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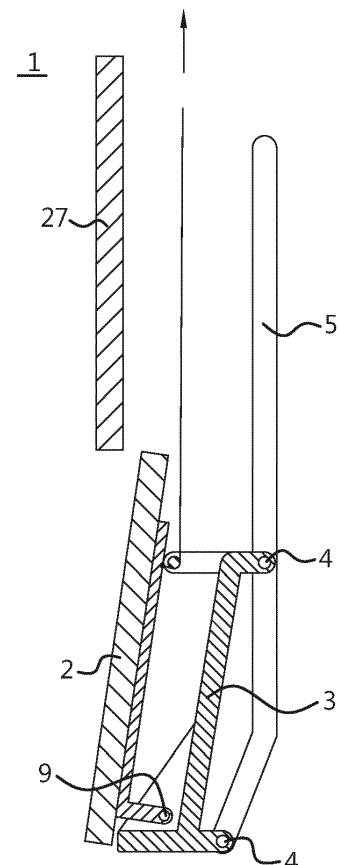
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(54) **VERTICAL SLIDING DOOR AND SUSPENSION SYSTEM**

(57) In a first aspect, the invention provides a vertical sliding door with a door panel hinged to a movable frame with guide means for guiding along a guide track, the door panel further suspended from a pulling belt having an attachment end and an upward pulling end. In particular, the attachment end of the pulling belt runs at least between the door panel and the frame, wherein it is curved around a belt guide on the door panel or frame, to pull the door panel from the pulling end towards the frame in a hinged fashion. In further aspects the invention provides a vertical sliding door, a suspension system for vertical sliding doors, a kit for mounting vertical sliding doors, and methods for opening and closing sliding doors.

Fig. 5B



Description

TECHNICAL FIELD

[0001] The invention is directed to vertical sliding doors. Among other things, the invention provides a suspension system for vertical sliding doors and door panels.

PRIOR ART

[0002] Vertical sliding doors are known as such. Sliding doors with vertically slidable door panels are used in cabinets, for example.

[0003] US 2010 072 868 describes an automated cabinet door system. The system provides several movable panels, which mutually overlap in steps. The side edges of the panels run along vertical tracks. The panels are individually slidable in vertical direction. In this way the cabinet can be opened (maximum overlap) and closed (minimum overlap). There is always a certain amount of overlap between the panels. The system therefore takes up quite a lot of space. It also does not look very refined.

[0004] WO 2005 054 613 also describes a vertical sliding door having two door panels. The panels are fitted laterally on wheels in guide rails. Opening and closing is done manually by sliding the door panels vertically. In the closed position, the panels form one closing plane. During opening, the lower door panel is first hinged in front of the upper door panel by forward pivoting of the guide rails. However, the mechanics are quite complex. The system therefore requires very professional installation.

[0005] Finally, EP 2 821 576 discloses another automated cabinet with a system for moving the cabinet panels up and down. In closed position, the panels together form one closing plane. However, the closing mechanism requires that the bottom and top edge portions of the panels be chamfered. Such panels have a higher cost price.

[0006] A number of important properties of sliding doors are the simplicity, the production cost, the installation cost, the ease of maintenance, the clean / sleek appearance, the durability, the robustness, the ease of use and the closing capacity.

[0007] Apart from the above, US 2008 023 159 discloses another vertical sectional door. The door panels are mutually linked via hinges. Wheels are also mounted on the hinges. Lateral tracks guide the panels and wheels in their upward and downward movement. The panels are raised and lowered together via a pull cable attached to the bottom panel. However, the present invention is rather directed to vertical sliding doors, with panels that can slide past each other. Especially in the open position, such sliding doors take on a much more compact configuration.

[0008] The present invention contemplates an improved sliding door, and/or an improved suspension system for the sliding door panels. The invention also tries

to provide solutions to the above problems.

SUMMARY OF THE INVENTION

[0009] To this end, the invention provides a vertical sliding door according to claim 1. At least one door panel is hingedly provided on a corresponding movable frame with guide means for upward and downward guidance along a guide track. The door panel is further suspended from a pulling belt with an attachment end and an upward pulling end. In particular, the attachment end runs at least between the door panel and the frame, curving around a belt guide on the door panel or frame. This allows the door panel to be pulled towards the frame from the pulling end, in a mutually hinged manner. Preferably this is accompanied by the rolling, sliding or shifting of the attachment end around the belt guide.

[0010] It is particularly advantageous that the movement of the door panel between its open and closed positions can be completely controlled from the pulling end. After all, the tension force in the pulling end is guided around the belt guide and can therefore also act as a moment of force between the frame and the door panel, with respect to their mutual pivot axis. The tension force therefore has a double effect. Firstly, such a tension force creates a tractive force between the frame and the door panel, in the rearward direction. Thus, a moment of force that makes the door panel pivot towards the frame. Secondly, such a tension force creates an upward tractive force on the frame and the door panel. Thus, a tractive force that pulls the whole up.

[0011] In a particularly preferred embodiment, the door panel at rest (when the pulling belt is relaxed) always assumes its closed position, hinged away from the frame. Preferably, this is done automatically or passively. Optionally, a compression spring is provided for this purpose (see, for example, claim 2). Optionally, this is through the action of gravity on a well-chosen design (see Fig. 5A-C for illustration). The invention is not limited to any of these.

[0012] In a preferred embodiment, the door panel first pivots out of the closing plane when pulled up, and then moves upward. When lowering, on the other hand, the door panel will preferably first move downward, and then pivot back into the closing plane. The relevant thresholds for the tension force in the pulling belt are set accordingly by a well-chosen design. Reference is made to claims 4, 14 and 15. Incidentally, this mechanism is compatible with rectangular panel edges.

[0013] In further aspects, the invention also provides a cabinet according to claim 10, a suspension system according to claim 11, a mounting kit according to claim 13, and methods for opening and closing sliding doors, according to claims 14 and 15.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014]

Figures 1A-C illustrate, schematically, the opening and closing of a vertical sliding door according to a possible embodiment.

Figures 2A-F show vertical cross-sections of a cabinet provided with a sliding door with two movable door panels, according to a possible embodiment.

Figures 3A-F show exploded perspective drawings of the same cabinet, according to a possible embodiment.

Figures 4A-B show a perspective view and a vertical section of another cabinet according to an alternative embodiment.

Figures 5A-C illustrate, schematically, a vertical sliding door according to an alternative embodiment without a spring mechanism.

DETAILED DESCRIPTION OF THE INVENTION

[0015] The invention relates to a vertical sliding door, a cabinet, a suspension system, a mounting kit as well as a method for opening and closing vertical sliding doors.

[0016] Unless otherwise defined, all terms used in the description of the invention, including technical and scientific terms, have the meaning as commonly understood by a person skilled in the art to which the invention pertains. For a better understanding of the description of the invention, the following terms are explained explicitly.

[0017] In this document, 'a' and 'the' refer to both the singular and the plural, unless the context presupposes otherwise. For example, 'a segment' means one or more segments.

[0018] When the term 'around' or 'about' is used in this document with a measurable quantity, a parameter, a duration or moment, and the like, then variations are meant of approx. 20% or less, preferably approx. 10% or less, more preferably approx. 5% or less, even more preferably approx. 1% or less, and even more preferably approx. 0.1% or less than and of the quoted value, insofar as such variations are applicable in the described invention. However, it must be understood that the value of a quantity used where the term 'about' or 'around' is used, is itself specifically disclosed.

[0019] The terms 'comprise', 'comprising', 'consist of', 'consisting of', 'provided with', 'have', 'having', 'include', 'including', 'contain', 'containing' are synonyms and are inclusive or open terms that indicate the presence of what follows, and which do not exclude or prevent the presence of other components, characteristics, elements, members, steps, as known from or disclosed in the prior art.

[0020] Quoting numerical intervals by endpoints comprises all integers, fractions and/or real numbers between the endpoints, these endpoints included.

[0021] In a first aspect, the invention relates to a vertical sliding door having at least one door panel which is configurable between a raised open position and a lowered closed position, which door panel is hinged to a movable frame with guide means for upward and downward guidance along a guide track, and wherein the door panel is further suspended from a pulling belt having an attachment end and an upward pulling end adapted to raise and lower the door panel. In particular, the attachment end runs at least between the door panel and the frame, wherein the attachment end is curved around a belt guide on the door panel or frame to pull the door panel from the pulling end towards the frame in a hinged fashion.

[0022] One possibility is that the pulling belt is attached to the door panel and extends from the door panel to around a belt guide on the frame. Another possibility is that the pulling belt is attached to the frame and extends from the frame to around a belt guide on the door panel. Preferably there is at least one belt guide (optionally several, see below). More preferably, the pulling belt is curved upwardly around said belt guide, wherefrom the pulling belt forms an upward pulling end.

[0023] Preferably, the attachment end extends at least between its attachment point (e.g. on the door panel or the frame) and a belt guide (e.g. on the frame or door panel respectively). Optionally, it is the same belt guide as above, alternatively the pulling belt is guided around several belt guides. The attachment point can be provided directly on the door panel, or indirectly on a panel support on which the panel is mounted. Pulling upwards on the pulling end now causes a tension force in the pulling belt, so also in the attachment end and around the belt guide(s). This tension force causes a tractive force that tends to pull the attachment point towards the latter belt guide, and thus to pivot the door panel and the frame towards each other.

