known and certified performance levels.

[0080] Previously the anchorage comprised two distinct parts, the profile **10** and one or more bolts of the type shown in Figure **10;** it was recommended to the user to use them correctly without combining profiles **10** and bolts coming from different manufacturers.

[0081] The previous teachings enable, in addition to what is known up to now, the sliding, or longitudinal shear, load resistance to be increased, as a third performance of the anchorage after the transverse shear and tensile resistance.

[0082] The anchorage with sliding performance is obtained with the simple use of common threaded bars **30** to be combined with the threaded hole **26** of the connector **24.**

[0083] Advantageously, such threaded bars **30** have a standard thread MA, which can be easily found all over the world.

[0084] Such threaded bars **30** can be easily coupled with the connectors **24** which can be advantageously and cheaply produced by the same manufacturer as of the profiles **10** making the first toothings **17** and the second toothings **41** with the most appropriate coupling tolerances so as to increase the mechanical resistance of their coupling as much as possible.

[0085] Furthermore, the plate connectors **24** can be easily coupled with threaded pins **30** having various lengths, which can be very easily found in most countries and also in relatively remote places.

[0086] As, for example, in the embodiment of Figures **1, 2, 6, 8** the engagement edges **15** can be advantageously inclined towards the external back **14** of the profile **10,** i.e. bent towards the inside of the profile **10,** with an angle of inclination β, β' [beta, beta first] preferably comprised between **40°-90°,** more preferably between **50°-75°,** even more preferably between **60°-70°** and for example equal to about **68°.**

[0087] Advantageously, the angle of inclination β, β' is substantially acute.

[0088] An acute angle β, β' and for example comprised between **40°-90°** makes the fixing system **2** much more resistant to axial tractions on the pins **30.**

[0089] The engagement edges **15** join the respective side flaps **13, 13'** forming bends whose internal surfaces have average radii of curvature RC preferably comprised between **0.5** and **5** millimetres, and more preferably between **1** and **3** millimetres (Figure **6**A).

[0090] The two side flaps **13, 13'** are inclined with respect to the external back 14, 14' by an angle γ, γ' [gamma, gamma first] preferably comprised between **45°-**

130°, more preferably between **85°-100°** and even more preferably between **87°-92°.**

[0091] Angles γ, γ' proximal to **90°,** and for example comprised between **75°-105°,** between **80°-100°** or between 87°-92° increase the tensile resistance of the fixing system making it particularly suitable for making anchorages buried in concrete elements; such angles make the anchoring of the profile **10** to the concrete particularly effective and firm, possibly making the anchorages **16** superfluous.

[0092] As, for example, in Figure **6, 8** the angle γ [gamma] may be comprised between **85°-100°** or about between **87°-92°** .

[0093] As, for example, in Figure **7, 9** the angle β' [beta, beta first] can be comprised for example between **90°-120°** and the angle γ' [gamma first] can be comprised, for example, between **65-75°** degrees.

[0094] Accordingly, each connector **24** is preferably provided with a pair of inclined engagement surfaces **38** and **40** which can be engaged in shape coupling with the respective engagement edges **15** of the fixing profile **10, 10'.**

[0095] Furthermore, advantageously on each engagement surface **38, 40** a second toothing **41** is provided configured for being engaged with the toothing **17** of the corresponding engagement edge **15** (Figure **3**).

[0096] As will be set out in detail below, the teeth of the first toothings **17** of the engagement edges **15** actually can have strongly variable cross sections, which can be seen in Fig **2**B, ideally moving along the direction of the width of the tooth itself, and have a substantially overall wedge shape, as shown for example in Figures 2A, 2B.

[0097] The second toothings 41 and/or the first toothings 17 can be zinc-coated, for example hot zinc-coated, without this compromising the correct operation and mechanical resistance.

[0098] For coupling with the possible wedge shape of the teeth of the toothings **17,** the teeth **410** of the toothings **41** are smaller than the teeth of the toothings **17** so as to be able to enter sufficiently into the compartments between the teeth of the toothings **17,** as shown for example in Figure **2B,** where the profiles of the cross sections of the teeth **410** of the toothings **41** are shown with dashed and dotted lines.

[0099] The teeth **410** of the toothings **41** can have cross sections with substantially constant sizes and shapes, ideally moving along the width direction of the tooth itself.

[0100] The contact between the two inclined surfaces **38** and **40** of the connector **24** and the two corresponding engagement edges **15** of the fixing profile **10** allow the loads be stably transferred from the connector **24** to the internal channel **12,** passing from such open upper edge to the external back **14,** and from such external edge **14** to the anchoring nails **16** that enable the definitive transfer of the loads to the concrete.

[0101] The engagement between the toothings **17** and **41** notably increases the resistance of the fixing system to longitudinal sliding loads. For example, it was possible to obtain a profile **10** whose sliding resistance passed from **600** kg for smooth surfaces **15** to **2,300** kg for toothed surfaces **17.**

[0102] The profile **10** according to the mentioned claims was designed to have a tensile load resistance of **1,700** kg.

[0103] Each connector **24** is also preferably provided, at the respective inclined surfaces **38** and **40,** with a pair of rounded edges **42** and **44** configured for not generating indentations in the internal channel **12** in the assembled configuration of the fixing system.

[0104] The internal channel **12** advantageously has an overall height H, measured between the external back **14** and the open edge, which is smaller than the width W**2**, measured in the transverse direction of the fixing profile **10,** of the internal channel **12** itself.

[0105] This latter feature enables the fixing profile **10** to occupy a reduced space within the concrete, thanks to the low depth of the internal channel **12,** allowing for example the profile **10** to be positioned above the reinforcing bars/rebars.

[0106] A penetration -or embedding- by a greater depth H of the fixing profile **10** in the concrete can increase the fixing performance and therefore the load applicable to the fixing, but constrains the positioning of the reinforcement cages, imposing possible changes to the design and complex steps for preparing the reinforcements.

[0107] The mechanical effects on the fixing system between the engagement edges **15,** the toothings **17** of the channel and the inclined surfaces **38, 40** and the toothings **41** of the connector **24** enable lower punctual strain with respect to the anchoring bolts of the system itself, contributing to greater performance levels with less local stress and a greater distribution of high loads with respect to the loads supported - or applied - by the anchoring bolts **24'.**

[0108] In this way, the use of calculation coefficients in use in the design legislative standards give the fixing system higher levels of safety, an aspect which cannot be neglected in light of the applications of the fixing in the fixing sector for building constructions.

[0109] Each connector **24** can be provided with a connection portion **26,** having for example the shape of a circular, square, polygonal hole, slit or other opening or female seat, preferably provided with a standard thread MA or other standard mechanism.

[0110] The adoption of a "standard" connection characterises the anchoring system simplifying the compatibility of the present invention with accessories that can be easily found throughout the world such as, for example, a simple threaded bar **30** preferably provided with a standard or unified thread, preferably MA.

[0111] On the other hand, the state of the art of anchoring systems with anti-sliding features exclusively provided for the use of bolts with a head designed like the channel **12,** such as, for example, the anchor head screw **24'** shown in Figure **10.**

[0112] Now, anchor head screws are not commonly

used and may be difficult to find, especially in certain regions of the world and in case of urgency, causing building site delays.

[0113] During the mounting of the connection system and prior to being tightened, each connector **24** can slide in and along the internal channel **12** of the respective fixing profile **10.**

[0114] During the mounting in the site, the connector **24** can change position until the moment of tightening the bolt or other pin **30** with the other fixing components.

[0115] The threaded pin **30** can possibly be provided with a hexagonal end **31** -for example male hexagonal - which enables it to be screwed with electric screwdrivers.

[0116] Using the threaded pin **30** with electric screwdrivers **26** fixing the pin 30 in the hole 26 of the connector **24** is extremely quick and safe.

[0117] The hexagonal head **31** may be male or female - in the latter case internal to the threaded bar **30.**

[0118] In embodiments not shown, the hexagonal end can be replaced with male or female coupling heads provided for coupling with corresponding screwing tools, and have for example a Torx shape (R).

[0119] This enables the fixing system to assume an adjustable position along the channel **12.**

[0120] The connector **24** enables the load to be applied to the fixing profile **10** at any point along its length and independently from the position of the anchored nails **16** placed on the external back **14** of the fixing profile **10** itself.

[0121] According to an aspect of the present invention, the fixing profile **10** previously described can be produced through the following process:

S.**1**) preparing a metal sheet LM which forms two major faces FM**1**, FM**2** facing in two directions in the space substantially opposite each other;

S.**2**) making on at least one of such major faces at least one toothing **17** extending in a predetermined working direction DL, by plastic cold forming;

S.**3**) bending, again by cold deformation, the semi-finished product obtained by step S.**2** in order to obtain the fixing profile **10** so that the latter has substantially C-shaped cross sections and forms the aforesaid internal channel **12,** external back **14** and so that the at least two engagement edges **15,** the at least one toothing **17** is located at or near to a respective engagement edge **15,** and so that the inner channel **12,** the outer back **14,** the at least two engagement edges **15** and the at least one toothing **17** extend longitudinally with respect to the fixing profile **10.**

[0122] In step S.**1** the metal sheet LM is preferably a metal band or strip, preferably flat.

