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## (54) Opening mechanism for sliding doors

(57) Opening mechanism (11a, 11b) for each of a plurality of doors (12) of a furniture unit (10) arranged alongside each other in the closed position and provided with travel means (32a, 32b), comprising a frame (40a, 40b) extractable from the furniture unit with a horizontal movement so as to displace one door with respect to an adjacent door, a horizontal support element (20a, 20b), joined to the frame, for the travel means. The mechanism is characterized in that the door comprises a first auxiliary guide (22a, 22b) which is parallel to the support guide and offset depth-wise with respect to the latter by an amount equivalent to the horizontal movement of the frame, so that extraction of the door (12A) results in alignment of the auxiliary guide with the guide joined to the frame of the adjacent door (12C), producing from the two guides thus aligned a section (22a, 22b) along which the travel means are able to travel, causing the extracted door (12A) to be arranged over the adjacent door (12C).

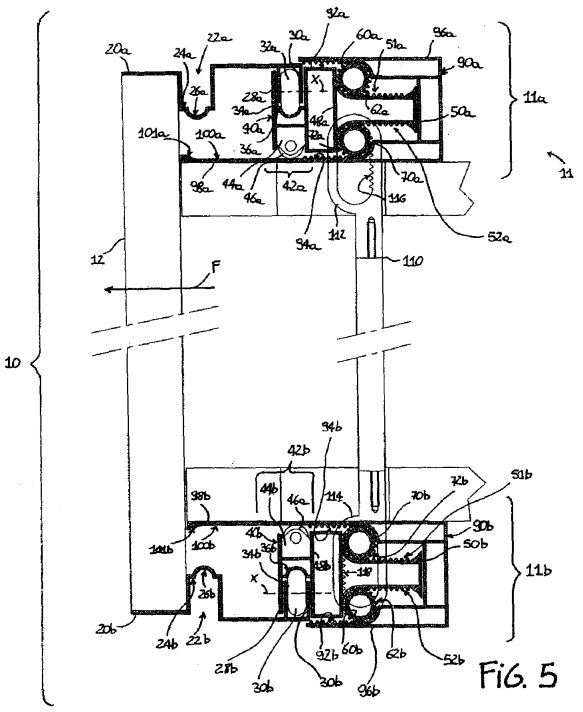

Fig. 5

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## Description

**[0001]** The present invention relates to an opening mechanism for sliding doors, in particular of cupboards.

**[0002]** For the opening of cupboard doors, to which reference will be made by way of example, hinging systems or systems sliding on guides are very widespread on the market. The first systems, which are used in particular with doors which, when closed, are coplanar, are strong and simple to build, but require a considerable amount of free space in front of the cupboard, to allow opening of the doors. Clearly, in small dwellings and/or in the case of very wide doors, this results in wastage of space. The second systems can be divided into sliding opening systems with doors arranged over each other and sliding opening systems with coplanar doors. The systems with doors arranged over each other are strong, but not pleasing from an aesthetic point of view because the doors, sliding one behind the other on two fixed separate guides which are offset depth-wise, in the closed position are not coplanar but arranged alongside each other in two parallel planes. Apart from leaving visible a corner of the door which is potentially dangerous, this system tends to allow dust to enter into the cupboard through the gap between the two closed doors.

**[0003]** Systems with coplanar doors use extraction mechanisms so that the door is free to slide in front of the adjacent door so as to become coplanar with the latter once closed. An example of this latter system with coplanar doors is the mechanism described in the patent IT1192099. Here each door of the cupboard is fixed by means of flanges to roller wheels travelling on the inner edge of two U-shaped guides, i.e. an upper guide and lower guide, which by means of a frame with rocker arm and carriages are kept always parallel to each other and may be displaced horizontally with respect to the body of the cupboard along the direction of its depth. When the door is extracted, the inner edge of its guide is aligned with the outer edge of the guide of the adjacent closed door. The extracted door is able to slide on the two edges thus aligned, being arranged in front of the adjacent closed door. In this solution the rocker arm and carriage frame is very complicated, may jam and is costly.

**[0004]** Another known system, which is similar to the previous system, comprises two doors which are each supported by oscillating arms on four carriages, two of which are slidable on the top and on the bottom of the cupboard along a guide fixed to the cupboard and extending along the whole front side thereof. The oscillating arms may extend with respect to the carriage, thus causing the depth-wise displacement of one door with respect to the other one. In order to arrange one door over the other one, the displaced door is pushed edgewise with consequent travel of the four carriages inside the guide from one end to the other one. In this case also, the construction with the four carriages is complicated and costly. Moreover, as also occurs in the above case, the displacement operation is often difficult to perform because of the vibrations affecting the door, the difficulty in correct alignment of the guides and the imperfect synchronization between the upper and lower guides (or carriages).

**[0005]** Another major disadvantage of the known systems is that only two doors may be arranged over each other such that the number of doors which may be open simultaneously is limited.

**[0006]** The main object of the present invention is therefore to provide an opening mechanism for sliding doors which does not have these drawbacks.

**[0007]** These and other objects are achieved by means of an opening mechanism for each of a plurality of doors of a furniture unit, arranged alongside each other in the closed position and provided with sliding travel means, comprising:

- a frame extractable from the furniture unit with a horizontal movement so as to displace one door with respect to an adjacent door;
- a horizontal support guide, joined to the frame, for the travel means;

characterized in that the door comprises a first auxiliary guide which is parallel to the support guide and offset depth-wise with respect to the latter by an amount equivalent to the horizontal movement of the frame, so that extraction of the door results in alignment of the auxiliary guide with the guide joined to the frame of the adjacent door, producing from the two guides thus aligned a section along which the travel means are able to travel, causing the extracted door to be arranged over the adjacent door.