[0024] The term 'pulling belt', as used herein, is to be broadly interpreted as a flexible lifting means. Pulling belt can refer, inter alia, to a belt, wire, band, cord, cable, steel cable, chain or line. The invention is not limited to any of these. Such a flexible lifting means has the advantage that it is easy to roll up. Optionally, it is a flat or band-shaped pulling belt. The belt guide is suitable for guiding the pulling belt around it. The belt guide therefore functions as a pulley. That is, the belt guide gives direction to tension forces in the pulling belt. Optionally, the belt guide provides a (curved) sliding surface or a rolling surface. The pulling belt is bent/wrapped around the belt guide. The pulling belt may slip or slide with respect to the belt guide. The sliding door can comprise one or more door panels. In the closed position the panels preferably form one closing plane. It is more preferably a vertical closing plane. Preferably there is at least one further overlying panel. Optionally, it is a fixed panel. Preferably, the door panel is brought up to past the overlying panel when opened. Optionally, the panels will at least partially overlap in the open position. In one possible embodiment, the door panel is in the raised open position behind the

overlying panel. The suspension system (with the fittings, guide tracks, etc.) is then in closed position behind the closed sliding door.

[0025] In its upward-downward movement, the door panel is guided by its frame along guide tracks. Guidance is upward-downward, along a vertical guiding plane (e.g. parallel to the side walls of the cabinet). The pivoting is about a horizontal pivot axis that is perpendicular to the guiding plane, horizontal in the door opening. The belt guide preferably also extends in the direction of the pivot axis. Preferably, the pivotal range of the door panel is limited to less than 90° in the installed state, preferably less than 60°, more preferably 30° or less.

[0026] Preferably, both the attachment point and the (first) belt guide are located higher than the pivot axis. A tension force in the pulling belt will then tend to pull the door panel towards the frame, wherein an upper edge part of the door panel is moved out of the closing plane, and preferably rearwardly out of the closing plane. Any overlying panel will then no longer be in the way of moving the door panel upwards.

[0027] The upward movement itself takes place by guiding the frame along a guide track. It can be a guide groove, a guide rail or a guide rib. The invention is not limited to any of these. The guide track is preferably not part of the sliding door itself, but rather of the structure (e.g. a cabinet) in which the sliding door is provided. Preferably, the guide track comprises at least one oblique forward segment to guide the bottom edge of the door panel in and out of the closing plane. Preferably said oblique forward segment comprises a lower end on which the frame can rest in the closed position. The pivot axis here provides a rigid support for the lower edge part of the door panel. Optionally, the guide track further comprises a vertical upward segment to guide the door panel upward to behind an overlying panel.

[0028] Preferably, it is a simple, linear guide groove of substantially constant width and depth along its course.

[0029] Optionally, the sliding door is fully automatically controlled, with a motor for raising and lowering the pulling end, and with a control for controlling the motor.

[0030] In a further or alternative embodiment, the sliding door is further provided with a spring mechanism that is prestressed to pivot the door panel away from the frame. As an advantage, the door panel automatically assumes its closing position at rest. Optionally, it is a compression spring arranged between the door panel and the frame. Optionally, the compression spring is arranged at a higher position than the pivot axis. That is, suitable for moving the upper edge part forwards and backwards. It is preferably a conical compression spring. When compressed, conical compression springs take up less space. The door panel can thus be stored more compactly. Alternatively, however, the spring mechanism includes a torsion spring, a leaf spring or a tension spring. The invention is not limited to any of these.

[0031] In a further or alternative embodiment, the attachment end is attached to the door panel, and wherein

the belt guide is formed by the frame. The belt guide therefore does not move with the door panel, so that the pulling end can always be pulled from more or less the same direction.

[0032] In a further or alternative embodiment, the sliding door has a design

- wherein pulling the door panel toward the frame requires a first tension force in the pulling belt, and
- wherein the pulling up of the door panel and the frame requires a second tension force in the pulling belt, higher than the first.

The door panel is therefore first automatically moved out of the closing plane and only then raised. This can be compatible with a rectangular upper edge part for the door panel.

[0033] In a further or alternative embodiment, the door panel is hingedly provided on the frame, about a pivot axis located along a lower edge part of the door panel. Preferably, the (first) belt guide and the attachment point are located higher than this pivot axis. The door panel will then hinge towards the frame when the pulling belt is tightened. The pivot axis provides a solid positioning of the lower edge part in the closing plane (in the closed position).

[0034] In a further or alternative embodiment, the door panel is provided on an upper edge part with a support element which, in the closed position, bears against a further, upper door panel. The support element limits the pivotal range of the door panel. It also ensures a solid positioning of the upper edge part in the closing plane (in the closed position). One or more such support elements can be provided upwards or sideways.

[0035] In a further or alternative embodiment, the upward pulling end is coupled to a catch hook arranged in a path of a further, underlying door panel. The catch hook is therefore engaged when pulling up the further, underlying door panel. Optionally, the catch hook is mounted on the frame and/or on the door panel, sliding upwards and downwards, over a limited range. Thus, when sliding upwards, the pulling end is pulled up, resulting in the inward hinging of the door panel (as described above). As soon as the door panel reaches the closed hinged position, the frame and the door panel are pulled up together with the further, underlying door panel. See, for example, Fig. 2-3. The catch hook allows the sliding door to be freely expanded to two or more overlying door panels. All panels can be pulled up together with the bottom panel.

[0036] In a further or alternative embodiment, the pulling belt extends downwardly around a first belt guide and upwardly around a second belt guide on the frame. As an advantage, the door panel can be engaged at a lower level. In the raised position, the door panel can thus be raised higher, for example up to completely in front of the lifting means.

[0037] In a further aspect, the invention relates to a

cabinet having a vertical sliding door with at least one door panel configurable between a raised open position and a lowered close position, in accordance with the sliding door described above. The same features can thus be reiterated, and the same advantages apply. Optionally, the cabinet comprises at least one movable door panel and one fixed overlying panel. Optionally, the cabinet comprises left, and right side walls provided with guide tracks, preferably one per movable door panel. Preferably, the cabinet also provides a lifting means (e.g., a motor) for pulling up the upward pulling end.

[0038] In a further aspect, the invention relates to a suspension system for vertical sliding doors, comprising:

- a frame with guide means for guiding the frame along a guide track,
- a panel support which is hinged to the frame, around a pivot axis, which panel support is suitable for mounting a door panel, and
- a pulling belt with a pulling end and with an attachment end that is attached to the panel support at an attachment point.

In particular, the frame further forms a belt guide arranged to guide the attachment end from the attachment point to the frame and bend around it to pull the panel support from the pulling end towards the frame in a hinged manner. Preferably, the suspension system is suitable for suspending the sliding door as described above. The same features can thus be reiterated, and the same advantages apply.

[0039] Preferably, the belt guide is parallel to the pivot axis. Preferably, the guide means are arranged for guiding along a plane perpendicular to the belt guide and the pivot axis. Optionally, the suspension system includes an aluminium frame and an aluminium panel support. Optionally, the panel support is provided with mounting holes through which fasteners (e.g. screws) can be secured for mounting a door panel.

[0040] In a further or alternative embodiment, the suspension system is further provided with a spring mechanism that is prestressed to pivot the panel support away from the frame. Preferably, it is a compression spring, more preferably a conical compression spring as described above.

[0041] In a further aspect, the invention relates to a kit for mounting a vertical sliding door, which kit comprises at least one door panel and a corresponding suspension system for mounting the door panel. In particular, the suspension system corresponds to the suspension system described above. The kit is an assembly kit for the installation of vertical sliding doors.

[0042] In a further aspect, the invention relates to a method for opening a vertical sliding door, which sliding door comprises at least one movable door panel and an overlying panel, wherein the door panel is located in a vertical closing plane below the overlying panel, and the method comprises the steps of (i) hinging the door panel

so that it is at an angle to the closing plane, and (ii) pulling the door panel up past the overlying panel.

[0043] In particular, the door panel is suspended from a pulling belt with an upward pulling end, wherein the hinging and pulling up are accomplished by pulling up the upward pulling end.

[0044] In a further aspect, the invention relates to a further method for closing a vertical sliding door, which sliding door comprises at least one movable door panel and an overlying panel, wherein the door panel is disposed along the overlying panel, and the method comprising the steps of (i) lowering the door panel up to below the overlying panel, wherein the door panel is at an angle to a vertical closing plane, and (ii) pivoting the door panel up to into the closing plane. In particular, the door panel is suspended from a pulling belt with an upward pulling end, wherein the lowering and pivoting are accomplished by lowering the upward pulling end.

[0045] Preferably, these methods are suitable for opening/closing the sliding door described above. The same features and advantages can be reiterated in this regard. Preferably, the pivoting and pulling up (on opening) are two separate steps. Preferably, the lowering and pivoting (on closing) are two separate steps. Preferably, the door panels are guided in their upward and downward movement along fixed guide tracks. That is, guide tracks that do not hinge as is the case in WO 2005 054 613.

[0046] In what follows, the invention is described by way of non-limiting examples and figures illustrating the invention, and which are not intended to and should not be interpreted as limiting the scope of the invention.

