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(54) **CONSTRUCTION SYSTEM**

(57) Construction system comprising a plurality of columns arranged on a ground surface and panels arranged between adjacent columns, with the special feature that the columns are manufactured from a material containing cellulose and are identical to each other, wherein each column comprises a U-shaped cross-section

tion with two parallel legs and a base located therebetween, and wherein the legs of the U-shaped cross-section are folded in order to form grooves extending in the longitudinal direction of each column. The invention also relates to said column as such for use in a construction system.

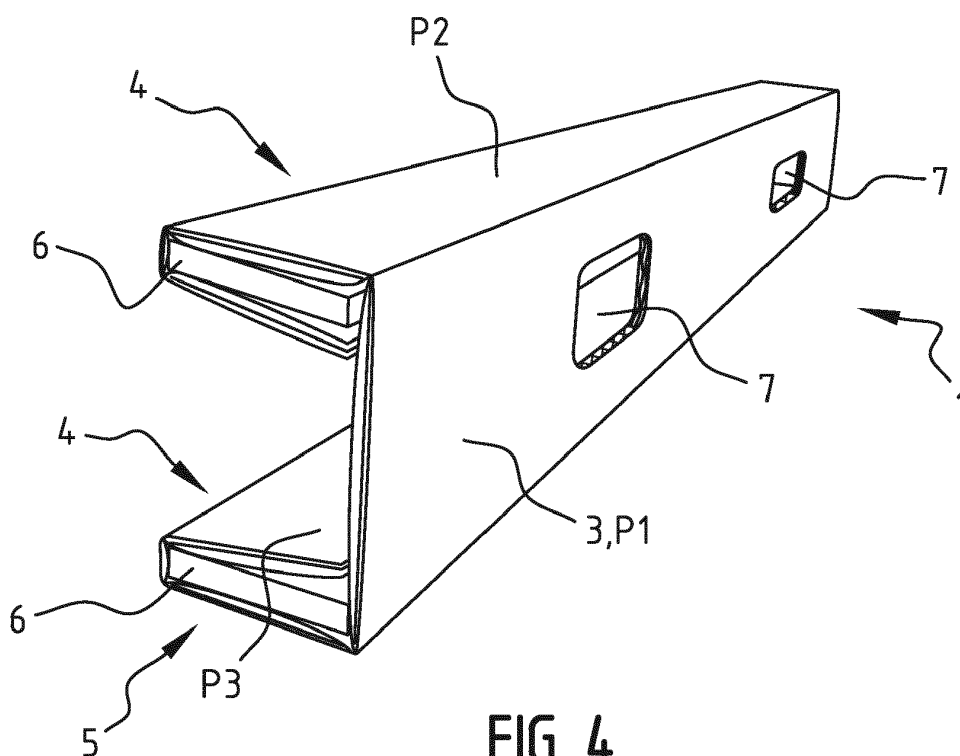


FIG. 4

Description

[0001] The invention relates to a construction system, such as a wall system, comprising a plurality of columns arranged on a ground surface and panels arranged between adjacent columns. Such systems are suitable for creating for instance walls, ceilings, floors and other surfaces.

[0002] Such a construction system is generally known, for instance as wall system. In the known system use is made of columns, i.e. posts, to be arranged on a ground surface such as a floor, which columns are provided with panels, for instance of plasterboard. The columns, manufactured from metal, have a U-shaped or C-shaped cross-section against which the panels are mounted using screws. Alternatively, use can also be made of columns, i.e. posts, made of wood, which generally take a rectangular and solid form.

[0003] A drawback of the known construction system is that the fire resistance thereof is inadequate in practice. It is found particularly in practice that the columns of the known system collapse (too) quickly in case of fire, so that the resistance thereof to fire penetration (flames passing through the system) does not meet increasingly higher safety standards. The screws in the known system are more particularly found to conduct the heat created during a fire very effectively, which results in heating of the respective plaster panel and the respective leg (flange) of the U-shaped (or C-shaped) cross-section of the column in question. The U-shaped cross-section thereof thereby bends (bimetal effect) and the plaster panel breaks away therefrom. Finally, the components of the known system are either too light to have sufficient structural strength (which must be comparable to a so-called metal-stud wall), or too heavy to be easily transported and applied.

[0004] The invention has for its object, among others, to obviate the above stated drawbacks of the prior art, i.e. to provide a construction system with columns and panels which is fireproof and form-retaining, inter alia in the sense that the columns thereof have a greater resistance to fire penetration.

[0005] The columns and the panels according to the invention must further be strong yet light-weight, wherein the columns and panels can be manufactured, processed, transported and applied in simple manner, and wherein the system is able to withstand great forces exerted thereon.

