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AUTOMATIC UNIVERSAL DOOR CLOSER

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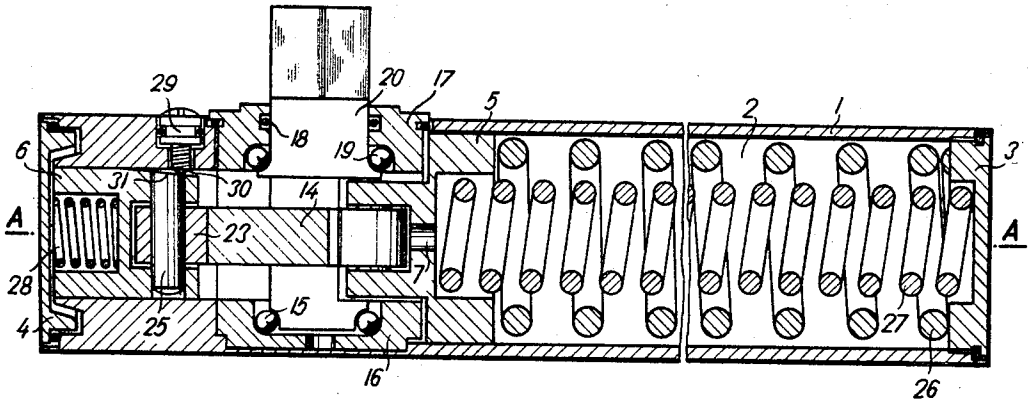

Fig. 1

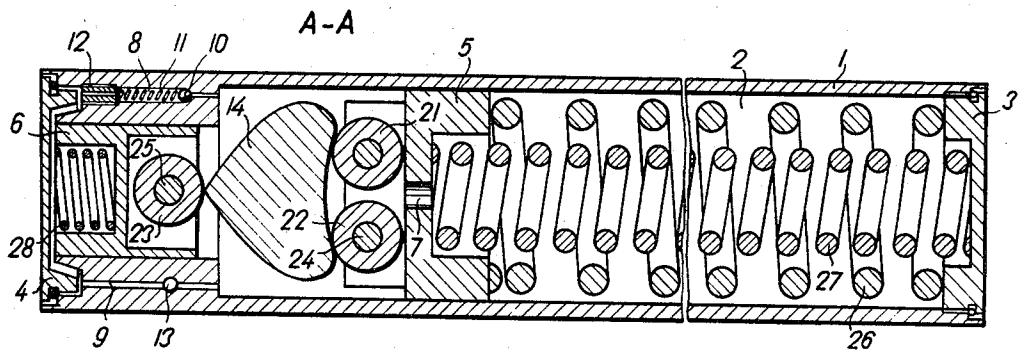

Fig. 2

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AUTOMATIC UNIVERSAL DOOR CLOSER

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U.S. Cl. 16—55 9 Claims

ABSTRACT OF THE DISCLOSURE

An automatic universal door closer, wherein the forces for closing the door are transmitted via a cam, comprising an elongated tubular housing having two pistons axially slidably mounted therein, which divide the tubular housing into three chambers, which are in hydraulic communication with each other. A cam rotatably transversely mounted in said tubular housing between said two pistons and operatively connected to a door. The cam, including one concave and two convex cam surfaces, and the two pistons include means which bear against the cam surfaces of the cam in order to control the movement thereof. One of the two pistons defining between itself and the end of the tubular housing a damping space, which is one of the three aforementioned chambers, and which is in communication with the adjacent chambers via, at least, one suction passage and one discharge channel disposed in the walls of said housing. The tubular housing being filled with hydraulic fluid. Biasing means are mounted in the tubular housing for urging the two pistons towards each other.

BACKGROUND OF THE INVENTION

The present invention relates to an automatic universal door closer.

The door closer of this invention is very compactly constructed and also provides a remarkable reduction in the transmissoin ratio between the door wing and the working members of the door closer.

The door closers of the prior art are generally relatively large and do not fully utilize the space in which their working elements act.

SUMMARY OF THE INVENTION

It is accordingly a primary object of the present invention to provide a construction for an automatic door closer which will avoid the aforementioned drawback.

In particular, it is an object of the present invention to provide a relatively simple structure which will operate in a manner far superior to known constructions for automatic door closers.

In particular, it is an object of the present invention to provide an automatic door closer which can perform the same functions as the known automatic door closers but has substantially reduced dimensions when compared with the latter.

