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(54) **Facade cladding system**

(57) The invention provides a system for cladding a facade, comprising panels and fastening means for installing the panels on the facade, spaced therefrom by some distance. The fastening means comprise elongate suspension means extending in vertical direction along the facade, spaced therefrom by some distance, which are provided with a number of suspension elements along their length. The fastening means further comprise hook members which are attached to the rear side

of the panels for suspending engagement with the suspension elements. According to the invention, the hook members are of substantially U-shaped horizontal cross-section, with the elongate suspension means extending between the two legs of said U-shape. The invention further provides a suspension means, a panel, a suspension element, a building and a method for use with such a facade cladding system.

EP 1 441 085 A1

Description

[0001] The invention relates to a system for cladding a facade, comprising panels and fastening means for installing the panels on the facade, spaced therefrom by some distance, said fastening means comprising elongate suspension means extending in vertical direction along the facade, spaced therefrom by some distance, which are provided with a number of suspension elements along their length, said fastening means further comprising hook members which are attached to the rear side of the panels for suspending engagement with the suspension elements. More specifically, the invention is in particular, but not exclusively, aimed at panels which are at least partially made of wood- or cellulose-containing materials. Such panels are characterized by a relatively low weight, which makes it possible to use them in relatively large dimensions.

[0002] A system as referred to in the introduction is described in European patent application EP-A2-387127. Said system employs cables which are tensioned in vertical direction along a facade. Turnbuckles are clamped down on said cables at regularly spaced intervals along the length thereof. Each turnbuckle is rigidly connected with the facade in question. The turnbuckles are provided with an upwardly oriented hook on their side remote from the facade, from which facade panels can be suspended. To that end, the facade panels are provided with a downwardly oriented hook on their rear side, which hook mates with the upwardly oriented hook of the turnbuckles. An important drawback of such a system is its complexity, in particular as regards the specific attachment of the turnbuckles to the cables on the one hand and the attachment of the turnbuckles to the facade on the other hand. In addition to that, tensions can be introduced into the cable via the turnbuckles. In addition, because of the horizontal spacing between the facade panels and the turnbuckles that is made necessary by the presence of the hooks therebetween, the facade panels will furthermore exert a significant bending moment on the turnbuckles and on the cables.

[0003] The object of the invention is to provide, whether or not in preferred embodiments thereof, a system for cladding a facade as referred to in the introduction, by means of which a significant improvement is achieved in regard to the drawbacks of the prior art as described above, more specifically a system by means of which the cladding of a facade with panels can take place in a quick and efficient manner without highly qualified personnel being needed for carrying out the relevant operations and without the use of high-quality and thus costly technical means being required.

[0004] In the first place, the system according to the invention is characterized in that said hook members are of substantially U-shaped horizontal cross-section, with the elongate suspension means extending between the two legs of said U-shape. A system according to the

main aspect of the invention makes it possible to clad a facade with panels in a quick and efficient manner without highly qualified personnel being needed. In addition to that, the spacing that is according to the invention present between the suspension means and the facade minimizes the thermal bridge effects between the facade and the facade panels. Another advantage arises from the low cost of the materials that are required for this facade system. Cladding a facade with panels will sooner be profitable as a result of the above advantages. In addition, the web of the U-shape is highly suitable for attaching the hook members to the rear side of the panel, whilst the underside of the two legs of the U-shape can support on the suspension element for suspending engagement therewith. Thus it is possible to reduce the mechanical load, more specifically the bending moment, that acts on the suspension means in question. Furthermore, a suspension means extends advantageously between the two legs of the U-shape, so that the amount of space that is required between the facade on the one hand and the rear side of the panels on the other hand, but also between a suspension means and the rear side of the panels, can remain within acceptable bounds.

[0005] Preferably, the U-shape of the hook members has been obtained by flanging a plate. In this way an inexpensive production process is used for manufacturing the hook members, so that said means can be produced in large numbers at low cost.

[0006] The hook members are preferably made of a metal, more preferably of steel, even more preferably of stainless steel. These types of materials are in principle quite capable of absorbing the mechanical load that is exerted on the hook members, and they are sufficiently corrosion resistant, which may for example be required in coastal regions.

[0007] In order to prevent the hook members from moving sideways off the suspension elements, it is strongly preferred for the hook members and the suspension elements to interlock in a form-locked manner during their suspending engagement.

[0008] A constructionally very advantageous embodiment is obtained if the hook members and/or the suspension elements are provided with slots to enable said form-locked engagement. The slots are preferably present in the hook members as well as in the suspension elements, so that the form-locked engagement acts in two perpendicular directions.

