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(54) **Piece of furniture with opening/closing device**

(57) A Piece of furniture with a frame on which one or more doors are guided such that through sliding they can uncover the port of the relative compartment.

A cable is drawn between two fixed points placed one at the top and one at the bottom in respect of the compartment, and there are at least two constraints, integral with the door while the cable is integral with the

frame or vice versa, which are arranged so as to engage the cable on two opposite sides thereof so that from the mutual interaction between the cable and the constraints a vincular reaction arises that balances the momentum generated by the weight of the door.

The door can easily be displaced over another door.

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## Description

**[0001]** The present invention relates to a piece of furniture provided with a closing/opening device for its doors, such as the cabinet with one or more doors described below. The invention can be extended to other types of parts of furniture (wardrobes, bedside tables, shelving, etc.).

**[0002]** It is known that the market requires pieces of furniture increasingly complex and full of comforts. A highly sought requirement is that the movable door of a piece of furniture can slide sideways to overlap the adjacent door, thereby uncovering the port of the compartment just behind it. That is why to this purpose a myriad of solutions and mechanisms have been invented. A known, common solution is to arrange at the top and at the bottom of the cabinet frame two guides or rails on which two trolleys integral with the door can slide. These trolleys have an extender mechanism that allows the user to pull out the door and then move it over the adjacent one. The goal is achieved, but at the cost of very complicated mechanics, difficult to calibrate and costly to produce.

**[0003]** The main object of the invention is to make an opening/closing device for sliding components of pieces of furniture of the type above that is very easy to build and very reliable.

**[0004]** This object is achieved by a piece of furniture with a frame on which one or more doors are guided such that through sliding they can uncover the port of the relative compartment, characterized by comprising:

a cable drawn between two fixed points placed one at the top and one at the bottom in respect of the compartment,  
at least two constraints, integral with the door while the cable is integral with the frame or vice versa, which are arranged so as to engage the cable on two opposite sides thereof (of the cable) so that from the mutual interaction between the cable and the constraints a vincular reaction arises that balances the momentum generated by the weight of the door.

**[0005]** Preferably the invention is carried out according to these variants (alone or in combination):

- (i) the constraints comprise transmission means for the cable that are rotatable about an axis. This facilitates the sliding of cable and the door;
- (ii) the transmission means have non-coplanar axes of rotation to better deviate the cable without creating internal tensions and/or torsions therein (see below);
- (iii) as per a preferred construction, for maximum stability, the transmission means comprise four pulleys, two upper pulleys and two lower pulleys, mounted to deviate the cable and spatially arranged as described in (i) and/or (ii);
- (iv) two pulleys have the rotation axis vertical, ap-

proximately parallel to the plane of the door, and two pulleys have the rotation axis horizontal, forming a non-right angle with the perpendicular to the plane of the door, preferably between 15 and 50 degrees;

(v) in cases (iii) and/or (iv) the pulleys may be carried respectively by two sliding mechanisms, lower and upper, couplable inside the door; advantageously such sliding mechanisms may be equal in construction, with great savings in manufacturing;

(vi) the sliding mechanisms comprise a fastening bracket to the door and a support plate whereon the pulleys are rotatably pivoted;

(vii) the fastening bracket and the support plate are mutually hinged or articulated, the second being able to oscillate with respect to the first;

(viii) effective and simple embodiments are obtained: if the plate comprises a flat elongated portion, on which about at the center thereof there is vertically pivoted a pulley, and on whose side near the door there is pivoted another pulley; if the pulley on the side near the door is rotatably supported by a rigid member that extends vertically from the flat portion and that is preferably adjustable to modify the position of the rotation axis of the pulley; if optionally on the end portion of the flat portion opposed to the door a wheel is mounted that slidably engages a guide. In the latter case an excellent level of integration is achieved and the maximum number of components is limited.

**[0006]** It is an advantageous option to place the fixed points one above and one below the frame, outside the compartment. Thus the latter is not invaded, thus no useful space is subtracted.

**[0007]** It is another advantageous option, combinable with the preceding, to place the fixed points nearly diagonally opposite to each other with respect to the compartment. So the carrying effect of the interaction cable constraints and/or the side displacement of the door are maximized.

