(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 3 366 164 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
29.08.2018 Bulletin 2018/35

(21) Application number: **18158693.4**

(22) Date of filing: **26.02.2018**

(51) Int Cl.:
A47F 3/04 *(2006.01)* ***E05F 1/10*** *(2006.01)*
E05F 1/12 *(2006.01)* ***E05F 3/22*** *(2006.01)*

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
MA MD TN

(30) Priority: **28.02.2017 IT 201700022495**

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(54) **REFRIGERATED CABINET WITH ONE OR MORE AUTOMATICALLY CLOSING DOORS**

(57) A refrigerated cabinet with one or more self-closing doors, comprising a support frame (2), which defines a load compartment 3, and at least one door (10) for closing the load compartment. The door is hinged to the frame with a vertical rotation axis (X) and may rotate to move between a closed position and a predefined position of maximum opening. The cabinet comprises an automatic door closing system, which comprises a hydropneumatic piston (40). The piston is hinged to the door in an offset position with respect to the rotation axis by means of a lever extension (43) integral with the door. The two hinging points of the piston are positioned with respect to the rotation axis so that: the hydropneumatic piston exerts a force (F) which always develops an angular momentum (M) for closing the door about the rotation axis, and the perpendicular distance (B) between the dynamic action axis (Y) of the piston and the rotation axis (X) decreases as the degree of angular opening of the door increases.

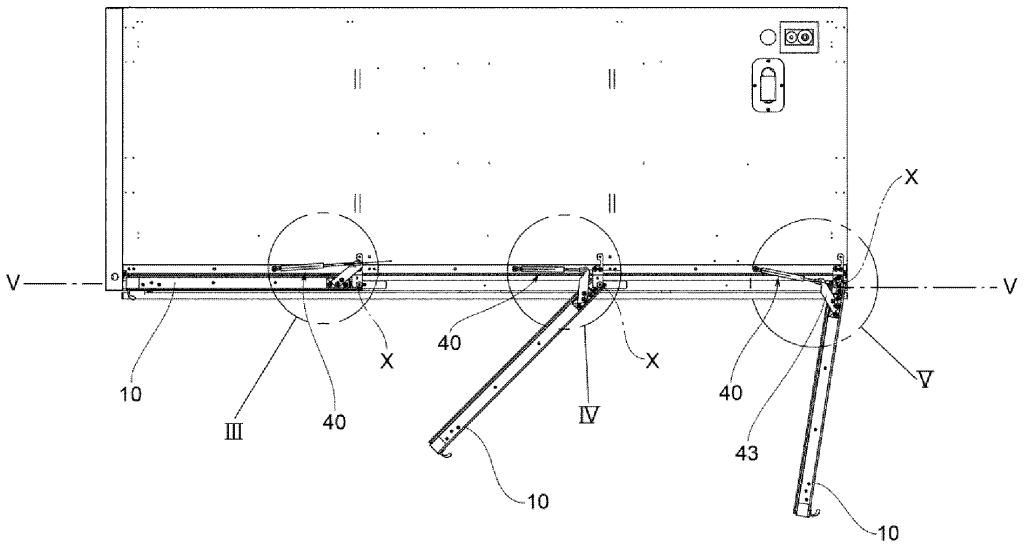

FIG.2

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Description

Scope

[0001] The object of the present invention is a refrigerated cabinet with one or more automatically closing doors.

[0002] Such refrigerated cabinet may be vertical, semi-vertical or combined, and may be at a negative or positive temperature.

Prior art

[0003] In the commercial refrigeration field, it is possible to distinguish between vertical, semi-vertical or combined negative-temperature cabinets and vertical or semi-vertical positive-temperature cabinets. These cabinets are equipped with doors that allow access to the load compartment for storage and taking of food and guarantee a reduced entrance of heat from the surrounding environment inside the cabinet. This allows the temperature of food stored in the cabinets to be maintained with a good level of energy efficiency. It follows that during normal sales activity, the shorter the time needed for the doors to close after being opened by a customer, the less electricity consumed by the cabinet for preserving the temperature therein. For this reason, the doors are equipped with automatic closing systems. These systems must also allow a stop position with the door open to facilitate loading operations of the cabinet.

[0004] At present, the doors for freezer cabinets and refrigerated cabinets used in the commercial refrigeration field have an automatic closing system based on torsion springs.

[0005] Such springs are loaded by opening the door and release their potential elastic energy during the closing movement of the same door. Since such systems are based on elastic energy, the force with which the door closes responds in principle to Hooke's law. Therefore, the greater the angle at which the door is opened, the greater the force that will tend to close it. In closing, the elastic force that is generated tends to accelerate the door against the support (frame) of the cabinet causing an impact that causes noise, vibrations, and sometimes even causes the adjacent doors to open.

[0006] Consequently, there exists: an increase in the noise level in shops where such cabinets are installed; a reduction of the useful life of the parts subject to impact such as gaskets; a general tendency toward loosening of threaded members subject to vibration; not rarely a separation of parts assembled with snap systems on the frame uprights (i.e. lighting systems).

[0007] To facilitate the loading stage of the cabinet, devices that keep the door open at about 90° are used. The latter may be either springs shaped to fit in specially provided abutments with an intentional action of the operator in loading the cabinet or snap systems that are activated by forcing the door over ninety degrees. The desired functions of automatic closing and of stopping the door therefore require the use of at least two devices.

[0008] As an alternative, there are closing systems based on gravity hinges. When the door is opened, the hinge climbs on an inclined ramp, storing potential energy which is then released during closing. These systems have similar disadvantages to those of torsion spring systems. The door accelerates during the entire closing journey ending with a shock against the cabinet frame. This impact causes noise, vibrations and stress that decrease the useful life of some components, in particular the gasket that is the interface between the door and the cabinet. Moreover, over time the inclined plane becomes worn and flattens out, with the risk of not assuring the closure of the door. The phenomenon is accentuated by the weight of the doors that for freezer cabinets (triple glazed doors) may reach up to 50kg. These solutions are therefore used almost exclusively in refrigerated cabinets. Finally, the door stop position (which allows the cabinet to be loaded) is made with grooves on the inclined plane. These grooves further increase the wear of inclined surfaces.

[0009] There are also closing systems with hydraulic mechanisms that guarantee a softer closing of the door. Such systems are commonly based on a cam which, being rotated by the opening of the door, compresses a spring. The energy that the spring returns is partially dissipated in a hydraulic circuit which allows for a slowed down closing. The main limit of these systems lies in the fact that the closure is slowed down for the entire angle of opening of the door with a longer closing time that reduces the cabinet's energy efficiency, allowing heat exchange between the cabinet and the surrounding environment for a longer time. Another limit of this solution lies in the fact that such systems do not actually prevent violent impacts if the door is pushed. An additional limit is related to the modes of installation. In fact, the hydraulic system varies its effective response according to the position in which it is installed. A calibration stage is therefore required. In fact, the viscosity of the oil is affected by the temperature at which it operates and an installation inside the cabinet requires different contrivances than an external installation.

Presentation of the invention

[0010] Therefore, the object of the present invention is to eliminate the drawbacks of the prior art described above, providing a refrigerated cabinet with one or more automatically closing doors that do not generate impacts between the door and frame while minimizing the closing time of the same door.

[0011] A further object of the present invention is to provide a refrigerated cabinet with one or more automatically closing doors that allow the door stop in a defined open position without the use of additional door stop devices with respect to the door's automatic closing system.

[0012] A further object of the present invention is to

provide a refrigerated cabinet with one or more automatically closing doors that is simple and economical to make.

Brief description of the drawings

[0013] The technical features of the invention, according to the above objects, are clearly apparent from the content of the claims below and the advantages thereof will become more apparent in the following detailed description, made with reference to the accompanying drawings, which represent one or more purely exemplifying and non-limiting embodiments, wherein:

- Figure 1 shows a perspective view of a refrigerated cabinet according to the invention, comprising three automatically closing doors, shown respectively in a closed condition, in a semi-open/semi-closed condition and in a door stop open condition;
- Figure 2 shows a plan view from above of the cabinet of Figure 1;
- Figures 3, 4 and 5 each show an enlarged view of the details highlighted respectively in the circles indicated with III, IV and V in Figure 2;
- Figure 6 shows an orthogonal front view of a door of the cabinet of Figure 1, sectioned at half height for illustrative purposes, with lower hinging means of the same door highlighted in the circle VII;
- Figure 7 shows an enlarged view of the detail highlighted in the circle indicated at VII in Figure 6;
- Figure 8 shows a detailed perspective view of the lower hinging means shown in Figure 7;
- Figures 9a, 9b and 9c show three orthogonal plan views of the lower hinging means of Figure 8, shown in three different operating positions assumed by the door and corresponding respectively to the closed condition, the semi-open condition, and the open door stop condition;
- Figure 10 shows the graphs of the trend of the stress at the handle when opening and closing and of the trend of the closing speed of the door with respect to the angular value of opening/closing the door and with respect to the relative position assumed by the stem along the cylinder of the hydropneumatic piston of the automatically closing door.