[0006] For this purpose a construction system of the type stated in the preamble has the special feature according to the invention that the columns are manufactured from a material containing cellulose and are identical to each other, wherein each column comprises a U-shaped cross-section with two parallel legs and a base located therebetween, and wherein the legs of the U-shaped cross-section are folded (inward) in order to form grooves extending in the longitudinal direction of each column. Each groove is therefore bounded by one of the

legs of the U-shaped cross-section and its folded part thereof. A support material and/or an insulating material is/are preferably received in the grooves. The support material serves to be able to screw the panels, such as wall panels, efficiently and firmly onto the columns. The support material and the insulating material ensure that the columns remain intact for longer in the case of fire, without the integrity of the columns being compromised in the case of fire. It is preferred for the support material and/or the insulating material to be slat-like, so that the slats can be mounted in the grooves. If the support material is glued into the grooves, the support material also functions as strengthening material. Instead of or in addition to gluing, the support material can be (fixedly) bonded or be attached using (double-sided adhesive) tape.

[0007] The construction system according to the invention has a sustainable composition, is easy to recycle, can be disposed of in the same waste stream as plaster, and can be easily assembled. The system particularly reduces CO₂ emission as compared to steel profiles, and can be recycled in the existing waste paper recycling streams. The system also provides for a better acoustic insulation, has less effect on wireless signals such as Wi-Fi signals, and does not require earthing. It further has smaller tolerances as compared to existing alternatives. Finally, the system requires less material as compared to existing alternatives to achieve a similar structural performance, wherein the material is also manufactured from organic material in ecological manner.

[0008] The columns of the construction system according to the invention are also referred to as paper-stud profiles.

[0009] In contrast to metal columns (also referred to as metal-stud profiles), paper-stud profiles do not bend excessively when heated. Fire tests have shown that a wall constructed with paper-stud profiles, provided on two sides with a single plasterboard panel, retains its form for longer than a wall provided with metal-stud profiles. Paper-stud profiles carry less sound and, in contrast to metal, have almost no effect on wireless signals. Paper-stud profiles are not electrically conductive, whereby they need not be earthed (in for instance medical environments). Finally, manufacture of a profile of cellulose requires less energy relative to an equivalent metal profile.

[0010] Paper-stud profiles are exceptionally light, can be easily shortened and processed in dust-free manner, contain no toxic substances and have no sharp edges, making the product highly suitable for professional processing, this in respect to laws regarding working conditions, and for processing by private parties.

[0011] Paper-stud profiles can even be processed more easily than wood. They are lighter, can be sliced, this in contrast to wood, and an equivalent structural result can be achieved with less material. Paper-stud profiles carry less sound than wood posts, which enhances the acoustic insulating values between spaces. The profiles are also more compact in transport. Paper-stud pro-

files have minimal dimensional tolerances. While solid wood is susceptible to warping and twisting, paper-stud profiles are perfectly straight.

[0012] Paper-stud profiles are bio-based. This means that the (cellulose) material is ecological and is composted in a short period of time. Cellulose can also be recycled well, and thereby functions after use as raw material for other products in which cellulose is incorporated. Paper-stud profiles can thus be used repeatedly as element and as raw material, whereby they are highly suitable for the vision of a circular economy, wherein waste and scrap are avoided.

[0013] Paper-stud profiles can be provided with covering material in several ways. When used vertically, they function as support structure for wall panelling and, when used horizontally or diagonally, as for instance ceiling, roof or floor supports. Material can be adhered to the profiles using gluing or mastic. Another option is the use of (double-sided) tape to form a connection. The profiles can optionally be provided with screwable strips whereby the material can also be screwed onto the profiles. It is further possible to work with semi-permanent fastening means such as velcro, zip fastenings, ties, clips, clamps, coupling strips or other semi-permanent fastening means known to the skilled person.

[0014] The main constituent of paper-stud profiles is cellulose. Owing to their absorbent capacity, the profiles can be impregnated very well so as to thereby increase the functional performance, wherein it is possible to envisage increased fire-resistance, reduced smoke generation in case of combustion, increased resistance to moisture, and structural reinforcement of the profiles.

[0015] Free outer ends of the folded legs of the U-shaped cross-section preferably extend to the base thereof. These free outer ends are more particularly glued to the base. The grooves are then each bounded by one of the legs of the U-shaped cross-section, its folded part thereof, and the base of the U-shaped cross-section. Each groove then forms as it were a duct, i.e. channel, with a triangular cross-section. The folded part of each of the legs of the U-shaped cross-section therefore extends obliquely, i.e. at an obtuse angle relative to the base, so that the strength is increased. This is because the effective width of the base is then smaller.

[0016] It is noted that the panels are preferably manufactured from a sheet material. In a preferred variant the columns are arranged at a fixed mutual distance of 60 cm on the ground surface. If a greater bending stiffness is required, this mutual distance amounts to 30 or 40 cm.

[0017] In a preferred embodiment of a construction system according to the invention each column is manufactured from one blank. The blank is particularly provided with an elongate main panel and with elongate side panels arranged on either side of the main panel, wherein the side panels can be pivoted relative to the main panel along a first fold line. The first fold line is preferably a single fold line which for instance takes the form of a

crease line or perforation line.

