Sept. 25, 1962 M. R. MAZURE 3,055,724

FURNITURE DOOR

Filed July 1, 1958 2 Sheets-Sheet 1

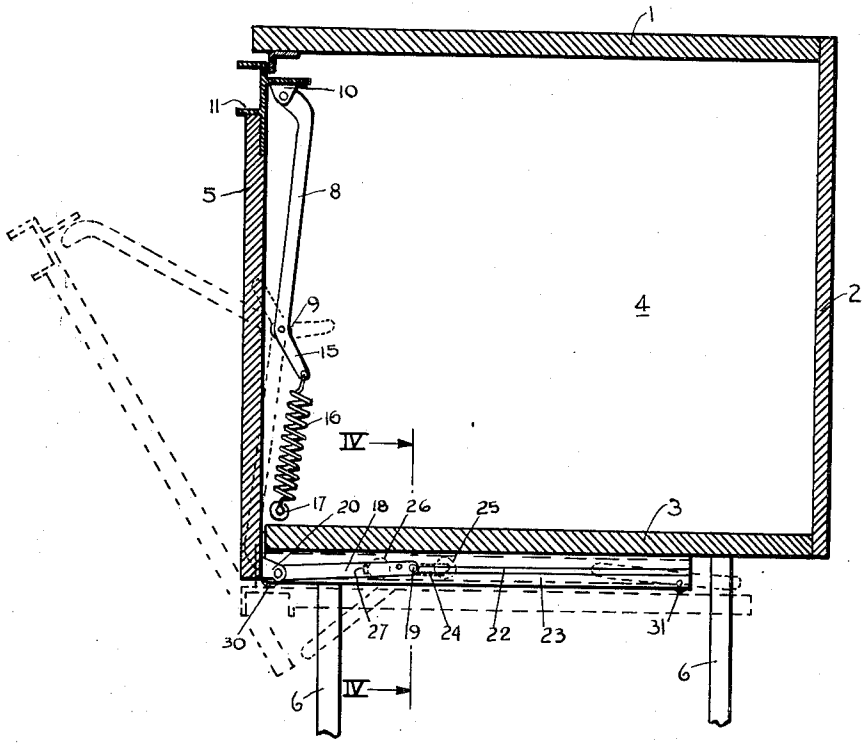


FIG. 1

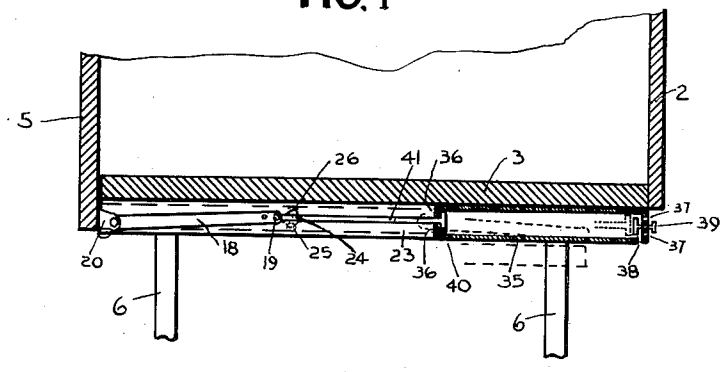


FIG. 3

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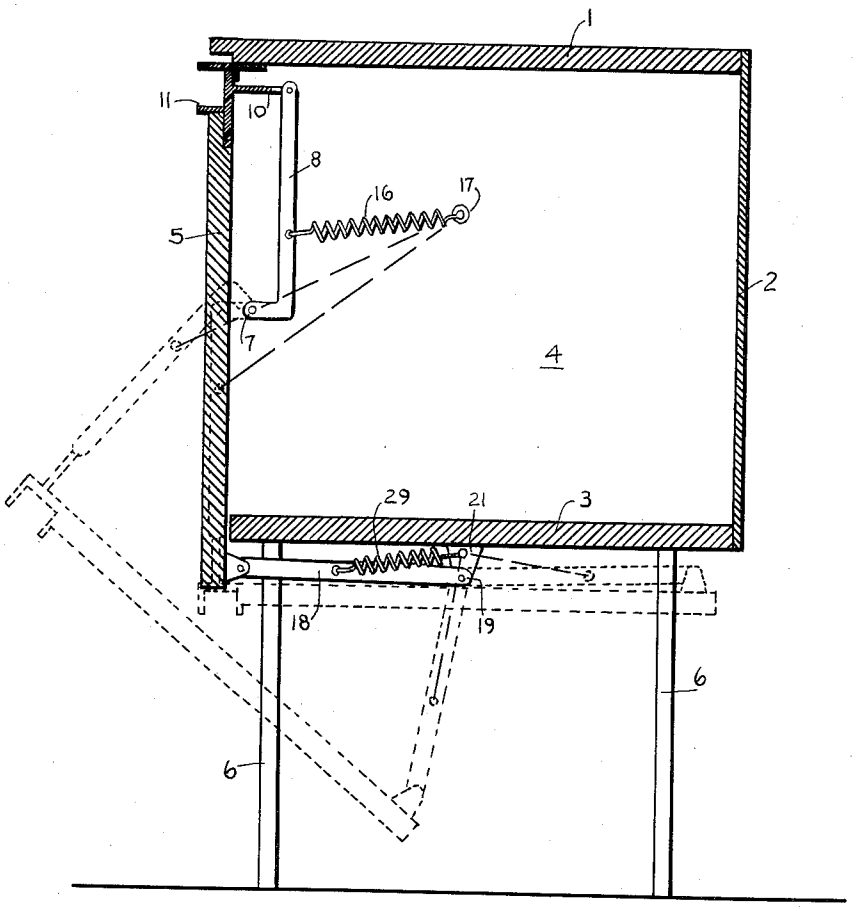


FIG. 2

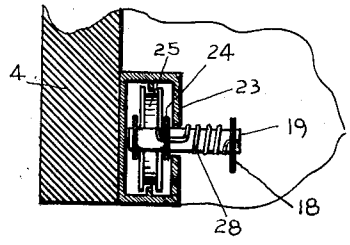


FIG. 4

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FURNITURE DOOR

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The present invention relates to doors for furniture, and more particularly to disappearing doors.

Hinged doors such as are customarily provided on pieces of furniture project outward from the opening to be covered when in the open position and are therefore frequently objectionable from a purely aesthetic and a utilitarian point of view. Sliding doors do not share this shortcoming. Sliding doors, however, when in the open position, still obstruct a substantial portion of the door opening. Foldable or collapsing doors have been used where a door not projecting from the door frame and still fully revealing the door opening when in the open condition was required. Such doors, however, do not present an unbroken face when closed and are thus limited in their application to fine furniture.

An object of the invention is to provide a door structure which does not project outward from the door opening when in the open position.

Another object is the provision of a door structure which leaves the door opening entirely unobstructed when in the open position.

Yet another object is the provision of a door structure which when closed presents to the viewer an unbroken face suitable for use in fine furniture.

A further object is the provision of a door structure which is simple and foolproof in its construction and operation.

Still another object is the provision of a door which disappears when in the open position.

With these and other objects in view, as will hereinafter more fully appear, and which will be more particularly pointed out in the appended claims, reference is now made to the following description taken in connection with the accompanying drawings in which:

