US 20050183351A1

(19) **United States**

(12) **Patent Application Publication**

(10) **Pub. No.: US 2005/0183351 A1**

(43) **Pub. Date: Aug. 25, 2005**

Brunnhofer

(54) **COMPOSITE PROFILES SUITABLE FOR INSULATING WINDOW UNITS**

(75) Inventor: **Erwin Brunnhofer**, Fuldabruck (DE)

Correspondence Address:
TUCKER, ELLIS & WEST LLP
1150 HUNTINGTON BUILDING
925 EUCLID AVENUE
CLEVELAND, OH 44115-1475 (US)

(73) Assignee: **Technoform Caprano und Brunnhofer GmbH & Co. KG**, Fuldabruck (DE)

(21) Appl. No.: **11/038,765**

(22) Filed: **Jan. 19, 2005**

(30) **Foreign Application Priority Data**

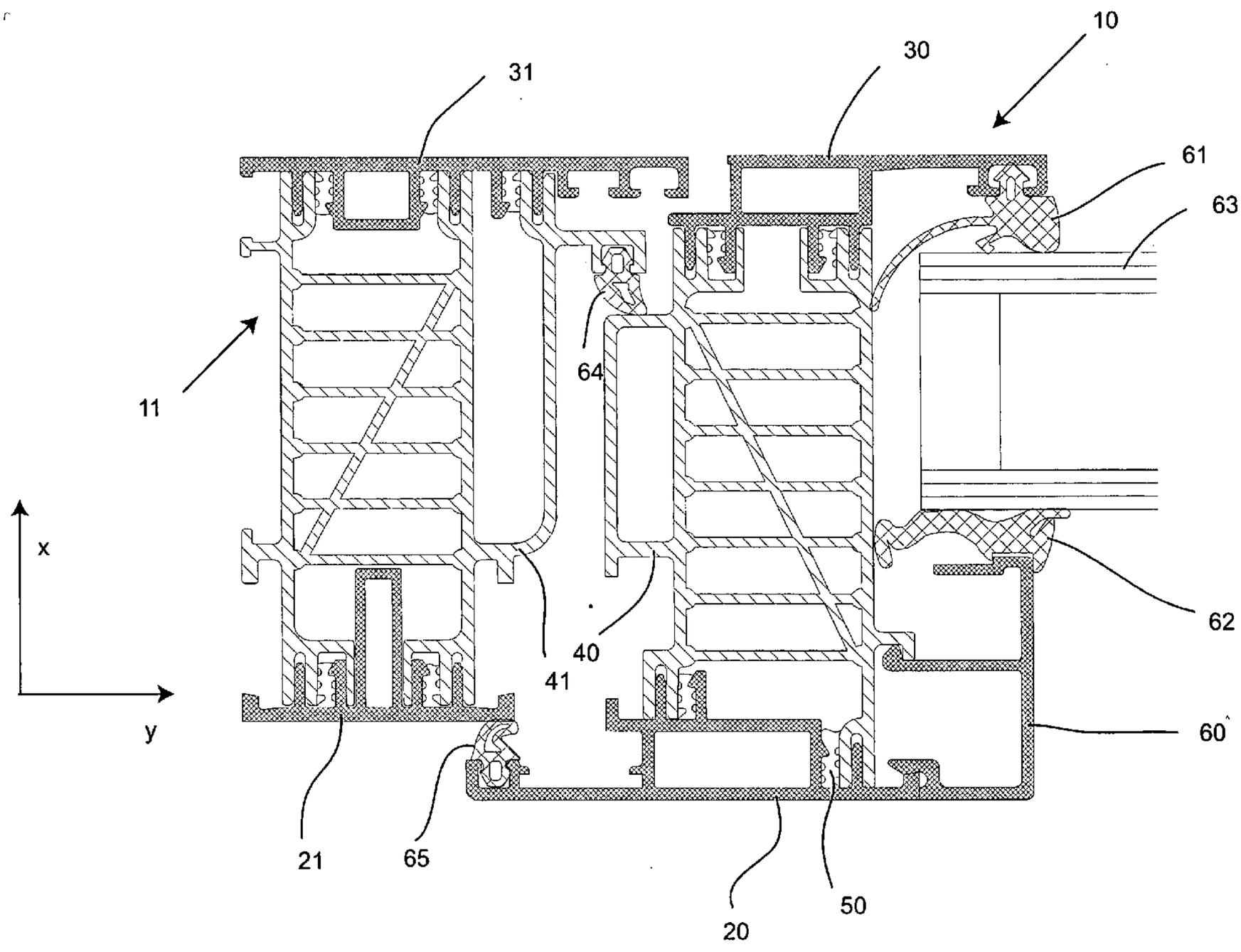
Jan. 19, 2004 (EP) 04 001 031.6
Jan. 7, 2005 (EP) 05 000 249.2

Publication Classification

(51) **Int. Cl.**[7] **E04C 5/08**; E04C 3/00
(52) **U.S. Cl.** **52/204.5**; 52/582.1; 52/579

(57) **ABSTRACT**

Composite profiles for windows, doors and facades preferably include a profile member **20, 21, 30, 31**) and a connecting member (**40, 41**) extending in a longitudinal direction and respectively having connectable profile and connecting member connecting portions. At least one assembly recess (**22, 42**) and at least one corresponding assembly protrusion (**37, 47**) are respectively formed on the profile and connecting member connecting portions, each of which comprises form fit elements (**25, 25*r*, 35, 35*r*, 45**) that are connectable by hardening a curable resin. The connecting portions are disposed between sealing devices (**24, 34, 44, 46, 46*r*, 47, 48, 48*r***) that extend along at least one of the profile member and the connecting member (**40, 41**), such that the connecting portions are not visible from outside the composite profile when the at least one assembly protrusion is inserted into the at least one assembly recess.



