DOUBLE-ACTION DOOR

BACKGROUND OF THE INVENTION

1. Field of the Invention:

The present invention relates to door technology and more particularly, to a double-action door having wide open angle and two-way opening characteristics.

2. Description of the Related Art:

A door can be used as a normal-open partition (e.g., for easy access) or normal-close partition (e.g., for access control) in a public place of a building.

In time of emergency, an escapee normally will push a closed door panel intuitively instead of pulling it. Technically, providing two-way escape route and keeping a fire door closed are requisite tasks to ensure a high level of safety.

Single-action and double-action doors are commercially available. A single-action door can simply be opened in one particular direction. A double-action door can be opened in either of two reversed directions. However, due to the limitation of the turning angle of the hinges between the door frame and the door panel, the opening angle of the door panel of a double-action door cannot be widely opened, for example, through 180 degrees.

SUMMARY OF THE INVENTION

The present invention has been accomplished under the

circumstances in view. It is therefore the main object of the present invention to provide a double-action door, which provides a door-in-door structure with a small door in a large door, allowing the door panel to be opened in either of two reversed directions.

To overcome conventional technical problems, the invention provides a double-action door of a door-in-door structure defining a large door and a small door in the large door. Thus, the double-action door can be opened in either of two reversed directions, providing a two-way escape route and keeping in a normally closed condition for fire protection.

The double-action door of the invention eliminates the drawbacks of conventional double-action doors that provide a limited door panel turning angle and can simply allow the door panel to be opened in either "Push" or "Pull" manner, i.e., the double-action door allows the door panel to be opened in a large angle by a push action or a pull action.

To achieve the objects of the present invention, the double-action door is based on the architecture of two door frames and one door panel. This double-action door is a door-set structure comprising an outer door frame, an inner door frame hinged to the inside of the outer door frame and biasable relative to the outer door frame in one direction, and a door panel hinged to the inner door frame and biasable relative to the inner door frame in a

reversed direction. Subject to the reversed arrangement of the hinges between the outer door frame and the inner door frame and the hinges between the inner door frame and the door panel, the double-action door can be opened in either of two reversed directions in a large angle, for example, 180 degrees. Therefore the double-action door is practical for use as an escape door or fire door.

Further, a two-way door closer is mounted in the inner door frame and coupled between the outer door frame and the door panel for buffering the closing movement of the door panel and for enabling the door panel to be opened in either of two reversed directions.

Further, two double-action doors can be symmetrically arranged together, forming a double-swing double-action combination door.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic elevational view illustrating an operation status of a double-action door in accordance with a first embodiment of the present invention.

FIG. 2 is an elevational view of the double-action door in accordance with the first embodiment of the present invention.

FIG. 3 is a schematic applied view of the first embodiment of the present invention, illustrating the door panel and the

inner door frame biased relative to the outer door frame from a close position toward an open position.

FIG. 4 corresponds to FIG. 3, illustrating the door panel and the inner door frame biased relative to the outer door frame from the close position to the open position through 180 degrees.

FIG. 5 corresponds to FIG. 5, illustrating the door panel and the inner door frame biased relative to the outer door frame in the second direction (I).

FIG. 6 corresponds to FIG. 5, illustrating the door panel and the inner door frame biased relative to the outer door frame in the second direction (II).

FIG. 7 corresponds to FIG. 5, illustrating the door panel and the inner door frame biased relative to the outer door frame in the second direction (III).

FIG. 8 is a schematic applied view of the first embodiment of the present invention, illustrating the door panel biased relative to the inner door frame and the outer door frame from a close position toward an open position.

FIG. 9 is a schematic perspective view of a double-action door in an open position in accordance with a second embodiment of the present invention.

FIG. 10 is a schematic drawing of the second embodiment of the present invention, illustrating the door panel biased

relative to the inner door frame and the outer door frame in the second direction from the close position toward the open position.