[0047] Figures 1A-C illustrate, schematically, the opening and closing of a vertical sliding door **1**. The sliding door **1** comprises a door panel **2** that can move between a lowered closed position (Fig. 1A) and a raised open position (Fig. 1C). To guide the door panel **2** in this, it is hingedly provided on a movable frame **3**. The pivot axis **9** lies along a lower edge part **10** of the door panel **2**. That is, transverse to the drawing. This allows the door panel **2** to pivot forwards **18** and backwards **19**, relative to the frame **2**. In turn, the frame **3** can move upwards **16** and downwards **17**, via guide means **4** and along an adapted guide track **5**. Such guide means **4** are provided at the top and at the bottom of the frame **3**.

[0048] In its closed position (Fig. 1A) the door panel **2** is in a vertical closing plane **14**.

[0049] The frame **3** is in an extreme downwards position. The door panel **2** itself is hinged as far forward as possible, away from the frame **3**. The corresponding pivotal range **13** is here approximately 15°. This is of course not limiting for the invention. A compression spring **12'** keeps the door panel **2** in this forward hinged position. The compression spring **12'** is arranged between the frame **3** and the door panel **2**, and provides a pressure force that pushes the door panel **2** away from the frame **3**. This creates a moment of force which tends to pivot the door panel **2** away from the frame **3**, in the forward direction **18**.

[0050] The sliding door **1** further provides a lifting belt **6**. The lifting belt is attached to the door panel **2** at an attachment point **7**. From the attachment point **7**, the lifting belt **6** runs in a backward direction **19** to the frame **3**. Subsequently, the lifting belt **6** bears off upwardly **16** around a belt guide **8** formed by the frame **3**. Finally, the lifting belt runs in an upward direction **16**, wherein the pulling belt **6** forms an upward pulling end **6a**. It is important that the pulling belt **6** can roll or slide freely over the belt guide **8**. The main function of the belt guide **8** itself is to change the pulling direction of the pulling belt **6**.

[0051] The upward pulling end **6a** of the pulling belt **6** now allows to control the movements of the door panel **2**. For instance, a tension force **15** in the pulling belt **6** has a double effect. Firstly, such a tension force **15** provides a tractive force on the door panel **2**, in rearward direction. That is, a tractive force that pulls the door panel **2** towards the frame **3**. This creates a moment of force which tends to pivot the door panel **2** towards the frame **3**, opposite to the aforementioned moment of force of the compression spring **12'**. Secondly, such a tension force **15** in the pulling belt **6** provides an upward tractive force on the frame **3**, at the level of the belt guide **8**. That is, a tractive force that is inclined to pull up the frame **3** with the door panel **2**.

[0052] The weight of the door panel **2** and the frame **3** on the one hand, and the spring characteristic and placement of the compression spring **12'** on the other hand, will determine which movement is initiated first. Preferably, the rearwardly hinging of the door panel **3** requires a lower tension force **15** than the pulling up of the frame **3** and the door panel **2**. The compression spring **12'** is selected and positioned accordingly.

[0053] From the closing position (Fig. 1A) the sliding door **1** can be opened by pulling up the pulling end **6a** of the pulling belt **6**. In view of the foregoing, the door panel **2** will first hinge backwards, up to against the frame **2**. As shown in Fig. 1B, the door panel **2** will then form an oblique angle with the closing plane **14**. The upper edge part **11** of the door panel **2** has moved out of the closing plane **14**. In its upward movement, the door panel **2** will therefore no longer be hindered by any overlying panel (not shown). Once the pivotal movement is completed (Fig. 1B), the door panel **2** is in its end position against the frame **3**. The tension force **15** in the pulling belt **6** can thus increase further when the pulling end **6a** is pulled up further. Eventually the frame will start to move **3** upwards. This movement is guided by the guide means **4** along the guide track **5**. The door panel **2** follows the same movement, up to its raised position (Fig. 1C).

[0054] From the open position (Fig. 1C) the sliding door **1** can be closed again by lowering the pulling end **6a** of the pulling belt **6**. In view of the foregoing, the frame **3** and the door panel **2** will first move downward to the maximum downward position (Fig. 1B). Preferably, the frame **3** rests with its lower guide means **4** on a downward end **5c** of the guide track **5**. Incidentally, the guide track **5** comprises a vertical section **5a** and an oblique section

5b, for guiding the upward and downward movements. The oblique section **5b** allows the lower edge part **10** of the door panel **2** to be brought forward **18** into the closing plane **14**. Subsequently, when the pulling end **6a** is lowered further, the door panel **2** will start to pivot away from the frame **3**, under the influence of the compression spring **12'**. The door panel **2** is thereby brought in its entirety parallel to the closing plane **14**. In view of the forward pivotal movement it will not be necessary to bevel the upper edge part **11**. The upper edge part **11** can for instance be rectangular, without this hindering too much a close connection with the overlying panel (not shown).

[0055] Figures 2A-F show vertical sections of a cabinet **20** provided with a sliding door **1** with two movable door panels **2', 2''**. Figures 3A-F show exploded views of the same cabinet **20**, in perspective. The movement of the panels **2', 2''** between their lowered closed position (Fig. 2A/3A) and their raised open position (Fig. 2F/3F) is illustrated.

[0056] The cabinet **20** has a forward cabinet opening **21** with side walls **24** on the left and right. Along the inside, the side walls **24** are provided with grooves **5', 5''**, for guiding the door panels **2**. Namely, each door panel **2** is hingedly mounted on a frame **3** which is guided via guide means **4** (e.g. wheels or sliding blocks) along a corresponding groove **5**, in its upward and downward movement. More specifically, the suspension system **22** comprises a panel support **23** which is hingedly provided on the frame **3**. The panel support **23** forms a mounting plate against which the door panel **2** is mounted (e.g. via screws).

[0057] As can be seen in Fig. 3A-F, each panel **2** is provided with two such suspension systems **22**: one on the left and one on the right. The guide means **4** interact with grooves **5** provided in the adjacent side walls **24**. However, below the singular is often used to refer to 'the' suspension system **22** and the elements comprised by it. In general, the number of suspension systems **22** per door panel **2** is not limiting to the invention.

[0058] The lower suspension system **22'** comprises a pulling belt **6'** which is attached to the door panel **2'** at an attachment point **7'**. More specifically, the pulling belt **6'** is attached to the panel support **23'** against which the door panel **2'** is mounted. If the tension force in the pulling belt **6'** is sufficiently low (Fig. 2A/3A), the frame **3'** is in its extreme downward position, and the door panel **2'** is fully hinged forward, up to into the closing plane **14**. An upper edge part **11'** of the door panel **2'** forms a support element **25'** which abuts against a lower edge part **10''** of the overlying panel **2''**. A compression spring **12'** provided between the frame **3'** and the panel support **23'** keeps the door panel **2'** pressed in this closed position.

[0059] When the upward pulling end **6a'** is pulled up, a tension force builds up in the pulling belt **6'**. Thus, inter alia, also in the attachment end **6b'** which runs between the frame **3'** and the door panel **2'**, and which is wrapped around a belt guide **8a'** on the frame **3'**. This results in a tractive force between the attachment point **7'** (on the

door panel 2') and the belt guide 8a' (on the frame 3'), opposite to the pressure force of the compression spring 12'. With a sufficiently high tension force, the door panel 2' will thus hinge out of the closing plane 14, up to against the frame 3'. This is accompanied by the sliding or slipping of the attachment end 6b' along the belt guide 8a'. The situation is shown in Fig. 2B-3B.

[0060] In the embodiment shown, the frame 3' of the lower door panel 2' provides two belt guides 8a', 8b'. From the attachment point 7', the attachment end 6b' first bends downwardly around the first belt guide 8a', and then upwardly around the second belt guide 8b'. The second belt guide 8b' is located lower. Advantageously, the point of engagement for pulling up the lower door panel 2' is therefore lower.

[0061] The tension force in the pulling belt 6' can now increase further. When the upward pulling end 6a' is pulled up further, the frame 3' and the door panel 2' therefore start to move upward. See Fig. 2C-3C. In this movement the frame 3' is guided along the groove 5'. Given the high tension force in the pulling belt 6', the door panel 2' stays at all times hinged against the frame 3'. The spring 12' remains compressed.

[0062] The overlying panel 2'' is still arranged in the closing plane 14. However, this panel 2'' also provides a pulling belt 6'' with an upward pulling end 6a'', this time coupled to a catch hook 26''. The catch hook 26'' is arranged in the upward path of the underlying panel 2', and is slidably mounted on the frame 3'. The catch hook 26' here has the possibility of (obliquely) moving upwardly and downwardly relative to the frame 3'', under the influence of forces acting on the hook 26'. At rest (Fig. 1A-D) the catch hook 26'' is retracted downwards, under the influence of the compression spring 12''.

[0063] As shown in Fig. 2D-3D, the locking hook 26'' can be carried along in the upward movement of the underlying door panel 2'. First, the catch hook 26'' shifts in an upward direction, which is accompanied by a slipping or sliding of the attachment end 6b'' of the pulling belt 6'' around the belt guide 8''. In a similar way as above, the door panel 2'' hinges up to against the frame 3'', against the force of the compression spring 12''. The situation is shown in Fig. 2E-3E.