[0123] The predetermined processing direction DL in step S.**2** may be for example the direction in which the metal sheet is caused to advance during a rolling step or in a continuous bending machine.

[0124] A continuous bending machine in the present description means a machine comprising a plurality of work stations that simultaneously perform respective processes on the band, strip or other metal sheet while it advances along the machine itself.

[0125] Preferably in step S.**2**), at least two toothings **17** parallel or at least longitudinal to one another are created on at least one of such major faces, through plastic cold forming and both toothings **17** extend in the predetermined processing direction.

[0126] Preferably, in step S.**2**) each toothing **17** is arranged at or near to a respective edge of the metal sheet and is preferably arranged substantially parallel or longitudinal to such edge, which preferably forms one of the engagement edges **15** of the finished **10** profile.

[0127] In step S.**2** the toothing or toothings **17** can be made through an appropriate die **50** provided with a forming toothing **52** in turn comprising a plurality of forming teeth **520** (Figure **4, 4**A).

[0128] The die **50** is or advantageously comprises a forming roller configured for forming -for example by moulding or pressing **17-** the finished profile **10** rolling or roto-translating on the starting band, strip or other metal sheet LM (Figure **4**, **4**A).

[0129] Advantageously the forming toothing or toothings **52** extend at or in proximity to the bases - or other ends - of the forming roller **50** (Figure **4**).

[0130] In that case the forming toothings **52** are separated by an appropriate distance from one another (Figure **4**).

[0131] Advantageously, at least part of the forming teeth **52,** and more preferably all, have triangular shaped (Figure **4**A) or severed tip shaped (Figure **4**B) cross sections, so as to be able to produce toothings, described in more detail, having teeth whose cross sections are also substantially triangular or trapezoidal.

[0132] Teeth of such shapes form semi-processed toothings **17"** whose teeth may possibly be later deformed by bending rollers **54, 56** reducing the total movements of the metal -and therefore the internal tensions- and without excessively changing the overall shape of the teeth during the deformation.

[0133] In other embodiments not shown, at least part of the forming teeth **520,** and more preferably all of them, have substantially trapezium or cusp shaped cross sections.

[0134] Preferably, the cross sections of the forming teeth **520** have a minimum height HDF comprised between **1** and **10** millimetres or between **1** and **5** millimetres or between **1** and **3** millimetres, and more preferably comprised between **1.5-2.5** millimetres and for example about equal to **2.3** millimetres, where such height HDF means the difference in level between the top and the deepest point of a same cross section of the tooth in question (Figure **4**A).

[0135] Preferably, the cross sections of at least part of the forming teeth **520,** and more preferably all of them, form an angle at the vertex α [alpha] preferably com-

prised between **30°-110°** or between **40°-90°,** and for example equal to **60°** (Figure **4**A).

[0136] Preferably, step S.**2** is performed prior to step S.**3**.

[0137] A possible particular example used in the aforementioned fixing system is now described.

[0138] The fixing profile **10,** in which one or more connectors **24** or **24'** have been previously inserted, can be for example embedded in a concrete cast leaving the internal channel **12** and the connectors **24** or **24'** facing the external environment.

[0139] Once the concrete has solidified, one or more of the threaded pins **30** can be threaded into the respective threaded holes **26** or other connecting portions **26** of the various connectors.

[0140] The threaded pins **30** may possibly be glued into the respective female seats **26** of the connectors **24** increasing cohesion and preventing any detachment.

[0141] Possibly counterplates **58** and washers **60** can be inserted onto the threaded pins **30** and respective nuts **62** can be screwed so as to clamp the counterplates in a pack against the profile **10.**

[0142] The counterplates **58** can have the shape of brackets to which other concrete or metal components or components of electrical or electronic appliances can in turn be fixed.

[0143] The counterplates **58** can possibly be previously buried in other concrete elements to be assembled to the first.

[0144] A possible particular embodiment of a process for producing the fixing profile **10** is now described.

[0145] A metal band slides in a continuous bending machine -not shown- in the predetermined direction DL.

[0146] In a first work station, the band is crushed and engraved by the roller **50** which rolls on the metal band LM rotating onto itself about an axis AR**1** preferably perpendicular to the predetermined sliding direction DL.

[0147] Through cold deformation the two forming toothings **52** of the roller **50** form along the band LM two semi-processed toothings **17",** which extend parallel -or more generally can extend longitudinally- to one another (Figure **4**).

[0148] Possibly the teeth of such semi-processed toothings **17"** can in part project above the remaining surface of the metal band LM.

[0149] Subsequently, one or more bending stations, at least one of which may be provided with a pair of bending rollers **54, 56** of the type shown in Figure **5,** bend the metal band so as to form the fixing profile **10,** in particular forming the internal channel **12,** the external back **14** and the two engagement edges **15.**

[0150] One or more pairs of bending rollers preferably comprise a first **54** and a second roller **56** which both form two truncated cone-shaped or however tapered end stretches (Figure **5**).

[0151] Such rollers preferably rotate on themselves about axes of rotation AR**2**, AR**3** parallel to one another.

[0152] Preferably, the shapes of the sides of the rollers are substantially complementary to one another (Figure **5**).

[0153] For that purpose, preferably in the first **54** and in the second roller **56,** the diameter of such ends is respectively increasing and decreasing ideally moving along the axis AR**2**, AR**3** and towards the outside of the roller itself.

[0154] There may be three or more of such bending stations and for example a number comprised between **3-25, 5-20, 5-14** stations.

[0155] In a known way, the metal band LM is pressed passing into the middle of each pair of bending rollers **54, 56;** in particular when pulling the metal sheet and making it advance in the various bending stations, each pair of bending rollers **54, 56** possibly deforms the semi-processed toothings, possibly giving the teeth more of a wedge shape, without compromising the ability of the toothings **41** of the connectors **24** to be coupled.

[0156] Preferably the predetermined working direction DL coincides with the longitudinal direction in which the finished profile **10, 10', 10", 10'''** extends.

[0157] As partly already described, the toothings **17** enable the sliding resistance of the fixing systems of the type in question to be notably increased.

[0158] This enabled the author of the present invention to obtain the results previously disclosed.

[0159] The cold deformation of the toothings **17** hardens and toughens the metal, increasing the mechanical resistance of the toothings **17** themselves in general; at the same time, it enables the necessary processes for producing the profiles **10, 10', 10", 10'''** to be uniformed, enabling them to be obtained mainly if not exclusively through cold deformations and increasing the efficiency and productivity of the production process and in particular reducing energy consumptions, in particular if compared with the energy consumptions of drawing processes or more generally hot forming processes, making the production process eco-sustainable.

[0160] Most of the processes for producing fixing profiles **10, 10', 10", 10'''** can be performed by the same bending machine, preferably of the continuous type.

[0161] As already mentioned, the toothings **17** performed on the fixing profile through cold moulding -or more generally deformation- are more resistant to toothings that have been hot moulded or made for example by the removal of shavings, contributing to increasing the mechanical resistance of the profile **10, 10', 10", 10'''** not only to sliding but also to shear and tensile strain.

[0162] The embodiments previously described are subject to different modifications and variations without departing from the scope of protection of the present invention.

[0163] For example, the threaded pins or even not threaded **30** can also be obtained as single parts from the respective connectors **24'.**

[0164] Every reference in this description to "an embodiment", "an example of embodiment" means that a particular feature or structure described in relation to

such embodiment is comprised in at least one embodiment of the invention and in particular in a particular variant of the invention as defined in a main claim.

[0165] The fact that such expressions appear in various steps of the description does not imply that they necessarily only refer to the same embodiment.

[0166] Furthermore, when a feature, element or structure is described in relation to a particular embodiment, it is observed that it falls within the skills of the average person skilled in the art to apply such feature, element or structure to other embodiments.

[0167] Numerical references that only differ in terms of different superscripts **21', 21", 21**^{III} unless specified otherwise indicate different variants of an element with the same name.

[0168] Moreover, all details may be replaced with other technically equivalent elements.

[0169] For example, the materials used, and the dimensions, may be any according to the technical requirements.

[0170] It is to be understood that an expression of the type "A *comprises* B, C, D" or "A *is formed by* B, C, D" also comprises and describes the special case in which "A *is comprised of* B, C, D".

[0171] The expression *"A comprises an element B"* unless specified otherwise can be interpreted as *"A comprises one or more elements B".*

[0172] References to a "first, second, third, ... n-th entity" have the sole aim of distinguishing them from one another but the indication of the n-th entity does not necessarily imply the existence of the first, second ... (n-**1**)th entity.

[0173] The examples and lists of possible variations of this application are to be considered as non-exhaustive lists.

