

## **DOOR CLOSER**

### **Description**

The present invention relates to a door closer for closing a door.

5        EP 3 315 704 A1 shows a system for monitoring safety-relevant functions of a door closer. A combination of position and acceleration signals is used to verify whether the door closer has been broken or tampered with. For example, it can be detected whether a lever connected to the output shaft of the door closer has been unhooked.

10        The object of the present invention is to provide a door closer that enables a door to be used safely by simple means - in particular simple manufacture and low-maintenance operation.

The object is achieved by the features of the independent claim. The dependent claims relate to preferred configurations of the invention.

15        The invention shows a door closer for closing a door. The door closer has a housing. The housing is in particular made of metal, preferably cast. An output shaft of the door closer is supported in the housing so as to be rotatably movable. The output shaft can be rotated about an axis of rotation.

20        The output shaft is designed for fastening a lever arrangement. According to a first mounting variant, the door closer can be fastened on the door, i.e. on the door leaf. The lever arrangement forms the connection to the wall. For example, a slide rail of the lever arrangement is fastened to the wall. In the context of the present invention, the term "wall" also includes the door frame. According to a second mounting variant, the door closer can be fastened to the wall. The  
25        lever arrangement then forms the connection from the door closer to the door, i.e. to the door leaf. For example, the slide rail of the lever arrangement is fastened on the door, i.e. on the door leaf.

30        The door closer comprises a mechanical energy storage device. The mechanical energy storage device is designed in particular as a spring. A spiral spring is particularly preferred. The mechanical energy storage device is arranged in the housing and drives the output shaft to rotate in a closing direction of rotation. As will be described in detail, a transmission unit can be located between the energy storage device and the output shaft in order to convert  
35        between the movement of the output shaft and the movement of the energy storage device.

The output shaft rotates in the "closing direction of rotation", in particular when the door closer is properly installed to close a door and the door closes. When the door is opened, the output shaft rotates in the opposing direction, also known as the opening direction of rotation. The door closer is preferably designed without a drive such that it is in particular not a door drive operated in a motorised manner.

The door closer is preferably designed without a connection to an external electrical power supply.

It can be provided that the door closer comprises hydraulic oil to dampen the closing movement.

The door closer also comprises a sensor unit, which is preferably designed and arranged to detect an actual angle of rotation of the output shaft. The sensor unit comprises a sensor and an encoder.

The encoder is arranged or designed on the output shaft. The encoder is preferably a separate component that is arranged, in particular connected, at least indirectly to the output shaft. The encoder and the output shaft are in particular designed such that the encoder rotates with the output shaft.

Alternatively, the output shaft can also be designed in such manner that it acts as an encoder.

The sensor of the sensor unit is designed and arranged for identifying the encoder, in particular without contact. The sensor is particularly preferably designed to detect a position and/or a rotation and/or an acceleration of the encoder. It is in particular provided that the combination of sensor and encoder makes it possible to detect an actual angle of rotation of the output shaft.

The sensor unit makes it possible to detect the position and/or movement of the output shaft by simple means. As the encoder is located directly on the output shaft, the position and/or movement can be detected very precisely. This allows conclusions to be drawn about the proper functioning of the door closer, which means that the door can be operated safely. For example, it can be detected whether the door is open or closed. It can also be detected whether the lever arrangement is damaged or tampered with, as described in detail in connection with an evaluation unit.

The arrangement of the encoder directly or indirectly only via an encoder fastening on the output shaft also has the advantage that the encoder and thus the entire sensor arrangement can be added to existing door closers. The

necessary approvals usually already exist for such existing door closers such that no or only minor changes to the approval are required by adding the sensor unit. This is due in particular to the fact that the relatively small encoder does not affect the mechanics inside the door closer and therefore the basic function of the door closer, namely to close the door securely, is not affected by the sensor unit.

The axis of rotation of the output shaft preferably intersects the sensor and/or the encoder. This ensures that an arrangement of sensor and encoder is as close as possible to the axis of rotation, enabling precise detection of the actual angle of rotation in the tightest of spaces.

It can be provided that the encoder is arranged symmetrically to the axis of rotation, whereby the axis of rotation intersects the centre of the encoder, in particular a dividing line between the north and south poles.

The sensor is preferably arranged symmetrically to the axis of rotation, whereby the axis of rotation intersects the sensor, in particular in the centre of the sensor.

It can be provided that the sensor is arranged, in particular fastened, to a sensor receiving device. The sensor receiving device preferably positions the sensor on the end face of the output shaft.

The sensor receiving device comprises a bracket. The bracket is in particular in one piece.

The bracket is preferably made of plastic.

It is preferably provided that the sensor receiving device comprises a sensor circuit board. The sensor is arranged on the sensor circuit board and the sensor circuit board is preferably fastened to the bracket.

It is preferably provided that the door closer comprises a mounting plate and the housing of the door closer is fastened to the mounting plate. The mounting plate preferably comprises fastening elements, in particular in the form of holes, to screw the mounting plate to the door or wall and to fasten the housing and any other elements to the mounting plate.

The sensor receiving device, in particular the bracket, is preferably fastened to the mounting plate. The sensor receiving device is fastened, in particular screwed, to the mounting plate in particular so as to be reversibly detachable. For example, the sensor receiving device can be fastened directly to the mounting plate. This makes it possible to position the sensor relatively fixedly and accurately.

The sensor receiving device rests against the housing of the door closer and/or can be fastened thereto. The sensor receiving device is fastened to the housing so as to be reversibly detachable, i.e. it is connected in a form-fitting and/or force-fitting manner. For example, the sensor receiving device can be

5 fastened directly to the housing. The fastening relative to the housing enables in particular very precise positioning of the sensor relative to the encoder, which is located on the output shaft.

It can be provided that the housing comprises a housing base body. The housing, in particular the housing base body, can comprise an opening. The

10 opening is used in particular to receive the output shaft and/or an axle bearing for the output shaft.

The housing can comprise an axle bearing closure. The axle bearing closure can be received in the housing base body, in particular in the opening. It can be provided that the axle bearing closure is arranged in the opening in such

15 manner that the opening is partially unclosed. In other words, it can be provided that the axle bearing closure is set back from an outer edge of the opening.

The housing can comprise an inner surface. The inner surface preferably encloses the opening.

The bracket preferably has a bracket projection.

20 The bracket projection preferably extends around the output shaft and/or the encoder such that the output shaft and/or the encoder protrude into the bracket projection.

It can be provided that the bracket, in particular the bracket projection, protrudes into the opening of the housing. The bracket, in particular the bracket

25 projection, preferably rests against the inner surface. This means that the bracket rests against the housing.

The bracket, in particular the bracket projection, preferably rests against the housing at a plurality of, in particular at least three, points. This ensures precise positioning of the bracket projection in relation to the encoder.

30 One circumference of the bracket projection, in particular an outer circumference of the bracket projection, particularly preferably rests circumferentially against the housing, in particular in the opening. This ensures very precise positioning of the sensor in relation to the encoder.

The bracket is preferably clamped to the housing.

