

Title: Door closer with a hydraulic closing delay system

Description

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The present invention relates to a door closer with a hydraulic closing delay system according to the type defined in detail in the generic part of the claim 1.

- 10 A door closer of this species is known from the patent specification DE 42 39 219 C2. This door closer is embodied as an automatic door closer for unilateral doors and comprises a closer shaft which can be coupled to a door leaf, which shaft, from a closing position, is rotatable
- 15 in a direction of rotation and, within the housing, is non-positively and positively connected to a cam disc. The cam disc cooperates with a roller, which is located in or at a longitudinally movable spring force accumulator, upon which a compression spring acts which forms an energy
- 20 accumulator. The inner space of the door closer housing has two pressure compartments separated by a hydraulic piston, which compartments are connected to each other through channels, to allow for differently throttled draining of the pressure medium from the pressure compartment,
- 25 which becomes smaller during the closing operation of the door leaf, and through a non-return valve which is disposed

in the piston and opens as well during an opening movement of the door leaf.

A rotatably supported roller is disposed in or at the spring
5 force accumulator, wherein, furthermore, a second roller is
disposed at the fluid displacing hydraulic piston, said rollers
respectively rolling over sections of the cam disc. When the
door leaf is being opened, the cam disc is brought into
rotation either directly or via an arm assembly. On account
10 of the contour of the cam disc, the compression spring of
the spring force accumulator is compressed such that
energy is stored in the spring force accumulator. This
energy is utilized to automatically close the door leaf
subsequently to the opening operation. For this purpose,
15 the compression spring presses against the working piston,
the roller, which is in contact with the cam disc, being
rotatably supported within the working piston. The hydraulic
piston, on the other hand, serves for dampening the
rotational movement of the door leaf, the speed of the
20 rotational movement, in particular of the closing movement
of the door leaf being adjustable via a throttle valve
arrangement.

The problem arising in such automatic door closers is that,
25 in particular with room doors, for example in hotels, an
opening is carried out up to approximately 90° and the door
leaf, subsequently to the opening operation, immediately

executes the closing movement. However, it should be possible to suspend this automatic closing for a short period of time, in order to be able to pass through the room door, for example with the luggage. For fire protection reasons it is inadmissible to provide door leaves with a mechanical hold-open device, which doors are not coupled to the fire protection system. On the other hand, electromagnetic hold-open devices are very expensive and require an additional smoke switch.

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Therefore, a delay in the closing movement of the door leaf subsequent to the complete opening is desirable, such as to be able to pass through the door without having to actively hold the door leaf in place.

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Furthermore, door closers are known which are able to realize a delayed closing with additional throttle valves. This delayed closing may be effective over the entire opening angle of the door closer or only over partial segments of the opening angle. It is therefore very complicated to achieve a restricted delayed closing over an opening angle of only 70° to 90° for example. The expensive and complicated bore holes constitute another drawback, which are required for the fluid to be able to flow back and forth between the pressure compartments via the one or more additional throttle valves. Since these small throttle valves tend to clog-up rather quickly, because

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smallest particles deposit in the channels or in the valve seats, the reliability of this solution is very limited. In the event valve arrangements, having corresponding small control openings are provided to effect the delayed closing
5 over partial segments of the opening angle, they may accumulate impurities such that the dampening function is adversely affected. Thus, the longevity of such dampening devices controlled via control openings does not offer a satisfying solution.

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Therefore, it is the object of the present invention to provide a door closer with a hydraulic closing delay system, which has a simple configuration and allows for a prolonged and maintenance-free operating period.

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This problem is solved based on a door closer according to the generic part of the claim 1 in conjunction with the characterizing features thereof. Advantageous further developments of the present invention are indicated in the
20 dependent claims.

The invention includes the technical teaching according to which the contour section of the cam disc cooperating with the pick-off element has an angle segment, which, in
25 relation to the angle of rotation of the cam disc, causes a larger stroke of the hydraulic piston for an increase in the

fluid displacement, in order to generate a delay in the closing movement of the door leaf.

