

DEVICE FOR AUTOMATICALLY CLOSING SLIDING DOORS

The present invention relates to a device for automatically closing a sliding door after the door is opened manually, and more particularly to an automatic door closer of the telescopic type.

An automatic door closer is already known which comprises large and small two pipes assembled telescopically and in which the small pipe is biased into the large pipe by a tension spring at all times. With this device, it is impossible to obtain an opening (or closing) stroke larger than the length of the large pipe, so that the device naturally must have an increased length for use with a door of larger width. The device then becomes large-sized and requires a large space for installation. The device has another drawback in that the size of the doors for which it is usable is limited relative to its length.

In view of these drawbacks, the main object of the present invention is to provide a device for automatically closing sliding doors which has a shortened length but is adapted to give a sufficiently large door opening stroke and which is therefore usable for doors of widely varying sizes.

To fulfill this object, the invention provides

a device for automatically closing a sliding door for a passage opening comprising a first pipe disposed horizontally, a second pipe provided within the first pipe and movable axially thereof, a third pipe provided within the second pipe and movable axially thereof, first tension spring means for biasing the second pipe into the first pipe, and second tension spring means for biasing the third pipe into the second pipe, one of the first pipe and the third pipe being connected to a structure defining the passage opening, the other pipe being connected to the door.

Since the three pipes are assembled telescopically, the automatic closing device of the above construction, although having a shortened length, affords a sufficiently large opening stroke and is usable for doors of varying sizes despite its shortened length.

According to a preferred embodiment of the invention, the third pipe is connected to a structure or door by connecting means attached to one end of the pipe. The connecting means comprises a rod portion projecting from the above end of the third pipe and a connector including a main body having an engaging portion for the rod portion to fit in. The connector main body is slidable relative to the structure or the door but can be fixed thereto.

According to the embodiment, the device main body is fixed to the structure or door first, and the connector main body is thereafter adjusted by sliding to fit the rod portion into the engaging portion of the connector main body, whereby the third pipe can be connected to the door or the structure. Thus the device is easy to install. With the conventional automatic closer of the telescopic type, the innermost pipe is connected to a door or structure first, and the closer main body is then fixed to the structure or door, so that the closer is cumbersome to install.

Various features and advantages of the present invention will be readily understood from the following description of embodiments given with reference to the accompanying drawings, in which:

Fig. 1 is a front view schematically showing an automatic closing device of the invention as installed in place for a sliding door;

Fig. 2 is a front view in vertical section showing the device in its entirety;

Figs. 3a to 3c are fragmentary enlarged views of Fig. 2;

Figs. 4a to 4c are fragmentary enlarged plan views in section showing the device;

Fig. 5 is a view of the device as it is seen

along the line X-X in Fig. 2;

Fig. 6 is a view in section taken along the line Y-Y in Fig. 2;

Fig. 7 is a view of the device as it is seen  
5 along the line Z-Z in Fig. 2;

Fig. 8 is an exploded perspective view showing connecting means according to the invention;

Fig. 9 is a front view showing the device before being connected to the door by the means;

10 Fig. 10 is a front view showing the device as connected to the door by the means; and

Fig. 11 is a side elevation showing the connecting means.

With reference to Figs. 1 to 7, a door 1 is  
15 slidable on a rail 2 for opening or closing a passage opening 3 formed in a building wall 5 or like structure. An automatic closing device 4 is attached to the lintel (not shown) for guiding the upper end of the door 1 and is positioned in parallel to the sliding direction of the  
20 door 1. The device 4 has a length about one half of the opening (or closing) stroke of the door 1 as will be described in detail later.

The automatic closing device 4 chiefly comprises an elongated channel support 7 horizontally fixed to the  
25 lintel of the opening 3 by brackets 6 or like fixing

means, a first pipe 8 having an approximately circular cross section and attached to the support 7 in parallel thereto, a second pipe 9 slidably fitted in the first pipe 8, a third pipe 12 slidably fitted in the second pipe 9 and having a cap 10 closing an outwardly projecting end thereof and connected to an upper portion of the door 1 by connecting means such as a bracket 11, caps 13, 14 closing the support 7 and the first pipe 8 at their opposite ends, a spring mount 16 provided within the support 7 near one end thereof and supported by an adjusting screw 15 on the cap 13 at one end of the support 7, a roller mount 17 provided within the support 7 and movable between an intermediate portion of the support 7 and the other end thereof along its length, a pair of tension springs 20, 20 provided within the support 7 and each having one end fitting around and supported by a male screw member 18 on the spring mount 16 and the other end fitting around and supported by a male screw member 19 on the roller mount 17, a wire 24 reeved in a U-shaped form around a roller 21 on the roller mount 17 and having one end supported by the cap 14 at the other end of the support 7 and the other end extending through a bore 22 in the cap 14 and held by a support member 23 which is fixed to the second pipe 9 and adapted to bear against the outer surface of the cap 14, a slider 25 provided at one end of the second

pipe 9 remote from the aforementioned end of the third pipe 12 and adapted for sliding contact with the first pipe 8, a slider 26 provided at the other end of the third pipe 12 and in sliding contact with the second pipe 9, and diametrically large and small tension springs 31, 32 disposed within the third pipe 12 and externally attached, each at one end thereof, to large and small male screw members 27, 28 on the slider 25. The other ends of the springs 31, 32 are externally attached to large and small male screw members 29, 30 on the cap 10.