[0009] Preferably, the suspension elements extend parallel to the facade on either side of the associated suspension means. As a result, the suspension elements are evenly loaded by the weight of the panels, whilst in addition it is no longer necessary to exert a bending moment on the associated suspension means.

[0010] Preferably, the suspension elements are substantially plate-shaped for reasons of constructional simplicity.

[0011] In order to obtain an advantageous mechani-

cal load on the suspension means, the suspension means preferably extend at least substantially in the plane of the associated suspension elements.

[0012] An optimum use of materials is obtained if the suspension elements have a horizontally extending longitudinal direction.

[0013] A very suitable embodiment of the suspension elements is obtained if the suspension elements comprise two element parts which clampingly engage the suspension means on opposite sides. In principle, said clamping engagement can be realised at any longitudinal position of the suspension means, so that a system can be adapted for use with panels of varying dimensions.

[0014] In order to prevent the suspending engagement between the hook elements and the suspension elements from being released, for example under the influence of heavy wind loads, which might lead to the panels falling down, the fastening means preferably comprise fixing means for fixing the suspending engagement between the hook elements and the suspension elements.

[0015] A simple constructional solution to this problem is obtained if said fixing means comprise springs which are operative between the hook elements and the suspension elements.

[0016] A very advantageous embodiment is obtained if the elongate suspension elements are flexible cables. Cables are available in great lengths, they can easily be cut to the desired length at the location of the facade to be clad, but they can also be supplied in the desired length. Cables furthermore provide an advantageous possibility of attaching the suspension elements separately to the cables in a production environment specially equipped for that purpose, so that a high degree of precision can be obtained and, in addition, no labourious operations at the location of the facade to be clad will be required. This makes it possible to realise a considerable saving of time in cladding the facade. If the cables are twined, a very reliable system will be obtained. The same advantage applies if the cables are made of stainless steel, so that they will be less liable to corrosion.

[0017] In a very advantageous embodiment, the suspension elements are pre-tensioned. In this way the negative effects of temperature fluctuations, which in principle may lead to the suspension elements increasing or decreasing in length and/or to cable relaxation in general, are minimised as much as possible.

[0018] In particular in situations in which the facade to be clad has a considerable height, it is preferable, especially if cables are used as the suspension means, for the fastening means to comprise holder means attached to the facade for holding the suspension means between the ends of said suspension means, spaced from the facade. In this way, a constant spacing can be maintained between the suspension means and the facade along the entire length of said suspension means. The holder means prevent the facade panels from "flap-

ping", movement of the facade panels towards and away from the facade in a direction perpendicularly to the facade, and enable the use of the individual suspension elements having a considerable length. In addition to that, no stresses (in tension) can thus be introduced into the suspension means via the holder means. Accordingly, another preferred embodiment of the invention is characterized in that said holder means comprise guide means for guiding the suspension means.

[0019] The maintaining of a fixed spacing between the facade and the suspension means preferably takes place by guiding the suspension means in such a manner, that vertical movement of the suspension means along the holder means is in principle possible, for example in that the suspension means are passed through an eye of the holder means. This is advantageous in particular during installation of the cladding system according to the invention on a facade, since it enables an easy installation of the system.

[0020] In another preferred embodiment of the invention, at least two suspension means are provided for each vertical row of panels, which suspension means each extend straight behind the vertical row of panels, near opposing vertical circumferential edges of the panels of the vertical row of panels. On the one hand this achieves that the suspension means are not exposed to view, or only between the horizontal seams between two neighbouring panels positioned one above the other of a row of panels, whilst on the other hand a stable suspension of the panels can be obtained in this manner.

[0021] Alternatively, the suspension means may extend between two adjacent vertical rows of panels, and the suspension elements with which the suspension means are provided may be in suspending engagement with the hook elements associated with the panels of the adjacent vertical rows of panels. The advantage of such a construction is that the required number of suspension means can be practically halved, because one suspension means is used for two vertical rows of panels rather than for one vertical row of panels. The two outermost rows of panels on a facade are an exception in this regard, of course.

[0022] The invention furthermore relates to a suspension means for use in a system according to the invention as described above, which suspension means is provided with the suspension elements in a regular pattern. As already indicated above, the suspension means advantageously make it possible to attach the suspension elements thereto in a production environment, in particular if cables are used as the suspension means.

[0023] The invention further relates to a panel for use in a system according to the invention as described above, which panel is provided with hook members attached to the rear side thereof. The same advantage as with the suspension means according to the invention applies for the panel according to the invention, since the hook members, too, can be attached to the panel in an optimised production environment, thus minimising

the amount of work to be carried out at the location of the facade to be clad.