With the inventive angle segment in the cam disc, it will be
5 achieved that, when the pick-off element moves along the angle of rotation of the cam disc, the hydraulic piston will perform a larger stroke in relation to the angle of rotation. In this case, the cam disc is in operational connection with a first roller, which moves in rolling contact along the cam
10 disc, and is in a stroke-like movable connection with and against a compression spring of a spring force accumulator, and is accommodated within a working piston, the pick-off element being formed by a second roller, and the first roller and the second roller with their
15 associated pistons being disposed opposite each other in relation to the cam disc. As an alternative, the pick-off element may consist of a sliding tappet, which is in sliding contact with the cam disc along the contour thereof.

20 In this case, the angle segment is configured such that an increased gradient of the angle α between H1 and H2 is introduced into the contour, in order to increase the ratio of the stroke of the hydraulic piston in relation to the angle of rotation of the door leaf. It is not until the second roller gets
25 in contact with the rest of the contour section of the cam disc ahead of the angle segment H1 to H2, that the door leaf can close at the normal closing speed. All the above

can be made possible without any additional valve arrangement and thus without any additional control openings, because the stroke information with the increased stroke for the hydraulic piston is contained
5 directly on the cam disc and thus no clogging of the small control openings at the valve arrangements is able to occur on account of impurities, etc. Thus, the inventive door closer is less expensive and more reliable than the door
10 closers having the same functioning according to the state-of-the-art, because in this case the valve arrangements, which are expensive and tend to clog-up with impurities, can be foregone.

According to an advantageous further development of the
15 cam disc, the latter has an active cam path and a passive cam path, the active cam path being in operational connection with the first roller and the passive cam path with the second roller. In this case, the angle segment H1 to H2 is configured as a contour section within the passive
20 cam path. In this case, the active cam path forms the operational section of the cam disc, which, together with the spring force accumulator, produces the closing force on the door leaf. The section of the passive cam path, on the
25 other hand, is in operational connection with the hydraulic dampening device, such that the second roller moves in rolling contact along the passive cam path and generates the required stroke within the fluid displacing hydraulic

piston. In this case, the configuration of the passive cam path may be realized independently from the active cam path, because the shape of the passive cam path does not affect the torque characteristics of the door closer, but only
5 the delayed closing and thus the timely progression of the closing operation.

According to the state-of-the-art, door closers have a flat, constant stroke progression over the entire range of
10 rotation of the door with the consequence that the hydraulic control of the flow rates of the volume flow of the hydraulic fluid is realized via various throttle positions of several valves. Thus, the delayed closing in the angle range of 90° to 70° is controlled, for example, by a separate valve.
15 Another valve is provided for the normal closing range of 70° to 5° , and for the final latch range of 0° to 5° , again an additional valve is provided. Each of these valves can be disposed in a separate hydraulic bore hole or controlled via by-passes. According to the invention, it is possible to
20 configure a hydraulic final latching control by means of a corresponding configuration of the passive cam path, in that a segment of a circle with zero stroke, which is concentrically disposed with regard to the axis, is positioned in the range of rotation of the final latching.
25 Thereby several door closing sections at different closing speeds can be generated with a single regulating valve

only and without any feedback to the torque characteristics (opening and closing).

An advantageous further development of the invention is
5 based on the fact that the angle segment H1 – H2 is
incorporated in one such section of the passive cam path
which corresponds to an opening angle of the door leaf
from 50° to 100°, and preferably corresponds to 70° to 90°.
Depending on the specific embodiment of the door, the
10 door leaf can generally be opened up to 90°, whereby even
larger opening angles are possible. If the door leaf is
opened, for example, up to 70° or even up to 90°, the
second roller moves in rolling contact first over a
conventionally configured contour of the cam disc in the
15 area of the passive cam path. In the transitional area
towards the angle segment H1 to H2 however, the stroke
movement of the hydraulic piston experiences acceleration
even at a constant rotational movement of the door leaf,
because the radius of the cam disc strongly decreases
20 from the stroke H1 to the stroke H2. Thereby, the fluid
displacing hydraulic piston continues to come closer to the
axis of rotation of the cam disc. If the door stands still for
example at an opening of 90° and is released by the user,
the second roller moves again in rolling contact in the
25 reverse direction of rotation over the inventive angle
segment from H2 to H1, H2 describing the small radius,
and H1 the maximum radius of the cam disc. In this case,

the hydraulic piston has to perform a disproportionately larger stroke and thus has to displace an increased volume of hydraulic fluid, which in turn results in a slow-down, respectively delay in the closing movement of the door leaf.