35 The bracket, in particular the bracket projection, preferably clamps radially

on the outside of the inner surface of the housing, whereby the bracket is fastened to the housing. The inner surface can enclose the opening.

Alternatively or additionally to the bracket resting against an inner surface of the housing, the housing can comprise a protruding edge. The bracket can rest  
5 against an outer surface of the protruding edge. The bracket can preferably rest against the outer surface, in particular be clamped to the outer surface, at a plurality of points, particularly preferably circumferentially.

The bracket, in particular the bracket projection, is preferably supported against the housing, in particular axially on the inside. For example, it can be  
10 provided that the bracket, in particular the bracket projection, rests against the housing in the direction of the axis of rotation of the output shaft. This can in particular define the positioning of the sensor in the direction of the encoder.

The bracket, in particular the bracket projection, in particular rests against the axle bearing closure.

15 It is preferably provided that the door closer comprises a panel. The panel covers at least the housing of the door closer. The panel is preferably fastened to the mounting plate.

The panel preferably has opposing end walls. The end walls are preferably connected to one another via opposing side walls.

20 It is in particular provided that the two end walls and the two side walls together form the base body of the panel. This base body of the panel can preferably be closed by means of a removable cover of the panel.

Additionally or alternatively, the sensor receiving device can rest against the panel, in particular on the inside. The bracket is preferably clamped between  
25 the panel and the housing. This provides a further option for positioning the sensor receiving device and thus the sensor accurately and with as little play as possible.

The sensor receiving device preferably comprises at least one fastening spring, in particular as an integral part of the bracket. The fastening spring is used  
30 in particular to press the remaining sensor receiving device against the housing. This further improves the positioning of the sensor.

The fastening spring can be supported on a component of the door closer, in particular on the panel.

The fastening spring can be used to apply pretension to the clamped  
35 bracket in particular.

The panel preferably comprises at least one bracket receptacle for the bracket.

The bracket preferably rests against the bracket receptacle and/or the mounting plate.

5       The panel preferably comprises fastening tabs, with the fastening tabs being recessed on the bracket receptacle for inserting the bracket. The panel can be fastened to the mounting plate, in particular screwed, by means of these fastening tabs.

10       The bracket receptacle is preferably doubled on the inside of one of the two side walls of the panel. This double design of the bracket receptacle is used in particular when the housing is changed between a left-sided arrangement and a right-sided arrangement, as will be explained in detail.

It is preferably provided that the encoder comprises a permanent magnet and the sensor is a magnetic sensor, in particular a Hall sensor.

15       The permanent magnet is preferably designed in such manner that the north pole forms one end of the permanent magnet and the south pole forms the other end of the permanent magnet. When the encoder rotates, the north and south poles change position in space. For example, the permanent magnet is round and the north pole and the south pole each form one half of the permanent magnet.  
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The encoder is preferably fastened, in particular screwed, to the end face of the output shaft.

It can be provided that the encoder is fastened to an encoder fastening so that it cannot rotate. The encoder fastening is in particular connected to the output shaft in a form-fitting and/or force-fitting manner. The encoder fastening in particular rotates with the output shaft when the door closer is in operation. Preferably, the encoder fastening is fastened directly to the output shaft and/or the encoder is fastened directly to the encoder fastening.  
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30       The output shaft particularly preferably has a fastening receptacle on at least one side, in particular on both sides. This fastening receptacle is in particular a bore coaxial to the axis of rotation of the output shaft.

The fastening receptacle particularly preferably has an internal thread.

The encoder fastening is preferably inserted, preferably fastened, particularly preferably screwed, into the fastening receptacle.

35       The encoder fastening has a fastening head. The encoder is preferably

fastened, in particular adhered, to the fastening head.

In a preferred embodiment, the fastening head has a form-fitting element that ensures the precise positioning of the encoder. In addition, it is preferably provided that the fastening head has an edge surrounding the encoder such that  
5 the edge also ensures that the encoder is fastened to the fastening head in the precise position.

The encoder fastening is preferably at least partially made of plastic.

The output shaft is preferably exposed on two opposing sides of the housing. The output shaft can therefore be designed for optional fastening of the  
10 lever arrangement to one side or the other side. It is provided that the lever arrangement can be fastened to both sides of the output shaft, but - as described by the term "optional" - is only actually fastened to one of the two sides.

In the case of a specific door closer in one installation situation, a first side of the output shaft is therefore used to fasten the lever arrangement. The encoder  
15 is preferably fastened at least indirectly on the other, second side of the output shaft. In principle, this other, second side is also suitable for fastening the lever arrangement.

The output shaft can comprise a fastening receptacle on both sides. In principle, both fastening receptacles are suitable for fastening a fastening  
20 element for fastening the lever arrangement to the output shaft. The fastening element can correspond to a screw, for example. The fastening receptacles can, for example, be designed to receive an identical fastening element.

It is preferably provided that one of the fastening receptacles is used to fasten the lever arrangement. When the door closer is mounted, a fastening  
25 element, with which the lever arrangement is fastened to the output shaft, is fastened in the fastening receptacle on one side of the output shaft. The encoder fastening is arranged in the other fastening receptacle on the other side of the output shaft.

The output shaft in particular has a connection, preferably a polygon,  
30 preferably a square, on each of the two opposing, exposed sides for fastening the lever arrangement so that it cannot rotate.

The connection is arranged at least partially in the opening so that the lever arrangement can encompass the connection. It can be provided that the connection protrudes from the opening or is located completely in the opening.

35 It can be provided that both connections are surrounded by an opening. It

may be that an axle bearing closure is arranged set back on both sides of the output shaft.

As the encoder can preferably be mounted on either of the connections, the sensor receiving device must also be mountable on both sides of the output shaft. It may be that the openings on the two sides have different depths. It may therefore be that different brackets are provided for the two sides. It may be that each of the brackets rests axially against the axle bearing closure and/or that each of the brackets rests radially against the opening. It may be that each of the brackets rests against a plurality of points in the opening, in particular circumferentially. Each of the brackets can preferably be clamped in an opening. Due to the different depths of the opening, it may be that the brackets have different heights.

For example, the sensor and/or the sensor circuit board can be fastened to both brackets.

In a mounted door closer, the lever arrangement is fastened to one side of the output shaft and the encoder is fastened to the other side of the output shaft. This means that the side of the output shaft not used for the lever arrangement can be used for the sensor arrangement.

The lever arrangement preferably comprises a slide rail and a lever, with one end of the lever being guided in the slide rail and the other end of the lever being able to be fastened to the output shaft.

Alternatively, the lever arrangement preferably comprises a linkage, with the linkage having two rods rotatably connected to one another. One end of the linkage can be fastened to the output shaft. The other end of the linkage can be rotatably fastened to the wall if the door closer is mounted on the door or can be rotatably fastened to the door if the door closer is mounted on the wall.

As described, the encoder is preferably located on the output shaft and rotates with the output shaft. In contrast, the sensor is installed stationary, but is preferably located in the immediate vicinity of the encoder, in particular on the end face of the output shaft.

The door closer preferably comprises a module. The module has at least one battery and/or a data transmission unit.

The sensor is preferably connected to the module for data and/or power transmission.