[0024] The invention also relates to a suspension element for use in the system according to the invention as described above.

[0025] The invention furthermore relates to a building provided with the system according to the invention as described above.

[0026] Finally, the invention relates to a method of using the system according to the invention as described above, which method comprises the steps of:

- A fixing elongate suspension means in vertical direction to the facade to be clad,
- B providing the suspension means with the suspension elements,
- C attaching the hook members to the rear side of the panels,
- D effecting suspending engagement between the hook members and the suspension elements.

[0027] Preferably, step B and/or a step C are carried out at a production location remote from the facade to be clad.

[0028] The specific advantages of the method according to the invention, whether or not in preferred embodiments thereof, have already been explained in the description of the system according to the invention.

Figure 1 shows a facade (partially) clad with the system according to the invention.

Figure 2 shows the area II in Figure 1.

Figure 3 shows the area III in Figure 2.

Figure 4 shows the left-hand cable in Figure 3 from a different perspective.

Figure 5 shows the rear side of a panel.

[0029] Figure 1 shows a facade 1 of a building 2, which is clad with facade panels 3. The facade panels 3 on the right-hand side of the facade are not shown for the sake of clarity. The dimensions of the facade panels are about 0.80 x 0.80 m. The facade panels 3 are embodied as flat plates with a base of thermosetting resins, which are homogeneously reinforced with wood fibres. Steel angle sections 4, 5 are fixed to the facade 1 at the bottom side and the upper side thereof, with the vertical leg 6 of said angle sections being fastened to the facade 1 (more specifically to the inner leave) with bolts and the horizontal leg 7 extending perpendicularly to the facade 1 in a direction away from said facade. Two vertically extending, twined stainless steel cables 9, 10 are tensioned between the horizontal legs 7 of the angle sections 4 and 5 for each vertical panel row 8. The spacing in horizontal direction between the cables 9 and 10 is slightly less than 0.80 m, so that the two cables 9, 10 are hidden from view behind the facade panels 3, extending near the vertical edges of the facade panels 3. The cables 9, 10 have threaded ends 11, 12. Attached

to the sides of the horizontal legs 7 of the angle sections 4, 5 remote from the cables 9, 10 are nuts 13, which mesh with said threaded ends 11, 12 and by means of which the cables 9, 10 can be pre-tensioned. Anchor pins 14 provided with spiral eyes 15 are fixed to the facade at regularly spaced-apart positions along the length of the cables 9, 10, through which eyes the cables 9, 10 in question extend, thus preventing (excessive) flapping of the cables 9, 10.

[0030] The spacing between the facade 1 and the facade panels 3 can be influenced by adjusting the dimensions of the angle sections 4, 5, so that said spacing can be geared to accommodating any insulating materials or to effecting the necessary ventilation. Since the cables extend rectilinearly along the height of the facade 1, the facade panels 3 will almost automatically be correctly aligned, without refined adjusting facilities being needed for this purpose. It is also conceivable to have the cables 9, 10 follow a specific non-rectilinear contour of a facade by using spacers (not shown), so that it is possible to follow a convex or curved shape of a facade and clad the facade with facade panels, using the present system according to the invention. In addition to that it will be apparent from Figure 1, certainly in combination with Figure 2, that any thermal bridge effects are minimised as a result of the minimal contact between the respective materials of the facade panels 3 and the facade 1.

[0031] The facade panels 3 are suspended from the cables 9, 10, as it were. To that end, the respective cables 9, 10 are provided with two anchoring elements for each facade panel 3, viz. an upper anchoring element 16 and a lower anchoring element 17. Thus four anchoring elements are provided for each facade panel 3.

[0032] Two upper hook elements 18 and two lower hook elements 19 are provided at the rear side of the facade panels 3 (see Figure 5), at positions corresponding to the positions of the two upper anchoring elements 16 and the two lower anchoring elements 17.

[0033] The anchoring elements 16, 17 consist of two identical plates 20, 21 which extend in horizontal longitudinal direction, parallel to the facade 1, and which are provided at their centres with a vertically extending, semicircular recess having a diameter corresponding to that of the cables 9, 10. The two plates 20, 21 are clamped together by means of two bolt-nut combinations 22, 23, with the cable 9, 10 in question being clamped down between the two plates 20, 21, so that movement in vertical direction of the respective anchoring element 16, 17 along the cables 9, 10 (four example under the influence of the weight of the facade panels 3) is no longer possible as a result of the friction thus obtained between the plates 20, 21 and the cables 9, 10. The anchoring elements 16, 17 are provided with shallow vertically oriented slots 24, 25 both at their upper side and at their lower side, the function of which slots will become apparent hereinafter.

