

Title: Door operator, in particular swing door operator

Description

The invention relates to a door operator, in particular a
5 swing door operator according to the generic part of patent
claim 1.

Such a door operator is known from DE 295 21 068 U1. An
overhead door closer with a slide rail linkage is known from
DE 40 38 720 C2, which has a cam drive unit allowing for
10 an optimum door moment curve and a comfortable
operation. In principle this overhead door closer would be
therefore suitable as a door operator as well; however,
experiments conducted during the course of the invention
have shown that applying oil pressure to the drive unit
15 results in a very unfavourable transformation of the
hydraulic pressure in the resulting movement of
stroke/rotation and repeated stroke. Since about 75% of
the output capacity to be applied is required for tensioning
the spring force accumulator of such door closer, whereas
20 only about 25% of the output capacity needs to be
delivered by the system for accelerating the door. As it is
furthermore desirable to keep the narrow structural shape
of such a door closer for door operators as well, the
dimensions of the structural components cannot be
25 adapted to the extremely high load. Thus, although

functionally and technically advantageous, the known overhead door closer is not suitable as a door operator.

Another swing door operator is known from DE 197 56 496 C2. This swing door operator has an electromechanical drive unit, which is provided with a drive motor and a gear and with a subsequent power transmission unit for the connected door. The power transmission unit has a spindle with a spindle nut partially overlapping the former, which spindle is non-positively and positively connected to a toothed rack. Although this swing door operator can be installed concealed, the door moment curve is not as optimal as with the above described door closers having the cam technology. On account of their dimension, these door closers need to be accommodated in special profiles.

Therefore, it is the object of the present invention to provide a door operator of the species indicated in the generic part of patent claim 1, which can be installed completely concealed within the door profile or frame profile, and does not require any special constructions of the door system.

This problem is solved by the features of patent claim 1.

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 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, which would interfere with the design of the door system, are necessary. 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 results from the fact that, with the inventive door operator, a direct introduction of force for tensioning a spring force accumulator is possible. Therefore, the possibility is given of avoiding unnecessary stress of the mechanical structural components.

At first the inventive construction allows for a very compact design, and it is possible to directly utilize the major portion of the total output capacity without redirection for pre-tensioning the spring force accumulator. Therefore, there is no unnecessary stress on structural components, nor load on bearings, nor any loss on account of friction nor loss of efficiency. Through disposing a cam plate assembly, with a single cam plate being disposed in the largest diameter range, a mechanical tension-compression connection is created, which, in conjunction with the force transmission rollers, allows to precisely guide the cam disc on the output shaft. Through this structural measure, the disposition is

particularly suitable for realizing hold-open functions, or controlled free-wheeling functions.

By providing preferably provided specific hydraulic controls, such as through the use of a solenoid valve, further
5 hydraulic functions such as free-wheeling, hydraulic hold-open or hydraulic closing sequence control are made possible.

Furthermore, it is possible to realize a hydraulic opening damping and to use differently built drive units.

10 Advantageous further developments of the invention are the subject matter of the dependent claims.

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

Figure 1: shows a diagrammatically simplified basic illustration of an embodiment of an inventive door operator,

20 Figure 2: shows a sectional top view on the door operator according to Figure 1.

Figure 3: shows a vertical section through the door operator according to Figure 1 in the area of the output shaft,

Figure 4: shows an illustration of the door operator enlarged in scale, corresponding to Figure 1, in the area of the output shaft, and

5 Figure 5: shows an illustration of the door operator enlarged in scale, corresponding to Figure 3, in the area of the output shaft.

Figure 1 shows an inventive door operator 1, which in particular can be executed as a swing door operator. The door operator 1 has a drive unit 2, which, via an output
10 shaft 9, can be coupled to a door not illustrated in Figure 1, for example via a lever 26 and a slide channel 24 with a sliding member 25. The drive unit 2 is disposed in a housing 13.

