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WO-A1-03/104580
FR-A1- 2 384 077
FR-A5- 2 221 036

DESCRIPTION

[0001] This invention concerns a system of construction elements for the dry construction of structures.

[0002] Construction elements for the dry construction of masonry, eliminating wet techniques, are known. A construction element in the form of a body for the dry placement of masonry with an approximate shape of a rectangle or square in a horizontal projection has been described in Polish patent application PL 292 616 6. At least one raised area in the shape of a frame is present on the upper side of this element, upon which a construction element with recesses corresponding to the raised areas is placed.

[0003] Another solution described in Polish patent application PL 290 398 presents a method for raising walls from gypsum blocks as well as a block for raising walls without the use of binding material. The block has the shape of a rectangular prism with conical protrusions on its upper surface and conical recesses on its lower surface, where the cones on both surfaces have a shared axis of symmetry.

[0004] The construction elements create systems for the construction of structures. One such system of elements for wall construction can be found in German patent application DE 195 02 979. This system includes elements that can be connected using a dry method. One contact surface of the element has a recess, while the other surface has a protrusion matching this recess.

[0005] Another solution is a construction element with cooperating elements and at least one hollow passage described in German patent application DE 195 08 383. The elements indicated in this document possess interlocking surfaces that make shifting impossible in the direction of the wall being raised as well as in a direction perpendicular to the wall. The interlocking elements were made as a protrusion and groove, which cross on locking faces and, in particular, lie at a straight angle relative to each other. The construction element described in this solution can be used for dry construction.

[0006] Another construction element, described in European patent application EP 0 872 607, possesses mutually complementing connecting elements on its upper and lower surfaces, which create protrusions on the upper surface and recesses on the lower surface. These recesses and protrusions have a trapezoidal cross-section. Connecting elements in the lengthwise direction are parallel to the longer sides. The width of these elements comprises 1/3 the width of the shorter sides. They can be placed in the central part of the shorter sides. This solution refers to a dry-built wall made from construction elements, but with the use of braces to tie individual elements together.

[0007] The construction elements described above have certain flaws in their technical state that result in difficulties in their practical implementation. For example, in the solution found in

DE 195 08 383, the protrusions present on surfaces of the building element are easily damaged, which is related to significant problems with transport and large losses of material.

[0008] Furthermore, none of these solutions ensures full caulking when the gravitational load is placed on all contacting surfaces, which, especially in the case of curtain and load-bearing walls, is very significant.

[0009] Document FR 2 221 036 A5 discloses nestable modular elements and a method of connecting them, wherein each element has a different but complementary shape and has a core and at least one lateral wing, whose upper and lower portions have, respectively, projections or recesses that facilitate positioning and locking the elements in a superimposed or juxtaposed way; connection of these elements is ensured by means of introducing, once each row of elements is completed, a rigid tube or rod into the connection openings made in the core of each element.

[0010] Document FR 2 384 077 A1 relates to a floor/ceiling element of a vaulted or hollow type made of a plastic material, such as expanded polystyrene, having two parallel lateral sides, each of which is equipped with a projection for placing the element on two parallel beams, one lateral side having beneath a respective projection a tongue destined to be placed beneath the beam adjacent that lateral side, said tongue having a width of projection from the respective side greater than a width of the beam, and the lateral side opposite to the lateral side with a tongue having a recess accommodating the free end of the tongue, said recess being made by means of an offset in one lateral side of the element, and the distance between the projection and the offset being slightly bigger than the distance between the projection and the tongue on the other lateral side.

[0011] According to FR 2 384 077 A1, the prior art elements (namely, elements No. 1 and No. 12) by themselves do not carry any loading, without making a load-carrying structure, namely pouring concrete on the said elements forming a base, they in themselves do not constitute a floor or a ceiling.

[0012] FR 2 384 077 A1 presents a solution that takes time to complete, because in order to obtain a floor/ceiling it is required to carry out the process of pouring on the prepared and pre-set elements (1 and 12). Joining the surfaces 8a and 9a is insufficient to carry loading, which results in that it is necessary to use a cement surface, and these elements constitute in this solution only a "base" for further creating the fundamental element of a floor/ceiling. Moreover, in the cited solution FR 2 384 077 A1 the elements are placed in a row one after the other.

[0013] Document WO/03/104580 A1 describes a self-aligning cementitious block (10) and a wall system of such blocks stacked and joined by mortar to form a vertically oriented wall structure, where the block comprises alignment means which correctly align the block (10) relative to the blocks upon which it is stacked such that the side walls are parallel to the side walls of the lower blocks. The alignment means comprise tongue members (30) and groove members (40) of corresponding configuration, where the tongue members (30) preferably extend downward from the two end walls (12) and the middle wall (13) a distance below the lower edges of the side walls (12), and where the groove members (40) of inferior or lower blocks receiving the tongue members (30) of a superior or upper block stacked thereupon. Starter blocks with a flat underside and corner blocks are also provided.

[0014] None of the above discussed documents discloses a construction element shaped so that in the case of a system of plurality of such construction elements it is possible to perfectly guide subsequent elements placed during the assembly as well as to precisely and durably fix these elements in the whole building structure, without the need to use any mortar, adhesive or mechanical couplers.

[0015] The aim of this solution was to develop such a system of construction elements, the shape of which would make it ideally possible to lay down consecutive elements during the assembly of the structure and ensure a precise and lasting fix of these elements throughout the structure without the need for any mortar, adhesives or mechanical connecting elements.

[0016] Another aim was the development of a system of elements that could be assembled by lower qualified workers working only with appropriate supervision and also one that would make it possible for a home to be built by its future users without the need for heavy construction equipment.

[0017] These aims have been achieved thanks to the invention as defined in the appended claims.

[0018] The system of construction elements for the dry construction of structures with block-type elements in the form of geometric bodies with protrusions on their surfaces is comprised of construction element modules for raising walls, the ceiling and the roof. A module is comprised of two elements with their sides adjacent to each other connected by a third element, creating a self-tightening joint whereby the shaped protrusions of the construction elements have doubly inclined guiding contact surfaces inclined at specific angles α and β, which are the guide surface and the self-tightening surface. The angles are determined, respectively, to the perpendicular of the upper or lower protrusions and the guiding or self-tightening surfaces.

[0019] In an advantageous solution, the angle of inclination α is within a range of 40°-50° and the angle β is within a range of 6°-12°. In the most optimal solution, the angle of inclination α is equal to 45° and angle β is equal to 7°.

[0020] In keeping with the invention, the system of construction elements has a protrusion composed of two adhering trapezoids, where the trapezoid with a smaller angle of inclination in the mutual connection of elements functions as a portion of a self-tightening wedge with a convergence angle of **2α.**

[0021] The invention includes construction element modules for walls, the ceiling and roof.

[0022] The wall module construction element includes three parts possessing recesses and protrusions located on the upper and lower surfaces, creating a self-tightening connection. The system of recesses and protrusions on the lower surface is shifted by half the length of the construction element in relation to the system of recesses and protrusions on the upper surface. The side-guiding and self-tightening contact surfaces of the protrusions and recesses are inclined at specific angles α and β, in which the cross-section of protrusions and recesses has the shape of two trapezoids of a common base with one lying on top of the other. The sides of the lower trapezoid are inclined at angle α, which is determined by the angle between the perpendicular to the lower protrusion surface and the guiding surface, and the sides of the upper trapezoid are inclined at an angle of β, which is determined by the angle between the perpendicular to the upper protrusion surface and the self-tightening surface.