Stated more specifically, the support 7 and the first pipe 8 are fixed to each other by the caps 13, 14 at the opposite ends. The portion of the cap 13 fitting to the first pipe 8 at one end is provided with a check valve 33 and a flow regulating valve 34. The check valve 33 having a ball 33b for opening or closing an air port 33a is closed when the door 1 is closed. The regulating valve 34 has a tapered screw 34b for regulating the amount of air flowing through an air port 34a. When the door 1 is closed, the valve 34 regulates the outflow of air from the first to third pipes 8, 9 and 12. Indicated at 35 is a retainer for the ball 33b.

The slider 25 attached to the second pipe 9 comprises an approximately cylindrical main body 37 having an air channel 36 therethrough and an annular sliding

member 39 of synthetic resin fitting around the main body 37 to contact the inner surface of the first pipe 8. A metal spacer 38 is provided between the main body 37 and the member 39.

5           The slider 26 attached to the third pipe 12 comprises an annular sliding member 41 of synthetic resin fitting around the third pipe 12, with a metal spacer 40 provided therebetween, to contact the inner surface of the second pipe 9.

10           The tension spring 31 is externally fitted around the tension spring 32. The force of the tension springs 20, 20 provided within the support 7 is adjustable by moving the spring mount 16 toward or away from the cap 13 with the adjusting screw 15. The force of the springs  
15   20, 20 is made approximately equal to the force of the springs 31, 32.

          The present device operates in the following manner. While the door 1 is closed, the second and third pipes 9, 12 are housed in the first pipe 8 as seen  
20   in Fig. 2. When the door 1 is opened from this state in the direction of arrow A shown in Fig. 1, the third pipe 12 slides outward from the second pipe 9 and, at the same time, the second pipe 9 also slides outward from the first pipe 8 while permitting air to flow in from outside  
25   through the check valve 33. Since the force of the

tension springs 20 is acting on the second pipe 9 through the wire 24 connected thereto by the support member 23 and through the roller 21 having the wire 24 reeved there-around in a U-shaped form, the force of the springs 20 acts in addition to the force of the tension springs 31, 32, giving a gradually increasing spring force with the sliding of the third pipe 12 and the second pipe 9 in succession.

Since the force of the springs 31, 32 biasing the third pipe 12 is approximately equal to the force of the springs 20, 20 biasing the second pipe 9, the amount of movement of the third pipe 12 is approximately equal to that of the second pipe 9, such that when the third pipe 12 moves to project outward from the second pipe 9, for example, by about one half, the second pipe 9 also projects outward by about one half. When the two pipes 12, 9 project out to the greatest extent, the slider 26 of the third pipe 12 bears against the support member 23 fixed to the second pipe 9, and the slider 25 of the second pipe 9 against the cap 14, whereby the sliders are prevented from slipping off.

The entire length of the wire 24 needs to be equal to the distance of movement of the second pipe 9, but since the wire 24 is reeved around the roller 21 in a U-shaped form, the distance between the roller 21 and

the cap 14 when the second pipe 9 is drawn into the first pipe 8 can be about one half of the distance of movement of the second pipe 9.

When the door 1 thus opened is released from the hand, the door 1 is automatically closed in the direction of arrow B in Fig. 1 by the forces of the springs 20, 31, 32. With this movement, the second and third pipes 9, 12 are returned to their original positions shown in Fig. 2 in an order reverse to the order for opening the door 1. At this time, the air within the pipes is discharged while being regulated by the flow regulating valve 34, so that the device operates while being suitably damped.

When the door 1 is fully opened, the assembly of the first, second and third pipes 8, 9, 12 are fully stretched, while when the door 1 is closed, the second and third pipes 9, 12 are accommodated in the first pipe 8. Accordingly the entire length of the first pipe 8, i.e. the device 4, can be about one half of the opening (or closing) stroke of the door 1.

A modification of the connecting means will be described below with reference to Figs. 8 to 11.

Although not shown in Figs. 1 to 7, a lintel 42 is attached to the building wall 5. The slidable door 1 and another door 1' are fitted in and supported by the lintel 42 at their upper ends. Rollers 43, 44 are mounted

rotatably on the upper ends of the doors 1, 1', while rollers are also attached to the lower ends of the doors as placed on the rails 2. While the two doors are thus slidable as being guided by the lintel and the sill, the other door 1' is usually locked in place against sliding. The device 4 may be fixed to the building wall, namely to the lintel 42, by bolts 45 serving as the fixing means in place of the brackets 6.