**[0008]** The invention is shown schematically in Fig. 1 and 2. A door 20 can slide sideways (direction L) on top and bottom guides 25, 27 with respect to a frame 19 of a piece of furniture 21. On the door 20 two fixed constraints R1, R2 are placed, for example pins or wheels, placed at different heights and on which a cable 26 engages, drawn between two fixed points P1, P2 placed diagonally with respect to the compartment covered by the door 20 when it is closed. As it will be clear soon, the position of the points P1, P2 may be different from that shown, and chosen conveniently adapted to the application.

**[0009]** The cable 26 has a (almost) vertical portion 26V and a horizontal portion 26H. The two constraints R1, R2, are arranged on two opposite sides of the section 26H and in such a manner that by engaging them the latter balances the momentum P generated by the weight of the door 20. In fact, the door 20 would tend under his

weight to tilt or tip while the cable 26 wins the moment thereof and prevents it from vibrating or reversing. The weight of the door 20 also loads the top guide 25 which supports it. To simplify the construction of the piece of furniture preferably the bottom guide 27 is not carried out as a bearing guide, and this has immediate benefits in terms of saving components and assembly time and care.

**[0010]** Furthermore, careful construction of the piece of furniture can allow to use only the bottom (or top) guides, provided that the remaining guide and the cable maintain the door very firmly and unable to swing.

**[0011]** The cable 26 may be arranged in many ways: as a "Z" (as in Fig. 2), as an "L" (as in Fig. 1) or it may also go through several ports to couple with several doors.

**[0012]** When the door (or doors) is (are) to be moved it is sufficient to push it (them) sideways.

**[0013]** The door will slide on the guides and contemporaneously the constraints R1, R2 will slide on the cable 26. In Fig. 1 and 2 there is shown in dash-line a shifted position for the door 20 and the cable 26. The path of the cable 26 adapts to the configuration imposed by the constraints R1, R2 in the shifted position; note how two horizontal portions are formed, one at the top and one at the bottom. Equivalently the constraints R2, R4 may be integral with the frame and the cable with the door 20, mutatis mutandis.

**[0014]** The advantages of the invention will be clearer from the following description of a preferred, exemplary embodiment of a cabinet, accompanied by drawings in which:

Fig. 1 and 2 show a schematic illustration of the invention;

Fig. 3 shows a cabinet equipped with the invention;

Fig. 4 shows an internal view of a door of the cabinet in fig. 3;

Fig. 5 and 6 show an axonometric, enlarged view from below and from above of a detail of fig. 3.

Fig. 7 shows a plan view of a mechanism in accordance with the invention.

**[0015]** In fig. 3 there is shown a module of cabinet 110 with a door 122 slidingly supported by a top guide 124 and a bottom guide 126, both rectilinear, which cooperate with a sliding mechanism 121, 127, respectively located at the top and at the bottom. There is also a curved guide 128 placed under the bottom of the cabinet 110, which in combination with a spacing bracket 150 serves to impose to the door 122 a determined movement towards the outside. Several modules can be put side by side to form a piece of furniture of increased capacity.

**[0016]** Fig. 4 shows in isolation the inside of the door 122, without displaying the frame of the piece of furniture 110 and other components in order to better illustrate the internal details. This inside is the same for any further door. On two corners of the door 122 are placed the

mechanisms 121, 127 between which there is provided a cable 120. The bottom mechanism 127 is equal to that 121, only mounted on the door 122 turned upside-down by 180 degrees. So only one will be described in detail, the 121, referring where necessary to components of the counterpart using the same number followed by an superscript.

**[0017]** The mechanism 121 (see fig. 5 and 6) includes a mounting plate 134 with two wings 136A, 136B spaced among each other and orthogonal to the frame. A support member 138 includes a flat horizontal plate 139 to which are rotatably pivoted at an end a wheel 140, which runs in the guide 124, and, nearly at the center, a first transmission pulley 142. The major dimension of the plate 139 develops along an axis D orthogonal to the surface of the door 122. The plate 139 couples integrally to the wings 136A, 136B through two downwards folding portions 137A, 137B, but could also be hinged thereto to oscillate vertically.