[0064] The tension force in the pulling belt 6' can now increase even further. When pulling up the upward pulling end 6a' further, both door panels 2', 2'' are pulled upwards. Their frames 3', 3'' are guided along the corresponding grooves 5', 5''. The lower door panel 2' is located behind and along the upper door panel 2''. See Fig. 2F-3F. Obviously, the invention is extended to any number of door panels 2.

[0065] Figures 4A-B show a perspective view and a vertical section of another cabinet 20 according to an alternative embodiment. The cabinet opening 21 is provided with two movable door panels 2', 2'' and one overlying, fixed panel 27. Via an upward pulling end 6a' on the lower door panel 2', the door panels 2', 2'' can be pulled up to behind the overlying panel 27. The mechanism is similar to that of Fig. 2-3. Furthermore, the cabinet 20 is provided with an automated lifting means 28 at the top, capable of pulling up the upward pulling end 6a'. As in the previous embodiment, the lower frame 3' here also provides a first belt guide 8a' and a second belt guide 8b'. This allows the lower door panel 2' to be engaged lower. In the raised position, the door panel 2' can thus be raised higher, e.g. to completely in front of the lifting means 28 (not shown). This configuration is more compact.

[0066] Figures 5A-C illustrate, schematically, a vertical sliding door 1 according to an alternative embodiment without a spring mechanism. The sliding door 1 comprises an underlying movable door panel 2 and an overlying fixed panel 27. The panels 2, 27 have rectangular bottom and top edge parts. Furthermore, the door panel 2 is configurable between a raised open position (Fig. 5C) and a lowered closed position (Fig. 5A). To this end, the door panel 2 is hinged provided on a movable frame 3, relative to a pivot axis 9. The frame 3 itself is provided with guide means 4 at the bottom and at the top, for upward and downward guidance along a guide track 5. For example, it is a guide rib, a guide rail or a guide groove.

[0067] A pull cable 6 with an upward pulling end 6a controls the position of the door panel 2. In Fig. 5A, the tension force in the pull cable 6 is sufficiently low. The frame 3 is thus in its extreme downward position. Optionally, the lower guide means 4 rests on a downward end 5c of the guide track 5. There is no spring mechanism. However, due to the design and under the influence of gravity, the door panel 2 and the panel support 23 are hinged forwards. They rest on a support leg 29 formed by the frame. The door panel 2 itself is located in a vertical closing plane 14.

[0068] The pull cable 6 is now attached to the door panel 2 with an attachment end 6b, at the level of an attachment point 7. A tension force in the pulling end 6a is thus deflected around the cable guide 8. A sufficiently high tension force will make the door panel 2 pivot against a stop 30 on the frame 3. See Fig. 5B. the further pulling up of the pulling end 6a results in the frame 3 and the door panel 2 being moved as a whole behind the fixed panel 27.

[0069] The numbered elements in the figures are:

- | | |
|----|--|
| 1 | Sliding door |
| 2 | Door panel |
| 3 | Frame |
| 4 | Guide means |
| 5 | Guide track (e.g. groove, rib, rail) |
| 5a | Vertical section |
| 5b | Oblique section |
| 5c | Downward end |
| 6 | Pulling belt (also: pull cable, pull cord) |
| 6a | Upward pulling end |
| 6b | Attachment end |
| 7 | Attachment point |
| 8 | Belt guide (also cable guide, cord guide) |

- 8a First belt guide
- 8b Second belt guide
- 9 Pivot axis
- 10 Lower edge part (panel)
- 11 Upper edge part (panel)
- 12 Spring mechanism / compression spring
- 13 Pivotal range
- 14 Closing plane
- 15 Tension force
- 16 Upwards
- 17 Downwards
- 18 Forwards
- 19 Backwards
- 20 Cabinet
- 21 Cabinet opening
- 22 Suspension system
- 23 Panel support
- 24 Side wall
- 25 Support element
- 26 Catch hook
- 27 Fixed panel
- 28 Lifting means
- 29 Support leg
- 30 Stop

[0070] It is believed that the present invention is not limited to the embodiments described above and that some changes may be made to the examples and figures described without revaluing the appended claims.

Claims

1. A vertical sliding door (1) with at least one door panel (2) which is configurable between a raised open position and a lowered closed position, which door panel (2) is hingedly provided on a movable frame (3) with guide means (4) for upward and downward guidance along a guide track (5), and wherein the door panel (2) is further suspended from a pulling belt (6) having an attachment end (6b) and an upward pulling end (6a) adapted to raise and lower the door panel (2), **characterised in that** the attachment end (6b) runs at least between the door panel (2) and the frame (3), and is bent around a belt guide (8) on the door panel (2) or the frame (3), to pull the door panel (2) from the pulling end (6a) towards the frame (3), in a hinged manner.
2. Sliding door (1) according to claim 1, further comprising a spring mechanism (12) prestressed to pivot the door panel (2) away from the frame (3).
3. Sliding door (1) according to any of claims 1-2, wherein the attachment end (6b) is attached to the door panel (2), and wherein the belt guide (8) is formed by the frame (3).
4. Sliding door (1) according to any of claims 1 to 3,
 - wherein pulling the door panel (2) towards the frame (3) requires a first tension force in the pulling belt (6), and
 - wherein the pulling up of the door panel (2) and the frame (3) requires a second tension force in the pulling belt (6), higher than the first.
5. Sliding door (1) according to any of the preceding claims, wherein the door panel (2) comprises a rectangular upper edge part (11).
6. Sliding door (1) according to any of the preceding claims, wherein the door panel (2) is hingedly provided on the frame (3), about a pivot axis (9) located along a lower edge part (10) of the door panel (2).
7. Sliding door (1) according to claim 6, wherein the door panel (2') is provided on an upper edge part (11') with a support element (25') which, in the closed position, bears against a further, upper door panel (2'').
8. Sliding door (1) according to any of the preceding claims, wherein the upward pulling end (6a'') is coupled to a catch hook (26'') arranged in a path of a further, underlying door panel (2').
9. Sliding door (1) according to any of the preceding claims, wherein the pulling belt (6') extends downwardly around a first belt guide (8a'), and upwardly around a second belt guide (8b') on the frame (3').
10. A cabinet (20) provided with a vertical sliding door (1) with at least one door panel (2) configurable between a raised open position and a lowered closed position, **characterised in that** the sliding door (1) corresponds to any of claims 1-9.
11. A suspension system (3, 6, 23) for vertical sliding doors (1), comprising:
 - a frame (3) with guide means (4) for guiding the frame (3) along a guide track (5),
 - a panel support (23) which is hingedly provided on the frame (3), around a pivot axis (9), which panel support (23) is suitable for mounting a door panel (2), and
 - a pulling belt (6) with a pulling end (6a) and with an attachment end (6b) attached to the panel support (23) at an attachment point (7),**characterised in that** the frame (3) further forms a belt guide (8) arranged to guide the attachment end (6b) from the attachment point (7) to the frame (3) and bend around it to pull the panel support (23) from the pulling end (6a) towards the frame (3) in a hinged

manner.

12. Suspension system (3, 6, 23) according to claim 11,
further comprising a spring mechanism (12) that is
prestressed to pivot the panel support (23) away 5
from the frame (3).

13. A kit for mounting a vertical sliding door (1), which
kit comprises at least one door panel (2) and a cor-
responding suspension system for mounting the 10
door panel, **characterised in that** the suspension
system (3, 6, 23) corresponds to one of claims 11-12.

14. A method of opening a vertical sliding door (1), which
sliding door (1) comprises at least one movable door 15
panel (2) and an overlying panel (27), wherein the
door panel (2) is located in a vertical closing plane
(14) below the overlying panel (27), and the method
comprises the steps of (i) hinging the door panel (2)
so that it is at an angle to the closing plane (14), and 20
(ii) pulling the door panel (2) up past the overlying
panel (27), **characterised in that** the door panel (2)
is suspended from a pulling belt (6) with an upward
pulling end (6a), wherein the hinging and pulling up 25
are accomplished by pulling up the upward pulling
end (6a).

