

Title: Door operator

Description

The invention relates to a door operator consisting of several components, such as mechanical, hydraulic and electrical drive systems, and/or one or more housings, the components being connected to each other.

A swing door operator having an electromechanical drive unit is known from DE 197 56 496 C2. This swing door operator has an open construction without a closed housing, whereby the individual components are affixed one after the other to a cover plate or to a covering, which in turn can be flush-mounted in the door leaf. Thus the gear and the drive motor are flange mounted to the cover plate via a bearing support. If greater torques are required, the exterior dimensions of gear and motor are considerably larger than illustrated in Figure 1 of DE 197 56 496 C2. The flange connection used therein between the gear and the cover plate requires that there is either enough space outside the diameter of the drive components, or that one of the components, as illustrated in this state-of-the-art, in at least one area, has a smaller diameter than the hole diameter of the flange connection, in order to have enough space for mounting the screw heads and/or nuts. In case there are additional components for a modularly designed drive, e.g. a closer spring with a housing, long drives are created, in which an undesired positional deviation of the

axes may lead to a premature failure of the overall drive. Another disadvantage of this state-of-the-art is that a closer spring can not be used as an additional or alternative structural component to the shown components, because
5 the arising forces can not be accommodated by the covering. When using a conventional cast housing, which is usual for door operators, housing lengths are generated which may extend nearly over the overall door length. With the dimensions required for the installation in the door, a
10 complete mounting of the drive components as series fabrication is no longer possible.

DE 197 17 993 A1 describes an automatic door operator, in which several return devices can be modularly connected by means of a coupling.

15 Door closers are known as well, in which a basic structure can be equipped with different closer springs, in order to achieve various torque curves. For this purpose the closer springs with a spring housing are screwed to the door closer, the spring housing, at the connection side, having a
20 female or male thread, which is screwed into a complementary thread at the door closer housing. When considering the longitudinal axis of the structural components as the axis of rotation for screwing-in the threads, it is impossible to pre-determine exactly in which
25 position the spring housing will bear against the door closer. Here, the problem is that no exact positional

disposition is possible, in particular not for the angular disposition at the housings.

Therefore, the object of the present invention is to provide a door closer of the species indicated in the generic part of patent claim 1, consisting of at least two components, which, with regard to their positional disposition, can be precisely aligned and interconnected.

This problem is solved in that two components are interconnected to a coupling, one component having a right-hand thread and the other component having a left-hand thread, and in that the right-hand and left-hand threads engage in complementary threads of the coupling. Thereby, once the components are axially aligned to each other, the components can be interlocked by rotating the coupling, without creating neither an axial deviation nor an angular deviation.

Components are meant to be drive systems, such as pump, motor and a hydraulic block, but also in particular housings and housing parts, which are able to accommodate or to be connected to the pump, the motor or the hydraulic block. This way several housings can be interconnected, which will accommodate the pump, the motor or the hydraulic block. However, the pump, motor or hydraulic block can be affixed to one housing as well, which in turn accommodates additional drive systems and drive elements. In this case, hydraulic block designates

substantially the structural combination of valves, lines, and/or other hydraulic components.

But also the basic components of a door closer or a door operator, which for example may consist of the cam technology with cam disc and compression rollers or of the piston technology with internally toothed piston and pinion, are understood as components. These basic components may be mounted in their own housing and, depending on the application case, may be combined with other drive components by means of the coupling. Since, depending on the application case, both the cam technology and the piston technology have advantages and disadvantages, the respectively appropriate technology can be combined by means of a uniform structural unit, which integrates the drive motor, hydraulic pump, spring compartment and spring force adjusting device. The coupling constitutes the prerequisite to interconnect the different components, which cooperate trouble-free only with a precise positional disposition.

Instead of the connection via threads, a bayonet catch or another releasable connection type can be used.

According to this solution, the coupling may have the function of a union nut and may be screwed onto the components from outside, or – as an advantage with regard to available space for installation into the door – may be a coupling installed in one – or both – components.