**[0008]** The advantages of the invention will emerge more clearly from the following description of an example of embodiment thereof for a cupboard, illustrated in the accompanying drawings, in which:

Fig. 1 shows a view of a cupboard provided with a mechanism according to the invention having a door open and arranged over a closed adjacent door;
Fig. 2 shows a view of the cupboard in Fig. 1 with the two doors closed;
Fig. 3 shows a partial view with the doors closed from an angle different from that shown in Fig. 2;
Fig. 4 shows a partial view with the doors open from an angle different from that shown in Fig. 1;
Fig. 5 shows a vertical section through the cupboard along the plane V-V in Fig. 2;
Fig. 6 is a cross-section similar to that of Fig. 5, but showing the door when it is extracted;
Fig. 7 shows, enlarged, the detail enclosed in the circle M shown in broken lines in Fig. 4;
Figs. 8a, 8b and 8c show schematic plan views of a cupboard provided with a mechanism according to the invention, with the four doors closed, with two doors extracted and with three doors extracted, respectively.

**[0009]** In Figs. 1 and 2, 10 denotes a cupboard which has two identical sliding doors 12, the closed one of which is denoted in Fig. 1 by 12C ("C" standing for closed) so as to distinguish it from the other door when it is open, the latter being indicated by 12A, and which incorporates a mechanism 11 according to the invention by means of which one of the two doors 12 can be extracted and arranged over the other door (Fig. 1).

**[0010]** If we now consider the following figures, these show in greater detail a cross-sectional view of the mechanism 11 according to the invention which consists of two modules 11a, 11b which are a mirror-image of each other in the direction of the height of the cupboard 10. Therefore, identical components will be indicated by the same number, the parts at the bottom being distinguished from the parts at the top by the suffixes "a" and "b" respectively. For the sake of simplicity only the module 11a will be considered.

**[0011]** The module 11a comprises - see Fig. 5 - five elements: a support element 20a, a horizontally oscillating element 40a, two identical coupling elements 60a, 70a and a fixed containing element 90a. These elements are fixed at the top and at the bottom of the cupboard 10 and extend substantially over the entire width of a door, having moreover a constant cross-section. The set of elements 40a, 60a, 70a, 90a forms a frame which is extractable from the cupboard with a horizontal movement, useful for positioning the door 12A so that it is displaced with respect to the adjacent door 12C in a direction perpendicular its plane of lie.

**[0012]** The door 12 is supported and fixed to the support element 20a which at the top has a horizontal groove 22a with at the bottom 24a thereof a concavity 26a, and an end with two vertical flanges 28a, 30a to which a roller wheel 32a with an axis of rotation X perpendicular to the door 12 is rotatably fixed. The two flanges 28a, 30a are contained in a support guide 34a (for example a groove) of the coupling element 40a, which is geometrically identical in terms of its form and its bottom 36a to the groove 22a. The coupling element 40a is composed of three parts:

- a head 42a which has, formed therein, at the top the guide 34a and at the bottom flanges 44a (only one of which is shown) for rotatably fixing onto each of them a roller wheel (only one of which is shown) with its axis of rotation parallel to the plane of lie of the door 12;
- a central body with a rectangular cross-section 48a;
- an elongated end part 50a which is tapered towards the back of the cupboard and on which a set of upper teeth 51 and a set of lower teeth 52a are provided.

**[0013]** These two sets of teeth 51a, 52a are engaged, respectively, by the two coupling elements 60a and 70a which are hollow cylinders with respective sets of teeth 62a, 72a on their surface. The two coupling elements 60a and 70a engage respectively also with two sets of horizontal teeth 92a, 94a provided on two parallel and horizontal surfaces 96a, 98a of the containing element 90a. The latter has the form of a U, with the surfaces 96a, 98a forming the two parallel arms of the U. The surface 98a, below the surface 96a, is longer and its smooth portion 100a, adjacent to the teeth 94a, forms a supporting and travel surface which is delimited by a stop 101a for the roller wheel 46a. The two modules 11a, 11b of the mechanism 11 are joined together and synchronized by means of a vertical bar 110, the ends of which are provided with two eyelets 112, 114 having respective internal teeth 116, 118. The two coupling elements which are closest to one another, 70a, 70b, are inserted, with a corresponding section, into the eyelets 112, 114 and mesh with the internal teeth 116, 118 of the latter. Therefore, an anti-clockwise rotation of the profile 70a results in raising of the bar 110 and a corresponding rotation of the profile 70b in the same direction and in a synchronized manner (the bar 110 therefore acts as a mechanical transmission system). The bar 110 may be engaged with the profiles 70a, 70b at their ends, also passing through suitable openings (and/or shapes) in the profiled parts.

