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(54) **A VERTICALLY FOLDABLE DOOR**

(57) A vertically foldable door (20), said door comprising two foldable door leaves (22, 24) arranged in parallel and at a distance from each other and thereby forming an interspace (26) between the two door leaves (22, 24). The door leaves are made of a flexible material. The door (20) is configured to be lifted in a lifting operation during which the door leaves (22, 24) are folded and to

be lowered in a lowering operation during which the door leaves are unfolded. The door comprises an inwards folding prevention device (1) arranged in the interspace (26) between the two door leaves (22, 24), such that inwards folding into the interspace (26) of at least a part of at least one of the door leaves (22, 24) is prevented during the lifting operation.

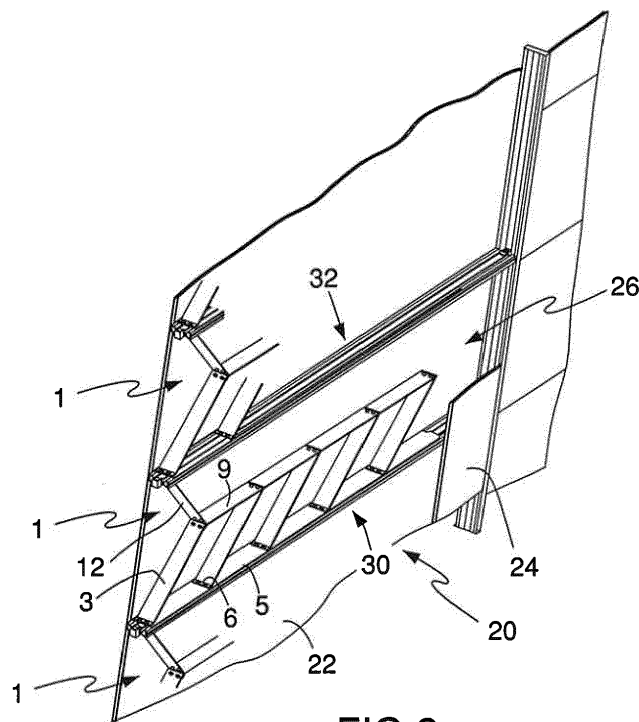


FIG.2

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Description

Technical field of the invention

[0001] The present invention relates to a vertically foldable door of the type having two parallel foldable door leaves arranged at a distance from each other and which door leaves are made of a flexible material. The door can be lifted up in a lifting operation during which the door is vertically folded and it can be lowered in a lowering operation during which the door is vertically unfolded.

Background

[0002] There exist many types of door systems for closing larger openings in building, such as warehouses, supermarkets and industrial halls. Some of these door systems make use of a curtain type of door made of a flexible material, and which door can be lifted up by means of a lifting device in order to expose the opening, and then lowered down again in order to close the opening. One type of such a door made of a flexible material is a door that is vertically foldable when lifted up. The folds may in principle fall on either side of the vertical axis of the door, i.e. towards the inside or towards the outside of the door. It is also known to have such a vertically foldable door that comprises two parallel door leaves that are secured to common elongated support members at their respective bottom and top. The two door leaves are lifted up simultaneously by means of a lifting device that lifts the bottom support member. The door leaves are also provided with intermediate support members, located at regular intervals between the top support member and the bottom support member and connected to the door leaves. When the bottom member is lifted up, the door leaf sections that located between the support members are successively folded as the bottom member is lifted upwards. In that case the two door leaves should fold towards the respective outside of the door.

[0003] The intermediate support members also have the function of transferring wind load to vertical guides connected to the ground, either as self-supported guides or mounted in the door frame of the door opening. This may be achieved since the support members are provided with protruding elements at their ends, which extend into vertical slots in said vertical guides. However, if the wind is strong it may occur that the wind succeeds in pushing in a section of door leaf between two intermediate support members into the interior of the door, i.e. into the interspace between the door leaves. This causes several problems such as the door not being able to fold properly, risk of damage to the door leaves and in particular the fabric etc.

Summary of the invention

[0004] An object of the present invention is to propose a vertically foldable door that has improved ability to with-

stand strong winds.

