

Title: SLIDING-ROD SWEEP WING ACTUATOR**Description**

The invention relates to a swing leaf actuator based on a sliding arm assembly.

Swing leaf actuators, which are adapted to open and/or to close a connected swing leaf are known for example from the document DE 100 23 760 A1. Such swing leaf actuators are usually operatively connected, by means of a normal arm assembly or a sliding arm assembly, to a leaf which is to be pivoted.

For hold-open devices, it is for example important to know, when the swing leaf has reached an open position in which the hold-open device is to be activated.

With swing leaf drives, the activation is usually realized by means of an incremental encoder, which is affixed to a rotating member of the swing leaf drive in a torque-proof manner and is supplied with energy by means of the existing energy lines or data lines leading to the swing leaf drive.

Another option would be monitoring the current of the drive motor of the swing leaf drive. If the current increases

excessively, it can be assumed that the swing leaf has reached a respective terminal position.

On the one hand, said solutions are disadvantageous in that the respective open position of the swing leaf can only be determined indirectly, namely via detecting and counting light-to-dark changes as a result of the rotation of the slotted disc of the respective incremental encoder or of the increase in motor current.

On the other hand, said incremental encoders are not necessarily applicable to purely mechanically working door closers, because said door closers normally do not have their own power connection. It is therefore difficult to incorporate incremental encoders into door closers. Generally, monitoring the motor current is not possible.

It is the object of the invention to come up with solutions for the above mentioned disadvantages.

This problem is solved by the subject matter of claim 1. Advantageous further developments of the invention are set forth in the dependent claims.

According to the invention, a swing leaf actuator has a sliding rail, in which in a known manner a slider of a sliding arm of the

swing leaf actuator is accommodated to be guided in a translational manner. The sliding arm is operatively connected to an output shaft of the swing leaf actuator in such a way that the swing leaf actuator is able to open and/or to close a connected swing leaf by means of the slider and the sliding rail. According to the invention, it is a question of a swing leaf actuator based on a sliding arm assembly in the shape of a swing leaf drive or a swing leaf closer. According to the invention, a sensor is stationarily accommodated in the sliding rail in such a way that the sensor is able to detect the presence of at least one pre-determined opening condition of the connected swing leaf. In other words, no expensive logic system is required to detect indirectly whether or not the swing leaf has reached the pre-determined opening condition. In addition, arranging the sensor in the sliding rail allows for an almost invisible accommodation of the sensor in the swing leaf actuator arrangement. Last but not least, this arrangement allows for a sensor application independently from the type of installation of the swing leaf actuator in a lintel installation or a door leaf installation.

Preferably, the sensor comprises a mechanical switch, which is actuated by the slider in the range of an opening position of the swing leaf corresponding to said pre-determined opening condition. This is a particularly simple and inexpensive realization of a sensor. "In the range of" means that actuating

the sensor can start, depending on its functioning, shortly before reaching the opening condition. Regularly, a mechanical switch has a switching element for example in the shape of a switching rocker, which has to cover a certain switching distance, prior to recognizing from the outside that the switch is actuated, namely changes its switched condition.

The sensor may comprise a proximity sensor, which is adapted to detect when the slider approaches and moves away from the proximity sensor. This configuration allows for a contactless actuation of the proximity sensor. It becomes now obvious that the term “in the range of” may concern a larger (detection) range than with the mechanical switch.

Preferably the switch is formed by means of a Reed contact. Correspondingly, at a side facing the Reed contact, the slider is preferably configured to be magnetic or is magnetized. On account of the magnetic forces, the Reed contact can be likewise switched in a contactless manner, when the slider approaches. There are in this case distinct switching states, in contrast to the proximity sensor. If necessary, a proximity sensor would additionally require a threshold circuit. Finally, the detection range may be considerably smaller than with the proximity sensor, such that the presence of the pre-determined opening condition can be quite precisely detected.