FIG. 1 shows a side elevation, in section, of a cabinet equipped with a door structure of the invention;

FIG. 2 shows a side elevation, in section, of a cabinet provided with a modified embodiment of the door structure of the invention;

FIG. 3 illustrates in sectional side elevation a modified detail of the door structure of FIG. 1; and

FIG. 4 shows a fragmentary sectional view of the door structure of FIG. 1 taken on the line IV—IV.

Referring now to the drawings, and more specifically to FIG. 1 which illustrates a preferred embodiment of the invention, there is shown a sectional side elevation of a cabinet having a top wall 1, a rear wall 2, and a bottom wall 3. There is furthermore shown one of two side walls 4, the front edges of top wall 1, of bottom wall 3, and one of the two side walls 4 bounding the opening which it is desired to close by a door. The opening can also be defined as bounded by two pairs of opposite walls, one pair located transverse to the other. The cabinet stands on legs 6.

The door 5 is held to the cabinet by elongated pivoted links of which two are shown. Angled link 8 is pivoted at one end to side wall 4 for rotation in a plane parallel to the side wall. The point of pivot is on a small bracket 9 adjacent the front end of the side wall 4 at mid-height of door 5. The other end of link 8 is pivoted to a bracket 10 mounted on the inside of door 5 near the top edge. The top portion of link 8 adjacent door 5 is curved at an angle from the substantially vertical direction of the main portion of link 8 when the door is in the closed position as illustrated. The door 5 is provided near its upper end with a handle or door knob 11 to facilitate operation of the door. An integral lever element 15 extends from link 8 beyond its pivot on bracket 9. A coil spring 16 is fastened with one end to the free end of lever element 15 and with the other end to a screw 17 fastened in the side wall 4 to urge link 8 into the closed position of the door.