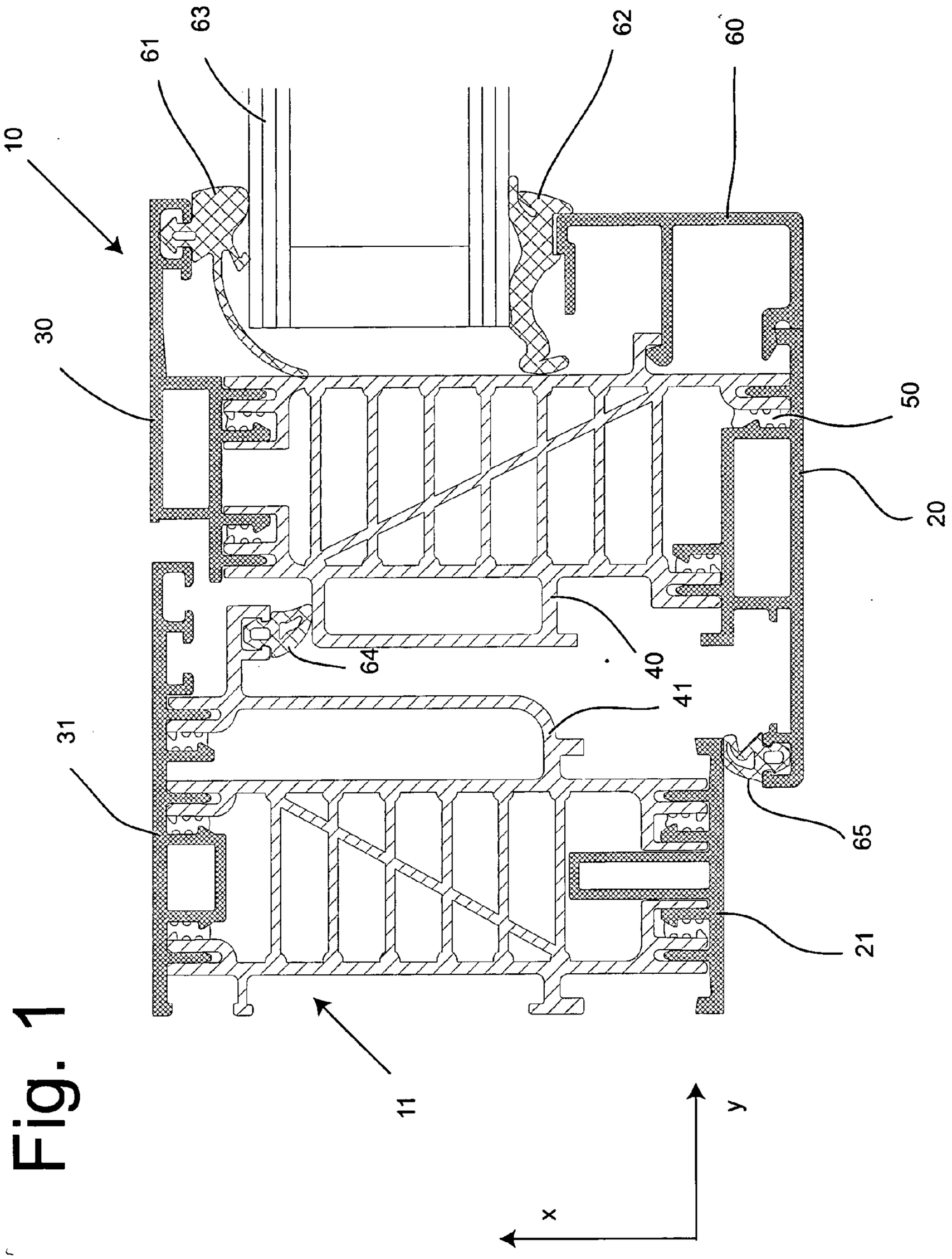


Fig. 1

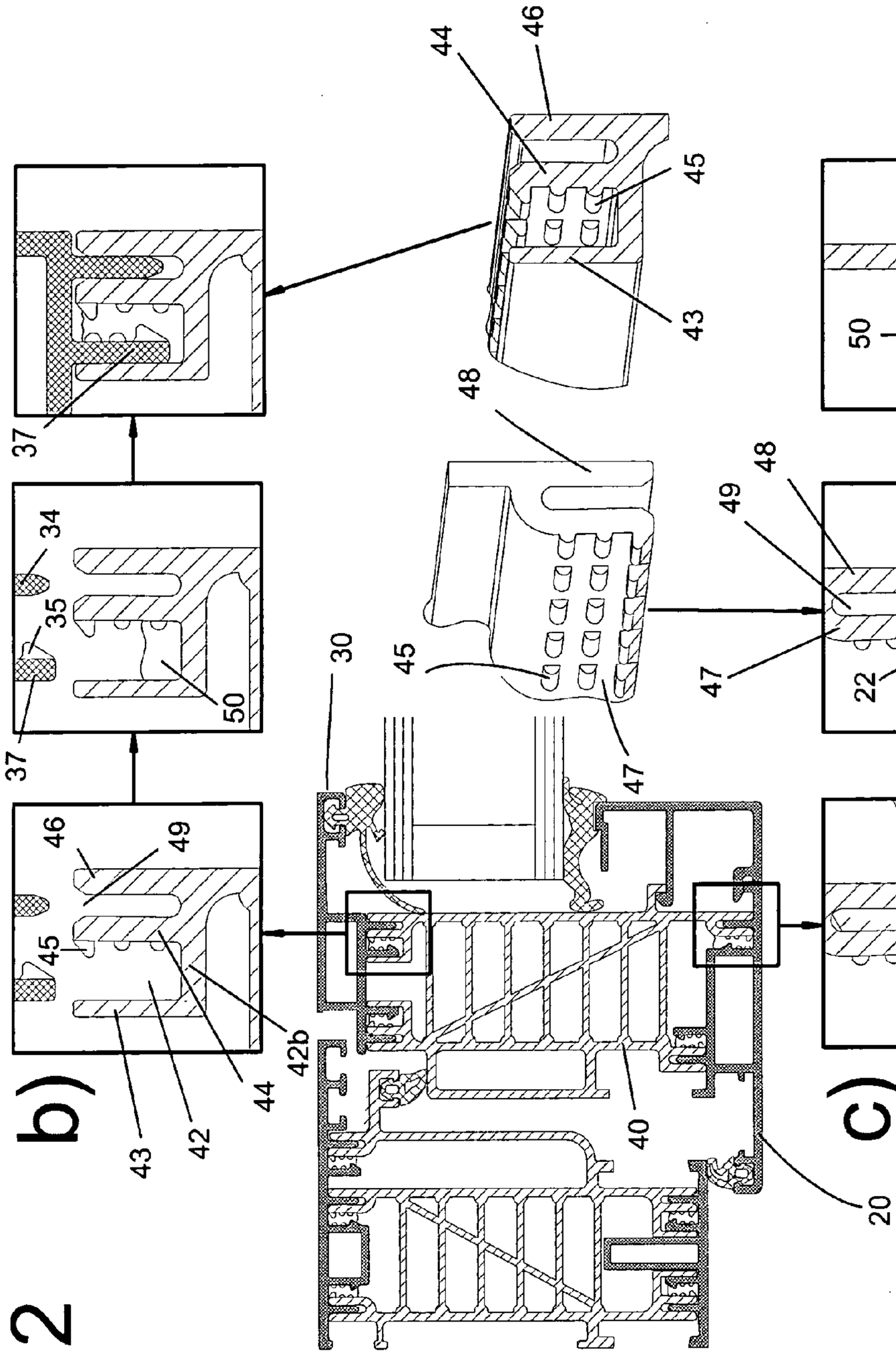


Fig. 2

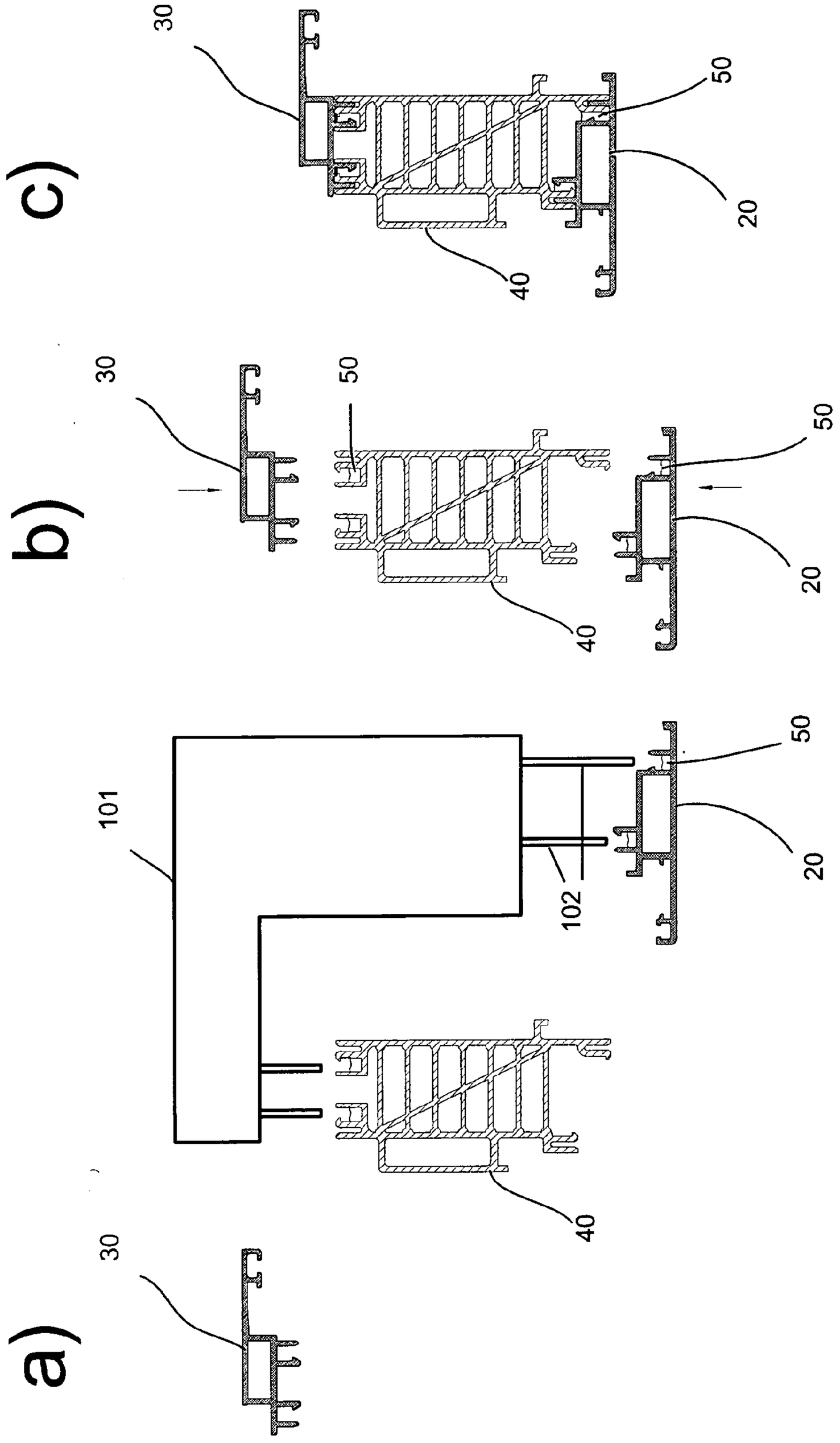


Fig. 3