[0034] The hook elements 18, 19 are of identical con-

struction and have been formed by flanging stainless steel plates. The hook elements 18, 19 comprise a part of U-shaped horizontal cross-section, comprising two legs 26, 27 and a web 28. A hole 29 for a screw 31 (or, alternatively, a pop rivet) is present in the web 28, as is a hole 30 formed with a punched portion extending towards the facade panel 3, which slips into a shallow hole in the rear side of the facade panel 3 in the installed position so as to correctly orient the hook elements 18, 19. It stands to reason that the screw 31 likewise engages in a bore at the rear side of the facade panel 3. Alternatively it would also be possible to form a hole for a second screw at the location of the punched portion 30, via which screw the hook elements 18, 19 are connected to the rear side of the facade panels 3. The upper side of the space between the legs 26, 27 is closed by a bent-over cover plate 33 having a V-shaped recess 34. The edges of the V-shaped recess 34 function to guide the cable during the installation process. Said recess 34 makes it possible for the cables 9, 10 to extend vertically between the legs 26, 27. At their bottom side, the legs 26, 27 are provided with slots 35 that flare out at their bottom side.

[0035] Figure 3 and Figure 4 show the suspending engagement between an upper element 18 and an upper anchoring element 16 from different perspectives for the cable 10, with slots 35 of the hook element 18 and slots 24 of the anchoring element 16 engaging each other, so that they are fixed in horizontal direction with respect to each other. Springs 36 are provided on the outer sides of the legs 26, 27 for the vertical fixation, which springs engage in a hole 37 in the legs 26, 27 at one end and in slots 25 of the anchoring element 16 at the other end. A hook pin may be used for mounting the springs 36, by means of which pin the springs can be pulled into grooves 25 or be forced out of said grooves upon removal of the springs. Although all four combinations of anchoring elements 16, 17 and hook elements 18, 19 are provided with two springs 36, it is also conceivable within the framework of the present invention to fit only the combinations of the lower anchoring elements 17 and the lower hook elements 19 with such springs 36. As will be apparent from the foregoing, the engagement between the hook elements 18, 19 and the anchoring elements 16, 17 takes place at diametrically opposed positions with respect to the cables 9, 10, as a result of which the mechanical load on the cables 9, 10 remains within bounds.

[0036] An important advantage of the facade cladding system according to the invention as described above by means of a preferred embodiment is the simple and quick application thereof. This advantage is in particular obtained if the anchoring elements 16, 17 are attached to the cables 9, 10 in correctly spaced-apart relationship at an earlier stage in a production environment equipped for that purpose. The same is true for the hook elements 18, 19, which may also be attached to the rear side of the facade panels 3 at an earlier stage, separate from

the facade cladding process itself, in a production environment equipped for that purpose. As a result, it is only necessary to fix the angle sections 4,5 as well as the anchor pins 14 to the facade on-site, tension the cables 9, 10 between the angle sections and suspend the facade panels 3 from said cables via the suspending engagement between the anchoring elements 16, 17 and the hook elements 18, 19.

[0037] Alternatively it is also conceivable to reduce the required number of cables 9, 10 by using one and the same cable for suspending two adjacent facade panels 3, seen in horizontal direction, with the cable in question extending behind the vertical seam between the adjacent facade panels 3. It will be apparent to those skilled in the art that it will be necessary or desirable to adapt the anchoring elements and/or of the hook elements for this purpose. For example, the use of wider anchoring elements may be considered in this connection.

Claims

1. A system for cladding a facade, comprising panels and fastening means for installing the panels on the facade, spaced therefrom by some distance, said fastening means comprising elongate suspension means extending in vertical direction along the facade, spaced therefrom by some distance, which are provided with a number of suspension elements along their length, said fastening means further comprising hook members which are attached to the rear side of the panels for suspending engagement with the suspension elements, **characterized in that** said hook members are of substantially U-shaped horizontal cross-section, with the elongate suspension means extending between the two legs of said U-shape.
2. A system according to claim 1, **characterized in that** the U-shape of the hook members has been obtained by flanging a plate.
3. A system according to claim 1 or 2, **characterized in that** said hook members are made of a metal, preferably of steel, more preferably of stainless steel.
4. A system according to claim 1, 2 or 3, **characterized in that** said hook members and said suspension elements interlock in a form-locked manner during their suspending engagement.
5. A system according to claim 4, **characterized in that** said hook members and/or said suspension elements are provided with slots to enable said form-locked engagement.