Detailed description

[0014] With reference to the accompanying drawings, a refrigerated cabinet with one or more automatically closing doors is indicated collectively with 1.

[0015] Such refrigerated cabinet may be vertical, semi-vertical or combined, and may be at a negative or positive temperature.

[0016] Here and in the following description and the claims, reference will be made to the refrigerated cabinet in the condition of use. It is in this sense that references to a lower or upper position, or to a vertical or horizontal orientation, are therefore to be understood.

[0017] According to a general embodiment of the invention, the refrigerated cabinet 1 comprises a support frame 2, which defines a load compartment 3, and at least one door 10 for closing such load compartment 3.

[0018] In particular, the frame 2 defines the support structure of the cabinet 1 and comprises a support base 2a, a plurality of side walls 2b (including a back wall) and a top 2c, which defines the top of the cabinet 1.

[0019] "Load compartment" means, in particular, the volume inside the structure of the refrigerated cabinet that is intended for displaying and storing the goods for sale.

[0020] The door 10 is associated with the frame 2 by hinging means 20, 30 which define a vertical rotation axis X about which the door 10 may rotate to move between a closed position and a predefined position of maximum opening. In other words, the door 10 is a vertical-type door.

[0021] The refrigerated cabinet 1 comprises an automatic closing system of the aforesaid at least one door 10.

[0022] The refrigerated cabinet 1 may comprise a single door 10, or two or more doors 10, as illustrated in Figures 1 and 2. Preferably, if the cabinet 1 is provided with two or more doors 10, each of these doors 10 is provided with an automatic closing system.

[0023] For simplicity of description, in the following part of the description, reference will be made to a single door 10. However, the description is intended to extend also to cases of cabinets with two or more automatically closing doors 10.

[0024] Preferably, the door 10 is glazed. However, embodiments may be foreseen wherein the door 10 is not glazed.

[0025] According to the embodiment illustrated in the attached figures, the aforesaid hinging means comprise an upper hinge 20, which is fixed to the top 2c of the frame 2 of the cabinet 1 and a lower hinge 3, which is fixed to the base 2a of the frame 2. The upper hinge 20 and the lower hinge 30 are vertically aligned with each other and define the aforesaid rotation axis X. Preferably, the hinges 20, 30 are made of materials with a low friction coefficient and self-lubricating to reduce both mutual wear and the need for maintenance and periodic greasing.

[0026] According to a first essential aspect of the present invention, the automatic closure system of the door 10 comprises a hydropneumatic piston 40 which is hinged - at its opposite two ends 40a and 40b along its own dynamic action axis Y - respectively to the frame 2 and to the door 10.

[0027] Preferably, the two hinging points 40a and 40b of the piston 40 to the frame 2 and to the door 10 are substantially at the same vertical height, so as to make the piston 30 work on a substantially horizontal plane. In this way, the force generated by the piston 40 does not have a substantially vertical component, which would need to be compensated, for example, by means of thrust

bearings, with an increase in costs and in constructive complexity. Such configuration also makes it possible to reduce the overall dimensions with respect to a configuration with hinging at different heights.

[0028] Such hinging defines for the piston 40 a rotationally free connection at both ends about the respective connecting pins. The hydropneumatic piston 40 can therefore follow the door 10 in rotation. This causes a progressive variation of both the spatial orientation of the piston 40 with respect to the frame 2 and to the door 10, and of the length extension of the piston 40 along its dynamic action axis Y. The variation in length extension of the piston (compression or extension) dynamically activates the piston itself.

[0029] A "hydropneumatic piston" is a device well known to a person skilled in the art and will not therefore be described here in detail, but rather only some general information will be provided.

[0030] More specifically, a hydropneumatic piston is a device consisting of two mechanical parts. A first part consists of a hollow cylinder, which is filled with a fluid and inside of which slides a movable part, called stem. At the end of the stem placed within the cylinder the stem has a head with dimensions corresponding to the inner section of the cylinder and which divides the cylinder into two variable volume chambers. The movement of the head of the stem inside the cylinder is controlled by the pressure difference between the two chambers. Unlike a pneumatic piston, which uses only gas as the internal fluid, a hydropneumatic piston uses both gas and oil as the internal fluid. This introduces a viscous damping in the movement of the stem within the cylinder.

[0031] A hydropneumatic piston is provided at its two ends 40a and 40b with couplings functional for connecting to the mobile component to be controlled (in this case, the door 10) and to the fixed reference component (in this case, the frame 2).

[0032] Preferably, according to the embodiment as shown in the attached figures, the hydropneumatic piston is provided at its first end 40a with a ball joint coupling and at its second end 40b with a forked coupling. The ball joint is used to compensate for horizontal misalignments resulting from the global installation tolerances of the cabinet.

[0033] A hydropneumatic piston is a linear actuator able to generate a force F along the longitudinal extension axis of the piston, defined hereinafter as the dynamic action axis Y. Such force F may be generated by the piston as a response to both a compression and an extension thereof.

[0034] In particular, the hydropneumatic pistons, unlike mechanical springs, have a curve representative of the force F returned in extension (i.e., following their compression) which is very flat, almost linear, as a function of the stroke of the piston. In other words, when compressed, a hydropneumatic piston 40 generates a substantially constant force F (of extension) as a function of the degree of compression of the piston.

[0035] Preferably, within the scope of the present invention, the ratio between the force F (of extension) generated in the initial phase of compression and the force F (of extension) generated in the final phase of compression is between 1.2 and 1.4.

[0036] Advantageously, as will be explained further on, the fact that a hydropneumatic piston generates, as a result of compression, a substantially constant force F (of extension) as a function of the degree of compression of the piston is functional for solving the problem underlying the present invention.

[0037] According to another essential aspect of the present invention, the aforesaid hydropneumatic piston 40 of the automatic closing system of the door 10 is hinged to the door 10 in an offset position with respect to the rotation axis X through a lever extension 43 which is integral in rotation to the same door 10.

[0038] The offset with respect to the rotation axis X defines an arm B for the force F exerted by the piston 40 on the door 10. The door 10 is therefore subjected to an angular momentum M about the rotation axis X.

[0039] As already mentioned, the hydropneumatic piston 40 follows in rotation the door 10 by varying its own orientation with respect to the frame 2 and the same door. Therefore, during the opening/closing movement of the door 10, the dynamic action axis Y of the piston 40 changes its orientation relative to the rotation axis X, with consequent variation also of the arm B of the force F, as may be seen in Figures 3, 4 and 5. The arm B is, in fact, defined by the perpendicular distance between the aforementioned action axis Y and the rotation axis X.

[0040] Considering that, as already mentioned, the force F generated by the hydropneumatic piston 40 is substantially constant, the value of the angular momentum M therefore varies substantially only according to the value of the arm B of the force F.

[0041] According to the invention, the two hinging points of the hydropneumatic piston 40 on the frame 2 and on the lever extension 43 are positioned with respect to the rotation axis X so that:

- between said closed position and said position of maximum opening of the door 10, the hydropneumatic piston 40 exerts a force F on the lever extension 43 along the dynamic action axis Y thereof, which force always develops about the rotation axis X an angular closing momentum M of the door 10; and
- the perpendicular distance B between the dynamic action axis Y of the hydropneumatic piston 40 and the rotation axis X (which defines the arm of said angular momentum M), decreases as the angular degree of opening of the door 10 about the rotation axis X increases, substantially up to nullifying itself in said predetermined position of maximum opening so that, in such predefined position of maximum opening, the angular momentum M is zero and the door 10 can automatically remain still in equilibrium.

[0042] Operationally, the door 10, once opened and left to the sole action of the hydropneumatic piston 40, will be subjected to a closing angular momentum M about the rotation axis X increasing in value as the angle of opening decreases. If the door 10 is opened until the aforesaid predefined position of maximum opening is reached, the angular momentum M will instead be substantially zero and the door 10 will be automatically held still in equilibrium. The position of maximum opening therefore defines a door stop position.

[0043] Due to the invention, the door stop in a predefined angular position of opening is obtained directly from the door closing system without the need to adopt devices intended to stop the door.

[0044] According to the embodiment illustrated in the attached Figures (in particular in Figure 5), the automatic closing system of the door 10 is sized in such a way that the position of maximum opening, corresponding to the door stop position, is fixed at an angle close to 90°, preferably between 80-85°. At such angular values of opening, the door is almost completely open and the loading operations of the refrigerated cabinet 1 are thus facilitated.

