(19) ORGANISATION AFRICAINE DE LA PROPRIETE INTELLECTUELLE

(51) Inter. Cl.[8] E04B 2/96 (2018.01)

(11) N° 20990

FASCICULE DE BREVET D'INVENTION

(21) Numéro de dépôt : 1202100430
PCT/IB2020/052277

(22) Date de dépôt : 13/03/2020

(30) Priorité(s) :

US n° 62/818,821 du 15/03/2019;
BE n° 2019/5399 du 19/06/2019

(24) Délivré le : 09/06/2023

(45) Publié le : 24.08.2023

(73) Titulaire(s) :
1-CLAEYS, Stephanie Catharina R.,
Theo De Belderlaan 4, 2240 ZANDHOVEN (BE);

2-CLAEYS, Laurens Léonard J.,
Theo De Belderlaan 4, 2240 ZANDHOVEN (BE) ;

3-CLAEYS, Nausikaä Els P.,
Theo De Belderlaan 4, 2240 ZANDHOVEN (BE)

(72) Inventeur(s) :
CLAEYS, Eric (BE)

(74) Mandataire : Cabinet Spoor & Fisher Inc. Ngwafor & Partners, The House of Gideon, Golf/Bastos Quarter, Opposite The American Embassy, Entrance-Saint John Paul, II Boulevard, P.O. Box 8211, YAOUNDE (CM).

(54) Titre : Curtain wall.

(57) Abrégé :

A curtain wall that comprises one or more mullions (2) and one or mote transoms (3) and panels (4-4A) that are fined with their edges (5) at least in the mullions (2) and optionally in the transoms (3). characterized in that the aforementioned mullion is assembled from at least an inner profile (2C) and an outer profile (2A) joined together by means of one or more plastic profiles (2B). wherein at least the inner profile (2C) consists substantially of steel.

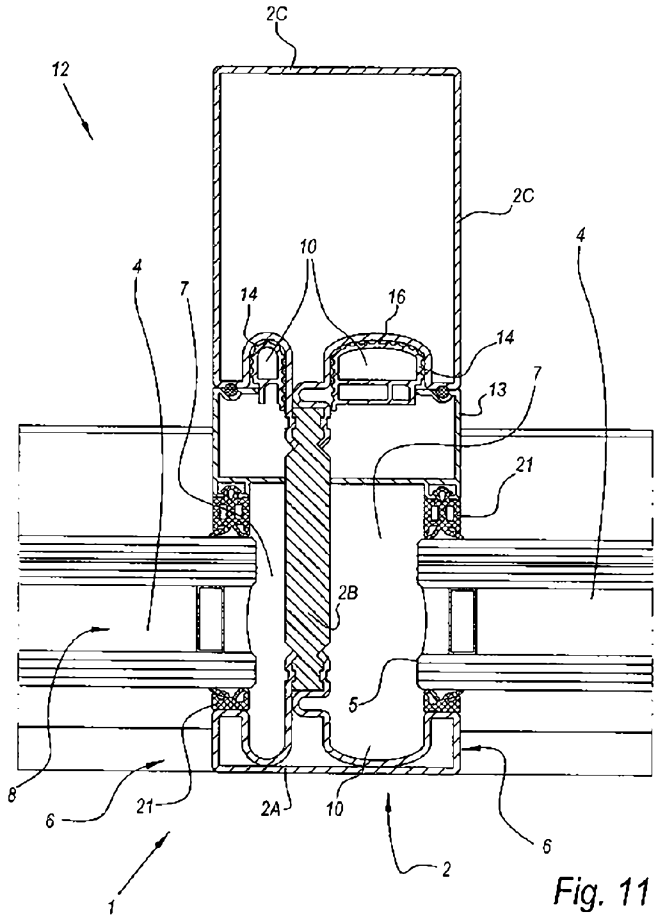

Fig. 11

Curtain wall

The present invention relates to curtain walls or curtain walling.

A curtain wall is a structure of mullions and transoms in which panels, usually glass panels, but possibly also dense panels, are placed so as to form an external wall of a building.

A disadvantage of the known curtain walls, for example the curtain wall known from KR 20130075240, is that the mullions and transoms are designed in such a way that they must be built up from outside into a structure of profiles. Also, the panels must then be installed from outside. When this has to take place at a height, this is complex and requires scaffolding or suspended working platforms and is dangerous for the people doing this work and for people located underneath.

Moreover, the known systems of mullions and transoms require a large number of components and a large number of operations for assembling them.

A curtain wall structure is known from US 3,266,210 with transoms that are mounted between the mullions. In this known structure the transoms are clicked into place in the mullions, which has the disadvantage that the transoms can also click loose again undesirably. Another important disadvantage of this known structure is that it does not offer a solution for the problem of tolerances. With a curtain wall there are two different kinds of tolerances, on the one hand the manufacturing tolerances as a result of the limitations in connection with the accuracy in production, and on the other hand placement tolerances as a result of placement in situ. The production tolerances comprise both the extrusion tolerance and the tolerance in further processing of the particular profiles. Moreover, the transoms should be mounted between the mullions with a clearance at their ends to allow for receiving, on the one hand, the thermal expansion of the transoms, and on the other hand the differential settlement of a building, which is unavoidable and is typical of a concrete or steel rough structure. However, this has the result that the joint between the mullions and transoms is not waterproof, which may give rise to leaks, which obviously is inadmissible for a façade.

The curtain wall structure in US'210 is not very versatile. It only allows working with one predetermined thickness of panels such as glass panels.

A curtain wall is known from WO 2017/201588 wherein the joint between the transom and the mullion forms a barrier to water, so that water that penetrates into the chambers of the mullions, for example via the rubber seal against which the window is fitted, can be led to the transom and there it is removed to the outside. The system from WO '588 in addition allows working with different thicknesses of panels such as glass panels by choosing suitable glazing beads that hold the panel in question in place along the inside of the curtain wall. The curtain wall in WO'588 can be installed from inside the building. The curtain wall in WO'588 may lose structural strength quickly in a fire.

The curtain wall from the aforementioned KR 20130075240 is at least built up on the basis of mullions consisting of roll-formed steel. However, the curtain wall from KR'240 forms a thermal bridge between inside and outside, and, as already mentioned, has the disadvantage that it must be installed from outside.

The present invention relates firstly to an alternative curtain wall, which according to various preferred embodiments offers a solution for one or more problems with the curtain walls from the prior art.

For this purpose, the invention relates to a curtain wall that comprises one or more mullions and one or more transoms, and panels that are mounted with their edges at least in the mullions and optionally in the transoms, wherein the one or more mullions extend vertically and on two opposite sides are provided with a groove with an access opening, said grooves forming a rebate in which the lateral edge of an aforementioned panel is fitted, wherein the one or more transoms extend horizontally between two mullions and, for example, have their ends fitted in the aforementioned grooves of these two mullions, with the characteristic feature that the aforementioned mullion is assembled from at least one inner and one outer profile joined together by means of one or more plastic profiles, wherein at least the inner profile consists substantially of steel. Fabricating the mullions at least partially from steel increases the stability of the structure, even at high temperatures, such as in the case of a fire. The plastic profile provides a thermal break between the inner profile and the outer profile.

The steel used may be for example stainless steel, galvanized steel, chromium-plated steel, or steel with some other coating.

Preferably the steel is corrosion-resistant per se, or is protected against corrosion by means of a coating. The coating may comprise zinc and/or aluminum. The steel may for example be hot dip galvanized or electroplated. In hot dip galvanizing, the object may be immersed in a bath of liquid zinc at a temperature of about 450°C. After cooling and solidification, the zinc layer is attached to the surface of the steel. In electroplating, the liquid is not heated, but electric current provides the adhesion. When the protecting material consists of zinc, this technique is also called electrolytic zinc plating. In the case of a coating that comprises aluminum, aluminizing may be employed. This technique is particularly interesting in the case of profiles for a curtain wall that require high heat resistance. According to a particular example, a so-called TSA technique (Thermal Spray Aluminum or Thermally sprayed zinc and aluminum layers) is employed for applying the respective coating.

The curtain wall of the invention may be produced in various ways in practice. According to a first possibility, the aforementioned inner profile comprises a steel tube. According to a second possibility the inner profile comprises a roll formed profile. According to a third possibility, the aforementioned inner profile comprises a steel tube and a roll formed profile made of steel. In this last case the inner profile may for example be assembled from a tube and a roll formed profile fastened thereon. Fastening may be carried out for example by means of one or more welded joints and/or screwed joints and/or riveted joints. Purely mechanical hook-in joints are not excluded.

The outer profile may consist essentially of steel or aluminum. Preferably the outer profile also consists of steel. For this, the same or some other steel may be used as for the inner profile. Preferably the steel used is rustproof per se, or is protected against corrosion by means of a coating. Preferably the outer profile comprises a roll formed profile.

In cases where both the inner profile and the outer profile are made of steel, it is possible that the panels of the curtain wall are held in the rebates even at greatly increased temperature, such as in a fire, and that there is limited risk of falling panels.

Preferably, the aforementioned plastic profile is fire-resistant and/or consists of a fiber-reinforced composite. A plastic profile of this kind increases the structural stability of the curtain wall at high temperatures, such as in a fire.

Preferably, the resin of the fiber-reinforced composite is thermosetting. Thus, for example, the plastic profile may consist of a fiber-reinforced composite, the matrix of which, in other words the resin, is made fire-retardant by adding additives and/or fillers. For example, aluminum nitrate or silicon carbide may be added. For example polyester, vinyl ester, epoxy or acrylate may be used as resin. For example, the resin known by the name Modar may be used. This is a modified acrylate resin. According to another example, the plastic profile may consist of a fiber-reinforced composite, the matrix of which, in other words the resin, is fire-retardant per se, on account of its chemical composition. For example, bisphenol (A) polyester, bisphenol vinyl ester and epoxy resin may be used as the resin.