[0005] Accordingly is defined a vertically foldable door, said door comprising two foldable door leaves arranged in parallel and at a distance from each other and thereby forming an interspace between the two door leaves, and which door leaves are made of a flexible material, and the door being configured to be lifted in a lifting operation during which the door leaves are folded and to be lowered in a lowering operation during which the door leaves are unfolded, wherein the door comprises an inwards folding prevention device arranged in the interspace between the two door leaves, such that inwards folding into the interspace of at least a part of at least one of the door leaves is prevented during the lifting operation. By providing a vertically foldable door with an inwards folding prevention device in the interspace between the door leaves is obtained the advantage that the door leaves will fold outwards as desired even when subjected to strong winds or other forces exerted from the outside. In doing so, the risk for the door leaves to be damaged if folded inwards will be avoided, and the risk of malfunctioning of the door due to sections of door leaves being stuck between the door leaves, or also stuck between horizontal support members, will be reduced.

[0006] According to one feature, the inwards folding prevention device may comprise a plurality of ribs arranged in parallel with each other and connected to each other by a first connection arrangement and by a second connection arrangement, and of which ribs at least one rib is connected to at least one door leaf, which ribs are arranged to assume a horizontal position when the door leaves are in a folded position and to be raised up when the door leaves are unfolded during the lowering operation. By providing a plurality of connected ribs that are arranged to assume a horizontal position when the door leaves are in a folded position, and to be raised up when the door leaves are unfolded during the lowering operation, is obtained the advantage of the inwards folding prevention device being foldable together with the door and thus taking up very little space when the door is folded. When the ribs are raised up from a horizontal position, i.e. towards a vertical direction, is obtained the advantage of a support for the door leaves also to some degree in the vertical direction

[0007] According to another feature, the ribs may be movably connected to the second connection arrangement. The second connection arrangement may for example be some type of string or cord that is movably attached to the ribs, or alternatively a relatively stiff member that is articulately connected to the ribs. The movable connection will assist in making it possible to obtain a compact inwards folding prevention device.

[0008] According to a further feature, the inwards folding prevention device may comprise a lifting means for raising up the ribs when the door leaves are unfolded during the lowering operation. The lifting means will provide a lifting force that assists in raising up the ribs. The lifting means may comprise a lifting member connected

to at least one of the ribs. Such a lifting member may for example be some type of string or cord that is movably attached to a rib or a relatively stiff member that is articulately connected to the rib.

[0009] According to another feature, the vertically foldable door may comprise at least two elongated horizontal support members for supporting the two door leaves at a distance from each other and which support members are connected to the door leaves, and wherein each rib is articulately connected at a lower end thereof to a lower support member of the at least two support members by means of the first connection arrangement. By connecting the ribs to the lower support member is obtained a fixed point for the ribs in a simple manner.

[0010] Further, each rib may be articulately connected at a lower end to a common bottom strip forming part of the first connection arrangement, which common bottom strip is mounted on a lower support member of the at least two support members. By connecting each rib to the same common bottom strip is obtained a simple and economic solution. It will also facilitate the operation of mounting the inwards folding prevention device in the door, since e.g. the ribs may be pre-mounted on the bottom strip.

[0011] According to another feature the ribs can comprise or be manufactured of an insulating material such as plastic or be designed as fiber reinforced composite elements or compound elements in order to avoid cold bridges.

[0012] According to another feature, the lifting member may be connected to an upper support member of the at least two support members. As already mentioned, such a lifting member may for example be some type of string or cord that is movably attached to a rib or a relatively stiff member that is articulately connected to the rib. By connecting the lifting member to the upper support member is obtained the advantage that when the lower support member is lowered down, the lifting member will pull at the ribs and raise them up, in a simple way.

[0013] According to yet another feature, the lifting member may have a length that corresponds to a length of the rib to which it is connected as measured between two points on the rib, of which the first point is the connection point between the rib and the lifting member and the second point is the point where the rib is articulately connected to the lower support member. This provides for a compact and simple design.

[0014] According to a feature of a first embodiment, the ribs may be connected to the second connection arrangement by their respective upper ends. This provides for good stability.

[0015] According to a feature of a second embodiment, the ribs may have a length such that the ribs extend past their respective connection points with the second connection arrangement, in a direction towards a neighbouring upper support member when the door is in an unfolded condition. This has the advantage that this type of longer ribs will, so to speak, "cover" more of the vertical

distance between the lower support member and the upper support member, and make it even more difficult for a door leaf to be pressed into the interspace between the door leaves.

