

**Title:   UV LASER EXPOSURE OF HOUSINGS AND  
COMPONENTS OF DOOR DRIVES AND DOOR  
CLOSERS**

**5   Description**

The present invention relates to a door operator or to a door closer, wherein the door operator or the door closer includes at least one housing, a reception and at least one  
10   piston, which is supported to be movable in said reception.

A door operator is a device for automatically opening and closing a door. The door may be for example a swing leaf door or a sliding door. A door closer, however, is only  
15   utilized for automatically closing a door. In this case, the door operator or the door closer effects in particular the movement of a door leaf into a casing or in relation to a casing. It is known to execute a door operator or a door closer in such a way that a cylindrically shaped reception is  
20   located in a housing of the door operator or of the door closer. A piston is supported to be movable in said reception. In particular in a door closer, the movement of the piston has the effect of tensioning a spring or of charging a corresponding energy-accumulating unit upon  
25   opening the door. If the door in the opened condition is released, the energy stored in the spring or in the energy-accumulating unit is utilized to close the door. Furthermore,

it is known to control and to adjust the closing speed of door closers, additionally likewise the opening speed in a door operator, by means of suitable methods, for example fluid displacement throttled by means of valves.

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The preferably cylindrically-shaped reception in the housing of the door operator or of the door closer positively surrounds the piston, the circumferential surface of the preferably likewise cylindrically-shaped piston is in contact  
10 with the internal circumferential surface of the reception of the housing. Upon actuating the door operator or the door closer, i.e. during an opening process and/or a closing process of the door, and thereby upon moving the piston inside the reception of the housing, the surfaces of the  
15 internal circumferential surface of the reception of the housing and the circumferential surface of the piston slide along each other. The friction produced thereby may generate noises which might be considered as disturbing. Furthermore, abrasion may be produced, which might  
20 negatively affect the functioning of the door operator or of the door closer.

It is the object of the invention to provide a door operator or a door closer of the species described in the introduction,  
25 the structural components thereof, in particular the reception in the housing and the piston being treated in a way that the high wear resistance of the door operator or of

the door closer is increased and in that the abrasion of the door operator or of the door closer during actuation is reduced.

- 5 According to the invention, this problem is solved with a door operator or a door closer having the features of the independent claim 1 of the patent application. Further features and details of the invention are set forth in the dependent claims and the description.

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The problem is solved by means of a door operator or a door closer of the species mentioned in the introduction, wherein the surface of the reception of at least one housing of the door operator or of the door closer and/or the surface  
15 of at least one piston is/are treated by exposure to electromagnetic radiation, in particular in the ultraviolet range. This treatment modifies the surfaces of the reception and/or of the at least one piston in such a way that the high wear resistance is increased and thus the abrasion is  
20 reduced. For example irregularities of the surface of the reception and/or of the at least one piston are smoothed out. Several pistons may be provided for example in a cam door closer.

- 25 In a preferred embodiment of the door operator or of the door closer, the surfaces of the reception and/or of the at least one piston have been exposed to electromagnetic

radiation of a pulsed excimer laser. Excimer lasers produce electromagnetic radiation in the ultraviolet wave range. Molecules, in particular gaseous molecules are utilized as the laser-active medium. In this case, gases such as  
5 hydrogen, argon or xenon for example, or a combination of noble gas halogenides, such as argon fluoride or xenon bromide. Excimer lasers are able to reach repetition rates of several kilohertz with pulse energies of up to over 1000 milli-joules. Thus making the specific treatment of metal  
10 surfaces of the reception and/or of the at least one piston possible.