6. A system according to any one of the preceding claims, **characterized in that** said suspension elements extend parallel to the facade on either side of the associated suspension means.
7. A system according to any one of the preceding claims, **characterized in that** said suspension elements are substantially plate-shaped.
8. A system according to claim 7, **characterized in that** said suspension means preferably extend at least substantially in the plane of the associated suspension elements.
9. A system according to any one of the preceding claims, **characterized in that** said suspension elements have a horizontally extending longitudinal direction.
10. A system according to any one of the preceding claims, **characterized in that** said suspension elements comprise two element parts which clampingly engage the suspension means on opposite sides.
11. A system according to any one of the preceding claims, **characterized in that** said fastening means comprise fixing means for fixing the suspending engagement between the hook elements and the suspension elements.
12. A system according to claim 11, **characterized in that** said fixing means comprise springs which are operative between the hook elements and the suspension elements.
13. A system according to any one of the preceding claims, **characterized in that** said elongate suspension elements are flexible cables.
14. A system according to any one of the preceding claims, **characterized in that** said suspension elements are pre-tensioned.
15. A system according to any one of the preceding claims, **characterized in that** said fastening means comprise holder means attached to the facade for holding the suspension means between the ends of said suspension means, spaced from the facade.
16. A system according to claim 15, **characterized in that** said holder means comprise guide means for guiding the suspension means.
17. A suspension means for use in a system according to any one of the preceding claims, which is provided with suspension elements in a regular pattern.
18. A panel for use in a system according to any one of the claims 1 - 16, which is provided with hook members attached to the rear side thereof.
19. A suspension element for use in a system according to any one of the claims 1 - 16.
20. A building provided with a system according to any one of the claims 1 - 16.
21. A method of using the system according to the invention according to any one of the claims 1 - 16, which method comprises the steps of:
- A fixing elongate suspension means in vertical direction to the facade to be clad,
B providing the suspension means with the suspension elements,
C attaching the hook members to the rear side of the panels,
D effecting suspending engagement between the hook members and the suspension elements.
22. A method according to claim 21, **characterized in that** step B is carried out at a production location remote from the facade to be clad.
23. A method according to claim 21 or 22, **characterized in that** step C is carried out at a production location remote from the facade to be clad.