[0045] Moreover, due to the invention, the intensity of the stress applied to the door in closing (defined by the angular momentum M) reaches its maximum when the door is near the closed position, i.e. in the position wherein the closing stress is more functional to ensure a complete and effective closure of the door 10.

[0046] Preferably, the two hinging points of the hydropneumatic piston 40 on the frame 2 and on the lever extension 43 are positioned with respect to the rotation axis X in such a way that even in the closed position said hydropneumatic piston 40 exerts a force F which via said lever extension 43 develops about the rotation axis X an angular momentum M which statically holds the door 10 closed. In this way the automatic closing system guarantees a complete and effective closing of the door 10.

[0047] According to the embodiment of the present invention illustrated in the accompanying figures, the hydropneumatic piston 40 is hinged to the frame 2 at a top portion 2c of the cabinet 1, while the piston 40 is hinged to the door 10 by the aforesaid lever extension 43 at a top portion of the same door. Preferably, the two hinging points are substantially at the same height. In this way, the hydropneumatic piston 40 operates lying on a horizontal plane.

[0048] According to one alternative embodiment not illustrated in the accompanying figures, the hydropneumatic piston may be hinged to the frame 2 at a portion of the support base 2a of the cabinet 1, while the piston 41 is hinged to the door 10 by the aforesaid lever extension 43 at a base portion of the same door. Also in this case, preferably, the two hinging points are substantially at the same height.

[0049] According to the embodiment of the invention illustrated in particular in Figures 2 to 5, the hinging point 40a of the piston 40 on the frame 2 is in a rearward position towards the inside of the cabinet with respect to a vertical plane V defined by the door 10 in the closed position. The rotation axis X lies on the vertical plane V.

[0050] In particular, as shown in Figures 2 to 5, the aforesaid lever extension 43 is sized such that the hinging point 40b of the piston 40 on the door 2 is always in a rearward position toward the inside of the cabinet with respect to the aforesaid vertical plane V, defined by the door 10 in the closed position, for any angular position assumed by the door between the closed position and the position of maximum opening (door stop). In this way it is ensured that between the angular operating positions of the door 10 there is always an arm B for applying force so as to cause an angular momentum M for closing the door.

[0051] Preferably, as shown in Figures 2 to 5, the hydropneumatic piston 40 is positioned rearwardly of the door 10, i.e., at the portion of the frame 2 at which the door 10 closes.

[0052] This simplifies the installation of the closing system on the cabinet 1 since, independently of the position of the door in the cabinet 1, a space for positioning the piston is always provided.

[0053] Moreover, with such an arrangement, the hydropneumatic piston 40 may be installed in such a way that it works in compression, i.e., it exerts its thrust in extension.

[0054] For this purpose, the two hinging points of the hydropneumatic piston 40 on the frame 2 and on the lever extension 43 are positioned relative to the rotation axis X so that the hydropneumatic piston 40 is always compressed in the opening movement of the door between the closed position and the position of maximum opening and always exerts a force F which is directed from the hinging point on the frame 2 toward the hinging point on the lever extension 43 along its dynamic action axis Y.

[0055] Preferably, as shown in Figures 2 to 5, the hydropneumatic piston 4 is hinged to the frame 2 at the cylinder 41 and is hinged to the door 10 (via the lever extension 43) at the stem 42. However, it is also possible to provide for an inverted assembly, i.e. with cylinder 41 on the door 10 and stem 42 on the frame 2.

[0056] Preferably, as illustrated in Figures 2 to 5, the lever extension 43 extends from the door 10 towards the inside of the cabinet 1. In this way, the extension 43 never protrudes with respect to the cabinet 1 but rather is always covered by the door 10.

[0057] Advantageously, the lever extension 43 is not made in one piece with the door frame, but rather consists of a profile fixed to the door by fixing means (such as rivets or screws).

[0058] Preferably, the refrigerated cabinet 1 comprises mechanical limit stop means 50 suitable to define a limit stop for the door having an angular opening value not lower than that corresponding to said position of maximum opening. These mechanical limit stop means 50 are suitable to prevent the door 10 from being forced in opening by stressing the hydropneumatic piston 40.

[0059] In particular, such means 50 are configured so as to define a limit stop for the door in an angular position corresponding to the aforesaid position of maximum opening (or door stop) or in such a way as to define a limit stop for the door in an upper angular position at the aforementioned position of maximum opening (or door stop), but which is within the operational limits of the hydropneumatic piston 40. It is essential that the angular position of limit stop defined by the aforementioned mechanical means 50 is not lower than that corresponding to the position of maximum opening (or door stop). In such case, in fact, the door would be prevented from reaching such position of equilibrium (wherein the angular momentum is substantially zero or in any case not sufficient to overcome the friction) and therefore the automatic closing system would be prevented from defining the door stop.

[0060] Operatively, such mechanical limit stop means 50 are not suitable for holding the door in the maximum opening/door stop position (this function is performed by the closing system, as already described), but are instead suitable to prevent the door 10 from being forced to open beyond the operating limits of the hydropneumatic piston. In this way, it is avoided that, if (even accidentally) the door is forced beyond the aforesaid door stop position, the hydropneumatic piston 40 is subjected to movements and/or stresses outside its operating range. If the door is forced in opening, the stress will be supported by the mechanical limit stop means 50 and not by the hydropneumatic piston 40, thus preventing the piston from being damaged.

[0061] According to the embodiment illustrated in the accompanying figures, the aforesaid mechanical limit stop means 50 are positioned at the lower hinge 30 of the door.

[0062] Preferably, as illustrated in Figures 6 to 9c, the aforesaid mechanical limit stop means 50 comprise in particular:

- a first plate 51 fixed to the door 10 at the lower hinge 30 and integral therewith in rotation about the axis X; on such first plate 51 there is provided a slot 52 having a circumferential arc shape, coaxial with the rotation axis X of the door 10;
- a second plate 53 fixed to the base of the frame 2 and which supports the hinge 30; from this second plate 53 extends a pin 54 which is inserted in the slot 52.

[0063] Operatively, the rotation movement of the door about the axis X causes a relative movement between the pin 54 and the slot 52, as shown in Figures 9a, 9b and 9c. The two ends of the slot define two limit stops for the pin 54. The slot 52 is dimensioned such that one of the two limit stops corresponds to the angular position of the position of maximum opening or to an upper angular position placed within the operating range of the piston 40. In this way, any mechanical stress resulting from an attempt to force the door to open would be releases from the first plate 51 on the pin 54 and then onto the frame 2 of the cabinet.

[0064] According to a further aspect of the invention, the cylinder 41 of the hydropneumatic piston 40 has at least two longitudinal portions with different internal cross-sections.

[0065] More specifically, a first longitudinal portion 41a of the cylinder has a greater internal cross-section than the second longitudinal portion 41b. Due to such configuration, the head 45 of the stem 42 of the piston 40 at such first portion 41a meets a lower sliding resistance than that which it meets in the second portion 41b. Consequently, the head of the stem 42 of the piston 40 may slide faster when it passes into the first portion 41a with respect to when instead it passes into the second portion 42b.

[0066] According to the invention, the hydropneumatic piston 40 is oriented with respect to the rotation axis X in such a way that:

- the head 45 of the stem 42 passes into the aforesaid first portion 41a when the door 10 moves in the angular range of opening between the position of maximum opening and a first predefined intermediate angular position; and
- the head of the stem 42 passes into the aforesaid second portion 41b when the door 10 moves in the angular range of opening between a second predefined intermediate angular position and said closed position.

[0067] Due to the invention, the closing speed of the door 10 is therefore differentiated as a function of the angular position of closure it assumes. Such speed differentiation as a function of the angular position assumed by the door is exploited in such a way that:

- in an initial closing phase (i.e. in positions closer to maximum opening) the door moves faster, so as to reduce closing times and reduce the entry of warm ambient air into the cabinet 1; and
- in a final closing phase (i.e. in positions closer to closing) the door slows down, so as to avoid a violent impact against the cabinet frame.

[0068] Due to the invention, it is therefore possible to realize an automatic door closing system which does not generate impacts between door and frame and at the same time minimizes the closing time of the same door.

[0069] The transition from the initial closing phase (faster) to the final closing phase (slower), i.e., the angular width of these two closing phases, is established during the sizing and installation of the hydropneumatic piston.

[0070] Advantageously, by suitably sizing the internal sections of the cylinder 41 of the hydropneumatic piston, it is possible to differentiate at will the progress of the

closing speed from the position of maximum opening to the closed position.