15. A method of closing a vertical sliding door (1), which
sliding door (1) comprises at least one movable door 30
panel (2) and an overlying panel (27), wherein the
door panel (2) is disposed along the overlying panel
(27), and the method comprising the steps of (i) low-
ering the door panel (2) up to below the overlying
panel (27), wherein the door panel (2) is at an angle 35
to a vertical closing plane (14), and (ii) pivoting the
door panel (2) up to into the closing plane (14), **char-
acterised in that** the door panel (2) is suspended
from a pulling belt (6) with an upward pulling end
(6a), wherein the lowering and pivoting are accom-
plished by lowering the upward pulling end (6a) 40

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Fig. 1A

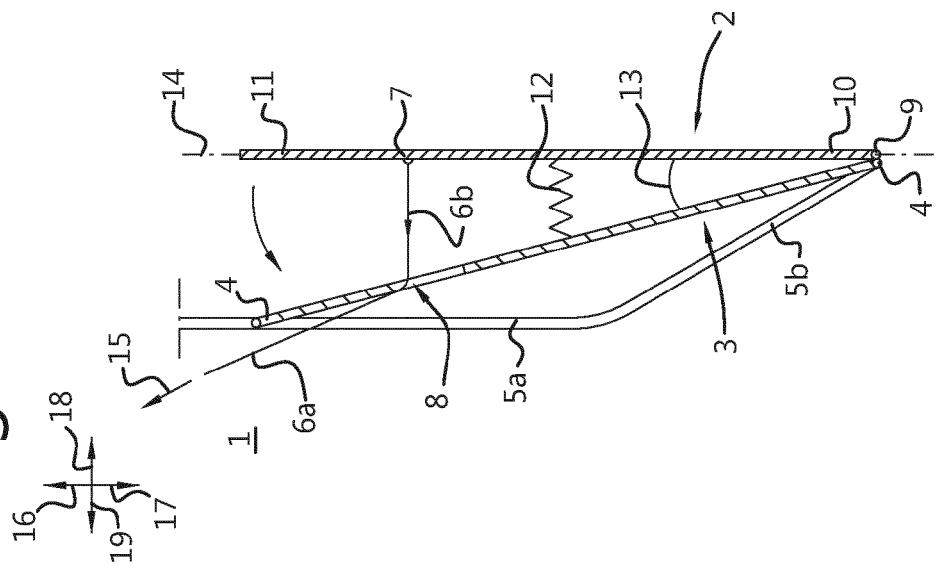


Fig. 1B

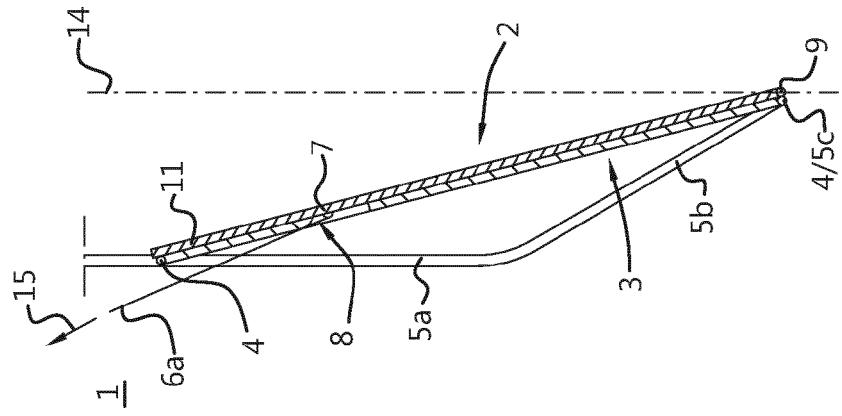


Fig. 1C

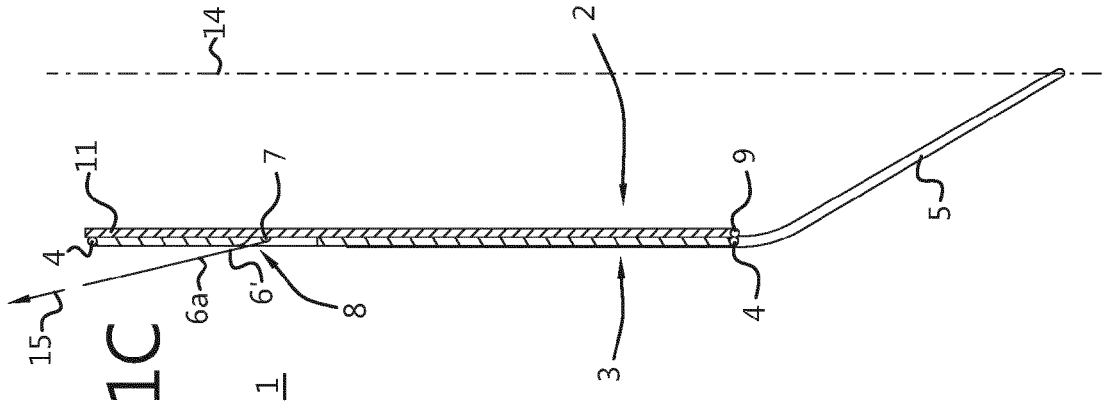


Fig. 2A

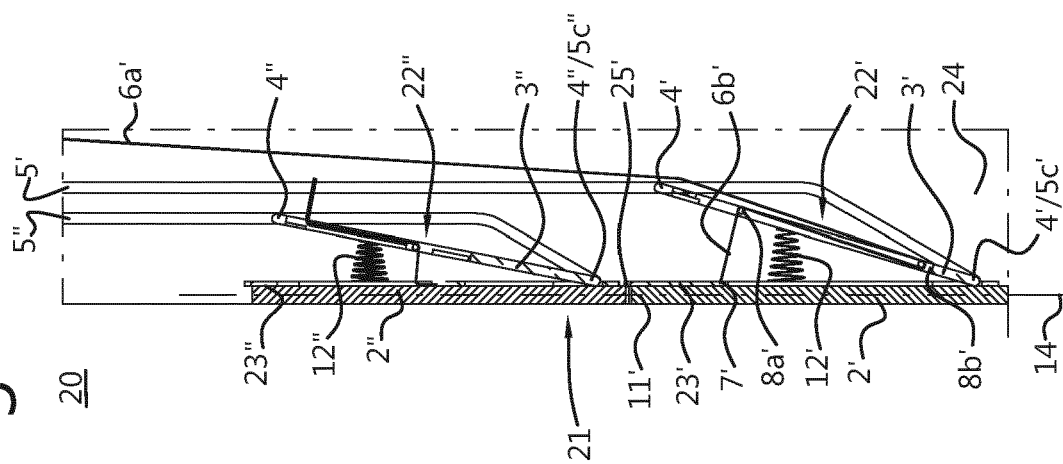


Fig. 2B

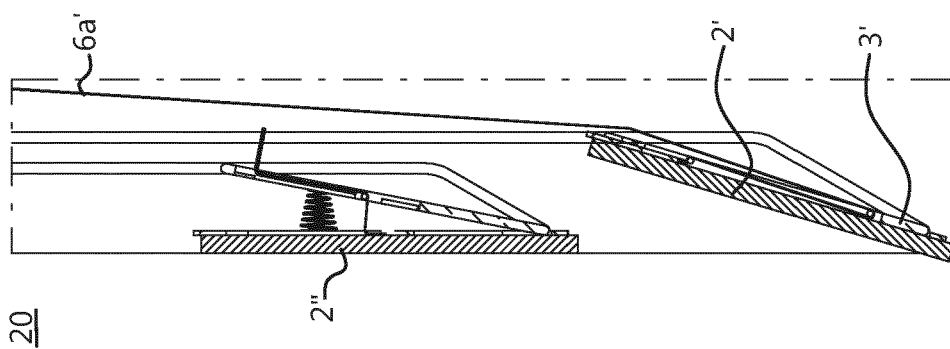


Fig. 2C

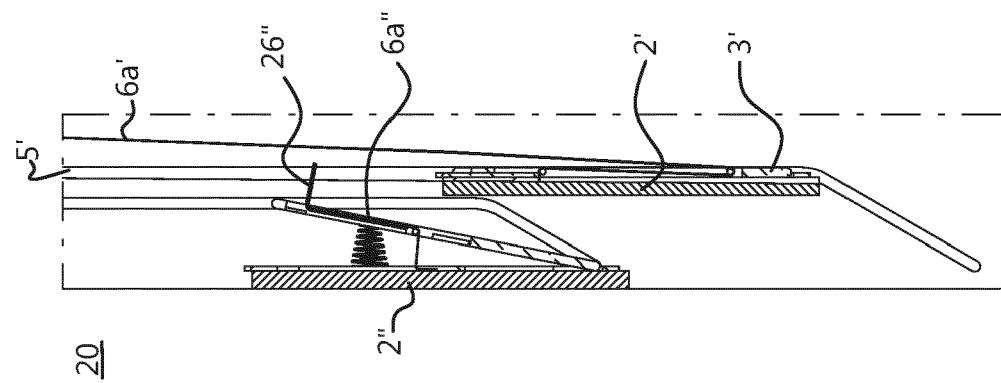


Fig. 2D

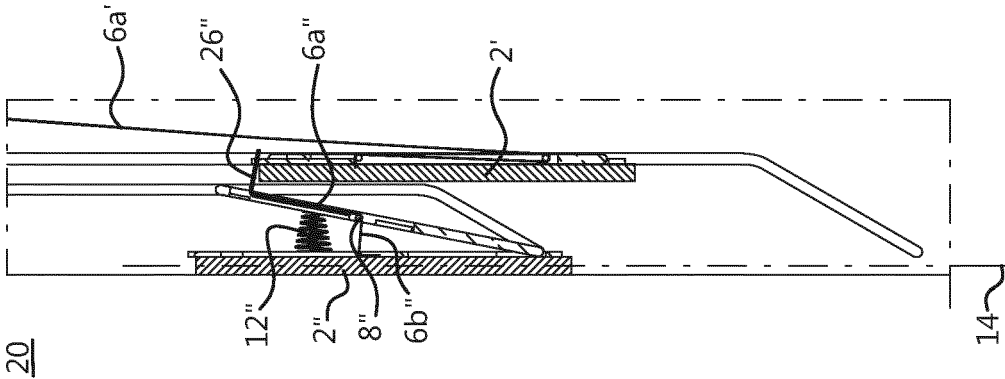


Fig. 2E

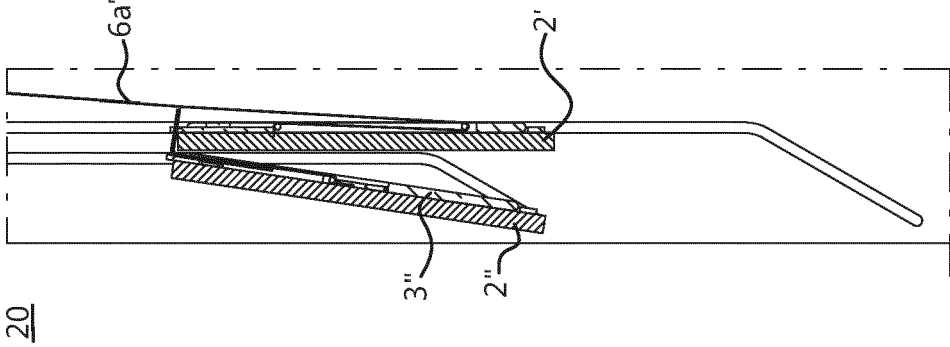
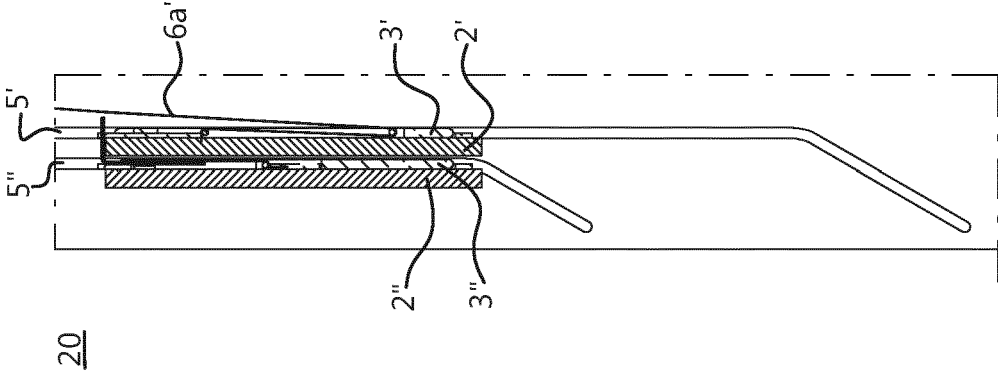
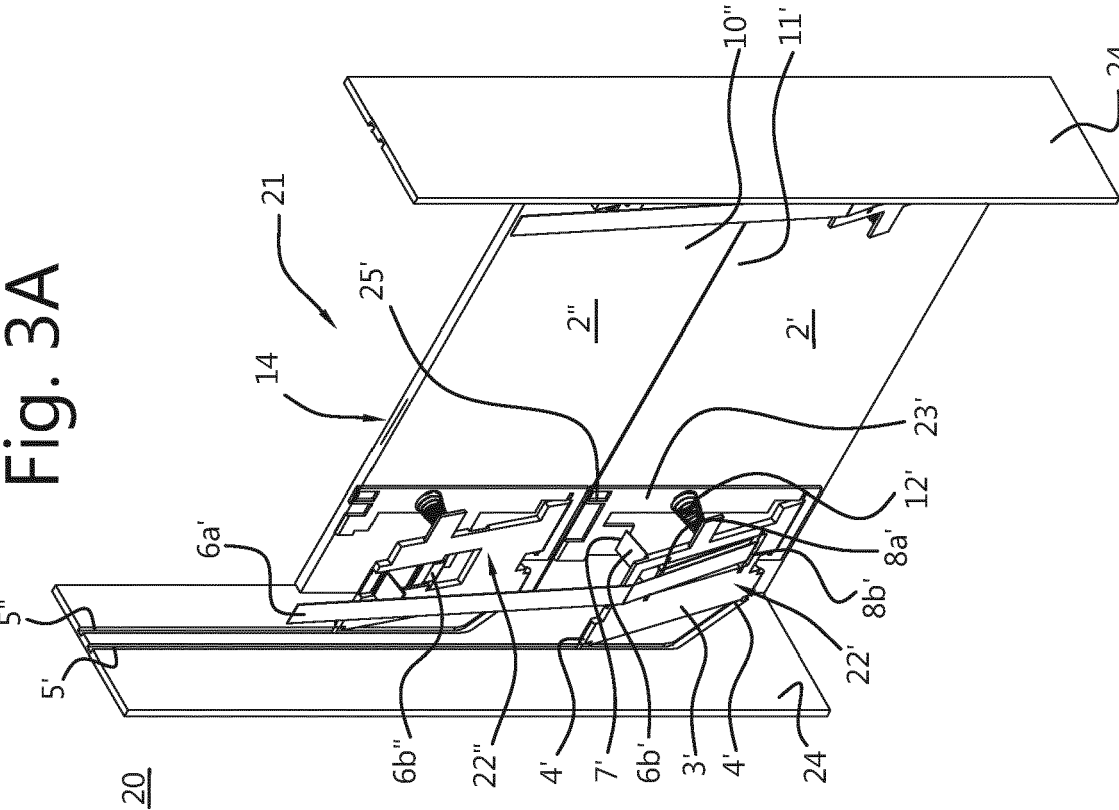
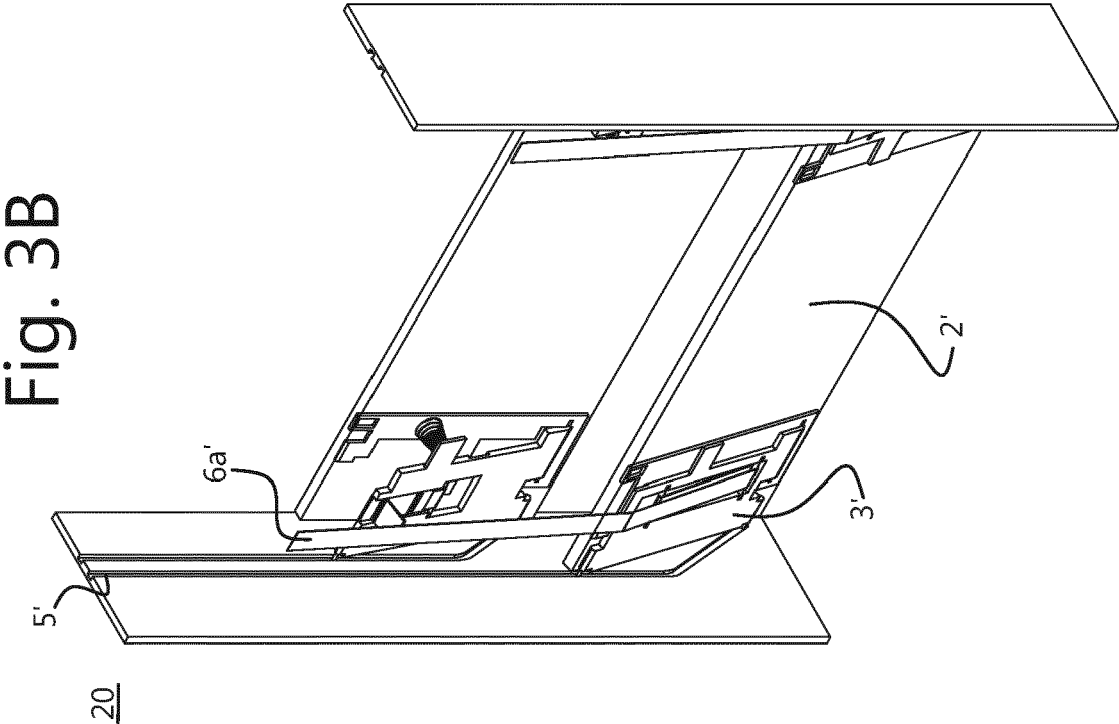