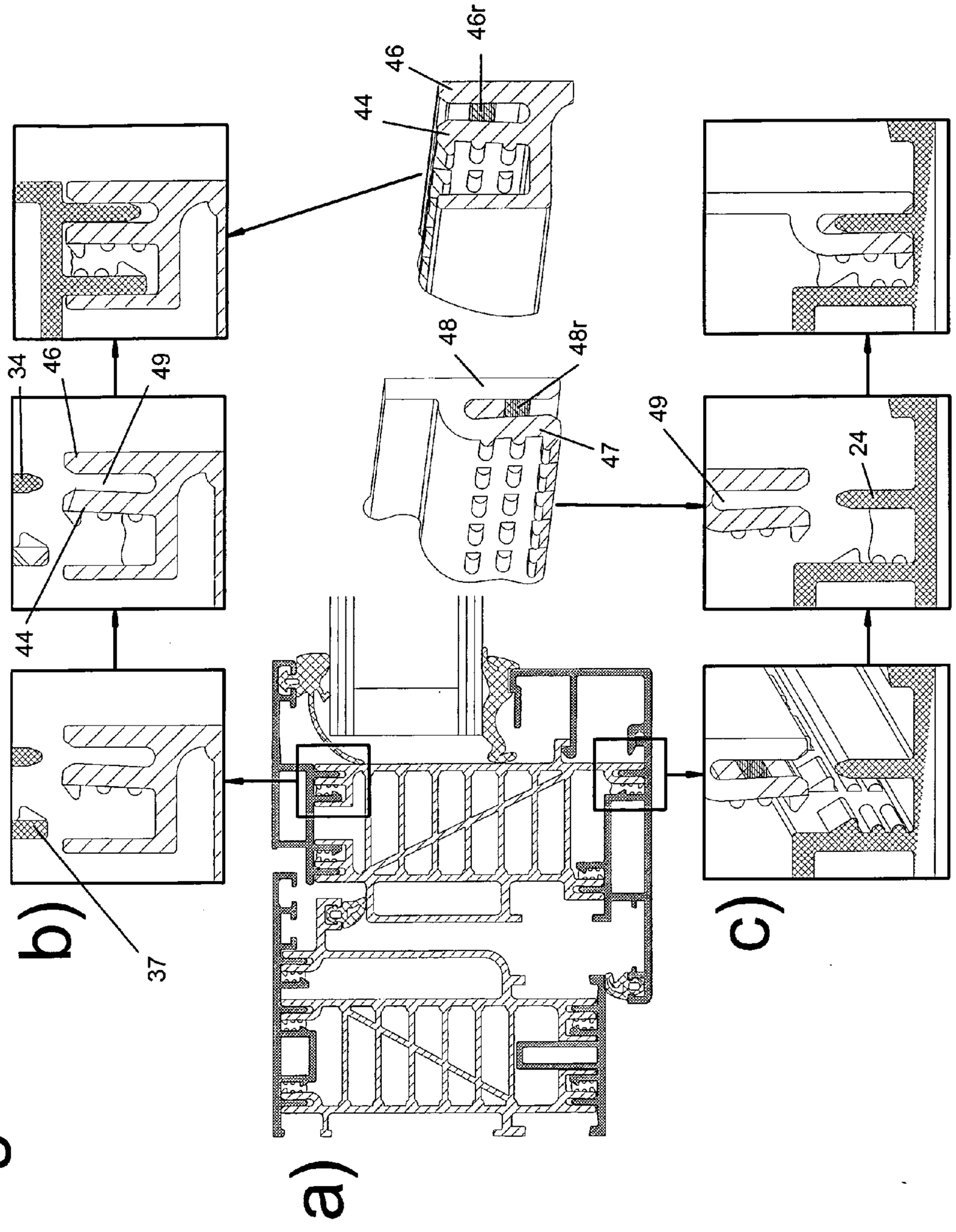


Fig. 4

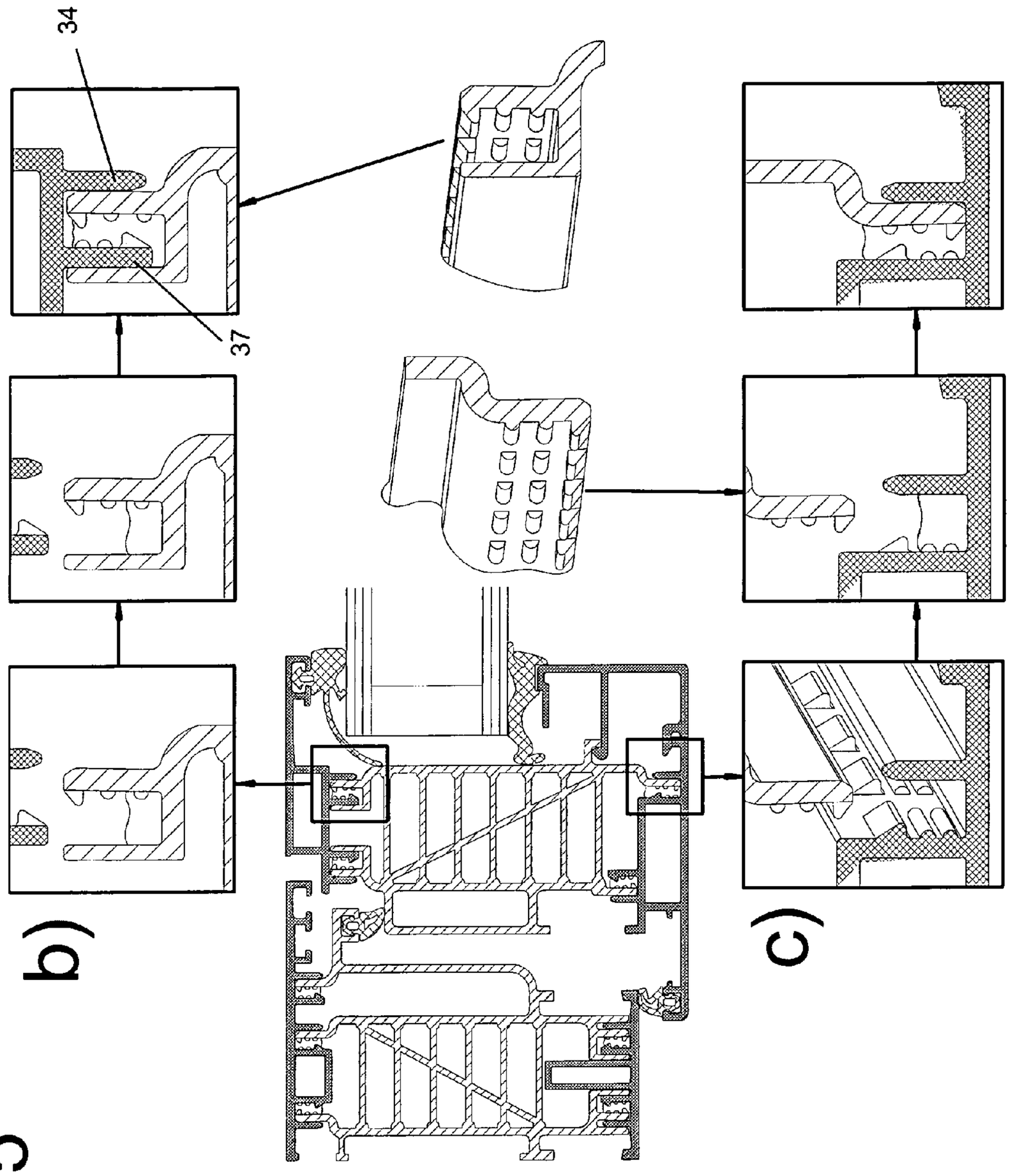
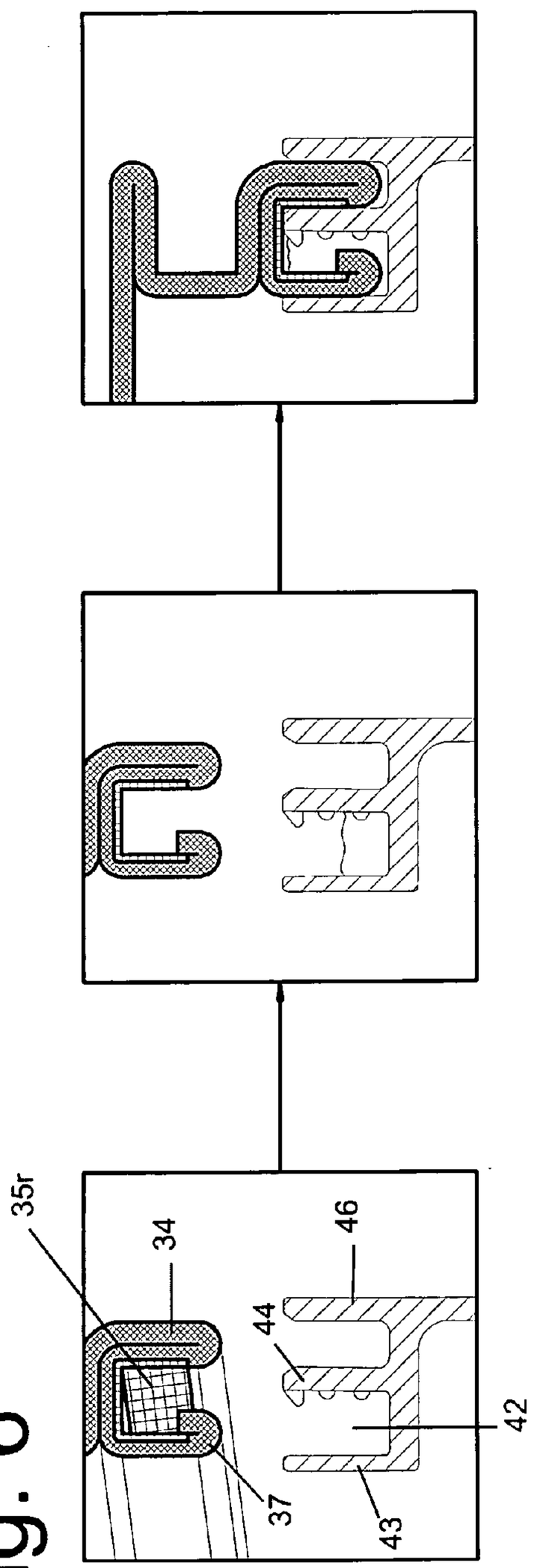
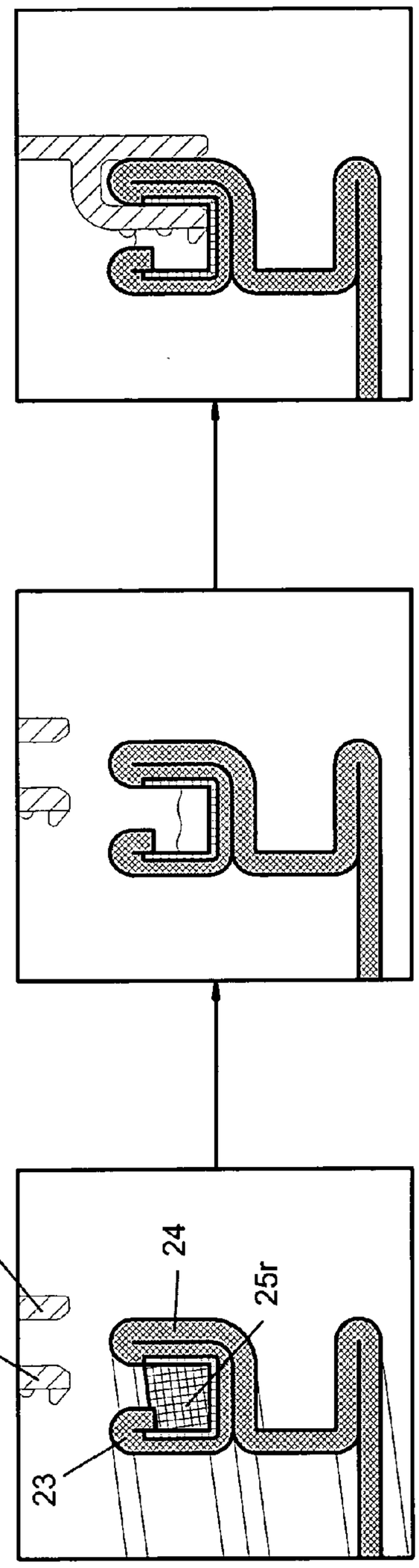