**[0014]** Fig. 6 shows the same mechanism 11 after the door 12A has been extracted and positioned over the closed door 12C (in the drawings the opening movement corresponds to a movement to the left - see arrow F in Fig. 5). Comparing Fig. 5 with Fig. 6 the operating principle of the mechanism 11 is self-explaining. Extraction of the door 12C towards the outside of the cupboard 10 (to the left in Fig. 6) causes the movement of the roller wheels 46a, 46b in the same direction as far as the respective stops 101a, 101b on the surfaces 100a, 100b which is accompanied by the travel movement, in the same direction, of the coupling elements 60a, 70a and 60b, 70b on the teeth 92a, 94a and 92b, 94b, respectively. As the coupling elements 60a, 70a and 60b, 70b rotate, meshing with the teeth 92a, 94a, 51a, 52a and 92b, 94b, 51b, 52b, respectively, the toothed end parts 50a, 50b also move in the direction F and the bar 110 is raised. In fact, the two coupling elements 70a, 70b rotate in an anti-clockwise direction and mesh with the teeth 116, 118 in the eyelets 112, 114 along a toothed arc with a rising motion. The perfectly synchronous movement of the moving parts in the two modules 11a, 11b is ensured by the rod 110 which, forcing the four coupling elements 60a, 70a, 60b, 70b to rotate in synchronism, allows the elements 40a, 40b to move together. This eliminates oscillating movements of the door during the displacement movement. Obviously the coupling elements 70a, 70b may mesh with the teeth of a rigid connecting body which may also have a different form, or by means of a chain or belt.

**[0015]** When the door 12C is extracted completely, the groove 22a (22b) is aligned with the corresponding groove in the adjacent door 12C - see Fig. 6. Therefore, a continuous guideway is formed for the roller wheel 32a (32b), extending along the two doors, i.e. the door just extracted 12 and the closed adjacent door 12C. It is there-

fore sufficient to pull the extracted door 12 sideways in order to cause the roller wheel 32a (32b) to travel in the guide formed by the two grooves 22a (22b) and consequently arrange it in front of the adjacent closed door 12C - see also Fig. 1 and Fig. 4.

**[0016]** It is clear from the figures that the extracted door, namely the door which opens, is coupled with the door 12C by means of the flanges 28a, 30a, (28b, 30b) and the roller wheels 32a (32b) which are inserted so as to travel inside the guideway 22a(22b) of the door 12C. The latter also supports the door 12.

**[0017]** The invention may thus also be applied to cupboards with more than two doors. By enabling the oscillating element 40a (40b) and the two coupling elements 60a, 70a (60a, 70b) to perform a horizontal travel movement with various intermediate stable positions, the position of the extracted door 12 may be displaced (offset) depth-wise into positions which are increasingly distant from the closed door 12C. For example, in the case of a cupboard with doors, a first extracted door may be arranged over and coupled with a second adjacent closed door, and the first and second door together may be extracted so as to be arranged over and coupled with a third door, which is closed and adjacent to the second door, and so on. With the set of three doors, the first door is arranged on the second door and the second door on the third door, which is closed. The first door is then extracted with a displacement equal to about twice that of the second door, in view of the thicknesses of the second and third doors. The method may also be applied to any number of doors, provided that the horizontal travel movement of the oscillating element 40a (40b) is adapted.

**[0018]** Another possibility offered by the invention is being able to extract more than one door at a time. For example, in a cupboard 200 with four doors 210, 212, 214, 216, as shown in Fig. 8a, it is possible to extract two adjacent doors 210, 212 and then arrange them in front of the other two closed doors 214, 216, respectively - see Fig. 8b. In this case, therefore, the extracted door 210 has a travel movement which is half the length of the cupboard 200, something which is not possible with the known opening mechanisms. By adapting the outwards displacement of the extraction mechanism it is also possible to position the two doors 210, 214 arranged on top of each other - one being already extracted and the other still closed - in front of the doors 212, 216 - see Fig. 8c, thus allowing simultaneous access to the inside of the cupboard over three quarters of its width.

**[0019]** Providing an auxiliary guide on a door - instead of incorporating it into the frame as in the prior art - in addition to simplifying the mechanical structure of the frame, eliminates the limitation of being able to arrange only two doors on top of each other. In fact, the extracted door may be arranged over an adjacent door, which therefore acts as a support, remaining coupled with the latter. The set of two doors is connected to the cupboard only by means of the sliding coupling means of the supporting door which supports the extracted and laterally displaced door. If this supporting door, in turn, is extracted and displaced, it will be coupled with another door and will transport, together with it, the door which it is supporting. By virtue of this, the horizontal depth-wise displacement of the frame must correspond in the various cases to the distance needed to align the support and auxiliary guides of the two doors involved in the opening sequence, namely the displaced door and the door which receives it. Therefore, a door may comprise at least one second auxiliary guide parallel to the support guide and offset depth-wise with respect to the latter by an amount equal to a horizontal movement of the frame which is necessary for extraction of the door beyond two or more doors already superimposed to ensure alignment of the at least one second auxiliary guide with a support guide on the frame of the adjacent door already superimposed, producing from the two aligned guides a section along which the coupling means are able to travel, causing the extracted door to be arranged over the (already) superimposed adjacent door.

**[0020]** Advantageously the guide may be constructed in a very simple manner in order to keep to a minimum the components and the costs. If the guide is formed with a groove on the door, the complexity of the mechanism is further reduced and the reliability increased.