According to another advantageous embodiment of the invention, the surfaces of the reception and/or of the at  
15 least one piston of the at least one housing of the door operator or of the door closer are treated with electromagnetic radiation having such an energy density in the electromagnetic radiation, that the respective surface will have a modified material structure in a micrometer  
20 range, in particular up to a depth reaching from 0.5 micrometer to 2.5 micrometer, when compared to the rest of the material of the at least one housing and/or of the at least one piston. In this case, said modified material structure has a higher strength and/or a smoother surface  
25 finish than the areas of the door operator or of the door closer which have not been treated with light. By means of applying a high energy density into the metal surfaces of

- the reception and/or of the at least one piston, said surfaces are fused in a micro range. Grooves and channels, which are produced when manufacturing the reception and/or the at least one piston, are thus smoothed
- 5 out when the surface subsequently re-hardens. Furthermore, the crystal structure in the metal is regenerated upon hardening, whereby a higher strength of the surface may be achieved.
- 10 In another preferred embodiment of the inventive door operator or of the inventive door closer, it is provided that the surface of the reception and/or the surface of at least one piston are treated with such an energy density of the electromagnetic radiation that the surfaces, on account of
- 15 plasma formation during the treatment in the micrometer range, in particular up to a depth reaching from 0.5 micrometer to 2.5 micrometer, have a higher nitrogen content than the areas of the door operator or of the door closer which are not treated with light. When treating the
- 20 surfaces of the reception and/or of the at least one piston by exposure with such an energy density, among other things, nitrogen from the ambient air has been ionized and has formed parts of the plasma. Upon cooling of the plasma and thus the accompanying recombination,
- 25 nitrogen atoms have been introduced into the crystal lattice of the metal, of which the at least one housing and the at least one piston consist. The treated surfaces thus have a

higher nitrogen content than the non-light treated areas of the door operator or of the door closer. A higher nitrogen content results in a higher strength of the surfaces of the reception and/or of the at least one piston, whereby wear  
5 and abrasion during operation of the inventive door operator or of the inventive door closer are lowered.

Furthermore, the surfaces of the reception and/or of the surface of at least one piston of the inventive door operator  
10 or of the inventive door closer may be treated with such an energy density of the electromagnetic radiation that the surfaces, on account of plasma formation during the treatment in the micrometer range, in particular up to a depth reaching from 0.5 micrometer to 2.5 micrometer,  
15 may have a lower graphite content than the areas of the door operator or of the door closer which are not treated with light. Structural components of a door operator or of a door closer, in particular the at least one housing and the at least one piston, are preferably manufactured from casting  
20 materials, which are produced in particular in a grey cast iron casting method. In this case, carbon in the shape of graphite is added to the iron. Thereby, the cast iron becomes very hard and is therefore very well suited as a material for door operators or for door closers. Graphite is  
25 present in the material as graphite particles. Said particles are considerably softer than the surrounding iron. Upon actuating the door operator or the door closer and the

thereto related friction between the reception and/or the at least one piston, abrasion is generated which consists mostly of graphite. By the treatment with electromagnetic radiation at a high energy density, the graphite particles  
5 exposed at the surfaces of the reception and/or of the at least one piston are heated and evaporate in the following. Therefore, after the treatment, the graphite particle content in the light-treated areas of the door operator or of the door closer is lower than before the treatment. Thus, during  
10 operation of the door operator or of the door closer, abrasion, in particular graphite containing abrasion can be avoided.

Further advantages, features and details of the invention  
15 will result from the following description, in which exemplary embodiments of the invention are described in detail, reference being made to the drawings. In this context, the features mentioned in the claims and in the description, individually or randomly combined may be  
20 essential to the invention.

The annexed Figures and the description of the Figures are intended for a better understanding of the inventive door operator or of the inventive door closer. Items or parts of  
25 items, which are essentially the same or are similar, are identified by the same reference numerals. The Figures are

just diagrammatic illustrations of possible embodiments of the invention, in which

5                   Figure 1:       shows a perspective view of an inventive door closer,

                  Figure 2:       shows a perspective sectional view of a housing of the inventive door closer according to Figure 1,

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                  Figure 3:       shows a perspective view of a piston of the inventive door closer according to Figure 1.

15                   A diagrammatic perspective view of an embodiment of an inventive door closer 1 is shown in Figure 1. In this case, the mechanical components of the door closer 1 are surrounded by a housing 2. The inside of the housing 2 is accessible through a screwable terminal plate 4. Inside the door closer 1, the mechanical components are actuated by  
20                   means of a shaft 3. A (non-visible) piston 7 is retained in a movable manner in a reception 5 of the housing 2 and is driven via the shaft 3. On account of the inventive treatment of the surfaces 6, 8 of the reception 5 respectively of the piston 7, the friction between these  
25                   structural components of the door closer 1 is reduced. The high wear resistance and the life span of the door closer 1 can be thus increased.