FIG. 11 is a schematic drawing illustrating the operation of the two-way door closer in one direction in accordance with the second embodiment of the present invention.

FIG. 12 is a schematic drawing illustrating the operation of the two-way door closer in a reversed direction in accordance with the second embodiment of the present invention.

FIG. 13 is a schematic perspective view of a double-action door in accordance with a third embodiment of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIGS. 1-8, a double-action door in accordance with the present invention is shown. The double-action door comprises an outer door frame **2** defining an inner edge **21**, an inner door frame **3** defining an inner edge **31** and an outer edge **33** opposite to the inner edge **31** and being smaller than the inner edge **21** of the outer door frame **2**, at least one, for example, two first hinges **4** connected between the outer door frame **2** and the inner door frame **3** at different elevations for allowing the inner door frame **3** to be biased relative to the outer door frame **4** in a first direction **S1** between a close position and an open position, a door panel **5** defining an outer edge **51** being smaller than the inner

edge **31** of the inner door frame **3**, at least one, for example, two second hinges **6** connected between the inner door frame **3** and the door panel **5** for allowing the door panel **5** to be biased relative to the inner door frame **3** in a second direction **S2** reversed to the first direction **S1** between a close position and an open position.

Referring to FIG. 3 again, the second hinges **6** prohibit the door panel **5** from being biased relative to the inner door frame **3** in the first direction **S1**, and allow the door panel **5** to be moved with the inner door frame **3** relative to the outer door frame **2** in the first direction **S1** to open a large door **A**.

Referring to FIG. 8 again, the door panel **5** can be biased relative to the inner door frame **3** in the second direction **S2** reversed to the first direction **S1** to open a small door **B**.

Based on the aforesaid arrangement for allowing the large door **A** to be opened in the first direction **S1** or the small door **B** to be opened in the second direction **S2**, the invention achieves a double action for outward or inward opening (leftward or rightward opening).

Referring to FIGS. 1 and 3 again, the inner door frame **3** further comprises a stop plate **30** covering a part, for example, the upper part of the inner edge **31** of the inner door frame **3** so that a corresponding part of the door panel **5** can be stopped against the stop plate **30** and moved with the inner door frame **3** in the first

direction **S1** steadily.

When compared to conventional door structures, the invention uses reversed hinges to couple the outer door frame **2**, the inner door frame **3** and the door panel **5**, forming a door-indoor architecture that is substantially a unique door-set structure of one frame with two door panels. This door-set structure defines a large door **A**, and a small door **B** in the large door **A**, wherein the inner door frame **3** and the door panel **5** constitute the large door **A** that can be turned relative to the outer door frame **2** between an open position and a close position in the first direction **S1**; the door panel **5** constitutes the small door **B** that can be turned relative to the inner door frame **3** between an open position and a close position in the second direction **S2** reversed to the first direction **S1**. Thus, the double-action door of the present invention can be opened in a large angle in either of two reversed directions, achieving the functions of an emergency exit and a fire escape.

When compared to a conventional double-action door that limits the turning angle of the door panel, the invention allows the door panel to be biased through 180 degrees. When the double-action door of the present invention is used as an entrance door, interior door, access door or fire door in a building, it can work as a left-handed door as well as a right-handed door.

Further, the first hinges **4** or second hinge **6** are buffer

hinges having gear buffer means, hydraulic buffer means, spring buffer means, pneumatic buffer means, friction buffer means, or any of their combinations mounted therein for enabling the large door or small door to be automatically returned to the close position after having been opened, or buffering the moving speed of the door panel to reduce noises.