[0018] In a further preferred embodiment of a construction system according to the invention each side panel is connected at a longitudinal edge thereof remote from the main panel to an elongate wing panel, wherein the wing panel can be pivoted relative to the side panel along a second fold line. The second fold line is particularly a double fold line, for instance formed by a double crease line or double perforation line. The distance between the fold lines lying at a mutual distance (i.e. double fold line) in the panel is then particularly between 1.5 and 3 times the thickness of the blank, preferably about 2 times the thickness of the blank. The first fold lines and the second fold lines preferably run parallel to each other.

[0019] A glue is preferably applied to each first fold line and/or to each second fold line in order to locally glue together panel parts on either side of each first fold line and/or panel parts on either side of each second fold line. A very stable connection of in each case mutually opposite panel parts is thus obtained at the position of the first and second fold lines. The glue can be a so-called hot-melt glue or a cold glue, or a combination thereof. The glue is preferably applied either continuously along a fold line or discontinuously (i.e. for instance every 0.5 cm or 1 cm) along a fold line.

[0020] Free longitudinal edges of the wing panels are preferably glued to the main panel using preferably the same type of glue as stated above. This increases the construction strength.

[0021] In a further preferred embodiment of a construction system according to the invention the panels are arranged on the outer side of the legs of the U-shaped cross-section. The panels are here preferably screwed or glued onto the outer side of the legs of the U-shaped cross-section.

[0022] In a further preferred embodiment of a construction system according to the invention the panels are manufactured from a heat-insulating and/or sound-insulating material. The panels are preferably formed by plasterboard panels. In another preferred variant the panels are manufactured from Fermacell (a mixture of plaster and paper fibres) or from magnesium-reinforced glass fibre or fire-resistant chipboard or fire-resistant MDF (medium density fireboard, i.e. resin-bound wood fibres).

[0023] In a further preferred embodiment of a construction system according to the invention the columns are manufactured from paper or cardboard, preferably from a plurality of layers of cardboard glued to each other, preferably of so-called EB quality. The cardboard is preferably constructed from five layers of cardboard, namely a first layer of corrugated cardboard and a second layer of corrugated cardboard with a flat layer therebetween, wherein the first and the second corrugated cardboard layer are each provided on their outer sides with a flat cardboard layer. The first corrugated cardboard layer has a corrugation height of preferably 2.5 mm, while the second corrugated cardboard layer has a corrugation height of preferably 1.5 mm. The present construction system

is eminently suitable for application in hospitals, since no metal is used, or in office buildings, since no materials are used that are able to disrupt wireless signals, for instance for email and phone traffic. A groove with an at least substantially V-shaped cross-section is particularly arranged at the position of a predetermined fold line, wherein the groove extends through the layers of cardboard to the flat cardboard layer (i.e. outer layer) in order to form a hinge in the outer layer for the purpose of pivoting the side panels relative to the main panel and the wing panels relative to the side panels. This achieves that only the outer layer forms a hinge, while no other material is present at this position. The panel can therefore easily bend at this position. The outer layer is optionally weakened at the position of the predetermined bend line.

[0024] In a further preferred embodiment of a construction system according to the invention holes are arranged in the base for the purpose of leading therethrough public utility lines and/or pipes.

[0025] The invention likewise relates to a column as such for use in a construction system according to the invention, wherein the column is manufactured from a material containing cellulose, wherein the column comprises a U-shaped cross-section with two parallel legs and a base located therebetween, and wherein the legs of the U-shaped cross-section are folded in order to form grooves extending in the longitudinal direction of each column.

[0026] The invention will be further elucidated with reference to figures shown in a drawing, wherein:

- figures 1 and 2 show schematic perspective views of a cardboard blank for manufacturing a column in a preferred variant of a construction system according to the invention, wherein the blank can be folded from a folded-out ("flat") position (figure 1), via a partially folded-up position (figure 2) into a whole folded-up position (figure 3);
- figure 3 provides a schematic perspective view of a U-shaped column from the blank of figures 1 and 2, wherein a slat-like support material is slid into one of the formed grooves;
- figure 4 corresponds to figure 3, with the understanding that holes for public utility lines are also provided in the base of the U-shape; and
- figure 5 shows a schematic perspective view of columns and (wall) panels of figures 1, 2, 3 and 4, but now in assembled state.

[0027] Figure 1 shows the blank P from which a column 1 can be manufactured by means of folding along different fold lines F1, F2 in longitudinal direction of the blank P (corresponding to the longitudinal direction of the column 1 manufactured therefrom). Figure 1 shows the fold-

ed-out, i.e. "flat", position of blank P. In the flat position a plurality of blanks P can be stacked easily and transported efficiently, since there is almost no empty space between the plurality of blanks.

[0028] The blank P consists of a material containing cellulose, such as cardboard. The material can consist of several layers, which are preferably glued to each other. In the present embodiment of Figure 1 the cardboard consists of at least two outer flat cardboard layers with a core layer of profiled cardboard therebetween. The core of profiled cardboard gives the blank P the necessary strength, without significant weight having to be added. The profile of the cardboard is for instance corrugated, wherein the ridges of the corrugations are for instance pointed in order to create triangular volumes between the outer flat cardboard layers. Such a triangular shape imparts strength and some thickness to the cardboard, without a significant weight increase. The volumes which are created in the cardboard likewise ensure that still air can be present therein, whereby the cardboard has excellent insulating functionality.