**[0021]** Other variants are nevertheless included within the scope of protection of the following claims.

## Claims

1. Opening mechanism (11a, 11b) for each of a plurality of doors (12) of a furniture unit (10) arranged alongside each other in a closed position and provided with sliding travel means (32a, 32b), comprising:

   - a frame (40a, 40b) extractable from the furniture unit with a horizontal movement so as to displace one door with respect to an adjacent door;
   - a support element (20a, 20b), joined to a support guide (34a, 34b) on the frame by means of the travel means;

   **characterized in that** the door comprises a first auxiliary guide (22a, 22b) which is parallel to the support guide and offset depth-wise with respect to the latter by an amount equivalent to the horizontal movement of the frame, so that extraction of the door (12A) results in alignment of the auxiliary guide with the guide joined to the frame of the adjacent door (12C), producing from the two guides thus aligned a section (22a, 22b) along which the travel means are able to travel, causing the extracted door (12A) to be arranged over the adjacent door (12C).

2. Mechanism (11a, 11b) according to Claim 1, wherein

the door comprises at least one second auxiliary guide, parallel to the support guide and offset depthwise with respect to the latter by an amount equal to the horizontal movement of the frame necessary for extraction of the door beyond two or more adjacent doors already arranged over each other to cause alignment of the at least one second auxiliary guide with the support guide on the frame of an adjacent door already superimposed, producing from the two aligned guides a section along which the travel means are able to travel, positioning the extracted door in front of the outermost adjacent door already superimposed.

**3.** Mechanism (11a, 11b) according to Claims 1 or 2, wherein each auxiliary guide is formed with a groove on the door.

**4.** Mechanism (11a, 11b) according to Claim 3, wherein the groove is formed superficially in the support element (20a, 20b) which supports the door.

**5.** Mechanism (11a, 11b) according to any one of the preceding Claims, wherein the frame extractable from the furniture unit comprises a containing element (90a, 90b) which is fixed to the furniture unit and from which a horizontally oscillating element (40a, 40b) which supports the door extends.

**6.** Mechanism (11a, 11b) according to Claim 5, wherein at least one mechanical coupling element (60a, 70a, 60b, 70b) is arranged between the oscillating element (40a, 40b) and the containing element (90a, 90b).

**7.** Mechanism (11a, 11b) according to Claim 6, wherein an assembly formed by a containing element (90a, 90b) fixed to the furniture unit, at least one coupling element (60a, 60b) and a horizontally oscillating element (40a, 40b) is arranged along the horizontal sides of each door and extends substantially along the whole width of the said door.

**8.** Mechanism (11a, 11b) according to Claims 6 or 7, wherein the coupling element (60a, 60b), the oscillating element (40a, 40b) and the containing element (90a, 90b) have a constant cross-section.

**9.** Mechanism (11a, 11b) according to any one of Claims 5 to 8, wherein the oscillating element (40a, 40b) comprises a head (42a, 42b) in which a groove (34a, 34b) is formed at the top, the head being integral with an elongated end part (50a, 50b) on which a set of upper teeth (51a, 51b) and a set of lower teeth (52a, 52b) are present.

**10.** Mechanism (11a, 11b) according to any one of Claims 5 to 9, wherein the containing element (90a, 90b) has a U-shaped cross-section, with horizontal surfaces (96a, 98a, 96b, 98b) forming the two parallel arms of the U having respective facing teeth (92a, 94a, 92b, 94b) on their surface.

**11.** Mechanism (11a, 11b) according to Claim 10, wherein one of the two horizontal surfaces is longer than the other one and comprises a smooth portion (100a, 100b) adjacent to the respective set of teeth (94a, 94b).

**12.** Mechanism (11a, 11b) according to Claim 11, wherein the smooth portion forms a supporting and travel surface, delimited by a stop (101a, 101b), for a roller wheel (46a, 46b) fixed rotatably onto the head of the oscillating element and with its axis of rotation parallel to the plane of the door.

**13.** Mechanism (11a, 11b) according to any one of Claims 9 to 12, wherein the coupling element (60a, 60b, 70a, 70b) is a cylinder with a set of teeth (62a, 72a, 62b, 72b) on its surface which meshes with the teeth of the oscillating element and the containing element.

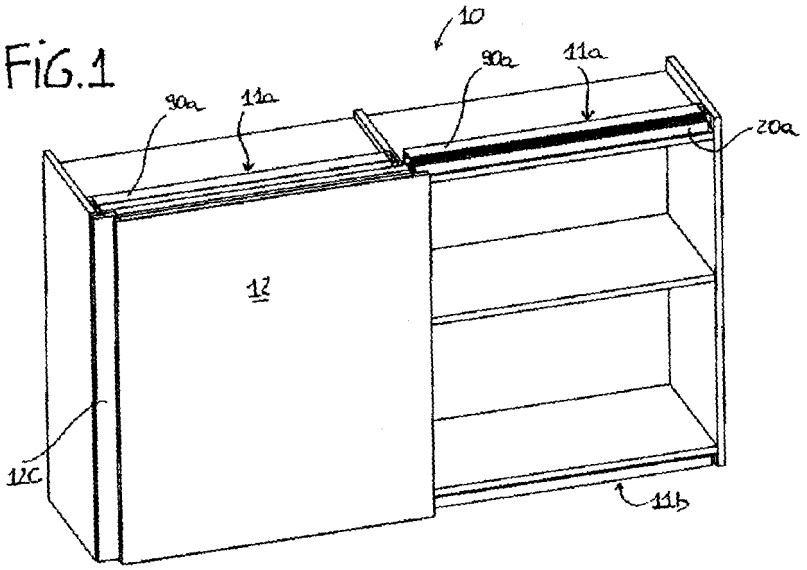
**14.** Mechanism (11a, 11b) according to any one of Claims 9 to 13, wherein the support element at one of its ends directed towards the furniture unit has, rotatably fixed, a roller wheel (32a, 32b) with an axis of rotation (X) perpendicular to the door and travelling in the longitudinal groove formed in the head of the oscillating element.