Preferably, the fibers of the fiber-reinforced composite are fire-retardant per se, as is the case for example when the fibers consist of glass fiber, aramid fiber and/or carbon fiber. Preferably aramid fibers are used, since these offer increased thermal insulation. According to other examples, S-glass fibers, quartz glass fibers, boron, graphite or ceramic fibers are used. These last-mentioned examples are of particular interest when increased resistance to very high temperatures is required.

Preferably the aforementioned inner profile forms at least partially an undercut of the aforementioned groove, wherein, preferably, at least one fastening attachment is mounted in the aforementioned undercut for fixing one or more glazing beads thereon. The fastening attachment may be made of plastic, preferably a thermoplastic, for example polyvinyl chloride. Thermoplastics are easy to form, for example by extrusion or injection molding.

Preferably, the aforementioned transom is also assembled from at least one inner and one outer profile joined together by means of one or more plastic profiles, wherein at least the inner profile consists substantially of steel. For the inner and outer profiles and for the plastic profile, the same materials may be used as described above in connection with the transom.

Preferably, the groove formed in the lateral edge of the mullion has an oblong cross section, which at one or more of the transverse ends is configured with a rounded section and/or at one or more of the transverse ends is free from rounding with a radius less than 2 millimeters, or even is free from rounding with a radius less than 5 millimeters. Owing to the fact that one or more of the transverse ends of the undercut groove is configured with a rounded section or with rounding of 2 millimeters or more, or even 5 millimeters or more, various advantages may be achieved. For example, with said geometry of the undercut groove it is easier to obtain a completely or

partially waterproof joint between the aforementioned transoms and the mullions, than is the case with an undercut groove with a rectangular section. In this last case it is difficult to achieve waterproofing at the location of the vertexes.

Preferably, on at least one, and preferably on both, of the ends of the transoms, a head piece is provided that comes into contact with one or more of the aforementioned transverse ends of the groove formed in the lateral edges of the mullion. At the location of said contact there is preferably compression of the material of the head piece. Through deformation of the material of the surface of the head piece, a water-tight and/or air-tight joint may be obtained between the transom and mullion, even with a difference in geometry between the head piece and the transverse end in question, for example owing to tolerances. Preferably the head piece consists, completely or at least on the surface thereof where the joint is to be formed, of a material that is more easily compressible or softer than the material of the aforementioned transom. The head piece preferably consists of a separate part that is fixed on the end of the respective transom.

Preferably, the joint between the transom, more particularly the head piece fitted thereon, and the mullion, more particularly the groove formed in the lateral edge thereof, is produced exclusively by mechanical means, namely by positioning the transom, more particularly the head piece, in the groove. Preferably the aforementioned joint is disconnectable and reconnectable. The aforementioned joint is thus preferably free from adhesives, or other fastening means, such as sealant. As mentioned above, the joint of the head piece and the groove preferably provides a seal of the point of connection between the transom, more particularly the head piece, and the mullion, more particularly the groove formed in the lateral edge thereof.

It is clear from the foregoing that on the aforementioned ends of the transoms, preferably a seal is provided that forms a barrier to water. The aforementioned barrier preferably comprises at least one seal of the aforementioned groove, wherein this seal is formed at least partially by the aforementioned head pieces, and more particularly by the contact of the aforementioned head pieces with one or more of the transverse ends of the groove formed in the lateral edge of the mullion. Preferably said seal is obtained by connection of the head piece in question with all walls of the aforementioned groove. In other words the shape of the head piece is preferably configured in such a way that it forms a contact over both complete transverse ends, and over the innermost transverse wall of the groove.

It is to be noted that a seal on the points of connection between transoms and mullions may lead to control of infiltration water per individual façade section or panel, namely a so-called field effect. When all points of connection between transoms and mullions surrounding a façade section are sealed, preferably at least by means of contact between the head piece in question and the groove, a so-called field effect can be obtained. This field effect allows simple detection, more particularly localization, of the cause of inward seeping water. Such seeping is, with a field effect, namely due to a leak present in the relevant façade section, and not from façade sections adjacent or above, in contrast to traditional curtain walls wherein infiltration water is collected over several façade sections in the mullions and is led away. It is clear that leaks in façade sections and the risk of inward seeping water must be minimized as far as possible and even prevented.

Preferably, the water from the mullions is led away via one or more openings made in the transom, wherein these openings are preferably located at a distance from the mullions, for example at a distance of between 10 and 300 mm. In this way, discharge of water may be obtained per panel or façade section. As mentioned above, such drainage is advantageous for detecting the cause of any inward leaking water. Inward leaking water is not of course the intention and should emphatically be avoided. In this kind of configuration, no discharge for water needs to be provided in the mullions, and any infiltration water in the curtain wall is led away to the outside per façade section.

Preferably, in the cases wherein the head piece is fitted as a single-part or multi-part, but separate portion over the end of the transom, a sealing fastening means is fitted between the aforementioned head piece and the relevant transom. The sealing fastening means may for example be an elastic or plastic sealant and/or a fastening means based on silicone, a liquid butyl sealant or similar. This will prevent water that is located on the transom from finding its way between the head piece and the transom, for example as a result of small deformations of the head piece.

As mentioned above, preferably one or more fastening attachments for fastening glazing beads are glued in at least one of the aforementioned transverse ends, preferably in the transverse end that is located on the inside of the curtain wall. Gluing of the fastening attachments makes it possible to simplify the geometry of the mullions, in comparison with the mechanical connection from the prior art, for example WO 2017/201587. In the case wherein the head pieces on the

transoms are fitted into the groove of the mullions by means of a rotating motion, this is achievable without locking elements of a mechanical connection forming an obstruction.

Preferably, the aforementioned fastening attachments are glued in undercuts of the aforementioned groove. Preferably the aforementioned first glazing beads are each fastened by means of several first fastening attachments positioned at a distance from one another along the mullion. As stated above, gluing of the fastening attachments may lead to a simpler design of the mullions. This simpler design may be configured so that the cavities in the mullion are easier to seal, for example by means of the ends or head pieces of the transoms, such as may be the case with the mullions and the groove in the lateral edge thereof.

It should further be noted that fastening of the aforementioned first glazing beads each by means of several first fastening attachments positioned at a distance from one another along the mullion is also advantageous in the case wherein the fastening attachments are fastened to the mullions by means of mechanical locking, or in other words in the case wherein the fastening attachments are fastened with clips.

Preferably the fastening attachments have a surface with one or more ribs. These ribs preferably form a surface that is easier to glue in the aforementioned transverse ends of the groove. The tops of these ribs preferably come into contact with the surface of one of the aforementioned transverse ends of the groove, whereas between two adjacent ribs there is space for receiving glue or some other cured fastening means. The transverse ends of the groove are preferably free per se from large irregularities such as ribs, so that good sealing is still possible at the fastening points between transom and mullion on the basis of the aforementioned head pieces.

Preferably the curtain wall of the invention further displays the characteristic features that the aforementioned grooves in the lateral edge of the mullion have an access opening, wherein the access opening has a first fixed dimension or width in the horizontal direction, wherein the transoms have a second dimension in the horizontal direction and at right angles to the profile direction of the transoms, wherein the second dimension is greater than the first dimension, wherein the transoms have a third dimension in a nonhorizontal direction at right angles to the profile direction, wherein the third dimension is less than the first dimension, so that the ends of the transoms, in a rotated state of the transoms in which the direction of the third dimension is horizontal, pass through the access opening and wherein the transoms are provided with a locking element, for example in the form of a movable rod, wherein the mullions are provided

with a locking groove for receiving a portion of the aforementioned locking element, for example a portion of said rod, so as to block a rotational motion of the transoms thereby. The presence of locking of the transoms increases the structural stability of the curtain wall at greatly increased temperatures, such as in a fire.

The foregoing makes clear that the curtain walls of the invention may be configured in such a way that they can be installed from the inside of a building without too many operations. For example, the transoms, in a state when rotated about their longitudinal axis, are placed in the access openings and then by rotation they receive their desired orientation and are fixed or clicked in the undercut grooves, wherein preferably an airtight and/or watertight seal of the undercut groove is achieved. During construction of the curtain wall, the transoms may be secured by means of the locking element and the locking groove. For example, with a simple displacement of a locking element, for example a rod or strip, sufficient locking may be achieved against loosening of the transoms fitted between the mullions.

Preferably, the inner profile, the plastic profile and the outer profile are fastened to each other, and preferably are not dismountable from one another, preferably so that the width of the aforementioned access opening has a fixed dimension. The relevant mullions extend from the inside of the curtain wall to the outside of the curtain wall and perform all functions that a mullion from the prior art, erected from outside, may have, namely thermal break, drainage per façade section and the like. It is clear that the mullions are preferably prefabricated, wherein most of the part-profiles that are fastened to one another are already fastened to each other before the curtain wall is installed at the construction site. Preferably the mullions on the one hand and/or the transoms on the other hand are delivered to the construction site as an assembled whole. The possibility of working with a prefabricated mullion, with which drainage per façade section may nevertheless be achieved, is unique and the curtain wall of the present invention can offer an ideal solution for this, according to preferred embodiments.

The installation of the curtain wall of the invention, namely the fastening of transoms and mullions together, is preferably screw-free. Preferably, an airtight and/or watertight seal is obtained at the fastening points between transoms and mullions, for example exclusively by means of the aforesaid contact between the optional head pieces on the transom and the groove in the lateral edge of the mullion.

In a preferred embodiment, one or more walls of the grooves are provided with a recess in which a portion of the transoms is located, wherein the transoms are supported vertically by a bottom edge of said recess. The aforementioned recess preferably extends in the horizontal direction through one or more of the transverse walls that delimit undercuts of the aforementioned groove. This is an easy way of obtaining fastening of the transoms to the mullions, without additional fastening pieces. In addition, this kind of suspension allows the transoms to have some clearance in their profile direction, which is desirable for taking up stresses in the curtain wall. The transoms "hang" in this recess and are preferably supported on the mullion both at the front and on the inside. In this way the loads on the transoms are transmitted to the mullions.

The aforementioned recess may be formed in the mullions by milling out, punching out or cutting out.