The module and the sensor unit can be connected to one another by

electrical cables.

The data transmission unit is preferably designed for wireless data transmission.

5 The at least one battery is preferably designed to supply power to the sensor unit and/or the data transmission unit. It is particularly preferably provided that the data transmission unit is designed to transmit a battery status of the at least one battery, for example a charge status.

10 As mentioned, the door closer can comprise a panel that covers the housing of the door closer. The module is in particular located, preferably completely, under the panel. The module is particularly preferably fastened to the inside of the panel.

The module can preferably be fastened to one of the end walls of the panel, particularly preferably optionally to both end walls of the panel.

15 The module can preferably be arranged on both sides of the panel due to the optional left-sided arrangement and right-sided arrangement of the housing. For this reason, a module receptacle for fastening the module is preferably located on both end walls of the panel.

20 Additionally or alternatively, the module can preferably be fastened on the mounting plate. The module can preferably be fastened to two opposing sides of the mounting plate.

The module can preferably be detached from the panel and/or mounting plate in a non-destructive manner, in particular for battery replacement, preferably without tools.

25 The module preferably has a module circuit board. The module is fastened in particular by means of this module circuit board. The module circuit board is in particular fastened to the panel, preferably the module receptacle.

The module particularly preferably has a housing arrangement. This housing arrangement is in turn fastened to the module circuit board. The housing arrangement is preferably designed to receive at least one battery.

30 The module is preferably fastened at a distance from the mounting plate. This distance can prove to be advantageous in the event of a fire if the mounting plate is heated via the door, as the distance prevents the heat from being transferred directly to the module and thus to the batteries. The distance is in particular chosen so that the at least one battery is at least 5 mm away from the  
35 mounting plate.

The housing has a first end face that faces a hinge on the door when the door closer is installed. Furthermore, a second end face of the housing is defined, which is opposite the first end face. Accordingly, the second end face faces a main closing edge of the door. The module is preferably arranged next to the second end face of the housing.

The mounting plate, the housing and the module are preferably designed such that the housing can be fastened to the left and right sides of the mounting plate without rotating the mounting plate. In the left-sided arrangement, the hinges of the door are to the left of the door closer; in the right-sided arrangement, the hinges of the door are to the right of the door closer. The first end face must always face the hinges.

In the left-sided arrangement of the housing, the module is located to the right next to the housing above the mounting plate. In the right-sided arrangement of the housing, the module is located to the left next to the housing above the mounting plate. The module is in particular located completely above the mounting plate in both arrangements and therefore does not protrude laterally beyond the mounting plate.

The mounting plate and the housing are in particular designed such that the housing can be fastened on the mounting plate on the left side in one orientation and on the right side in a 180° rotated orientation.

As already mentioned, the door closer can comprise a transmission unit, which is located in the housing of the door closer and is designed to transmit the movement between the output shaft and the energy storage device. The transmission unit is in particular designed for reciprocal transmission between the rotational movement of the output shaft and the linear movement of the energy storage device.

The transmission unit preferably has a cam that rotates with the output shaft. The cam sits in particular on the output shaft and can be an integral component of the output shaft.

The cam is in particular heart-shaped and therefore has two convex flanks that converge in a depression.

The transmission unit preferably comprises a closing piston that is guided on the cam in a rolling or sliding manner. On the closing piston is located in particular a closing piston roller, which rolls on the cam. The closing piston is guided in particular in a linearly movable manner in the housing and is driven by

the energy storage device. If the closing piston moves in one direction, it charges the energy storage device. When the energy storage device is discharged, the closing piston is pushed in the opposing direction by the energy storage device.

Two halves can be defined on the housing, with the first half being  
 5 assigned to the first end face and the second half being assigned to the second end face. The output shaft is located in the first half and therefore closer to the first end face than to the second end face. The energy storage device is preferably located at least partially in the second half and therefore closer to the second end face than to the first end face. The energy storage device is therefore  
 10 located between the output shaft and the second end face

The invention further comprises a monitoring system comprising the described door closer and the evaluation unit. The evaluation unit is preferably electronic. The evaluation unit preferably comprises an electronic processor and/or an electronic memory. It can be provided that the evaluation unit  
 15 comprises a timer for determining a time and/or a time period.

The output shaft preferably rotates within a first angle range to open and close the door. This first angle range must be distinguished from a second angle range in which the output shaft can rotate, but which is not occupied by the output shaft as long as the door closer is properly installed on the door and in operation.  
 20 If the door closer is not installed, the output shaft rotates in particular in the second angle range, as this discharges the energy storage device as far as possible. This allows a limit value to be defined for an actual angle of rotation that is not reached with an installed door closer or is only reached in the closed position. The limit value can limit the second angle range.

25 When installing the door closer, the lever arrangement is mounted on the output shaft and the output shaft is rotated into the first angle range via the lever arrangement. If the door closer is installed, the lever arrangement is always connected to the output shaft on one side and to the wall or door on the other.

This means that the output shaft can only move within the first angle range.  
 30 The output shaft can in particular rotate at most up to the limit between the first angle range and the second angle range, but does not rotate into the second angle range. This means that the limit between the first angle range and the second angle range represents a "closed position" of the output shaft. In this closed position of the output shaft, the associated door is closed. The angle for  
 35 the closed position of the output shaft is referred to as the "closing angle of

rotation". For example, the closing angle of rotation can correspond to the limit value, which defines the limit between the first angle range and the second angle range in the evaluation unit.

5 If damage now occurs to the door closer or the lever arrangement or, for example, the lever arrangement is tampered with, in particular if the lever arrangement is detached, the output shaft rotates from the first angle range into the second angle range. The limit value is passed here.

10 As will be described in detail, the evaluation unit does not have to be located in the door closer, but can also be located at any other point. The limit value, in particular the closing angle of rotation, is stored in the evaluation unit.

15 This limit value, in particular the closing angle of rotation, can be a value fixedly stored in the evaluation unit or a value that can be changed depending on the installation situation of the door closer. It is also possible to define the closing angle of rotation in the evaluation unit by way of a corresponding learning process after the door closer has been installed.

20 The evaluation unit is preferably designed to generate a message if the actual angle of rotation is in the second angle range, in particular if the actual angle of rotation has passed the limit value; the generation of the message is therefore dependent on whether or not the actual angle of rotation is in the second angle range.

25 The message is, for example, a signal that the evaluation unit generates and uses within itself, for example to issue a warning, and/or that the evaluation unit transmits to another unit. Based on the message that is generated in the evaluation unit, it can be concluded that the damage or tampering described above has occurred. This in turn leads to the conclusion that the door may not be properly closed by means of the door closer, which is relevant in particular for fire doors.

30 It is preferably provided that the door closer is designed to rotate the output shaft into the second angle range as soon as a connection - in particular the lever arrangement - between the output shaft and the door or between the output shaft and the wall is detached. It should be noted in particular that the lever arrangement connects the output shaft to the door if the door closer is fastened to the wall or the lever arrangement connects the output shaft to the wall if the door closer is fastened to the door.