Furthermore, when installing the sliding rail both to a carrying body (door leaf installation of the swing leaf actuator) such as a door casing, and to said swing leaf (overhead installation of the swing leaf actuator), such a swing leaf actuator has preferably electrical elements by means of which the sliding rail is adapted to couple the at least one sensor to connecting lines of an associated, if required higher-ranked circuit, for example of a control circuit. In this case, the connecting lines lead into an area of the carrying body, to which, depending on the above-mentioned installation type, the swing leaf actuator or the sliding rail thereof is affixed in a stationary manner. In other words, said elements provide a universal applicability of sensors in a sliding rail and namely independently from the fact whether or not the swing leaf actuator has its own power supply connection. Furthermore, the elements allow for coupling the sensor invisibly from the outside to an associated control circuit or activation circuit, for example of a hold-open device.

Preferably the at least one pre-determined opening condition corresponds to a completely open position or closed position of the connected leaf. In other words, the sensor acts as a sort of end-position switch for at least one end position of the leaf.

Further features and advantages of the invention will become apparent from the following description of preferred embodiments, in which:

Figure 1 shows an arrangement of a swing leaf actuator according to an embodiment of the invention in a partial exploded illustration,

Figure 2 shows a section of the swing leaf actuator of Figure 1, without sliding rail,

Figure 3 shows an exploded view of the arrangement shown in Figure 2 with sliding rail,

Figure 4 shows a perspective partial view of the sliding rail of Figure 1,

Figure 5 shows an arrangement of a swing leaf actuator according to a second embodiment of the invention in a partial exploded illustration, and

Figure 6 shows an arrangement of a swing leaf actuator according to a third embodiment of the invention in a partial exploded illustration.

Figure 1 shows an arrangement 1, which illustrates a swing leaf actuator 10, which, by way of example, is configured as a door operator, and affixed to a door casing as the stationary carrying body 2 in an overhead installation. A swing leaf 4, likewise

configured by way of example as a door leaf, is affixed to the door casing 2 to be pivotable via door hinges 3. The output shaft 11, not visible in this case, of the door operator 10 is operatively connected to a sliding rail 30 via a sliding arm 20, which rail is attached to the leaf 4 in a usual manner. The attachment device of the sliding arm 20 to the output shaft 11 is concealed by a cover 17.

The sliding rail 30 is configured to be preferably open to both frontal faces and is terminated at the frontal face by means of one respective end cap 31, just the left cap being represented in this case. A stopper 34, which prevents a slider 22 of the arrangement 1, not visible in this case, from impacting against the end cap 31 on the left-hand side, is inserted between the sliding rail 30 and the left end cap 31 in Figure 1. A Reed contact 32 and a stopper 33 are inserted in the terminal area of the sliding rail 30 on the right-hand side frontal face. The function of the stopper 32 is similar to the one of the stopper 34. The Reed contact 32 engages in a magnetic interaction with the slider 22. If the slider 22 reaches the proximity of the Reed contact 32, the latter switches. In this position the leaf is, in said example, in the completely open position.

Figure 2 shows the swing leaf actuator 10 of Figure 1 without cover and without sliding rail 30 in a sectional view. As can be seen, the sliding arm 20 is operatively connected to the output

shaft 11 of the door operator 10 via an attachment disc 12 in a torque-proof manner. By way of example, the output shaft 11 is operatively connected to a drive pulley 14 of the door operator 10 via a driven pulley 13 and a belt 15. The drive pulley 14 is operatively coupled to a drive mechanism of the door operator 10, which mechanism is not illustrated in detail. Such a drive mechanism normally comprises a drive motor and a closer mechanism, which both are rotationally and operatively connected to the output shaft 11. The above-mentioned slider 22 is articulated to be freely rotatable at the distal end of the sliding rail 30 opposite the output shaft 11 preferably by means of a connecting member 21, which is disposed in between.