[0023] The ceiling module construction element contains a basic and supplementary ceiling element as well as a ceiling beam. The basic and supplementary ceiling construction elements possess side contact surfaces, which are guiding and self-tightening and inclined at angles α and β, upon which self-tightening connections are formed. These surfaces are found on protrusions located near the upper edge of the adjacent basic and supplementary ceiling construction elements in which the side self-tightening contact surface creates angle β with the perpendicular to the upper surface of the ceiling element, and the lateral guiding contact surface and the perpendicular to the lower surface of the ceiling construction element form angle α. Basic and supplementary ceiling construction elements are alternately placed.

[0024] The roof module construction element includes a basic roof construction element and a supplementary roof element as well as a roof rafter beam. The basic and supplementary roof construction elements have protrusions located on their side surfaces and the roof rafter beam has recesses throughout its entire length. The guiding and self-tightening surfaces of recesses and protrusions create a self-tightening connection. Protrusions on the side surface of the basic roof construction element and the roof supplementary element constitute a mutual fitting of recesses on the roof rafter beam. Furthermore, recesses and protrusions are situated at an acute angle relative to the perpendicular to the roof surface. The guiding and self-tightening lateral contact surfaces of protrusions and recesses are inclined at specific angles α and β while the side walls of the self-tightening part of protrusions and recesses are inclined at an angle of β relative to the perpendicular of the lower surface of the protrusion and recess. The side walls of the guiding surfaces of recesses and protrusions are inclined at the acute angle α to the perpendicular of the lower surface of the protrusion and recess. Furthermore, the guiding surfaces of the protrusions and recesses are inclined at acute angle γ. Also the side walls of the protrusion and recess in the self-tightening and guiding part have different lengths. Basic roof construction elements and supplementary roof elements are alternately placed.

[0025] The system of construction elements for the dry construction of structures is meant for the raising of a compact and low structure as well as for the completion of walls in buildings with a skeletal structure. Furthermore, this system can be used as blocks for raising miniature constructions.

[0026] The self-tightening connections occurring between protrusions along the elements cause the presence of additional shear stresses distributed over these protrusions when tensile forces are present in the wall.

[0027] An advantage to this solution is the simplicity of designing structures with the application of highly advanced numerical techniques and the very quick, exceptionally precise and tool-less execution of the designed structures without the use of wet techniques and with the possibility of utilizing industrial robots for production of the construction elements in a factory as well as at the construction site.

[0028] Another advantage of this solution by this invention is a lack of waste in the process of building structures. Thanks to this invention, the need for a high precision of assembly of individual system elements has been achieved, which significantly simplifies the effort of workers while simultaneously shortening the time of execution of the entire building task to even two weeks from the supply of materials to the construction site. This significantly decreases expenses sustained during construction work as well as during finishing work.

[0029] Thanks to the application of systems from this invention, it is possible for even lower qualified persons to raise structures without the use of heavy construction equipment, e.g., by lower qualified workers or by the future users of the structure.

[0030] Another distinguishing property of the system that makes it different from solutions known to this point is the fact that there is no possibility for a perfect fit of the upper surface of one element with the lower surface of another by placing the elements exactly on top of one another.

[0031] This system also includes construction elements for assembling window and door joints in full view during the raising of walls, without the need for additional fixings and sealants, which obviously shortens the assembly time and ensures greater heating comfort, resulting in lower expenditures for the user of the structure on heating/air conditioning.

[0032] All of these aspects undoubtedly lead to a decrease in unit costs of raised structures. This system also ensures, according to its assumptions, high design flexibility and interior planning as well as the possibility of building structures in areas prone to seismic activity. An additional advantage is the independence of the construction work from the time of year at any geographical latitude as well as from access to water that is necessary for the preparation of materials such as mortar.

[0033] According to this invention, one property distinguishing this ideal solution from other solutions is the fact that there are at least three cooperating elements, which unequivocally ensures a mutual connection that allows for the self-caulking of connections due to the presence of resultant stresses between neighbouring elements.

[0034] This caulking makes it possible to build very precise constructions without the necessity of executing further levelling work before executing the finishing layers. Caulking also causes an increase in the thermal and acoustic insulation of walls executed using the system according to the invention.

[0035] The high precision of making elements according to the invention and the module graduation equal to 30 cm allows for sufficiently arbitrary construction of buildings. Thanks to the appropriate computer software, it is possible to easily transpose any architectural design to a design using the system according to the invention. In addition, designing with this system allows for the immediate and precise specification of the demand for the amounts of individual elements necessary for the execution of the accepted building task. There is also no need to account for a material surplus for so-called "losses" that occur during the execution of masonry work using conventional methods.

[0036] The dimensions of the buildings after construction will have dimensions corresponding exactly to the dimensions designed by the architect. There is no need to check inventory after execution, which may be necessary for interior planning. The documentation for executing finishing work can be made at the design stage.

[0037] All of these system properties allow for a significant decrease in the price of the final product, the dwelling, through a significant shortening of the time of execution of the completed task.

[0038] The objects of the invention are presented in examples in drawings, in which

Fig. 1 - shows an axonometric projection showing the connection of several wall construction elements with self-tightening surfaces,

Fig. 2 - projection of several connected wall construction elements,

Fig. 3 - projection of the shorter side of the wall construction element,

Fig. 4 - projection of the longer side of the wall construction element,

Fig. 5 - magnification of the marked fragments from Fig. 2, 3 and 4 showing the self-tightening and guiding surfaces of the wall construction element,

Fig. 6 - axonometric projection of the basic wall construction element with upper surface,

Fig. 7 - axonometric projection of the basic wall construction element with lower surface,

Fig. 8 - axonometric projection of the half near-frame wall construction element with upper surface,

Fig. 9 - axonometric projection of the near-frame wall construction element with upper surface,

Fig. 10 - axonometric projection of the left corner wall construction element with upper surface,

Fig. 11 - axonometric projection of the left corner wall construction element with lower surface,

Fig. 12 - axonometric projection of the right corner wall construction element with upper surface,

Fig. 13 - axonometric projection of the right corner wall construction element with lower surface,

Fig. 14 - axonometric projection of the under-frame wall construction element with upper surface,

Fig. 15 - axonometric projection of the under-frame wall construction element with lower surface,

Fig. 16 - axonometric projection of the over-frame wall construction element with upper surface,

Fig. 17 - axonometric projection of the over-frame wall construction element with lower surface,

Fig. 18 - axonometric projection showing the connection of several ceiling construction elements,

Fig. 19 - projection of connected basic and supplementary ceiling construction elements,

Fig. 20 - magnification of the marked fragment from Fig. 19 showing the self-tightening and guiding surfaces of basic and supplementary ceiling construction elements,

Fig. 21 - axonometric projection of ceiling beam with upper and side surfaces,

Fig. 22 - axonometric projection of the basic ceiling construction element with lower and side surfaces,

Fig. 23 - axonometric projection of the supplementary ceiling construction element with upper and side surfaces,

Fig. 24 - axonometric projection showing the connection of several roof construction elements,

Fig. 25 - projection of connected roof construction elements with self-tightening surfaces,

Fig. 26 - magnification of the marked fragment from Fig. 25 showing the self-tightening and guiding surfaces of the roof construction element,

Fig. 27 - axonometric projection of the basic roof construction element with upper surface,

Fig. 28 - axonometric projection of the supplementary roof construction element with lower surface,

Fig. 29 - axonometric projection of the roof rafter beam with lower surface,

Fig. 30 - representation of forces occurring at connection of wall construction elements,

Fig. 31 - representation of forces occurring at the disconnection of wall construction elements.