Fig. 5



a)



b)

Fig. 6

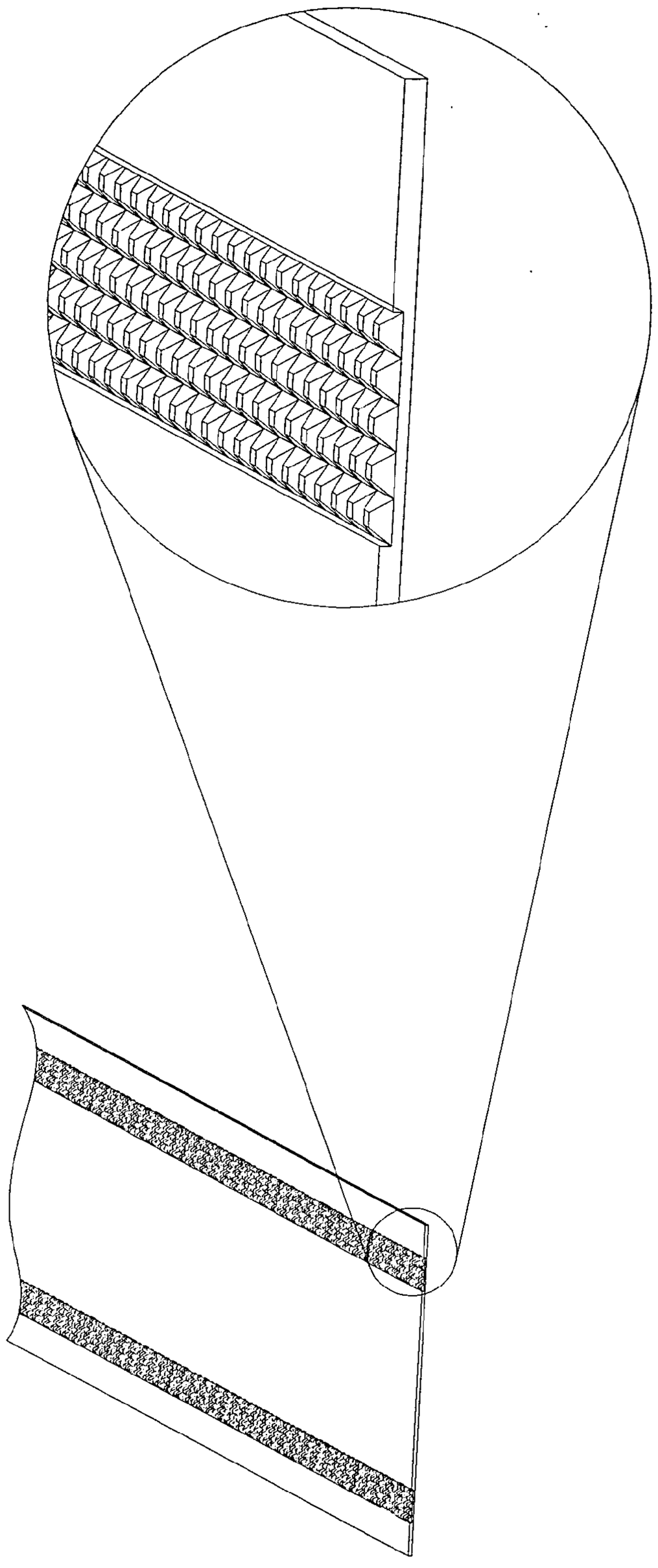


Fig. 6 c)

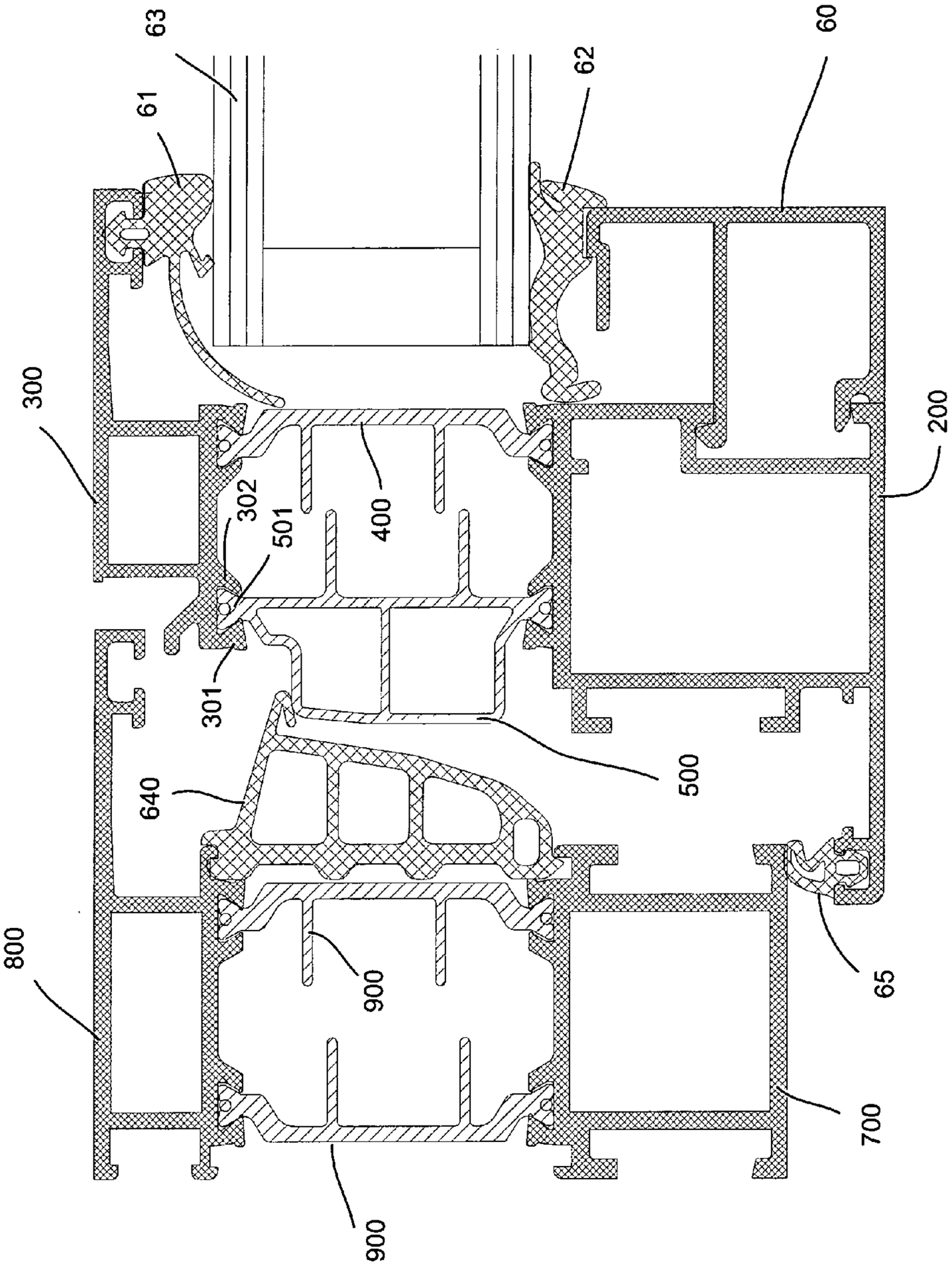


Fig. 7 PRIOR ART

COMPOSITE PROFILES SUITABLE FOR INSULATING WINDOW UNITS

CROSS-REFERENCE

[0001] This application claims priority to European Patent Application No. 04 001 031.6, filed Jan. 19, 2004, and European Patent Application No. 05 000 249.2, filed Jan. 7, 2005, the contents of which are incorporated herein by reference.

TECHNICAL FIELD

[0002] The present invention relates to a composite profile, and in particular to a composite profile for window, door and facade elements.