In a further preferred embodiment, the transoms are Z profiles, with a first vertical leg that projects upward and that is located on the inside of the transom, a second vertical leg that projects downwards and that is located on the outside of the transom, and a horizontal connecting piece between the first and the second leg. As a result, the vertical legs provide sufficient stiffness, while the horizontal connecting piece leaves sufficient space for installing a panel above the transom. In addition, this kind of transom limits inward seeping of water. The height of the first vertical leg is preferably 20 millimeters or more, so that it is only at a pressure difference of 200Pa that there is a risk of water on the transom moving inwards as a result of a hydrodynamic pressure difference.

Preferably, for blocking the rotation of the transoms, the aforementioned locking groove with the locking element, for example the rod, therein is fitted to the inside of the second leg. This makes it easy, when constructing the curtain wall, to be able to move the rod from inside, in other words from a floor against which the curtain wall is fitted.

Preferably said grooves have a different depth on the different sides of the mullions. This makes it possible for the panels also to be placed from inside, by fitting a panel slanting in the deepest groove, then setting it in the desired orientation and then moving it toward the shallow groove.

Preferably the panels are glass panels. According to a particular embodiment, the panels are so-called "smart glazing" panels, namely glass panels whose transparency, reflection, heat transfer or other properties can be regulated on the basis of electronic signals.

It is clear that the outside of the curtain wall is the side that is exposed to atmospheric effects.

As mentioned above, in horizontal cross section the grooves preferably have undercuts and, not counting their access opening, preferably have an elongated shape wherein the transverse ends preferably have a rounded section or are configured with rounding of 2 millimeters or more.

In a further preferred embodiment, the transoms and the mullions define rectangular openings, wherein one or more panels are placed in said openings, thereby closing these openings, wherein the one or more panels are fixed by means of first glazing beads, which are fastened to an aforesaid mullion by means of first fastening attachments, wherein the first fastening attachments and the mullions are arranged in order to be able to fasten the first fastening attachments to an aforesaid mullion, preferably as stated above by fixing it by gluing it in the aforementioned undercut groove or by fixing it by clipping it by means of mechanical locking elements, wherein the first fastening attachments and the first glazing beads are preferably arranged in order to be able to fix the first glazing beads by clicking them on the first fastening attachments. In this way, first glazing beads may be fastened easily, simply by clicking. This makes it possible to fit the panels from the inside. As mentioned above, preferably several fastening attachments are used, spaced apart along the mullion.

According to an alternative to fixing the fastening attachments by gluing, or in combination therewith, the first fastening attachments and said mullions may be arranged in order to be able to fix the first fastening attachments by clicking to an aforesaid mullion in a direction at right angles to the plane of the panel in question, wherein the first fastening attachments and the first glazing beads are arranged so as to be able to fix the first glazing beads by clicking to the first fastening attachments in a direction parallel to the plane of the panel in question. Preferably, however, the fastening attachments are only attached to the mullion by gluing. Fitting of the fastening attachments on the mullions may be carried out before mounting the respective mullion, for example as a component of a prefabricated mullion, delivered as such to the site. It is, however, also possible for the fastening attachments to be fixed on the mullions after mounting the mullions, for example in connection with placement of the panels and/or the glazing beads.

In another preferred embodiment, the one or more said mullions and the first glazing beads are arranged so that the first glazing beads rest against the mullion, on their side turned away from the panel in question.

In another preferred embodiment, the one or more panels are fixed by means of second glazing beads, which are fixed to an aforesaid transom by means of second fastening attachments, wherein the second fastening attachments and the one or more said transoms are arranged in such a way that the second fastening attachments can be fixed to an aforesaid transom, wherein the second fastening attachments and the second glazing beads are arranged so that the second glazing beads can be clicked onto the second fastening attachments. The advantages mentioned in connection with the first glazing beads and the mullions are thus also applicable to the transoms and the second glazing beads. It is clear that the fastening attachments for the second glazing beads can be fixed to the transoms in a similar way as the fastening attachments for the first glazing beads are fixed to the mullions.

Preferably the first and/or the second fastening attachments are made of plastic, such as PVC (polyvinyl chloride), PP (polypropylene), PA (polyamide), PE (polyethylene), PET (polyethylene terephthalate), and the first glazing beads are preferably made of aluminum.

For better illustration of the features of the invention, some preferred embodiments are described hereunder, as examples without any limiting character, referring to the appended drawings, in which:

Fig. 1 shows a curtain wall, which illustrates some features of the invention, but does not form part thereof;

Figs. 2 and 3 show, on a larger scale, a cross section according to the section lines II-II and III-III, respectively, shown in Fig. 1;

Figs. 4 and 5 show head pieces in perspective, which according to the invention can be fitted on the ends of the transoms;

Figs. 6 and 7 illustrate, in a cross section according to line VI-VI shown in Fig. 1, how the transom with the head pieces can be fitted in the undercut groove;

Fig. 8 shows, in a view similar to that in Fig. 3, a curtain wall with the features of the invention;

Fig. 9 shows an alternative in one and the same view;

Fig. 10 shows, on a larger scale, a cross section according to the line X-X shown in Fig. 1, for a curtain wall with the features of the invention; and

Figs. 11 and 12 show, in a view similar to that in Figs. 8 and 10 respectively, a variant with the features of the invention.

Fig. 1 shows a curtain wall 1 under construction. The curtain wall 1 comprises mullions 2 and transoms 3. Panels 4, such as glazing, are secured with their edges 5 in the mullions 2 and in the transoms 3. The mullions 2 extend vertically, and the transoms 3 extend horizontally. In the example, they are profiles 2-3 that are delivered prefabricated to the site. The complete curtain wall 1, including panels 4, can be installed from inside.

Fig. 2 shows that the mullions 2 are provided on two opposite sides 6 with an undercut groove 7 with an access opening 8. The groove 7 forms a rebate into which the lateral edge 5 of the aforementioned panels 4 can be fitted. The transoms 3 extend horizontally between the two mullions 2. The mullions 2 shown comprise several part-profiles 2A-2B-2C fastened to each other, and not dismountable from each other, including a part-profile 2B that forms a thermal break.

Fig. 3 shows that the ends of the transoms 3 are secured in the aforementioned grooves 7 of the mullions 2. For this purpose, head pieces 9 are fitted over the ends of the transoms 3.

The aforementioned undercut groove 7 has an oblong cross section, which is configured with a rounded section at one or more of the transverse ends 10, and, in this case, at the transverse ends 10 is free from rounding with a radius less than 2 millimeters. Figs. 2 and 3 clearly show that the aforementioned oblong cross section is oriented with its long axis 11 transverse, or even perpendicular, to the aforementioned panels 4.

As shown in Fig. 2, the aforementioned panels 4 are fixed along the inside 12 of the curtain wall 1 by means of glazing beads 13, which are fastened to the aforementioned mullion 2, for example, as here by means of fastening attachments 14 to which the respective glazing beads 13 can be secured by means of mechanical locking means 15, more particularly clicked or snapped, preferably as explained in more detail in WO 2017/201587. In the example, the fastening attachments 14 are glued to the mullion 2 at the location of the transverse end 10 of the undercut groove 7 that is located on the inside 12 of the curtain wall 1. For this purpose, in the example the fastening attachments 14 are provided with a surface with ribs 16, the tops of which come into contact with the surface of the respective transverse end 10, while between two adjacent ribs there is space for receiving glue or some other cured fastening means. The transverse ends 10 of the undercut groove 7 are free per se from irregularities such as ribs.

It is to be noted that the fastening attachments 14 may be made as long or almost as long as the glazing beads 13 for which they are intended. Preferably, however, a glazing bead 13 is secured by means of several fastening attachments 14 located at a distance one above another, for example three per glazing bead 13. This kind of configuration forms an example of the second independent aspect mentioned in the introduction. For example, the fastening attachments 14 may extend in each case over a distance of 2 to 20 cm, for example about 5 cm, in the mullion 2, with a distance between two adjacent fastening attachments 14 of 10 to 50 cm, for example 20 to 30 centimeters.

Fig. 3 clearly shows that the aforementioned head pieces 9 have a geometry that is complementary to the cross section of the undercut groove 7, and in the example comes into contact with both transverse ends 10 thereof. As mentioned above, owing to said contact, a water-tight and/or air-tight joint is formed between the transom 3 and the mullion 2. Preferably, contact between head piece 9 and undercut groove 7, such as here, is formed over the complete perimeter of the walls of the undercut groove 7.

Figs. 4 and 5 show a perspective view of the head pieces 9 used in Fig. 3. Said head pieces 9 comprise several openings 17, along which a sealing fastening means may be applied or injected. The fastening means is intended to provide a barrier to moisture that is located on the transom 3, and that otherwise would find its way between the transom 3 and the head piece 9.

Fig. 6 shows that the transom 3 with the head piece 9 fitted thereon can initially be represented from the upper side and/or at an angle between two mullions 2, namely with the head piece 9 in the undercut groove 7. Then the transom 3 and the head piece 9 are rolled, at the location of a recess 18 in the mullion 2, into the final position, shown in Fig. 7, for example in a manner similar to that described in more detail in WO 2017/201589. During this rolling motion W, compression, preferably of the material of the head piece 9, may occur at the contacts between the respective head piece 9 and the undercut groove 7, so that the sealing effect at the connecting or fastening point between transom 3 and mullion 2 can be increased.

Figs. 6 and 7 clearly show that the undercut groove 7 has an access opening 8, which in the horizontal direction H has a width B1 that is less than width B2 of the transoms 3 measured in the horizontal direction H and at right angles to the longitudinal direction of the transom 3. In a nonhorizontal direction, for example in the vertical direction V, at right angles to the longitudinal direction, the transom 3 has a dimension A that is less than the width B1 of the access opening 8

of the undercut groove 7, so that the ends of the transoms 3, in a rotated state, for example the state in Fig. 6, pass through the access opening 8. Preferably the transom 3, and/or the mullion 2 further comprise means for locking the rotation of the transom 3 in the final position, for example that shown in Fig. 7. Although not shown here, it may be configured similarly to that explained in more detail in WO 2017/201589.