Claims

1. Fixing system for building constructions comprising at least one fixing section **(10, 10', 10", 10''')** having C-shaped cross-sections, wherein:

- said fixing section **(10, 10', 10", 10''')** forms an internal channel **(12),** an external back **(14)** and at least two engagement edges **(15, 15', 15");**
- the fixing section is obtained by substantially cold deforming a metal sheet (LM) forming two major faces (FM**1**, FM**2**);
- at least one of the two major faces (FM**1**, FM**2**) of the metal sheet (LM) at or near at least one of the two engagement edges **(15, 15', 15")** forms at least a first toothing **(17);**
- the internal channel **(12),** the external back **(14),** the at least two engagement edges **(15, 15', 15")** and the at least one first toothing **(17)** extend longitudinally with respect to the fixing profile **(10);**
- the at least one first toothing **(17)** is obtained by plastic cold forming.

2. Fixing system according to claim **1,** wherein the at least one first toothing **(17)** is made on a portion of one of the two major faces (FM**1**, FM**2**) facing the inside of the fixing profile **(10, 10', 10", 10''')** itself.

3. Fixing system according to claim **1** or **2,** wherein the at least one first toothing **(17)** is made on a portion of one of the two major faces (FM**1**, FM**2**) facing the outside of the fixing profile **(10, 10', 10", 10''')** itself.

4. Fixing system according to one or more of the previous claims, comprising one or more connectors **(24),** on each of which at least one second toothing **(41)** is formed, configured to engage with the at least one first toothing **(17)** of the fixing profile **(10, 10', 10", 10''').**

5. Fixing system according to one or more of the previous claims, in which the engagement edges **(15, 15', 15")** are inclined towards the external back **(14)** with a substantially acute angle of inclination β, β' [beta, beta first] and for example comprised between **40°-90°.**

6. Fixing system according to one or more of the previous claims, in which the fixing profile **(10, 10', 10", 10''')** forms two lateral flaps **(13, 13', 13")** that extend perpendicularly or however transversally to the external back **(14, 14', 14")** and are inclined with respect to the external back **(14, 14')** by an angle (γ, γ') comprised between **75°-105°** or between **85°-100°** or between **87°-92°.**

7. Fixing system according to claim **4,** wherein at least part of the connectors **(24)** are configured to be housed in the internal channel **(12)** of the fixing profile **(10, 10', 10", 10''').**

8. Fixing system according to one or more of the previous claims, wherein the at least one first **(17)** and/or second toothing **(41)** is of the straight tooth type.

9. Process for producing a fixing profile **(10, 10', 10", 10'''),** comprising the following steps:

S.**9.1**) preparing a metal sheet (LM) which forms two major faces (FM**1**, FM**2**) facing in two directions substantially opposite each other;
S.**9.2**) making on at least one of said major faces at least one toothing **(17)** extending in a predetermined working direction (DL), by plastic cold forming;
S.**9.3**) bending, again by cold deformation, the semifinished product obtained by step S.**9.2** in so as to obtain the fixing profile **(10, 10', 10",**

10''') so that the latter has substantially C-shaped cross sections and forms an internal channel **(12),** an external back **(14)** and at least two engagement edges **(15),** the at least one toothing **(17)** is located at or close to a respective engagement edge **(15),** and the inner channel, the outer back, the at least two engagement edges **(15)** and the at least one toothing **(17)** extend longitudinally with respect to the fixing profile **(10, 10', 10", 10''').**

10. Process according to claim **5,** comprising the following steps:

S.**10.1**) making on at least one of said major faces (FM**1**, FM**2**) by plastic cold forming at least two toothings **(17)** substantially parallel or in any case side by side with each other, and extending in the predetermined working direction (DL);
S.**10.2**) bending, still by cold deformation, the semifinished product obtained through step S.**10.1**) so as to obtain the fixing profile **(10, 10', 10", 10''')** so that each one of the at least two toothings **(17)** is located at or close to a respective engagement edge **(15)** and extends longitudinally to the fixing profile **(10, 10', 10", 10''')**.

11. Process according to claim **9** or **10,** wherein the at least one toothing **(17)** is made by means of a die **(50)** provided with a forming toothing **(52)** which in turn comprises a plurality of forming teeth **(520).**

12. Process according to claim **11,** wherein one or more forming teeth **(520)** has one or more of the following features:

- substantially triangular or trapezium shaped cross sections;
- cross-sections of substantially truncated cusp shape;
- cross-sections with a minimum height (HDF) comprised between **1** and **10** millimetres, and more preferably between **2-5** millimetres and for example about **3** millimetres;
- cross sections that form an angle at the vertex (α [alpha]) preferably comprised between **30°-110°** or between **40°** - **90°** and for example equal to about **60°.**

13. Process according to claim **9** or **10,** wherein step S.**9.2**) is carried out before carrying out step S.**9.3**), or step S.**10.1**) is carried out before carrying out step S.**10.2**).

14. Process according to one or more of claims **9** to **13,** wherein in step S.**9.3**) the semi-processed product obtained through step S.**9.2** is bent so as to obtain a fixing profile **(10, 10', 10", 10''')** having the features according to claim **2** or **3.**

15. Process according to claim **11,** wherein the die **(50)** comprises a roller configured for forming the at least one toothing **(17)** by rolling or roto-translating on said metal sheet (LM).

