

Title: Door Closer**Description**

The invention relates to a door closer.

A door closer is known to the expert for example from
5 EP 756 663 B1. A cam plate unit, serving as a
rotational/translational transformer, is incorporated in a
housing of the door closer. An eccentric cam disc which
is rotated through the movement of a door leaf forms the
basis for this. The cam plate unit has supporting and
10 pressure rollers between which the cam disc is non-
positively disposed. Therefore the rotational movement
of the cam disc results in a translational movement of
the cam plate unit. Depending on the direction of
movement, this translation produces a charging of an
15 energy accumulator, such as a spring. The stored
energy allows for the return movement of the cam plate
unit, which in turn produces a rotation of the cam disc
and of the drive shaft connected thereto. This rotational
movement is used to close the door leaf.

20 The door closer disclosed in the above-mentioned
European patent documentation has an energy
accumulator in the shape of a compression spring. On
the one hand, this spring is bearing against a projection
of the housing, and on the other hand, against a piston,
25 which is connected to the cam plate unit. It has proven

to be disadvantageous that the mounting of the piston in the housing of the door closer is very costly. On account of the projection, against which the spring bears, the only way to introduce the cam plate unit and the spring
5 is from opposite sides of the housing. Subsequently, in a very complicated manner, the piston needs to be attached at the cam plate unit by means of screws.

Furthermore, it is known to connect the piston to the cam plate unit by means of a piston pin. This type of
10 connection is less expensive than the one described above. However, for mounting purposes, the piston pin needs to be accessible from the outside. Therefore, the end of the cam plate unit can not be completely surrounded by the housing during the mounting
15 procedure. Therefore, a very complicated, multipart housing needs to be used, in order to be able to connect the cam plate unit, which is already partially incorporated into the housing, to the piston, which has not yet been incorporated into the housing. This
20 produces high manufacturing expense resulting in correspondingly high cost.

Based on the state-of-the-art mentioned above, it is therefore an object of the present invention to provide a door closer, which, at the least possible manufacturing
25 expense, guarantees a simple mounting of the individual components.

The solution to the problem is achieved through the inventive door closer with the features of claim 1. Preferred further developments of the invention are specified in the dependent claims 2 to 15.

- 5 The inventive door closer has a drive shaft which is connectable to a door leaf and which is rotatably supported. Within the housing of the door closer, the drive shaft is connected to a cam disc, which is disposed between at least one supporting means and at least one
10 pressure means. Advantageously, the cam disc is formed to be eccentric. The supporting means and the pressure means are mounted to the cam plate unit. A piston is located in the housing of the door closer for damping purposes, which piston subdivides the housing
15 filled with a compression medium into two pressure compartments, and is connected itself to the cam plate unit. Furthermore, a spring is incorporated into the housing, which, on the one hand, cooperates with the piston and, on the other hand, cooperates with the
20 housing. Advantageously, the piston is formed to be multipart. It has a coupling element and an exterior element, the coupling element being, at least partially, positively supported in a reception of the exterior element. In order to allow for a connection between the
25 exterior element and the coupling element, the reception of the exterior element and the external surface of the coupling element have respectively at least one groove.

A retaining ring, which connects the two elements, is located in the grooves. According to the invention, the grooves are disposed such that, once mounting is completed, the retaining ring is located within the piston
5 such as to be inaccessible.

With the inventive door closer it is intended that the cam plate unit and the spring are inserted into the housing respectively from opposite sides. In this case, the spring is located in a cylindrically shaped bearing, the one side
10 thereof being delimited by a projection of the housing. The cam plate unit is introduced through the projection from the other side of the housing. Prior to that and according to the invention, the cam plate unit has been already connected to the coupling element. The
15 diameter thereof is chosen such that it can be passed through both the projection and the spring. To complete the inventive door closer, the exterior element is inserted into the cylindrically shaped bearing of the housing. Upon inserting the coupling element into the
20 exterior element, a retaining ring interconnects the two elements and thus forms the piston. Depending on the design, the spring can be simultaneously pre-loaded through mounting the exterior element and the coupling element.