It is clear that the fitting of mullions 2 and transoms 3, and the installation of the panels 4, can be carried out completely without screws, and from the inside 12 of the building, yet obtaining an airtight and/or watertight joint of mullions 2 and transoms 3. In this way, a field effect for water drainage, as stated in the introduction, is obtained.

Figs. 6 and 7 further show that the transoms 3 also comprise several part-profiles 3A-3B-3C that are fastened to each other, and are not dismountable from one another, including a part-profile 3B that forms a thermal break. Preferably the transoms 3 are prefabricated, or in other words they are delivered to the site in the assembled state.

It is also clear from the example that the undercut grooves 7 on the opposite edges 6 of the mullions 2 preferably have a different depth. This configuration allows the panels 4, such as panels 4 for glazing, to be brought into the curtain wall 1 by means of a so-called shuffle technique, wherein one edge of the panel 4 is fitted in the deepest undercut groove 7, the panel is rotated in the plane of the glazing, and is then pushed into the shallower undercut groove 7. The glazing is preferably fixed in its final position at least by means of the aforementioned glazing beads 13.

Figs. 6 and 7 clearly show that the transoms 3 may be configured with at least a first leg 19 that projects upward and that is located on the inside of the transom 3, and preferably with a second leg 20 that projects downwards and that is located on the outside of the transom 3. The one or more legs 19-20 provide additional bending strength of the profile. The first leg 19 preferably has a height H1 of 20 millimeters or more, so that it is only at a hydrodynamic pressure difference of 200 Pa that there is a risk of the water on the transom 3 moving inwards.

Fig. 8 shows a curtain wall 1 with the features of the invention. In this case the inner profile 2C of the mullion 2 is made of steel. More particularly, in this case the inner profile 2C consists of a roll-formed steel profile. The inner profile 2C is connected via two plastic profiles 2B, which form a thermal break, to the outer profile 2A, which in this example also consists of steel, more

particularly a roll-formed steel profile. Otherwise the figure shows similar components and features as Fig. 2. The practical configuration of the fastening attachments 14 and the glazing beads 13 may be identical or similar to those from the example in Fig. 2. Just as in the preceding examples, the panels 4 are fixed with their edges in the groove 7 by means of glazing beads with seals 21, more especially rubber seals, for example seals made of EPDM.

Fig. 9 shows another example, wherein the inner profile 2C is assembled per se from a steel tube 22 and a roll formed profile 2D fastened thereon. A tube 22 means a hollow profile with a closed perimeter. Assembling profiles 2C and 2D gives a similar geometry as profile 2C in Fig. 8.

Fig. 9 further shows that the fastening attachments 14 may extend over the full distance between the two opposite transverse edges 10 of the groove 7. At the location of the two opposite transverse edges 10, the fastening attachments 14 may be glued or may be fastened in some other way, for example by means of a mechanical hooking or clicking connection. The practical configuration of the glazing beads 13 may be identical or similar to that of the example in Fig. 2.

Fig. 10 shows an example of a transom 3 which, according to a preferred embodiment, as shown here, may be assembled from at least one steel inner profile 3C, at least one plastic profile 2B and an outer profile 2A. Otherwise the transom 3 has similar features as the transom 3 shown in the context of Figs. 6 and 7.

It should further be noted that the transom 3 may be covered along the outer side of the curtain wall 1 by means of a separate profile 23. This separate profile 23 may also be constructed from steel, or may be made from some other material such as aluminum. In the example in Fig. 10, the separate profile 23 also comprises a rubber seal 21, which on the underside of the panel 4 comes into contact with the edge thereof. This need not necessarily be so, and the separate profile 23 may fulfill a merely aesthetic function, while the rubber seal 21 on the underside of the panel 4 may then be fastened for example on the outer profile 2A.

Fig. 11 shows a variant for a mullion 2, which has substantially identical features as described on the basis of Fig. 8, but wherein the inner profile 2C, consisting of a roll-formed steel profile, is connected via only one plastic profile 2B, which forms a thermal break, to the outer profile 2A, which in this case also consists of a roll-formed steel profile.

Fig. 12 shows a variant for a transom 3, which has substantially identical features as described on the basis of Fig. 10.

It should further be noted that mention in the foregoing of an inside 12 of a curtain wall 1 means the portion of the curtain wall 1, namely of the transoms 3 and the mullions 2, that is directed toward the inside of the building. This inside 12 does not necessarily begin at the innermost surface of the curtain wall 1, but begins behind the plane of the glazing.

The present invention is by no means limited to the embodiments described above, but curtain walls of this kind may be produced while remaining within the scope of the present invention.

The invention is not limited to the embodiment/s illustrated in the drawings. Accordingly, it should be understood that where features mentioned in the appended claims are followed by reference signs, such signs are included solely for the purpose of enhancing the intelligibility of the claims and are in no way limiting on the scope of the claims.

Claims:

1.- A curtain wall that comprises one or more mullions (2) and one or more transoms (3) and panels (4-4A) that are fitted with their edges (5) at least in the mullions (2) and optionally in the transoms (3), wherein the one or more mullions (2) extend vertically and are provided on two opposite sides (6) with a groove (7) with an access opening (8), said grooves (7) forming a rebate in which the lateral edge (5) of an aforementioned panel (4-4A) is fitted, wherein each of the one or more transoms has two ends, wherein the ends of the one or more transoms are provided with compressible head pieces (9), wherein the one or more transoms (3) extend horizontally between two mullions (2) and their ends are fitted with the head pieces (9) in the aforementioned grooves (7) of these two mullions (2), wherein the one or more transoms (3) are fastened to two mullions (2) without the use of screws by fitting the ends of the one or more transoms with the head pieces (9) in a recess (18) in the aforementioned grooves (7) of these two mullions (2), characterized in that the aforementioned mullion is assembled from at least an inner profile (2C) and an outer profile (2A) joined together by means of one or more plastic profiles (2B), wherein the inner profile (2C), the outer profile (2A) and the one or more plastic profiles (2B) are fastened to each other and are not dismountable from one another, wherein at least the inner profile (2C) consists substantially of steel.

2.- The curtain wall as claimed in claim 1, characterized in that the inner profile (2C) comprises a steel tube (22).

3.- The curtain wall as claimed in claim 1 or 2, characterized in that the inner profile (2C) comprises a roll formed profile.

4.- The curtain wall as claimed in one of the preceding claims, characterized in that the outer profile (2A) consists substantially of steel or aluminum.

5.- The curtain wall as claimed in claim 4, characterized in that the aforementioned outer profile (2A) consists substantially of steel and comprises a roll formed profile.

6.- The curtain wall as claimed in one of the preceding claims, characterized in that the aforementioned inner profile (2C) at least partially forms an undercut of the aforementioned groove (7), wherein at least one fastening attachment (14) is mounted in the aforementioned undercut for fixing one or more glazing beads (13) thereon.

7.- The curtain wall as claimed in one of the preceding claims, characterized in that the aforementioned plastic profile (2B) is fire-resistant and/or consists of a fiber-reinforced composite.

8.- The curtain wall as claimed in one of the preceding claims, characterized in that the aforementioned transom (3) is also assembled from at least an inner profile (3C) and an outer profile (3A) joined together by means of one or more plastic profiles (3B), wherein at least the inner profile (3C) consists substantially of steel.

Abrégé:

Curtain wall

A curtain wall that comprises one or more mullions (2) and one or more transoms (3) and panels (4-4A) that are fitted with their edges (5) at least in the mullions (2) and optionally in the transoms (3), characterized in that the aforementioned mullion is assembled from at least an inner profile (2C) and an outer profile (2A) joined together by means of one or more plastic profiles (2B), wherein at least the inner profile (2C) consists substantially of steel.