[0071] The transition from the initial closing phase (faster) to the final closing phase (slower) may be sudden. In other words, the aforesaid first predefined intermediate angular position (i.e., where the faster, initial closing phase ends) coincides with the aforesaid second predefined intermediate angular position (i.e. where the slower, final closing phase begins).

[0072] Preferably, the passage between the two closing phases may be smooth, due to an intermediate closing phase, characterized by intermediate closing speeds, preferably decreasing progressively.

[0073] Due to the presence of an intermediate closing phase, it is possible to provide for a more marked difference in speed between the initial closing phase and the final closing phase, ensuring a more significant reduction of closing time and, at the same time, an impact of the door on the frame as soft as possible, while avoiding sudden changes in the speed of the door when closing, which could excessively stress the mechanical parts of the closing system.

[0074] According to a preferred embodiment, the cylinder 41 of the hydropneumatic piston 40 may comprise an intermediate longitudinal portion 41c which is comprised between the first 41a and the second longitudinal portion 41b. Such intermediate longitudinal portion 41c has an internal connecting cross-section between the sections of said first portion 41a and said second portion 41b, such that, at the intermediate portion 41c, the head of the stem 42 of the piston 40 meets a sliding resistance intermediate with respect to that which it meets in said first portion 41a and that in said second portion 41b and thus slides therein at an intermediate speed.

[0075] Operationally, the hydropneumatic piston 40 is oriented with respect to the rotation axis X such that the head of the stem 42 passes into said intermediate portion 41c when the door 10 moves in the angular range of opening comprised between the aforementioned first predefined intermediate angular position (i.e., where the faster initial closing phase ends) and the aforesaid second predefined intermediate angular position (i.e., where the slower final closing phase begins).

[0076] According to a preferred embodiment of the present invention, the initial (faster) closing phase covers an angular range from 80°-85° (maximum closed position) to 60°-50° (first intermediate position); the intermediate closing phase (decreasing intermediate speed) covers an angular range of 60°-50° (first intermediate position) up to 15°-25° (second intermediate position); the final closing phase (slower) covers the remaining angular range to the closed position, i.e. from 15°-25° to 0°.

[0077] Preferably, the cylinder 41 of the hydropneumatic piston has a longitudinal groove 44 formed on the inner surface of the same cylinder. Such groove 44 extends longitudinally with width and/or depth varying as a function of the longitudinal position for at least a part of the cylinder 41, as shown schematically in Figure 10. Due to this groove 44, it is possible to easily differentiate the internal sections of the cylinder 41 in the various longitudinal portions 41a, 41b, 41c without changing the overall shape of the cylinder.

[0078] Advantageously, the hydropneumatic piston 40 may also act as a damper due to the viscous damping effect provided. This guarantees an impact-resistant effect. If the door is thrown closed with a higher speed than would have occurred if left free to close by itself, it slows down automatically due to the aforementioned viscous damping. The piston 40 then absorbs the extra energy given by the thrust and disperses it in the form of heat.

[0079] A refrigerated cabinet has been constructed with a door equipped with an automatic closing system according to the invention, using a hydropneumatic piston having a ratio equal to 1.21 between the force F (of extension) generated in the initial compression phase and the force F (of extension) generated in the final compression phase.

[0080] For such a specific construction case, the following are shown in the graphs of Figure 10 - depending on the angle of opening of the door and the stroke of the piston stem - the trend of the stress on the door handle in opening (graph B) and in closing (graph C) and the trend of the closing speed (graph V). The trend of the stresses (opening and closing) on the handle reflects the trend of the angular momentum in opening and closing. One may note that the closing stress decreases as the angle of opening of the door increases, until it substantially nullify itself at an angle of opening between 80° and 85°. Such angular values therefore correspond to zero angular momentum or one so low that the friction of the hinges is not overcome. Such trend of angular momentum reflects the fact that the angular momentum varies substantially only as a function of the arm B, which decreases as the angle of opening increases. As already stated, the force F generated by the piston may be considered substantially constant. The closing speed decreases as the closing angle is reduced: it remains at a substantially constant high value from 85° to about 50°, and then progressively decreases to a minimum value at 0°.

[0081] The behavior described in terms of angular momentum at the rotation axis and the closing speed varies according to the following parameters:

- Temperature: the viscosity of the oil inside the hydropneumatic piston varies with the temperature; the variation in viscosity causes the closing speed curve to vary;
- Construction tolerances of the components: they influence both the closing speed and the angular momentum relative to the axis of the door by varying the geometry of the connecting points of the piston with respect to the same axis and consequently the arm of the force determining the momentum.
- Assembly tolerances: the positioning tolerances of the fulcra of the piston determine a change in the

kinematics of the hinge; misalignment of the upper and lower hinges may cause the closing speed to increase or decrease depending on whether the weight of the door is unbalanced toward the inside or the outside of the cabinet.

- Friction: the friction generated in the rotation of the two pins of the hydropneumatic piston and in the rotation of the door about the hinges dissipates part of the energy returned by the piston; the weight of the door itself therefore influences the type of response of the device described.

[0082] The present invention offers several advantages, some of which have already been described.

[0083] The automatic door closing system in the refrigerated cabinet according to the invention allows simultaneously for violent impacts between door and frame to be avoided and for the closing time of the same door to be minimized.

[0084] The automatic door closing system in the refrigerated cabinet according to the invention allows the door to stop in a defined open position without the use of additional door stop devices with respect to the automatic closing system of the door.

[0085] The automatic closing system of the door in the refrigerated cabinet according to the invention is simple and inexpensive to produce as it does not require the installation of complex devices. In particular, it may be achieved with devices (see hydropneumatic pistons) available on the market and less expensive than hydraulic systems.

[0086] Furthermore, the following should be emphasized:

- the slowed down closing of the door only in the end closing angular range allows a lower heat entrance into the cabinet;
- the slowed down closing of the door only in the end closing angular range limits the time in which the space is occupied in the corridor of the store;
- the absence of impacts reduces the noise level at the point of sale where the refrigerated cabinet is installed;
- the absence of impacts extends the useful life of the components directly involved in the impact (gaskets and contact areas;)
- the absence of impacts avoids vibrations, extending the life of all the components in the cabinet;
- The slowdown in the end closing angular range avoids the rebound effect on the adjacent doors; doors closing too fast could, in fact, cause the adjacent doors to open.

[0087] The invention thus conceived therefore achieves the foregoing objects.

[0088] Obviously, in its practical implementation, forms and configurations other than those described above may be also assumed without, for this reason, departing from the present scope of protection.

[0089] In addition, all details may be replaced by technically equivalent elements and the dimensions, shapes and materials used may be of any kind according to the need.

Claims

1. Refrigerated cabinet with one or more automatically closing doors, comprising a support frame (2), which defines a load compartment (3), and at least one door (10) closing said load compartment (3), wherein said door (10) is associated to said frame (2) by hinging means (20; 30) which define a vertical rotation axis (X) about which the door (10) may rotate to move between a closed position and a predefined position of maximum opening, wherein said cabinet (1) comprises an automatic closing system of said at least one door (10), **characterized in that** said automatic closing system comprises a hydropneumatic piston (40) which is hinged - at its two opposite ends (40a, 40b) along a dynamic action axis (Y) thereof - respectively to the frame (2) and to the door (10), wherein said hydropneumatic piston (40) is hinged to the door in an offset position with respect to the rotation axis (X) of the door (10) by means of a lever extension (43) which is integral in rotation with said door (10), wherein the two hinging points of said hydropneumatic piston (40) on the frame (2) and on the lever extension (43) are positioned with respect to the rotation axis (X) in such a way that:

    - between said closed position and said position of maximum opening said hydropneumatic piston (40) exerts a force (F) on the lever extension (43) along its dynamic action axis (Y) which always develops about the rotation axis (X) an angular closing momentum (M) of the door (10) ; and
    - the perpendicular distance (B) between the dynamic action axis (Y) of the hydropneumatic piston (40) and the rotation axis (X), which defines the arm of said angular momentum (M), decreases as the degree of angular opening of the door (10) about the rotation axis (X) increases, substantially up to nullify itself in said predetermined position of maximum opening so that in said predefined position of maximum opening the angular momentum (M) is zero and the door (10) can automatically stay still in equilibrium,

    and in that the cylinder (41) of said hydropneumatic piston (40) has at least two longitudinal portions with different internal cross sections, wherein a first portion (41a) has a larger internal cross-section than the second portion (41b) so that the head of the stem (42) of the piston (40) at said first portion (41a) meets

less resistance to sliding than that it meets at the second portion (41b) and can slide more quickly, said hydropneumatic piston (40) being oriented with respect to the rotation axis (X) in such a way that the head of the stem (42) moves into said first portion (41a) when the door (10) moves in the angular range of opening between said position of maximum opening and a first predefined intermediate angular position and in such a way that the head of the stem (42) moves into said second portion (41b) when the door (10) moves in the angular range of opening between a second intermediate predefined angular position and said closed position.