35 In addition, it is preferably provided that the output shaft in its closed

position, i.e. when the door is closed, is driven by the energy storage device to rotate into the closing direction of rotation. This means in particular that the output shaft is still driven by the energy storage device in its closed position and the energy storage device is not completely discharged. This ensures in particular  
5 that the energy storage device can still rotate the output shaft from the closed position into the second angle range.

The closing piston is preferably guided on one flank of the cam. The flank runs into a depression of the cam, with the closing piston, in particular with its closing piston roller, resting against the flank and thus in the first angle range and  
10 not against the depression in the closed position of the output shaft. The closing piston moves along the flank in the direction of the depression when the actual angle of rotation moves into the second angle of rotation range.

When the output shaft rotates in the closing direction of rotation, the pretension of the energy storage device or the energy stored in the energy  
15 storage device decreases, with it being provided in particular that a minimum pretension is not present in the energy storage device in the closed position, but only in the second angle range.

The output shaft can preferably be rotated in the opening direction of rotation to charge the energy storage device when the door is opened. The door  
20 is opened in particular by manual actuation of the door, in particular by a user.

The evaluation unit is preferably designed such that a door closing time is monitored by means of the evaluation unit. For this purpose, the evaluation unit receives the actual angle of rotation. This is possible, for example, by recording how long the actual angle of rotation changes in the closing direction of rotation  
25 until the closing angle of rotation is finally reached. If the recorded door closing time deviates from at least one time limit value, a corresponding message is preferably issued. Based on this message, maintenance of the door closer, for example, can be considered.

The door closing time may be too short or too long. This means that an  
30 upper and a lower time limit value can also be defined for the door closing time.

The at least one time limit value is in particular stored electronically in the evaluation unit. If the at least one time limit value is not observed, the evaluation unit is designed to generate a message.

It is preferably provided to monitor how long the door is open. This allows  
35 a door opening time to be monitored. This can be done by regularly verifying the

actual angle of rotation. The evaluation unit is preferably designed to determine and/or monitor the door opening time. For this purpose, the evaluation unit can, for example, track over time actual angle of rotations in the first angle range, which do not correspond to the closing angle of rotation. The evaluation unit is  
5 designed to generate a corresponding message if the door is open for longer than a predefined time duration value. The time duration value can be stored in the electronic memory of the evaluation unit.

In addition, the evaluation unit is preferably designed to generate an all-clear message if the actual angle of rotation, after it has been detected in the  
10 second angle of rotation range, is again in the first angle of rotation range.

In addition, the evaluation unit is preferably designed to generate an all-clear message if the actual angle of rotation corresponds to the closing angle of rotation if the time duration value was previously exceeded.

Additionally or alternatively, the all-clear message can be generated when  
15 a person acknowledges a corresponding warning, for example on the external unit described or on the door by actuating an operating element.

As already mentioned, the evaluation unit is designed in particular to relay the generated message to an external unit. This unit can be a building control unit and/or a cloud and/or a server and/or a terminal and/or a mobile terminal. The  
20 terminal is, for example, a computer. The mobile terminal is a smartphone or tablet, for example.

By relaying the message from the evaluation unit to the external unit, a corresponding warning can be generated in the unit in any desired manner. For example, the mobile terminal can be used to indicate that a certain door closer  
25 has been damaged or tampered with.

According to an optional first variant, it is provided that the evaluation unit generating the message is arranged in the region of the door, in particular in the door closer, as an internal evaluation unit. The expression "in the door closer" is in particular to be understood in that the evaluation unit is located underneath the  
30 panel of the door closer. Alternatively, the evaluation unit can also be located next to the door closer, for example in the region of the door.

According to an optional second variant, it is provided that the evaluation unit generating the message is outsourced as an external evaluation unit, with the door closer being designed to send the actual angle of rotation or a value  
35 derived therefrom to the external evaluation unit - in particular by means of a data

transmission unit, which is described below.

If the evaluation unit is designed as an internal evaluation unit, the at least one battery of the module is preferably also provided to supply power to the evaluation unit.

5        If it is an external evaluation unit, the data transmission unit of the module can send the actual angle of rotation or a value derived therefrom to the external evaluation unit. If it is an internal evaluation unit, the generated message can be sent to the external unit, i.e. for example the server or the terminal, via the transmission unit.

10        Furthermore, it is preferably provided that status messages regularly are generated. With the internal evaluation unit, these status messages can be generated in the door closer and sent to the external unit via the data transmission unit. In the case of an external evaluation unit, the status messages can also be generated within the door closer and transmitted to the external  
15        evaluation unit via the data transmission unit. The regular transmission of the actual angle of rotation or a value dependent thereon can also be regarded as a status message. The external unit, for example the server or the mobile terminal, is preferably used to generate a warning if the status message is missing and/or incorrect and/or has corresponding content.

20        The invention further comprises a method for operating a monitoring system, in particular the monitoring system described above. The advantageous configurations described for the monitoring system and the subclaims associated with the monitoring system find correspondingly advantageous application in the context of the method.

25        The method provides that the actual angle of rotation, which depends on the angle of rotation of the output shaft of the door closer is detected. As described, the output shaft is used to fasten the lever arrangement. The output shaft is driven to rotate in the closing direction of rotation by the mechanical energy storage device of the door closer. The output shaft can be rotated into a  
30        first angle range, which can be used to open and close the door, and into a second angle range.

      A message is generated when the actual angle of rotation is in the second angle range, with the closing angle of rotation representing a closed position of the output shaft and thus a closed position of the door and separates the first  
35        angle range from the second angle range. The message is generated in particular

by means of the described evaluation unit.

The invention will now be explained further on the basis of an exemplary embodiment, for which the following is shown:

- 5      Fig. 1      a schematic representation of a monitoring system according to the invention with an external evaluation unit and a door closer according to the invention in accordance with an exemplary embodiment,
- Fig. 1a     a schematic representation of a variant of the monitoring system with internal evaluation unit in the door closer according to the invention in accordance with the exemplary embodiment,
- 10     Fig. 2      a perspective view of the door closer according to the invention in accordance with the exemplary embodiment,
- Fig. 3      an exploded representation of the door closer according to the invention in accordance with the exemplary embodiment,
- 15     Fig. 4      components inside a housing of the door closer according to the invention in accordance with the exemplary embodiment,
- Fig. 5      a schematic sectional view of a detail of the door closer according to the invention in accordance with the exemplary embodiment,
- Fig. 6      a perspective view of the door closer according to the invention in accordance with the exemplary embodiment without panel,
- 20     Fig. 7      the section A-A marked in Fig. 2,
- Fig. 8      a detail from Fig. 7,
- Fig. 9      one end face of an output shaft of the door closer according to the invention in accordance with the exemplary embodiment,
- 25     Fig. 10     a sensor receiving device of the door closer according to the invention in accordance with the exemplary embodiment,
- Fig. 11     a detail of the panel of the door closer according to the invention in accordance with the exemplary embodiment,
- Fig. 12     a variant of the sensor receiving device of the door closer according to the invention in accordance with the exemplary embodiment,
- 30     Fig. 13     a perspective view of the door closer according to the invention in accordance with the exemplary embodiment with the cover open,
- Fig. 14     a sectional view of a module in the door closer according to the invention in accordance with the exemplary embodiment,
- 35     Fig. 15     a perspective view of the module of the door closer according to the

- invention in accordance with the exemplary embodiment,
- Fig. 16 a variant for configuring the module of the door closer according to the invention in accordance with the exemplary embodiment,
- Fig. 17 a sectional view of the variant of the module from Fig. 16,
- 5 Fig. 18 a variant for fastening the module of the door closer according to the invention in accordance with the exemplary embodiment, and
- Fig. 19 different representations of the left-sided arrangement and right-sided arrangement of the housing of the door closer according to the invention in accordance with the exemplary embodiment, with
- 10 different components being hidden for the sake of clarity.