[0029] The blank P of Figure 1 is divided into a main panel P1, two side panels P2 located on either side of the main panel P1, and two wing panels P3 extending outward from a longitudinal side of each side panel P2 remote from main panel P1. Fold lines F1, F2 are arranged between the individual panels P1, P2, P3 in order to be able to fold the blank P at the fold lines F1, F2. Situated between main panel P1 and side panels P2 are single fold lines F1 and situated between side panels P2 and wing panels P3 are double fold lines F2. A double fold line, such as fold line F2, comprises two parallel single fold lines arranged at some distance from each other. A double fold line is advantageous when the fold to be arranged comprises a fold of more than about 90°. The double fold, as must be arranged between side panels P2 and wing panels P3, comprises substantially two successive single folds of about 90°, whereby a fold of about 180° is effectively obtained. The single fold lines F1 and double fold lines F2 extended substantially parallel in longitudinal direction of the blank P.

[0030] Figure 2 shows a partially folded-up position of the blank P, wherein the blank P lies between the flat position and the end position. In the end position the blank P forms the column 1 according to the invention. Several characteristics of the column 1 can already be identified in the shown intermediate position. The main panel P1 forms the base 3 of column 1, and the side panels P2 and wing panels P3 together form the legs 4 of column 1. In the end position legs 4 and base 3 together form a U-shaped profile, as can be seen in the following figures. In the end position the double fold line F2 between wing panels P3 and side panels P2 forms a groove 5 extending in longitudinal direction, this being a space formed in a leg 4 of the column 1 between double fold line F2, base 3 and the side panel P2 and wing panel P3 of leg 4. The fold lines F1, F2 give the column 1 the necessary strength against bending, so that it functions as a strong construc-

tion element. Groove 5 can also provide for an insulating function, since it can comprise still air. The double fold line F2 is shown exaggerated to some extent in the figures for the purpose of elucidation. In practice the two fold lines of the double fold line F2 preferably lie relatively close together so that the groove 5 has substantially a triangular cross-section. It is however also possible to opt for a distance between the two fold lines of double fold line F2 such that a groove 5 with rectangular cross-section or even with a trapezoidal cross-section is obtained.

[0031] Referring to figures 1 and 2, an adhesive is applied to each first fold line F1 in order to in each case locally glue together panels P1, P2 on either side of each first fold line F1. An adhesive is likewise applied to each fold line of each double fold line F2 in order to locally glue the panel part lying between the fold lines of each double fold line F2 to in each case panels P2, P3. Free longitudinal edges 10 of wing panels P3 are glued to main panel P1. An optimal construction rigidity is hereby obtained.

[0032] Figure 3 shows the end position, i.e. fully folded-up position, of the blank P, whereby it forms the column 1. Column 1 comprises a base 3 and two legs 4 extending parallel relative to each other. Base 3 and legs 4 here form a substantially U-shaped angular profile, or C-shaped profile. Groove 5 has a triangular cross-section, whereby the effective width of base 3 is reduced. This improves the bending strength of column 1. The longitudinal edges 10 (see Figures 1 and 2) of wing panels P3 are preferably in contact with base 3, i.e. main panel P1, in the end position. Longitudinal edges 10 extend in longitudinal direction of column 1 and can be glued to base 3 for further strengthening of column 1.

[0033] As shown in Figure 3, a strengthening material 6 is arranged in the groove 5, which material is slat-like and comprises a length which corresponds substantially to the length of column 1 so that strengthening material 6 at least substantially fills the groove when it has been wholly arranged. In Figure 3 the strengthening material has been arranged only partially in one of the grooves 5. Strengthening 6 can optionally be glued to the inner surface of groove 5. Strengthening 6 gives column 1 additional strength. The strengthening material 6 can also have insulating, fire-resistant, fire-retardant, smoke generation-minimizing or other useful characteristics.

[0034] Figure 4 shows the column 1 in a perspective bottom view. In figure 4 the two grooves 5 of column 1 are now provided with strengthening material 6. The shown column 1 is therefore ready for use as construction element. Holes 7 are also arranged in base 3 of column 1 for the purpose of leading therethrough public utility lines and/or pipes (not shown). It is possible here to envisage electricity cables or conduits, water conduits, gas conduits, ethernet cables, telephone cables, heating pipes, glass fibre cables and so on. The column 1 according to Figure 4 comprises two rounded rectangular holes 7. Column 1 can also comprise a different number of holes 7, or even no holes 7. The holes 7 can also have

a different shape, such as circular, square, star-shaped and so on. A hole 7 can also be arranged such that flanges (not shown) are formed thereby, which can function as support element for cables and other public utility lines and/or pipes.