Fig. 2F





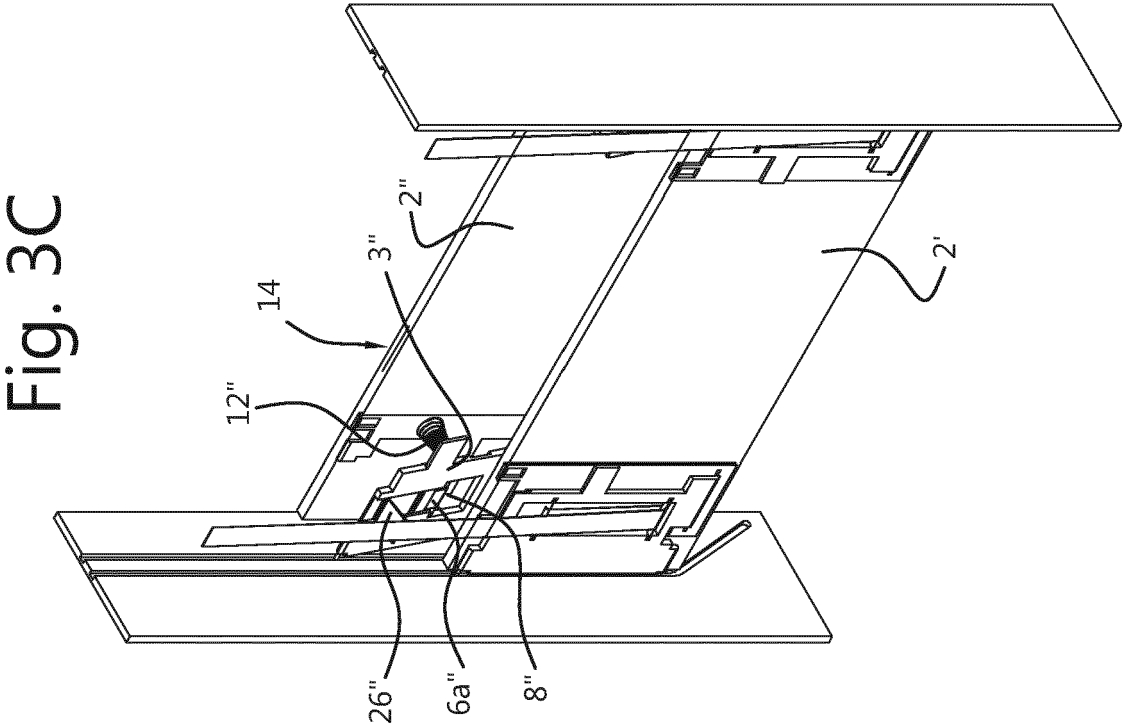
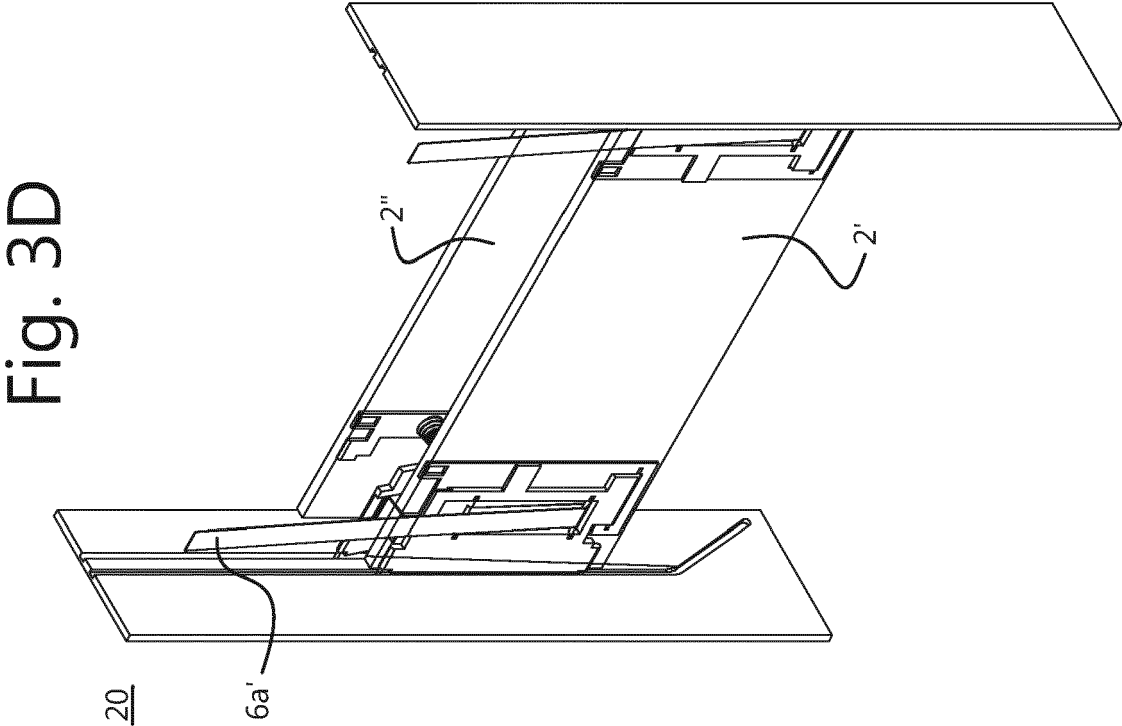