A straight second link 18 is pivotally fastened at one end to the bottom edge of door 5 by bracket 20. The other end carries a rotatable pin 19 passing through a slot 22 in the web of a guide channel 23 which extends along the bottom wall 3 of the cabinet. On the far side of slot 22, pin 19 is fixedly mounted on a truck 24 which travels on the lower flange of channel 23 with two wheels 25 and 26. A spring 28 fastened to truck 24 urges link 18 to pivot counterclockwise about pin 19 relative to truck 24, as best seen in FIG. 4. Rail 23 is equipped with guide rollers 30 and 31 at its front and rear ends, respectively, the rollers being mounted on pins parallel to the door 5 and the bottom wall 3. Travel of truck 24 is limited on the one hand by the back stop 27, and on the other hand by bracket 10 acting as front stop.

When the door 5 is opened by pulling handle 11 forward, bracket 10, and thereby the top edge of the door 5 with handle 11 move forward and downward through an arcuate path, the center of curvature of which is at the fixed pivot point 9 of link 8, and the radius of curvature of which is substantially equal to the distance between the pivot points of link 8 on brackets 9 and 10 respectively. The lower edge of the door at the same time performs a compound movement. It travels in a circular path counterclockwise about pin 19 under the restraint of spring 28. At the same time, the horizontal component of the force exerted by link 18 on pin 19 as the door gradually swings from a vertical to a horizontal position starts truck 24 sliding towards the rear wall 2 taking along the pin 19 and the lower edge of door 5. The space swept by the door during this movement is determined by the fixed distance between the top edge of the door and the fixed pivot of link 8 in bracket 9, by the guide roller 30 which keeps the inside of the door out of contact with the front edge of the cabinet bottom wall 3, and by the length of the bracket 18 which limits the downward travel of the bottom edge of door 5 and has to be selected according to the clearance available under the bottom wall 3.

When the truck 24 abuts against back stop 27, link 18 on continued movement of door 5 swings upward counter-clockwise until the door 5 reaches a position of complete concealment below the bottom wall 3, leaving the opening of the cabinet entirely unencumbered. The top edge of the door 5 in the open position is substantially flush with the front edges of side walls 4, top wall 1 and bottom wall 3, and the lower edge portion of the door 5 is spaced rearward from the front edge of bottom wall 3 a distance equal to the distance between the locations of the point of pivoting of the first link to the door in the open and in the closed position respectively of the door.

An intermediate position and the open position of the door are indicated in FIG. 1 by outlines in long and short dashes respectively. As can be seen therefrom, the double-acting spring 16 holds the door in the closed position. Its force has to be overcome to open the door 5. Shortly before the fully open position of the door is reached, the line of force of the spring 16 passes through the pivot of link 8 on bracket 9. From then on, the spring 16 will urge the door 5 into the open position and will hold it there.

FIG. 2 illustrates a modified embodiment of the door structure of the invention, there being shown a cabinet

having a top wall 1, rear wall 2, side walls 4 and legs 6. The door 5 is held to the cabinet by links of which two are shown. A first link 8 is pivoted at one end to the side wall 4 by means of a pin arrangement 7 for rotation in a plane parallel to the side wall. The other end of link 8 is pivoted to a bracket 10 on the inside of door 5 near the top edge and is integral with an outwardly projecting handle or knob 11. A coil spring 16 is fastened to link 8 at a point spaced from the pivot pin 7 and is fastened at its other end to a screw 17 in side wall 4 to urge the link 8 into the closed position of door 5.

A straight second link 18 is pivotally fastened at one end to the bottom edge of door 5 by bracket 20. The other end is fastened to a pin 19 mounted in a fixed bracket 21. The length of link 18 between its pivot points in brackets 20 and 21 is substantially equal to the distance between the pivot points of link 8 on pin arrangement 7 and bracket 10, respectively. A spring 29 is fastened at one end to link 18 intermediate its pivot points and is fastened at its other end to the bracket 21 at a point above pin 19 so as to urge the link 18 upward towards bottom wall 3.