**15.** Mechanism (11a, 11b) according to any one of Claims 6 to 14, wherein the coupling elements are synchronized by means of a mechanical transmission system.

**16.** Mechanism (11a, 11b) according to Claim 15, wherein the mechanical transmission system is formed by a rigid bar (110) comprising teeth (116, 118) which mesh simultaneously with the teeth of the coupling elements.

**17.** Furniture unit (10) comprising a sliding opening mechanism for a door made according to any one of the preceding claims.

FIG.1



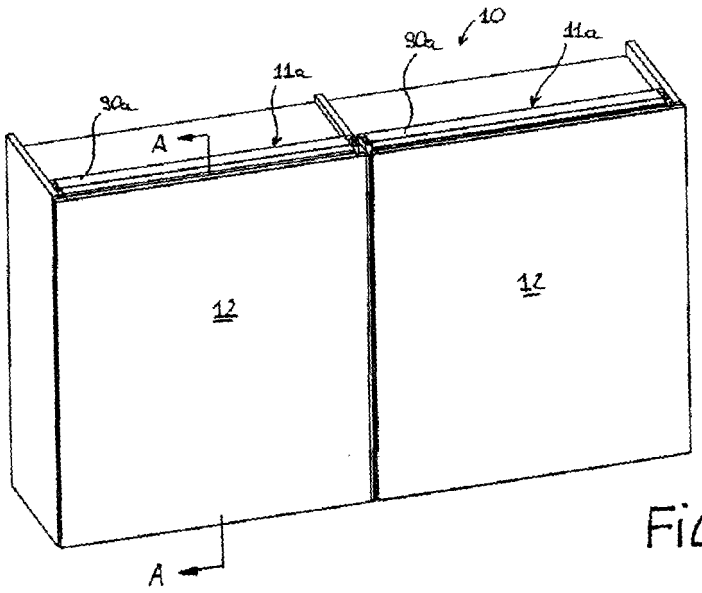




FIG. 2

FIG. 3

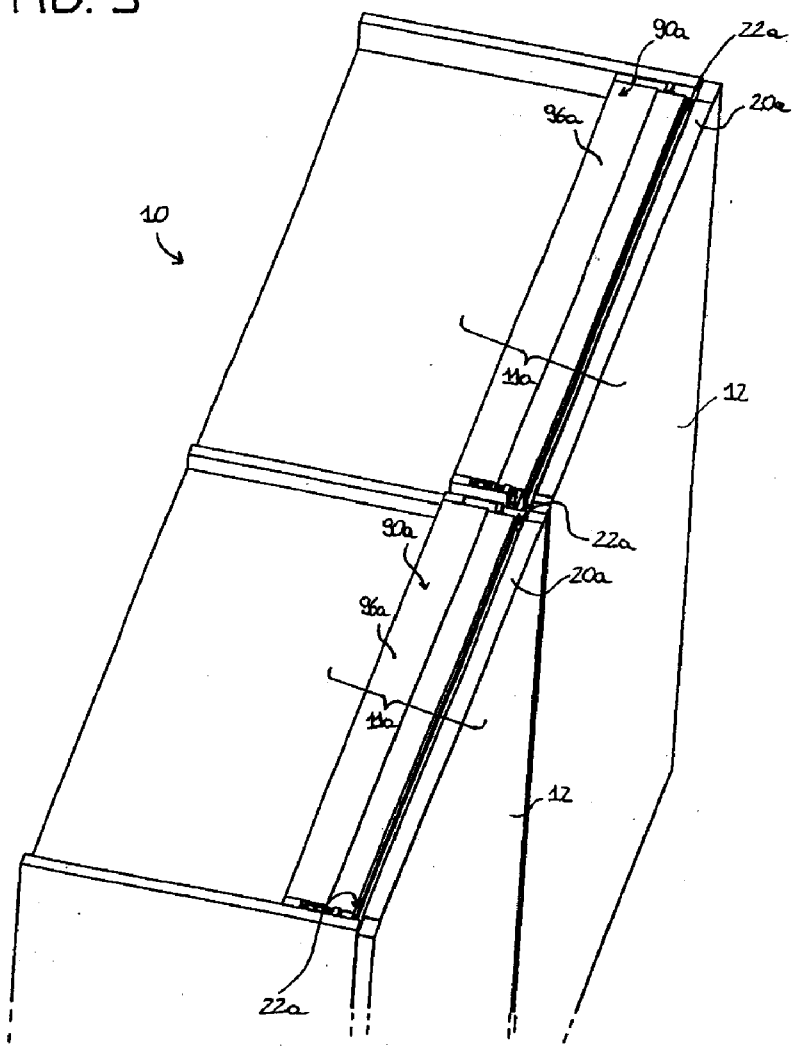
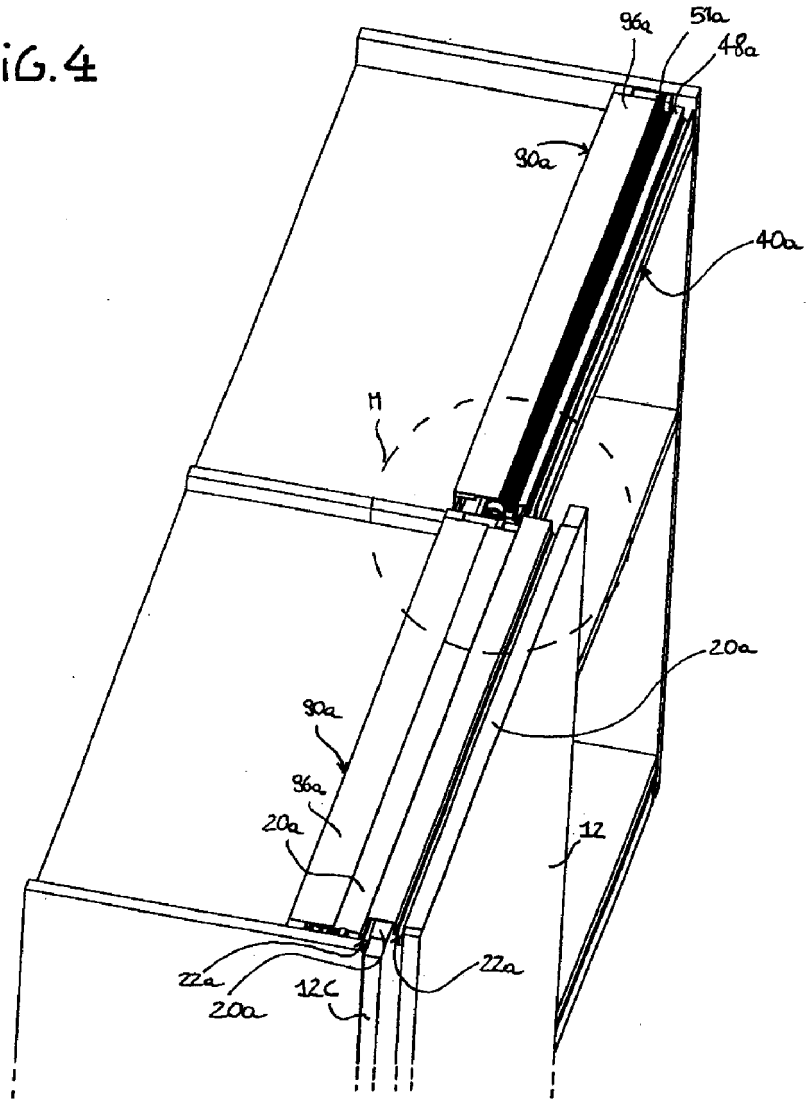