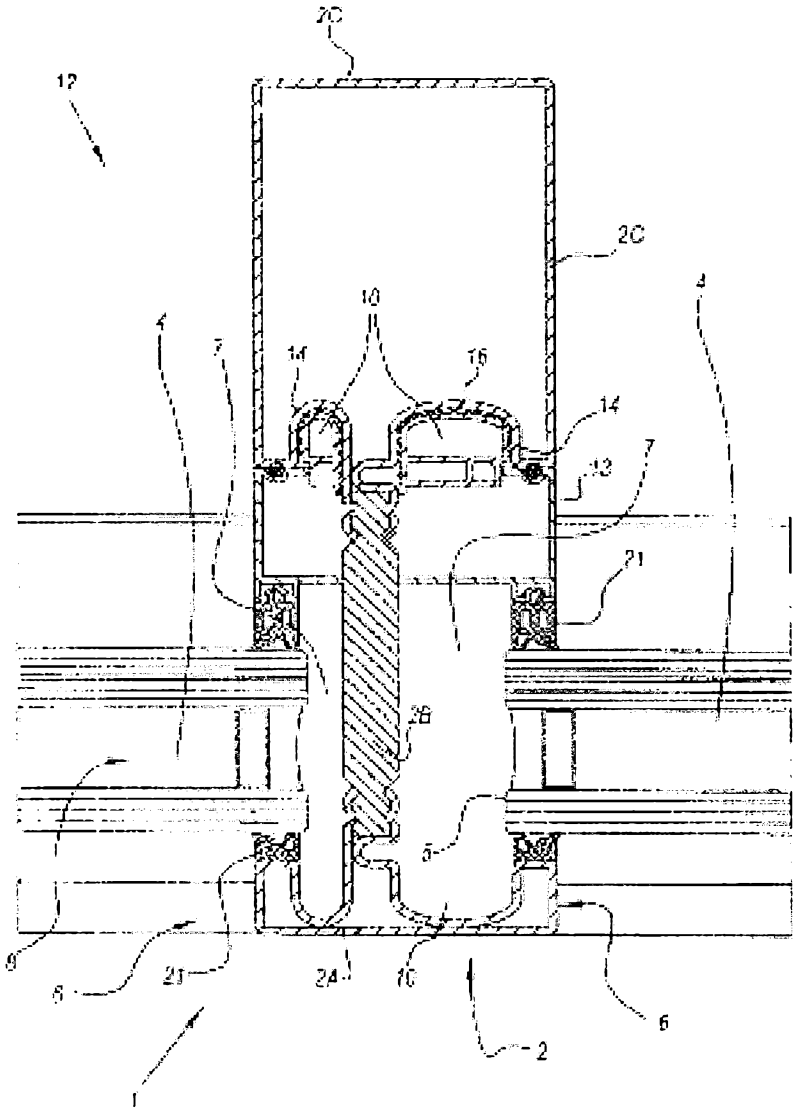

Fig. 11

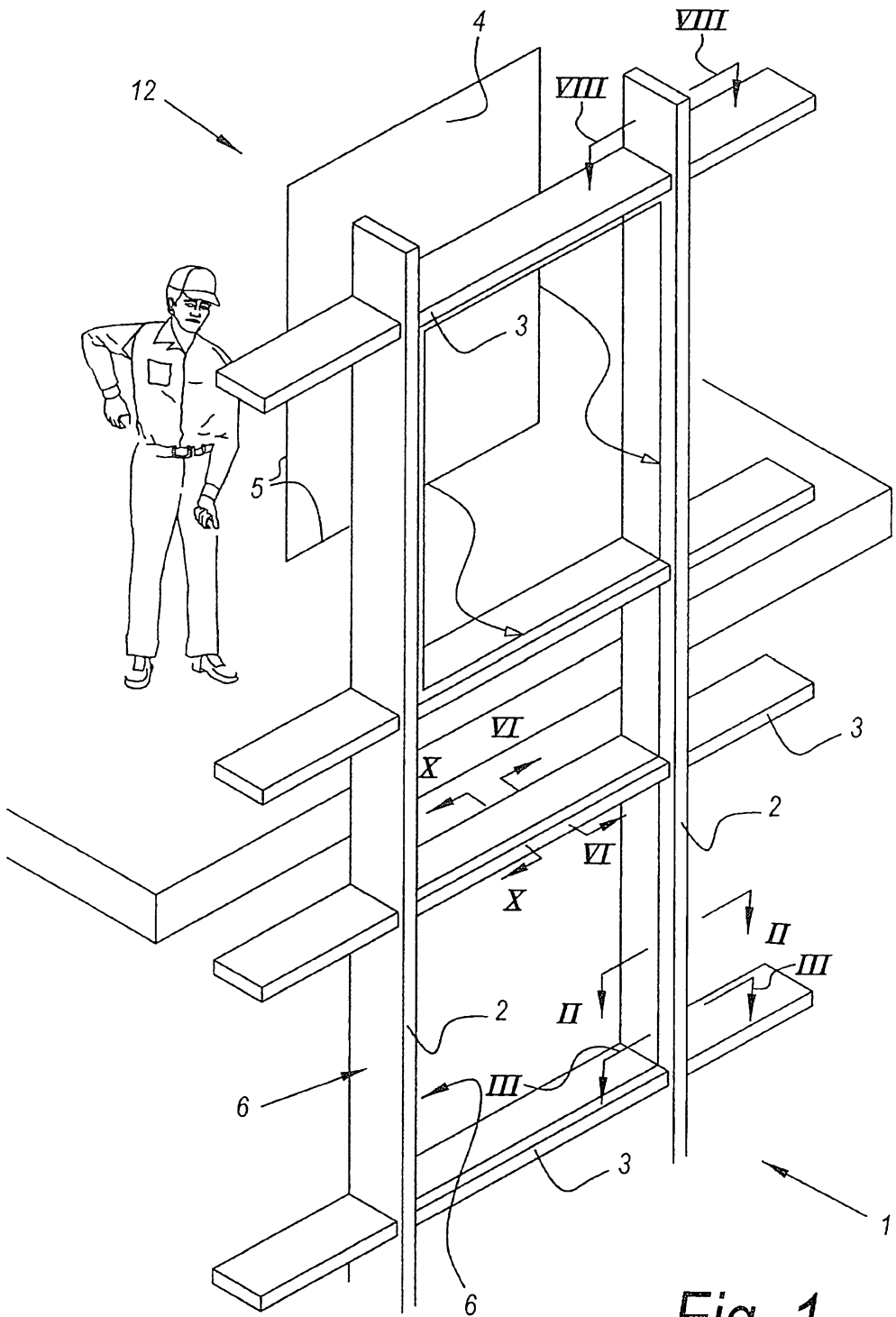

Fig. 1

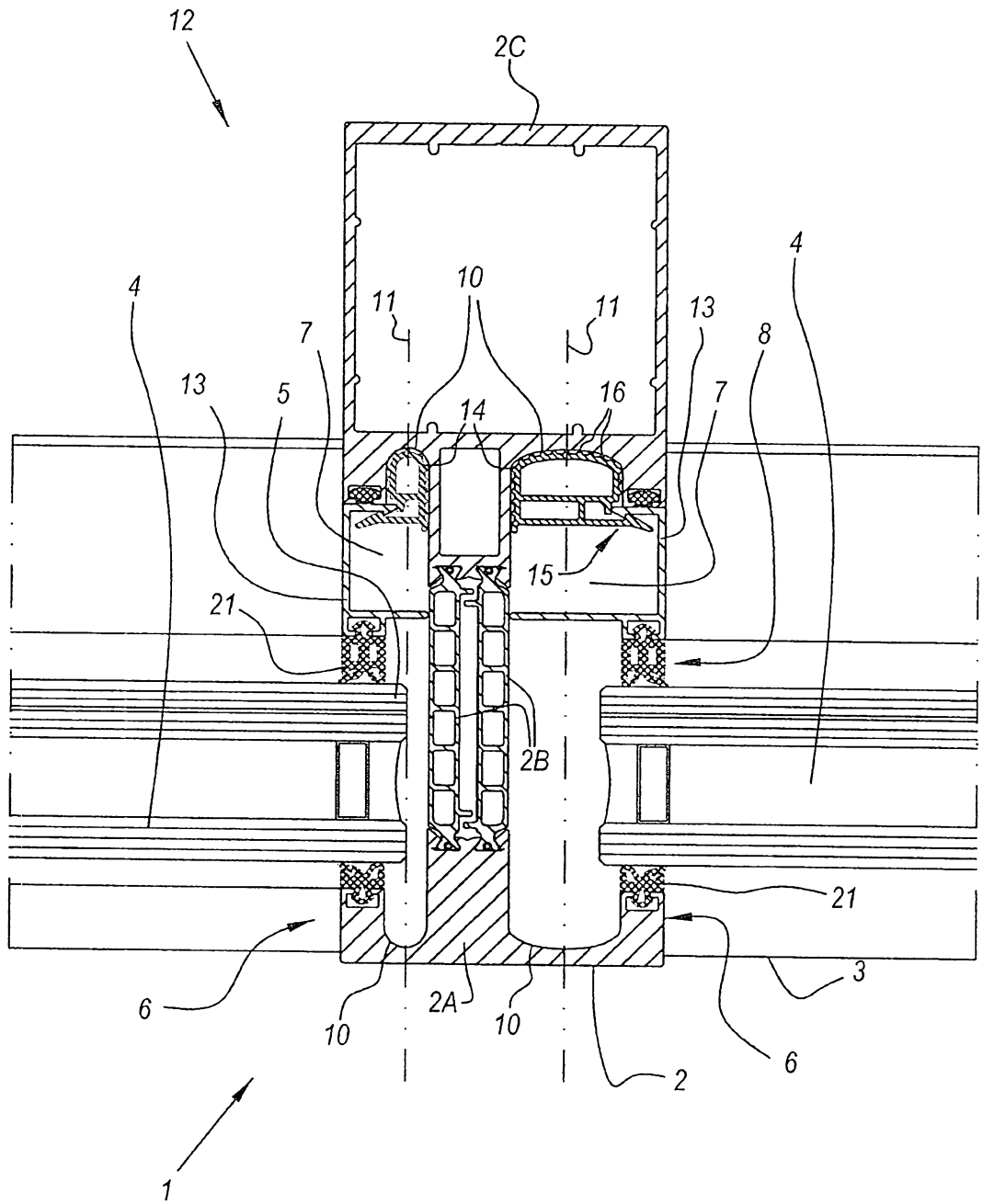

Fig. 2