The door structure of FIG. 2 operates in substantially the same manner as that of FIG. 1. When the handle 11 is pulled to open the door, the upper edge portion travels through an arc substantially circular about pin 7. The lower edge portion travels through a substantially circular path about the pin 19. As indicated by the dotted outlines of an intermediate position and of the open position of door 5 in FIG. 2, the door swings about the bottom edge of the cabinet opening, and is completely concealed under the bottom wall 3 located parallel thereto and extends in a direction normal to the direction it occupies when in the fully opened position.

The embodiment of the door structure of the invention illustrated in FIG. 2 is substantially simpler in design than that of FIG. 1 in that it does not employ a slidable pivot on the cabinet for bracket 8, thus also obviating the need for guide rollers 30 and 31. The double-acting springs 16 and 29 both urge the door 5 into the open as well as the closed position, their force having to be overcome initially during the opening and the closing movement of the door.

It is necessary for the lower edge portion of the door to be located in the fully opened position of the door at a point spaced from the front edge of the bottom wall a distance equal to the distance between the locations of the point of pivoting of the first link to the door in the open and the closed position respectively of the door. In the embodiment of FIG. 1 this displacement is provided both by the pivotal movement of link 18 and by the translatory movement of truck 24, along guide channel 23. In the embodiment of FIG. 2, the displacement is provided solely by pivoting of link 18 which for this reason has to be longer. The lowest position of the lower edge of door 5 during the opening operation thus is lower in the embodiment of FIG. 2 than in that of FIG. 1, and use of the door structure of FIG. 2, while less costly to produce, is limited to cabinets in which the required bottom clearance is available.

FIG. 3 illustrates dashpot means for retarding rapid movement of the door 5 towards its open position as in sudden dropping of the door 5 from a partially opened to the fully open position under the force of gravity. As seen in FIG. 3, the door 5 is connected to a truck 24 by a straight link 18 pivoted to the door and the truck respectively at bracket 20 and pin 19, respectively. Wheels 25 and 26 rotatably mounted on truck 24 travel along the flanges of a guide channel 23 in a similar manner as the corresponding elements in FIG. 1.

To prevent rapid movement from a partly open to the fully open position of the door 5, a pneumatic cylinder 35 is arranged parallel to and adjacent the bottom wall 3 in line with and behind guide channel 24. The pneumatic cylinder 35 is provided with openings 36 of relatively large cross section in the front wall, and with aperture 37 of about equal size in the rear wall. A small hole 38 passes through the cylindrical wall portion adjacent the rear wall. A valve, spring-biased toward the open position, is adapted to block apertures 37 when pressed towards the rear wall of cylinders 35. A piston 36 is reciprocably mounted in cylinder 35 and is connected to truck 24 by an integral piston rod 41.

When the door moves towards the open position, truck 24 travels backward along guide channel 23 as described above. This causes piston 40 to travel towards the rear wall of cylinder 35. As long as the movement of the door is not very rapid, air can escape from the cylinder space between piston 40 and valve 39 freely and no appreciable pressure develops in the cylinder 35. If the movement of the door is rapid, as when the door is dropped from a partially opened position, air pressure building up in cylinder 35 presses valve 39 against the rear wall of the cylinder so as to close apertures 37. Further movement of the door is thus cushioned by the amount of air trapped in the cylinder which acts as a dashpot, and further movement is limited by the relatively low rate of air escape through hole 38.

This pneumatic cushion does not interfere with opening of the door 5 at any speed, air being able to rush into the cylinder through openings 37 at a sufficient rate to prevent any negative pressure of significant magnitude from developing within cylinder 35.

The illustrative embodiments of the door structure of the invention shown in the drawing are equipped with two links pivotally fastened to the upper portion and to the lower edge of the door respectively. Such an arrangement is sometimes sufficient. More usually, however, at least three links will be required, two of them arranged in laterally paired positions. It is evident that more than three links may be employed and four will be found to be most advantageous for cabinets of moderate width. A greater number of links and associated elements arranged in parallel is preferred in the case of very wide or exceptionally heavy doors.

The door structure of the invention is completely concealed under the bottom of the cabinet when in the open position. There is no need for projecting parts to require floor space when the door is open. While the door of the invention projects beyond the front edge of the cabinet during opening and closing, it is necessary in any case to leave such space unoccupied to permit access to the cabinet opening, and the door structure of the invention may thus be said to require no additional floor space beyond that occupied by the cabinet itself.