2. Refrigerated cabinet according to claim 1, wherein the two hinging points of said hydropneumatic piston (40) on the frame (2) and on the lever extension (43) are positioned with respect to the rotation axis (X) in such a way that even in said closed position said hydropneumatic piston (40) exerts a force (F) which via said lever extension (43) develops about the rotation axis (X) an angular momentum (M) which statically holds the door (10) closed.

3. Refrigerated cabinet according to claim 1 or 2, wherein the piston (40) is hinged to the frame (2) at a top portion of said cabinet (1), while the piston (40) is hinged to the door (10) by means of said lever extension (43) at a top portion of said door, preferably the two hinging points of the piston (40) to the frame (2) and to the door (10) being substantially at the same vertical height.

4. Refrigerated cabinet according to one or more of the preceding claims, wherein the hinging point (40a) of the piston (40) on said frame (2) is in a retracted position towards the inside of the cabinet with respect to a vertical plane (V) defined by the door (10) in said closed position, said rotation axis (X) lying on said vertical plane (V).

5. Refrigerated cabinet according to claim 4, wherein said lever extension (43) is sized so that the hinging point (40b) of the piston (40) on said door (2) is always in the retracted position towards the inside of the cabinet with respect to said vertical plane (V) defined by the door (10) in said closed position.

6. Refrigerated cabinet according to one or more of the preceding claims, wherein said hydropneumatic piston (40) is positioned behind said door (10) and wherein the two hinging points of said hydropneumatic piston (40) on the frame (2) and on the lever extension (43) are positioned with respect to the rotation axis (X) in such a way that said hydropneumatic piston (40) is always compressed in the opening movement of the door between said closed position and said position of maximum opening and always exerts a force (F) which is directed from the hinging point on the frame (2) towards the hinging point on the lever extension (43) along its dynamic action axis (Y), preferably said lever extension (43) extending from said door (10) towards the inside of said cabinet (1).

7. Refrigerated cabinet according to claim 6, wherein said hydropneumatic piston (40) is hinged to the frame (2) at the cylinder (41) and is hinged to the door (10) at the stem (42).

8. Refrigerated cabinet according to one or more of the preceding claims, wherein said hydro-pneumatic piston (40) generates a substantially constant compression force (F) as a function of the degree of compression of the piston, preferably the ratio between the force (F) generated in the initial compression phase and the force (F) generated in the final compression phase being comprised between 1.2 and 1.4.

9. Refrigerated cabinet according to one or more of the preceding claims, wherein the cylinder (41) of said hydropneumatic piston (40) comprises an intermediate longitudinal portion (41c) which is comprised between said first (41a) and said second longitudinal portion (41b) and has an internal connection cross-section between the cross-sections of said first (41a) and said second portion (41b), such that at said intermediate portion (41c) the head of the stem (42) of the piston (40) meets a resistance to sliding intermediate compared to that which it meets in said first (41a) and said second portion (41b) and slides therein at an intermediate speed, in which the head of the stem (42) passes into said intermediate portion (41c) when the door (10) moves in the angular opening between said first and said second predefined intermediate angular positions.

10. Refrigerated cabinet according to one or more of the preceding claims, wherein said cylinder (41) has at least one longitudinal groove (44) made on its inner surface, said groove (44) extending longitudinally with a width and/or depth varying as a function of the longitudinal position for at least a part of the cylinder (41), said groove (44) differentiating in the longitudinal direction the dimensions of the internal cross-section of the longitudinal portions (41a, 41b, 41c) of said cylinder (41) .

11. Refrigerated cabinet according to one or more of the preceding claims, wherein said hinging means comprise an upper hinge (20) which is fixed to the top of the frame (2) of said cabinet and a lower hinge (30) which is fixed to the base of the frame (2) of said cabinet (1), wherein said upper hinge (20) and said lower hinge (30) are aligned with each other and de-

fine said rotation axis (X) .

12. Refrigerated cabinet according to one or more of the preceding claims, comprising mechanical limit stop means (50) suitable to define a limit stop for the door having an angular value on opening not less than that corresponding to said position of maximum opening, wherein said mechanical limit stop means (50) are suitable to prevent the door (10) from being forced upon opening, stressing said hydropneumatic piston (40).

13. Refrigerated cabinet according to claims 11 and 12, wherein said mechanical limit stop means (50) are positioned at said lower hinge (30).