[0039] An example wall module consists of three wall construction elements. The wall construction elements (3, 4, 5, 6, 7, 8, 9) possess recesses and protrusions located on the upper and lower surfaces forming self-tightening connections. The system of recesses and protrusions on the lower surface is shifted by half the length of the construction element in relation to the system of recesses and protrusions on the upper surface.

[0040] According to the invention, in the system the wall element is a construction element with an outline in the shape of a rectangular prism, upon which protrusions and recesses are located on the upper and lower surfaces.

[0041] The lateral guiding (1) and self-tightening (2) contact surfaces of the protrusions and recesses are inclined at specific angles α and β. The cross-section of protrusions and recesses has a shape of two trapezoids with a common base lying one on top of the other. The sides of the lower trapezoid are inclined at angle α, which is determined by the perpendicular to the lower protrusion surface and the guiding surface (1), and the sides of the upper trapezoid are inclined at an angle of β, which is determined by the perpendicular to the upper protrusion surface and the self-tightening surface (2).

[0042] The basic wall construction element (3) presented in Figs. 6, 7 has a longitudinal protrusion on its upper surface along the element's longitudinal axis with a cross-section of two trapezoids with a common base lying one on top of the other, and two transverse protrusions situated along the outer edges of the shorter side. The two transverse protrusions have a width equal to half the width of the lengthwise protrusion and a cross-section of two trapezoids with a common base with one lying on top of the other only from the internal side of the element. The longer trapezoid base comprises about 1/3 of the width of the entire wall construction element.

[0043] On the lower surface, this element has recesses along its longitudinal and transverse axes with cross-sections of two trapezoids with a common base with one lying on top of the other.

[0044] Protrusions and recesses on the lower surface do not correspond to the corresponding protrusions and recesses on the upper surface of the same element.

[0045] The condition making it possible to form a wall is that the protrusions and recesses on the lower surface are shifted by half the length of the construction element relative to the system of protrusions and recesses on the upper surface.

[0046] The basic element presented in Figs. 6, 7 is not a universal element by means of which complete building walls can be made. Special modifications of this element shown as further elements of the system are needed for this purpose, and they have been presented on successive drawings.

[0047] Other wall construction elements are the half near-frame element (4) shown on Fig. 8 and the near-frame element (5) shown on Fig. 9. They are different from the basic wall construction element (3) by the shape of one of the side walls, which possesses a rectangular recess situated centrally. The width of this recess is greater than the longer trapezoid base.

[0048] Other wall construction elements are construction elements constituting the left (6) and right (7) corner wall elements (7) presented on Figs. 10 and 11 and Figs. 12 and 13, respectively. In this element, a protrusion with a cross-section of two trapezoids with a common base with one lying on top of the other is situated on the upper surface along with two transverse protrusions situated along the external edges of the shorter side, which are identical to those on the basic wall construction element.

[0049] On the lower surface, this element has recesses with cross-sections of two trapezoids with a common base with one lying on top of the other. One is situated at half of the element's length along the longitudinal axis, two others are situated transverse to the longer side of this element and one more is located along the longer side at half of the element's length.

[0050] Further wall construction elements are construction elements constituting the under-frame wall element (8) shown in Figs. 14 and 15 as well as the over-frame wall element (9) shown in Figs. 16 and 17. They are different from the basic wall construction element by the shape of one of the upper or lower walls, which possesses a rectangular recess situated centrally. The width of this recess is greater than the width of the longer trapezoid base.

[0051] The cross-sections of protrusions found on system elements, according to the invention, are comprised of two trapezoids adhering to each other. The trapezoid with the lesser angle of inclination in the connection of mutual elements functions as a part of a wedge, and in relation to this, physical relationships similar to those of a wedge occur.

[0052] An exemplary ceiling module is presented in Figs. 18-23. It consists of a basic ceiling construction element (Fig. 22) and a supplementary ceiling construction element (Fig. 23) as well as ceiling beams (Fig. 21).

[0053] The basic (11) and supplementary (12) ceiling construction elements possess guiding (1) and self-tightening (2) lateral contact surfaces, inclined at angles α and β, upon which self-tightening connections are formed. These surfaces are found on protrusions situated near the upper edge of neighbouring basic and supplementary ceiling elements. The lateral self-tightening contact surface and the perpendicular to the upper surface of the ceiling element form angle β, and the upper lateral guiding contact surface forms angle α with the perpendicular to the lower surface of the ceiling element.

[0054] As shown in Fig. 20, the basic (11) ceiling construction element, in the upper part of protrusions situated near the upper edges has a cross-section of two trapezoids with a common base lying one on top of the other, possessing short sides and a long base.

[0055] In the lower part of the protrusions visible in Figs. 18 and 19, the basic ceiling elements (11) possess a rounded edge transitioning into the lower edge with protrusion length **d** parallel to the upper surface. The length of the lower edge **d** of the protrusions corresponds to the upper width of the ceiling beam (10). The lower part of the basic ceiling element (11) shown on Fig. 19 possesses a protrusion with a trapezoidal cross-section, inside of which a hollow oval recess can be found.

[0056] The supplementary ceiling construction element (12) according to Figs. 19, 20 and 23 has a cross-section of two trapezoids with a common base with one lying on top of the other, with short sides and a wide and long base, in the upper part of the protrusions situated near the upper edges.

[0057] Below the trapezoidal protrusions, the side walls of the supplementary ceiling element (12) are perpendicular to the upper and lower surfaces of this element for about 1/3 of their height and are diagonal near the lower edge. Inside of the supplementary ceiling construction element (12) a hollow oval recess can be found.

[0058] Ceiling beam (10) shown in Fig. 21 has a trapezoidal cross-section, of which the upper base **d** corresponds to the length of the lower edge **d** of the protrusions from the basic ceiling construction element (11).

[0059] Basic (11) and supplementary (12) ceiling construction elements are placed alternately. In one row, the placement is started from the basic ceiling construction element (11), and in the next, the row is started from the supplementary ceiling construction element (12).

[0060] An example roof module is presented in Figs. 24-29. The roof module consists of the basic roof construction element (15) presented in Fig. 27 and the supplementary roof element (16) shown in Fig. 28, as well as the roof rafter beam (17) shown in Fig. 29. The basic and supplementary roof elements have protrusions located on their side surfaces, and the roof rafter beam has recesses on its entire length. A self-tightening connection is formed on the self-tightening contact surfaces (2) of recesses and protrusions. Protrusions on the side surface of the basic roof construction element and the roof supplementary element constitute a mutual fitting of recesses on the roof rafter beam. Furthermore, recesses and protrusions are situated at an acute angle relative to the perpendicular to the roof surface.

[0061] The guiding and self-tightening lateral contact surfaces of protrusions and recesses are inclined at specific angles α and β, and the self-tightening part of protrusions and recesses has side walls that are inclined at an angle of β relative to the perpendicular to the lower surface of the protrusion and recess, and the guiding surfaces of recesses and protrusions have side walls inclined at acute angles α to the perpendicular of the lower surface of the protrusion and recess. Furthermore, protrusions and recesses have guiding surfaces inclined at acute angle γ. The side walls of the protrusion and recess in the self-tightening and guiding part have different lengths.

[0062] The basic roof construction element (15) shown in Fig. 27 has cuboidal protrusions on its side walls up to half of its height, on which protrusions having a guiding and self-tightening part are placed at an angle to the upper edge.