[0016] According to another feature, the at least two elongated horizontal support members may comprise at least two of the following:

- a top support member for supporting a respective upper end of the two door leaves at a distance from each other,
- a bottom support member for supporting a respective bottom end of the two door leaves at a distance from each other, and
- at least one intermediate support member located between the top support member and the bottom support member,

wherein anyone of the top support member and any intermediate support member can form the upper support member, and anyone of any intermediate support member and the bottom support member can form the lower support member.

[0017] Consequently, the door may be provided with an inwards folding prevention device at different locations along the door leaves. The door may also be provided with more than one such device. Accordingly, the vertically foldable door may comprise a plurality of inwards folding prevention devices as defined in any one of the preceding claims, which devices are arranged at different levels in the vertical direction of the door.

[0018] In addition, the inwards folding prevention device may constitute a unit and it may be extended in the horizontal direction of the door by being connected with an extension unit formed of another inwards folding prevention device of the same construction with the exception of not having a lifting member. Thus, if a door is very wide, several inwards folding prevention may be coupled together to cover the desired width.

[0019] Generally, there is also the advantage of the design of the inwards folding prevention device that its main parts may be assembled as a separate unit that may be mounted in an existing door by connecting it to an upper and a lower support member.

[0020] Further features and advantages of the invention will also become apparent from the following detailed description of embodiments.

Brief description of the drawings

[0021] The invention will now be described in more detail, with reference being made to the enclosed schematic drawings illustrating different aspects and embodiments of the invention, given as examples only, and in which:

Fig. 1 illustrates schematically, in a perspective view, the basic details of an inwards folding prevention device for a vertically foldable door, according to the

present invention;

Fig. 2 is a schematical partial illustration of a first embodiment of a vertically foldable door comprising an inwards folding prevention device according to the present invention;

Fig. 3 is a schematical partial illustration of a second embodiment of a vertically foldable door comprising an inwards folding prevention device according to the present invention;

Fig. 4 is a schematical detail view of an inwards folding prevention device in a folded position, of a vertically foldable door according to the present invention; and

Fig. 5 is a schematical side view of a prior art, vertically foldable door in a partly folded position.

[0022] Elements that are the same or represent corresponding or equivalent elements have been given the same reference numbers in the different figures.

Detailed description

[0023] Generally, in a vertical foldable door of the type to which the invention relates, see Fig. 5, the door 40 comprises an elongated, bottom support member 41 (e.g. a beam; not shown in Fig. 2) for supporting a respective bottom end of the two door leaves 42, 44 at a distance from each other, and a corresponding top support member 45 (not shown in Fig. 2) for supporting a respective upper end of the two door leaves at a distance from each other. The bottom support member and the top support member would extend along the entire width of the door. The door leaves 42, 44 would be secured to the bottom support member 41 and the top support member 45 in one way or another. The door leaves are made of a foldable material that allows them to be folded when the door is lifted upwards, which is achieved by lifting the bottom support member 41 to which the lower ends of the door leaves are attached. The foldable material may e.g. be some kind of fabric, a flexible tarpaulin type of material or other flexible material that is suitable depending on where the door is intended to be installed. The door leaves as such are designed to be folded outwards during the lifting operation. Furthermore, in order to stabilize the door 40 and the door leaves 42, 44, a vertically foldable door also usually comprises one or more elongated intermediate support members 46 that are arranged horizontally at intervals between the bottom support member and the top support member. Also these intermediate support members 45 would extend along the entire width of the door, and the respective door leaf 42, 44 would be connected to the sides of the intermediate support members. When the door is lifted upwards, each section 50 of a door leaf that is located between two support members will fold outwards, and this will be done successively as the door is lifted, starting with the lowermost section. A door 40 that has been partly uplifted is shown schematically in Fig. 5, in which the outwards folded door leaf

sections 50 can be seen. This is a type of vertically foldable door that is known from the prior art, and which has already been discussed above.

[0024] In Fig. 1 is schematically illustrated the basic details of an inwards folding prevention device 1 for a vertically foldable door, according to the present invention. The device comprises a plurality of ribs 3 that are arranged in parallel and at a distance from each other. The ribs 3 are connected with each other by means of a first connection arrangement comprising a bottom strip 5. Each rib 3 is articulately connected to the common bottom strip 5 by a lower end of the rib. The rib is articulately connected by means of an articulation 6 such as a hinge device or similar that is secured to the bottom strip 5. Preferably the ribs 3 are secured to the bottom strip 5 at regular intervals. In the illustrated example, the inwards folding prevention device 1 comprises a set of five ribs 3, but any number of ribs can be foreseen, depending on the size of the door. The bottom strip 5 is configured to be mounted on a lower horizontal support member 30 forming part of the door, as will be explained later.