[0035] Figure 5 shows an embodiment of a construction system according to the invention. The construction system comprises columns 1, as described above, front panels 2' and rear panels 2", such as wall panels of for instance plasterboard, optional filler material 8 and fastening means 9, such as screws. Front panels 2' and rear panels 2" are fastened with fastening means 9 to the outer side of the legs 4 of columns 1. The surfaces of the panels 2', 2" facing toward columns 1 are therefore in contact with the side panels P2 of columns 1. The fastening means 9 can extend partially or wholly through the legs 4 of the columns, i.e. through the side panels P2, particularly through strengthening 6, more particularly through wing panels P3, and still more particularly into filler material 8. The filler material 8 can comprise various suitable materials, such as fire-resistant, fire-retardant, heat-insulating, sound-insulating and/or strengthening material, or other materials known to the skilled person. The construction system can function as various types of construction element, such as a floor element, a ceiling element, a wall element, a roof element or combinations thereof. Other structural applications can likewise be envisaged. In some cases one of the panels 2', 2" can be replaced with an existing panel, such as a brick wall, a foundation, structural beams and so on, wherein the existing panel replaces one of the panels 2', 2". The present invention can therefore for instance be utilized to insulate existing walls, floors, ceilings or roofs.

[0036] It is noted that the invention is not limited to the exemplary embodiments shown in the figures but also extends to other embodiments falling within the scope of protection of the claims.

Claims

1. Construction system comprising a plurality of columns (1) arranged on a ground surface and panels (2) arranged between adjacent columns (1), **characterized in that** the columns (1) are manufactured from a material containing cellulose and are identical to each other, wherein each column (1) comprises a U-shaped cross-section with two parallel legs (4) and a base (3) located therebetween, and wherein the legs (4) of the U-shaped cross-section are folded in order to form grooves (5) extending in the longitudinal direction of each column (1).
2. Construction system according to claim 1, wherein each column (1) is manufactured from one blank (P).
3. Construction system according to claim 2, wherein the blank is provided with a main panel (P1) and with

side panels (P2) arranged on either side of the main panel (P1), and wherein the side panels (P2) can be pivoted relative to the main panel (P1) along a first fold line (F1).

4. Construction system according to claim 3, wherein the first fold line (F1) is a single fold line. 5
5. Construction system according to claim 3 or 4, wherein each side panel (P2) is connected at a longitudinal edge thereof remote from the main panel (P1) to a wing panel (P3), and wherein the wing panel (P3) can be pivoted relative to the side panel (P2) along a second fold line (F2). 10
6. Construction system according to claim 5, wherein the second fold line (F2) is a double fold line. 15
7. Construction system according to claim 3, 4, 5 or 6, wherein a glue is applied to each first fold line (F1) and/or to each second fold line (F2) in order to locally glue together panel parts on either side of each first fold line (F1) and/or panel parts on either side of each second fold line (F2). 20
8. Construction system according to claim 5, 6 or 7, wherein free longitudinal edges (10) of the wing panels (P3) are glued to the main panel (P1). 25
9. Construction system according to any one of the foregoing claims 1-8, wherein a support material (6) and/or an insulating material is received in the grooves. 30
10. Construction system according to claim 9, wherein the support material (6) is slat-like. 35
11. Construction system according to any one of the foregoing claims 1-10, wherein the panels (2', 2'') are arranged on the outer side of the legs (4) of the U-shaped cross-section. 40
12. Construction system according to claim 11, wherein the panels (2', 2'') are screwed or glued onto the outer side of the legs (4) of the U-shaped cross-section. 45
13. Construction system according to any one of the foregoing claims 1-12, wherein the panels (2) are manufactured from a heat-insulating and/or sound-insulating material. 50
14. Construction system according to claim 13, wherein the panels (2) are formed by plasterboard panels. 55
15. Construction system according to any one of the foregoing claims 1-14, wherein holes (7) are arranged in the base (3) for the purpose of leading

therethrough public utility lines and/or pipes.

16. Construction system according to any one of the foregoing claims 1-15, wherein the columns are manufactured from cardboard, preferably from a plurality of layers of cardboard glued to each other.
17. Column (1) for use in a construction system according to any one of the foregoing claims 1-16, wherein the column (1) is manufactured from a material containing cellulose, wherein the column (1) comprises a U-shaped cross-section with two parallel legs (4) and a base (3) located therebetween, and wherein the legs (4) of the U-shaped cross-section are folded in order to form grooves (5) extending in the longitudinal direction of each column (1).