DESCRIPTION OF THE RELATED ART

[0003] Composite profiles for window, door and facade elements of the type related hereto comprise two profile members, an outer profile and an inner profile, which are connected to each other by one or a plurality of insulating elements formed as connection members. 90% of the composite profiles used today are made of aluminum, wherein the connection of the profile members and the insulating members is accomplished by rolling (bending) as described, for example, in DE 1 101 734.

[0004] **FIG. 7** shows an example of such a known composite profile relating to window elements. An insulating glass unit **63** is held between seals **61**, **62** in a window frame formed of composite profiles. A movable composite profile comprises a profile member **200** (inner profile) which is connected via two insulating members **400**, **500** formed as connecting members to another profile member **300** (outer profile). Another profile member **60** is attached to the profile member **200**, which holds the insulating glass unit **63** via the seals **61**, **62** at the composite profile formed of members **200**, **300**, **400**, **500**. The building-side part of the window frame is formed of another stationary composite profile made of profile members **700**, **800** connected to each other via the insulating members **900**, **900** formed as connecting members. Seals **65**, **640** seal the interspace between the two composite profiles. In **FIG. 7**, the connection of the profile member **300** with the connection member **500** is shown as a rolled (bent) connection. The profile members **200**, **300**, **700**, **800** are made of aluminum. A connecting member connection portion **501** has a dovetail-shaped cross section. A profile member connecting portion **301**, **302** comprises a recess having a dovetail-shaped cross section. One side wall **301** of the profile member connecting portion is pressed (bent) during rolling in the direction of the other wall **302** after the connecting member connecting portion **501** has been inserted into the recess, which recess did not yet have the dovetail-shaped cross section at the time of the insertion of the portion **501**, as described, for example, in DE 1 101 734.

[0005] The composite profiles manufactured by such a known connecting method have technical limits, if the aim is to achieve improved thermal values and/or to use different or other materials such as wood, plastics and steel in addition to or alternatively to aluminum for the inner profile members and the outer profile members.

[0006] The thicknesses of the composite profile and its parts in the direction in which the two profile members face each other (i.e. direction x shown in **FIG. 1**) are known as the "construction depth". The rolling process requires a profile design that only uses about 50% of the construction depth of the composite profile for the insulating elements. This requirement limits the thermal values that can be achieved for composite profiles of identical construction depth.

[0007] The thickness of the walls for the inner profile members and outer profile members made of aluminum must be larger for a reliable rolling process than is necessary to provide adequate static mechanical strength. For example, a wall thickness of about 2 mm is needed for a reliable rolling process, whereas a wall thickness of only about 1.5 mm is necessary to provide the adequate static mechanical strength.

[0008] If the construction depth of the insulating elements is selected to be relatively large in order to provide good thermal values, the construction depth of the composite profiles increases significantly. In this case, for example, many window types having relatively small dimensions can not be opened with pivot-and-bottom-hung-mountings.

[0009] Furthermore, composite profiles having such large construction depths also require larger manufacturing tolerances in the direction of the construction depth. The reasons are mainly that (i) the insulating elements made of plastic have (relatively large) manufacturing tolerances and (ii) dimension changes occur after manufacturing due to further crystallization and/or moisture absorption and/or moisture release or the like by the plastic material.

[0010] The prior art discloses several different techniques for improving the properties of such composite profiles. For example, EP 0 103 272 A2 (family member U.S. Pat. No. 4,525,408) discloses a foaming method. DE 1 260 105 (family member GB 1,078,503) discloses a composite profile where the members are connected using an adhesive. DE 75 22 009 U discloses a composite profile, wherein the profile members snap into recesses in a profile rod and a curable adhesive is used for securing the same. DE-OS 2 033 442 A (family member U.S. Pat. No. 4,128,934), DE 27 12 956 A, DE 34 23 712 (family member U.S. Pat. No. 4,686,754), and U.S. Pat. No. 3,393,487 each disclose composite profiles using a curable resin in composite profiles. DE 100 33 861 A1 discloses a composite profile, wherein the insulating profile is inserted in the longitudinal direction and is connected using a curable resin afterwards.

[0011] EP 0 085 410 A2 discloses another composite profile manufactured by rolling, wherein an auxiliary material such as an adhesive is used for an additional securing of the connection. U.S. 2003/0217818 A1 discloses a folding device for a room divider or room closure using composite profiles. U.S. Pat. No. 4,338,753 discloses an arrangement for connecting two profile members, wherein a cavity can be filled with a hardenable filler. Also, DE 26 50 944 A1 discloses a composite profile for window and facade constructions, wherein the connection between the outer profile and the inner profile is made by a connecting bar and the use of a curable filler, which connection permits movement of the profiles relative to the connecting bar in the longitudinal direction thereof.

[0012] All the known techniques using curable adhesives or resins have the disadvantage that the shearing strength in

the longitudinal direction tends to reduce as the adhesive material ages. Only the above described rolling approach, in which a significant knurling or roughened or ridged surface is provided on the inner side of the aluminum profile member, exhibits sufficient shearing strength for long term use. The other described composite profiles made by foaming, adhesives, clips or the use of curing resins may not exhibit sufficient shearing strength in the longitudinal direction due to deterioration the foaming materials, the adhesives, the resins, etc., over time.

[**0013**] Furthermore, when curable materials are used, problems with surplus material and the visibility of such surplus material frequently occur.

[**0014**] DE 30 33 206 A1 (family member GB 2 083 116 A) discloses a composite profile that utilizes a form fit of recesses and protrusions.

SUMMARY OF THE INVENTION

[**0015**] It is an object of the present teachings to provide improved composite profiles that overcome one or more problems of the known art.

[**0016**] The present composite profiles advantageously maintain adequate shearing strength in the longitudinal direction of the composite profile even if the adhesion between a cured (hardened) connecting material and profile members and/or the connecting member fails due to aging. Preferably, a form fit is provided between form fit elements, such as a first and second holding element, which form fit, is maintained by the cured (hardened) connecting material. This form fit is present in both the transverse and longitudinal directions, i.e., not only in the longitudinal direction as in the known art. Because rolling (bending) is no longer necessary to form the composite profiles, a variety of materials, such as aluminum, wood, plastics, etc., can be used in any combination for the profile members.

[**0017**] Furthermore, constructive constraints caused by the known rolling process are alleviated, such that the amount or percentage (length) of the profile members in the construction depth of the composite profile can be reduced and the arrangement of the profile member connecting portions and the connecting member connecting portions is possible without the geometrical constraints caused by the known rolling process.

[**0018**] Further advantages and features of the present teachings will be apparent from the following detailed description of the embodiments with reference to the figures and the appended claims.

BRIEF DESCRIPTION OF DRAWINGS

[**0019**] **FIG. 1** shows a cross sectional view perpendicular to the longitudinal direction of a window frame comprising two composite profiles according to the present teachings.

[**0020**] **FIG. 2** shows, in view a), the embodiment of **FIG. 1** with two frames enclosing connection elements, and in views b) and c), enlarged views of two frames in sequential steps of mounting the connection elements using an adhesive and the final mounted state thereof.

[**0021**] **FIG. 3** schematically shows in views a) to c) the mounting of the right side portions of the composite profile of **FIG. 1**.

[**0022**] **FIG. 4** shows a first modification of the embodiment of **FIG. 1** in views corresponding to the views of **FIG. 2**.

[**0023**] **FIG. 5** shows a second modification of the embodiment of **FIG. 1** in views corresponding to the views of **FIG. 2**.

[**0024**] **FIG. 6** shows a third modification of the embodiment of **FIG. 1**, wherein the views in a) and b) correspond to the views of **FIG. 2***b*) and c), and view c) shows a metal sheet with knurling which has not yet been bent.

[**0025**] **FIG. 7** shows a window frame made of composite profiles according to the prior art.

DETAILED DESCRIPTION OF THE INVENTION

[**0026**] **FIG. 1** shows a window frame with composite profiles according to one representative embodiment of the present teachings. The longitudinal direction (i.e., the z direction) of the composite profiles extends perpendicularly to the paper plane (x and y directions) of **FIG. 1**. The window frame may comprise two composite profiles. A first composite profile **10** may comprise a first profile member **20** (e.g., an inner profile that is arranged at an inner side of a building frame (not shown)) and a second profile member **30** (e.g., an outer profile that is movable with respect to the stationary building frame). The first profile member **20** is connected to the second profile member **30** by a first connecting member **40** formed as an insulating element. The first profile member **20** is connected to the second profile member **30** via the first connecting member **40** by a cured (hardened) connecting material **50**, such as a curable resin that hardens after curing or the like, in a manner that is described in more detail further below. In this manner, the members **20**, **30**, **40** form the first composite profile **10**. Another profile member **60** is mounted on the connecting profile **10** such that an insulating glass unit **63** is held between seals **61**, **62**. Such a constructional unit forms the movable part of an insulating window frame.

[**0027**] The building-side or fixedly disposed part (when mounted on the stationary building frame) of the window frame is formed by a second composite profile **11** that may comprise a third profile member **21** (inner profile) and a fourth profile member **31** (outer profile) connected by a second connecting member **41** formed as an insulating element. The interspace between the two composite profiles **10**, **11** is sealed by the seals **64**, **65** when the window is closed. The members **21**, **31** and **41** are also fixedly connected using a curable connecting material **50**, as will be described further below.