[0063] The supplementary roof element (16) according to Fig. 28 has an L-shaped extension for placing this element on the roof beam (17) along its upper surface. The length of extension **z** corresponds to the upper width of the roof rafter beam (17). On the side walls of the supplementary element (16), under the L-shaped extension, protrusions with guiding and self-tightening parts are placed at an angle to the upper edge.

[0064] The roof rafter beam (17) shown in Fig. 29 is a rectangular prism, in which diagonal recesses having a guiding (1) and self-tightening (2) part have been added.

[0065] Basic (15) and supplementary (16) roof construction elements are alternately placed. In one row, the placement of rows is started from the basic roof construction element (15), and in the next, the row is started from the supplementary roof construction element (16).

[0066] Figs. 30 and 31 present the distribution of forces occurring at the connection and disconnection of wall construction elements on the contact surfaces of protrusions and recesses.

[0067] Fig. 30 presents the cooperation of protruding parts being wedge sectors (hereinafter referred to as "wedge") with an angle of convergence of **2α**, driven in with force ***Q*** occurring during assembly of elements of the objective system. Based on the figure presented on the magnified fragment of Fig. 30, the pressures applied to the walls of individual elements can be calculated. Between the lateral surfaces of the "wedge" and the surfaces that the "wedge" is driven between, pressures equal to normal reactions ***N***, and forces of friction ***T*** will occur. Due to the symmetry of the "wedge," the pressures and forces of friction will be equal to one another.

[0068] Considering the case where the "wedge" is driven in during the connection of elements, the forces of friction will act opposite to the vectors of velocity lying on the side surfaces of the "wedge." By calculating the equilibrium of the system of forces, i.e., by projecting all forces on the vertical direction of the **y** axis, the following is obtained:

$$2T \cos \alpha + 2N \sin \alpha - Q = 0$$

due to the fact that **T** = **μN,**

where:

μ - is the coefficient of friction,

T - force of friction,

N - force of pressure on the surface over which the considered element is shifting,

ergo:

$$2\mu N \cos \alpha + 2N \sin \alpha = Q$$

hence the pressures exerted by the "wedge" on the walls of the material:

$$N = \frac{Q}{2(\mu \cos \alpha + \sin \alpha)}.$$

[0069] The force ***P*** necessary to remove a "wedge" that had been driven in earlier with a force of ***Q***, shown in Fig. 31, is calculated as follows. In this case, the reaction of force ***P*** will be directed downwards, and the force of friction ***T*** will also change its reaction to the opposite. Let us therefore project all forces on the vertical direction of the **y** axis:

$$P + 2N \sin \alpha - 2T \cos \alpha = 0$$

due to the fact that **T = μN,**

ergo:

$$P = 2\mu N \cos \alpha - 2N \sin \alpha$$

$$P = N (\mu \cos \alpha - \sin \alpha)$$

hence, after substituting the **N** value previously calculated, the force ***P*** necessary for removing a "wedge" driven in earlier with a force of ***Q*** is equal to:

$$P = \frac{Q(\mu \cos \alpha - \sin \alpha)}{\mu \cos \alpha + \sin \alpha}.$$

Analyzing the above:

[0070] If the forces of friction and the forces of pressure are in equilibrium, the "wedge" will be able to slide out freely, therefore:

$$2\mu N \cos \alpha - 2N \sin \alpha = 0$$

$$\mu \cos \alpha = \sin \alpha \quad \mu = tg\alpha$$

$$\alpha = \rho$$

- where **ρ** is the angle of friction.

[0071] If **α < ρ** then a force of ***P*** would be necessary to pull out the "wedge" driven into the material. If this condition is fulfilled, a self-locking system is in place. The connection of two system elements fulfilling the above condition can be recognized as a persistent quick release connection.

[0072] Furthermore, according to the scope of the invention, the system of construction elements is meant for raising low structures and also for completing walls in buildings with a skeletal structure.

[0073] The system described in the patent application also finds an application as blocks for raising miniature constructions possessing the same properties and shapes and differing from the above only in terms of the size and the material they are made from.

REFERENCES CITED IN THE DESCRIPTION

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- WO03104580A1 **[0013]**

Patentkrav

1. System af konstruktionselementer til tør konstruktion af strukturer, hvori konstruktionselementerne besidder facongivne fremspring til gensidig forbindelse under samling, der omfatter en flerhed af konstruktionselementmoduler til at opstille en væg, et loft eller et tag, hvori hvert modul omfatter to konstruktionselementer med hosliggende sider forbundne af et tredje konstruktionselement, kendetegnet ved, at de to elementer med hosliggende sider, der er forbundne af det tredje element, er i en selvspændende forbindelse, hvori de facongivne fremspring og fordybninger fra konstruktionselementerne har dobbelt-hældende tværgående kontaktoverflader, der omfatter en ledende (1) overflade og en selvspændende (2) overflade, som er hældende ved specifikke vinkler α og β, hvori hældningsvinklen α er inden for et interval på 40° - 50°, og hældningsvinklen β inden for et interval på 6° - 12°, og disse vinkler er bestemt henholdsvis imellem den vinkelrette på den øvre eller nedre fremspringsoverflade og den ledende eller selvspændende overflade,
hvori konstruktionselementerne indbefatter konstruktionselementer til vægge, der har fremspring og fordybninger placerede på de øvre og nedre overflader og danner en selvspændende forbindelse, når de bliver forbundet sammen, sådan at de ledende overflader på de forbundne fremspring og fordybninger er i anlægskontakt med hinanden, og sådan at de selvspændende overflader på de forbundne fremspring og fordybninger er i anlægskontakt med hinanden, og hvorved et system af fordybningerne og fremspringene på de nedre overflader på en første række af vægkonstruktionselementerne, der er forbundne med de respektive fordybninger og fremspring på de øvre overflader på en anden række af vægkonstruktionselementerne, er forskudt med halvdelen af længden af vægkonstruktionselementet i forhold til den anden række af vægkonstruktionselementerne.

2. System ifølge krav 1, hvori faconen af

konstruktionselementerne utvetydigt sikrer en gensidig forbindelse imellem i det mindste tre konstruktionselementer, der tager højde for den automatiske forsegling af forbindelser imellem de i det mindste tre konstruktionselementer på grund af tilstedeværelsen af den resulterende spænding på de ledende overflader og selvspændende overflader imellem nabokonstruktionselementer uden mørtel eller befæstelseselementer.

3. System ifølge krav 1, hvori hvert konstruktionselement har et langsgående fremspring på dets øvre overflade langs elementets langsgående akse, hvilket langsgående fremspring udstrækker sig imellem to tværgående fremspring, der er placerede langs de ydre kanter tværs over bredden af den øvre overflade på konstruktionselementet.

4. System ifølge krav 3, hvori de to tværgående fremspring har en bredde, der er lig med halvdelen af en bredde af de langsgående fremspring.

5. System ifølge et hvilket som helst af kravene 1 - 4, hvori hældningsvinklen α er lig med 45°, og vinkel β er lig med 7°.