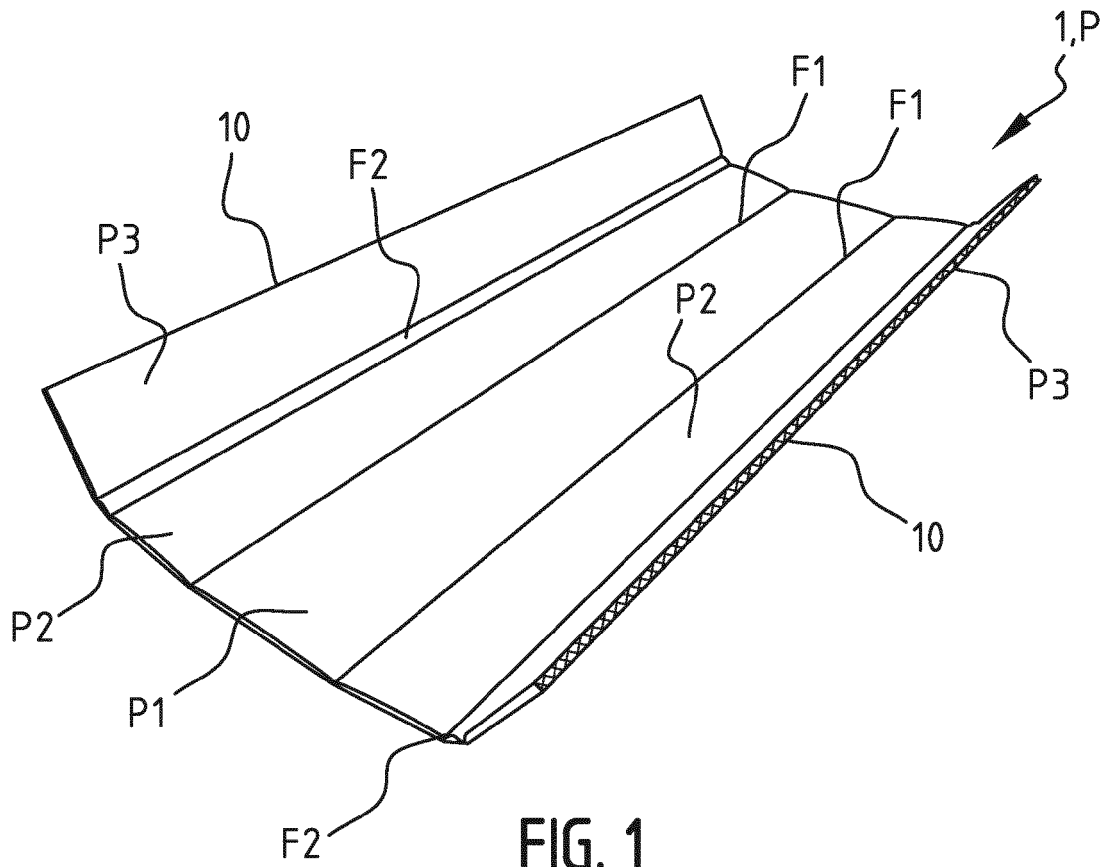


FIG. 1

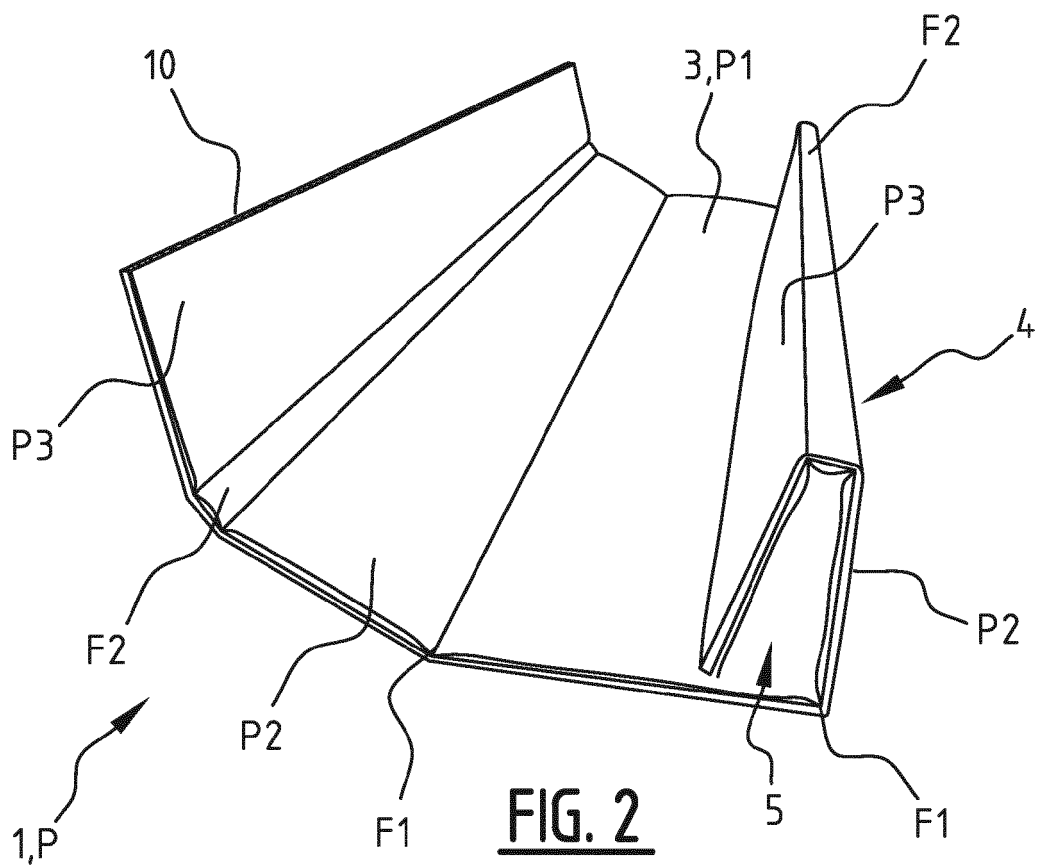


FIG. 2

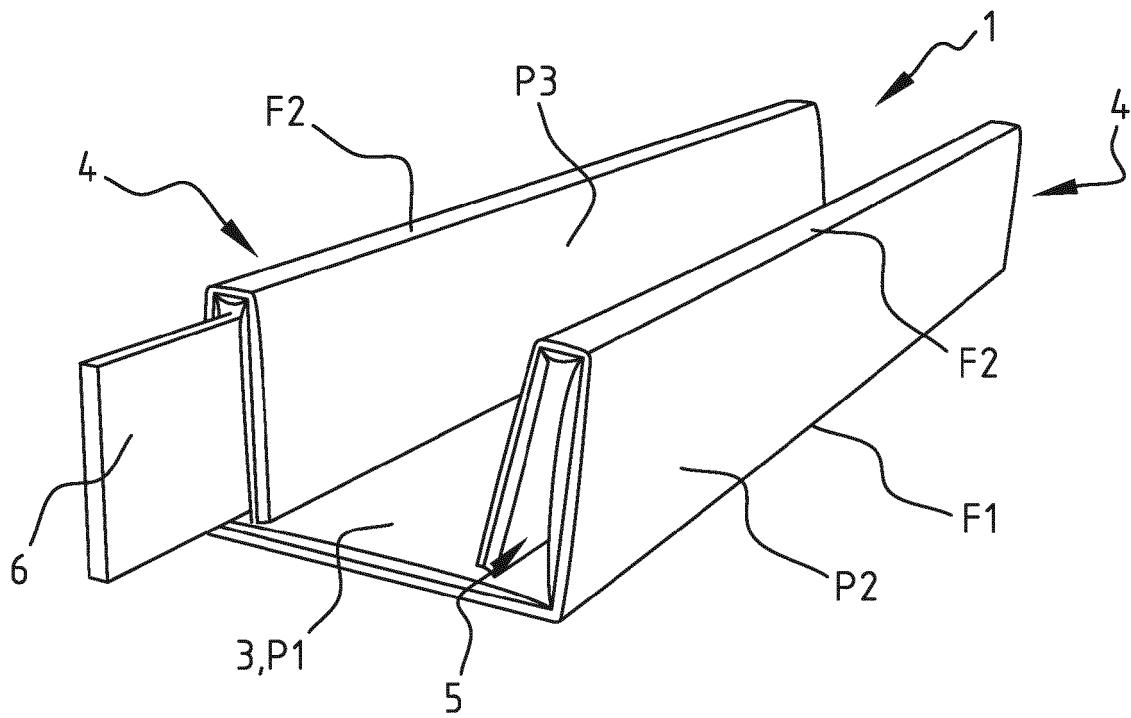


FIG. 3

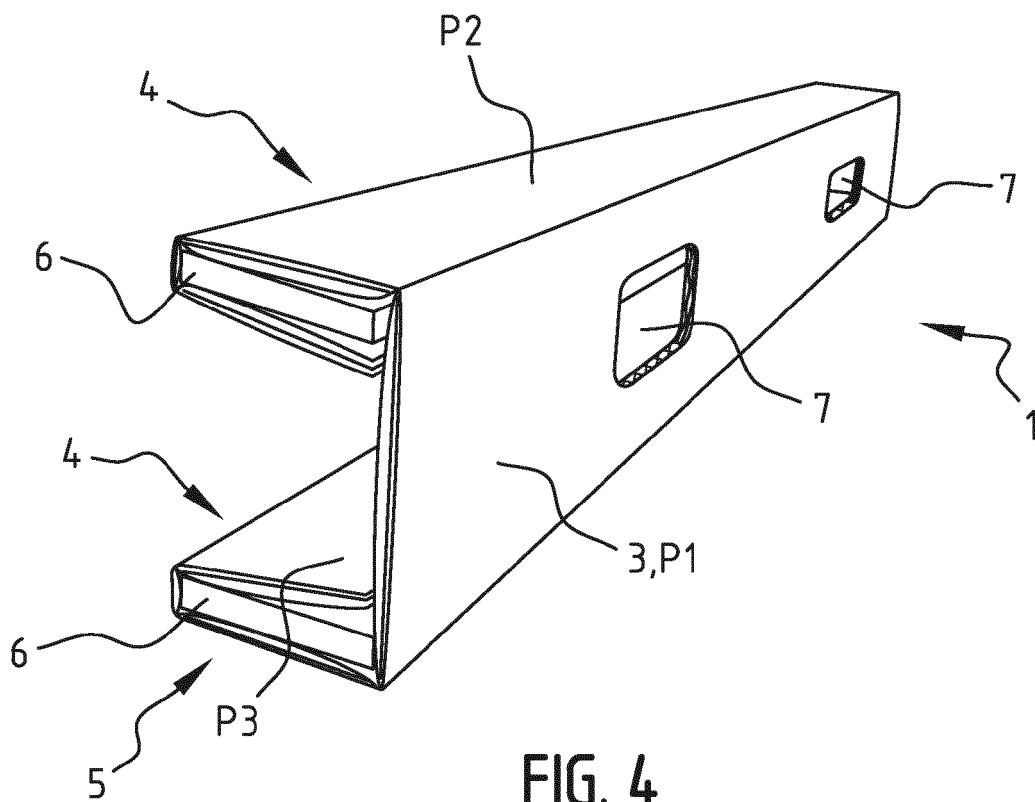


FIG. 4

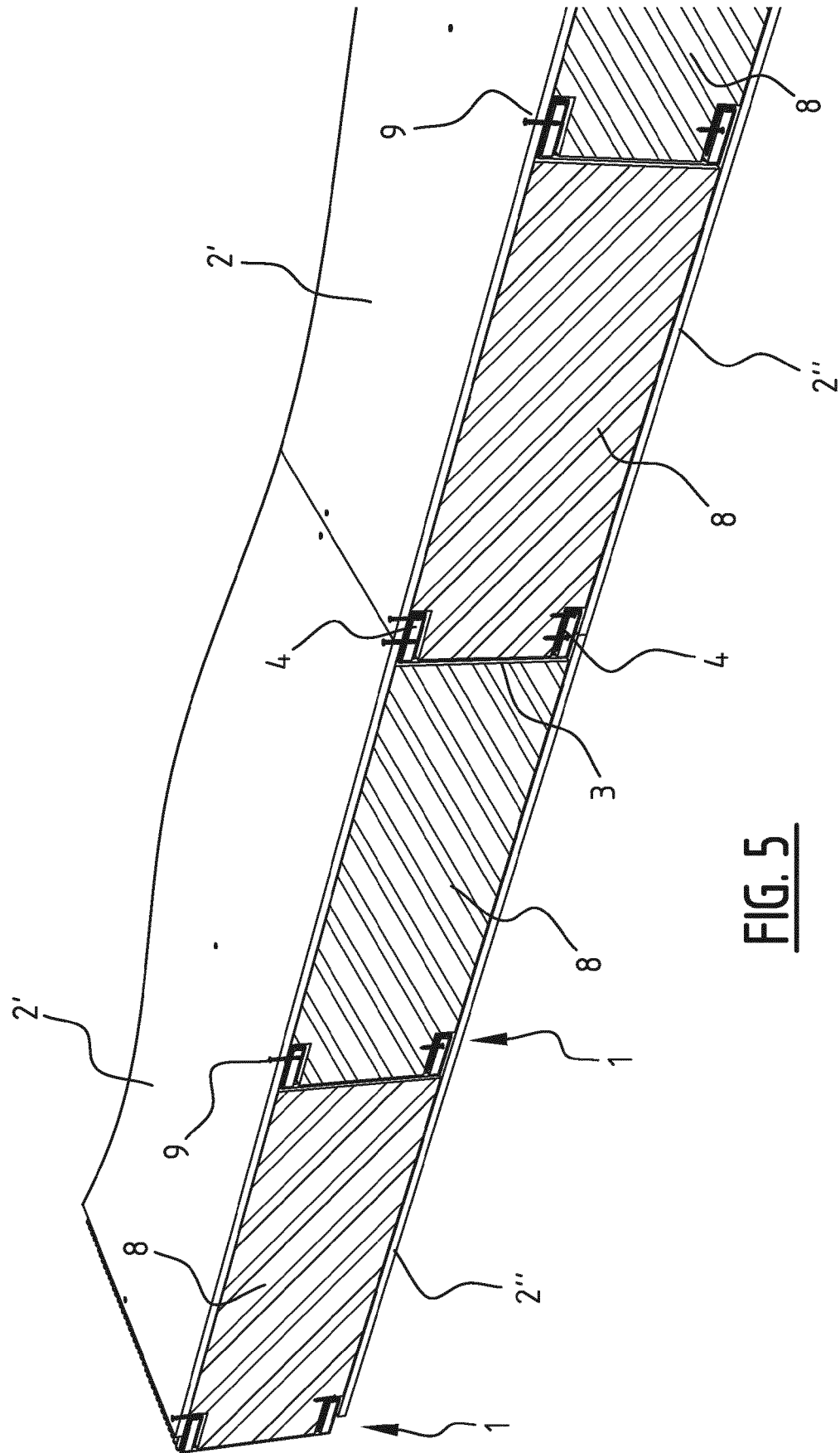


FIG. 5



EUROPEAN SEARCH REPORT

Application Number
EP 21 16 3325

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DOCUMENTS CONSIDERED TO BE RELEVANT			
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The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 10 June 2021	Examiner Galanti, Flavio
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	

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**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 21 16 3325

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This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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10-06-2021

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