[**0028**] The direction x shown in **FIG. 1**, i.e. the direction in which the first profile member **20** faces the second profile member **30**, is referred to as the transverse direction hereinafter. The construction depth of the composite profiles **10**, **11** and its constituting parts/members is the construction depth in the transverse direction. The direction perpendicular to the transverse direction and perpendicular to the longitudinal direction is indicated hereinafter as the horizontal direction y (from left to right in **FIG. 1**). The same definition of the longitudinal direction, the transverse direction, and the horizontal direction will be utilized herein for all figures and the description of all embodiments and modifications.

[0029] In **FIG. 2**, the embodiment of **FIG. 1** is shown in view a). View b) shows an enlarged view of a first frame marked in view a), in which sequential mounting steps and the final mounted state are shown. View c) shows an enlarged view of a second frame marked in view a) in an analogous manner.

[0030] The first profile member **20** comprises a first profile member connecting portion which is shown in the second frame of **FIG. 2***a*). This first profile member connecting portion extends over at least a part of the length of the first profile member **20** in its longitudinal direction, more preferably over the complete length of the first profile member **20**. Referring to **FIG. 2***c*), the first profile member connecting portion comprises an assembly recess **22** extending in the longitudinal z direction. The assembly recess **22** is formed by a recess bottom **22***b* and two walls **23**, **24** protruding from the recess bottom **22***b* essentially in the transverse direction. The recess **22** has a generally U-shaped or similar cross section which is open on one side such the depth direction of the assembly recess **22** extends essentially in the same direction as the transverse direction, i.e., essentially parallel thereto. In the embodiment shown in **FIGS. 1 and 2**, one of the two walls is freestanding, namely wall **24**. The volume of assembly recess **22** corresponds to the volume defined by the two walls **23**, **24**, the recess bottom **22***b* and a horizontal line perpendicular to the terminal end of the freestanding wall **24**.

[0031] First form fit elements are preferably formed as teeth-like protrusions (holding elements) **25** on one of the two walls **23**, **24**. In the embodiment shown in **FIG. 2**, three rows of protrusions **25** are arranged on the wall **23** in the longitudinal direction. The protrusions **25** are spaced in longitudinal direction, such that continuous intervening spaces or recesses are present between rows of protrusions **25** in the longitudinal direction and intermittent intervening spaces or recesses are present between individual protrusions **25** in the longitudinal direction.

[0032] A second profile member connecting portion of the first profile member **20**, which is not shown in **FIG. 2** in detail, is formed in a similar manner. However both walls defining the assembly recess are preferably freestanding. Whether and how many walls of the assembly recess are freestanding will be discussed below with reference to a representative holding device.

[0033] The first connecting member **40** preferably comprises a first connecting member connecting portion having an assembly protrusion **47**. The assembly protrusion **47** is preferably formed as a protrusion because it is inserted into the assembly recess **22** when the profile members **20**, **30** and the connecting members **40** are connected. In other words, the assembly protrusion **47** preferably should protrude from the connecting member **40** to at least an extent that allows insertion of the same as described below. On one side of the assembly protrusion **47**, form fit elements are formed as protrusions (second holding elements) **45**. In the embodiment shown in **FIG. 2**, three rows of protrusions **45** are again arranged in the longitudinal direction with recesses (interspaces) therebetween.

[0034] In the mounted state (i.e., the right most frame of view c)), the assembly protrusion **47** is inserted into the assembly recess **22**. Thus, the first and second holding elements (protrusions **25**, **45** face each other and do not overlap in the longitudinal direction. As shown in the middle frame of view c), the assembly recess **22**, or more precisely the interspace between the wall **23** having the first holding elements **25** and the assembly protrusion **47** having the second holding elements **45**, is filled with a curable (hard-enable) connecting material **50** in an uncured (liquid) state before the assembly protrusion **47** is inserted into the assembly recess **22**, as will be further discussed below. Thereafter, the connecting material **50** is cured or hardened.

[0035] Because the protrusions **25**, **45** are arranged in rows with interspaces in the longitudinal direction, a form fit is provided between the first and second holding elements (protrusions) **25**, **45** and the cured (hardened) connecting material **50**. Accordingly, adequate shearing strength in the longitudinal direction is ensured, irregardless of whether adhesion between the connecting material **50** and the first profile member **20** and/or the connecting member **40** is lost or diminished due to deterioration caused by aging.

[0036] Adequate shearing strengths in the transversal direction and the horizontal direction are also ensured by this form fit between the protrusions **25**, **45** and the connecting material **50**, again irregardless of whether the adhesion between the connecting material **50** and the first or second profile members **20**, **30** and/or the connecting member **40** is lost or diminished due to deterioration caused by aging.

[0037] In the representative embodiment shown in **FIGS. 1 and 2**, the first connecting member connecting portion shown in view c) also comprises a wall **48** extending in parallel to the assembly protrusion **47**. The assembly protrusion **47** and the additional wall **48** define an interspace (recess) **49**. The width (in the horizontal y direction) of the interspace **49** is selected such that it is less than or equal to the width (in the horizontal y direction) of the freestanding wall **24**. When the assembly protrusion **47** is inserted into the assembly recess **22**, the freestanding wall **24** is inserted into the interspace **49**, preferably by elastic expansion of the width of the interspace **49** between the assembly protrusion **47** and the additional wall **48**. In this case, after the assembly protrusion **47** has been inserted into the assembly recess **22** to the desired extent, a holding force is generated due to friction between the freestanding wall **24**, the assembly protrusion **47** and the additional wall **48**. This holding force will hold the position of the first profile member **20** relative to the connecting member **40** independent of the curing of the connecting material **50**, as long as no force larger than this holding force is applied thereto. Accordingly, in this embodiment, the freestanding wall **24**, the assembly protrusion **47** and the additional wall **48** form a holding device. If such a holding device is utilized, at least one freestanding wall preferably should be provided.

[0038] However, as can be seen from another representative embodiment shown in **FIG. 5**, such a holding device may be eliminated. In this case, until the connecting material is cured, the relative positioning of the members optionally may be maintained by other (e.g., external) means.

[0039] In the representative embodiment shown in **FIGS. 1 and 2**, the freestanding wall **24** is preferably arranged on the side of the assembly recess **22** that is directed towards the outside of the profile members, i.e. the potentially visible side, if at least two connecting portions are present at the corresponding profile/connecting members. By means of

this arrangement, it is ensured that any excess or surplus resin (connecting material), which could spill out of the recess **22** during or after the assembly protrusion **47** is inserted into the assembly recess **22**, is not visible from outside the composite profile. The same arrangement preferably may be utilized for all other pairs of connecting portions of the corresponding profile/connecting members so as to improve the visual appearance of the final product.

[**0040**] The second profile member **30** preferably comprises a second profile member connecting portion as shown in greater detail in view b) of **FIG. 2**. This second profile member connecting portion preferably comprises an assembly protrusion **37** on which form fit elements (e.g., protrusions) may be formed as second holding elements **35** in the same way as the assembly protrusion **47**. The first connecting member **40** preferably comprises a second connecting member connecting portion, which is also shown in detail in view b). This second connecting member connecting portion comprises an assembly recess **42** defined by a recess bottom **42***b* and two walls **43**, **44** and extends in the longitudinal direction in a similar way as was described above with respect to the assembly recess **22**. On a first wall **44**, form fit elements (e.g., protrusions) **45** are provided as first holding elements in a similar way as the protrusions **25**. The form fit between the second profile member **30** is secured by curing (hardening) the connection material **50** in the same manner as was discussed above with respect to the form fit between the first profile member **20** and the connection member **40**.

[**0041**] As shown in greater detail in **FIG. 2***b*), a second holding device is formed by the freestanding wall **34** which extends in parallel to the assembly protrusion **37**, and an additional freestanding wall **46**, which extends in parallel to the first wall **44** disposed outside of the assembly recess **42**. The walls **44**, **46** define an interspace (recess) **49** having a width slightly less than or equal to the thickness of the freestanding wall **34**. In this case, a holding force between the walls **44**, **46** is generated when the assembly protrusion **37** is inserted into the assembly recess **42** in an analogous manner as the above-described holding device.

[**0042**] Accordingly, the holding devices of the first representative embodiment shown in **FIGS. 1 and 2** preferably include one freestanding wall (which also may be called a "clamped element") disposed on one member and two walls extending in parallel (which also may be called a "clamping elements") disposed on a second member. The two parallel walls are preferably separated by a distance that is slightly less than or equal to the thickness of the freestanding wall such that after the insertion of the freestanding wall into the interspace (i.e., the recess between the parallel walls), a holding force is generated due to the friction. Naturally, these walls should preferably be arranged (positioned) such that the freestanding wall is inserted into the interspace while the assembly protrusion is being inserted into the assembly recess and such that the freestanding wall is inserted into the interspace when the assembly protrusion is being inserted into the assembly recess. The freestanding wall and the two parallel walls preferably, but not necessarily, form one of the two walls defining the assembly recess and/or the assembly protrusion.

[**0043**] In the embodiment shown in **FIGS. 1 and 2**, the first connecting member **40** comprises four connecting member connecting portions. Two connecting member connecting portions each are respectively assigned for connection to the first profile member **20** and the second profile member **30**. The two profile members **20**, **30** each comprise two corresponding profile member connecting portions such that a total of four pairs of connecting portions are present. With respect to the embodiment shown in **FIGS. 1 and 2**, it is noted that the connecting member connection portions are not required to be positioned in the same plane in the horizontally direction (see, for example, the connecting portions between the first profile member **20** and the connecting portion **40**).