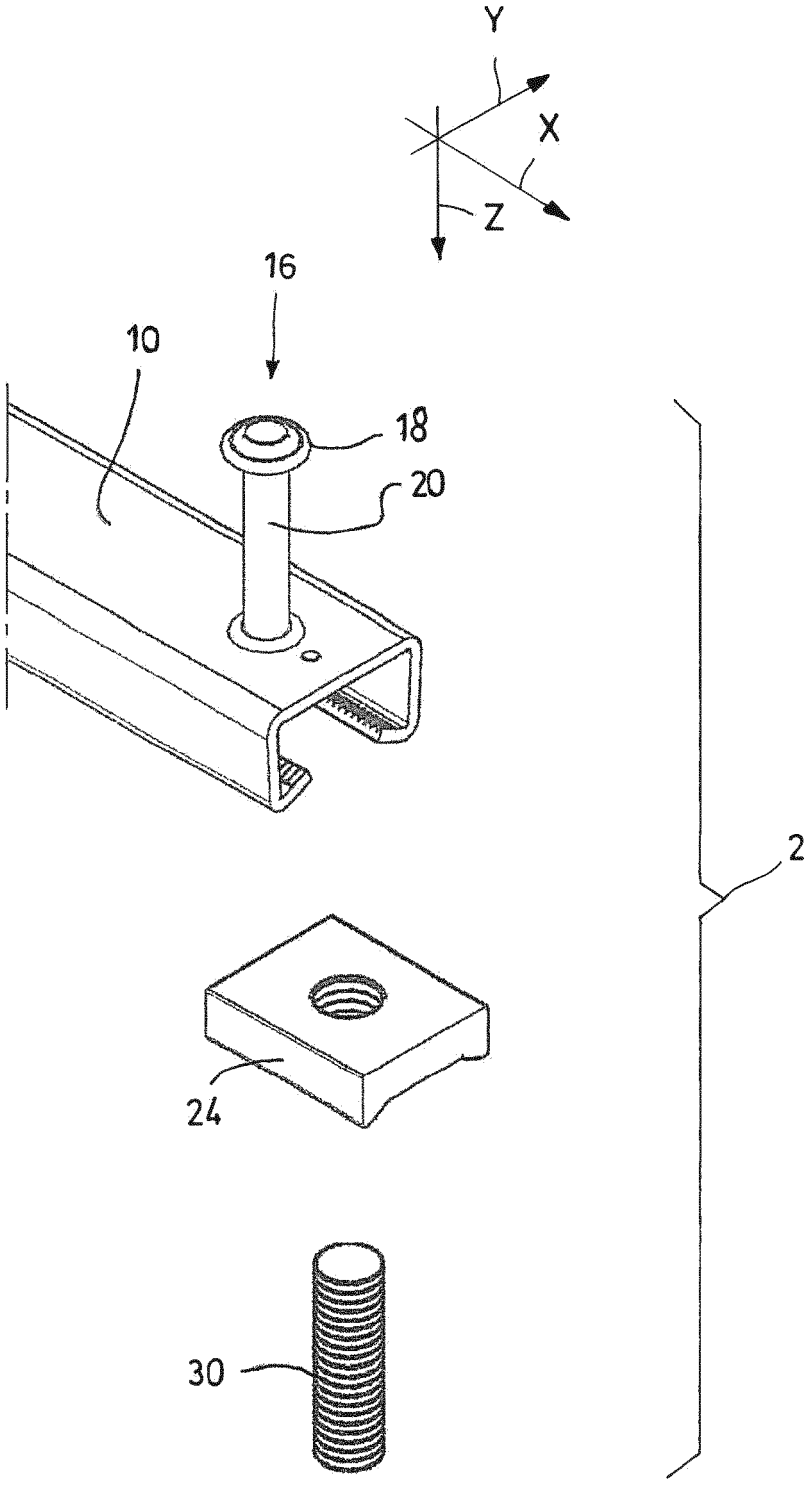


Fig.1

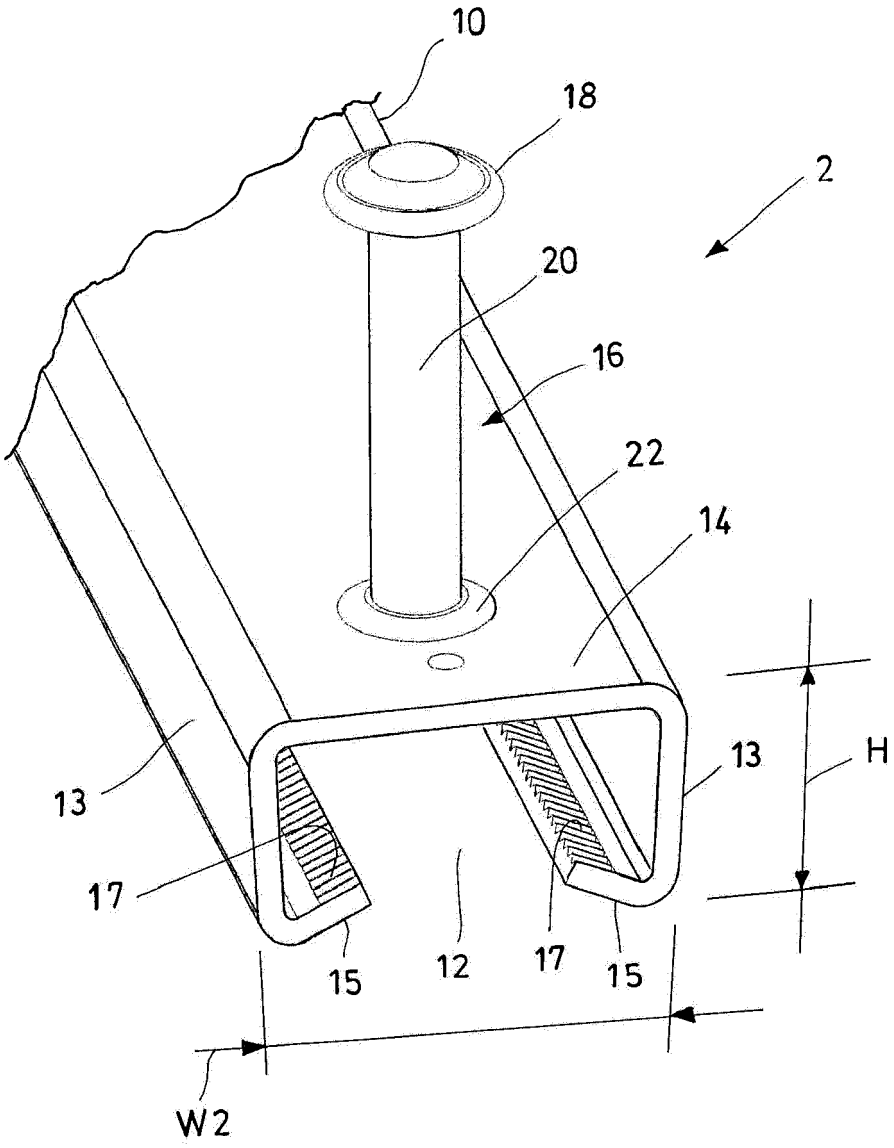


Fig.2

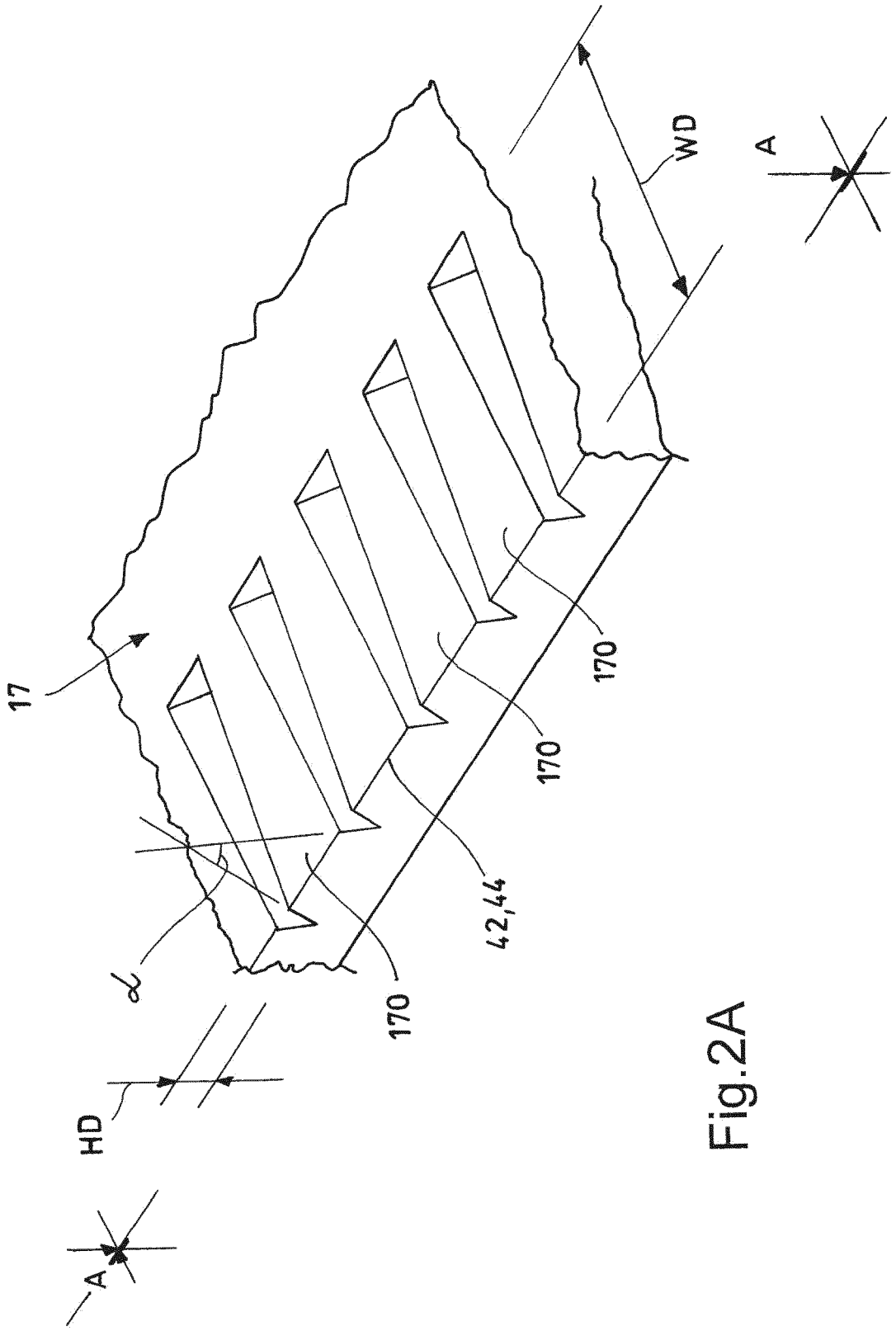