6. System ifølge et hvilket som helst af kravene 1 - 5, hvori modulerne indbefatter en flerhed af vægmoduler.

7. System af konstruktionselementer til tør konstruktion af strukturer, hvori konstruktionselementerne besidder facongivne fremspring til gensidig forbindelse under samling, der omfatter en flerhed af konstruktionselementmoduler til at opstille en væg, et loft eller et tag, hvori hvert modul omfatter to konstruktionselementer med hosliggende sider forbundne af et tredje element, kendetegnet ved, at de to elementer med hosliggende sider, der er forbundne af det tredje element, er i en selvspændende forbindelse, hvori de facongivne fremspring og fordybninger fra konstruktionselementerne har dobbelt-hældende tværgående

kontaktoverflader, der omfatter en ledende (1) overflade og en selvspændende (2) overflade, som er hældende ved specifikke vinkler α og β, hvori hældningsvinklen α er inden for et interval på 40° - 50°, og hældningsvinklen β inden for et interval på 6° - 12°, og at disse vinkler er bestemte henholdsvis imellem den vinkelrette på den øvre eller nedre fremspringsoverflade og den ledende eller selvspændende overflade,

hvori konstruktionselementmodulet til at opstille et loft omfatter et basalt loftkonstruktionselement (11) og et supplerende loftkonstruktionselement (12) såvel som et loftsbjælke (10) konstruktionselement, hvori det basale loftkonstruktionselement og det supplerende loftkonstruktionselement (12) har ledende (1) og selvspændende (2) tværgående kontaktoverflader, der er hældende ved specifikke vinkler α og β, på hvilke der er dannet selvspændende forbindelser, med disse overflader placerede ved fremspring, som er placerede nær den øvre kant af det basale naboloftkonstruktionselement (11) og supplerende (12) loftkonstruktionselement, hvorved de selvspændende (2) tværgående kontaktoverflader danner en vinkel β med den vinkelrette på den øvre overflade på gulv-/loftselementet, og den ledende (1) tværgående kontaktoverflade danner en vinkel α med den vinkelrette på den nedre overflade af loftskonstruktionselementet,

hvori de tre samvirkende konstruktionselementer utvetydigt sikrer en gensidig forbindelse, der tager højde for den automatiske forsegling af forbindelser på grund af tilstedeværelsen af resulterende spændinger imellem naboelementer.

8. System ifølge krav 7, hvori de basale og supplerende loftskonstruktionsbyggeelementer er skiftevis placerede langs dets langsgående akse.

9. System af konstruktionselementer til tør konstruktion af strukturer, hvori konstruktionselementerne besidder facongivne fremspring til gensidig forbindelse under samling, der

omfatter en flerhed af konstruktionselementmoduler til at opstille et tag, kendetegnet ved, at hvert tagmodul omfatter to konstruktionselementer med hosliggende sider svarende til et basalt tagkonstruktionselement (15) og et supplerende tagelement (16), der er forbundne af et tredje konstruktionselement, som svarer til et konstruktionselement til en tagspærbjælke (17), som skaber en selvspændende konstruktion, hvori de facongivne fremspring fra konstruktionselementerne har dobbelt-hældende tværgående kontaktoverflader, der omfatter en ledende (1) overflade og en selvspændende (2) overflade, der er hældende ved specifikke vinkler α og β, hvori disse vinkler henholdsvis er bestemte imellem den vinkelrette på den øvre eller nedre fremspringsoverflade og den ledende eller selvspændende overflade, hvorved de basale (15) og supplerende (16) tagkonstruktionselementer besidder udvidelser, der er placerede på tværgående overflader, og konstruktionselementet til en tagspærbjælke (17) har fordybninger, der svarer til de facongivne fremspring, igennem hele dets længde, hvori de ledende (1) og selvspændende (2) kontaktoverflader på fordybninger og facongivne fremspring skaber selvspændende forbindelser, hvorved udvidelserne på den tværgående overflade på det basale tagkonstruktionselement (15) og på konstruktionselementet for det supplerende tagelement (16) udgør en gensidig sammenpasning til fordybninger i konstruktionselementet til en tagspærbjælke (17), og hvori fordybningerne og de facongivne er placerede i en spids vinkel i forhold til den vinkelrette på tagoverfladen.

10. System ifølge krav 9, hvori de ledende og selvspændende tværgående kontaktoverflader på fremspring og fordybninger er hældende ved specifikke vinkler α og β, i hvilket den selvspændende del af fremspring og fordybninger har tværgående vægge, der er hældende ved en vinkel β i forhold til den vinkelrette på den nedre overflade på fremspringet og fordybningen, og de ledende overflader på fremspring og fordybninger har tværgående vægge, der er hældende ved en spids vinkel α i forhold til den vinkelrette på den nedre

overflade på fremspringet og fordybningen, og ydermere fremspring og fordybninger har ledende overflader (1), der er hældende ved en spids vinkel γ, og også de tværgående vægge på fremspring og fordybninger i de selvspændende og ledende overflader har forskellige længder.

11. System ifølge krav 9, hvori de basale (15) og supplerende (16) tagkonstruktionselementer er placerede skiftevis.

DRAWINGS

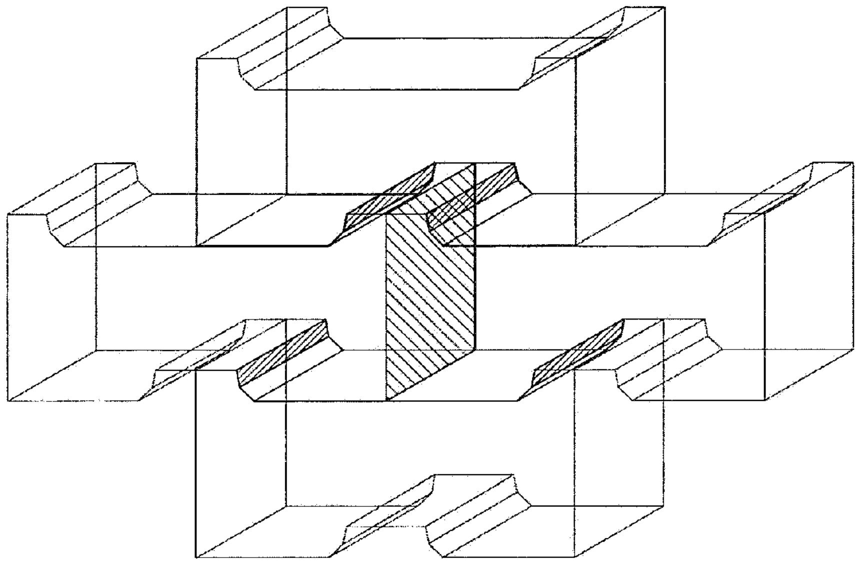
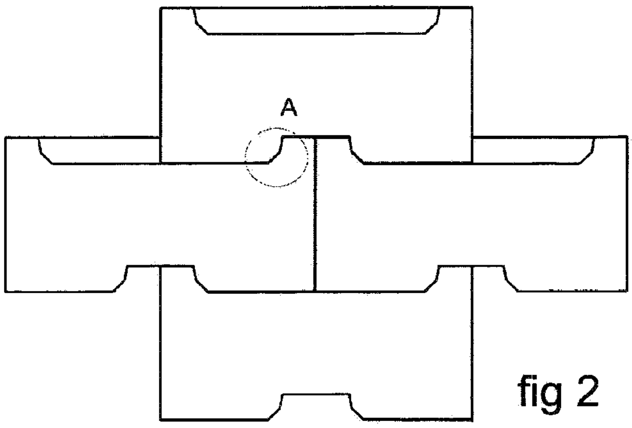


fig 1



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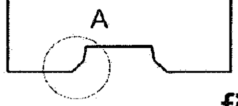