The illustrated modification of the connecting means, which is used in place of the bracket 11, generally comprises a rod portion 46 projecting from one end of the piston 12 and having an enlarged spherical lower end 47, and a connector including a main body 49 having a recessed engaging portion 48 for the rod portion 46 to fit in.

The connector main body 49 is slidable relative to the door 1 but can be fixed thereto. The connector is attached to the door 1 as opposed to the rod portion 46 when the door 1 is closed, i.e. when the piston 12 is retracted. The connector includes, in addition to the connector main body 49, a seat member 50 which is fixed to the door 1 with screws and on which the connector main body 49 is slidable, a lug 51 integral with the main body 49 for providing the engaging portion 48, and a fastening screw 54 for fixing the main body 49 to the seat member 50 by being inserted through a vertical slot 52 in the main body and screwed

into a threaded bore 53. The engaging portion 48 is elongated in a direction perpendicular to the length of the device 4 and has a width approximately equal to the diameter of the lower end 47 of the rod portion 46.

5 To connect the automatic closing device 4 to the door 1, the device 4 is fixed in position on the inner side face of the lintel 42, and the connector main body 49 is thereafter attached to the door 1 at a specified position by the seat member 50 and the fastening screw 54.

10 At this time, the fastening screw 54 is slightly loosened to lower the main body 49 to its lower limit position along the slot 52, with the engaging portion 48 away from the lower end 47 of the rod portion 46. The main body 49 is then raised to engage the rod portion lower end 47 in

15 the engaging portion 48. In this state, the screw 54 is tightened to fix the main body 49 to the seat member 50. Since the engaging portion 48 is elongated perpendicular to the device 4 installed in place, an error can be absorbed if involved in the installation of the device 4

20 relative to the door 1.

According to the embodiment described above, the main body of the device 4 is attached to the building wall, and the third pipe is connected to the door by connecting means, but the device may be installed in a

25 manner exactly reverse to the above. The means for fixing

the device may be the brackets 6 as seen in Figs. 1 to 7  
or the bolts 45 as shown in Figs. 8 to 11 or some other  
suitable means. In any case, it is to be understood that  
the present invention can be modified variously within  
5 the scope defined by the appended claims.

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## CLAIMS

1. A device for automatically closing a sliding door for a passage opening comprising a first pipe disposed horizontally, a second pipe provided within the first pipe and movable axially thereof, a third pipe provided within the second pipe and movable axially thereof, first tension spring means for biasing the second pipe into the first pipe, and second tension spring means for biasing the third pipe into the second pipe, one of the first pipe and the third pipe being connected to a structure defining the passage opening, the other pipe being connected to the door.

2. A device as defined in claim 1 wherein the second pipe is made slidable within the first pipe by a slider provided at its one end and having a sliding member in contact with the inner surface of the first pipe, and the third pipe is made slidable within the second pipe by a slider provided at its one end and having a sliding member in contact with the inner surface of the second pipe.

3. A device as defined in claim 2 wherein the first pipe is fixed to a support extending in parallel thereto and having movably supported therein a roller mount carrying a roller, and the first tension spring means is disposed to connect the roller mount to a spring mount



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provided in the vicinity of one end of the support and biases the second pipe into the first pipe through a wire reeved around the roller and having one end attached to the support and the other end connected to the other end of the second pipe, the second tension spring means connecting the slider of the second pipe to the other end of the third pipe.

4. A device as defined in claim 3 wherein the position of the spring mount is adjustable.

5. A device as defined in claim 1 wherein the first tension spring means and the second tension spring means are adjusted to have approximately the same biasing force.

6. A device as defined in claim 1 wherein the third pipe is connected to the structure or the door by connecting means attached to an end portion thereof.

7. A device as defined in claim 6 wherein the connecting means is a bracket.

8. A device as defined in claim 6 wherein the connecting means comprises a rod portion projecting from the end portion of the third pipe and a connector including a connector main body having an engaging portion for the rod portion to fit in and adapted to slide on and to be fixed to the structure or the door.

9. A device as defined in claim 8 wherein the



connector further includes a seat member fixed to the structure or the door and permitting the connector main body to slide thereon and to be fixed thereto, a lug  
5 formed on the connector main body and provided with the engaging portion, and a fastening screw inserted through a slot in the connector main body for fixing the main body to the seat member.

10. A device as defined in claim 1 wherein the first pipe is provided at its one end with a check valve for permitting flow of air only into its interior and a flow regulating valve for regulating the rate of discharge  
5 of air from the interior.

11. A device for automatically closing a sliding door, substantially as described herein with reference to, and as illustrated in, Figures 1 to 7 of the accompanying drawings.

12. A device for automatically closing a sliding door, substantially as described herein with reference to, and as illustrated in, Figures 8 to 11 of the accompanying drawings.

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