- 5 If the opening angle of the door leaf reaches a value, for example 70° , the second roller has overcome the maximum stroke $H1$, and can move in a rolling contact over the rest of the regularly configured passive cam path into the closing position $H0$.

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- In further continuation, it is intended that the cam disc is rotatable about an axis of rotation and that the passive cam path, in relation to the axis of rotation, comprises a maximum stroke radius (R_{max}), which forms the
- 15 transitional area of the passive cam path into the angle segment $H1$ to $H2$ and is larger than the maximum stroke radius of the active cam path. The maximum stroke radius within the cam disc thus forms a cam geometry over which the second roller has to move in rolling contact, whereby
- 20 the hydraulic piston performs the correspondingly increased stroke movement. Therefore, it is furthermore intended that the angle segment $H1$ to $H2$, within the passive cam path, exhibits a concave contour oriented towards the axis of rotation in order to form a saddle-like
- 25 contour. The movement behaviour of the door leaf is thereby influenced during the range of the delayed closing, wherein, with a more accentuated configuration of the

saddle-like contour, the slow-down of the closing movement of the door leaf is not realized in a uniform manner, and a maximum delay is located in the lower range, for example at 70°. Thus, the door slows down from
5 90° to 70° while closing, the minimum closing speed being at approximately 70°. If the door leaf has passed the 70°, a uniform and non-delayed closing movement is performed, as it is known in conventional door closers.

10 Advantageously, the hydraulic piston borders a rear pressure compartment filled with hydraulic fluid which is in fluidal communication with the frontal pressure compartment via a throttle valve. The cam disc is accommodated in the frontal pressure compartment, which
15 is separated from the rear pressure compartment simply by the hydraulic piston. If the hydraulic piston moves in the direction of the rear pressure compartment, the latter is reduced in volume, whereas the frontal pressure compartment increases in volume to the same amount. In
20 this case, the hydraulic fluid, displaced from the rear pressure compartment, flows into the frontal pressure compartment via the throttle valve, the adjustment of the flow cross-section in the throttle valve affecting the dampening effect of the movement of the hydraulic piston.
25 The throttle valve can be disposed within the housing of the door closer; however, a disposition within the hydraulic piston itself is likewise possible.

According to an advantageous further development of the inventive door closer, it is furthermore intended that an auxiliary compression spring is located in the rear pressure compartment between the housing and the hydraulic piston, which spring presses the second roller against the passive cam path of the cam disc. In this case, the auxiliary compression spring does not affect the dampening behaviour of the hydraulic piston, because it has just enough rigidity that is sufficient to force the spring to push the hydraulic piston in the direction of the frontal pressure compartment in order to refill the rear pressure compartment with hydraulic fluid during the return movement of the hydraulic piston.

According to possible embodiments of the door closer, the latter may be configured as a slide channel door closer, as an overhead door closer, as a floor spring or as a frame door closer. The precise installation position of the door closer and the embodiment of the door closer with regard to the operational connection of the closer shaft to the door leaf does not constitute by any means a restriction to the present invention such that the cam disc can be directly disposed on the axis of rotation of the door leaf and the door closer may be connected to the door leaf without any arm assembly. The active cam path is formed in a conventional manner in that a constant closing force can

be generated over the entire angle of rotation over which the first roller is in contact with the cam path.

Another advantageous embodiment can be achieved in that the door closer is disposed in a door jamb or in a door leaf. This results in an invisible solution for the user, which solution is easy to integrate with any design of a possible interior decoration of a room, for example in hotels.