In a preferred embodiment, the right-hand and left-hand threads of the components are a female thread for this purpose, and the complementary threads of the coupling are male threads. Thus, the coupling is screwed into the components.

The following explanation refers to the use of the coupling with at least one housing, which will be connected to another component, such as a hydraulic block, pump or to a second housing part. In this case, in a preferred embodiment, the coupling may have an internal bore and be penetrated by a piston rod, a spring push-rod or a spindle, such that different components having various functions can be interconnected modularly and their functions complement each other.

The coupling is sealed with joints in relation to the piston rod and to the housing, such that a separate pressure compartment can be formed in each housing.

On its frontal side, the coupling may have tenon holes, in which the tenons of a tool engage. Thus, a housing can be completely pre-mounted and the coupling is attached with the second housing. The tool penetrates the second housing and, with its tenons, engages in the tenon holes of the coupling, such that the coupling is rotated by rotating the tool, and the housings move towards each other axially along the threads. By further rotating, the housings are interlocked until the frontal sides tightly abut each other.

In a hydraulic door operator, hydraulic channels are machined into the housings parallel to a longitudinal axis of the housings, which channels are interconnected in true alignment, at the abutting frontal sides of the housings connected by the coupling. Due to the fact that the axial positional and the angular disposition of the housings is precisely guaranteed on account of the coupling connection, the channels and lines, exiting at the frontal sides of the housings, can be sealed towards the outside towards the gap between the housings and can be interconnected at little expense. Another non negligible advantage results from manufacturing these channels and lines, because deep bores are always very expensive in manufacturing and are inaccurate with regard to tolerances. By using several housings or by flange-mounting of hydraulic block or pump, the bores along the longitudinal axis for the hydraulic channels may have a smaller depth, because, through the precise axial positional disposition and angular disposition, a connection of the channels is possible via the frontal sides of the components without any problem.

Another improvement is achieved, if connectors, which seal off the hydraulic channels to the outside, are inserted into the adjoining open hydraulic channels of the first and second housings. In this case, the connectors simultaneously assume the function of fixing the position of the housings with regard to each other and absorb part of

the torques, which arise when the housings are screwed to the coupling.

On account of its compact structure, the inventive door operator allows for a concealed installation within a door profile or a frame profile and thus allows for a total
5 integration with the door system. Particularly the installation in common narrow door profiles is possible.

As an advantage, neither special door profiles nor any special constructions are necessary, which would interfere
10 with the design of the door system. Another advantage results from an economical mounting combined with a wide applicability, and it is moreover possible to retrofit existing door systems with the inventive door operator.

Another advantage resides in the use of various materials
15 for components, which are interconnected via the coupling. A basic housing with the dampening, the cam disc and the drive shaft may be manufactured from cast iron or cast steel and the complementing housing part with the compression spring from aluminium.

20 Another advantage results from the ease of mounting of the door operators, which only now allow for series fabrication. When using the previous cast housings having an inner diameter of 20 to 50 mm depending on the application case, an efficient mounting of the drive systems
25 with a housing length of 500 to 900 mm is no longer possible, because the labour constant of reaching into this

narrow bore with mounting tools is far too important. Thus, a pre-mounting of the structural units outside the housing-halves is possible. The housings can be manufactured with industrial standard machines, making the door operator
5 inexpensive, because no special machines are required and there are far less rejects with the shorter housing parts.

It is likewise possible to design the door operator according to a modular concept with different components.

10 Further details, features and advantages of the invention will become apparent from the following description of exemplary embodiments, reference being made to the drawings, in which:

Figure 1: shows a perspective view of a door operator
15 with a split housing and a coupling,

Figure 2: shows a sectional illustration through the area of the coupling,

Figure 3: shows a diagrammatical illustration of a door operator with a modular concept.