A door closer 1 according to the invention is described below on the basis of Figures 1 to 19. This can be a component of a monitoring system 100 according to the invention.

According to Fig. 1, the monitoring system 100 comprises an evaluation  
 15 unit 101. In Fig. 1, the evaluation unit 101 is located outside the door closer 1 as an external evaluation unit 101. Alternatively, the evaluation unit 101 can also be a component of the door closer 1 as an internal evaluation unit 101 - according to Fig. 1a.

Furthermore, the monitoring system 100 comprises an external unit 102,  
 20 for example a server, a cloud, a building control unit, a terminal or a mobile terminal. The evaluation unit 101 and the external unit 102 are connected to one another for data transmission.

The door closer 1 comprises a data transmission unit 44. In Fig. 1, a  
 25 wireless data transmission from this data transmission unit 44 to the external evaluation unit 101 is represented purely schematically. If the evaluation unit 101 is located inside the door closer 1 as an internal evaluation unit according to Fig. 1a, the data transmission unit 44 transmits wirelessly to the external unit 102.

The monitoring system 100 further comprises a lever arrangement 103. A  
 lever 104 and a slide rail 105 are components of the lever arrangement 103.

30 According to Fig. 1, the door closer 1 is located on a door 200. Accordingly, the slide rail 105 is fastened to a wall 202. The lever 104 connects the door closer 1 with the slide rail 105 on the wall 202. As the schematic representation in Fig. 1 shows, the wall 202 is synonymous with the frame of the door 200.

The door 200 is supported so as to be rotatably movable relative to the  
 35 wall 202 via two hinges 201.

Unless otherwise stated in detail, reference is always made below to all figures:

The door closer 1 has a housing 2. A first end face 2.1 and an opposing second end face 2.2 are defined on the housing 2 (see Fig. 3).

5 In addition to the housing 2, the door closer 1 has a mounting plate 50 and a panel 30. The housing 2 is fastened on the mounting plate 50. The mounting plate 50 comprises fastening elements 51 in the form of holes. The mounting plate 50 is used to fasten the door closer 1 to the door 200 or the wall 202. In addition, the door closer 1 comprises a module 40. Fig. 3 shows an exploded  
10 representation of these four assemblies, namely housing 2, module 40, panel 30 and mounting plate 50.

Furthermore, the door closer 1 has an output shaft 3. The output shaft 3 is supported in the housing 2 so as to be rotatably movable and is driven by an energy storage device 4 in the form of a spiral spring (see Fig. 4). As Fig. 7 in  
15 particular shows, the output shaft 3 is supported on both sides by means of an axle bearing 13. The axle bearing 13 is secured with a screwed-in axle bearing closure 14. This axle bearing closure 14 is regarded as a component of the housing 2.

The output shaft 3 is exposed on both sides (see Fig. 7) such that in principle the lever arrangement 103 can be fastened to the output shaft 3 on both  
20 sides. However, only one side of the output shaft 3 is actually used to fasten the lever arrangement 103. The respectively other side of the output shaft 3 is used to position a sensor unit 20 in the door closer 1.

The output shaft 3 has a connection 3.1 on each of its two sides, here in the form of a square. The output shaft 3 can be rotated about an axis of rotation 3.3. Coaxial to the axis of rotation 3.3, the output shaft 3 has a fastening receptacle 3.2 on both sides. The fastening receptacle 3.2 is in the form of a hole with an internal thread and is used to fasten the lever arrangement 103 or an encoder 21 of the sensor unit 20, as will be described in detail.  
25

Both fastening receptacles 3.2 are identical. This means that the same fastening element can be inserted into each fastening receptacle 3.2 in order to fasten the lever 104.  
30

In Fig. 4, the housing 2 is hidden such that the internal components can be seen. Accordingly, the door closer 1 comprises a transmission unit 5 inside  
35 the housing 2. This transmission unit 5 has a cam 5.1 that rotates with the output

shaft 3. A closing piston 5.2 is guided on the cam 5.1 in a rolling manner by means of a closing piston roller 5.3. The closing piston roller 5.3 rolls on a flank 5.4 of the cam 5.1. The schematic sectional view in Fig. 5 shows this in detail.

5 Figs. 4 and 5 also show that a damping piston 6 is guided in the housing 2 in a linearly movable manner. This damping piston 6 also rolls on the cam 5.1 with a damping piston roller 7.

The cam 5.1 has two opposing flanks 5.4, which converge in a depression 5.5. The flanks 5.4 run convexly such that a heart-shaped cam 5.1 results.

10 In the representations according to Figs. 4 and 5, the energy storage device 4 is in a discharged state. The closing piston roller 5.3 rests against the cam 5.1 inside the depression 5.5. This relative position between cam 5.1 and closing piston roller 5.3 only occurs if the door closer 1 is not yet installed or if the connection via the lever arrangement 103 is interrupted due to damage or tampering. However, if the door closer 1 is installed correctly and the connection  
15 between the door closer 1 and the wall 202 is ensured via the lever arrangement 103, the output shaft 3 is rotated relative to the representation in Fig. 5 such that the closing piston roller 5.3 rests outside the depression 5.5.

Fig. 5 illustrates purely schematically a closing direction of rotation 12 in which the output shaft 3 is rotated when the door 200 is closed. An opening  
20 direction of rotation runs counter to this closing direction of rotation 12 marked.

Furthermore, Fig. 5 shows purely by way of example a closing angle of rotation 10 of the output shaft 3, which separates a first angle range 8 and a second angle range 9. The closing angle of rotation 10 is represented here in simplified form only as a line, since in the context of the invention it is not  
25 important from which 0° position the closing angle of rotation 10 is measured, but rather that the closing angle of rotation 10 separates the first angle range 8 from the second angle range 9. The angle of rotation of the output shaft 3 marked by way of example is the actual angle of rotation 11 - also represented in simplified form as a line. A reference leg of all angles of rotation, including the closing angle  
30 of rotation 10 and the actual angle of rotation 11, can in principle be placed at different positions, as only the relative values of the angles of rotation to each other are important.

According to the schematic representation in Fig. 5, the actual angle of rotation 11 lies in the second angle range 9. If the output shaft 3 is rotated counter  
35 to the closing direction of rotation 12, the actual angle of rotation 11 moves out of

the second angle range 9, exceeds the closing angle of rotation 10 and reaches the first angle range 8. During normal use of the door, the actual angle of rotation 11 only moves in this first angle range 8.