Figure 3 shows an exploded view of the arrangement 1 shown in Figure 2, in this case with the sliding rail 30. The disc 12 of the door operator 10 is disposed in a torque-proof manner with regard to the driven pulley 13. With its right end in Figure 3, the sliding arm 20 is accommodated in a torque-proof manner in a reception groove 12a of the disc 12. Fastening the sliding arm 20 to the disc 12 is realized via a fastening opening 20a, for example by means of a non-illustrated attachment screw. The connecting member 21 is accommodated either in a torque-proof manner or to be freely rotatable in a fastening opening 20b at the left end of the sliding arm 20 in Figure 3, namely at the other end. Correspondingly, the slider 22 is coupled to the connecting member 21 to be freely rotatable or in a torque-

proof manner. The slider 22 has such an exterior contour that it is guided in the sliding rail 30 preferably without play.

Figure 4 shows a perspective partial view of the sliding rail 30 from the side which is not visible in Figure 1. As described above, the slider 22 is accommodated in the sliding rail 30 to be guided in a translational manner. The slider 22 is articulated to be freely rotatable at the sliding arm 20. The above mentioned stopper 33 is preferably clamped in the sliding rail 30. In addition, the above-indicated Reed contact 32 is accommodated in the sliding rail 30 preferably between the slider 20 and the stopper 33. The Reed contact 32 serves in addition to bridge a distance existing between the slider 22 and the stopper 33 in the completely open position of the connected leaf 4 in this case. By way of example the stopper 33 is clamped in the sliding rail 30 by means of a clamping device, which in this case is configured as a hexagon screw 33a, as indicated by the screw driver 5.

Figure 5 shows an exploded view of an arrangement 1 according to a second embodiment of the invention. As can be seen, in this case a modified slider 22 and a switching element 35 are located at the left frontal side end of the sliding rail 30. The slider 22 and the switching element 35 are configured such as to be accommodated to essentially accurately fit in the sliding rail 30 and in this case, the slider is guided in a

translational manner. At opposite inside lateral surfaces facing each other, the sliding rail 30 has contact rails 30a, which are preferably configured along the entire length of the sliding rail 30. At corresponding lateral surfaces facing the contact rails 30a, the slider 22 has contact tongues or contact springs 22a, only the frontal one is visible in this view. When inserting the slider 22 into the sliding rail 30, the contact springs 22a reach electrical contact with the contact rails 30a, on account of their elastic structure they are pressed in the direction of the switching element 35 and thus bear against the respective contact rail 30a; preferably they are pressed against the rail. The switching element 35 has likewise at corresponding lateral surfaces preferably likewise contact springs 35a, which likewise reach electrical contact with the above-mentioned contact rails 30a, as soon as the switching element 35 is inserted into the sliding rail 30.

Furthermore, at its end facing the slider 22, the switching element 35 has preferably a momentary contact switch 35b, which is actuated by the slider 22, as soon as the leaf 4, in the illustrated example, is located in the closed position. If the momentary contact switch 35b is configured as a normally open contact, an electrical contact is established between the contact springs 35a of the switching element 35. As a result a remote circuitry, for example in the shape of a control circuit, coupled to the switching element 35, may be activated correspondingly or

the command to execute a certain action can be signalled to said circuitry.

At its end facing the sliding arm 20 and on its exterior circumference, the connecting member 21 has contact rails 21a which are preferably configured to be completely closed. At its end facing the slider 22, the connecting member 21 has connectors, which by way of example are configured as plug-in contacts 21b. At its side facing the connecting member 21, the slider 22 has corresponding electrical contacts, in this case in the shape of non-visible female connectors. When inserting the connecting member 21 into the slider 22, the plug-in contacts 21b reach electrical contact with the associated female connectors. The contacts 21b are in electrical contact with respectively one of the two contact rails 21a, however not in contact with each other.

On its inside, the sliding arm 20, respectively the fastening opening 20b has two contact rails 20c, which in this case are disposed one above the other and are electrically insulated from each other, only one rail is visible in this view. The two contact rails 20c are configured in such a way that they reach electrical contact with one of the respective contact rails 21a, when inserting the connecting member 21 into the fastening opening 20b of the sliding arm 20. The contact rails 20c may be

likewise configured as contact tongues or contact springs protruding to the inside.