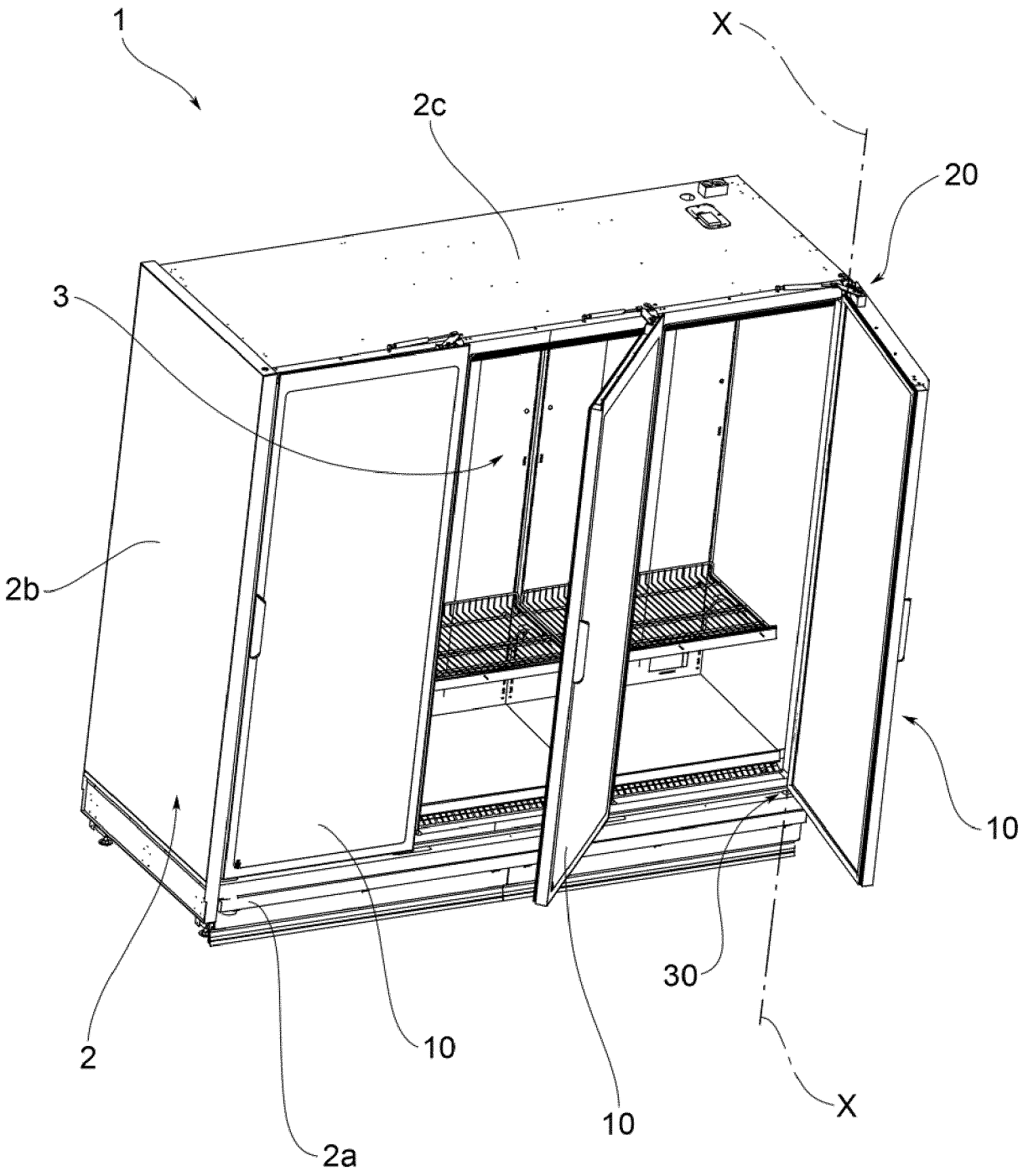


FIG.1

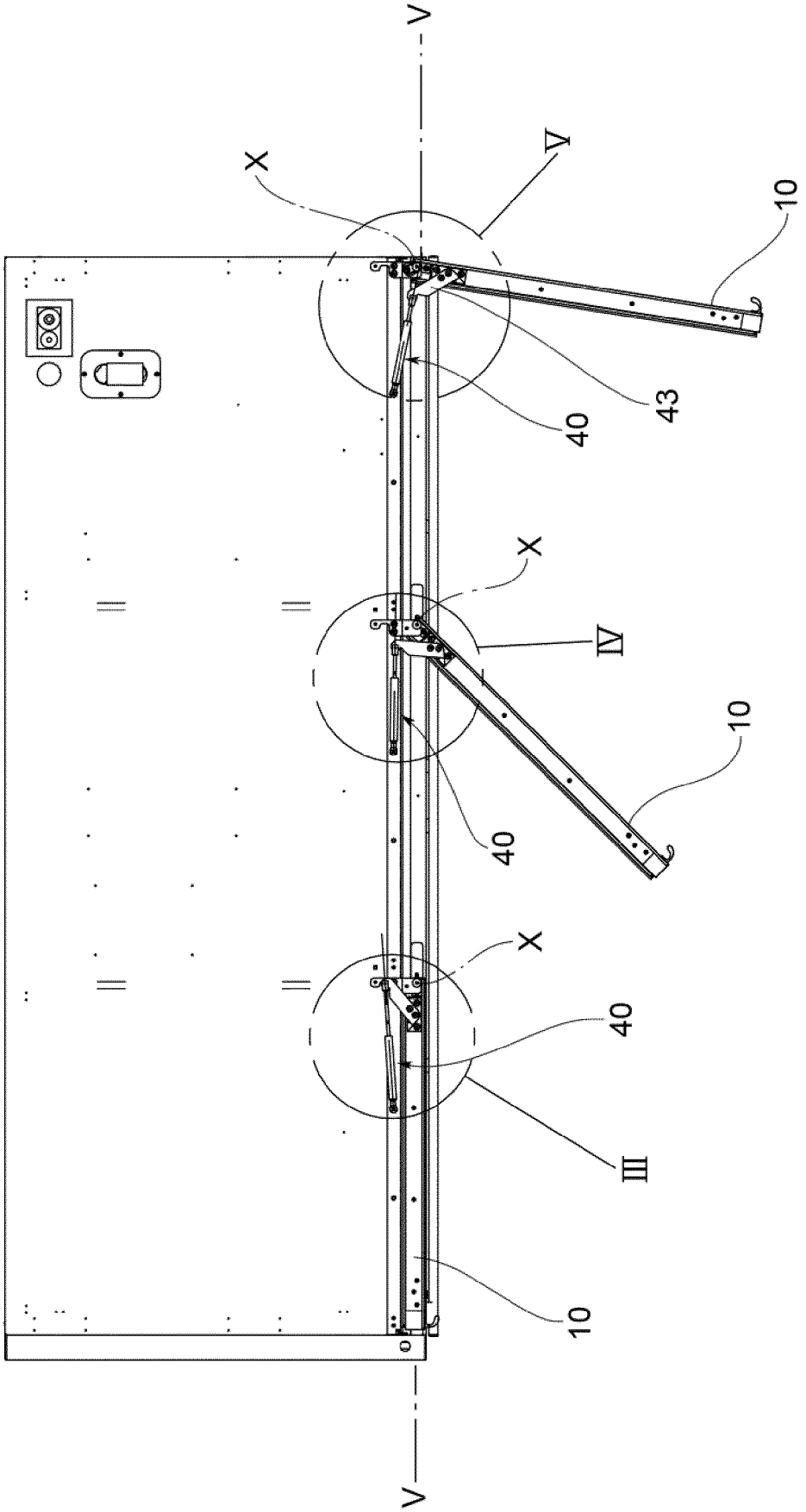


FIG.2

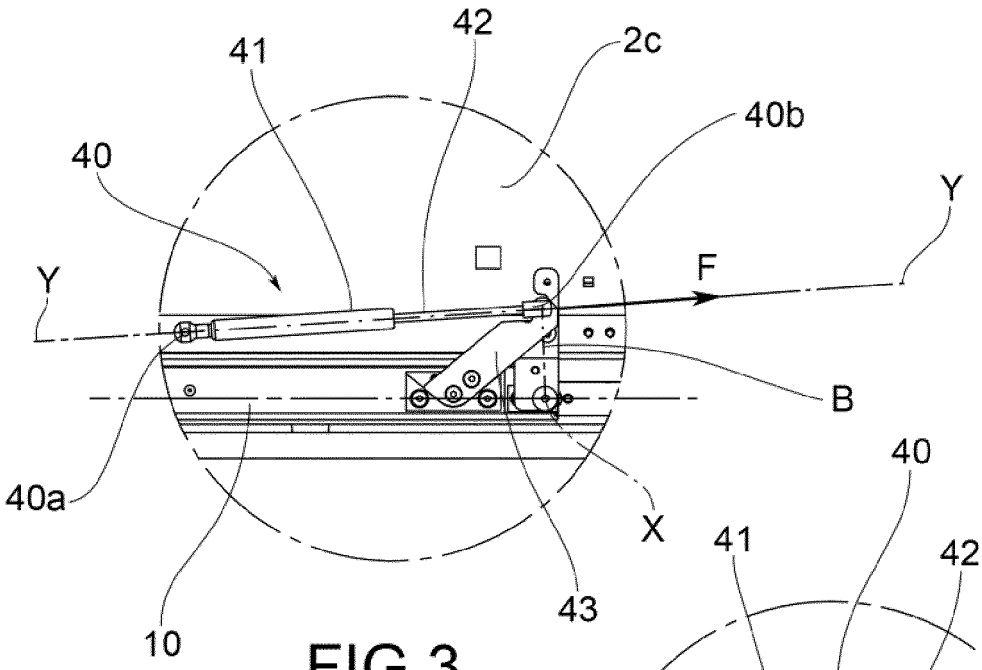


FIG.3

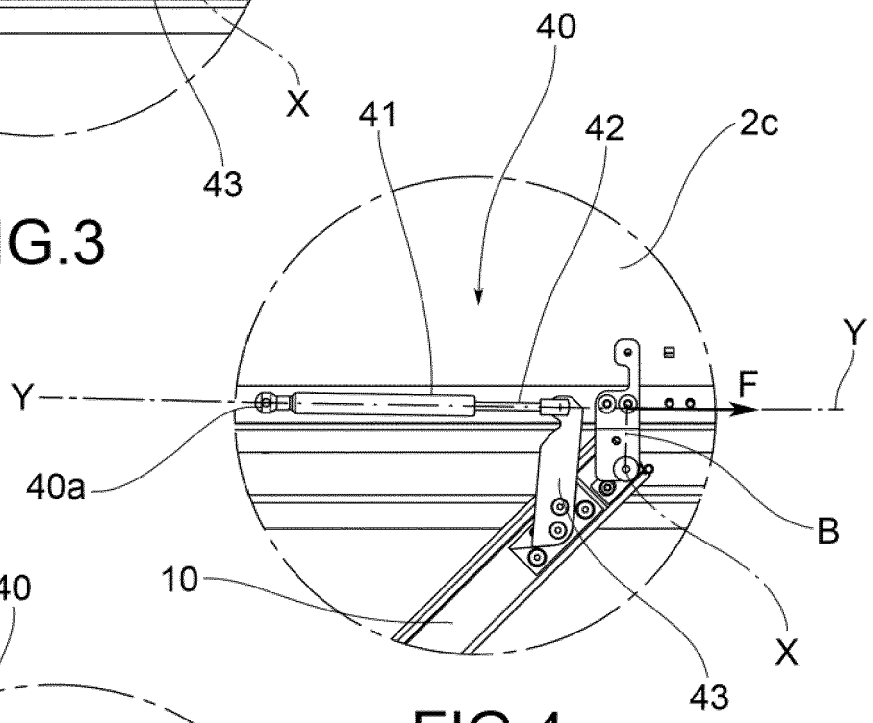


FIG.4

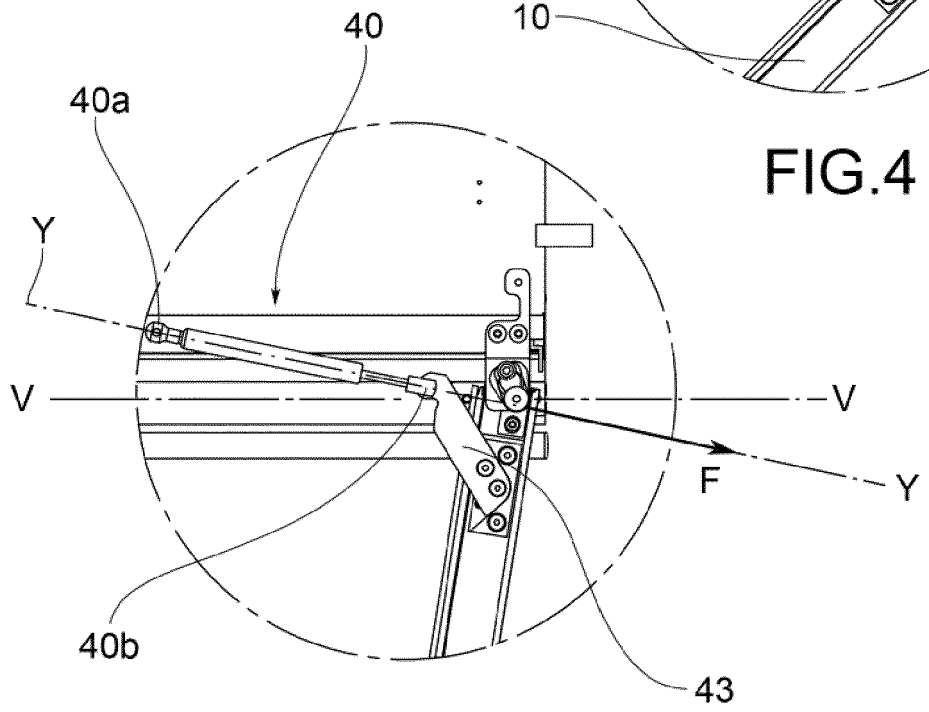


FIG.5

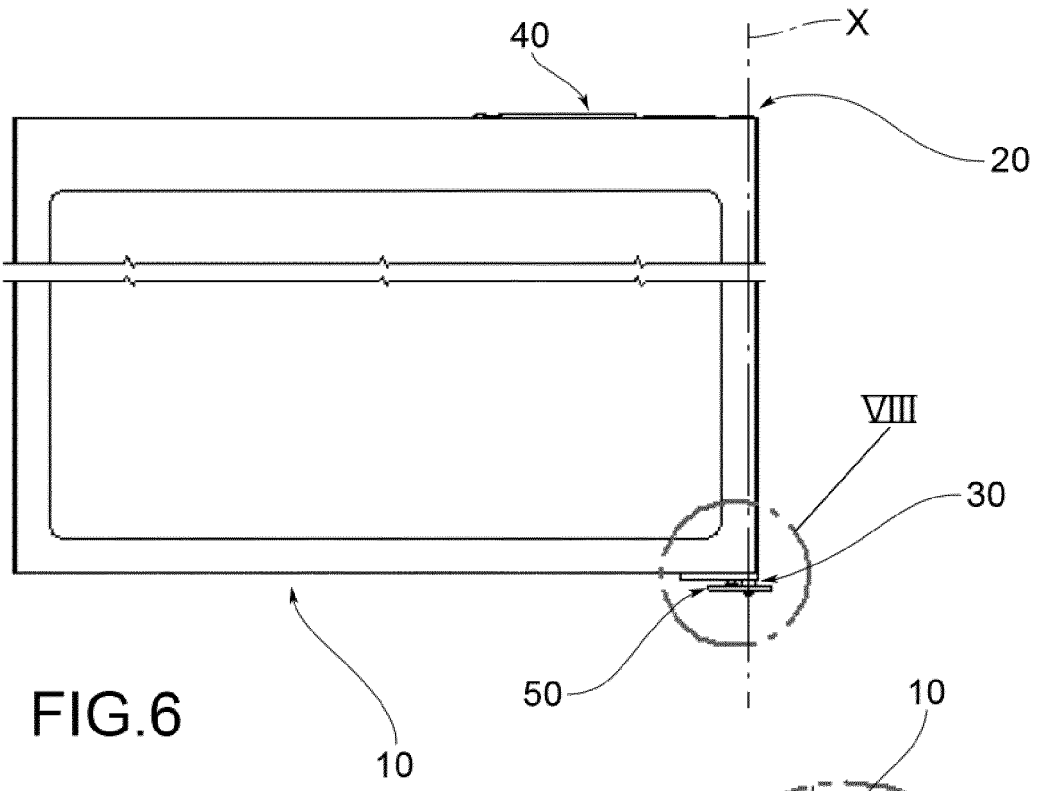


FIG.6

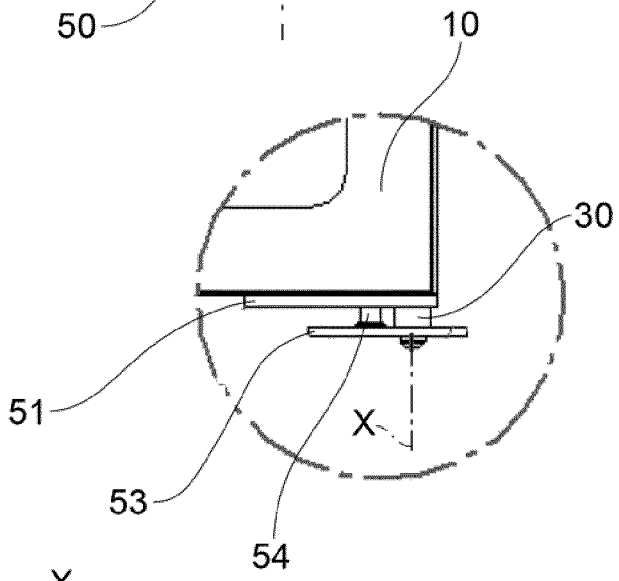


FIG.7

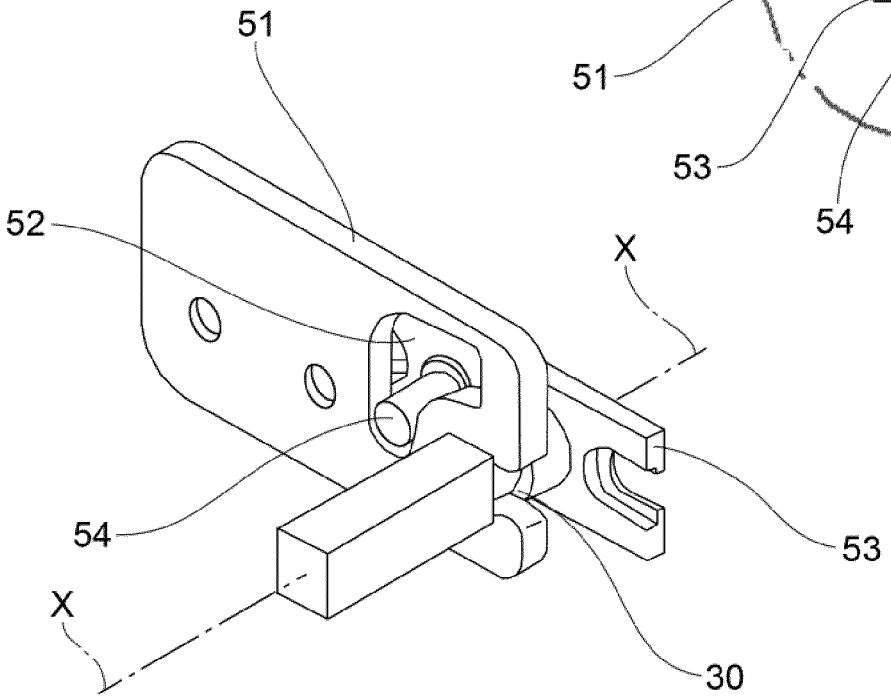


FIG.8

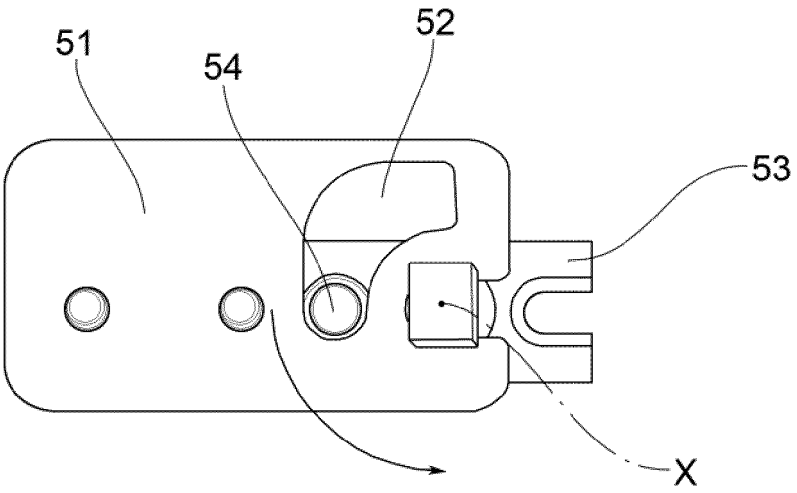


FIG.9a

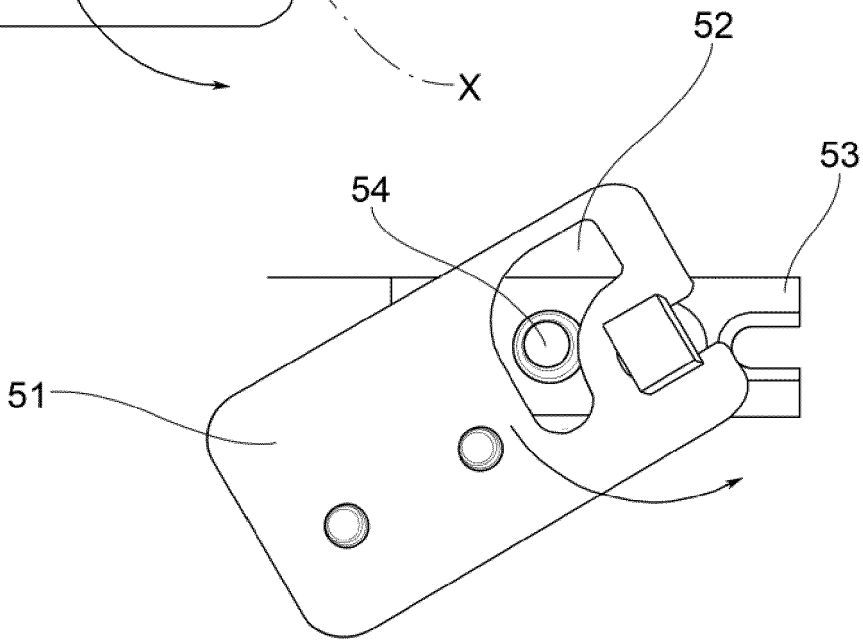


FIG.9b

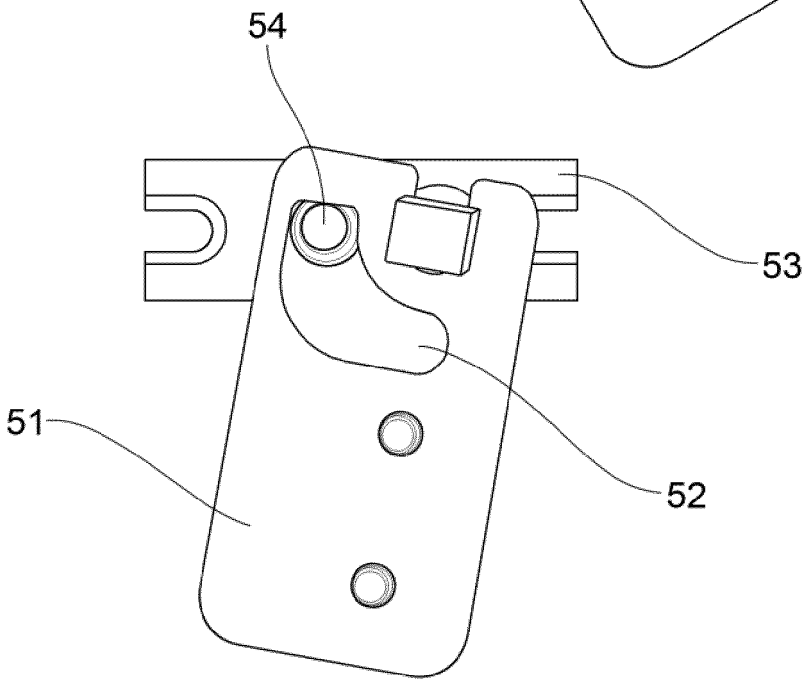
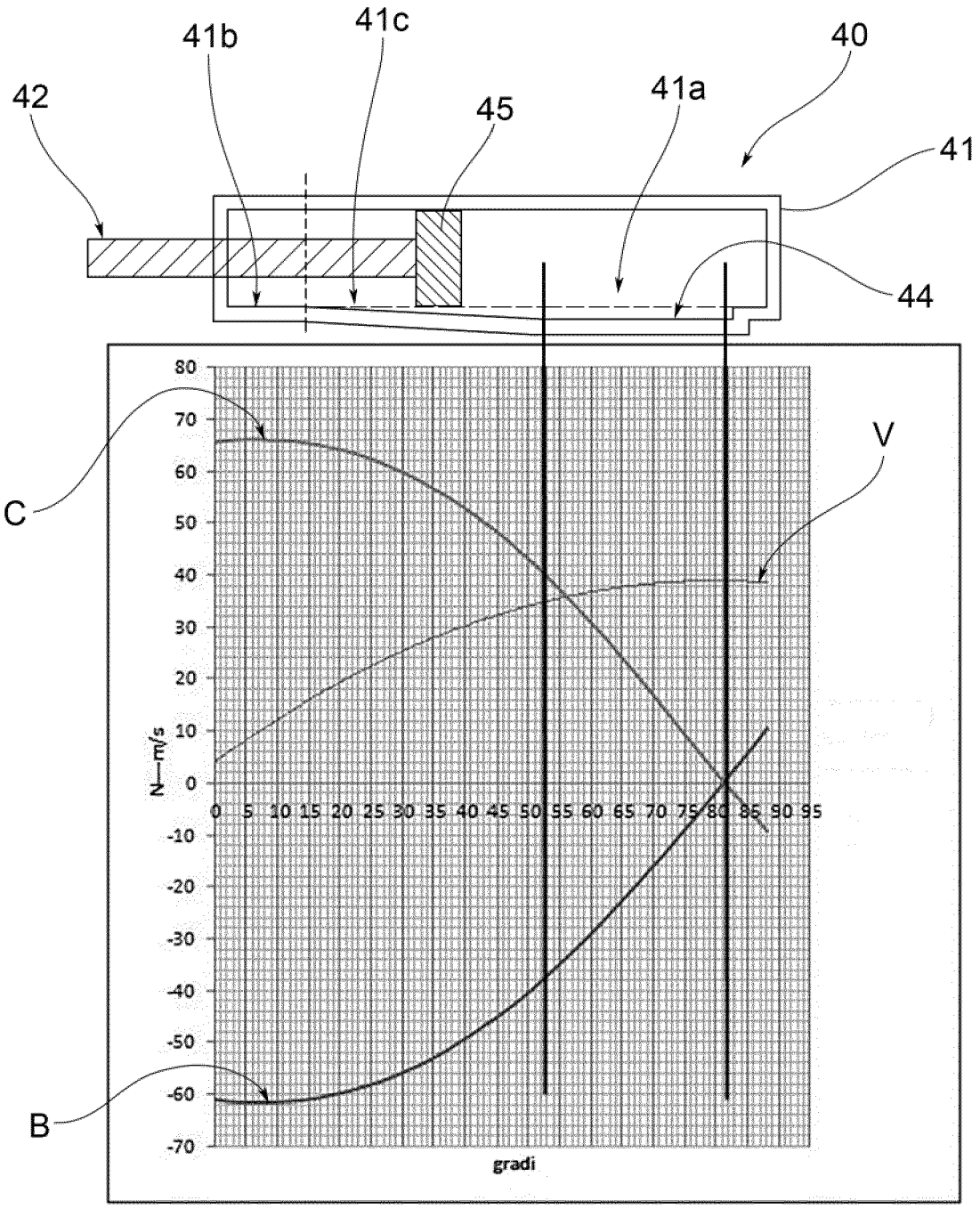


FIG.9c


41b
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41a