FIG. 4



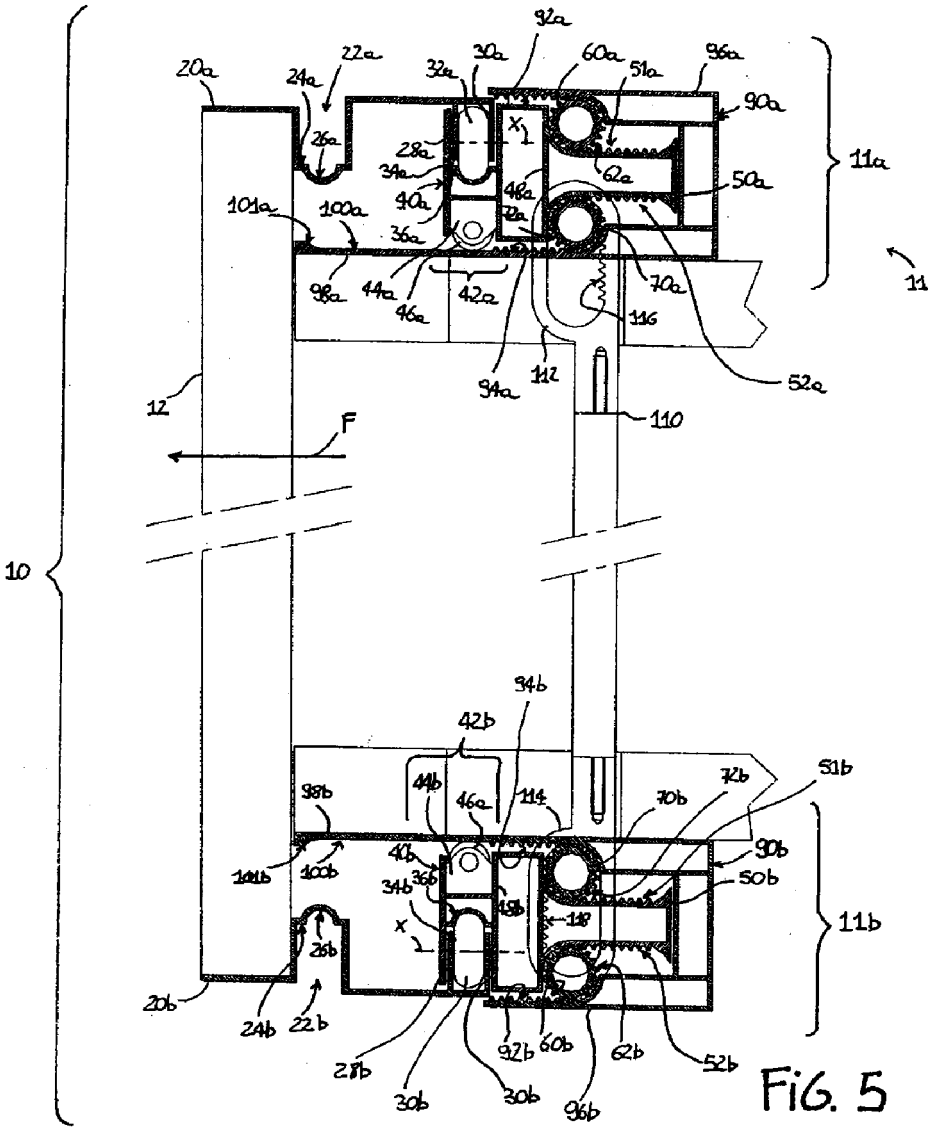

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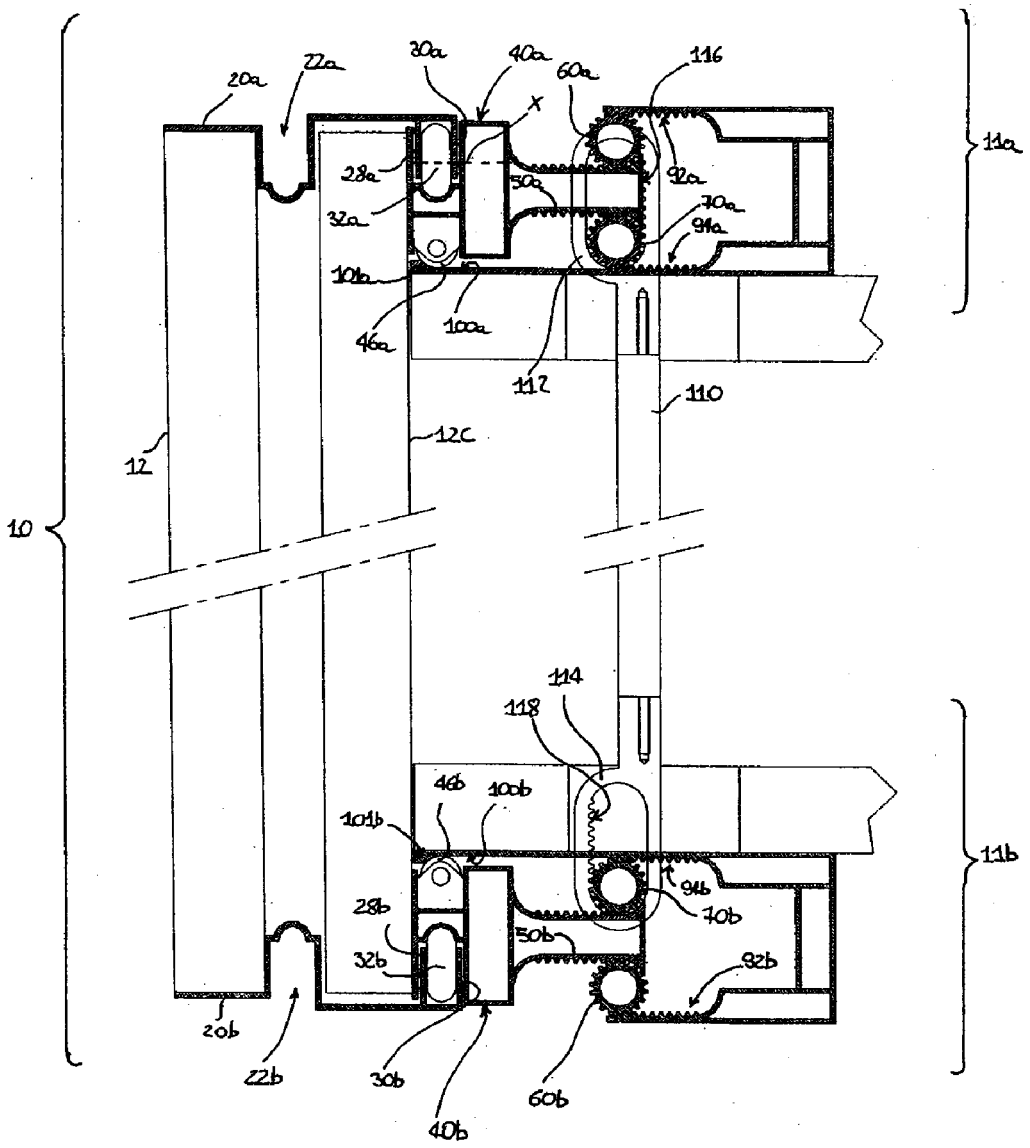