At the other end, the sliding arm 20 has contact springs 20d preferably in the area of the fastening opening 20a at two exterior surfaces preferably facing away from each other. When inserting the sliding arm 20 into the reception groove 12a of the disc 12, the contact springs 20a reach electrical contact with one respective corresponding contact surface 12b, which are electrically insulated from each other. The contact springs 20d are electrically connected to a respective associated one of the contact rails 20c. The contact surfaces 12b are in electrical contact preferably with contact surfaces respectively contact rails 16a of a disc 16 of the door operator 10 which are likewise electrically insulated from each other and only one of them is visible. In this case, non-illustrated contacts, for example in the shape of carbon brushes engage at said contact rails 16a, which contacts are coupled to the above-mentioned connecting lines of a control circuit or to circuitry which is configured in any other way.

Figure 6 shows a swing leaf arrangement 1 according to a third embodiment of the invention.

In this case, the swing leaf actuator 10 is configured by way of example as a door closer and is shown as door leaf installation.

In other words, the door closer 10 is fastened to a door wing or a door leaf 4 and the sliding rail 30 is fastened to the carrying body 2, namely to a door frame in this case. The sliding rail 30 is preferably configured to be open again towards the frontal sides and is provided with end caps 31 at the frontal sides. In a known manner, the sliding arm 20 connects the door closer 10 functionally to the sliding rail 30. Furthermore, in this case, again a switching element 35, the invisible switch 35a thereof pointing to the right side in Figure 6, is inserted by way of example into the left frontal end of the sliding rail 30.

As the sliding rail 30 is already affixed to the carrying body, there are no wiring issues, like those arising with the overhead installation. In other words, in this case, a sensor can be utilized for example in the shape of a switching element 35 with lines 35c serving for power supply being led to the outside.

The lines 35c are preferably guided out of the sliding rail 30 in a concealed manner and are coupled to the aforementioned connecting lines or are configured integrally with them. The lines 35c may be likewise inserted into the switching element 35 to be electrically coupled thereto by means of plug-in contacts.

In the illustrated example, the lines 35c are guided in the direction of the carrying body 2 out of the sliding rail 30. Additional corresponding openings at the side of the sliding rail

30 facing the carrying body 2 allow preferably for carrying out this action. As an alternative, the lines 35c are guided out of the sliding rail 30 at the frontal side. This is for example appropriate, if the sliding rail 30 abuts with its associated frontal side, for example against a housing wall.

As a result, independently from the installation type of a swing leaf actuator 10 based on a sliding arm assembly, the invention provides an efficient solution allowing to incorporate inexpensive sensors 35 into the sliding rail 30 of said swing leaf actuator 10 for detecting the obtained opening condition and/or closing condition of the connected leaf 4.

The invention is not limited to the above described embodiments.

Moreover, the above described pairs of contact spring/contact tongue and contact rail/contact surface may be configured in a reversed manner.

The connecting member 21 may be configured integrally with the slider 22 or the sliding arm 20 such as to be able to omit the contact arrangement disposed there between. The disc 16 may be configured integrally with the sliding arm 20 and/or the disc 16 with similar consequences as above.

As, during opening and closing, the output shaft 11 of a swing leaf actuator 10 is rotated in opposite directions with regard to each other, it may be provided the connecting lines end in the disc 16. They just need to be run in a way to prevent the rotating output shaft 11 from causing cable clutter, from ripping the connecting lines or from damaging them in any other way.

Instead of separate switching elements 35, the latter ones may be incorporated into the slider 22. In this case, the stoppers 33, 34 form the abutments for the switches of the switching elements 35.

As an alternative, the stoppers 33, 34 may be configured as switching elements, similarly to the switching element 35, resulting in a reduction of the number of required parts.

In case several switching elements 35 would be used, they could be nevertheless electrically coupled in pairs to the same contact rail 30a. In this case, electric resistance values could determine which one of the switching elements 35 has been actuated. For this purpose, an electric resistance could be installed upstream of one of the switching elements 35.