[0025] The inwards folding prevention device 1 further comprises a second connection arrangement 7 for connection of the ribs 3 to each other. In the illustrated example, this second connection arrangement 7 comprises an elongated connection member 9 to which the upper end of each rib 3 is connected. Each rib 3 may e.g. be articulately connected by means of an articulation 8 such as a hinge device or similar that is secured to the connection member 9. The ribs 3 are secured to the connection member 9 with the same intervals as to the bottom strip 5.

[0026] The inwards folding prevention device 1 further comprises a lifting means 11, which in the illustrated example comprises a lifting member 12 of an elongated form. The lifting member 12 is connected at one lower end to one of the ribs 3, namely the first rib in the formed set of ribs, e.g. movably or articulately connected for example by a hinge device. At the other, upper end it is connected, e.g. movably or articulately connected, for example by a hinge device, to a horizontal upper support member 32 forming part of the door, as will be explained later.

[0027] In Fig. 2, is schematically shown an embodiment of a vertically foldable door 20 according to the present invention. The door comprises two foldable door leaves 22, 24 that are arranged in parallel and at a distance from each other. Thereby is formed an interspace 26 between the two door leaves. The door leaves will be referred to as the first door leaf 22 and the second door leaf 24.

[0028] In the embodiment that is schematically shown in Fig. 2, are illustrated intermediate support members in the form of a lower support member 30 and an upper support member 32. Between the two intermediate support members 30, 32, in the interspace 26 between them, is arranged an inwards folding prevention device 1 of the

type that has been described above. The inwards folding prevention device 1 is illustrated in its unfolded position corresponding to an unfolded, lowered and thereby closed door. The intermediate support member 32 forms the upper support member to which the lifting member 12 is articulately or at least movably connected. The intermediate support member 30 forms the lower support member on which the bottom strip 5 is mounted, and preferably secured.

[0029] In Fig. 3 is shown a second embodiment. In this embodiment, the ribs 13 are interconnected at their upper ends by means of the connection member 9. Since Fig. 2 shows the unfolded position of the door, it can be seen that the ribs only extend up to approximately half the distance between the support members 30, 32. In the embodiment in Fig. 3, the ribs 13 have been extended past the connection point with the connection member 9, and can be seen to extend over almost the entire distance between the two support members 30, 32. The ribs 13 are interconnected by the connection member 9 at about midpoint of the respective rib.

[0030] In Figs. 2 and 3, the door is illustrated in a lowered, unfolded position, and with the inwards folding prevention device likewise in an unfolded position, in order to prevent that sideways forces from e.g. hard winds will press sections of one of the door leaves into the interspace of the door. When the door is opened, i.e. when the door is lifted up, this is made by lifting the bottom support member of the door, and successively the intermediate members are lifted upwards, one after the other, and successively stacked one on top of the other. Thus the lower support member 30, shown in Figs. 2 and 3, will be lifted upwards, or rather pushed upwards by the underlying support member. The ribs 3, 13 will then start to fold down as the lower support member 30 is moved upwards, until they are lying flat against the lower support member 30, and also flat against the upper support member 32 which will then be forced to move upwards. In Fig. 4 are illustrated details of the door 20 in a folded position. It can be seen how two support members 30, 32 have been stacked one on top of the other with ribs 3 folded down between them. In this figure is also seen the folded lifting member 12, the hinge 6 where the rib 3 is connected to the bottom strip 5, as well as the bottom strip 5.

[0031] In order to obtain maximum compactness in the folded down position, it is advantageous if the distance between the attachment points on the bottom strip 5 of two neighbouring ribs 3 is at least as long as the length of the rib 3 that is to be folded down in that space, as shown in Fig. 2.

[0032] When the door is unfolded, the ribs 3, 13 will successively become upraised as the lower support member 30 is moved away from the upper support member 32, due to the pulling force from the lifting member 12 being attached to the upper support member 32.