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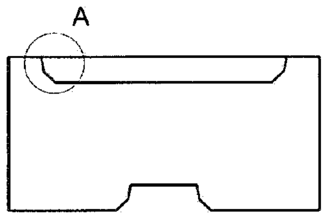


fig 4

Szczegół "A"

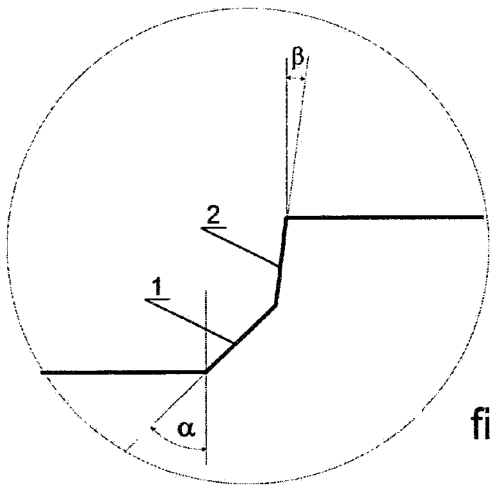
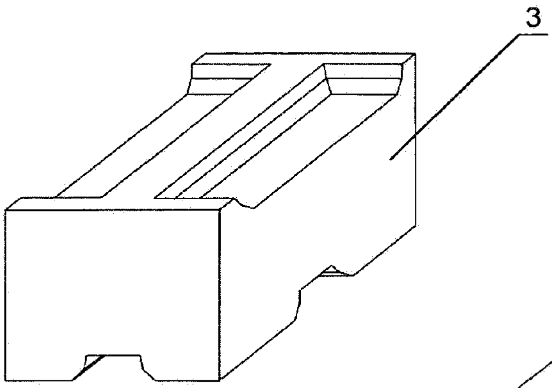


fig 5

Szczegół „A" - Detail "A"



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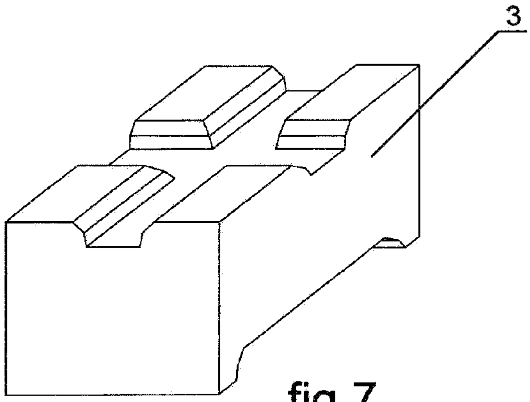

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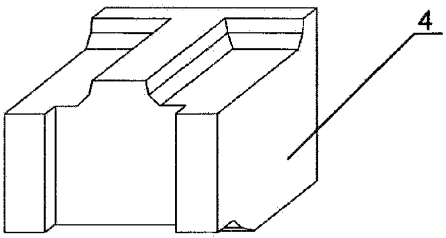

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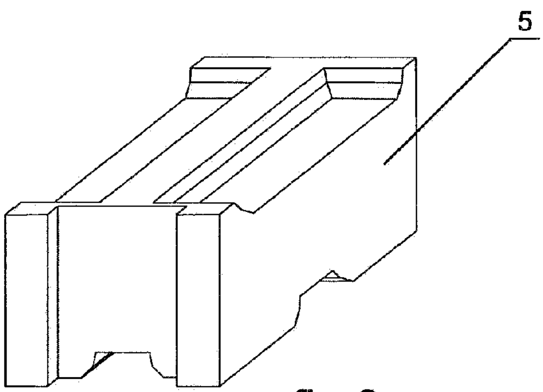

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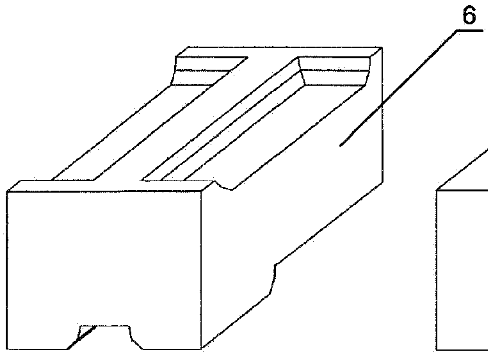

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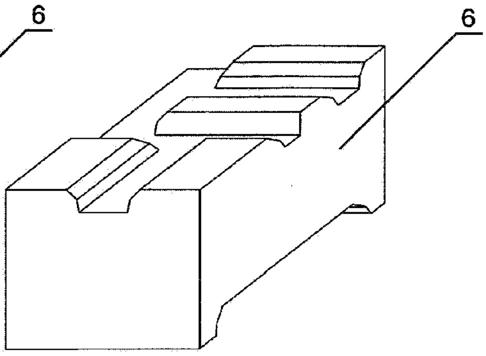

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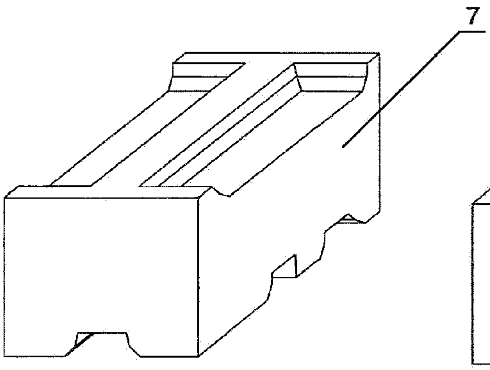

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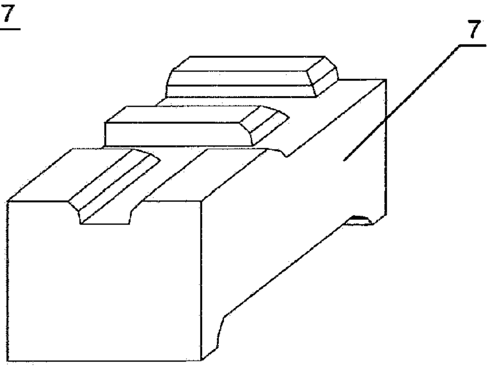

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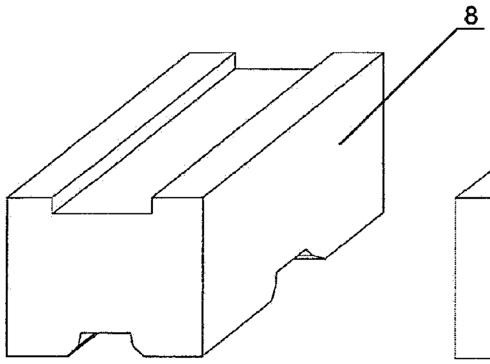

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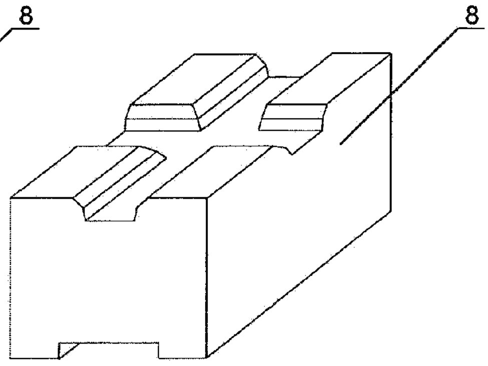