Fig.2A

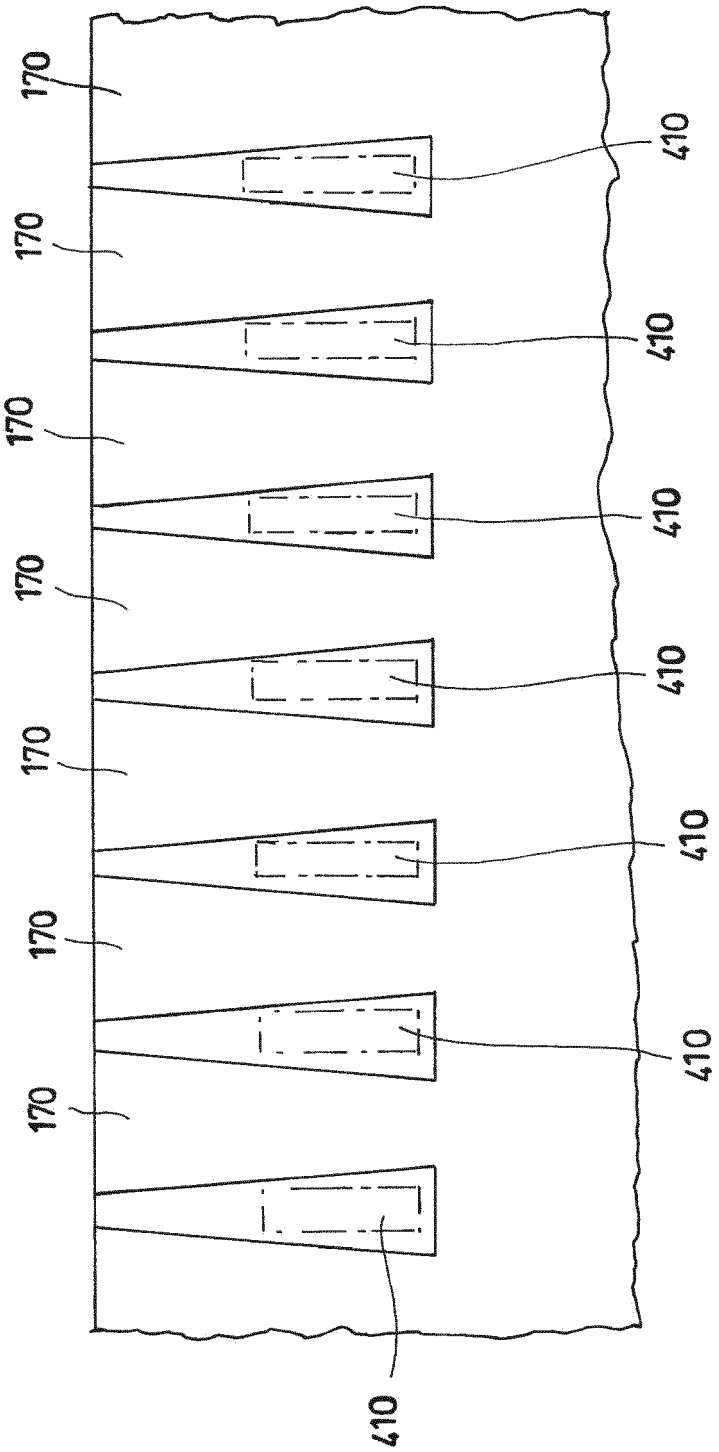


Fig.2B

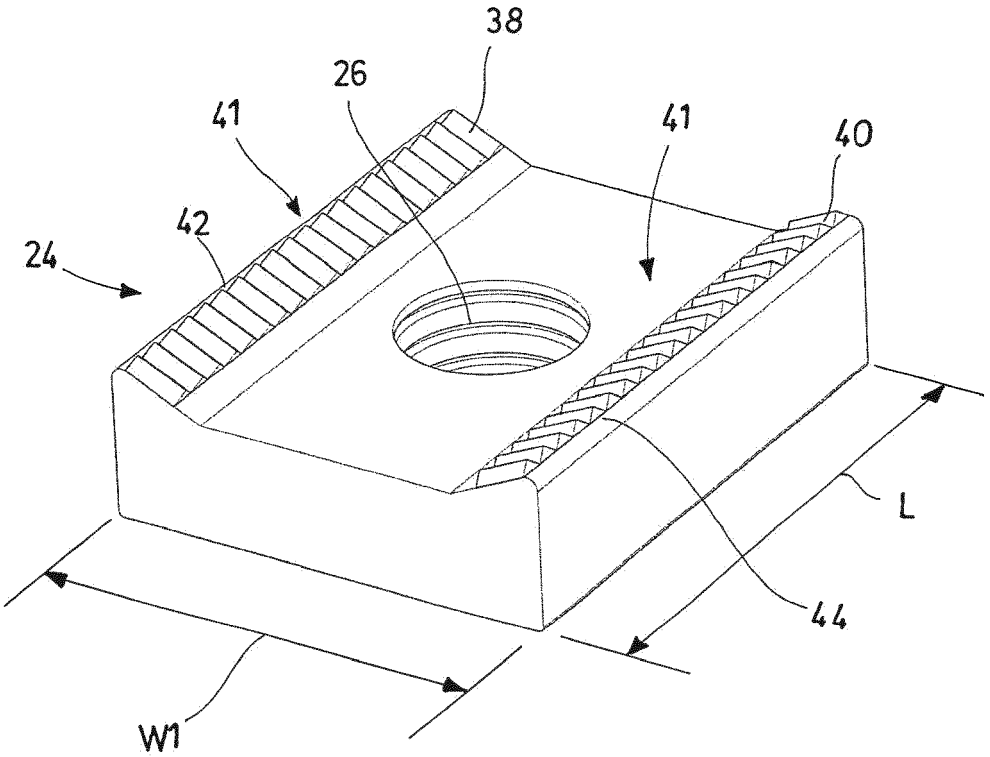


Fig.3