[0033] In the illustrated examples, all of the ribs 3, 13, bottom strip 5 and connection member 9 are made of a relatively stiff material, such that they can all be lifted up

as one unit and without being deformed, when a lifting force is applied via the lifting member 12 when the door leaves are unfolded. The ribs 3, 13 are generally flat strips of an elongated form and may have a certain width, which helps to provide stiffness. They are preferably identical, and stackable. The ribs 3, 13 may have a width that corresponds to the width of the support members 30, 32 in order to fill out the space between the door leaves 22, 23 as much as possible and this will also enhance their function of preventing inwards folding of parts of the door leaves. The lifting member 12 preferably has the same shape and width as the ribs 3, 13, but may be of a slightly flexible material. The lifting member 12 has a length that corresponds to the length of the rib 3, 13 to which it is connected, measured between two points, of which the first point is the connection point between the rib 3, 13 and the lifting member 12 and the second point is the point where the rib 3, 13 is articulately connected to the lower support member 30.

[0034] As an alternative, the lifting member 12 may for example be some type of string or cord that is simply movably attached to a rib and to the upper support member. It should also be mentioned that the connection member 9, which has been illustrated in the examples as being similar to the ribs and to which the ribs have been described as being articulately connected, could also alternatively be configured as some type of string or cord that is movably attached to a ribs.

[0035] In the given examples and embodiments, the inwards folding prevention device 1 has been described as being mounted between and connected to two intermediate support members. However, the device may just as well be mounted between a bottom support member of the door and the following intermediate member, or between a top support member and the following intermediate support member. Thus, anyone of the top support member and any intermediate support member can form the upper support member, and anyone of any intermediate support member and the bottom support member can form the lower support member. Moreover, it can be foreseen that a door can be provided with a plurality of inwards folding prevention devices arranged at different levels in the vertical direction of the door. This is also schematically shown in Figs. 2 and 3. In the example in these figures can be seen how the upper support member 32 actually forms a lower support member for the next inwards folding prevention device 1. It can also be foreseen that inwards folding prevention devices 1 are located at intervals in the vertical direction of the door, such that the space formed between two intermediate members on the level immediately above one inwards folding prevention device does not include any inwards folding prevention device. Naturally, there can be more than one such empty level.

[0036] Furthermore, it is foreseen that the described inwards folding prevention device 1 may constitute one unit that can be extended in the horizontal direction of the door 20 by connecting it with another inward folding

prevention device of the same construction forming an extension unit. This extension unit would not have to have any lifting member. Naturally, more than one extension unit may be connected in a row.

[0037] The invention shall not be considered limited to the illustrated embodiments, but can be modified and altered in many ways, as realised by a person skilled in the art, without departing from the scope defined in the appended claims.

Claims

1. A vertically foldable door (20), said door comprising two foldable door leaves (22, 24) arranged in parallel and at a distance from each other and thereby forming an interspace (26) between the two door leaves (22, 24), and which door leaves are made of a flexible material, and the door (20) being configured to be lifted in a lifting operation during which the door leaves (22, 24) are folded and to be lowered in a lowering operation during which the door leaves are unfolded, wherein the door comprises an inwards folding prevention device (1) arranged in the interspace (26) between the two door leaves (22, 24), such that inwards folding into the interspace (26) of at least a part of at least one of the door leaves (22, 24) is prevented during the lifting operation.
2. The vertically foldable door according to claim 1, wherein the inwards folding prevention device (1) comprises a plurality of ribs (3) arranged in parallel with each other and connected to each other by a first connection arrangement (5) and by a second connection arrangement (7), and of which ribs (3) at least one rib is connected to at least one door leaf (22, 24), which ribs (3) are arranged to assume a horizontal position when the door leaves (22, 24) are in a folded position and to be raised up when the door leaves (22, 24) are unfolded during the lowering operation.
3. The vertically foldable door according to claim 2, wherein the ribs (3) are movably connected to the second connection arrangement (7).
4. The vertically foldable door according to any one of claims 2-3, wherein the inwards folding prevention device (1) comprises a lifting means (11) for raising up the ribs when the door leaves are unfolded during the lowering operation.
5. The vertically foldable door according to claim 4, wherein the lifting means (11) comprises a lifting member (12) connected to at least one of the ribs (3).
6. The vertically foldable door according to any one of claims 4-5, wherein it comprises at least two elongated horizontal support members (30, 32) for supporting the two door leaves (22, 24) at a distance from each other and which support members (30, 32) are connected to the door leaves, and wherein each rib (3) is articulately connected at a lower end thereof to a lower support member (30) of the at least two support members (30, 32) by means of the first connection arrangement (5).