Fig 15

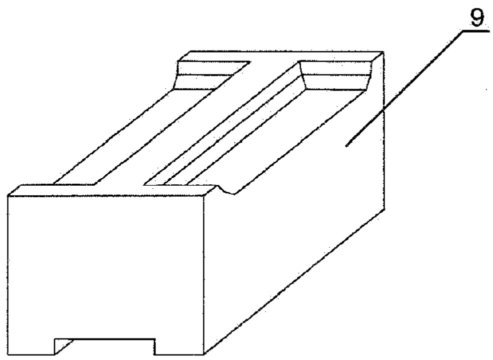


fig 16

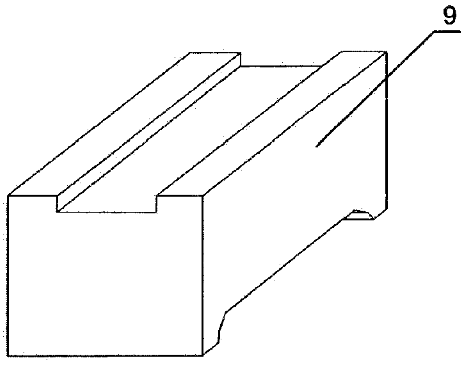
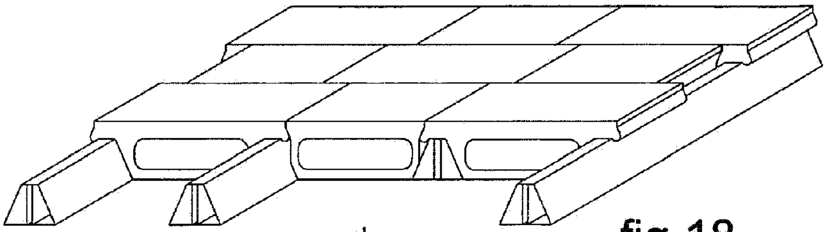


fig 17



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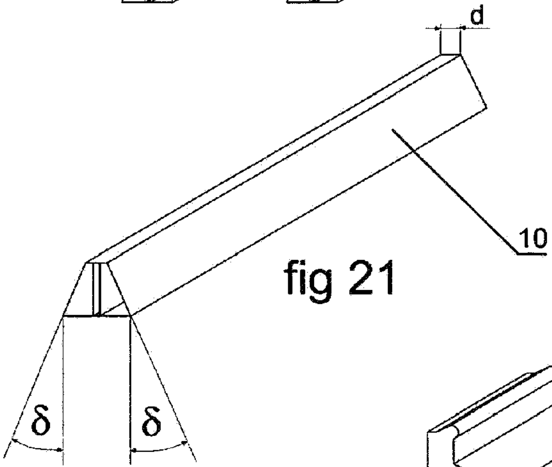

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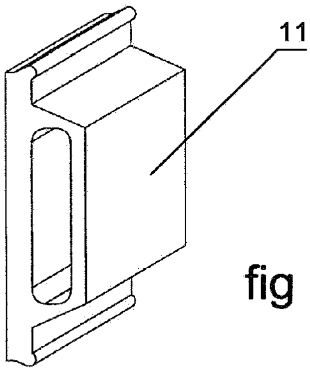

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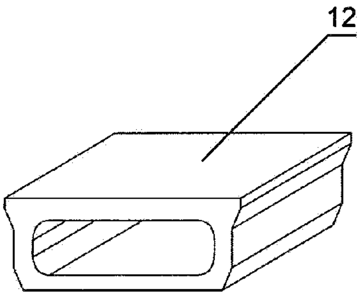

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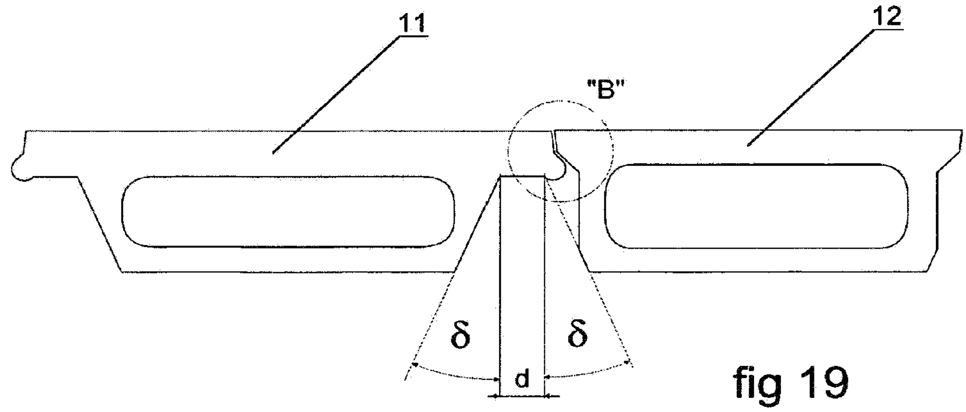


fig 19

Szczegół "B"

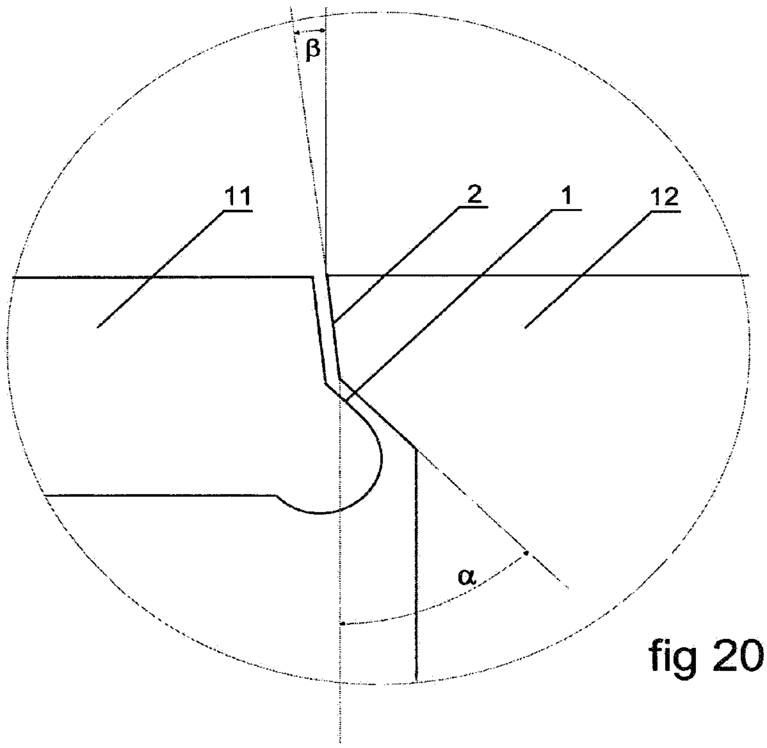


fig 20

Szczegół „B" - Detail "B"