25 The inventive piston allows for a door closer, which has a simple structure and an inexpensive manufacturing.

The connection between the coupling element and the cam plate unit can be realized prior to incorporating these elements into the housing. On account of the use of a retaining ring for coupling the exterior element to the coupling element an unassisted and automatic connection is guaranteed. According to the invention, the retaining ring is located as far in the inside of the piston that it is no longer accessible from the outside. On account of this type of support, on the one hand, subsequent disassembly is no longer possible and, on the other hand, this disposition ensures the complete incorporation of the coupling element in the exterior element.

By way of the inventive modular conception of the piston, differently dimensioned and shaped exterior elements can be connected to a coupling element. Depending on the size, the weight and the support of the door leaf, different energy accumulators are required within the door closer. The diameter of the spring, respectively of the housing of the door closer varies accordingly. Independently therefrom, always the same cam plate unit can be used with the inventive coupling element. It only needs to be guaranteed that the reception of the exterior element is always configured in the same way. On account of this modular design, a large amount of cam plate units and coupling elements

can be produced, independently from the fact in which door closer they will be installed ultimately.

Depending on the compression medium the housing of the door closer is filled with, the exterior element must
5 have different channels for the compression medium. If the compression medium is a fluid, such as oil or water, the valves incorporated into the channels must have a different design as if the compression medium is a gas, such as air.

10 Depending on the intended application, it has proven to be useful, that the exterior element is hardened. In this case, hardnesses of 45 to 65 HRC, in particular of 50 to 56 HRC are advantageous. Depending on the intended application, the exterior element as well as the coupling
15 element can be made from steel, stainless steel, a casting or from a plastic material. The latter ones are particularly to be preferred if the used compression medium is a gas.

It is likewise conceivable, that the cam plate unit and the
20 coupling element are formed in one piece. It has likewise proven to be convenient to use coupling elements, which have a T-shaped cross section. Generally, the coupling element is cylindrically formed guaranteeing a complete positive support in the
25 reception of the exterior element. In certain applications it is advantageous to form the coupling element like a

sector of a cylinder. Accordingly, the coupling element has a base surface corresponding to a segment of a circle.

The connection between the coupling element and the exterior element is realized via a retaining ring. In this case, it is a machine element which serves for axial fixation of structural components in relation to each other. The retaining ring may be made from spring steel, which is bent to form a ring. However, it does not form a complete ring, but is partially cut open. This allows for a radial compression. If the retaining ring is relaxed subsequently, this leads to a radial expansion. Depending on the intended application, the retaining ring may have a round, elliptically shaped or rectangular cross-section. Depending on the cross-section, different configurations of the grooves are conceivable, which are machined into the two elements of the piston. With retaining rings having a round cross-section, it has proven to be useful to provide the opposite sides of the grooves with chamfers. A self-locking disposition of the retaining ring is thus achieved once the mounting is complete.

Furthermore, it has proven to be advantageous that the coupling element is provided with an introduction chamfer, which guarantees an easy insertion of the coupling element into the reception of the exterior

element. In this case, inclinations of 20 to 40 degrees, in particular 25 to 35 degrees, with regard to the longitudinal axis of the coupling element, have proven to be advantageous. The exterior element as well may
5 present a chamfer in the area of the reception. It functions like a funnel ensuring an easy insertion of the coupling element. Inclinations of 5 to 15 degrees, in particular of 8 to 12 degrees have proven to be advantageous.

10 In another configuration of the inventive door closer, the cam plate unit and the coupling element are connected by means of a piston pin. The latter is inserted through openings in the coupling element and in the cam plate unit. In order to prevent the piston pin from sliding out
15 during use, the coupling element needs to be inserted as far into the reception of the exterior element that the flanks of the reception, at least partially, cover the piston pin. It is thereby ensured that the piston pin can not slide out of its guide. However, it is likewise conceivable to
20 replace the piston pin by a rivet or a screw.