7. The vertically foldable door according to claim 6, wherein each rib (3) is articulately connected at a lower end to a common bottom strip (5) forming part of the first connection arrangement, which common bottom strip is mounted on a lower support member (30) of the at least two support members (30, 32).
8. The vertically foldable door according to any one of claims 6-7, wherein the lifting member (12) is connected to an upper support member (32) of the at least two support members (30, 32).
9. The vertically foldable door according to claim 8, wherein the lifting member (12) has a length that corresponds to a length of the rib (3) to which it is connected as measured between two points on the rib, of which the first point is the connection point between the rib (3) and the lifting member (12) and the second point is the point where the rib (3) is articulately connected to the lower support member (30).
10. The vertically foldable door according to any one of claims 6-9, wherein the ribs (3) are connected to the second connection arrangement (7) by their respective upper ends.
11. The vertically foldable door according to any one of claims 6-9, wherein the ribs (3) have a length such that the ribs extend past their respective connection points with the second connection arrangement (7), in a direction towards a neighbouring upper support member (32) when the door is in an unfolded condition.
12. The vertically foldable door according to any one of claims 6-11, wherein the at least two elongated horizontal support members (30, 32) comprise at least two of the following:
 - a top support member for supporting a respective upper end of the two door leaves (22, 24) at a distance from each other,
 - a bottom support member for supporting a respective bottom end of the two door leaves (22, 24) at a distance from each other, and
 - at least one intermediate support member located between the top support member and the bottom support member,

wherein anyone of the top support member and any intermediate support member can form the upper support member (32), and anyone of any intermediate support member and the bottom support member can form the lower support member (30). 5

13. The vertically foldable door according to any one of the preceding claims, wherein it comprises a plurality of inwards folding prevention devices (1) as defined in any one of the preceding claims, which devices are arranged at different levels in the vertical direction of the door. 10