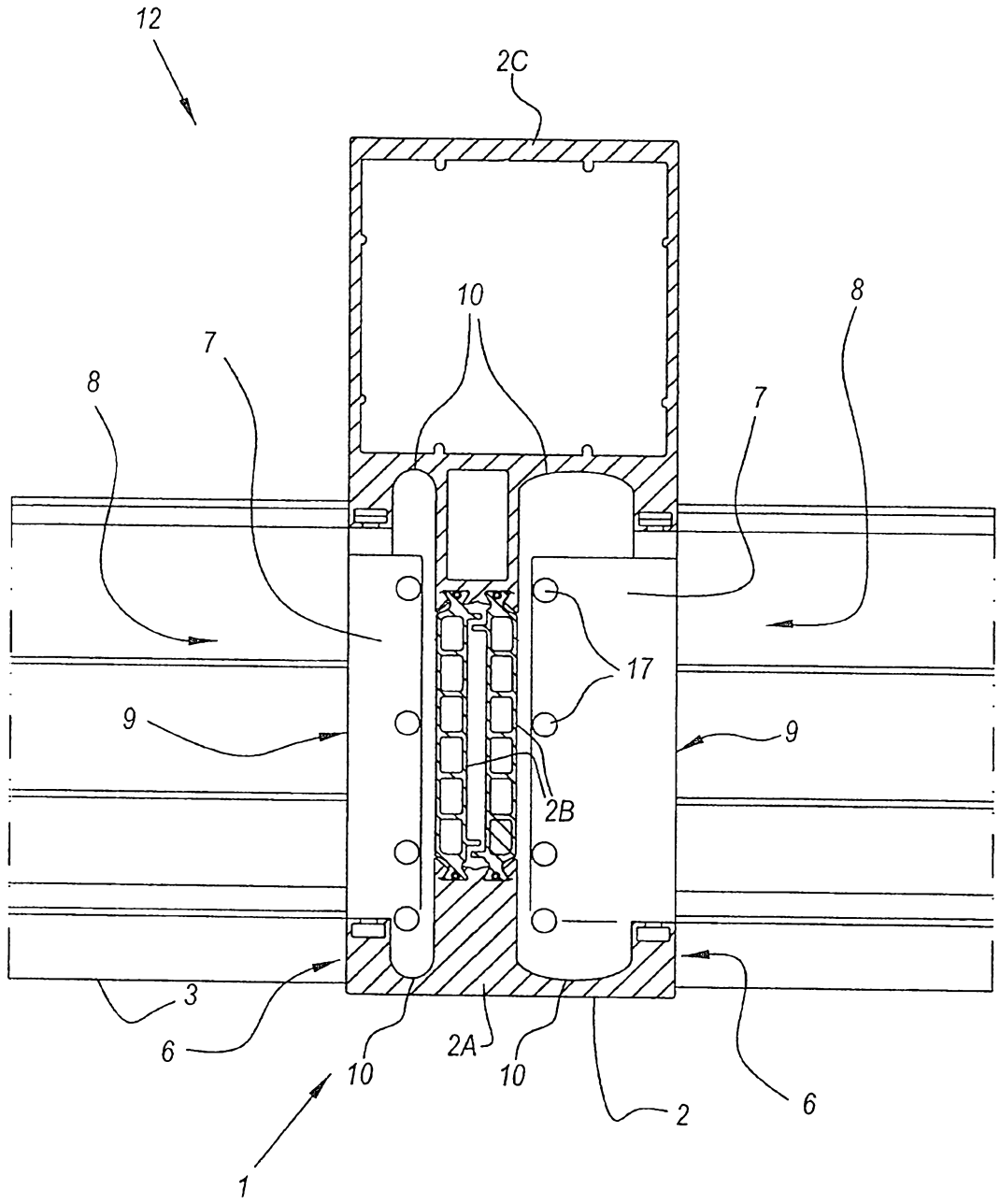

Fig. 3

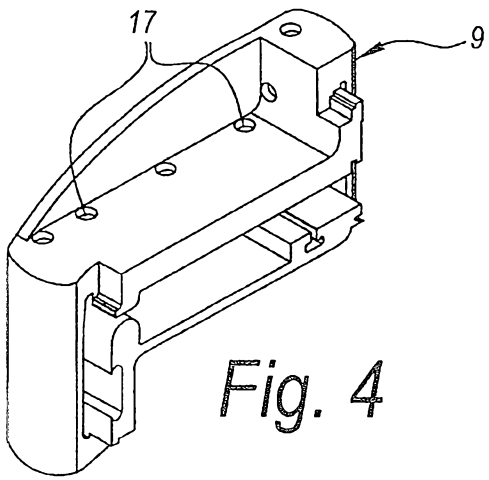

Fig. 4

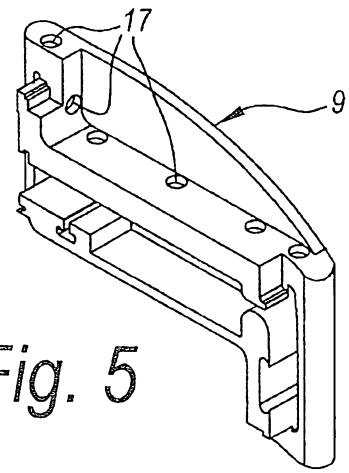

Fig. 5

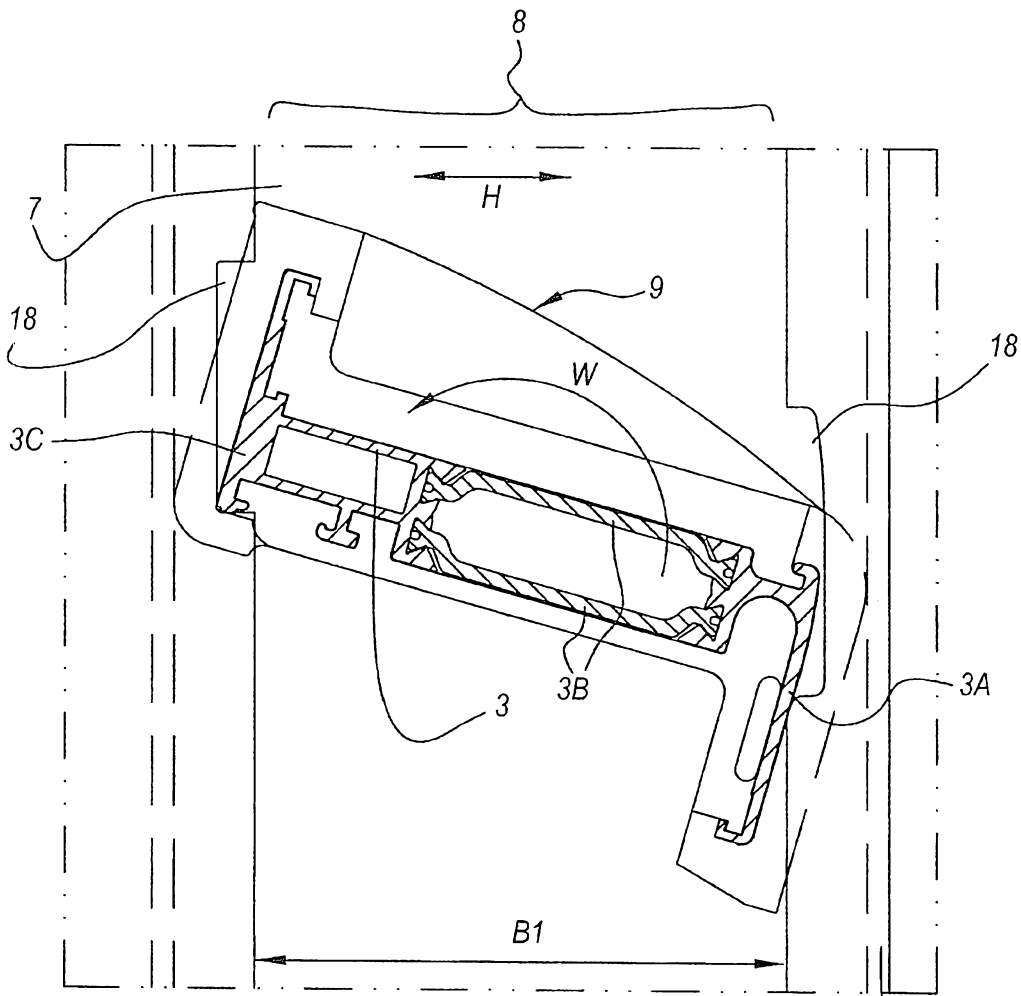