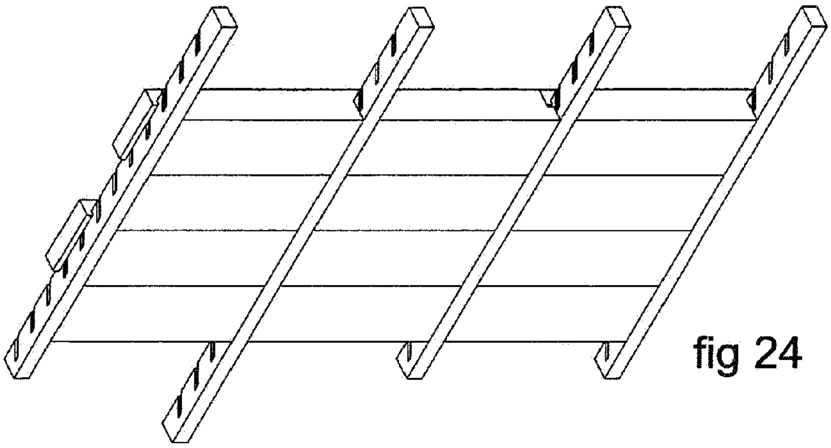


fig 24

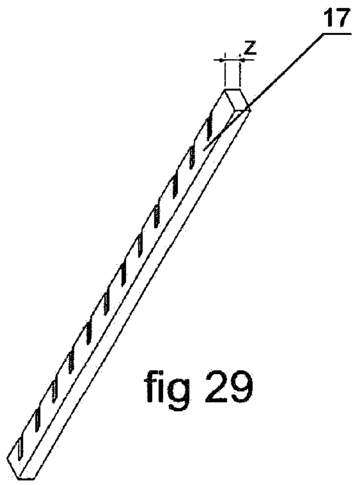
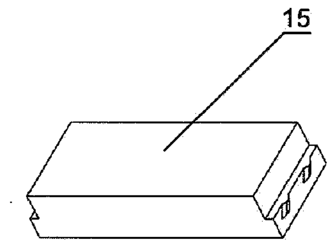


fig 29



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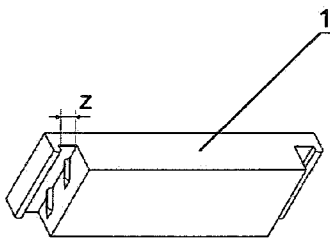

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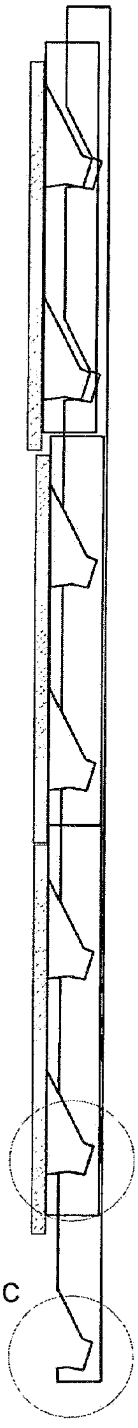


fig 25

Szczegół "C"

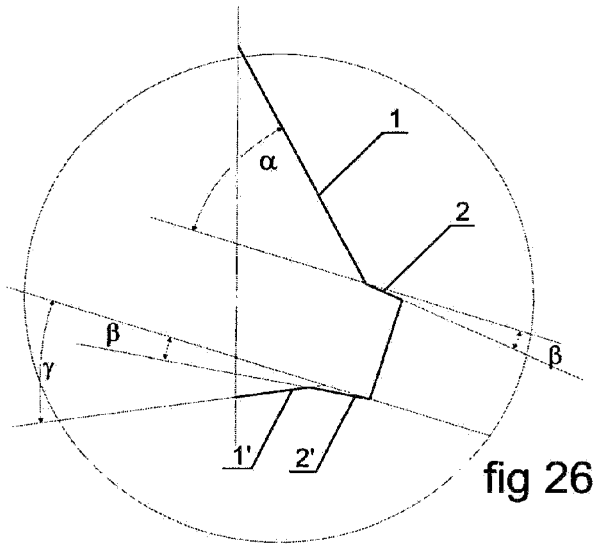
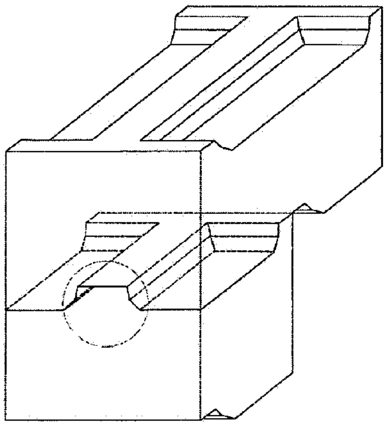


fig 26

Szczegół „C" - Detail "C"



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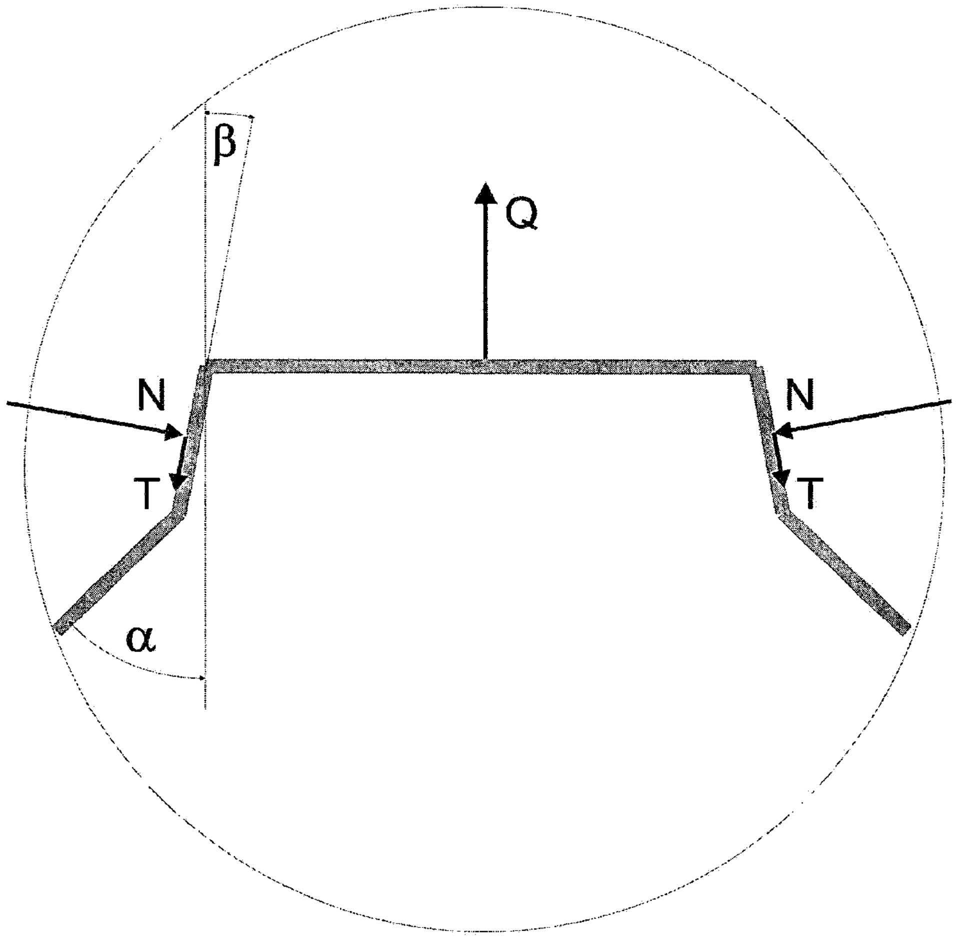

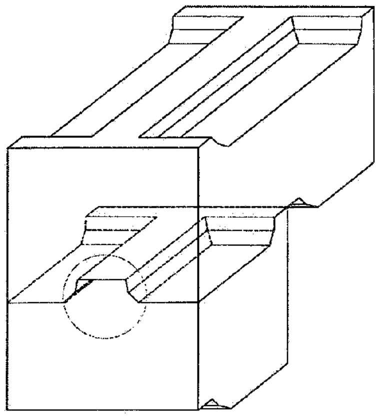

fig 31