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AUTOMATIC DOOR CLOSING DEVICE

This invention relates to an automatic door closing device, particularly to an automatic door closing device adapted to be installed on a foldable door.

Foldable doors, such as two-panel type foldable doors and multiple-panel type foldable doors, are capable of making efficient use of available space. The two-panel type foldable doors are suitable for bath rooms, indoor rooms, kitchens and the like. The multiple-panel type foldable doors are particularly suitable for large meeting rooms and the like. A conventional two-panel type foldable door normally includes two coupled door panels and a connecting member disposed between the door panels. The door panels are mounted pivotally on the connecting member with one of the door panels being mounted pivotally on one side of a door frame so that the door panels are turnable relative to the connecting member for moving toward and away from each other between a folded position, in which the door panels move toward and confront face-to-face with each other, and an unfolded position, in which the door panels move away from each other and are aligned along a straight line, and are turnable relative to said one side of the door frame for moving toward and away from said one side of the door frame. However, most of the conventional

foldable doors are relatively inconvenient in that the door panels are manually and not automatically closable.

Therefore, the object of the present invention
5 is to provide an automatic door closing device that is adapted to be installed on a foldable door and that is capable of overcoming the aforementioned problem.

According to the present invention, there is provided an automatic door closing device which is
10 adapted to be installed on a foldable door that includes two coupled door panels and a connecting member disposed between the door panels. The door panels are mounted pivotally on the connecting member so that the door panels are turnable relative to the
15 connecting member for moving toward and away from each other between a folded position and an unfolded position. The automatic door closing device comprises: a pulley unit adapted to be mounted on the connecting member; a positioner adapted to be mounted on one of
20 the door panels on one side of the pulley unit, the positioner being turnable away from the pulley unit when the door panels are in the folded position; a returning unit adapted to be mounted on the other one of the door panels on the other side of the pulley
25 unit; and a cord passing over the pulley unit and having two opposite ends connected respectively to the positioner and the returning unit, the cord

extending in a direction transverse to a line which is parallel to axis of rotation of the door panels. The returning unit includes a biasing spring connected to one of the ends of the cord for urging
5 said one of the ends of the cord so as to pull the positioner towards the pulley unit, thus placing the door panels in the unfolded position.

In drawings which illustrate an embodiment of the invention,

10 Fig. 1 is a perspective view of a foldable door with an automatic door closing device embodying this invention;

Fig. 2 is a fragmentary cross-sectional side view of the automatic door closing device of Fig. 1;

15 Fig. 3 is a fragmentary cross-sectional top view of the automatic door closing device of Fig. 1;

Fig. 4 is another fragmentary cross-sectional top view of the automatic door closing device of Fig. 1 with a pair of door panels moving to a folding state;

20 Fig. 5 is yet another fragmentary cross-sectional top view of the automatic door closing device of Fig. 1 with the door panels moving to an unfolding state; and

25 Fig. 6 is yet another fragmentary cross-sectional top view of the automatic door closing device of Fig. 1 with a locking unit in a locking position.

Figs. 1 to 4 illustrate an automatic door closing device embodying this invention. The automatic door closing device is installed on a foldable door 1 which is mounted pivotally on a door frame 13 and which includes left and right door panels 11, 12 and a connecting member 14 disposed between the left and right door panels 11, 12. The left door panel 11 is mounted pivotally on one side of the door frame 13, with the connecting member 14 coupling pivotally the left and right door panels 11, 12 so that the left and right door panels 11, 12 are turnable relative to the connecting member 14 for moving toward and away from each other between a folded position, in which the left and right door panels 11, 12 move toward and confront face-to-face with each other, and an unfolded position, in which the left and right door panels 11, 12 move away from each other and are aligned along a straight line, and are turnable relative to said one side of the door frame 13 for moving toward and away from said one side of the door frame 13.

The automatic door closing device includes a positioner 21 mounted securely on the left door panel 11, a returning unit 22 mounted securely on the right door panel 12, a cord 29 connected to the positioner 11 and the returning unit 22, a locking unit mounted on the connecting member 14 for holding and immobilizing the cord 29, and a pulley unit 23 mounted

on the connecting member 14 for receiving the cord 29.

The positioner 21 includes a first housing 211 secured to a top end of the left door panel 11, an elongated slot 212 formed in the first housing 211, a positioning plug 214 disposed in the first housing 211, and a fastener 213 extending through the slot 212 to secure the positioning plug 214 to the first housing 211. The fastener 213 is movable along the slot 212 for varying position of the positioning plug 214 in the first housing 211. The positioner 21 is turnable away from the pulley unit 23 when the left and right door panels 11, 12 are moved to the folded position.