The automatic door closer of this invention thus can be used for left and right hand doors, and swinging and sliding doors when the latter are provided with the necessary connecting levers.

Furthermore, the automatic door closer of the present invention may be mounted below the floor level, or above the ceiling levels, or, when provided with the necessary connecting levers, in any other position without affecting the proper operation of the device.

The shape of the cam is selected so that the forces produced within the closer for closing, that is resisting the opening of the door, initially increase quickly, but after the door has traversed a predetermined distance, increase at a slower rate. An accidental opening of the door due to, for example, an air current, is thus prevented.

It should be noted that a door directly connected to the cam of the door closer of the present invention can swing through an angle of up to 150°.

BRIEF DESCRIPTION OF THE DRAWING

The invention is illustrated, by way of example, in the accompanying drawing, which forms part of this application, and in which:

FIG. 1 is a longitudinal cross-sectional view of an automatic door closer in accordance with the invention; and

FIG. 2 is a sectional view along line A—A of FIG. 1.

DESCRIPTION OF PREFERRED EMBODIMENT

Referring now to FIGS. 1 and 2, there is illustrated therein the tubular housing **1** of the door closer, which has preferably a square cross section. This housing **1** may conveniently be mounted below the floor, or near the upper end of the door wing, or on the door frame, or any other place from where it can be suitably connected to the door. The elongated tubular housing **1** has an axial interior space **2** and is closed in a fluid-tight manner at its axial ends, respectively, with the covers **3** and **4**. The housing is filled with a suitable hydraulic fluid, such as oil. Two pistons **5** and **6** are axially reciprocally mounted in the housing **1** and divide the housing **1** effectively into three separate chambers. The latter are in communication with each other via the channel **7** in piston **5** and the channels **8** and **9**, which longitudinally extend through the walls of the housing **1**.

The channel **8** provides a passage for sucking the oil from the chamber between the two pistons **5** and **6** into the chamber behind the piston **6**. The passage **8** is provided with a suitable ball **10** and spring **11** and therefore acts as a nonreturn valve permitting only unidirectional flow in the afore-described direction. A hollow screw **12** is threaded into one end of the channel **8** and serves to adjust the compression on the spring **11**. A regulating needle **13** is adjustably mounted in the wall of housing **1** and extends transversely across the channel **9**, thereby serving to regulate the flow of the oil therethrough. A pin **20** is transversely and pivotally mounted between the pistons **5** and **6**. A cam member **14**, having preferably a heart shape, is integral with the pin **20**, which has a male square end projecting from the housing **1** so that it can be suitably connected to a turn-table of a door wing or a lever. A plate **16** is mounted in the wall of the housing **1**. The lower end of the pin **20** is supported on a ball race in a cavity of the plate **16**. The upper square end of the pin **20** extends through an opening in an upper plate **17**, which is sealed by means of a seal ring **18**. The upper plate **17** is mounted in a fluid tight manner in the housing **1**. A second ball race **19** is mounted in a suitable cavity of the upper plate **17** and serves to guide the pin **20**. The latter is thus axially and radially guided by the ball races **15** and **19**. The cam member **14** is preferably heart-shaped and the periphery, which extends transversely to the axis of the housing, includes one slightly concave and two symmetrical convex surfaces. A pair of rollers **21** and **22** is secured to the pins **24**, which are rotatably mounted in a pair of projections of the piston **5**. A roller **23** is secured to the pin **25**, which is rotatably mounted on a pair of projections to the piston **6**. As can be noted from FIG. 2, the rollers **21** and **22** bear against the concave surface of the cam member **14**, whereas the roller **23** bears against the point of the cam member **14** when the pin **20** is in its neutral position. A system of springs **26** and **27**, which bears with one of its two ends against

the pistons 5 and with the other against the cover 3, urges the pair of rollers 21 and 22 at all times against the transverse surfaces of the cam member 14. A spring 28, which acts in the opposite direction and bears against the cover 4 and piston 6, urges the roller 23 at all times against the corresponding transverse surface of the cam member 14. Furthermore, the oil pressure, which forms in the chamber adjacent to the cover 4, also urges the piston 6 and the roller 23 against the cam member 14. A screw 29 is threadably mounted in a fluid-tight manner in the upper wall of the housing 1 and protrudes inwardly so as to abut against a complementary oblique surface 31 of the piston 6, thereby limiting the stroke of the piston 6.