Further measures and advantages of the invention will result from the dependent claims, the following description and the drawings. In the drawings, on the one hand, the existing state-of-the-art is represented
25 and, on the other hand, the invention is diagrammatically

represented in several exemplary embodiments, in which

- 5 Figure 1: shows a diagrammatical illustration of a door closer which is known from the state-of-the-art,
- Figure 2: shows a diagrammatical illustration of an inventive piston for a door closer with a coupling element and an exterior element,
- 10 Figure 3: shows a cross-section through the piston of Figure 2,
- Figure 4: shows a cross-section through the piston of Figure 2, the coupling element being inserted into the exterior element, and
- 15 Figures 5a, b: show a diagrammatical illustration of an enlarged section of possible configuration alternatives of the grooves of the coupling element and of the exterior element, the retaining ring being
- 20 inserted.

A door closer 10 known from the state-of-the-art is shown in Figure 1. The door closer 10 has a housing 15 into which a cam plate unit 25 is incorporated. The latter has an opening 29 through which a drive shaft 20

protrudes. The drive shaft 20 is connected to a door leaf, which is not illustrated in this case. An eccentrically formed cam disc 22 is connected to the drive shaft 20. The connection can be positive and/or non-positive. A
5 movement of the door leaf leads to a rotation of the cam disc 22. In order to transform the rotation into a translation, the cam disc 22 is disposed between three supporting means, respectively pressure means 23, 24. If the drive shaft 20 rotates counter-clockwise, the cam
10 disc 22 presses against one of the pressure means 24, which results in moving the cam plate unit 25 into the frontal region 16 of the housing 15.

The rear region 17 of the housing 15 is cylindrically formed. A spring 28, which presses against a projection
15 18 of the housing 15, is supported in the rear region. The cam plate unit 25 penetrates through the inside of the helical spring 28 and is connected to a piston 30 by means of a piston pin 31. The one-piece piston 30 subdivides the housing 15 in a first 26 and a second
20 pressure compartment 27. Both compartments 26, 27 are filled with a compression medium, such as oil or air. Opening the door leaf results in a movement of the cam plate unit 25 in the direction of the frontal region 16 of the housing 15. Thereby the spring 28 is compressed. In
25 order to return the door leaf back into the initial position thereof, the force stored in the spring 28 is converted into a rotational movement of the drive shaft 20. For this

purpose, the spring 28 bears against the projection 18 of the housing 15 and urges the piston 30 into the direction of the end of the housing 15. On account of this movement, the pressure means 24 rotate the cam disc 22 in a clockwise direction. The compression medium, stored in the second pressure compartment 27, is compressed through the piston 30. Passing through – here not illustrated – channels for the compression medium in the piston 30, the compression medium from the second pressure compartment 27 reaches the first pressure compartment 26. The quantity of the volume flow of the compression medium delimits the return speed of the cam plate unit 25 and thus the closing speed of the door leaf.

The structure of the inventive piston 30 is illustrated in Figure 2. The cam plate unit 25, only diagrammatically illustrated in this case, has a piston pin 31, which serves for the connection to the coupling element 40. In the illustrated embodiment, the coupling element 40 is cylindrically formed. As explained above, the inventive door closer 10 is not limited to this shape. The coupling element 40 may as well consist of a segment of a solid cylinder. It is crucial that this segment be, at least partially, positively supported in a reception 51, which is illustrated in detail in Figures 3 and 4. For this purpose, the external surface 41 of the coupling element 40 must

present, at least partially, the same geometry as the one of the reception 51 of an exterior element 50.

A groove 42 is provided in the coupling element 40. In the exemplary embodiment illustrated in this case, the retaining ring 60 is supported in this groove 42. Therefore, this is an exterior retaining ring which is pressed into the groove 42 during mounting and subsequently expands again. The connection between the coupling element 40 and the exterior element 50 is thereby ensured.