The returning unit 22 includes a second housing 221 which is secured to a top end of the right door panel 12, which is aligned with the first housing 211 when the left and right door panels 11, 12 are in the unfolded position, and which has two opposite closed ends that are plugged respectively by a fixed plug 25 adjacent to the connecting member 14 and a vent plug 26 distal from the connecting member 14. The returning unit 22 further includes a biasing spring 24 and a piston 28. The biasing spring 24, which is in the form of a compression spring, is disposed in the second housing 211 between the fixed plug 25 and the vent plug 26, and has a stationary end 241 held

immovably at the fixed plug 25 and a free end 242 opposite to the stationary end 241 and movable toward and away from the fixed plug 25. The piston 28 is disposed slidably in the second housing 221 between
5 the biasing spring 24 and the vent plug 26, and is connected to the free end 242 of the biasing spring 24 on one side. The second housing 221 has an inner wall 226 which confines an inner space that is divided by the piston 28 into a first space 223 which extends
10 from the piston 28 to the fixed plug 25 and which receives the biasing spring 24, and a second space 224 which extends from the piston 28 to the vent plug 26. The piston 28 has a block member 281' which projects therefrom into the second space 224 and which
15 has an peripheral wall 281 in contact with the inner wall 226 of the second housing 221. The peripheral wall 281 has a slit 282 for establishing fluid communication between the first and second spaces 223, 224, and is tapered so that a portion of the peripheral
20 wall 281 is out of contact with the inner wall 226. The peripheral wall 281 is slidably deformable so that the slit 282 is openable to communicate the first and second spaces 223, 224 for venting air out of the first space 223 when the block member 281' moves
25 frictionally toward the fixed plug 25 and deforms along the inner wall 226 (see Fig. 4), and is closable when the block member 281' moves frictionally toward

the vent plug 26 and deforms along the inner wall 226 (see Fig. 5). The vent plug 26 has a T-shaped vent hole 261 for communicating fluidly with the second space 224 for venting air out of the second space 224, and a vent adjusting member 27 disposed movably in the vent hole 261 for blocking adjustably the vent hole 261 so as to regulate passage of air through the vent hole 261 and to smoothen the movement of the left and right door panels 11, 12 to the unfolded position.

10 The pulley unit 23 includes a third housing 231 which is disposed between the positioner 21 and the returning unit 22 and which is secured to a top end of the connecting member 14, and a pair of spaced apart guiding pulleys 232 mounted in the third housing 231. 15 The third housing 231 has two opposite side walls 234, a rear wall 233 interconnecting the side walls 234, and a backing plate 235 opposite to the rear wall 233 and connected to the side walls 234. The guiding pulleys 232 are disposed between the side walls 234 and between the rear wall 233 and the backing plate 20 235.

 The cord 29 extends through the side walls 234 of the third housing 231 in a direction transverse to a line which is parallel to axis of rotation of the left and right door panels 11, 12, and passes over 25 the guiding pulleys 232 between the backing plate 235 and the guiding pulleys 232. The cord 29 has opposite

fixed end 291 and moving end 292. The fixed end 291 and the moving end 292 extend respectively into the first and second housings 211, 221, and are secured respectively to the positioning plug 214 and the
5 piston 28. The biasing spring 24 urges the moving end 292 of the cord 29 via the piston 28 so as to pull the positioner 21 toward the pulley unit 23, thus placing the left and right door panels 11, 12 in the unfolded position.

10 Referring now to Fig. 6, in combination with Figs. 2 and 3, the locking unit includes a clamping member 40 which is mounted movably on the rear wall 233 of the third housing 23 between the guiding pulleys 232, which extends from the rear wall 233 toward the
15 backing plate 235, and which is movable between a locking position, in which the clamping member 40 presses the cord 29 against the backing plate 235, and an unlocking position, in which the clamping member 40 moves away from the cord 29. The clamping
20 member 40 includes a movable rod 41 which has a driven end 412 and a pressing end 413 opposite to the driven end 412 for pressing releasably the cord 29 against the backing plate 235. The driven end 412 extends outwardly of the third housing 231 through the rear
25 wall 233, and has an inclined cam face 414. The locking unit further includes an operating unit 3 which is mounted on the connecting member 14 for operating the