Referring to FIGS. 9 and 10, a double-acting door in accordance with a second embodiment of the present invention is shown. The double-action door of this second embodiment comprises an outer door frame **2** comprising an outer door frame inner edge **21** and a first top rail **25** at an upper side of the outer door frame inner edge **21**, an inner door frame **3** comprising an inner door frame inner edge **31**, an inner door frame outer edge 33 being smaller than the outer door frame inner edge **21** and a second top rail **35** at an upper side of the inner door frame inner edge **31**, at least one, for example, two first hinges **4** connected between the outer door frame **2** and the inner door frame outer edge **33** at different elevations for enabling the inner door frame **3** to be turned relative to the outer door frame inner edge **21** in the first direction **S1** between an open position and a close position, a door panel **5** comprising a door panel outer edge **51** smaller than the inner door frame inner edge **31**, at least one, for example, two second hinges **6** connected between the inner door frame **3** and the door panel

outer edge **51** for enabling the door panel **5** to be turned relative to the inner door frame inner edge **31** in a second direction **S2** reversed to the first direction **S1** between an open position and a close position to form a door-in-door structure, and a two-way door closer **7** comprising a casing **71** mounted in the second top rail **35**, a first arm **73** coupled to one side of the casing **71** and turnable in the first direction and a second arm **75** coupled to an opposite side of the casing **71** and turnable in the second direction **S2** reversed to the first direction **S1**.

Further, the first arm **73** defines a first front end **731** coupled to one side of the casing **71** and turnable relative to the casing **71** in the first direction **S1**, and a first rear end **733** coupled to the first top rail **25**. The second arm **75** defines a second front end **751** coupled to the opposite side of the casing **71** and turnable relative to the casing **71** in the second direction **S2**, and a second rear end **752** coupled to the door panel **5**.

The first top rail **25** defines a first sliding groove **251**. The first rear end **733** of the first arm **73** is slidably coupled to the first sliding groove **251**. The door panel **5** defines a second sliding groove **53**. The second rear end **752** of the second arm **75** is slidably coupled to the second sliding groove **53**.

Thus, the inner door frame **3** and the door panel **5** constitute a large door that can be opened from the outer door frame **2** in the

first direction **S1**; the door panel **5** can work as a small door and be biased relative to the inner door frame **3** in the second direction **S2** reversed to the first direction **S1** and away from the stop plate **30**.

When compared to the aforesaid first embodiment, this second embodiment is characterized in the door closer that can buffer the speed. The first rear end **733** of the first arm **73** is movably coupled to the first top rail **25** to buffer the inner door frame **3** and the door panel **5** when they are moved in the first direction **S1** between the open position and the close position. The second rear end **752** of the second arm **75** is movably coupled to the door panel **5** to buffer the door panel **5** when the door panel **5** is moved in the second direction **S2** between the open position and the close position.

Referring to FIGS. 11 and 12, the casing **71** of the two-way door closer **7** comprises a shaft **77** defining opposing top end **771** and bottom end **773**. The top end **771** extends out of one side of the casing **71**. The bottom end **773** extends out of the opposite side of the casing **71**.

The first arm **73** further comprises a first stop block **732** located at the first front end **731**, a first cam **735** located at the first front end **731** adjacent to the first stop block **732**, and a first shaft hole **737** cut through the first cam **735** and coupled to the top end **771** of the shaft **77**. Thus, the first cam **735** can stop against the

first stop block **732** to bias the inner door frame **3** and the door panel **5** in the first direction **S1**.

The second arm **75** further comprises a second stop block **753** located at the second front end **751**, a second cam **755** located at the second front end **751** adjacent to the second stop block **753**, and a second shaft hole **757** cut through the second cam **755** and coupled to the bottom end **773** of the shaft **77**. Thus, the second cam **755** can stop against the second stop block **753** to bias the door panel **5** in the second direction **S2**.

Referring to FIG. 11 again, the door panel **5** is stopped against the stop plate **30** at the inner door frame inner edge **31** to move the inner door frame **3** and the first cam **735** against the first stop block **737**, biasing the inner door frame **3** and the door panel **5**, i.e., the large door in the first direction **S1**.