**[0018]** A second transmission pulley 144 is rotatably pivoted on a vertical metal tab 146 (see also fig. 7) that extends from the bottom of the plate 139. Note that the tab 146 is tilted relative to axis D by an angle  $\alpha$  such as to align the cable 120 toward the race of the opposite pulley. The angle  $\alpha$  depends on the size of the brackets; preferred values are between 15 and 50 degree.

**[0019]** The cable 120 runs upwards up to the second pulley 144, is deviated by it to the other pulley 142 to be deviated again orthogonally to the D axis to a vertical abutment wall 132 of a stop bracket 130. The cable has an analogous path between the pulleys 142', 144' and is fixed through a bracket 165 to the frame of the piece of furniture 110 at a point nearly diagonally opposite to the anchor point obtained with the bracket 130.

**[0020]** The bracket 130 fixes the guide 124 on the frame of the piece of furniture 110 and with the wall 132 establishes an insurmountable starting point for the wheel 140.

**[0021]** The cable 120 ends in a pressed barrel 162 stuck in the wall 132 from which it emerges with a threaded portion on which there is screwed a regulator nut 160. With the nut 160 the tension of the cable 120 can be adjusted.

**[0022]** The pulley 144 is advantageously inclined to direct the cable 120 in an optimal way to the pulley 142. This avoids generating friction forces caused by the skidding of the cable 120 with respect to the pulleys 142, 144. In fact it is good that the races of the top pulley 144 and the bottom homologue 144' are aligned along the vertical. This ensures that the cable 120 while sliding on the pulleys 144, 144' always changes direction following the arc of a circle rather than a helix. To the same purpose the pulleys 142, 142' are devoted.

**[0023]** This solution also allows to limit the width of the plate 139, hence the weight, size and cost. The support member 138 may also be rotatably coupled by a hinge to the wings 136A, 136B so as to slightly oscillate and adapt to the path imposed by the guides.

**[0024]** Despite the preferred embodiment described allows to bring the cable 120 and the mechanisms 121, 127 onto the roof and below the bottom of the piece of furniture 110, with the advantage of concealing the whole thing during the opening of the door 122, as a variant it is possible to fix on the door 122 two wheels with rotation axis orthogonal to the same (see fig. 1). In this case, the cable would remain inside the compartment of the cabinet.

### Claims

1. Piece of furniture (21; 110) with a frame (19) on which one or more doors (20; 122) are guided such that through sliding they can uncover the port of the relative compartment, **characterized by** comprising:

a cable (26; 120) drawn between two fixed points (P1, P2; 162, 165) placed one at the top and one at the bottom in respect of the compartment, at least two constraints (R1, R2; 142, 144, 142', 144'), integral with the door while the cable is integral with the frame or vice versa, which are arranged so as to engage the cable on two opposite sides thereof so that from the mutual interaction between the cable and the constraints a vincular reaction arises that balances the momentum (P) generated by the weight of the door.

2. Piece of furniture according to claim 1, in which the constraints comprise transmission means (144, 144') for the cable that are rotatable about an axis.
3. Piece of furniture according to claim 2, in which the transmission means have non-coplanar rotation axes (D).
4. Piece of furniture according to claim 2 or 3, wherein said transmission means comprise four pulleys (142, 144, 142', 144'), two upper pulleys (142, 144) and two lower pulleys (142', 144'), mounted to deviate the cable.
5. Piece of furniture according to claim 4, in which two pulleys have vertical rotation axis, approximately parallel to the plane of the door, and two pulleys have horizontal rotation axis, forming a non-right angle with the perpendicular to the plane of the door, preferably between 15 and 50 degrees.
6. Piece of furniture second claims 4 or 5, in which the pulleys are carried respectively by two sliding mechanisms (121, 127), lower and upper, couplable inside the door.
7. Piece of furniture according to claim 6, in which the lower and upper sliding mechanisms are equal in

construction.