Fig. 6

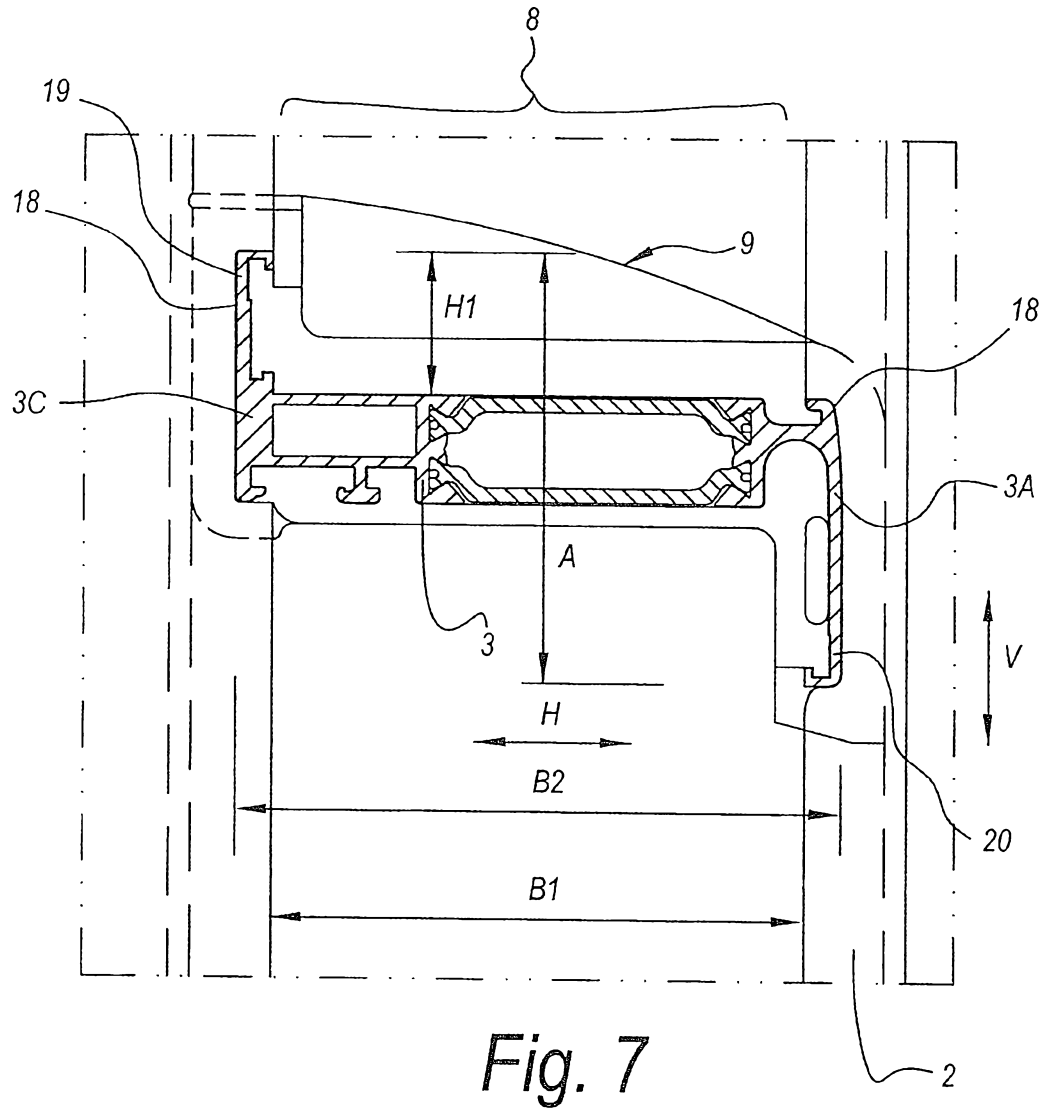

Fig. 7

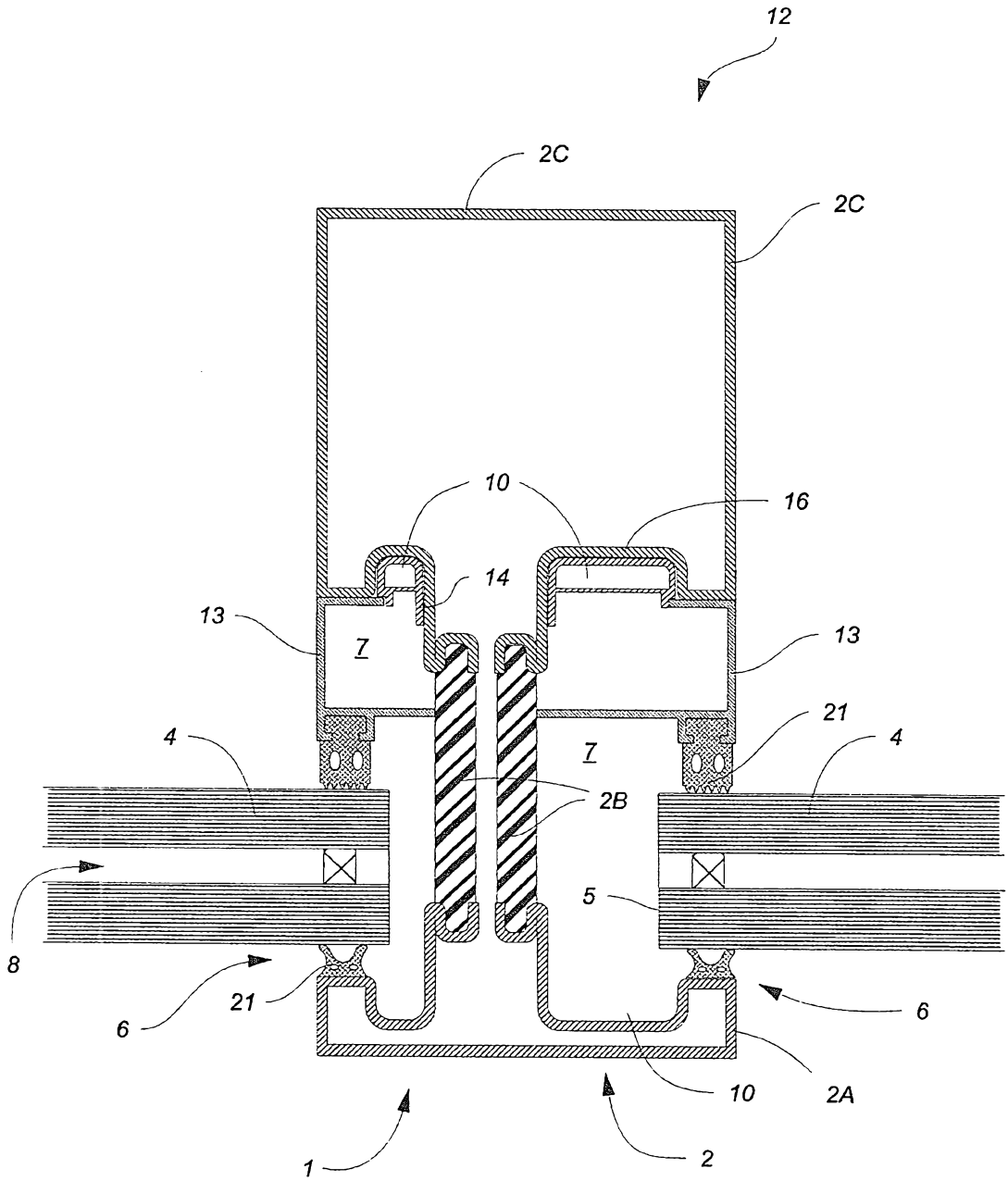

Fig. 8

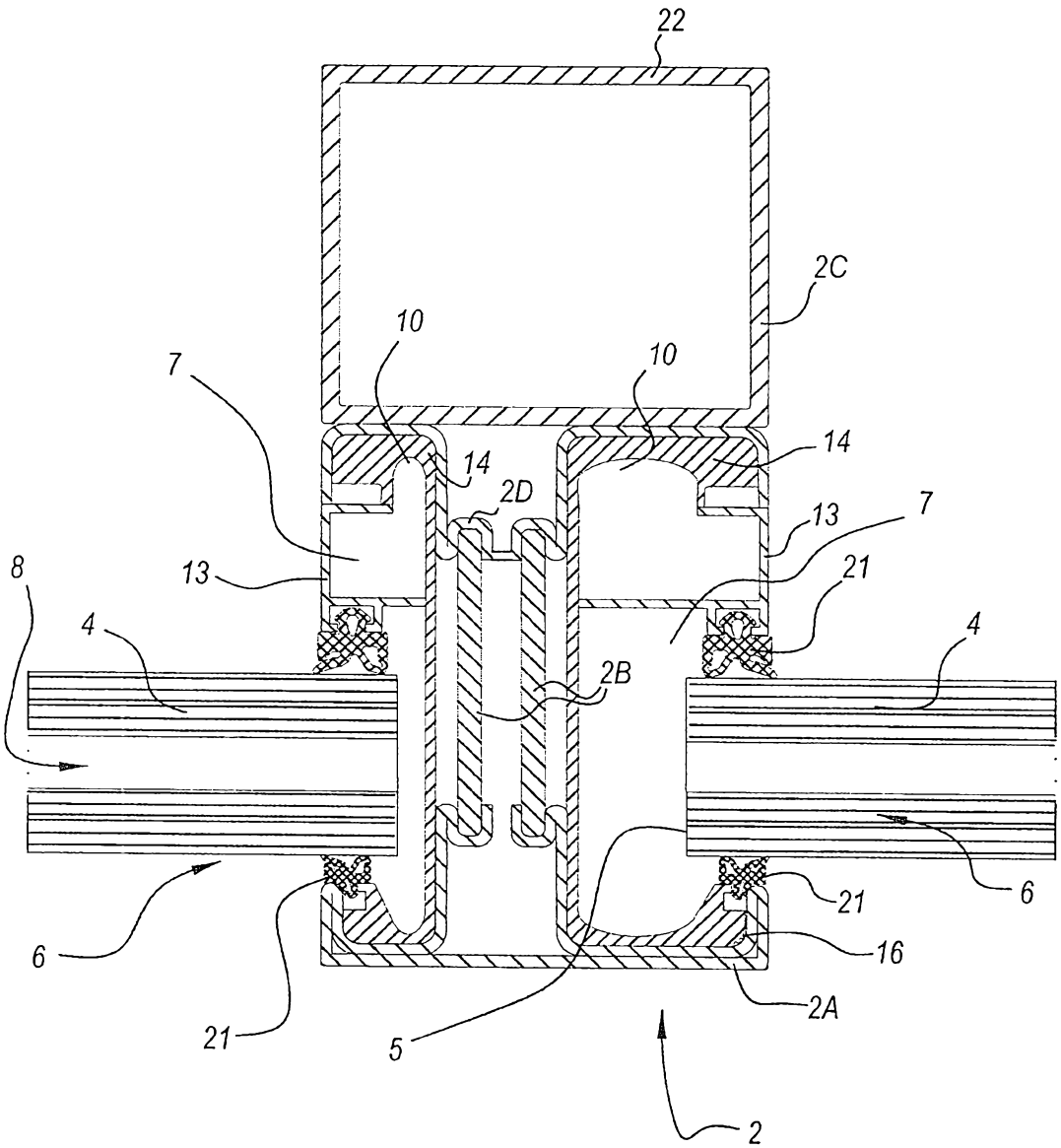