20 Figure 1 shows a door operator consisting of a first housing 1 and a second housing 2, which are interconnected via a coupling 4. The basic components, e.g. cam disc with damping piston, a drive shaft 3, as well as other hydraulic and mechanical structural components, are located in the
25 first housing 1. The door operator is connected to a door

frame or to a wall via a drive shaft 3 by means of a lever, not illustrated, via a sliding member and slide channel. As an alternative, depending on the application case, the use of a scissor arm assembly is possible. The second housing
5 2 accommodates further drive components such as the compression spring 18, hydraulic piston, pump, motor or control device. In this case, it is possible to modularly build the drive from more than two housings, which are then connected to one coupling 4, respectively. Instead of the
10 second housing 2, not illustrated drive systems, such as pump/motor 20 or a hydraulic block, can be flange-mounted. One or more hydraulic channels 13, which are connected and sealed towards the outside via connectors 14, extend parallel to the longitudinal axis 12 of the
15 housings 1, 2.

In Figure 2, the first housing 1 has a right-hand thread 1a and the second housing 2 has a left-hand thread 2a. The right-hand thread 1a engages in a complementary right-hand thread 4a of the coupling 4, and the left-hand thread
20 2a in a likewise complementary left-hand thread 4b of the coupling 4. Obviously, the left-hand and right-hand threads are interchangeable, whereby it is of importance that the threads be disposed with an **opposite pitch**. In this exemplary embodiment, first housing 1, coupling 4 and
25 second housing 2 are penetrated by a piston rod 5. The coupling 4 has sealing grooves 4d, wherein the piston rings or sealing rings 7 can be accommodated. Sealing grooves

4c are likewise machined into the outside diameter of the coupling 4, in which grooves the sealing rings 6 can be accommodated, such as round or radial sealing rings. This way, the pressure compartments of the housings 1 and 2 can be separated from each other via the coupling 4. In the second housing 2, via a pin 10, the piston rod 5 is connected to a piston coupling 11, against which, via a not illustrated piston, a compression spring bears, likewise not illustrated. Instead of the piston rod 5, a push-rod for a compression spring or a drive spindle can penetrate the housings 1 and 2 as well as the coupling 4. Tenon holes 8, into which the tenons 9a of a tool 9 engage, are drilled into a frontal side of the coupling 4. It is useful that the number of the tenons 9a or of the tenon holes 8 amounts at least to two, preferably four, which are evenly distributed on a circle about the central axis. Other non-positive power transmission means are likewise possible, such as a hexagon or the like.

A mounting of the housings 1 and 2 is performed as follows: The pre-mounted first housing 1 is stationary positioned. Outside the housings 1, 2, the piston rod 5 with the attached piston coupling 11 is pre-mounted with the pin 10, as well as with the coupling 4 and the sealing rings 6, 7. Then this complete structural unit is inserted in the housing 1 and the connectors 14 are inserted. The housing 2 is slid over the piston rod 5 with the thereto attached piston coupling 11, which projects from the coupling 4, until

the threads 1a, 2a of the housings 1, 2 engage in the threads 4a, 4b of the coupling 4.

The second housing 2 is axially aligned with regard to the first housing 1 and fixed such that the second housing 2 is
5 able to carry out an axial movement only. A tool 9 having tenons 9a is passed through the second housing 2. The tenons 9a engage in the tenon holes 8 of the coupling 4. By rotating the tool 9, the coupling 4 will be screwed simultaneous into the right-hand thread 1a of the first
10 housing 1 and into the left-hand thread 2a of the second housing 2, the positional and angular disposition of the housing 1 and 2 with regard to each other remaining unchanged; but they approach each other along the longitudinal axis 12 by rotating the coupling 4. The coupling
15 4 is rotated until the frontal sides of the housings 1 and 2 are abutting each other and are interlocked. In this case also, on account of the final fixing through the connectors 14, the position of the housings 1 and 2 with regard to each other remains unchanged.

20 In particular with hydraulic drives in which the housings have long bores as hydraulic channels, disposed parallel to the longitudinal axis, the exact positioning and the angular position are very important. Long drilled channels tend to deviate from the intended drilling axis; however, with
25 separate housings, the channels can be much shorter and are thus less expensive in manufacturing. The known solutions, i.e. to run hydraulic lines and channels so to

5 speak like a brake hose along the housing in order to avoid the long bores, are impossible to realize with the door operators, which are integral within the door as there is not enough mounting space. With this feature the invention provides for the first time the possibility to interconnect hydraulic door operators having divided or several housings, such that the channels or lines, which are integral with the housing, function like one continuous hydraulic line. On account of the radial sealing of coupling and connector, no frontal nor flat gasket is required.