14. The vertically foldable door according to any one of the preceding claims, wherein the inwards folding prevention device (1) constitutes a unit and wherein it is extended in the horizontal direction of the door by being connected with an extension unit formed of another inwards folding prevention device of the same construction with the exception of not having a lifting member. 15
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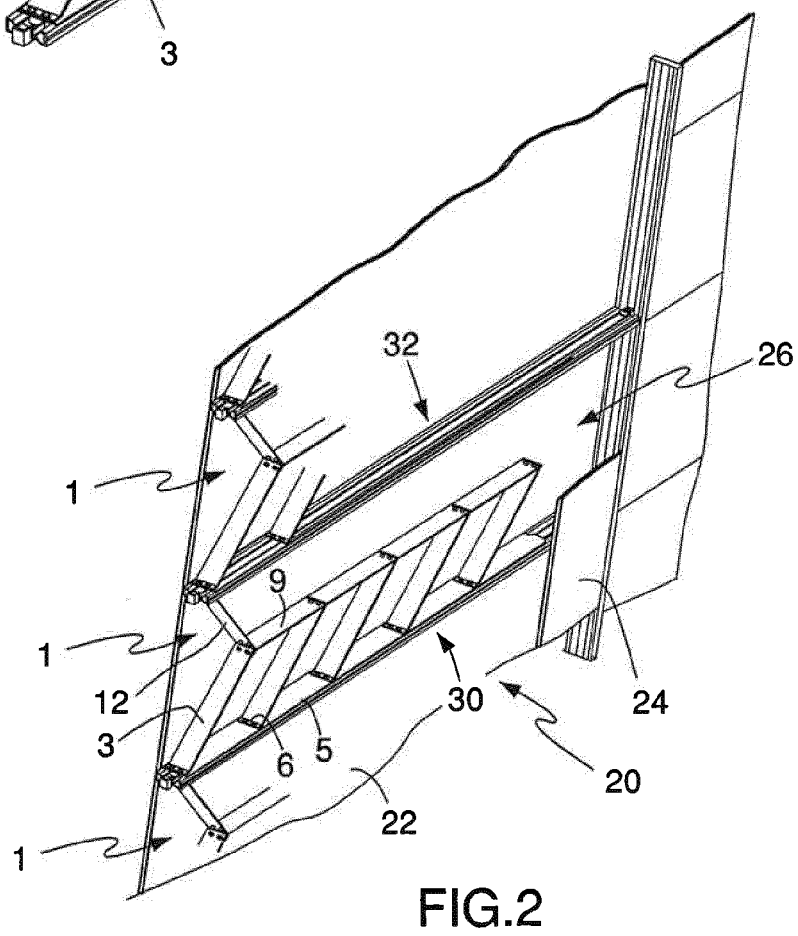
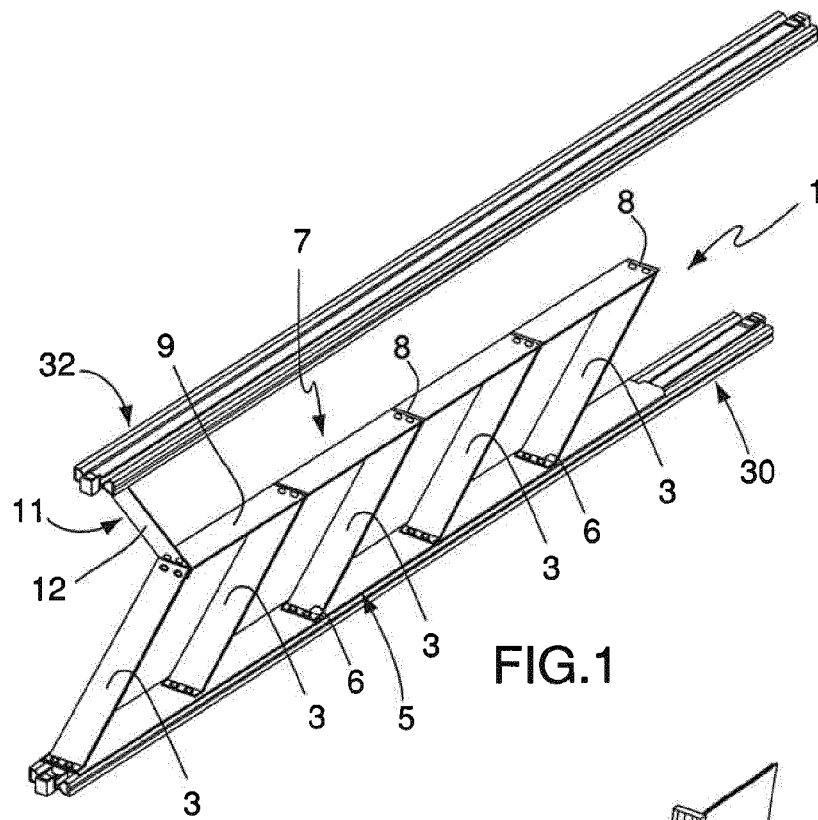
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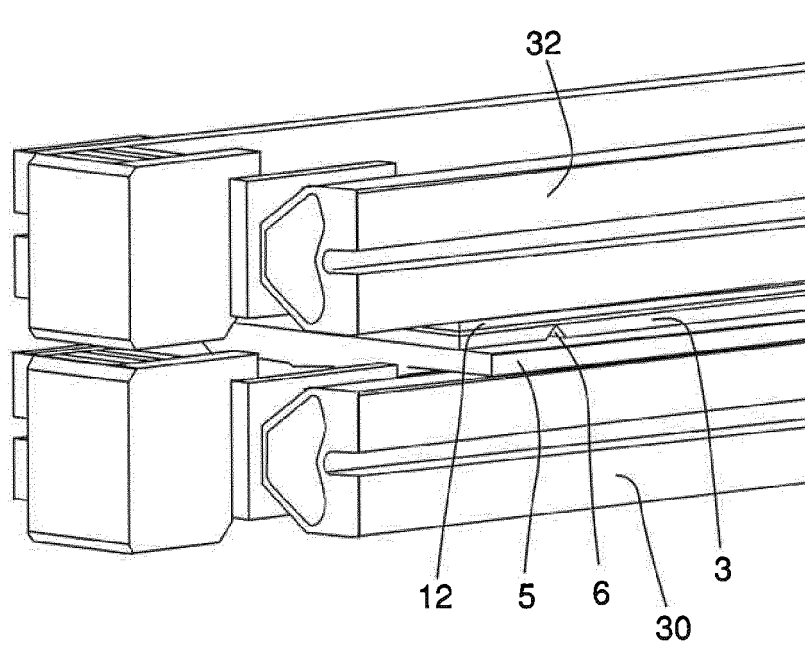