[**0044**] All assembly recesses **22**, **42** are identically oriented, i.e., in the same direction, such that the depth direction is substantially parallel to the transverse direction (e.g., with a deviation from the transverse that $<\pm 30°$, preferably $<\pm 20°$, more preferably $<\pm 10°$, even more preferably $<\pm 5°$, and most preferably $<\pm 2°$) and the recesses openings are all oriented in the same direction.

[**0045**] Further, the freestanding walls (clamped elements) **24**, **46** of each holding device, i.e., one for each pair of the connection portions of the profile and connecting members **20**, **30**, **40**, are preferably arranged such that they are positioned on the outer side of the corresponding connection portions. As a result, spilled resin (connecting material **50**) will not be visible from the outside of the composite profile after the freestanding wall **24**, **46** has been inserted into the interspace between the two parallel walls (clamping elements) **44**, **46**, **47**, **49** of the holding device. In this case, the holding device also serves as a connecting material "covering" device or a connecting material "sealing" device. These additional or alternative functions of covering and sealing, respectively, the connecting material are not limited by the holding function. If the holding force is not sufficient to hold the components until the connecting material cured or if external holding devices are used, the sealing function is still maintained.

[**0046**] In this representative embodiment, two types of connecting portions are provided. The first type includes the assembly recess **22** like the first profile member connecting portion and the second connecting member connecting portion. The second type includes the assembly protrusions **37**, **47** like the first connecting member connecting portion and the second profile member connecting portion.

[**0047**] Preferably, the connection portions of the same type present in one composite profile all have the same orientation in the transverse direction.

[**0048**] Furthermore, it is noted that the share (proportion) of the first connecting member **40**, i.e., the insulating element, along the construction depth is significantly greater than in the prior art. This is possible, because no rolling (bending) process is required, as in the prior art, whereby the connecting portions do not have to be designated to receive a large force without breaking.

[**0049**] The above description applies similarly to the second composite profile **11** shown in **FIG. 1**.

[**0050**] According to the present teachings, the above-noted problems of the prior art with respect to dimensional accuracy in the transverse direction can be solved in a simple manner, because the assembly protrusions **37**, **47** are inserted into the assembly recesses **22** until the desired

dimension is obtained. After that, the members **20**, **30**, **40** are maintained with this desired dimension in the transverse direction either by means of an external holding device or by means of the above described integrated holding devices until the connection material **50** is cured. Therefore, dimensional problems caused by varying manufacturing tolerances of the members **20**, **30**, **40** can be overcome. Such manufacturing tolerances are always present in composite materials, for example, due to (i) manufacturing using different manufacturing machines, (ii) different materials, (iii) subsequent crystallization of the plastic/resin material, (iv) water absorption by the plastic/resin material, (v) water release thereby, etc. Accordingly, a plurality of composite profiles **10**, **11** can be manufactured with the same dimensions in the transverse direction (=construction depth) independent of the manufacturing tolerances of their constituent members.

[**0051**] The problems present in the above-described known composite profiles manufactured using a rolling process also can be overcome without the disadvantages of the above-described known alternative solutions. For example, significantly more than 50% of the construction depth of the composite profile can be occupied by the insulating element **40**, the wall thicknesses can be reduced, freely selectable materials can be combined for the inner profile members **20** and the outer profile members **30** and relatively high thermal values can be obtained without increasing the construction depth. Moreover, the problems caused by varying or different tolerances in the transversal direction and the visibility of spilled resin or the like also can be overcome. Furthermore, reliability problems can be overcome with respect to reduced shearing strength in the longitudinal direction caused by deterioration of the adhesive due to aging.

[**0052**] Additionally, 5-head-solutions (i.e., composite profiles having 5 pairs of connecting portions) as shown in the composite profile **11** of **FIGS. 1 and 2**, which have not been obtained using known rolling processes, are possible without problems in accordance with the present teachings.

[**0053**] The assembly recess **22** serves as a reservoir for the non-cured connecting material. Preferably, the volume of the connecting material **50** filled into the assembly recess **22** does not exceed the volume of the assembly recess **22**. More preferably, the volume of the connecting material **50** filled into the assembly recess **22** is less than the volume obtained by subtracting the volume of the assembly protrusion **37**, **47** from the volume of the assembly recess **22** (see e.g., **FIG. 2***b*), right-most view). However, it is also preferable that this volume is less than the volume remaining after inserting the assembly protrusion **37**, **47** between the freestanding wall **24**, **34** and the opposite wall **23**, **43** of the assembly recess (see e.g., **FIG. 2***c*), right-most view).

[**0054**] A further advantage of the representative embodiment shown in **FIGS. 1 and 2** results in that the assembly of the members **20**, **30**, **40** in the transverse direction can be performed such that no protrusions, members, dovetails, connecting elements or the like are required to be inserted in the longitudinal direction of the composite profiles in order to overcome other tolerance problems.

[**0055**] The materials for the profile members **20**, **21**, **30**, **31** can be freely selected from materials such as wood, steel, plastics, aluminum, other metals, etc. For example, weather-resistant materials can be used for the outer profiles on the other hand. On the other hand, the materials for the inner profiles **20**, **21** can be selected by putting more emphasis on the insulating properties thereof such as synthetic materials including e.g., polyamide or PET having good heat-insulating characteristics.

[**0056**] The curable connecting material can be selected from a variety of curable resins, such as but not limited to poly-urethanes, poly-ethylenes and/or epoxies.

[**0057**] In preferred embodiments, the resin is suitable for powder coating. For example, the resin preferably may be resistant to degradation at temperatures of 200 to 220° C. for 20 to 30 minutes and/or in a cleaning bath if the composite profile will be subjected to an anodizing process.

[**0058**] Preferably, at least the visible surfaces of the connecting members **40**, **41** are conductive (e.g., have an electrical resistance less than 10^{-9} Ω). This property serves to ensure that the materials can be electrostatically coated. This conductivity can be achieved, e.g., by applying a conductive primer to the surface of the insulating element **40**, **41** and/or by introducing a conductive material into the insulating element **40**, **41**, if necessary.

[**0059**] In **FIG. 3**, a representative method for manufacturing the first composite profile is shown schematically. First, the first profile member **20**, the second profile member **30** and the first connecting member **40** are prepared. Then, the (identically oriented) assembly recesses of the first profile member **20** and the first connecting member **40** are filled with a predetermined volume of the curable connecting material **50**, for example via filling nozzles **102** in a corresponding filling machine **101** (see **FIG. 3***a*)). Subsequently, the (identically oriented) assembly protrusions of the first connecting member **40** and the second profile member **30** are inserted into their corresponding assembly recesses in the transverse direction (see **FIG. 3***b*)). In the embodiment of the composite profile shown in **FIG. 3**, the above-described holding devices are provided such that, after inserting the assembly protrusions, the respective members and the desired dimension (=construction depth) in the transversal direction can be obtained without using external holding devices. Moreover, if any connecting material spills over, it can not be seen from the outside of the composite profile.

[**0060**] **FIG. 4** shows a first modification of the embodiment shown in **FIGS. 1 and 2**. Specifically, the holding devices of **FIG. 4** are formed differently. In the representative embodiment shown in **FIG. 4**, the interspaces (recesses) **49** of the holding devices are formed such that they inwardly taper towards the opening in the cross section perpendicular to the longitudinal direction. Knurlings or grids **46***r*, **48***r* are formed on the inner sides of the walls **44**, **46** and **47**, **48**, respectively, facing the interspace. Corresponding knurlings or grids (not shown) may be formed on the freestanding walls **46**, **48** that will be inserted into the respective interspaces **49**. When the assembly protrusions **37**, **47** are inserted into the interspaces **49**, the interspaces **49** are widened against the resilient elastic force of the defining walls **44**, **49**, **47**, **48** and the knurlings or grids **46***r*, **48***r* engage each other in the end position. As a result, the holding force is not only generated by the resilient elastic force of the walls **44**, **49**, **47**, **48** and the corresponding friction but also by the engaging knurlings or grids **46***r*, **48***r*.

Therefore, the holding force can be significantly increased and the holding can be made more reliable, if desired.

[0061] **FIG. 5** shows a second modification of the embodiment shown in **FIGS. 1 and 2**, in which no holding devices are provided. In the embodiment shown in **FIG. 5**, it is also possible to omit the freestanding wall **34** (see **FIG. 5***b*)).

[0062] **FIG. 6** shows a third modification in which the inner surfaces of the first and second holding elements include knurlings **25***r*, **45***r*. Such a knurling, e.g., may consist essentially of protrusions and/or recesses and results, in case of a suitable selection of the curable connection material, the same effects and advantages as the larger protrusions. The profile members **20** and **30** shown in **FIG. 6** can be obtained by bending a pre-knurled metal sheet, as shown in **FIG. 6***c*).

[0063] Alternatively, the first and/or second holding elements, i.e., the protrusions and/or recesses, can also be obtained by providing net-like structures, engravements, dimples, especially rough surface structures, such as a roughened wood surface, etc. The present teachings are not particularly limited in this regard.

[0064] In all embodiments described and shown in the figures, the orientation of the depth direction of the assembly recesses, the protrusion direction of the assembly protrusions and the corresponding insertion direction of the assembly protrusions into the respective assembly recesses preferably each correspond to the transverse direction, which allows equalization (compensation) of different manufacturing tolerances. The equalization of the tolerances is also possible for orientation of the depth direction of the assembly recess and the protruding direction of the assembly protrusion and the corresponding direction of the insertion of $<\pm 90°$ in relation to the transverse direction. However, even in case of corresponding orientations and an insertion perpendicular to the transversal direction, all advantages except the equalization of the tolerances are obtained.