In order to achieve an easy introduction of the coupling element 40 into the exterior element 50, both elements 40, 50 have introduction chamfers, as represented in Figure 3. The coupling element 40 has an introduction chamfer 43, which is provided on the side of the coupling element 40 oriented towards the exterior element 50. Preferably, the chamfer has an inclination of 20 to 40 degrees, in particular of 25 to 36 degrees with regard to the introduction axis of the coupling element 40 into the exterior element 50. The latter one has a chamfer 53, which results in a funnel-shaped widening of the reception 51. It is thereby ensured that, in the event of a not completely centred position of the cam plate unit, the coupling element 40 is able to be easily and safely introduced into the reception 51. Advantageously the chamfer 53 has an inclination of 5

to 15 degrees, preferably of 8 to 12 degrees with regard to the common central introduction axis of the coupling element 40 and the exterior element 50.

Grooves 42, 52 are provided in both the exterior element 50 and in the coupling element 40. They serve as a reception for the retaining ring 60. Here, in the illustrated exemplary embodiment, the retaining ring 60 is an exterior retaining ring. Thus the groove 42 in the coupling element 40 must be able to completely accommodate the retaining ring. Therefore, the groove 42 has a greater depth than the groove 52 in the exterior element 50. The depth of the groove 52 of the exterior element 50 should amount to approximately half the diameter of the retaining ring 60. Once mounting is completed, the retaining ring 60 expands beyond the groove 42 of the coupling element 40 into the groove 52 of the exterior element 50. Through a corresponding selection of the depth of the groove 52, half of the retaining ring 60 is respectively located in both the grooves 42, 52. Thus sheer forces introduced into the retaining ring 60 through the translational movements of the coupling element 40 can be best absorbed.

However, it is likewise possible that the groove 52 in the exterior element 50 is deeper than the groove 42 in the coupling element 40. The principle of action is still the same. In this case however, the retaining ring 60 is not

pre-mounted on the coupling element 40, but in the groove 52 of the exterior element 50. Upon joining the exterior element 50 and the coupling element 40, the retaining ring 60 is no longer compressed into the groove of the coupling element 40, but is widened
5 through the coupling element 40 prior to snapping into both grooves 42, 52.

A cylindrically shaped notch 44, which serves for supporting the piston pin 31, is fitted into the coupling
10 element 40. The cam plate unit 25 is inserted into the coupling element 40 through a guide 45. The piston pin 31 introduced perpendicularly to the direction of movement of the cam plate unit 25, secures the connection. In another advantageous configuration, a
15 rivet or a screw can be used instead of the piston pin 31. Furthermore, an integral connection, in particular made from the same material, of the cam plate unit 25 and the coupling element 40 is conceivable.

The structure of the inventive piston 30 in the assembled
20 condition is revealed in Figure 4. The coupling element 40 is, at least partially, positively supported in the reception 51 of the exterior element 50. When introducing the coupling element 40 into the reception 51, the chamfer 53 has the effect of a funnel and
25 compresses the retaining ring 60 into the groove 42. As soon as the coupling element 40 is inserted as far into

the reception 51 that the retaining ring 60 reaches the same level as the groove 52, it will expand. The coupling element 40 and the exterior element 50 are thereby connected. As illustrated in Figure 4, once the coupling
5 element 40 and the exterior element 50 are connected, it becomes impossible to reach the retaining ring 60 without destruction. On account of the positive support of the coupling element 40 in the exterior element 50, even tools can not act upon the retaining ring.

10 In the reversed disposition, in which the groove 52 in the exterior element 50 is deeper than the groove 42 in the coupling element 40, the retaining ring 60 is first widened upon introducing the coupling element 40 into the exterior element 50. As soon as the coupling
15 element 40 is inserted as far into the reception 51 that the retaining ring 60 reaches the same level as the groove, it will regain its original diameter as far as the dimensions of the groove 42 allow for it.

A conceptual integration of the inventive piston 30 into
20 the door closer 10 of Figure 1 will illustrate the advantage of the invention. When mounting the door closer 10, the cam plate unit 25 is inserted through the frontal region 16 of the housing 15. In this case, the cam plate unit 25 passes the narrowed cross-section of the
25 projection 18, against which the spring 28 bears. The interior diameter of the projection 18 and of the spring

28 is selected such that the coupling element 40 can be pushed through them. According to the invention, it is intended to insert the exterior element 50 behind the spring 28 into the cylindrically formed region 17. In this case, a pre-loading of the spring 28 can already be achieved. On account of the chamfers 43, 53 at both elements of the piston 30, an easy joining is guaranteed. Once the coupling element 40 is inserted deep enough into the reception 51 of the exterior element 50, the retaining ring 60 interconnects the two elements. Thereby the spring 28 is enclosed within the housing 15 and, according to its function, can cooperate with the piston 30, on the one hand, and with the housing 15 on the other hand.