Figure 2 shows a diagrammatic perspective sectional view of the housing 2 of the inventive door closer 1 according to Figure 1. Other structural components are not illustrated. The internal circumferential surface 6 of the reception 5 is  
5 clearly visible. The inventive treatment of the surface 6 allows for reducing the friction when operating the door closer 1.

Figure 3 shows a diagrammatic perspective view of the  
10 piston 7 of the inventive door closer 1. The toothed rack 9 meshes with a correspondingly configured part of the shaft 3 (not shown) and effects a movement of the piston 7 in the reception 5 of the housing 2. In this case, the circumferential surface 8 of the piston 7 bears against the  
15 internal circumferential surface 6 of the reception 5 of the housing 2. On account of the inventive treatment of the surfaces 6, 8 with intensive laser light, for example in the ultraviolet range, the surfaces are hardened, smoothed out and graphite particles have been eliminated. Therefore, a  
20 door closer 1, and likewise an analogously configured door operator, with such treated structural components has less wear, lower noise development and a longer life span.

The elements illustrated in Figures 1 to 3 may illustrate a  
25 door operator as well. The described advantages are the same as those of the described door closer.

### List of reference numerals

|    |   |                                                   |
|----|---|---------------------------------------------------|
|    | 1 | door operator or door closer                      |
|    | 2 | housing                                           |
| 5  | 3 | shaft                                             |
|    | 4 | terminal plate                                    |
|    | 5 | reception in the housing                          |
|    | 6 | internal circumferential surface of the reception |
|    | 7 | piston                                            |
| 10 | 8 | circumferential surface of the piston             |
|    | 9 | toothed rack                                      |

## Patent claims

1. A door operator or a door closer (1) having at least one housing (2) and at least one piston (7) which is supported to be movable in a reception (5) of the at least one housing (2), **characterized in that** the surface (6) of the reception (5) and/or the surface (8) of the at least one piston (7) has/have been treated by exposure to electromagnetic radiation.  
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2. The door operator or the door closer (1) according to claim 1, **characterized in that** the electromagnetic radiation to which the surface(s) (6, 8) has/have been exposed consists of the light of a pulsed excimer laser.  
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3. The door operator or the door closer (1) according to claim 1 or 2, **characterized in that** the surface (6) of the reception (5) and/or the surface (8) of the at least one piston (7) are treated with electromagnetic radiation having such an energy density that the surface(s) (6, 8) of the reception (5) and/or of the at least one piston (7) have a modified material structure in the micrometer range, in particular up to a depth reaching from 0.5  $\mu\text{m}$  to 2.5  $\mu\text{m}$  compared to the rest of the  
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5 material of the housing (2) and/or of the at least one piston (7), wherein the modified material structure has a higher strength and/or a smoother surface finish than the areas of the door operator or of the door closer (1) which have not been treated with light.

10 4. The door operator or the door closer (1) according to one of the claims 1 to 3, **characterized in that** the surface (6) of the reception (5) and/or the surface (8) of the at least one piston (7) have been treated with electromagnetic radiation of such an energy density that the surfaces, on account of plasma development during the light treatment, in the micrometer range, in particular up to a depth reaching from 0.5  $\mu\text{m}$  to 2.5  $\mu\text{m}$  present a higher nitrogen content than the areas of the door operator or of the door closer (1) which have not been treated with light.

20 5. The door operator or the door closer (1) according to one of the claims 1 to 4, **characterized in that** the surface (6) of the reception (5) and/or the surface (8) of the at least one piston (7) have been treated with electromagnetic radiation of such an energy density that the surfaces, on account of plasma development during the light

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treatment, in the micrometer range, in particular up to a depth reaching from 0.5  $\mu\text{m}$  to 2.5  $\mu\text{m}$  present a lower graphite particle content than the areas of the door operator or of the door closer (1) which have not been treated with light.