8. Piece of furniture according to claim 6 or 7, wherein the sliding mechanisms comprise a fastening bracket (134, 134') to the door and a support plate (139, 139') whereon the pulleys are rotatably pivoted.
9. Piece of furniture according to claim 8, in which the fastening bracket and the support plate are hinged or articulated, the second being able to oscillate with respect to the first.
10. Piece of furniture according to claim 8 or 9, in which the plate comprises a flat elongated portion (139, 139'), on which about at the center there is vertically pivoted a pulley (142, 142'), and on whose side near the door there is pivoted another pulley (144, 144').
11. Piece of furniture according to claim 10, wherein the pulley (144, 144') on the side near the door is rotatably supported by a rigid member (146, 146') that extends vertically from the flat portion.
12. Piece of furniture according to claim 10 or 11, in which on the end portion of the flat portion opposed to the door a wheel (140, 140') is mounted that slidably engages a guide.
13. Piece of furniture according to any of the previous claims, in which the fixed points are placed one above and one below the frame.
14. Piece of furniture according to any of the previous claims, in which the fixed points are placed nearly diagonally opposite to each other with respect to the compartment.



FIG. 2

FIG. 1

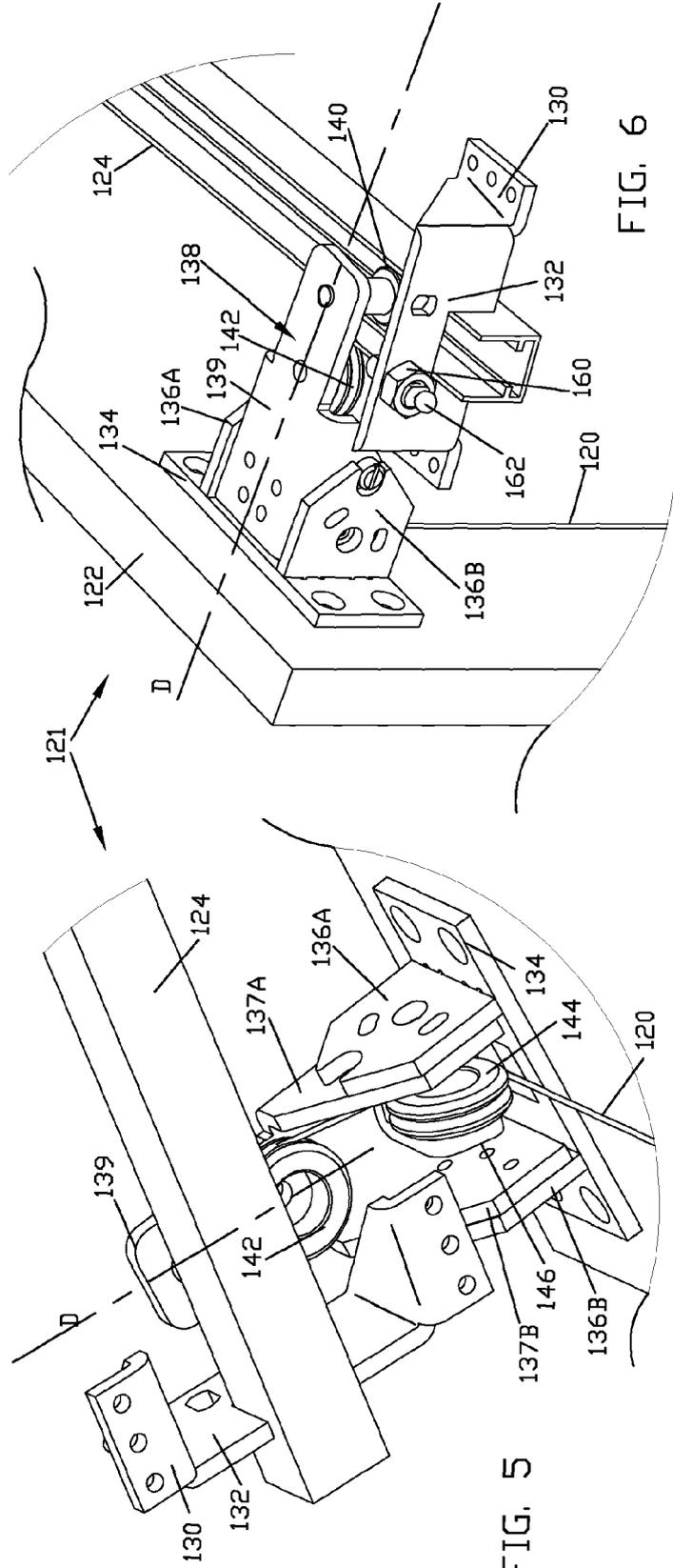


FIG. 5

FIG. 6