However, if damage or tampering occurs, in particular on the lever  
5 arrangement 103, the output shaft 3 rotates in the closing direction of rotation 12 due to the force exerted by the energy storage device 4 until the actual angle of rotation 11 is detected again in the second angle range 9.

According to the invention, the sensor unit 20 is provided for detecting the actual angle of rotation 11. The exact configuration of the sensor unit 20 is shown  
10 in particular in Figs. 3, 4 and 6 to 12. According to the invention, the encoder 21 is arranged indirectly on the output shaft 3 for this purpose. A sensor 23 is designed to identify the encoder 21 and determine the actual angle of rotation 11.

Accordingly, the sensor unit 20 comprises an encoder fastening 22 for fastening the encoder 21 to the output shaft 3. The encoder fastening 22 is  
15 preferably made of plastic. The encoder fastening 22 is screwed into one of the fastening receptacles 3.2 of the output shaft 3. The other fastening receptacle 3.2 is used to fasten the lever 104.

The encoder fastening 22 has a fastening head 22.1 (see Fig. 8). The encoder 21, in particular in the form of a permanent magnet, is fitted, in particular  
20 adhered, on this fastening head 22.1. This means that the encoder 21 is fastened to the end face of the output shaft 3 and rotates with the output shaft 3.

The fastening head 22.1 comprises an edge 22.2 and a form-fitting element 22.3 (see Fig. 9). The edge 22.2 surrounds the encoder 21. The form-fitting element 22.3 and the encoder 21 engage into one another. The edge 22.2  
25 and/or the form-fitting element 22.3 allow the encoder 21 to be positioned precisely relative to the output shaft 3 and thus relative to the axis of rotation 3.3. This in particular ensures that the encoder 21 is arranged symmetrically to the axis of rotation 3.3. In addition, the axis of rotation 3.3 intersects the encoder 21.

The encoder fastening 22 can have a tool engagement 22.4, which in  
30 particular makes it easier to screw the encoder fastening 22 into the fastening receptacle 3.2.

The sensor 23, which is in the form of a Hall sensor here, is located directly next to the encoder 21, but does not touch the encoder 21. The sensor 23 is designed to detect the different orientations of the encoder 21, which is in the  
35 form of a permanent magnet.

This sensor 23 is arranged on the end face of the output shaft 3 by means of a sensor receiving device 24 and thus in the immediate vicinity of the encoder 21. This means that the sensor 23 is also symmetrical to the axis of rotation 3.3. At the same time, the axis of rotation 3.3 intersects the sensor 23.

5       The sensor receiving device 24 comprises a bracket 24.1 and a sensor circuit board 24.2. The sensor 23 is located on this sensor circuit board 24.2. The sensor circuit board 24.2 is fastened by means of the bracket 24.1.

10       The bracket 24.1 has a bracket projection 24.4 (see Figs. 7, 8, 10). This extends around the output shaft 3 such that the output shaft 3 protrudes into the bracket projection 24.4.

15       The bracket projection 24.4 is supported axially on the inside against the housing 2, in detail the axle bearing closure 14. This means that the bracket 24.1 rests against the housing 2. Radially outside, the bracket projection 24.4 clamps on an inner surface of the housing 2, whereby the bracket 24.1 is fastened to the housing 2.

      The inner surface of the housing 2 surrounds an opening in the housing 2, into which the bracket projection 24.4 projects. The opening of the housing 2 receives the output shaft 3 and the axle bearing 13.

20       In addition, the figures, in particular Fig. 6, show that the bracket 24.1 has a fastening spring 24.5. The fastening spring 24.5 is located on the inside of the panel 30, whereby the bracket 24.1 is clamped between the panel 30 and the housing 2.

25       The sensor receiving device 24, in particular the bracket 24.1, has a bracket clip 24.3 (see Figs. 7 and 8). The sensor circuit board 24.2 is fastened to the bracket 24.1 by means of this bracket clip 24.3.

30       Fig. 11 in particular illustrates that the panel 30 has fastening tabs 30.1. The panel 30 can be fastened, in particular screwed, to the mounting plate 50 by means of these fastening tabs 30.1. Furthermore, Fig. 11 shows that the panel 30 has at least one bracket receptacle 30.2 on the inside. The bracket 24.1 protrudes into this bracket receptacle 30.2. It is in particular provided that a recess 30.3 without fastening tabs 30.1 is provided in the region of the bracket receptacle 30.2. This ensures that the fastening tabs 30.1 do not present an obstacle for the bracket 24.1 when the panel 30 is fitted. The bracket 24.1 rests against the mounting plate 50 and is thus positioned. It is also conceivable that the bracket 24.1 rests at least partially against the bracket receptacle 30.2. This can be used

35

to prevent twisting.

Fig. 12 shows an alternative fastening of the sensor 23. The sensor 23 is also arranged on the sensor circuit board 24.2. The bracket 24.1 receives the sensor circuit board 24.2. However, the bracket 24.1 is designed such that it can be fastened, in particular screwed, directly on the mounting plate 50. This also makes it possible to fasten the sensor 23 directly to the end face of the output shaft 3 and thus directly to the encoder 21.

The actual angle of rotation 11 determined by the sensor unit 20 can be used by the evaluation unit 101 to carry out at least one of the following different safety-relevant evaluations. A plurality or all of the following safety-relevant evaluations are preferably carried out.

On the one hand, the evaluation unit 101 can determine a door closing time. To this end, the evaluation unit 101 determines how long the actual angle of rotation 11 changes in the closing direction of rotation 12 until the closing angle of rotation 10 is finally reached. For this purpose, the evaluation unit 101 can record the door closing time with an electronic timer. If the recorded door closing time deviates from a stored time limit value or a plurality of stored time limit values, a corresponding message is output by the evaluation unit 101. For example, the message is sent to the external unit 102.

As a further safety-relevant monitoring function, the evaluation unit 101 monitors how long the door has been open by the evaluation unit 101 regularly verifying the actual angle of rotation 11. If the actual angle of rotation 11 has moved from the closing angle of rotation 10 into the first angle range 8, the door has been opened. The evaluation unit 101 now starts the timer and measures the door opening duration. If the next actual angle of rotation 11 received by the evaluation unit 101 is further within the first angle range 8, the evaluation unit 101 continues to run the timer. The evaluation unit 101 generates a message if the door is open for longer than a predefined time duration value. For example, the memory of the evaluation unit 101 can store a time duration value for the maximum time that the door may be open. If the time duration value is exceeded, the evaluation unit 101 generates a message. For example, the message is sent to the external unit 102.

As a further safety-relevant monitoring function, the evaluation unit 101 monitors whether the lever arrangement 103 is functioning properly. For this purpose, the evaluation unit 101 compares the actual angle of rotation 11 with a

closing angle of rotation 10. If the actual angle of rotation 11 is in the second angle of rotation range 9, a message is generated by the evaluation unit 101. If, however, the comparison shows that the actual angle of rotation 11 is outside the second angle of rotation range 9, the message is cancelled. For example, the  
 5 message is sent to the external unit 102.