Referring to FIG. 12 again, when the door panel **5** is pushed away from the stop plate **30** at the inner door frame inner edge **31**, the second cam **755** is stopped against the second stop block **753** to bias the door panel **5**, i.e., the small door in the second direction **S2** reversed to the first direction **S1**.

Referring to 13, a double-action door in accordance with a third embodiment is shown. This third embodiment uses a first door closer **8** and a second door closer **9** to substitute for the aforesaid two-way door closer **7**.

According to this third embodiment, the double-action door comprises an outer door frame **2** comprising an outer door frame inner edge **21** and a first top rail **25** at an upper side of the outer door frame inner edge **21**, an inner door frame **3** comprising an inner door frame inner edge **31**, an inner door frame outer edge **33** being smaller than the outer door frame inner edge **21** and a second top rail **35** at an upper side of the inner door frame outer edge **33**, at least one, for example, two first hinges **4** connected between the outer door frame **2** and the inner door frame outer edge **33** at different elevations for enabling the inner door frame **3** to be biased relative to the outer door frame inner edge **21** in the first direction **S1** between an open position and a close position, a door panel **5** comprising a door panel outer edge **51** being smaller than the inner door frame inner edge **31**, and at least one, for example, two second hinges **6** connected between the inner door frame **3** and the door panel outer edge **51** at different elevations for enabling the door panel **5** to be biased relative to the inner door frame inner edge **31** in the second direction **S2** between an open position and a close position.

The first door closer **8** comprises casing **81** fastened to the second top rail **35**, and an arm 83 coupled to the outer door frame **2** and turnable relative to the outer door frame **2** in the first direction **S1**.

The second door closer **9** comprises a casing **91** fastened to the inside of the second top rail **35**, and an arm **93** coupled to the door panel **5** and turnable relative to the door panel **5** in the second direction **S2**. The first top rail **25** defines a first sliding groove **251**. The first arm **73** defines a first rear end **733** slidably coupled to the first sliding groove **251**. The door panel **5** defines a second sliding groove **351** at a top side thereof. The second arm **75** defines a second rear end **752** slidably coupled to the second sliding groove **351**. By means of the first door closer **8** and the second door closer **9**, this third embodiment achieves the same effects as the aforesaid second embodiments.

Although a particular embodiment of the invention has been described in detail for purposes of illustration, various modifications and enhancements may be made without departing from the spirit and scope of the invention. Accordingly, the invention is not to be limited except as by the appended claims.

What the invention claimed is:

1. A double-action door, comprising:

an outer door frame defining an outer door frame inner edge;

an inner door frame defining an inner door frame inner edge;

at least one first hinge connected between said outer door frame and said inner door frame for enabling said inner door frame to be turned relative to said outer door frame inner edge between an open position and a close position in a first direction;

a door panel defining a door panel outer edge, said door panel outer edge being smaller than said inner door frame inner edge; and

at least one second hinge connected between said inner door frame and said door panel for enabling said door panel to be turned relative to said inner door frame inner edge in a second direction reversed to said first direction between an open position and a close position.

2. The double-action door as claimed in claim 1, wherein said door panel is movable with said inner door frame in said first direction subject to the constraint of said at least one second hinge to prohibit said door panel from moving in said first direction, thereby forming a large door.

3. The double-action door as claimed in claim 1, wherein said door panel is movable relative to said inner door frame in said second direction reversed to said first direction, forming a small door.

4. The double-action door as claimed in claim 2, wherein said door panel is movable relative to said inner door frame in said second direction reversed to said first direction, forming a small door.

5. The double-action door as claimed in claim 1, wherein said at least one first hinge and said at least one second hinge are buffer hinges.

6. The double-action door as claimed in claim 1, wherein said inner door frame further comprises a stop plate located at and covered on a part of said inner door frame inner edge for stopping against said door panel.