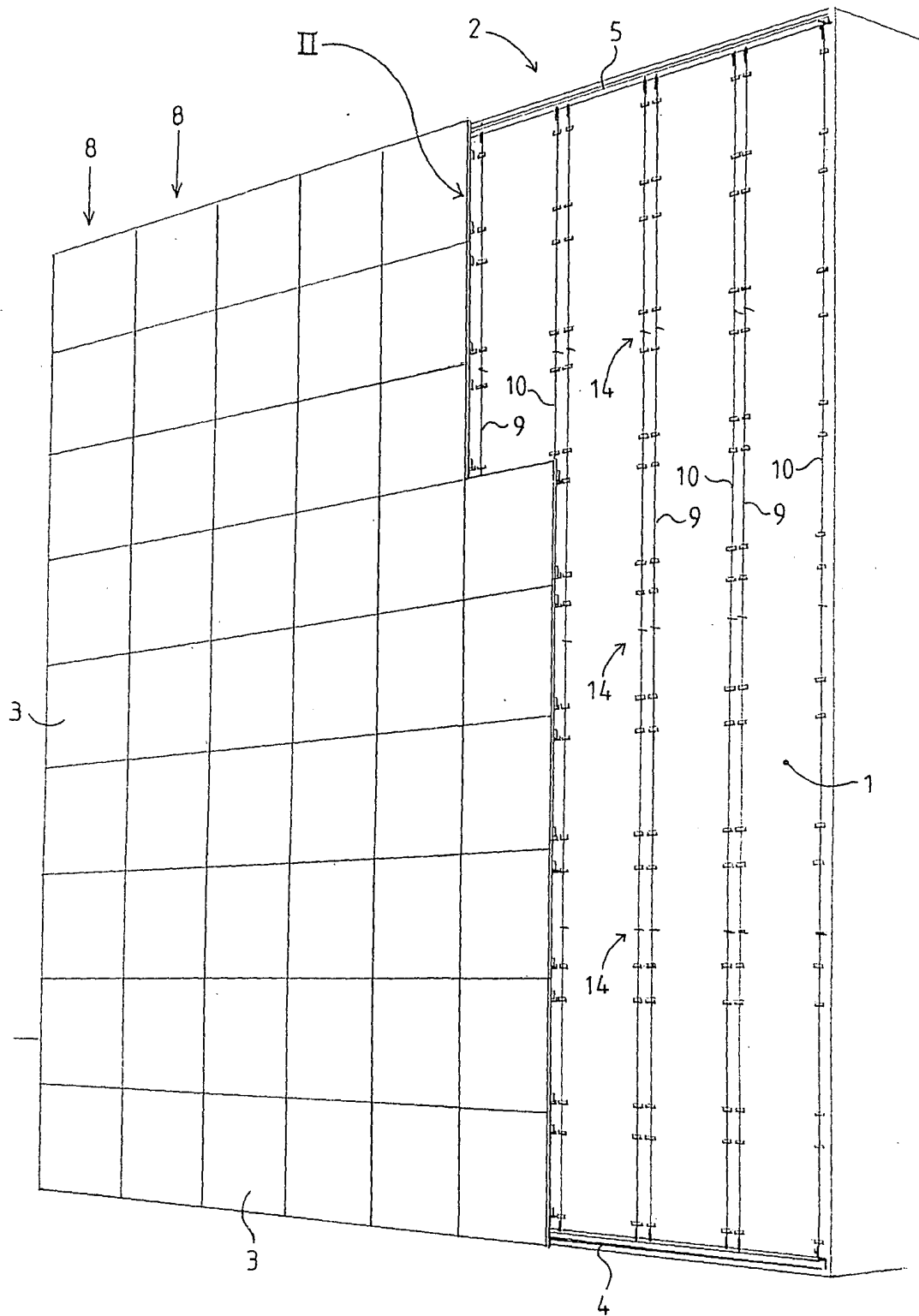
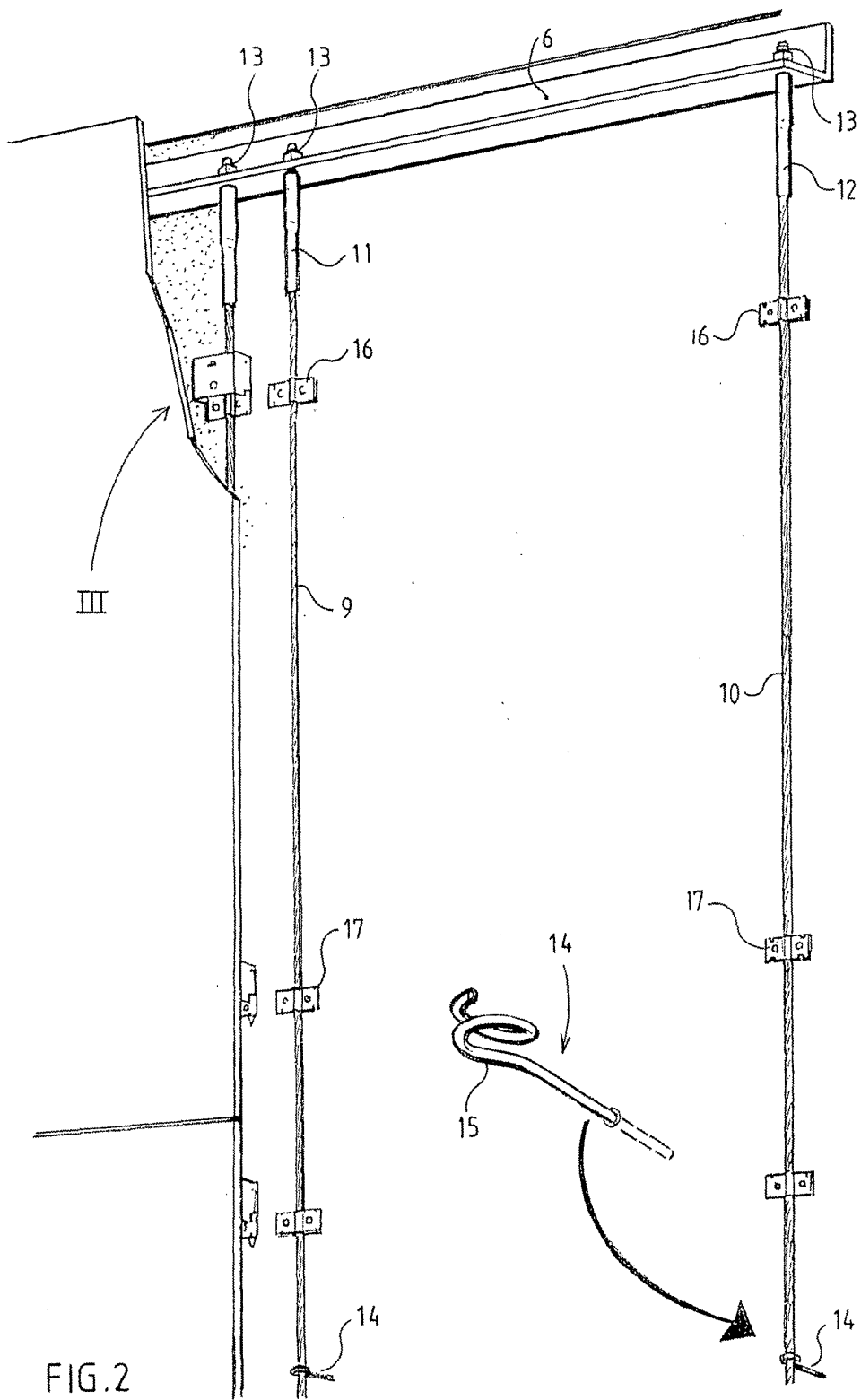