The external unit 102 can, for example, display the message as readable text on a screen. Additionally or alternatively, the external unit 102 can generate an audible and/or visual and/or haptic warning.

For example, the closing angle of rotation 10 can depend on the thickness  
 10 of a door 200.

The value of the closing angle of rotation 10 can be defined during commissioning. For this purpose, the evaluation unit 101 or the external unit 102 is in a commissioning mode. By means of a direct or indirect input, an installer can indicate that the door 200 is closed. The evaluation unit 101 and/or the  
 15 external unit 102 can then adopt this measured actual angle of rotation 11 as the closing angle of rotation 10. The closing angle of rotation 10 can thus be taught-in.

Alternatively, the installer can determine the respective closing angle of rotation 10 depending on the installation situation. For example, a table may be  
 20 present in which the closing angle of rotation 10 is indicated for different door thicknesses or for different door and/or frame geometries. The installer can, for example, enter the door thickness or the closing angle of rotation 10 via an input on the external unit 102.

In another alternative, the closing angle of rotation 10 is fixedly predefined.  
 25 According to Fig. 13, the panel 30 has two opposing end walls 31. The end walls 31 are connected to one another via two opposing side walls 32. It is in particular provided that the two end walls 31 and the two side walls 32 together form the base body of the panel 30. This base body of the panel 30 can be closed by means of a cover 33.

Fig. 13 shows the removed cover 33. It is easy to recognise that the described bracket receptacle 30.2 is doubled on the inside of one of the two side walls 32. This double design of the bracket receptacle 30.2 is used in particular when the housing 2 is changed between a left-sided arrangement A and a right-sided arrangement B, as will be explained in detail on the basis of Fig. 19.

35 The same applies to the represented axle recess 34 in Fig. 13. In the

representation shown, the left axle recess 34 is used to connect the lever arrangement 103 to the output shaft 3. On the right side of the represented housing 30 is also provided an axle recess 34, which is closed, for example, by a blind cover not represented or can be broken out.

5 Furthermore, Fig. 13 shows the aforementioned module 40 inside the panel 30. This module 40 can also be arranged on both sides of the panel 30 due to the optional left-sided arrangement A and right-sided arrangement B of the housing 2. Fig. 13 therefore shows a module receptacle 35 on both end walls 31 of the panel 30. In the representation according to Fig. 13, the right module  
10 receptacle 35 is used.

The module receptacle 35 has a module groove 35.1 and a module clip 35.2 in each case. As will be described, the module 40 comprises a module circuit board 43. This can be inserted into the module groove 35.1 and fixed by means of the module clip 35.2. Alternatively (see Fig. 18), the module 40 is fastened, in  
15 particular screwed down, on the mounting plate 50. In this alternative, the module groove 35.1 and the module clip 35.2 can be omitted.

The module 40 has a housing arrangement 41. According to Figs. 13 to 15, the housing arrangement 41 comprises an inner housing 41.1 and an outer housing 41.2. The inner housing 41.1 is used to directly receive batteries 42. The  
20 inner housing 41.1 is arranged in the outer housing 41.2. The outer housing 41.2 is fastened to the module circuit board 43 and additionally supported against the mounting plate 50 via spacers 41.3.

The spacers 41.3 secure a distance 41.4 (see Fig. 14) between module 40 and mounting plate 50. This distance 41.4 can prove to be advantageous in the  
25 event of a fire if the mounting plate 50 is heated via the door 200, as the distance 41.4 prevents the heat from being transferred directly to the module 40 and thus to the batteries 42.

Figs. 16 and 17 show a variant of the module 40. The housing arrangement 41 only has the inner housing 41.1. The inner housing 41.1 is used to directly  
30 receive the batteries 42. The inner housing 41.1 is fastened to the module circuit board 43. The distance 41.4 (see Fig. 17) is also maintained here.

Fig. 18 shows a variant for fastening the module 40 to the mounting plate 50. The housing arrangement 41 is fastened to the mounting plate 50 by means of a housing fastening 45, for example a screw. The module receptacle 35 can  
35 also be dispensed with. The module 40 can preferably be fastened to both sides

of the mounting plate 50 by means of the housing fastening 45 - due to the optional left-sided arrangement A and right-sided arrangement B of the housing 2.

5 The module 40 can be detached in a non-destructive manner in all the variants represented. For detachment without tools, the module clip 35.2 can be designed to be large enough for manual actuation. The housing fastening 45 can also be detachable without tools, e.g. by means of a wing screw.

10 As represented purely schematically in Figs. 14 and 17, 18, the data transmission unit 44 can be located in the module 40, for example in or on the module circuit board 43.

Two halves can be defined on the housing 2, with the first half being assigned to the first end face 2.1 and the second half being assigned to the second end face 2.2. The output shaft 3 is located in the first half and therefore closer to the first end face 2.1 than to the second end face 2.2. The energy storage device 4 is located at least partially in the second half and therefore closer to the second end face 2.2 than to the first end face 2.1.

20 As illustrated in particular by a combined view of, for example, Fig. 1 and Fig. 3, the first end face 2.1 faces the at least one hinge 201 of the door 200. Accordingly, the second end face 2.2 faces a main closing edge 203 of the door 200.

Fig. 19 illustrates in detail the already mentioned left-sided arrangement A of the housing 2 and the right-sided arrangement B of the housing 2. In the four illustrations in Fig. 19, components are gradually hidden in order to represent the complete structure clearly.

25 For the sake of clarity, Fig. 19 shows both arrangements A and B; in full knowledge that only one of these two arrangements is ever used on a door 200. For orientation, the first representation in Fig. 19 also shows the hinges 201 of the door 200. The first end face 2.1 of the housing 2 and thus half of the housing 2 with the output shaft 3 must always be assigned to these hinges 201.

30 Fig. 19 basically illustrates that the module 40 is arranged on the mounting plate 50 next to the second end face 2.2 of the housing 2. When changing between the left-sided arrangement A and the right-sided arrangement B, the mounting plate 50 is not rotated. The housing 2 is simply rotated such that the first end face 2.1 and the second end face 2.2 change their left-sided/right-sided orientation. The mounting plate 50, in particular with its fastening elements 51, is

designed such that the housing 2 can be fastened on the mounting plate 50 both in the left-sided arrangement A and in the right-sided arrangement B in such manner that the module 40 is always located next to the second end face 2.2.

As Fig. 19 shows, for example, the mounting plate 50 can have an orientation indicator 52, for example in the form of arrows. This orientation indicator 52 indicates the orientation with which the mounting plate 50 must be fastened. The last representation in Fig. 19 makes it clear that the orientation indicator 52 is oriented in the same way for both the left-sided arrangement A and the right-sided arrangement B, which means that the mounting plate 50 does not have to be rotated.