7. A double-action door, comprising:

an outer door frame comprising an outer door frame inner edge and a first top rail at an upper side of said outer door frame inner edge;

an inner door frame comprising an inner door frame inner edge and a second top rail at an upper side of said inner door frame inner edge;

at least one first hinge connected between said outer

door frame and said inner door frame for enabling said inner door frame to be turned relative to said outer door frame inner edge in a first direction between an open position and a close position;

a door panel;

at least one second hinge connected between said inner door frame and said door panel for enabling said door panel to be turned relative to said inner door frame inner edge in a second direction reversed to said first direction between an open position and a close position; and

a two-way door closer comprising a casing fastened to said second top rail, a first arm, said first arm comprising a first front end coupled to one side of said casing and biasable relative to said casing in said first direction and a first rear end movably coupled to said first top rail, a second arm, said second arm comprising a second front end coupled to an opposite side of said casing and biasable relative to said casing in said second direction and a second rear end movably coupled to said door panel.

8. The double-action door as claimed in claim 7, wherein said first top rail comprises a first sliding groove; said first rear end of said first arm is slidably coupled to said first sliding groove; said door panel comprises a second sliding groove located at a top side thereof; said second rear end of said second arm is slidably coupled to said second sliding groove.

9. The double-action door as claimed in claim 7, wherein said casing comprises a shaft defining opposing top end and bottom end, said top end extending out of one side of said casing, said bottom end extending out of an opposite end of said casing; said first arm further comprises a first stop block and a first cam located at the first front end thereof and a shaft hole cut through said first cam and coupled to said top end of said shaft so that said first cam is stoppable against said first stop block to bias said inner door frame and said door panel in said first direction; said second arm further comprises a second stop block and a second cam located at said second front end thereof and a second shaft hole cut through said second cam and coupled to said bottom end of said shaft so that said second cam is stoppable against said second stop block to bias said door panel in said second direction.

10. The double-action door as claimed in claim 8, wherein said casing comprises a shaft defining opposing top end and bottom end, said top end extending out of one side of said casing, said bottom end extending out of an opposite end of said casing; said first arm further comprises a first stop block and a first cam located at the first front end thereof and a shaft hole cut through said first cam and coupled to said top end of said shaft so that said first cam is stoppable against said first stop block to bias said inner door frame and said door panel in said first direction; said second

arm further comprises a second stop block and a second cam located at said second front end thereof and a second shaft hole cut through said second cam and coupled to said bottom end of said shaft so that said second cam is stoppable against said second stop block to bias said door panel in said second direction.

11. The double-action door as claimed in claim 7, wherein said door panel is movable with said inner door frame in said first direction subject to the constraint of said at least one second hinge to prohibit said door panel from moving in said first direction, thereby forming a large door.

12. The double-action door as claimed in claim 7, wherein said door panel is movable relative to said inner door frame in said second direction reversed to said first direction, forming a small door.

13. The double-action door as claimed in claim 11, wherein said door panel is movable relative to said inner door frame in said second direction reversed to said first direction, forming a small door.

14. The double-action door as claimed in claim 7, wherein said inner door frame further comprises a stop plate located at and covered on a part of said inner door frame inner edge for stopping against said door panel.

15. A double-action door, comprising:

an outer door frame comprising an outer door frame inner edge and a first top rail at an upper side of said outer door frame inner edge;

an inner door frame comprising an inner door frame inner edge and a second top rail at an upper side of said inner door frame inner edge;

at least one first hinge connected between said outer door frame and said inner door frame for enabling said inner door frame to be turned relative to said outer door frame inner edge in a first direction between an open position and a close position;

a door panel;

at least one second hinge connected between said inner door frame and said door panel for enabling said door panel to be turned relative to said inner door frame inner edge in said second direction reversed to said first direction between an open position and a close position;

a first door closer comprising a casing fastened to said second top rail and an arm coupled to said outer door frame and biasable relative to said outer door frame in said first direction; and

a second door closer comprising a casing fastened to said second top rail and an arm coupled to said door panel and biasable relative to said door panel in said second direction.