clamping member 40 to move to the locking and unlocking positions. The operating unit 3 has a manually operable knob 31 mounted on the connecting member 14 below the third housing 23, a rotary shaft 5 30 extending substantially horizontally and connected to the knob 31, a lever 32 connected to and turned by the shaft 30, and a link 332 extending upwardly in a vertical direction perpendicular to a line parallel to the rod 41. The link 332 has one end 10 connected to the lever 32 and another end extending to the driven end 412, and is movable upward and downward via the knob 31. The inclined cam face 414 inclines from a vertical line along a direction away from the link 332 when extending downwardly, and is 15 cammed by the link 332 for moving the pressing end 413 to press the cord 29 against the backing plate 235, thereby immobilizing the cord 29 and preventing the left and right door panels 11, 12 from moving automatically to the unfolded position. The clamping 20 member 40 further includes a pair of wings 411 projecting oppositely from the rod 41 between the driven end 412 and the pressing end 413, a pair of screw members 415 which have respectively tail ends mounted on the rear wall 233 of the third housing 23, 25 and headed ends extending respectively from the tail ends and through the wings 411 toward the cord 29, and a biasing member which includes a pair of coiled

springs 43 sleeved respectively around the screw members 415 between the headed ends and the wings 411 for urging the wings 411 to move the rod 41 away from the cord 29 when the link 332 is moved downward to
5 disengage the rod 41.

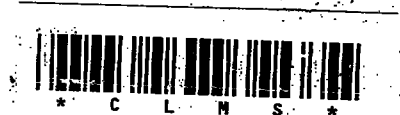
Referring now to Figs. 4 and 5, in combination with Fig. 3, when the left and right door panels 11, 12 are pulled toward each other, the moving end 292 of the cord 29 will pull the piston 28 which then pushes
10 the free end 242 of the biasing spring 24, and moves the piston 28 toward the fixed plug 25. The peripheral wall 281 will deform when moving frictionally along the inner wall 226 toward the fixed plug 25, thereby opening the slit 282 and permitting the air, which
15 resides in the first space 23 and which is compressed due to the movement of the piston 28, to flow from the first space 23 to the second space 24. As a result, the left and right door panels 11, 12 can be moved smoothly to the folded position. Moreover, the
20 guiding pulleys 232 permit the cord 29 to slide over smoothly and easily. When the aforesaid pulling action is released, the moving end 292 of the cord 29 and the piston 28 will be urged by the biasing spring 24 and thus move away from the fixed plug 25, thereby
25 moving the left and right door panels 11, 12 to the unfolded position. The peripheral wall 281 will also deform during the course of movement frictionally

along the inner wall 226 away from the fixed plug 25,
thereby closing the slit 282 and preventing the air,
which resides in the second space 24 and which is
compressed due to the movement of the piston 28, from
5 flowing to the first space 23 but only through the
vent hole 261. Moreover, by adjusting the vent
adjusting member 27, the air flow, which passes
through the vent hole 261, can be controlled, thereby
permitting the left and right door panels 11, 12 to
10 move smoothly and slowly to the unfolded position.



CLAIMS:

1. An automatic door closing device adapted to be installed on a foldable door which includes two coupled door panels and a connecting member disposed
5 between the door panels, the door panels being mounted pivotally on the connecting member so that the door panels are turnable relative to the connecting member for moving toward and away from each other between a folded position and an unfolded position, said
10 automatic door closing device comprising:
- a pulley unit adapted to be mounted on the connecting member;
 - a positioner adapted to be mounted on one of the door panels on one side of said pulley unit, said
15 positioner being turnable away from said pulley unit when the door panels are in the folded position;
 - a returning unit adapted to be mounted on the other one of the door panels on the other side of said pulley unit; and
 - 20 a cord passing over said pulley unit and having two opposite ends connected respectively to said positioner and said returning unit, said cord extending in a direction transverse to a line which is parallel to axis of rotation of the door panels;
 - 25 said returning unit including a biasing spring connected to one of said ends of said cord for urging said one of said ends of said cord so as to pull said



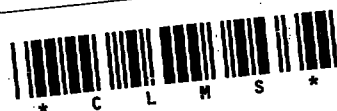
positioner towards said pulley unit, thus placing the door panels in said unfolded position.

2. The automatic door closing device of Claim 1, wherein said positioner includes a first housing, and
5 a positioning plug disposed in said first housing, said cord extending into said first housing and being secured to said positioning plug.