Furthermore, Figure 4 shows channels for the compression medium 32, 33, which ensure a flow of the compression medium between the two pressure compartments 26, 27. Depending on the dimensioning of the channels 32, 33 for the compression medium, a change in the return speed of the piston 30 and thus of the closing speed of the door leaf is the result. Furthermore, several, in particular differently dimensioned one-way valves can be installed into the channels 32, 33 for the compression medium. Through a respective design of the valves, it is possible that the volume flow is different depending on the direction of the flow. In order to generate, upon opening the door leaf,

the lowest possible resistance on account of the flow of the compression medium, in this case, the volume flow should be as high as possible. If the cam plate unit moves into the opposite direction – namely when closing
5 the door – the object is to achieve the slowest possible movement, requiring a small volume flow.

Opening respectively closing the door leaf entails a movement of the piston 30 within the housing 15. Through the change in the direction of movement, forces
10 are introduced into the piston 30 via the cam plate unit 25 and the piston pin 31. As in particular illustrated in Figure 4, a movement of the coupling element 40 within the exterior element 50 results in the fact that sheering forces act upon the retaining ring 60. The groove 52 has
15 a width larger than the width of the retaining ring 60. Therefore the coupling element 40 has a certain play within the reception 51. The cam plate unit 25 and the coupling element 40 can be moved without resulting in a movement of the exterior element 50. If however, the
20 retaining ring 60 is located at an edge of the groove 52, sheering forces acting upon it will be the result. This is illustrated in Figure 5a, which shows an enlargement of a section of Figure 4, and illustrates the support of the retaining ring 60 in particular. As can be seen, the
25 retaining ring 60 is partially supported in the two grooves 42 and 52. If a force into the direction of the arrow of forces 70 is introduced into the coupling element 40 by

means of the cam plate unit 25, the retaining ring 60 transfers this force onto the exterior element 50. The force of the spring 28, bearing against the exterior element 50, acts against the introduced force 70. These
5 opposite influences of forces onto the piston 30 result in a sheering force which acts upon the retaining ring 60.

In another configuration of the invention, the retaining ring 60 may have a round cross-section, which is self-retainingly supported at chamfered edges of the grooves
10 42, 52, as illustrated in Figure 5b. The two grooves 42, 52 have one respective edge 46, 56, which are oriented parallel towards each other and have an angle of about 40 to 60° with regard to the horizontal plane. The illustrated disposition guarantees an optimized
15 introduction of the sheering forces into the retaining ring 60. The sheering forces result in a radial compression of the retaining ring 60.

The retaining ring 60 intended for the inventive door closer 10 may be both an exterior retaining ring and an
20 interior retaining ring. The exterior retaining ring described in the exemplary embodiments is to be considered as an example only. Furthermore, the ring may have an arbitrary cross-section. The same applies to the configuration of the grooves 42, 52 in the two
25 elements 40, 50 of the piston 30, wherein the grooves

42, 52 may have arbitrary cross-sections. The invention is not limited to rectangular or chamfered grooves.

List of reference numerals

- 10 door closer
- 15 housing
- 16 frontal region of the housing 15
- 5 17 rear region of the housing 15
- 18 projection 18 in the housing 15

- 20 drive shaft
- 22 cam disc
- 10 23 supporting means
- 24 pressure means
- 25 cam plate unit
- 26 first pressure compartment
- 27 second pressure compartment
- 15 28 spring
- 29 opening in the cam plate unit 25

- 30 piston
- 31 piston pin
- 20 32 channels for the compression medium in the exterior element 50
- 33 channels for the compression medium in the coupling element 40

- 25 40 coupling element
- 41 external surface of the coupling element 40
- 42 groove in the coupling element 40