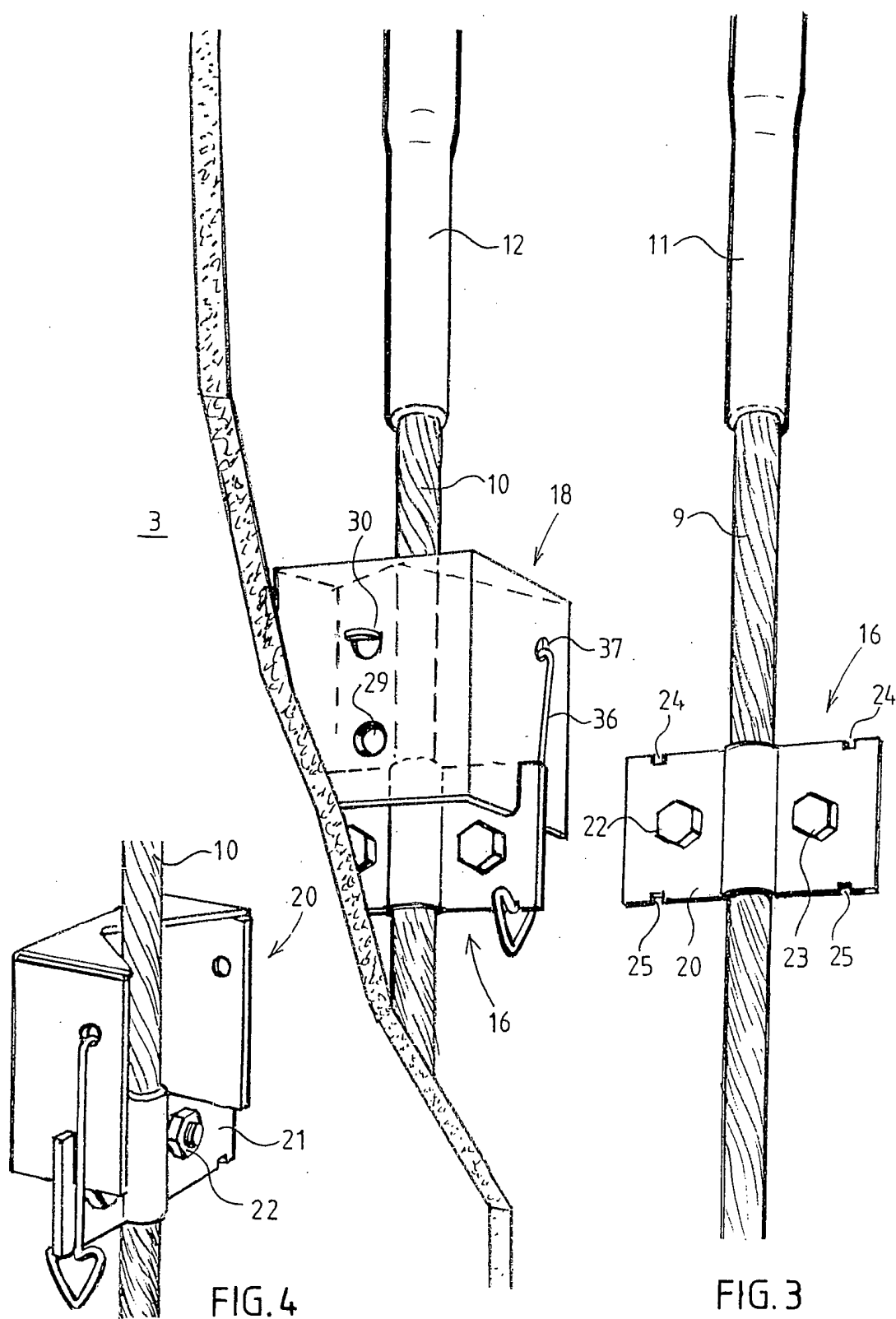