10 According to an advantageous further development, the closer shaft of the door closer may be in operational connection with a door jamb or a door leaf, for example via a slide channel arm assembly or a scissor arm assembly. The type of arm assembly, depending on the type of
15 installation, for example on the pull side or on the push side, can affect for example the closing moment characteristics of the cam mechanism.

Further measures improving the invention are indicated in the dependent claims or are illustrated in detail in the
20 following, in conjunction with the description of one preferred exemplary embodiment of the invention based on the Figures, in which:

25 Figure 1: shows a diagrammatical cross-sectional view of the inventive door closer,

Figure 2: shows a diagrammatical illustration of the cam disc, which is shown in the area of the passive cam path,

- 5 Figure 3: shows a top view on the cam disc, the area of the active cam path and the area of the passive cam path being indicated, and

- 10 Figure 4: shows a diagram of the stroke progression of the hydraulic piston over the angle of the door opening from the closing position H0 up to and over the angle segment H1 to H2.

The diagrammatically illustrated door closer 1 in Figure 1
15 has a closer shaft 2, which is rotatably accommodated in a housing 3. A cam disc 4 is brought into a torsion-resistant connection with the closer shaft 2, the closer shaft 2 in turn being torsion-resistently connected to a door leaf, the closing movement thereof being dampened through the
20 door closer 1. The housing 3 is filled with a dampening medium, which conventionally is hydraulic fluid. A first piston, which constitutes the working piston 8, is disposed in the housing 3 within the area that is filled with fluid. A second piston forms the hydraulic piston 5, the cam disc 4
25 being disposed between the working piston 8 and the hydraulic piston 5.

In the event the cam disc 4 is brought into rotation, by opening the door leaf and the closer shaft 2 performing a rotational movement, both the working piston 8 and the hydraulic piston 5 are thus caused to perform a stroke movement on account of the contour of the cam disc 4 rotating along. The working piston 8 is in operational connection with a compression spring 7 such that the former forms a spring force accumulator in conjunction with the compression spring 7. A first roller 6, which is in contact with the exterior contour of the cam disc 4, is rotatably supported in the working piston 8. The assumed direction of rotation about an axis of rotation 12 of the cam disc 4 is illustrated by an arrow, such that, if the cam disc 4 is rotated in the direction of rotation, the first roller 6 moves in rolling contact along a section of the cam disc 4, which is characterized by the active cam path 10. The active cam path 10 is configured in such a way that, in relation to the axis of rotation 12, the radius of the active cam path 10 continuously increases. The working piston 8 thereby moves in the direction of the compression spring 7 and compresses the latter. As a consequence, energy is stored in the compression spring 7, which can initiate the following closing movement of the door leaf. The first roller 6 is illustrated in a resting position, which is configured by a concave section within the cam disc 4.

If the cam disc 4 rotates in the direction of the arrow, a second roller 9, which is rotatably accommodated within the hydraulic piston 5, can move in rolling contact along the cam section of the cam disc 4, which is formed by the passive cam path 11. In this case, the hydraulic piston 5 moves in the direction of the axis of rotation 12, because the radius of the passive cam path 11 slightly decreases in relation to the axis of rotation 12. However, on account of the inventive contour of the passive cam path 11, the stroke movement of the hydraulic piston 5 is not uniform in relation to the rotational movement of the cam disc 4. In order for the hydraulic piston 5 to perform a stroke movement during an opening movement of the door, and thus during a rotational movement of the cam disc 4 in the illustrated direction of rotation, an auxiliary compression spring 16, which is propped between the housing 3 of the door closer 1 and the hydraulic piston 5, is provided within the rear pressure compartment 13.