- 43 introduction chamfer at the coupling element 40
- 44 support of the piston pin 31
- 45 guide for the cam plate unit 25
- 46 edge of the groove 42
- 5
- 50 exterior element
- 51 reception of the exterior element 50
- 52 groove in the exterior element 50
- 53 chamfer in the reception 51 of the exterior element
- 10 50
- 56 edge of the groove 52
- 60 retaining ring
- 15 70 force

Patent claims

1. A door closer (10) having a drive shaft (20), which is connectable to a door leaf and rotatably supported, wherein
- 5 the drive shaft (20) is connected within the housing (15) to a cam disc (22), which is disposed between at least one supporting means (23) and at least one pressure means (24),
- 10 the supporting means (23) and the pressure means (24) are located at a cam plate unit (25),
- 15 a piston (30) for damping purposes is disposed in the housing (15), the piston (30) subdividing the housing (15) filled with a compression medium into two pressure compartments (26, 27) and being connected to the cam plate unit (25),
- 20 a spring (28) cooperates, on the one hand, with the piston (30) and, on the other hand, with the housing (15),
- the piston (30) has a coupling element (40) and an exterior element (50),

the coupling element (40) is, at least partially, positively supported in a reception (51) of the exterior element (50),

5 the reception (51) and an external surface (41) of the coupling element (40) have grooves (42, 52),

10 a retaining ring (60) connects the coupling element (40) and the exterior element (50) and is disposed at least partially in the two grooves (42, 52) such that the retaining ring (60) is supported within the piston (30) such as to be inaccessible.

2. A door closer (10) according to claim 1, characterized in that, upon inserting the
15 the coupling element (40) into the exterior element (50), the retaining ring (60) interconnects the two elements.

3. A door closer (10) according to one of the claims 1 or 2, characterized in that the
20 the connection of the exterior element (50) to the coupling element (40) pre-loads the spring (28).

4. A door closer (10) according to one of the claims 1 to 3, characterized in that the coupling element (40) can be mounted to the cam plate unit (25) by means of a piston pin (31).
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5. A door closer (10) according to one of the claims 1 to 4, characterized in that the exterior element (50), in the region of the reception (51) has a chamfer (53), which in particular has an inclination of 5 to 15 degrees, preferably of 8 to 12 degrees.
6. A door closer (10) according to one of the claims 1 to 5, characterized in that the exterior element (50) is hardened, in particular to a hardness of 45 to 65 HRC, preferably to a hardness of 50 to 56 HRC.
7. A door closer (10) according to one of the claims 1 to 6, characterized in that the coupling element (40) has an introduction chamfer (43), which preferably has an inclination of 20 to 40 degrees, in particular of 25 to 35 degrees.
8. A door closer (10) according to one of the claims 1 to 7, characterized in that the groove (42) of the coupling element (40) and/or the groove (52) of the exterior element (50) have/has a rectangular cross-section.
9. A door closer (10) according to one of the claims 1 to 7, characterized in that the groove (42) of the coupling element (40) and the groove (52) of the exterior element (50)

respectively have edges (46, 56) which are disposed like a parallelogram.

10. A door closer (10) according to one of the claims 1 to 9, characterized in that the retaining
5 ring (60) is an exterior retaining ring, in particular that the exterior retaining ring is supported in the groove (42) of the coupling element (40).
11. A door closer (10) according to one of the claims 1 to 10, characterized in that the
10 coupling element (40) has a support (44) for the piston pin (31).
12. A door closer (10) according to one of the claims 1 to 11, characterized in that the
15 coupling element (40) and the cam plate unit (25) are made from one piece and from the same material.
13. A door closer (10) according to one of the claims 1 to 12, characterized in that the
20 coupling element (40) has a T-shaped cross-section, in particular that the coupling element (40) has a base surface in the shape of a circle segment.
14. A door closer (10) according to one of the claims 1 to 13, characterized in that the
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coupling element (40) is a stamped sheet metal part.

15. A door closer (10) according to one of the claims 1 to 14, characterized in that the groove
5 (42) is disposed on the side of the coupling element (40) oriented away from the support (44).