FIG. 2 illustrates the pin 20 and cam member 14 in their neutral positions. As mentioned before, the door wing is indirectly or directly mechanically connected to the pin 20 so that when the door wing is swung in either direction from its closed condition, the pin 20 and cam member 14 are also rotated. Due to the rotational movement of the latter, the piston 5 is urged, via the rollers 21, 22 and the pins 29, towards the cover 3, thereby slightly compressing the system of springs 26, 27. Similarly, the spring 28 causes an axial movement of the piston 6 in the same direction as the movement of the piston 5. Due to the afore-described movement of the two pistons 5 and 6, oil is forced through the opening 7 into the middle chamber from the right chamber, and from there through the channel 8 and in a negligible quantity through the throttled channel 9 into the left chamber behind the piston 6. The forces which form due to the compression of the spring system 26, 27 are instrumental in automatically closing the door wing. The rotational movement of the cam member 14 is damped by the force required for the oil to pass through the discharge channel 9 into the middle chamber between the pistons 5 and 6 and also through the opening 7 of the piston 5 into the right chamber. The stroke of the piston 6, that is the length of the damping path during the closing motion of the door wing, can be adjusted by means of the screw 29. The velocity of the closing motion can be adjusted by adjusting the needle 13 in the channel 9. A damping action is generally only required during the end phase of the closing motion of a door wing. Therefore, the stroke of the piston 6 is limited by the screw 29 so that the roller 23 can only follow the cam surface of cam member 14 during a portion of the opening or closing cycle of the pin 20.

Those door wings which open or close only in one direction require only a portion of the cam surfaces of the cam member 14 and, consequently, a part of the cam member 14 (the portion above the dashed line in FIG. 2) can be omitted, as well as the roller 21

It is, of course, possible to provide several discharge channels and several suction channels in the left end portion of the housing 1. It is, however, essential that at least one of the discharge channels discharge the oil into the left chamber at an outlet which becomes closed during the damping of the motion of the piston 6 before the latter reaches the end of its stroke in the direction away from cover 4. Due to this feature, the damping action is less pronounced at the beginning of the stroke and becomes more intense during the end phase.

Notches or cutouts, which are of complementary shape with respect to the rollers 21, 22, may be provided on the cam surfaces for stopping the door wing at preselected points as, for examples, in a preselected open position.

Although the present invention has been described in conjunction with one preferred embodiment, it is to be

understood that modifications and variations may be resorted to without departing from the spirit and scope of this invention, as those skilled in the are will readily understand. Such modifications and variations are considered to be within the purview and scope of the invention.

Having thus fully described my invention, what we claim as new and desire to secure by Letters Patent is:

1. An automatic universal door closer, comprising, in combination, a tubular housing, closed at both of its ends, and being filled with a hydraulic fluid;

a pair of pistons, axially reciprocally mounted in said housing and effectively dividing the latter into three axially aligned chambers, each one of said three chambers being in communication with the adjacent chambers, and the middle chamber being disposed between said pair of pistons;

cam means, rotatably mounted in said housing within the confines of the middle one of said three axially aligned chambers, the axis of rotation of said cam means being normal to the axis of said housing, said cam means transversely projecting from said housing;

biasing means, operatively connected to said pair of pistons for urging the latter towards said cam means, and

roller means, operatively mounted on said pair of pistons for contacting said cam means.

2. The automatic universal door closer as set forth in claim 1, wherein said cam means is substantially heart-shaped and includes a pair of symmetrically disposed convex surfaces and one concave surface.

3. The automatic universal door closer as set forth in claim 2, wherein said roller means, mounted on said pair of pistons, are adapted to follow along said concave and convex surfaces of said cam means.

4. The automatic universal door closer as set forth in claim 1, including a screw, adjustably mounted in the walls of said housing, and adapted to project into the path of the active stroke of a first one of said pair of reciprocally, movably mounted pistons, thereby limiting said stroke.

5. The automatic universal door closer as set forth in claim 4, wherein a second one of said pair of piston includes an opening for passing hydraulic fluid therethrough.

6. The automatic universal door closer as set forth in claim 5, including passage means disposed in the walls of said housing for placing said middle chamber in communication with the one chamber of said three chambers which is separated therefrom by said first piston.

7. The automatic universal door closer as set forth in claim 6, wherein said passage means includes at least one suction passage and at least one discharge passage.

8. The automatic universal door closer as set forth in claim 7, including one-way valve means operatively mounted in said suction passage and adapted to permit flow only from said middle chamber therethrough.

9. The automatic universal door closer as set forth in claim 7, including an adjustable needle operatively mounted in said discharge passage for regulating the flow of hydraulic fluid therethrough.

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