Fig. 5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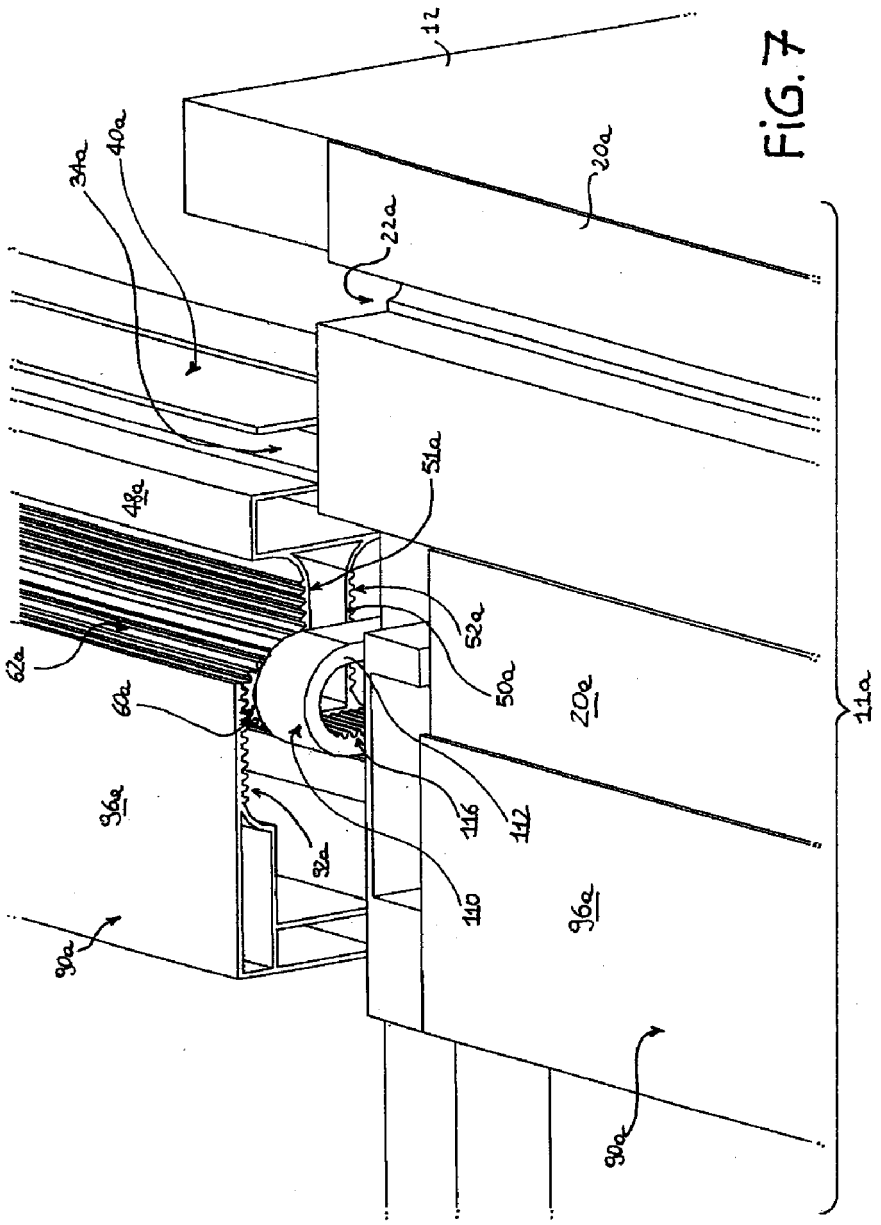
92b