#### **List of reference numerals**

|     |                                      |
|-----|--------------------------------------|
| 1   | Door closer                          |
| 2   | Housing                              |
| 2.1 | First end face                       |
| 2.2 | Second end face                      |
| 2.3 | Opening                              |
| 2.4 | Inner surface                        |
| 3   | Output shaft                         |
| 3.1 | Polygon                              |
| 3.2 | Fastening receptacle                 |
| 3.3 | Axis of rotation of the output shaft |
| 4   | Energy storage device                |
| 5   | Transmission unit                    |
| 5.1 | Cam                                  |
| 5.2 | Closing piston                       |
| 5.3 | Closing piston roller                |
| 5.4 | Flank                                |
| 5.5 | Depression                           |
| 6   | Damping piston                       |
| 7   | Damping piston roller                |
| 8   | First angle range                    |
| 9   | Second angle range                   |
| 10  | Closing angle of rotation            |
| 11  | Actual angle of rotation             |
| 12  | Closing direction of rotation        |

|      |                                           |
|------|-------------------------------------------|
| 13   | Axle bearing                              |
| 14   | Axle bearing closure as housing component |
| 20   | Sensor unit                               |
| 21   | Encoder                                   |
| 22   | Encoder fastening                         |
| 22.1 | Fastening head                            |
| 22.2 | Edge                                      |
| 22.3 | Form-fitting element                      |
| 22.4 | Tool engagement                           |
| 23   | Sensor                                    |
| 24   | Sensor receiving device                   |
| 24.1 | Bracket                                   |
| 24.2 | Sensor circuit board                      |
| 24.3 | Bracket clip                              |
| 24.4 | Bracket projection                        |
| 24.5 | Fastening spring                          |
| 30   | Panel                                     |
| 30.1 | Fastening tabs                            |
| 30.2 | Bracket receptacle                        |
| 30.3 | Recess                                    |
| 31   | End walls                                 |
| 32   | Side walls                                |
| 33   | Cover                                     |
| 34   | Axle recess                               |
| 35   | Module receptacles                        |
| 35.1 | Module groove                             |
| 35.2 | Module clip                               |
| 40   | Module                                    |
| 41   | Housing arrangement                       |
| 41.1 | Inner housing                             |
| 41.2 | Outer housing                             |
| 41.3 | Spacer                                    |
| 41.4 | Distance                                  |
| 42   | Batteries                                 |
| 43   | Module circuit board                      |

|     |                                        |
|-----|----------------------------------------|
| 44  | Data transmission unit                 |
| 45  | Housing fastening                      |
| 46  | Opening                                |
| 50  | Mounting plate                         |
| 51  | Fastening elements                     |
| 52  | Orientation indicator                  |
| 100 | Monitoring system                      |
| 101 | Evaluation unit                        |
| 102 | External unit                          |
| 103 | Lever arrangement                      |
| 104 | Lever                                  |
| 105 | Slide rail                             |
| 200 | Door                                   |
| 201 | Hinges                                 |
| 202 | Wall (frame)                           |
| 203 | Main closing edge                      |
| A   | Left-sided arrangement of the housing  |
| B   | Right-sided arrangement of the housing |

## **CLAIMS**

1. A door closer (1) for closing a door (200),
  - with a housing (2) and an output shaft (3) supported therein, designed for fastening a lever arrangement (103),
  - with a mechanical energy storage device (4) in the housing (2), which drives the output shaft (3) to rotate, wherein the energy storage device (4) is preferably a spring,
  - with a sensor unit (20) comprising a sensor (23) and an encoder (21),
  - wherein the encoder (21) is arranged or designed on the output shaft (3),
  - wherein the sensor (23) is designed and arranged for detecting the encoder (21), in particular without contact, wherein the sensor (23) is arranged on a sensor receiving device (24), wherein the sensor receiving device (24) comprises a bracket (24.1), wherein the bracket (24.1) rests against the housing (1) in the direction of an axis of rotation (3.3) of the output shaft (3).
  
2. The door closer (1) according to claim 1, wherein the sensor receiving device (24) positions the sensor (23) on the end face of the output shaft (3).
  
3. The door closer (1) according to one of the preceding claims, wherein the axis of rotation (3.3) of the output shaft (3) intersects the sensor (23) and/or the encoder (21); preferably wherein the sensor (23) is arranged symmetrically to the axis of rotation (3.3) and/or preferably wherein the encoder (21) is arranged symmetrically to the axis of rotation (3.3).
  
4. The door closer (1) according to one of claims 1 to 3, comprising a mounting plate (50) on which the housing (2) of the door closer (1) can be fastened, wherein the bracket (24.1) is fastened to the same mounting plate (50).
  
5. The door closer (1) according to one of claims 1 to 4, wherein the bracket (24.1) rests against and/or is fastened to the housing (2) of the door closer (1); in particular wherein the bracket (24.1) surrounds the output shaft (3) with a, preferably ring-shaped, bracket projection (24.4) and rests against and/or is fastened to the housing (2) with this bracket projection (24.4).

6. The door closer (1) according to one of claims 1 to 5, wherein the bracket (24.1) rests against an axle bearing closure (14) and/or the bracket (24.1) rests against an inner surface (2.4) of an opening (2.3) of the housing (2).

5

7. The door closer (1) according to one of claims 1 to 6, comprising a panel (30) which covers the housing (2) of the door closer (1), wherein the bracket (24.1) rests against the panel (30); preferably wherein the bracket (24.1) is clamped between the panel (30) and the housing (2).

10

8. The door closer (1) according to one of claims 1 to 7, wherein the sensor receiving arrangement (24) comprises at least one fastening spring (24.5), in particular as an integral part of the bracket (24.1), in order to apply pretension to the clamped bracket (24.1).

15

9. The door closer (1) according to one of the claims 1 to 8, wherein the panel (30) comprises at least one bracket receptacle (30.2) for the bracket (24.1); preferably wherein the panel (30) comprises fastening tabs (30.1) and the fastening tabs (30.1) are recessed on the bracket receptacle (30.2) for inserting the bracket (24.1).

20

10. The door closer (1) according to one of the preceding claims, wherein the sensor unit (20) is designed to detect an actual angle of rotation (11) of the output shaft (3); preferably wherein the sensor (23) is designed and arranged for identifying in a contactless manner a position and/or, in particular, rotation and/or acceleration of the encoder (21).

25

11. The door closer (1) according to one of the preceding claims, wherein the encoder (21) comprises a permanent magnet and wherein the sensor (23) is a magnetic sensor, in particular a Hall sensor.

30

12. The door closer (1) according to one of the preceding claims, wherein the encoder (21) is fastened, preferably screwed, to the end face of the output shaft (3).

35

13. The door closer (1) according to one of the preceding claims, wherein the output shaft (3) is exposed on two opposing sides of the housing (2), wherein a first side of the output shaft serves for fastening the lever arrangement (103), wherein the encoder (21) is fastened on the second side of the output shaft (3).

5

14. The door closer (1) according to one of the preceding claims, wherein the output shaft (3) comprises a fastening receptacle (3.2) on both sides, wherein both fastening receptacles (3.2) are suitable for fastening a fastening element for fastening the lever arrangement (103) to the output shaft (3), wherein an encoder fastening (22) is fastened in one of the fastening receptacles (3.2).

10

15. A monitoring system (100) with a door closer (1) according to one of the preceding claims and with an evaluation unit (101), wherein the evaluation unit (101) is designed to monitor a door closing time and/or to determine and/or to monitor how long the door (200) is open.

15