The one or more switches 35a of the one or more switching elements 35 may consist of any kind of switch. Instead of a normally open switch, likewise a normally closed switch can be

used. Instead of momentary contact switches, likewise pressure switches, corded switches or the like may be utilized. Instead of mechanical switches, likewise contactless switches, such as proximity sensors, Reed contacts or the like can be utilized. In case of a Reed contact, advantageously the facing surface of the opposite element, namely of the slider 22, according to the embodiments illustrated in the Figures, is configured to be magnetic or is magnetized.

As illustrated, the invention can be applied to any construction type of swing leaf actuators based on sliding arm assemblies.

The circuitry to which the sensor 35 may be coupled may consist of any kind. Said circuitry may be part of a central building management system. In this case, additional data lines/connections to the sensor 35 are conceivable. As an alternative, the data could be modulated onto the voltage supply signal.

In addition to activating a hold-open device by the sensor 35, multiple application cases are possible. One example is the closing delay system. In other words, if the sensor 35 detects for example that the connected leaf 4 has reached its completely open position, a coupled timing member can be activated with the result of holding the leaf 4 in the completely open position for a pre-determined duration. Another example is

an emergency exit door. When the closed condition of the connected leaf 4 is detected, a locking action can be activated. Said leaf 4 is thus arrested in the closed position, until receiving a signal in a known manner which results in the emergency path through said emergency exit door being cleared. Such a signal can be generated by means of actuating an emergency switch.

List of reference numerals

1	arrangement
2	carrying body
3	hinge
4	swing leaf
5	screw driver
10	swing leaf actuator
11	output shaft
12	attachment disc
12a	groove
12b	contact rail
13	driven pulley
14	drive wheel
15	belt
16	disc
16a	contact rail
17	cover
20	sliding rail
20a	fastening opening
20b	fastening opening
20c	contact rail
20d	contact spring

21	connecting piece
21a	contact rail
21b	plug-in contact
22	slider
22a	contact spring
30	sliding rail
30a	contact rail
31	end cap
32	Reed contact
33	stopper
33a	screw
34	stopper
35	switching element
35a	contact spring
35b	momentary contact switch
35c	line

Patent claims

1. A swing leaf actuator (10),
 - having a sliding rail (30), in which a slider (22) of a sliding arm (20) of the swing leaf actuator (10) is accommodated to be guided in a translational manner,
 - wherein the sliding arm (20) is operatively connected to an output shaft (11) of the swing leaf actuator (10) in such a way that the swing leaf actuator (10) is able to open and/or to close a connected swing leaf (4) by means of the slider (22) and the sliding rail (30),
 - wherein a sensor (35) is stationarily accommodated in the sliding rail (30) in such a way that the sensor (35) is able to detect the presence of at least one pre-determined opening condition of the connected swing leaf (4).
2. The swing leaf actuator (10) according to claim 1, wherein the sensor (35) comprises a mechanical switch (35b), which is actuated by the slider (22) in the range of an opening position of the swing leaf (4) corresponding to said respective pre-determined opening condition.

3. The swing leaf actuator (10) according to claim 1, wherein the sensor (35) comprises a proximity sensor, which is adapted to detect when the slider (22) approaches or moves away from the proximity switch.
4. The swing leaf actuator (10) according to claim 3, wherein
 - the proximity sensor is configured by means of a Reed contact, and
 - the slider (22) is configured to be magnetic or magnetized in such a way that, in a pre-determined opening condition of the leaf (4), the slider (22) is able to reach interaction with the Reed contact and switches the latter.
5. The swing leaf actuator (10) according to any of the preceding claims, furthermore comprising electrical components (12b, 16a, 20c, 20d, 21a, 21b, 22a, 30a, 35a), which are configured to couple the sensor (35), when the sliding rail (30) is mounted to both a stationary carrying body (2) and to a swing leaf (4), to connecting lines of an associated circuit, which lead to an area of the carrying body (2) to which the swing leaf actuator (10) or the sliding rail thereof (30) is attached.

6. The swing leaf actuator (10) according to any of the preceding claims, wherein the at least one predetermined open condition corresponds to a complete open position or closed position of the connected leaf (4).