The hydraulic piston 5 is delimited by a rear pressure compartment 13, as well as by a frontal pressure compartment 15. During the opening movement, the hydraulic piston 5 moves in the direction of the axis of rotation 12 and opens up the volume of the rear pressure compartment 13 such that the latter increases. At the same time, the volume of the frontal pressure compartment 15 decreases such that the hydraulic fluid, which is in both the

rear pressure compartment 13 and the frontal pressure compartment 15, can flow over via a hydraulic line 17. A throttle valve 14, which constitutes a flow restriction in order to correspondingly dampen the stroke movement of the hydraulic piston 5, is inserted within the hydraulic line 17. The throttle valve 14 may be configured as a unilaterally effective valve, such that the overflow of the hydraulic fluid from the frontal pressure compartment 15 to the rear pressure compartment 13 is not at all or only slightly dampened. If, however, the door leaf performs a closing movement, the hydraulic piston 5 moves back in the direction of the rear pressure compartment 13 and reduces the volume. The dampening effect of the throttle valve 14 may become effective in this case, such that the return movement of the hydraulic piston 5 in the direction of the rear pressure compartment 13 is made more difficult. Depending on the configured contour of the passive cam path 11, the return movement of the hydraulic piston 5 can be performed either accelerated or decelerated. If the return movement is accelerated, this results in an increased resistance of the closing movement of the door leaf, because the increased stroke of the hydraulic piston 5 accentuates an increase of the fluid displacement, and thus the inventive delayed closing starts.

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Figure 2 shows a section of the cam disc 4 which forms the passive cam path 11. An inventive angle segment H1 to

H2, which extends over the angle α , is formed within the passive cam path 11.

The first portion of the passive cam path 11 extends initially
5 from the closing position H0 to the beginning of the angle
segment H1. Furthermore, the second roller 9 is illustrated,
which is in contact with the first portion of the passive cam
path 11. If the second roller 9 moves in rolling contact over
this section of the passive cam path 11, an increased
10 stroke of the hydraulic piston is the result, which path
extends in a constant manner with the rotational movement
of the cam disc 4. If the contact of the second roller 9
reaches the position H1, the radius characteristics of the
passive cam path 11 change such that the radius
15 decreases from a maximum radius R_{max} to a minimum
radius, which is found at the end of the angle segment H2.
The hydraulic piston 5 thus performs a significantly
increased stroke movement for opening the rear pressure
compartment, such that, if the cam disc 4 initiates the
20 closing movement of the door leaf, the displacement of the
hydraulic fluid through the hydraulic piston is significantly
increased from the segment H2 to the segment H1.
Thereby the inventive delayed closing of the door leaf is
achieved, whereby this circumstance is simply achieved by
25 the specially configured contour of the passive cam path
11.

Figure 3 shows the division of the cam disc 4 into the passive cam path 11 and the active cam path 10. The direction of rotation about the axis of rotation 12 of the cam disc 4 is not directly determined; however, according to the present embodiment, the inventive cam disc 4 is intended for door leaves which perform a unilateral opening of approximately 90°.

Figure 4 shows a diagrammatical illustration of the stroke progression H over the door opening angle TÖ in a diagram. The stroke H of the hydraulic piston starts at a stroke H0, which represents the closed position of the door leaf. The stroke of an opening angle, starting at 0° up to approximately 70°, is represented by the progression of the stroke H0 to H1. The significantly increased stroke from H1 to H2 is visible from the curve, wherein, in relation to the axis of rotation 12 (compare Figure 3), the stroke H2 is smaller than the stroke H1. The dotted line for the continued progression of the stroke represents door opening angles, which are larger than 90°. The diagram reveals that the ratio of the stroke over the angle segment H1 to H2 is large when compared to the stroke of H0 to H1. The stroke is proportional to the required transport of the hydraulic fluid from the rear pressure compartment to the frontal pressure compartment such that the effect of the delayed closing becomes evident from the diagram.

The embodiment of the present invention is not limited to the above described preferred exemplary embodiment. Moreover, numerous different embodiments of a door closer are possible, which may be configured as a slide
5 channel door closer, as an overhead door closer, as a floor spring or as a frame door closer.