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FIG.10

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EUROPEAN SEARCH REPORT

Application Number
EP 18 15 8693

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
Y	JP H06 263186 A (ASAHI GLASS CO LTD) 20 September 1994 (1994-09-20) * abstract; figures *	1-3,7,9, 11	INV. A47F3/04 E05F1/10 E05F1/12
Y	CN 2 171 663 Y (ZHANG MINGQUAN [CN]) 13 July 1994 (1994-07-13) * figure 6 *	1-3,7,9, 11	E05F3/22
A	US 2008/189906 A1 (RESNIK CORINNE [DE] ET AL) 14 August 2008 (2008-08-14) * figure 2 *	1	

TECHNICAL FIELDS SEARCHED (IPC)

A47F
E05F
F25D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	20 June 2018	Canköy, Necdet

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20-06-2018

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
JP H06263186 A	20-09-1994	NONE	
CN 2171663 Y	13-07-1994	NONE	
US 2008189906 A1	14-08-2008	CN 101166882 A	23-04-2008
		DK 1875027 T3	18-09-2017
		EP 1875027 A1	09-01-2008
		ES 2637513 T3	13-10-2017
		JP 2008539346 A	13-11-2008
		KR 20080002821 A	04-01-2008
		PL 1875027 T3	30-11-2017
		SI 1875027 T1	29-12-2017
		US 2008189906 A1	14-08-2008
		WO 2006114255 A1	02-11-2006

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