Furthermore, the door operator 1 has a motor 3, as well as
15 a spring force accumulator 4 disposed in the housing 13, which accumulator is coupled to the motor 3 and the drive unit 2.

As depicted in Figure 1, the motor 3 is in driving connection with a hydraulic pump 5. In this case, the motor 3 and the
20 pump 5 can be flange-mounted to the housing 13. Via the hydraulic pump 5 and a first hydraulic line 22, the motor 3 is in hydraulic connection with a pressure compartment 7. Via a second hydraulic line 23, the motor 3 and the pump 5 are in hydraulic connection with a pressure compartment 6,
25 which forms a reservoir volume, and wherein a

compression spring 12 of the spring force accumulator 4 is disposed.

In the embodiment illustrated in Figure 1, the drive unit 2 is formed as a cam drive. This cam drive has a cam disc 8, which is disposed on the output shaft 9. The cam disc 8 cooperates with two force transmission rollers 10 and 11, which are disposed on both sides of the output shaft 9 and bear on cam paths of the cam disc 8.

As depicted in Figure 1, a spring tensioning piston 17, which directly introduces the force for tensioning the compression spring 12 into the latter, is disposed in the pressure compartment 7. The spring tensioning piston 17 is connected to the opening piston 28 and to a cam plate assembly 18 of the drive unit 2, via a piston rod 19, which, by means of the joint 20, passes in a sealing manner through the separating wall 20'.

Furthermore, Figure 1 shows that one end 14 of the spring 12 bears against a housing wall 15 of the housing 13, whereas the other end 16 bears against the spring tensioning piston 17.

As Figure 1 reveals, this division of the pressure compartments first of all allows for utilizing the advantages of the cam technology, preferably through suitable hydraulic controls (solenoid valves, throttles or the like). The set-up between the spring and the cam drive is

extremely decisive, as only this allows for direct tensioning of the spring. A further result is the extremely compact design explained at the beginning, which makes a completely concealed installation in door profiles or frame profiles possible.

Figure 2 shows a top view on the door operator 1 according to Figure 1 in the area of the output shaft 9. This top view reveals that the force transmission rollers 10, 11 are disposed on a cam plate assembly 18, which is connected to the spring tensioning piston 17 via the piston rod 19. Between the hydraulic compartment 6 and a reception compartment 21, an axial pressure compensation bore 17 extends through the piston rod 19 and the spring tensioning piston 17.

Figure 3 reveals that the cam disc 8 is divided into two cam discs 8', 8'', which are disposed towards each other and spaced apart along a longitudinal axis L of the output shaft 9. These cam discs 8', 8'' cooperate with two individual rollers 10', 10'' or 11', 11'' of the force transmission rollers 10, 11, correspondingly disposed towards each other and spaced apart.

On account of this division, it is possible to dispose the cam plate assembly 18 in the area of the largest diameter D between the individual rollers 10', 10'', 11', 11'' and the associated cam discs 8', 8''. This disposition is

advantageous in that it offers the largest diameter without the necessity to enlarge the reception compartment 21, such that the exterior dimensions of the door operator 1 can remain unaffected. Furthermore, the central disposition
5 avoids bending stress in the cam plate. At the same time, the cam plate assembly realizes a torsion protection for the piston.

As illustrated in Figures 2 and 3, the cam plate assembly 18 can be formed as an individual cam plate 18'.

10 Figures 4 and 5 show an alternative embodiment wherein the cam plate assembly is formed by pairs of bolts 18'', 18''', which can be fixed via appropriated bolt attachments. The cam plates or the bolts form, in this case, a tension-compression connection between the pistons. Springs can
15 be saved through this disposition. That is in particular a spring for pressing the force transmission roller 11 against the cam disc 8 via the damping piston 29.

Moreover, in this disposition the lateral guidance of the bolts 18'' and 18''' along the output shaft 9 or between the
20 cam discs 8' and 8'' achieves a torsion protection for the opening piston 28 and for the damping piston 29.