[0065] The first, second and third materials of the claims can be freely selected and they are not limited to a single material. For example, the third material can comprise a plurality of materials, e.g., the connecting member can be formed partly of polyamide and partly of poly-urethane-foam, and/or the first profile member (first material) can be partly a synthetic material like plastic and partly wood and/or the second profile member (second material) can be partly metal and partly a synthetic material like plastic.

[0066] Each of the above-described features and teachings may be utilized separately or in conjunction with other features and teachings to provide improved insulating window units and methods for designing and using the same. Representative examples of the present invention, which examples utilize many of these additional features and teachings both separately and in combination, were described in further detail with reference to the attached drawings. This detailed description is merely intended to teach a person of skill in the art further details for practicing preferred aspects of the present teachings and is not intended to limit the scope of the invention. Therefore, combinations of features and steps disclosed in the detailed description may not be necessary to practice the invention in the broadest sense, and are instead taught merely to particularly describe representative examples of the present teachings.

[0067] Moreover, the various features of the representative examples and the dependent claims may be combined in ways that are not specifically and explicitly enumerated in order to provide additional useful embodiments of the present teachings. In addition, it is expressly noted that all features disclosed in the description and/or the claims are intended to be disclosed separately and independently from each other for the purpose of original disclosure, as well as for the purpose of restricting the claimed subject matter independent of the compositions of the features in the embodiments and/or the claims. It is also expressly noted that all value ranges or indications of groups of entities disclose every possible intermediate value or intermediate entity for the purpose of original disclosure, as well as for the purpose of restricting the claimed subject matter.

1. A composite profile suitable for a window, door or facade element, comprising:

at least one profile member extending in a longitudinal direction, the profile member comprising at least one profile member connecting portion,

at least one connecting member extending in the longitudinal direction, the connecting member comprising at least one corresponding connecting member connecting portion arranged and constructed to be connected to the at least one profile member connecting portion such that at least one pair of corresponding connecting portions is present,

wherein one of the profile member connecting portion or the connecting member connecting portion comprises at least one assembly recess extending in the longitudinal direction and the other of the profile member connecting portion or the connecting member connecting portion comprises at least one assembly protrusion arranged and constructed to be inserted into the assembly recess in a direction perpendicular to the longitudinal direction,

wherein the at least one assembly recess comprises a plurality of first form fit elements and the assembly protrusion comprises a plurality of second form fit elements such that the first and second form fit elements are connectable in a form fit by a curable connecting material disposed within the assembly recess, and

at least two sealing devices extending along the longitudinal direction of at least one of the profile member and the connecting member, wherein the corresponding connecting portions are disposed between the at least two sealing devices such that the connecting portions are not visible from outside the composite profile when the at least one assembly protrusion is inserted into the at least one assembly recess.

2. A composite profile according to claim 1, wherein:

the at least one profile member comprises at least two profile member connecting portions,

the at least one connecting member comprises at least two corresponding connecting member connecting portions arranged and constructed to be respectively connected to the at least two profile member connecting portions such that at least two pairs of corresponding connecting portions are present,

at least one of the at least two profile member connecting portions or the connecting member connecting portions each comprise at least one assembly recess (**22**, **42**) extending in the longitudinal direction,

the other or the at least two profile member connecting portions or the connecting member connecting portions each comprises at least one corresponding assembly protrusion arranged and constructed to be inserted into the at least one assembly recess in a direction perpendicular to the longitudinal direction,

each assembly recess comprises a plurality of the first form fit elements,

each assembly protrusion comprises a plurality of the second form fit elements such that the first and second form fit elements are connectable in a form fit by the curable connecting material disposed in the at least one assembly recess, and

the corresponding connecting portions are arranged between the at least two sealing devices such that the connecting portions are not visible from outside the composite profile when the assembly protrusions are inserted into the assembly recesses.

3. A composite profile according to claim 1, wherein:

the at least one profile member comprises a first profile member made of a first material and a second profile member made of a second material,

the at least one connecting member is made of a third material and is arranged and constructed to be connected to the first profile member and the second profile member such that the composite profile extends in a first direction over a first length,

at least one of the first profile member and the second profile member comprises the at least one profile member connecting portion and the at least one connecting member comprises the at least one corresponding connecting member connecting portion, and

the at least one assembly recess and the at least one assembly protrusion extend in the longitudinal direction over at least a part of the first length.

4. A composite profile according to claim 1, wherein:

the at least one assembly recess comprises a plurality of first holding elements serving as the first form fit elements, which are disposed along the longitudinal direction and protrude or are recessed perpendicular to the longitudinal direction, and

the at least one assembly protrusion comprises a plurality of second holding elements serving as the second form fit elements, which are disposed along the longitudinal direction and protrude or are recessed perpendicular to the longitudinal direction.

5. A composite profile according to claim 1, wherein:

the at least two sealing devices are holding devices arranged and constructed to hold the position of the at least one profile member relative to the at least one connecting member after the at least one assembly protrusion has been inserted into the at least one assembly recess, independent of the insertion depth and independent of the curing of the connection material.

6. A composite profile according to claim 1, wherein:

the at least one assembly recess is defined on one side by a first wall that protrudes from one of the corresponding profile member or the corresponding connecting member.

7. A composite profile according to claim 6, further comprising:

a second wall adjacent and parallel to the at least one assembly protrusion defined by the first wall such that the first wall is positioned between the at least one assembly protrusion and the second wall after the at least one assembly protrusion has been inserted into the at least one assembly recess,

wherein the first wall, the second wall and the at least one assembly protrusion define one of the at least two sealing devices and serves as a first holding device arranged and constructed to hold, by a holding force, the first wall positioned between the second wall and the at least one assembly protrusion.

8. A composite profile according to claim 7, further comprising:

a third wall adjacent and parallel to the first wall and

a fourth wall adjacent and parallel to the assembly protrusion, wherein the fourth wall is arranged and constructed to be positioned between the first wall and the third wall after the at least one assembly protrusion has been inserted into the assembly recesses,

wherein the first wall, the third wall and the fourth wall define one of the at least two sealing devices and serves as a second holding device arranged and constructed to hold, by a holding force, the fourth wall positioned between the first wall and the third wall after the at least one assembly protrusion has been inserted into the at least one assembly recesses.

9. A composite profile according to claim 1, wherein the depth directions of the at least one assembly recess and the protruding directions of the at least one assembly protrusion are substantially parallel.

10. A composite profile according to claim 4, wherein the first holding elements and the second holding elements extend perpendicularly to the longitudinal direction such that the first holding elements and the second holding elements do not overlap when viewed along in the longitudinal direction.

11. A composite profile according to claim 2, wherein:

the at least one profile member comprises a first profile member made of a first material and a second profile member made of a second material,

the at least one connecting member is made of a third material and is arranged and constructed to be connected to the first profile member and the second profile member such that the composite profile extends in a first direction over a first length,

at least one of the first profile member and the second profile member comprises the at least one profile member connecting portion and the at least one connecting member comprises the at least one corresponding connecting member connecting portion, each assembly recess and each assembly protrusion extend in the longitudinal direction over at least a part of the first length

each assembly recess comprises a plurality of first holding elements serving as the first form fit elements, which are disposed along the longitudinal direction and protrude or are recessed perpendicular to the longitudinal direction,

each assembly protrusion comprises a plurality of second holding elements serving as the second form fit elements, which are disposed along the longitudinal direction and protrude or are recessed perpendicular to the longitudinal direction

the at least two sealing devices are holding devices arranged and constructed to hold the position of the at least one profile member relative to the at least one connecting member after the assembly protrusions have been inserted into the respective assembly recesses, independent of the insertion depth and independent of the curing of the connection material.

12. A composite profile according to claim 11, wherein:

each assembly recess is defined on one side by a first wall that protrudes from one of the corresponding profile member or the corresponding connecting member.

13. A composite profile according to claim 12, further comprising:

a second wall adjacent and parallel to each assembly protrusion defined by the first wall such that the first wall is positioned between the assembly protrusions and the second wall after each assembly protrusion has been inserted into its corresponding assembly recess,

a third wall adjacent and parallel to the first wall, and

a fourth wall adjacent and parallel to the assembly protrusion, wherein the fourth wall is arranged and constructed to be positioned between the first wall and the third wall after each assembly protrusion has been inserted into its corresponding assembly recesses,

wherein the first wall, the second wall and the assembly protrusion define one of the at least two sealing devices and serves as a first holding device arranged and constructed to hold, by a holding force, the first wall positioned between the second wall and the at least one assembly protrusion, and

wherein the first wall, the third wall and the fourth wall define a second of the at least two sealing devices and serves as a second holding device arranged and constructed to hold, by a holding force, the fourth wall positioned between the first wall and the third wall after each assembly protrusion has been inserted into its corresponding assembly recess.

14. A composite profile according to claim 13, wherein the depth directions of all the assembly recesses and the protruding directions of all the assembly protrusions are substantially parallel.

15. A composite profile according to claim 14, wherein the first holding elements and the second holding elements extend perpendicularly to the longitudinal direction such that the first holding elements and the second holding elements do not overlap when viewed along in the longitudinal direction.

* * * * *