Fig. 9

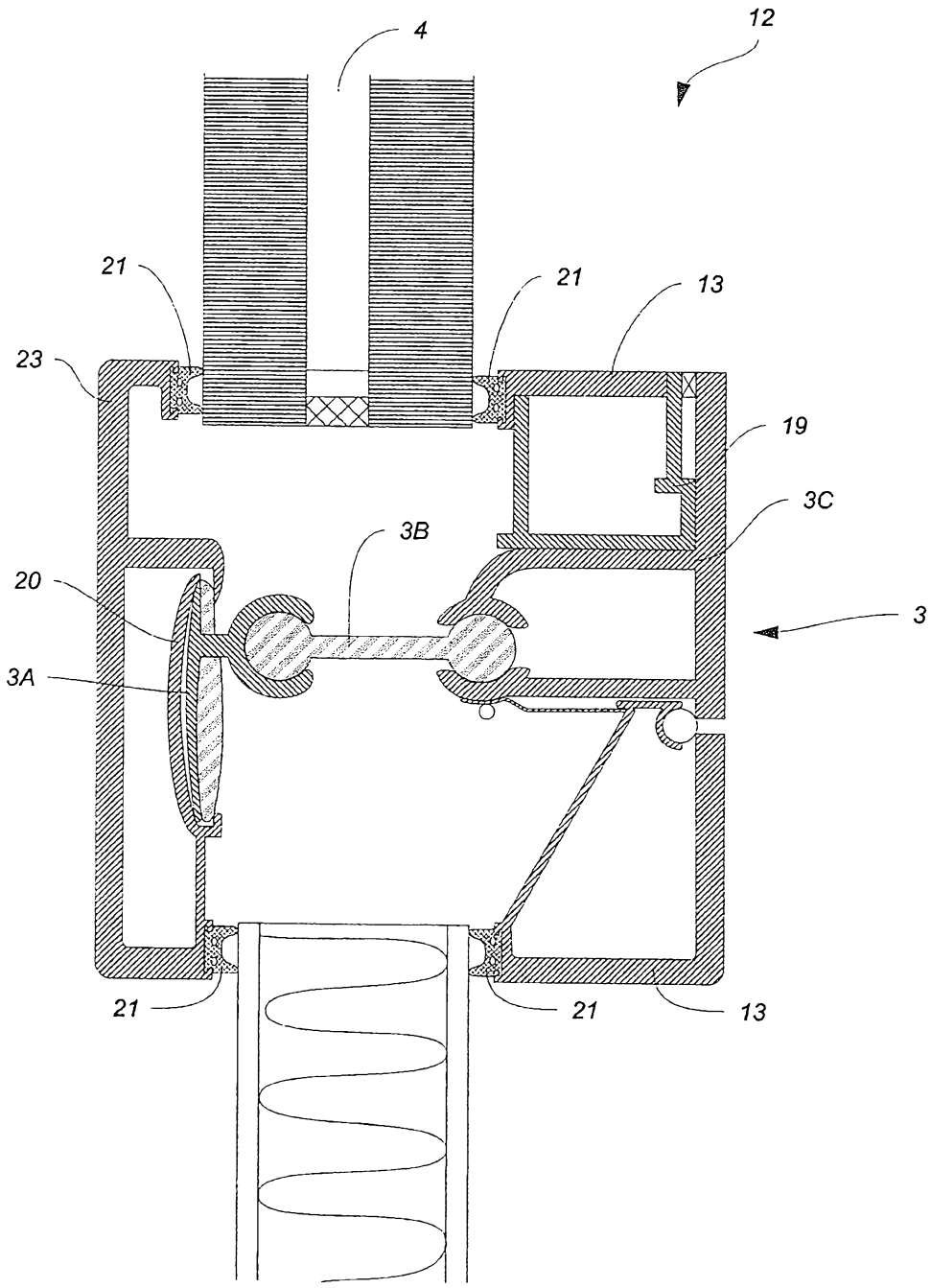

Fig. 10

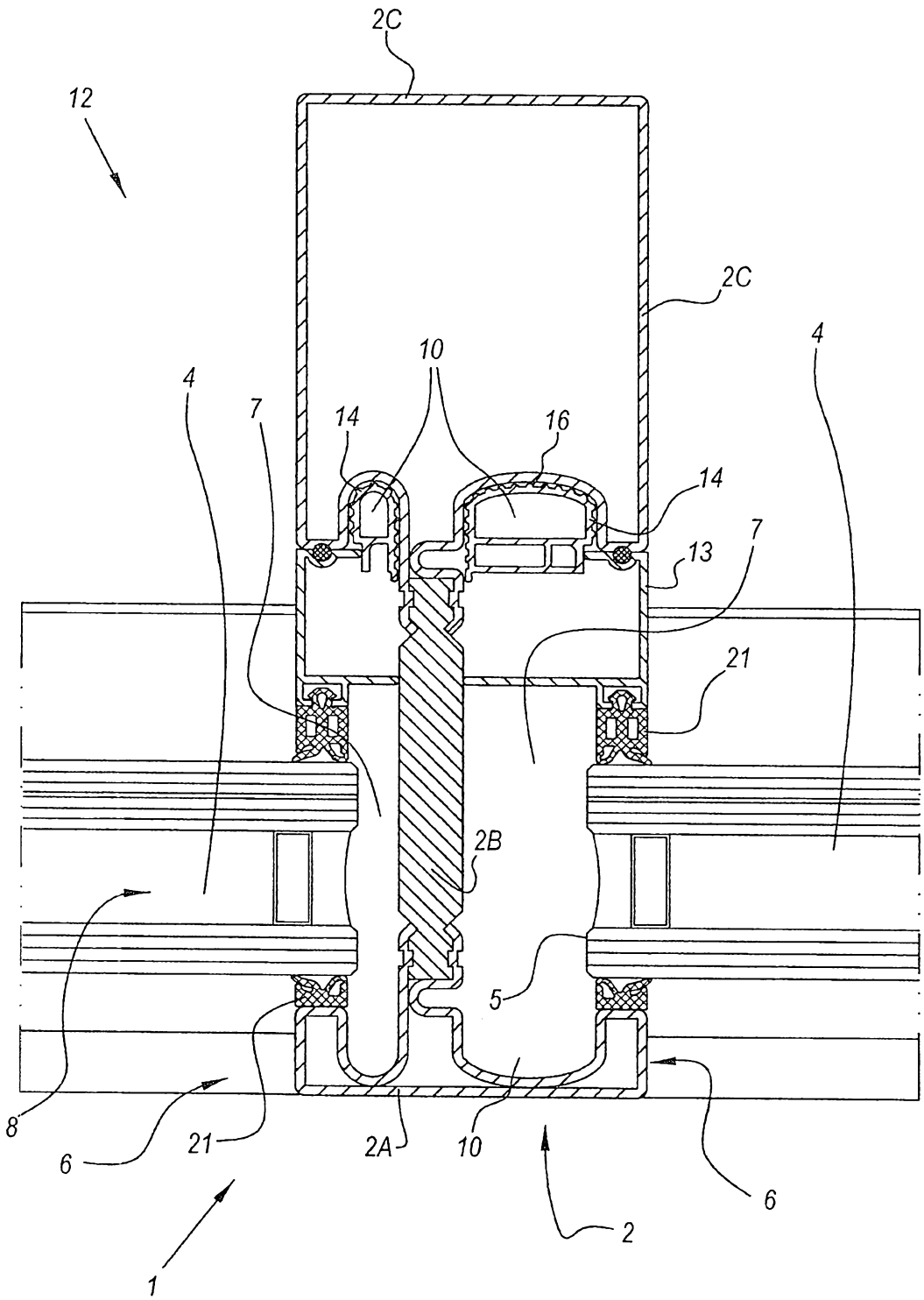

Fig. 11

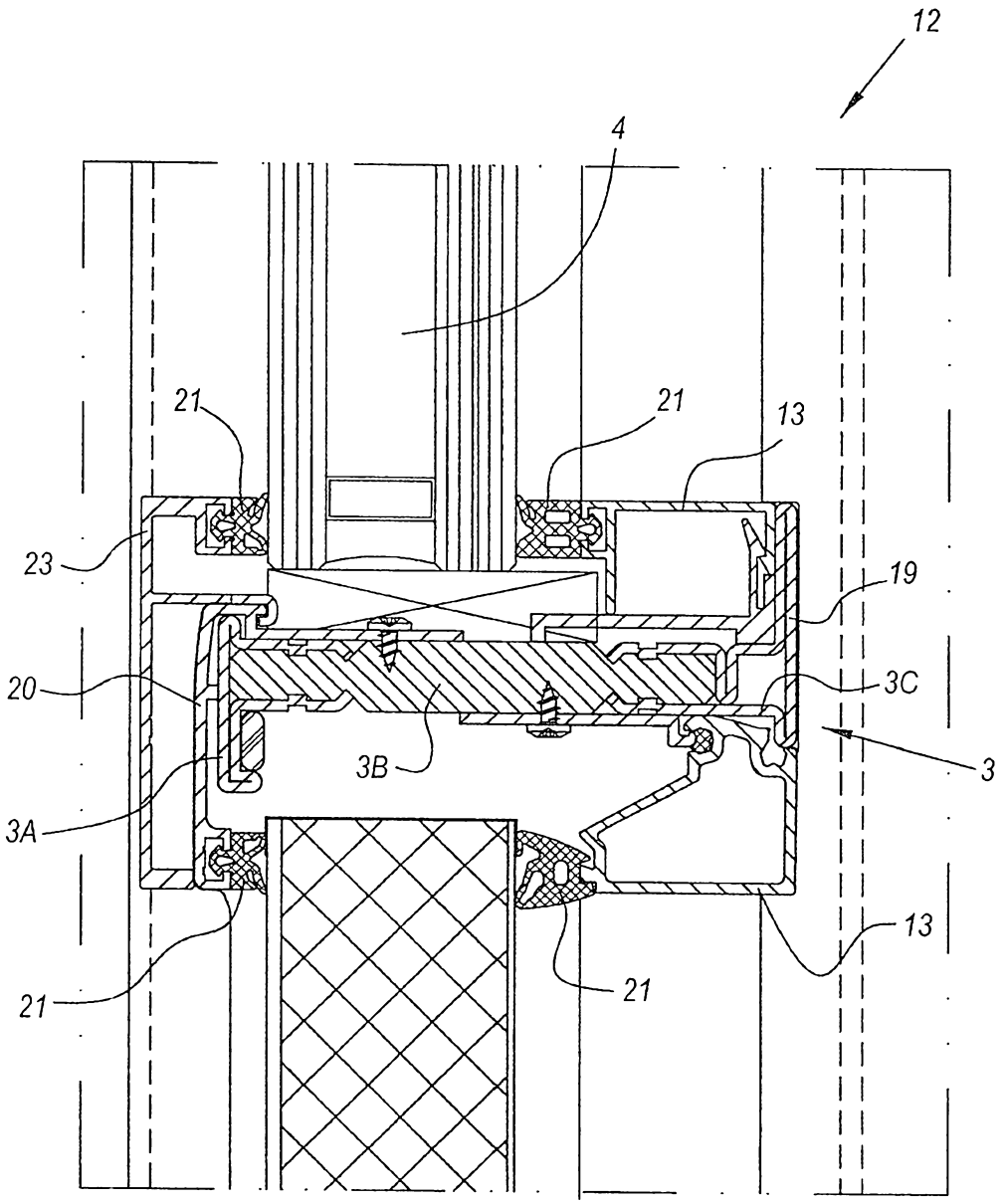

Fig. 12