List of reference numerals

	1	door closer
	2	closer shaft
5	3	housing
	4	cam disc
	5	hydraulic piston
	6	first roller
	7	compression spring
10	8	working piston
	9	second roller
	10	active cam path
	11	passive cam path
	12	axis of rotation
15	13	rear pressure compartment
	14	throttle valve
	15	frontal pressure compartment
	16	auxiliary compression spring
	17	hydraulic line
20		
	H0	closing position
	H1 – H2	angle segment
	Rmax	maximal stroke radius
	α	angle
25	TÖ	door opening
	H	stroke of the hydraulic piston

Patent claims

1. A door closer (1) with a closer shaft (2), which can be coupled to a door leaf and, starting from a closing position, is rotatable in at least one direction of rotation and is connected to a cam disc (4) supported within a housing (3), wherein said disc is cooperating with at least one pick-off element, which is in connection with a hydraulic dampening device and accommodated in a fluid displacing hydraulic piston (5),
characterized in that
the contour section of the cam disc (4) cooperating with the pick-off element has an angle segment (H1 to H2), which, in relation to the angle of rotation of the cam disc (4), causes an increased stroke of the hydraulic piston (5) for an increase in the fluid displacement, in order to generate a delay in the closing movement of the door leaf over the angle segment (H1 to H2).
2. A door closer (1) according to claim 1, characterized in that the cam disc (4) is in operational connection with a first roller (6), which moves in rolling contact along the cam disc (4), and is in a stroke-like movable connection with and against a compression spring (7) of a spring

5 force accumulator, and is accommodated within a working piston (8), the pick-off element being formed by a second roller (9), and the first roller (6) and the second roller (9) with the associated pistons (5, 8) being disposed opposite each other in relation to the cam disc (4).

10 3. A door closer (1) according to claim 1 or 2, characterized in that the cam disc (4) has an active cam path (10), which is in an operational connection with the first roller (6), and a passive cam path (11), which is in an operational connection with the second roller (9), the angle segment (H1 to H2) forming a contour section of the passive cam path (11).
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20 4. A door closer (1) according to one of the claims 1 to 3, characterized in that the angle segment (H1 to H2) is integral with a section of the passive cam path (11), which corresponds to an opening angle of the door leaf from 50° to 100°, preferably from 70° to 90°.

25 5. A door closer (1) according to one of the preceding claims, characterized in that the cam disc (4) is rotatable about an axis of rotation (12) and in that the passive cam path (11), in relation

5 to the axis of rotation (12), comprises a maximum stroke radius (R_{max}), which forms the transitional area of the passive cam path (11) to the angle segment (H1 to H2) and is larger than the maximum stroke radius of the active cam path (10).

6. A door closer (1) according to one of the preceding claims, characterized in that, within the
10 passive cam path, the angle segment (H1 to H2) has a concave contour oriented towards the axis of rotation (12) for the purpose of forming the saddle-shaped contour.

15 7. A door closer (1) according to one of the preceding claims, characterized in that the hydraulic piston (5) borders a rear pressure compartment (13), which is filled with hydraulic fluid and which, via a throttle valve (14), is in
20 fluidal communication with a frontal pressure compartment (15), which accommodates the cam disc (4).

25 8. A door closer (1) according to one of the preceding claims, characterized in that an auxiliary compression spring (16) is located in the rear pressure compartment (13) between the

housing (3) and the hydraulic piston (5), which spring presses the second roller (9) against the passive cam path (11) of the cam disc (4).

- 5 9. A door closer (1) according to one of the preceding claims, characterized in that the active cam path (10) is configured such that a constant closing force can be generated over the angle of rotation (H0 to H2).
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10. A door closer (1) according to one of the preceding claims, characterized in that the door closer (1) is configured as a slide channel door closer, as an overhead door closer, as a floor
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11. A door closer (1) according to one of the preceding claims, characterized in that the door closer (1) is disposed in a door jamb or in a door
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12. A door closer (1) according to one of the preceding claims, characterized in that the closer shaft (2) of the door closer (1) is in operational connection with a door jamb or with a door leaf via a slide channel arm assembly or a scissor arm
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- assembly.