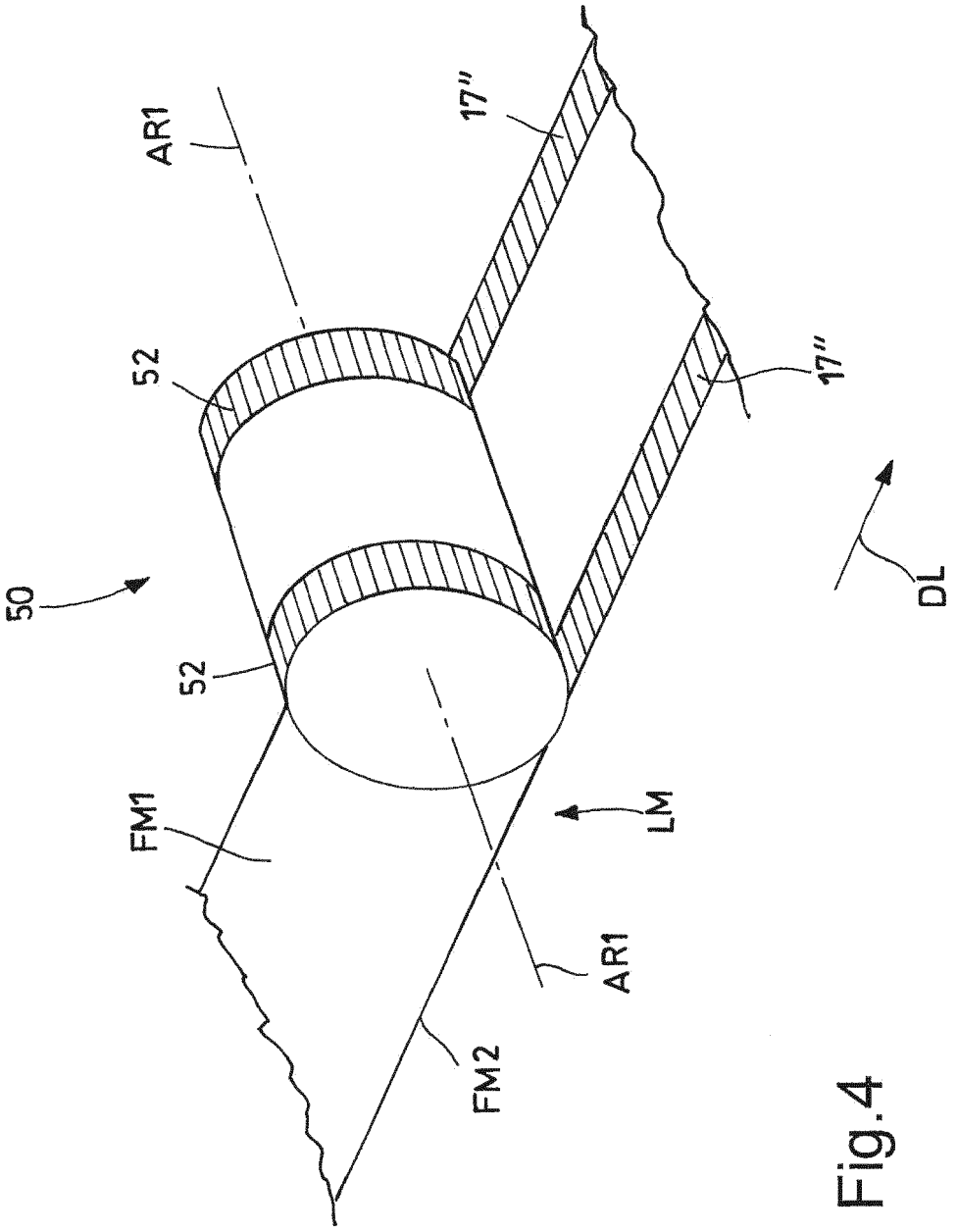


Fig.4

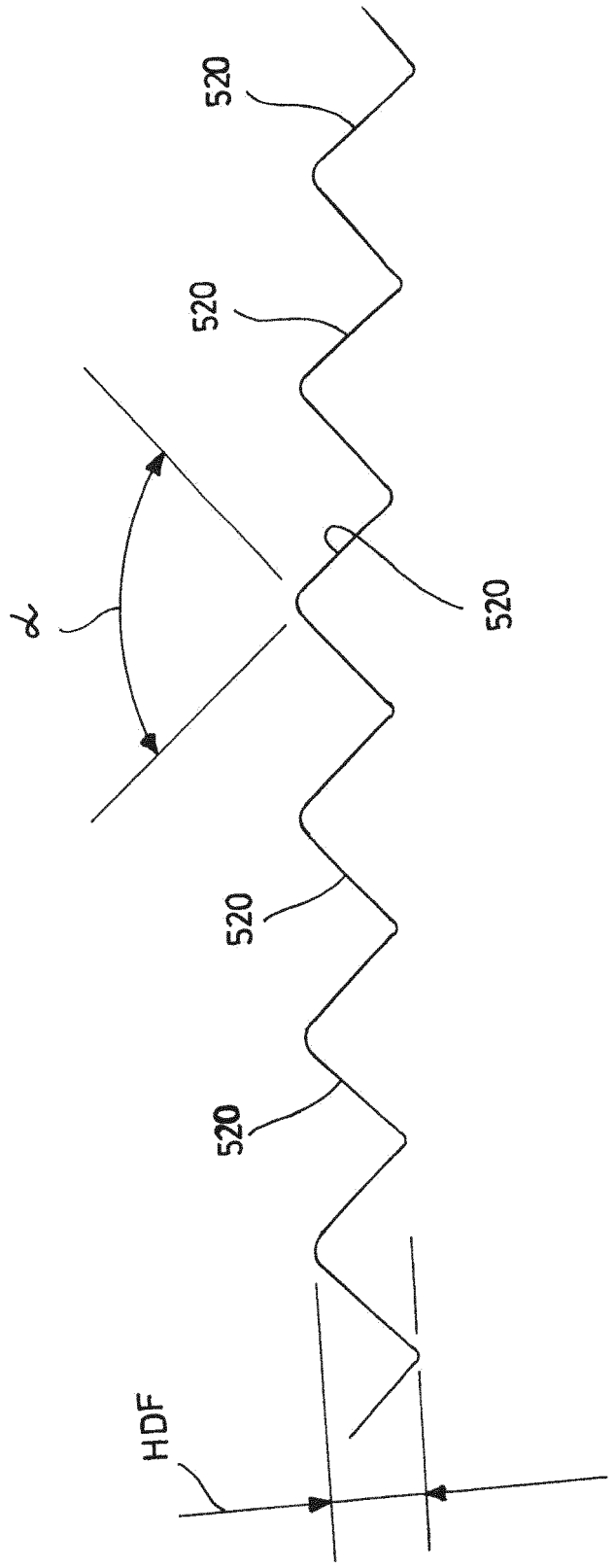


Fig.4A

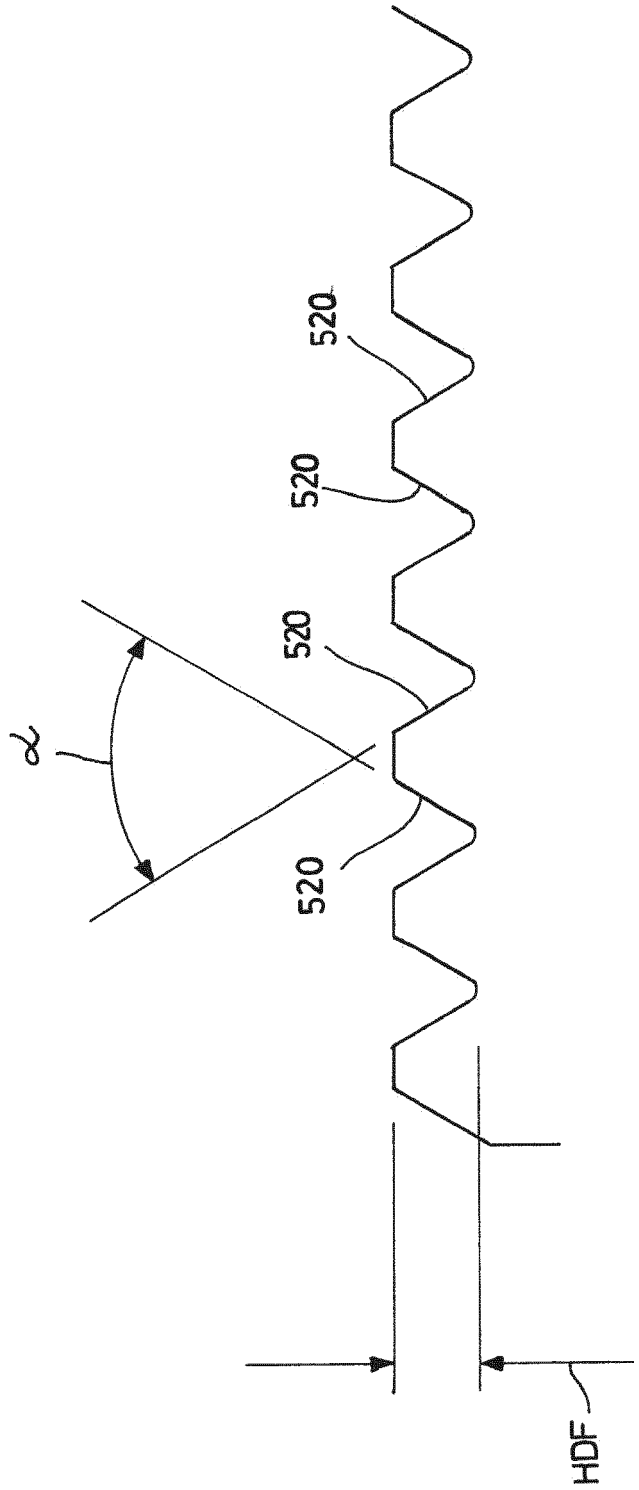


Fig.4B