Figure 3 shows a diagrammatic illustration of a modularly designed door operator, in which the second housing 2 accommodates the spring compartment and the spring force adjusting device. The basic components, e.g. cam technology having a cam disc 15 and compression rollers, or piston technology having an internally toothed piston 17 and pinion 16, are integral with the first housing. Depending on the used basic component, matching springs 18 or 19 are installed in the second housing 2. In this case, the first and second housing 1, 2 are connected through the coupling 4. A pump/motor unit 20 with or without hydraulic block can be flange-mounted at the other end of the second housing 2.

List of References

- 1 first housing
- 1a right-hand thread
- 2 second housing
- 5 2a left-hand thread
- 3 drive shaft
- 4 coupling
- 4a right-hand thread
- 4b left-hand thread
- 10 4c sealing groove
- 4d sealing groove
- 5 piston rod
- 6 sealing ring
- 7 sealing ring
- 15 8 tenon hole
- 9 tool
- 9a tenon
- 10 pin
- 11 piston coupling
- 20 12 longitudinal axis
- 13 hydraulic channel
- 14 connector
- 15 cam disc
- 16 pinion
- 25 17 internally toothed piston
- 18 compression spring
- 19 compression spring
- 20 pump/motor

Patent claims

1. A door operator consisting of several components such as mechanical, hydraulic and electrical drive systems, and/or one or more housings, at least
5 two components being interconnected by means of a plug-in or rotatable coupling (4), characterized in that one component has a right-hand thread (1a) and the other component has a left-hand thread (2a) and in that the right-hand and left-hand threads (1a, 2a) engage in
10 complementary threads (4a, 4b) of the coupling (4).
2. A door operator according to claim 1, characterized in that the right-hand and left-hand
15 threads (1a , 2a) of the components are female threads and the complementary threads (4a, 4b) of the coupling (4) are male threads.
3. A door operator according to claim 1, characterized in that the coupling (4) connects
20 two housings (1, 2).
4. A door operator according to claim 3, characterized in that the first housing (1) optionally accommodates mechanical elements for the cam technology or the piston technology
25 and in that the spring compartment and/or the spring force adjusting device and/or the drive

motor and/or the hydraulic pump are disposed in or at the second housing (2).

5. A door operator according to claim 1, characterized in that the coupling (4) is penetrated by a piston rod (5) or a spring push-rod or a spindle.
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6. A door operator according to one of the preceding claims, characterized in that the coupling (4) has at least one sealing groove (4d) for a sealing ring (7), which achieves a sealing of the piston rod (5), the spring push-rod or the spindle with regard to the housing (1) and/or the housing (2).
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7. A door operator according to one of the preceding claims, characterized in that the coupling (4) has at least one sealing groove (4c) for a sealing ring (6), which achieves a sealing of the coupling (4) with regard to the housing (1) and/or the housing (2).
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8. A door operator according to one of the preceding claims, characterized in that, on one frontal side, the coupling (4) has tenon holes (8), in which the tenons (9a) of a tool (9) engage.
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9. A door operator according to one of the preceding claims, characterized in that, parallel to a longitudinal axis (12) of the housings (1, 2), at
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least one hydraulic channel (13) extends through the first and the second housings (1, 2), which channel is interconnected in true alignment at the frontal sides, firmly abutting each other, of the housings (1, 2) connected by the coupling (4).

10. A door operator according to claim 10, characterized in that the hydraulic channel (13) of the first housing (1) and the hydraulic channel (13) of the second housing (2) are interconnected by means of connectors (14) in the area of the frontal sides, firmly abutting each other, of the housings (1, 2).

11. A door operator according to one of the preceding claims, characterized in that the door operator is a hydraulic door operator.