The door opening and all four edges thereof are entirely unobstructed when the door is in the open position. Such a door construction is of particular advantage where the cabinet is to be used with sliding shelves or built-in drawers.

Yet the door structure of the invention, when in the closed position, presents to the viewer an unbroken surface. The door can readily be made to overlap one or several of the walls the edges of which form the door opening. No hinges are visible in the closed position of the door and only the narrow edges of the upper link or links are visibly in the open position. The door structure of the invention is thus aesthetically very satisfactory to the furniture designer and user.

Because of the inherent simplicity of construction, the door of the invention is sturdy and foolproof in operation and requires no maintenance.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can be applying current knowledge readily adapt it for various applications without omitting features that, from the standpoint of prior art, fairly constitute essential characteristics of the generic or specific aspects of this invention and, therefore, such adaptations should and are

intended to be comprehended within the meaning and range of equivalence of the following claims.

What is claimed as new and desired to be secured by Letters Patent is:

1. A door structure for the door opening of a piece of furniture having opposite side walls, a top wall, and a bottom wall, said walls having opening-forming edges bounding said opening, comprising in combination, a door adapted to cover said opening; first link means for pivoting said door turnably about an axis parallel to said opening forming edge of said bottom wall, said first link means being mounted turnably about said axis on one of said side walls adjacent the opening-forming edge thereof and connected at the other end thereof to that portion of said door which is the upper portion thereof when said door is in closed position, and said first link means having in the open position of said door a length greater than the distance between the point of pivoting of said first link means to one of said side walls and the opening forming edge of said bottom wall; a support member mounted on said bottom wall for reciprocating movement spaced from and substantially parallel to said bottom wall between positions near the front edge and the back edge thereof respectively; pivot means mounted on said support member; and second link means connected at one end to the bottom edge of said door and connected at the other end to said pivot means for movement along said bottom wall in such a manner as to be adapted to guide said lower portion of said door between a closed position in which said lower portion is superimposed on the opening-forming edge of said bottom wall, and an open position in which said lower portion is located adjacent said bottom wall but spaced from said opening-forming edge thereof.

2. A door structure for the door opening of a piece of furniture having opposite side walls, a top wall and a bottom wall, said walls having opening-forming edges bounding said opening, comprising in combination a door adapted to cover said opening; first link means for pivoting said door turnably about an axis parallel to said opening forming edge of said bottom wall, said first link means being mounted turnably about said axis on one of said side walls adjacent the opening-forming edge thereof and connected at the other end thereof to that portion of said door which is the upper portion thereof when said door is in closed position, and said first link means having in the open position of said door a length greater than the distance between the point of pivoting of said first link means to one of said side walls and the opening forming edge of said bottom wall; a guide rail mounted on said bottom wall parallel to said side walls; a support member mounted on said rail for reciprocating movement between positions near the front edge and the back edge of said bottom wall respectively; pivot means mounted on said support member; and second link means connected at one end to the bottom edge of said door and connected at the other end to said pivot means for movement along said bottom wall in such a manner as to be adapted to guide said lower portion of said door between a closed position in which said lower portion is adjacent to said opening-forming edge of said bottom wall, and an open position in which said lower portion is located adjacent said bottom wall but spaced from said opening-forming edge thereof.

3. A door structure for the door opening of a piece of furniture having opposite side walls, a top wall, and a bottom wall, said walls having opening-forming edges bounding said opening, comprising in combination, a door adapted to cover said opening; first link means for pivoting said door turnably about an axis parallel to said opening forming edge of said bottom wall, said first link means being mounted turnably about said axis on one of said side walls adjacent the opening-forming edge thereof and connected at the other end thereof to that portion of said door which is the upper portion thereof

when said door is in closed position, and said first link means having in the open position of said door a length greater than the distance between the point of pivoting of said first link means to one of said side walls and the opening forming edge of said bottom wall; a guide rail mounted on said bottom wall parallel to said side walls; a support member mounted on said rail for reciprocating movement between positions near the front edge and the back edge of said bottom wall respectively; pivot means mounted on said support member; and second link means pivoted at one end to the bottom edge of said door and attached at the other end to said pivot means for movement along said bottom wall, the combined length of the distance between said positions of said support member near the front edge and the back edge of said bottom wall and of twice the length of said second link means between the pivot points thereof being substantially equal to twice the length of said first link means between the pivot points thereof, so that said second link means is adapted to guide said lower portion of said door between a closed position in which said lower portion is superimposed on the opening-forming edge of said bottom wall, and an open position in which said lower portion is located adjacent said bottom wall and spaced from said opening-forming edge of said bottom wall a distance equal to the distance between the locations of the point of pivoting of said first link means to said door in the open and in the closed position respectively of said door.