Furthermore, by utilizing nuts 30, which are disposed in the damping piston 29 and loaded by springs 31, a clearance-free disposition can be realized between the force

transmission rollers 10, 11 and the cam disc 8' and 8'', without using a cam plate assembly.

Such a clearance-free disposition is of great benefit for an optimal hold-open function of such a drive.

List of References

	1	door operator
	2	drive unit
	3	motor
5	4	spring force accumulator
	5	hydraulic pump
	6	pressure compartment (drive unit)
	7	pressure compartment (spring force accumulator)
	8	cam disc
10	8'	cam disc
	8''	cam disc
	9	output shaft
	10	force transmission rollers
	10'	roller
15	10''	roller
	11	force transmission rollers
	11'	roller
	11''	roller
	12	compression spring
20	13	housing
	14	end
	15	housing wall
	16	end
	17	spring tensioning piston
25	18	cam plate assembly
	18'	individual cam plate

	18''	pair of bolts
	18'''	pair of bolts
	19	piston rod
	20	joint
5	20'	separating wall
	21	reception compartment
	22	first hydraulic line
	23	second hydraulic line
	24	slide channel
10	25	sliding member
	26	lever
	27	compensating bore
	28	opening piston
	29	damping piston
15	30	counter nut
	31	clearance compensating spring
	D	diameter
	L	longitudinal axis

Patent claims

1. A door operator (1), in particular a swing door operator,

5 - with a drive unit (2), which can be coupled to a door via an output shaft (9) and is disposed in a housing (13);

- with a motor (3) being in driving connection with the drive unit (2), and

10 - with a spring force accumulator (4), which is disposed in the housing (13) and is coupled to the motor (3) and to the drive unit (2);

characterized in that

15 - a hydraulic pump (5) is provided, which is in driving connection with the motor (3) and is in hydraulic connection with a hydraulic compartment (6) representing a reservoir volume, and with a separate pressure compartment (7), which is associated to the spring force accumulator (4), and

20 - in that the drive unit (2) is formed as a cam drive with a cam plate assembly (18), which, in the area of the largest diameter (D) of a reception compartment (21) of the housing (13)

for the drive unit (2), is disposed around the output shaft (9).

2. A door operator according to claim 1, characterized in that the drive unit (2) is formed as a cam drive, which has a cam disc (8), which is disposed on the output shaft (9), and two force transmission rollers (10, 11), which are disposed on both sides of the output shaft (9) and bear on cam paths of the cam disc (8).
3. A door operator according to claim 1 or 2, characterized in that the spring force accumulator (4) has a compression spring (12), which with one end (14) bears against a housing wall (15) and with the other end (16) against a spring tensioning piston (17).
4. A door operator according to any of the preceding claims 1 to 3, characterized in that the pressure compartment (7), associated to the spring force accumulator (4), is disposed adjacent the spring tensioning piston (17).
5. A door operator according to any of the claims 1 to 4, characterized in that the force transmission rollers (10, 11) are disposed in the cam plate assembly (18), which is connected to the spring tensioning piston (17) via a piston rod (19).

6. A door operator according to claim 5, characterized in that the piston rod (17) extends through a joint (20).
- 5 7. A door operator according to claim 5 or 6, characterized in that the force transmission rollers (10, 11) have individual rollers (10', 10'' or 11', 11''), which are disposed spaced apart in a longitudinal direction (L) of the output shaft (9) and cooperate with associated, spaced apart cam
10 discs (8', 8'') of the cam disc (8).
8. A door operator according to any of the claims 5 to 7, characterized in that the cam plate assembly (18) has an individual cam plate (18').
9. A door operator according to any of the claims 5
15 to 7, characterized in that the cam plate assembly (18) has a pair of bolts (18'', 18''').
10. A door operator according to any of the preceding claims, characterized in that a clearance compensation is provided between the rollers (10,
20 11) and the cam disc (8).
11. A cam plate assembly (18) for a door operator, preferably a swing door operator, characterized by at least one of the characterizing features of the claims 1, 2, 5, 7, 8, 9 or 10.