Fig. 3F

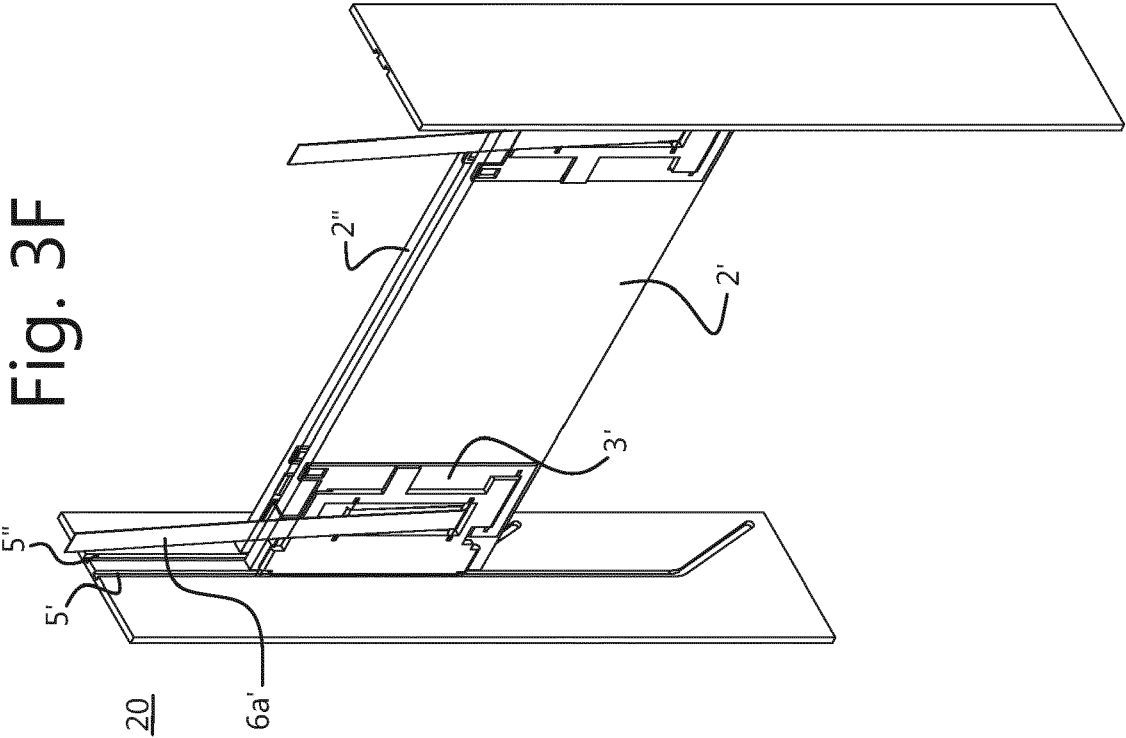


Fig. 3E

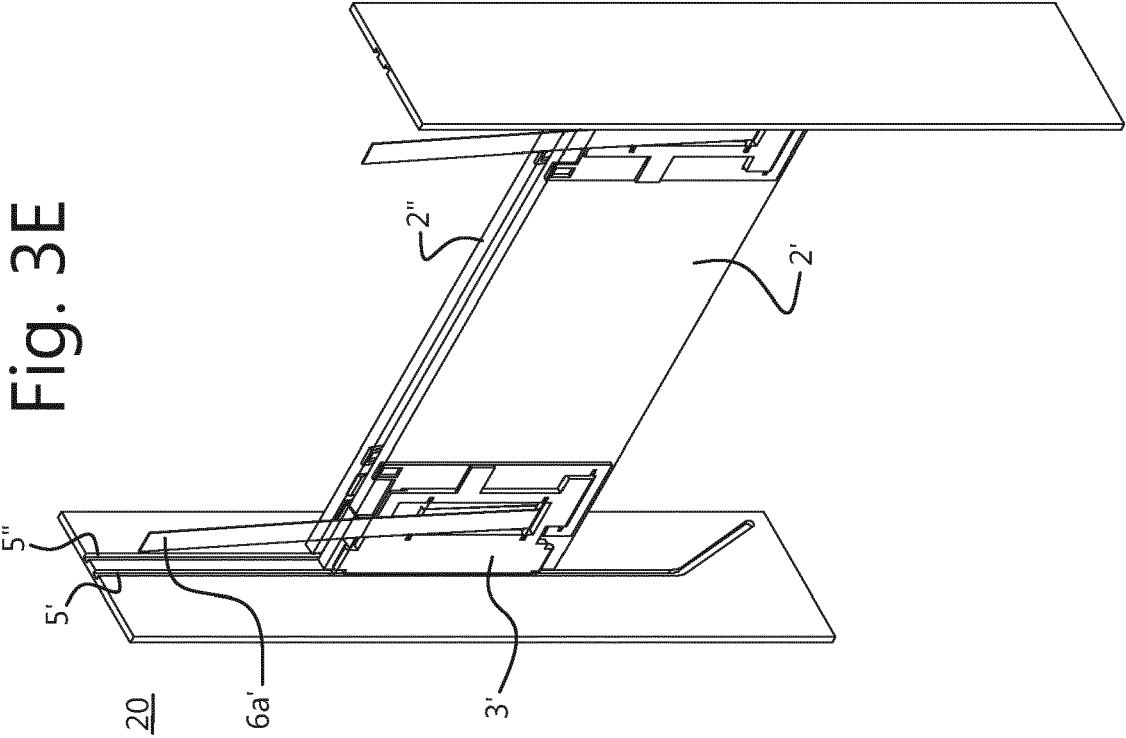


Fig. 4B

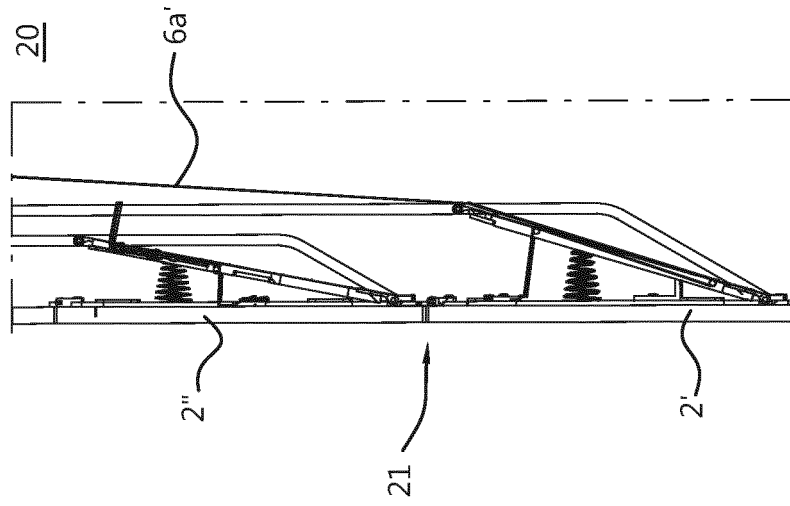
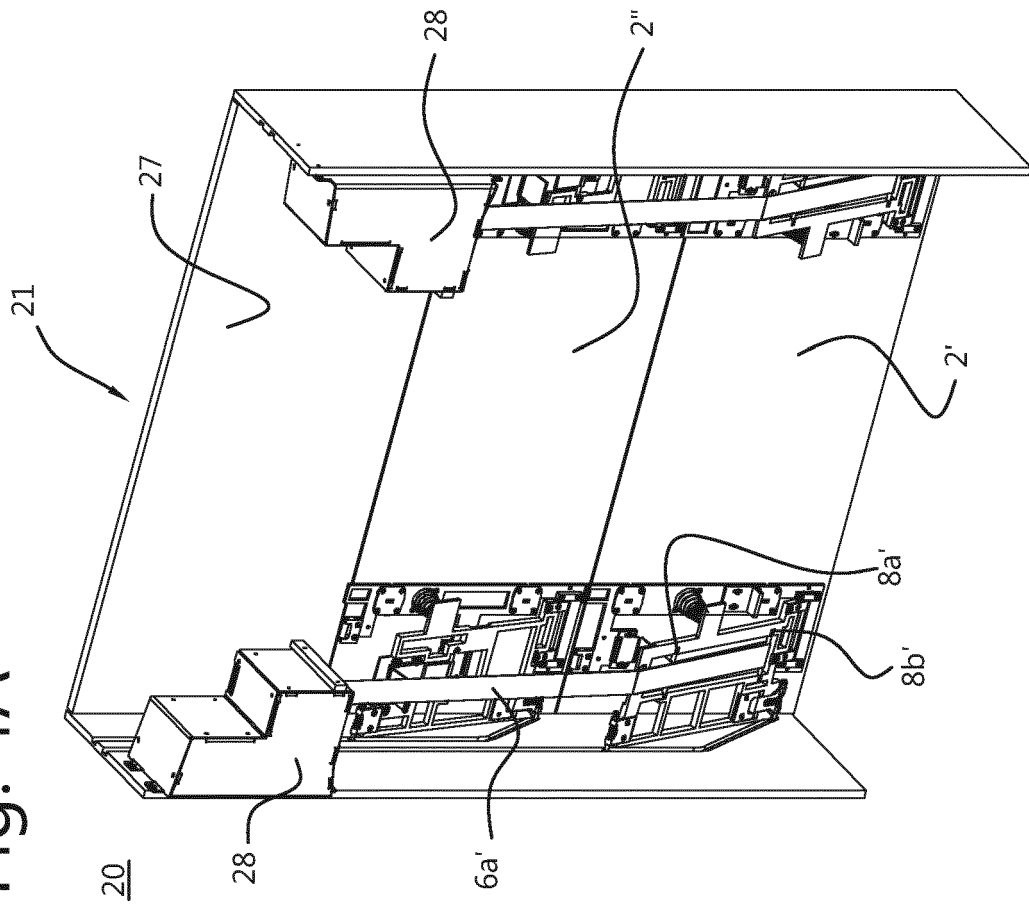
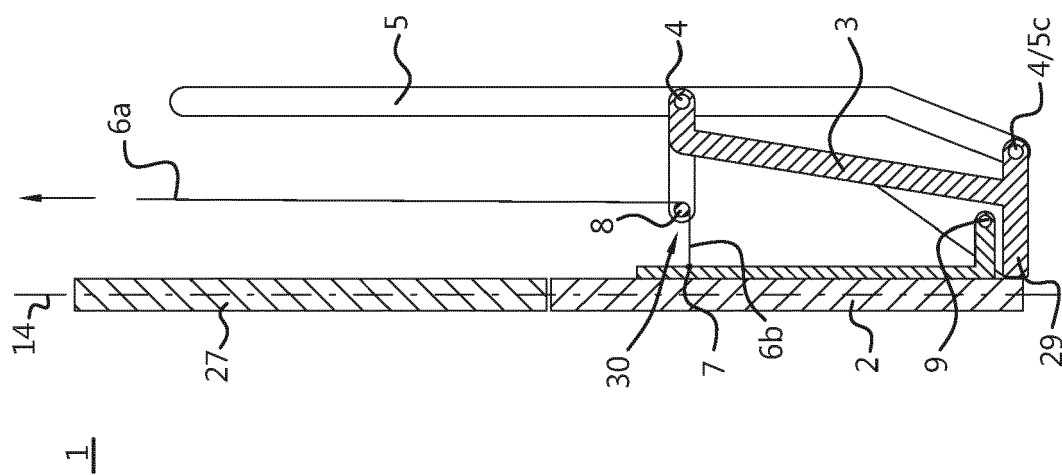
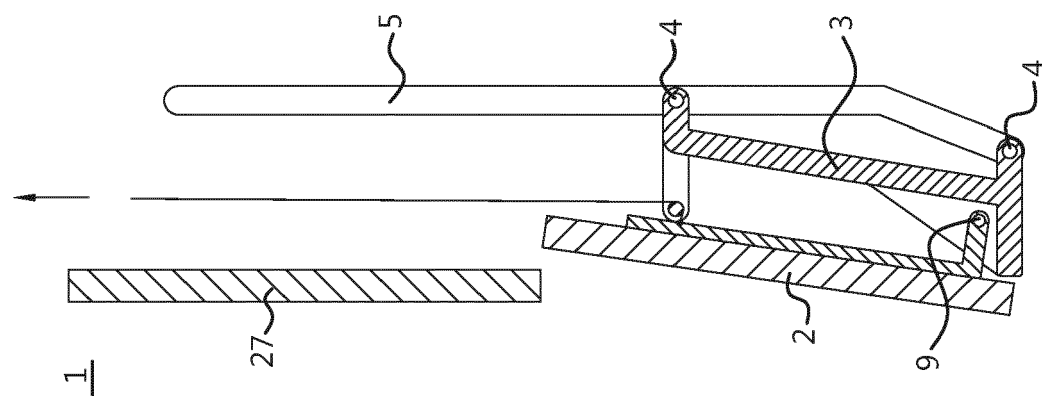
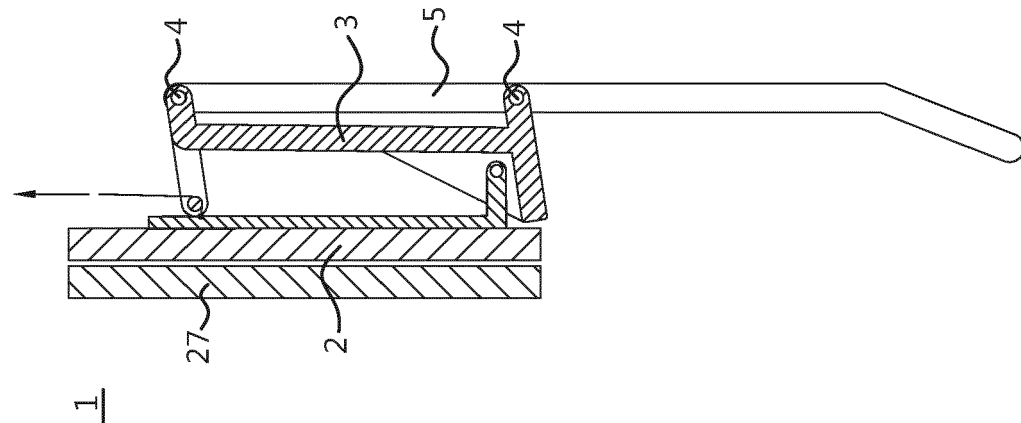


Fig. 4A







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			E05D E06B E05F
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 25 June 2021	Examiner Berote, Marc
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