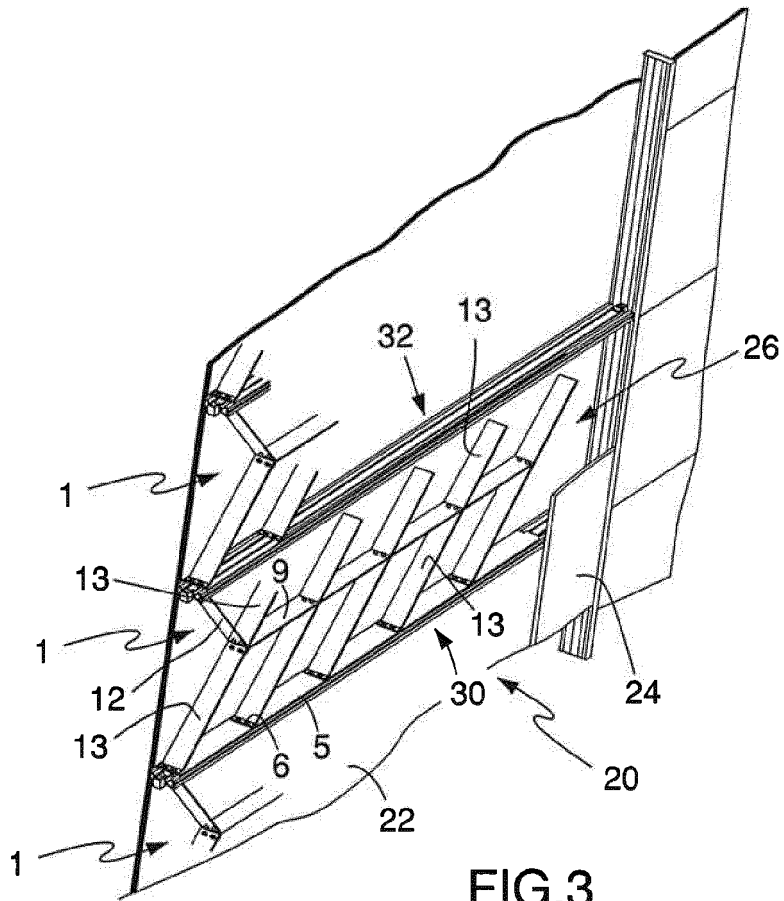
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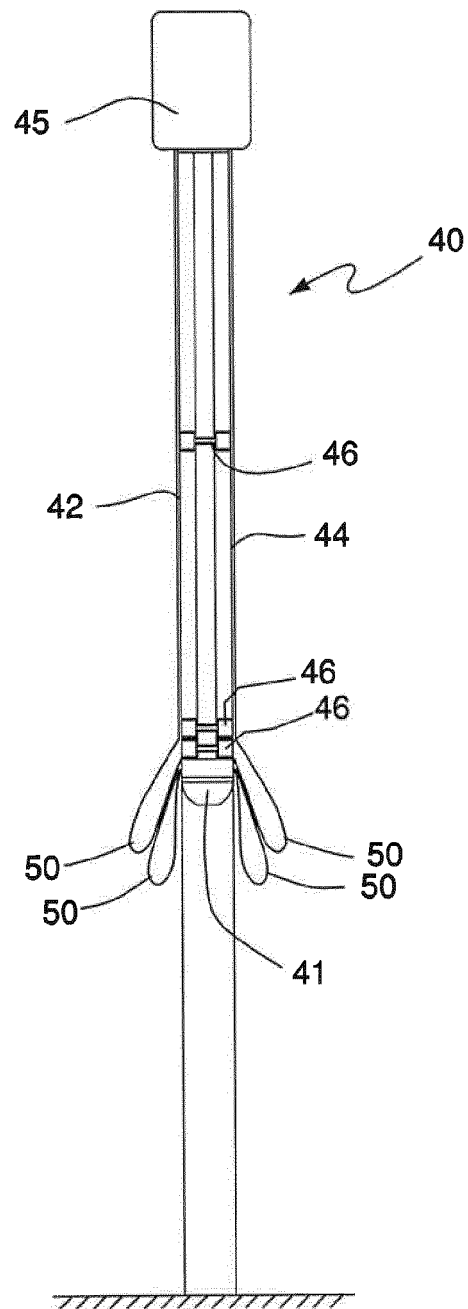


FIG.5



EUROPEAN SEARCH REPORT

Application Number
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DOCUMENTS CONSIDERED TO BE RELEVANT			
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Place of search The Hague		Date of completion of the search 5 April 2016	Examiner López-García, G
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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**ANNEX TO THE EUROPEAN SEARCH REPORT
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