4. A door structure for the door opening of a piece of furniture having opposite side walls, a top wall, and a bottom wall, said walls having opening-forming edges bounding said opening, comprising in combination, a door adapted to cover said opening; first link means for pivoting said door turnably about an axis parallel to said opening forming edge of said bottom wall, said first link means being mounted turnably about said axis on one of said side walls adjacent the opening-forming edge thereof and connected at the other end thereof to that portion of said door which is the upper portion thereof when said door is in closed position, and said first link means having in the open position of said door a length greater than the distance between the point of pivoting of said first link means to one of said side walls and the opening forming edge of said bottom wall, pivot means mounted on said bottom wall for reciprocating sliding movement spaced from and substantially parallel to said bottom wall between positions near the front edge and the back edge thereof respectively; second link means connected at one end to the bottom edge of said door and connected at the other end to said pivot means mounted on said bottom wall in such a manner as to be adapted to guide said lower portion of said door between a closed position in which said lower portion is adjacent to the opening-forming edge of said bottom wall, and an open position in which said lower portion is located adjacent said bottom wall but spaced from said opening-forming edge thereof; and resilient means urging said second link means to pivot counterclockwise relative to said bottom wall.

5. A door structure for the door opening of a piece of furniture having opposite side walls, a top wall, and a bottom wall, said walls having opening-forming edges bounding said opening, said door structure comprising a door adapted to cover said opening; first link means for pivoting said door about an axis parallel with the opening-forming edge of said bottom wall, said first link means having a first end turnably mounted on one of said side walls so as to be turnable about said axis and a second end pivoted to that portion of the door which is the upper portion thereof when said door is in closed position, the length of said first link means exceeding the distance between said axis and the opening-forming edge of said bottom wall so that said link means may move the upper portion of the door beneath said bottom wall; second link means pivoted at one end to that portion of

the door which is the lower portion when the door is closed, said second link means pivoted at its other end to said bottom wall for guiding the lower portion of said door between a closed position in which said lower portion is adjacent to the opening-forming edge of said bottom wall, and an open position in which said door is substantially parallel with and is located beneath said bottom wall and the upper and lower portions of said door are respectively adjacent to and spaced from the opening-forming edge of said bottom wall; and spring means mounted at one end on at least one of said walls of said piece of furniture and at the other end on at least one of said link means so as to permanently urge said door when it is positioned in an in-between position between said closed and said open positions of said door into either said open position when said door is nearer said open position or into said closed position when said door is nearer said closed position.

6. A door structure for the door opening of a piece of furniture having opposite side walls, a top wall, and a bottom wall, said walls having opening-forming edges bounding said opening, said door structure comprising a door adapted to cover said opening; first link means for pivoting said door turnably about an axis parallel with the opening-forming edge of said bottom wall, said first link means having a first end pivotable about said axis and connected to one of said side walls adjacent to the opening-forming edge thereof, and said first link means having a second end connected to that portion of said door which is the upper portion when the door is in closed position, the length of said first link means greater than the distance between said axis and the opening-forming edge of said bottom wall so that said link means

may move the upper portion of said door beneath said bottom wall; second link means located substantially beneath said bottom wall and connected at one end thereof to that portion of said door which is the lower portion when the door is in closed position and pivotally connected at its other end to said bottom wall so as to be turnable about another axis parallel with said first mentioned axis for guiding the lower portion of said door between a closed position in which said lower portion is adjacent to the opening-forming edge of said bottom wall and an open position in which said lower portion is adjacent to said bottom wall but is spaced from said opening-forming edge thereof; and double-acting spring means for at least one of said link means, said spring means having a first end connected to said one link means and a second end connected with said piece of furniture for biasing said door to its closed position when the line of force of said spring means is at one side of the pivot axis of said one link means and for biasing said door to its open position when the link of force of said spring means is at the other side of said last mentioned pivot axis.

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