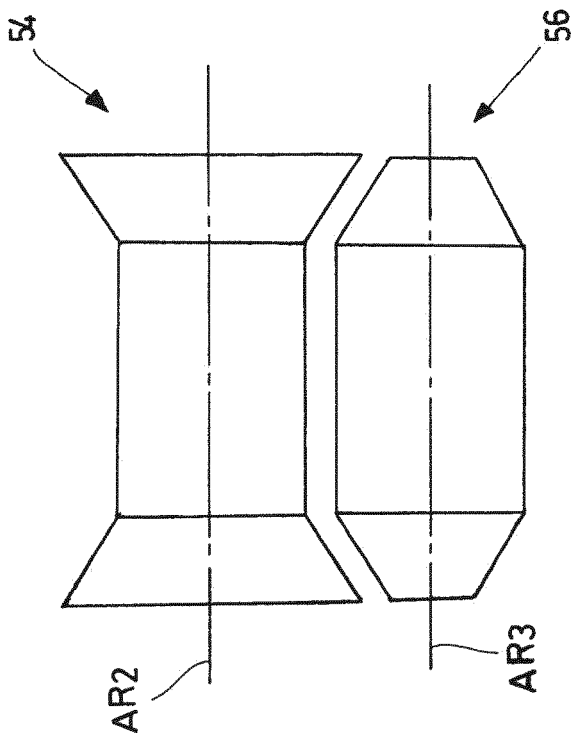


Fig.5

Fig.6

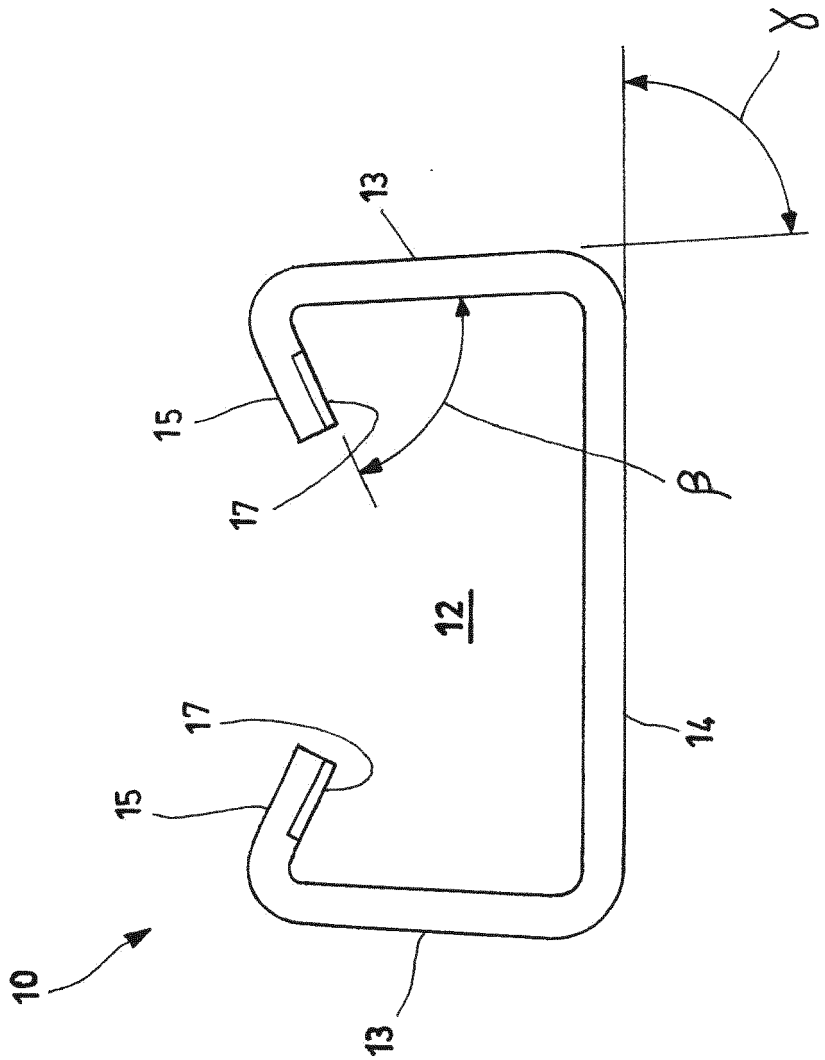
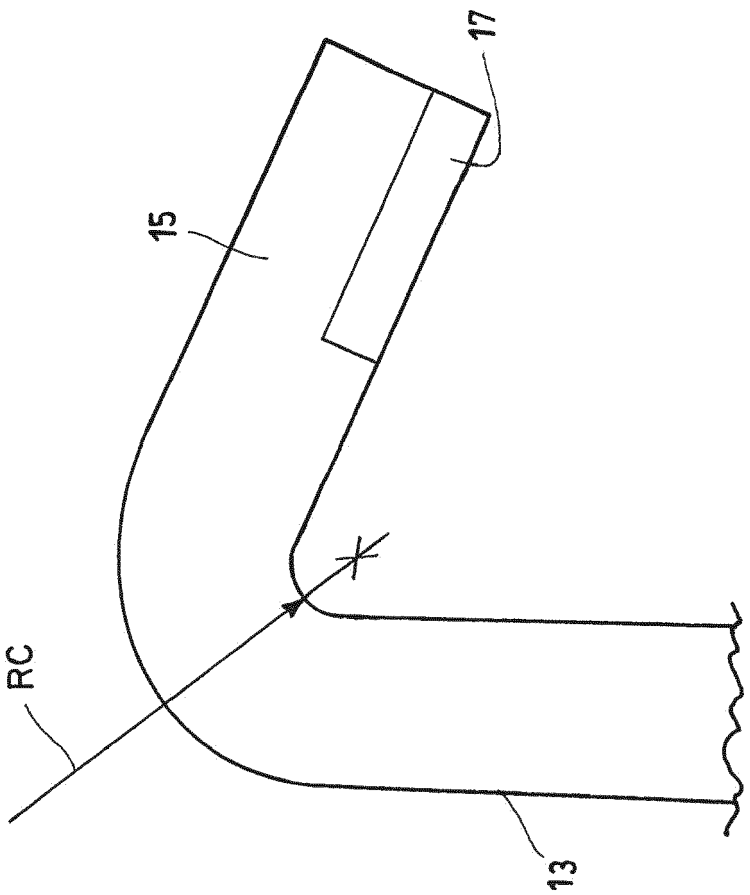