FIG. 6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96a
90a
90a

FIG. 7

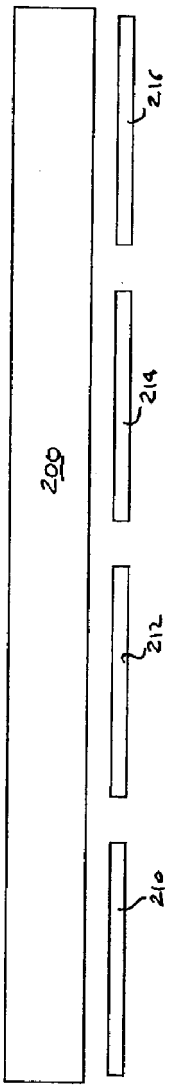


Fig. 8a

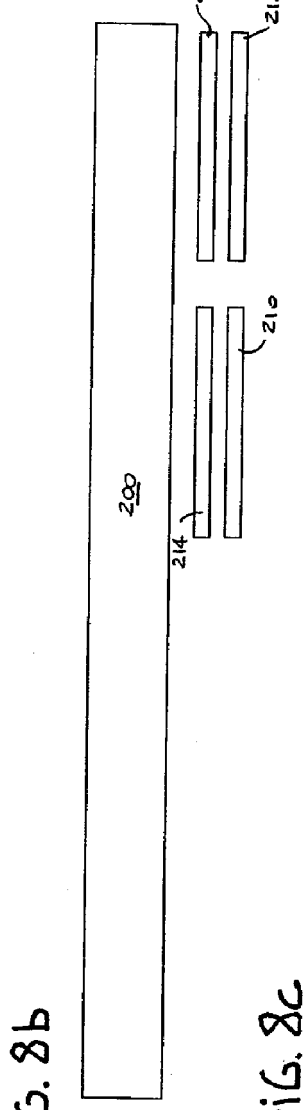


Fig. 8b

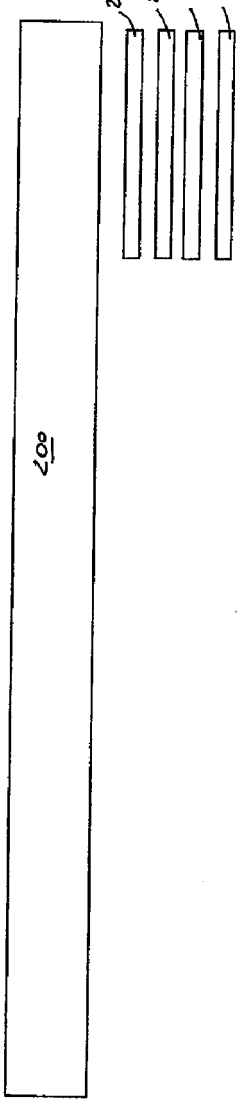


Fig. 8c

## REFERENCES CITED IN THE DESCRIPTION

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### Patent documents cited in the description


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