FIG.1





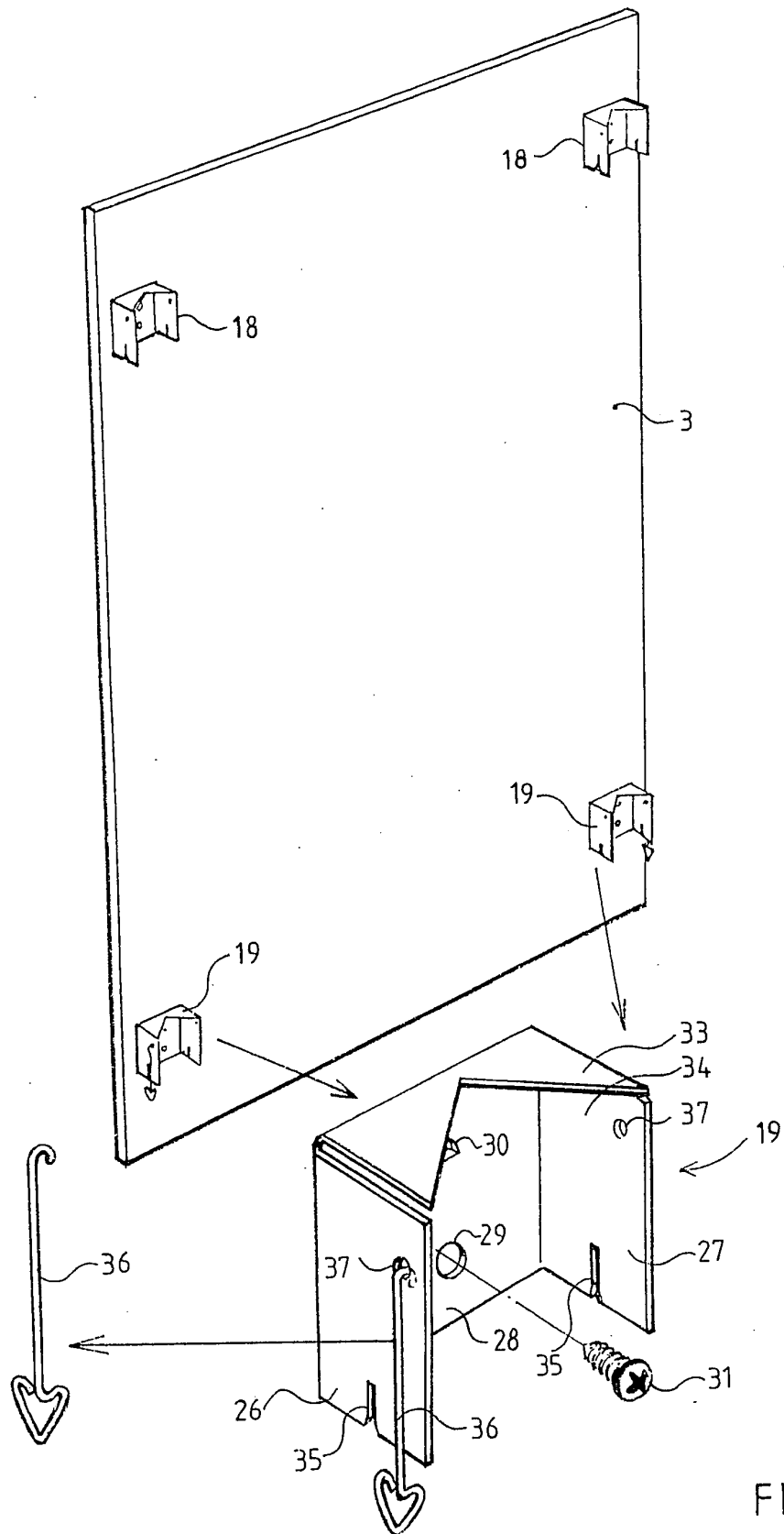


FIG.5



European Patent
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EUROPEAN SEARCH REPORT

Application Number
EP 04 07 5116

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.C1.7)
D,X	EP 0 387 127 A (MEUNIER THIERRY) 12 September 1990 (1990-09-12) * column 1, line 1 - column 6, line 24; figures 1-5 *	17-19	E04F13/08
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			TECHNICAL FIELDS SEARCHED (Int.C1.7)
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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 2 June 2004	Examiner Ayiter, J
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
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EP 04 07 5116

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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