Fig.6A



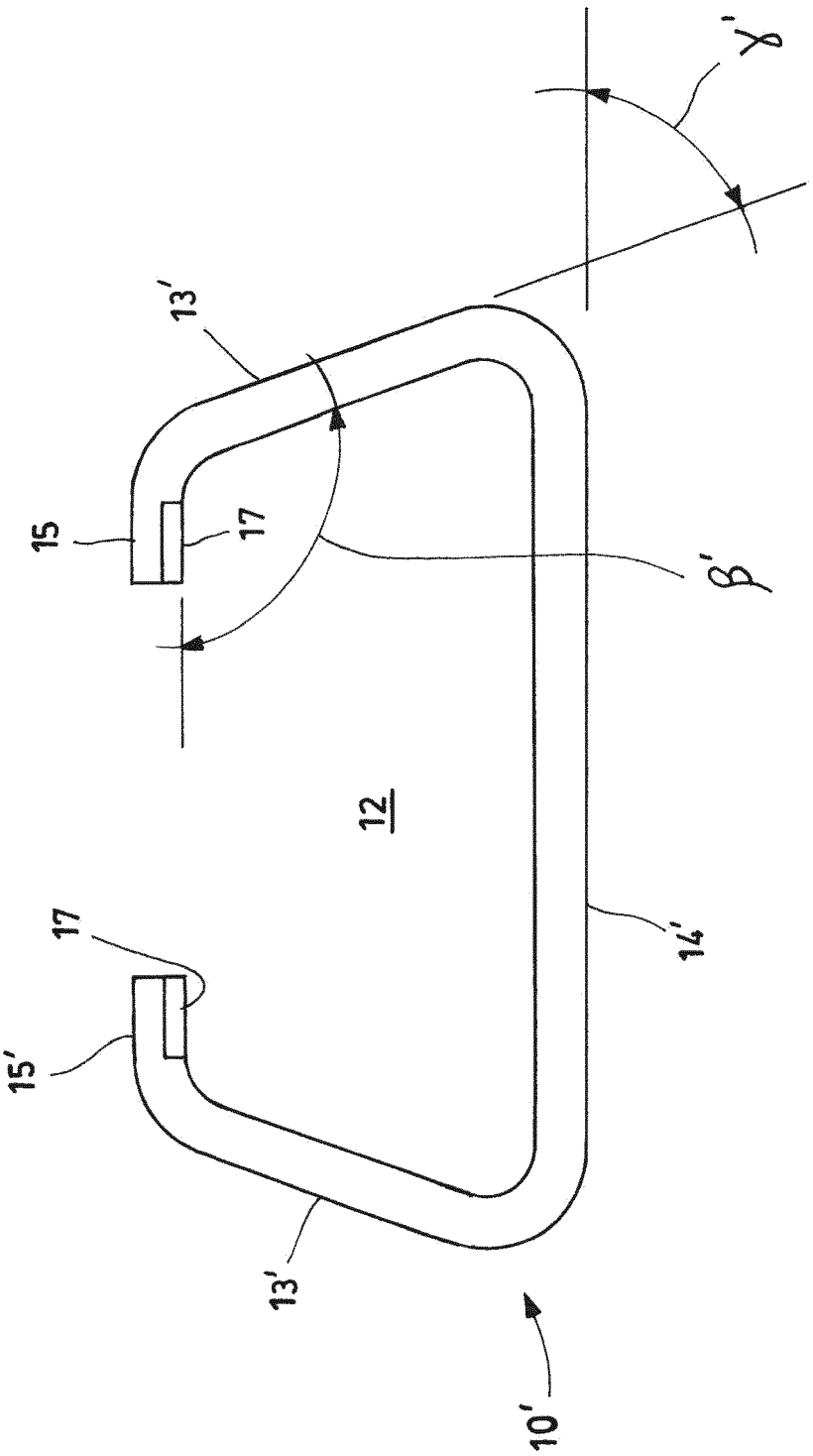


Fig.7

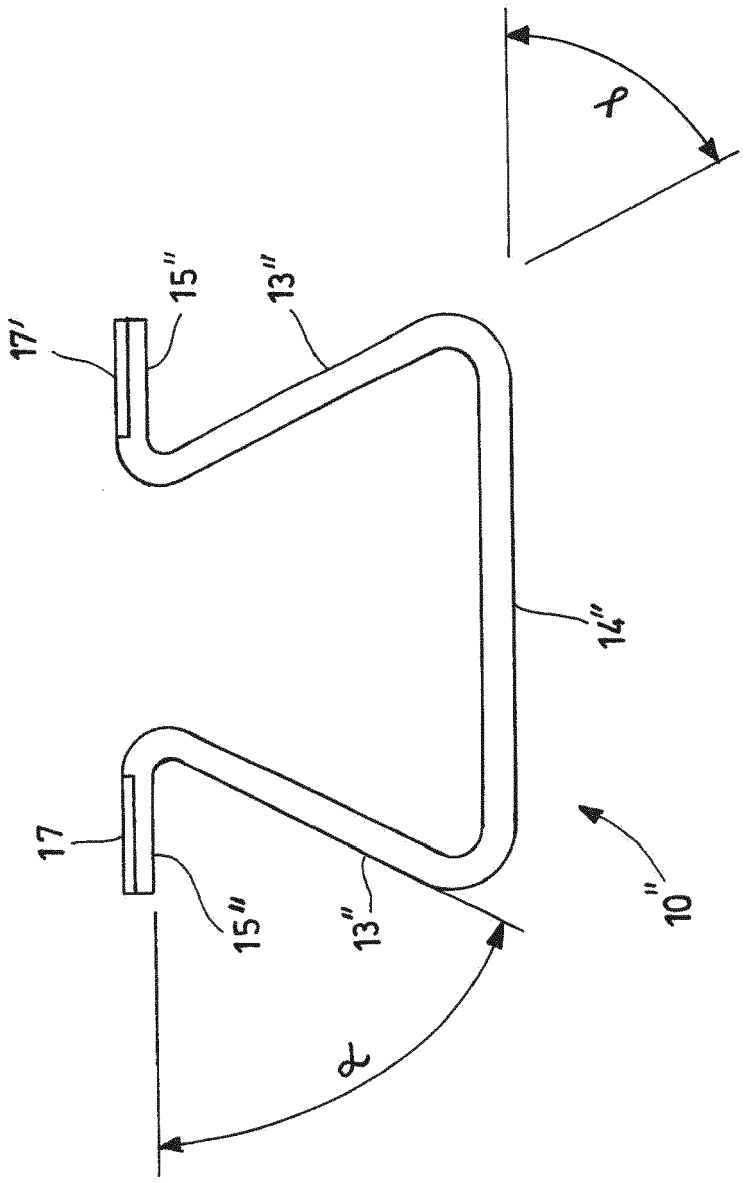


Fig.8

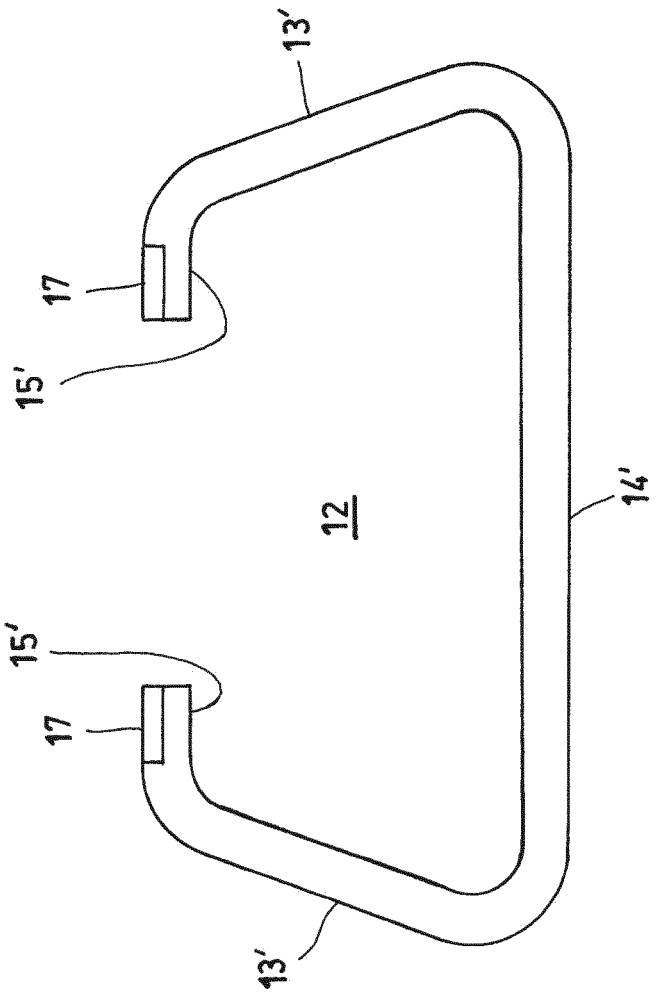
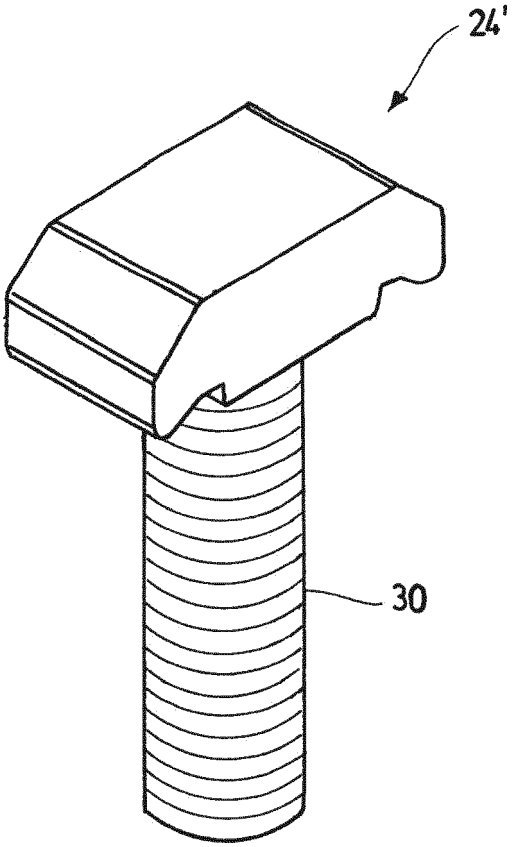


Fig.9

Fig.10



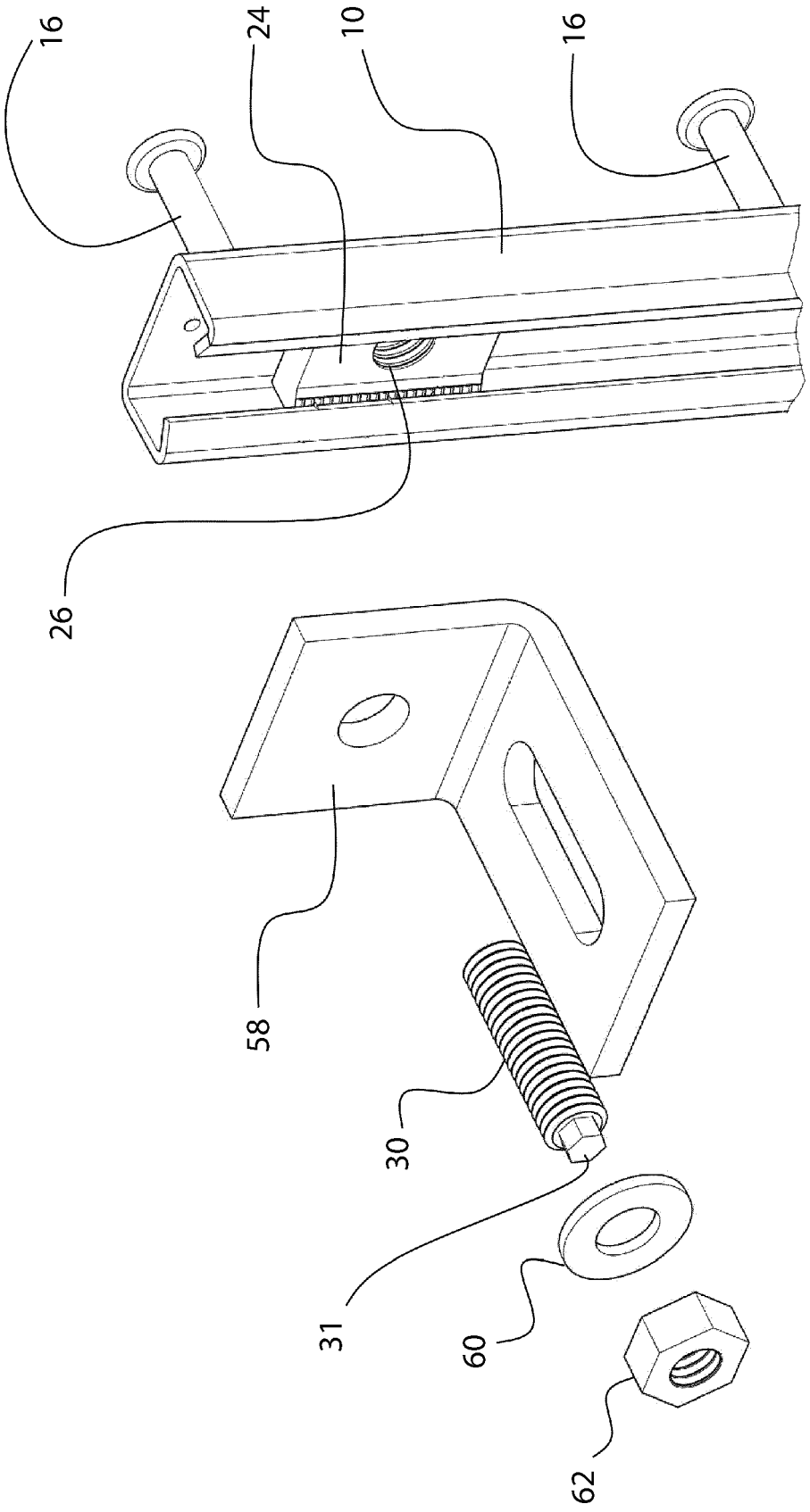


Fig. 11

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EUROPEAN SEARCH REPORT

Application Number
EP 20 20 3233

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	US 2018/320365 A1 (ALBARTUS DIRK [DE] ET AL) 8 November 2018 (2018-11-08) * paragraph [0023]; figures 1-6 * * paragraph [0031] - paragraph [0050] *	1,2,4, 6-15	INV. E04B1/41
X	EP 3 081 707 A1 (HALFEN GMBH [DE]) 19 October 2016 (2016-10-19) * paragraph [0044] - paragraph [0049]; figures 12-16 * * paragraph [0025]; figures 1,3,6 *	1,3-15	

TECHNICAL FIELDS SEARCHED (IPC)

E04B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	8 December 2020	Melhem, Charbel

CATEGORY OF CITED DOCUMENTS

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EPO FORM 1503 03.82 (P04C01)

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08-12-2020

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EPO FORM P0459

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

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