3. The automatic door closing device of Claim 2, wherein said first housing has an elongated slot, and
10 a fastener extending through said slot to secure said positioning plug to said first housing, said fastener being movable along said slot for varying position of said positioning plug in said first housing.

4. The automatic door closing device of Claim 1, wherein said returning unit includes a second housing
15 having two opposite closed ends, said biasing spring being a compression spring which has a stationary end held immovably at one of said closed ends, and a free end opposite to said stationary end and connected to
20 said cord between said closed ends, said stationary end being disposed between said pulley unit and said free end, said cord extending into said second housing from said pulley unit to said free end by passing through said stationary end.

25 5. The automatic door closing device of Claim 4, wherein said returning unit further includes a piston disposed slidably in said second housing between said

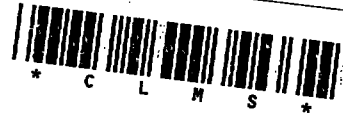


compression spring and the other one of said closed ends and connected to said free end, said second housing having an inner wall that confines an inner space, said piston dividing said inner space into a first space between said piston and said one of said closed ends, and a second space between said piston and said other one of said closed ends.

6. The automatic door closing device of Claim 5, wherein said returning unit further includes a block member disposed between said piston and said other one of said closed ends and connected to said piston, said block member having an peripheral wall in contact with said inner wall, said peripheral wall being tapered so that a portion of said peripheral wall is out of contact with said inner wall, said block member further having a slit for establishing fluid communication between said first and second spaces, said slit being openable for venting when said block member moves frictionally and deforms along said inner wall.

7. The automatic door closing device of Claim 6, wherein said second housing further has a vent hole formed in said other one of said closed ends for communicating fluidly with said second space.

8. The automatic door closing device of Claim 7, wherein said second housing further includes a vent adjusting member disposed movably in said other one



of said closed ends to block adjustably said vent hole so as to regulate passage of air through said vent hole.

9. The automatic door closing device of Claim 1,
5 further comprising a third housing adapted to be secured to the connecting member, said pulley unit including a pair of spaced apart guiding pulleys mounted in said third housing, said cord extending through said third housing and passing over said
10 guiding pulleys.

10. The automatic door closing device of Claim 9, wherein said third housing includes a locking unit mounted therein for holding and immobilizing releasably said cord.

15 11. The automatic door closing device of Claim 10, wherein said third housing includes two opposite side walls, a rear wall interconnecting said side walls, and a backing plate opposite to said rear wall and connected to said side walls, said guiding pulleys
20 being disposed between said side walls and between said rear wall and said backing plate, said locking unit including a clamping member which is mounted movably on said rear wall between said guiding pulleys and which extends from said rear wall toward said
25 backing plate, said cord extending between said clamping member and said backing plate, said clamping member being movable between a locking position, in



which said clamping member presses said cord against said backing plate, and an unlocking position, in which said clamping member moves away from said cord.

12. The automatic door closing device of Claim 11,
5 wherein said locking unit further includes an operating unit having a manually operable knob adapted to be mounted on the connecting member for operating said clamping member.

13. The automatic door closing device of Claim 12,
10 wherein said clamping member includes a movable rod which has a driven end and a pressing end opposite to said driven end for pressing said cord against said backing plate, said driven end being mounted movably on said rear wall and extending outwardly of said
15 third housing from said rear wall.

14. The automatic door closing device of Claim 13, wherein said operating unit further includes a rotary shaft connected to said knob, a lever connected to and turned by said shaft, and a link having one end
20 connected to said lever and another end extending to said driven end, said driven end having an inclined cam face to be cammed by said another end of said link for moving said pressing end to press said cord against said backing plate.

25 15. The automatic door closing device of Claim 14, wherein said shaft is substantially horizontal, said link extending in a vertical direction perpendicular

to a line parallel to said rod and being disposed below
said driven end, said link being movable upward and
downward via said knob and contacting said cam face
with said another end of said link, said cam face being
5 inclined from a vertical line along a direction away
from said link when extending downwardly.

16. The automatic door closing device of Claim 15,
wherein said clamping member further includes two
opposite wings projecting oppositely from said rod
10 between said driven end and said pressing end, and
a biasing member urging said wings to move said rod
toward said rear wall.

17. The automatic door closing device of Claim 16,
wherein said clamping member further includes a pair
15 of screw members having respectively tail ends
mounted on said rear wall, and headed ends extending
from said tail ends toward said cord, said screw
members extending respectively through said wings,
said biasing member including a pair of coiled springs
20 sleeved respectively around said screw members
between said headed ends and said wings.

