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(71) Applicant: **Alphatronics NV**
9160 Lokeren (BE)

(72) Inventors:
- **MALFAIT, Lieven**
  9160 LOKEREN (BE)
- **MALFAIT, Geert**
  9160 LOKEREN (BE)
- **VANVOOREN, Luc**
  9160 LOKEREN (BE)

(74) Representative: **Chielens, Kristof et al**
KOB nv
Patents
President Kennedypark 31c
8500 Kortrijk (BE)

(54) AUTOMATED HINGE DRIVE FOR ROTATING AND FOLDING GATES

(57) The present invention relates to a folding or rotating gate (1) with two or more gate wings (1), comprising:
- a post (2);
- a first gate wing (3) which is hingeably connected to the post (2);
- a second gate wing (4) which is hingeably connected to the first gate wing (3);
- drive means configured to fold the first (3) and second gate wing (4) open or shut, wherein the drive means comprise a first drivable hinge (5) configured to drive the first gate wing (3) and a second drivable hinge (6) configured to drive the second gate wing (4).

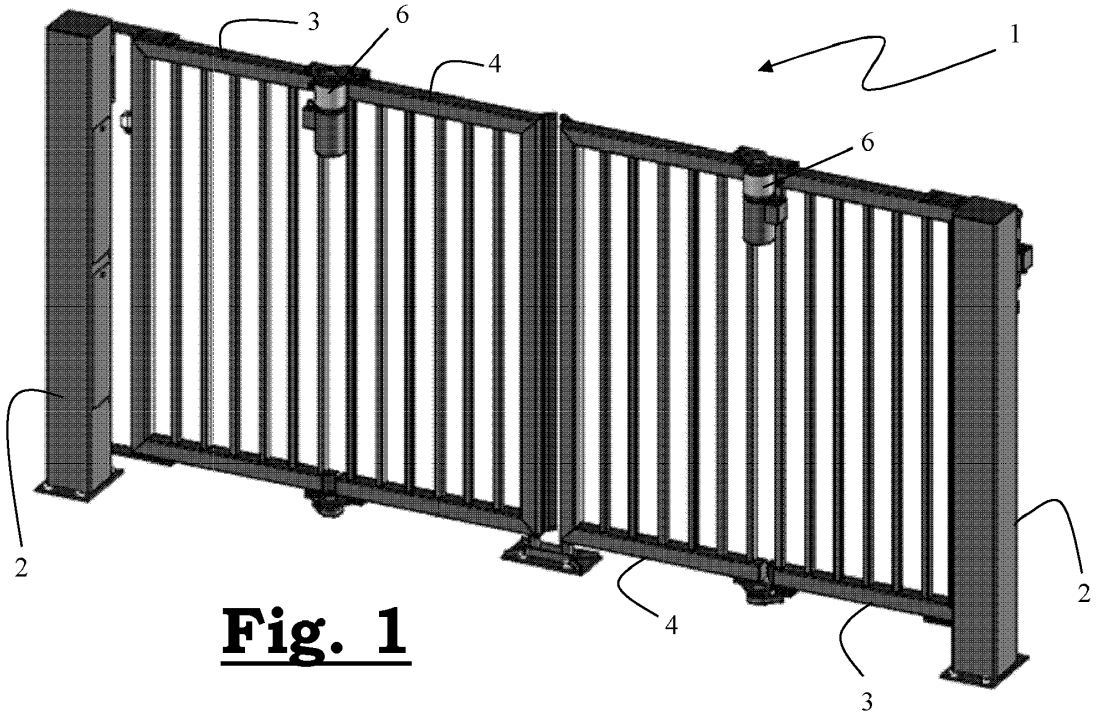


Fig. 1

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Description

[0001] The present invention relates to a folding or rotating gate with two or more gate wings comprising: a post, a first gate wing which is hingeably connected to the post, a second gate wing which is hingeably connected to the first gate wing and drive means configured to fold the first and second gates wing open or shut, wherein the drive means comprise a first drivable hinge configured to drive the first gate wing and a second drivable hinge configured to drive the second gate wing. The present invention relates in particular to an automated rotating or folding gate which opens and closes quickly.

[0002] In order to close off a site or for access control of vehicles, the installation of a rotating or folding gate which opens or closes in a few seconds is often opted for, thus offering a considerably higher level of protection compared to standard automatic gates or doors. Such rotating or folding gates are also seen as a high-quality alternative for barriers and have the additional advantage that they also impede the free passage of pedestrians and two-wheelers.

[0003] Usually, such rotating or folding gates are opened and closed by installing an electrical, pneumatic or hydraulic drive means on the post for driving the first gate wing. The second gate wing is driven mechanically by means of rods, gear racks or drive belts which are attached to the first gate wing. In this way, only at most two gate wings may be driven and the second gate wing cannot be driven autonomously. In addition, the transmission mechanism requires considerable maintenance, due to the large number of mechanical components. There is also a system in which the mechanical drive is fitted in either the upper or lower housing of the rotating or folding gate, in practice often also referred to as speed gate or bi-folding gate.

[0004] European patent EP 1 595 050 B1 describes a number of embodiments of folding gates. The folding gates described comprise: a post, a first gate wing which is hingeably connected to the post, a second gate wing which is hingeably connected (mechanically coupled) to the first gate wing, drive means configured to drive the first gate wing and a transmission mechanism configured to transfer the movement of the first gate wing onto the second wing, so that the first and second gate wing simultaneously are folded open or shut. Since, with these kinds of folding gates, the second gate wing is actuated by the first gate wing, at most two successive gate wings may be automated.

[0005] With the present gates, the forces which are required to make the second gate wing move are very large, since the angle with respect to the transmission mechanism and the gate is very small. As a result thereof, large forces are exerted on the driving wing (first gate wing) and the driven wing (second gate wing), leading to quicker wear and metal fatigue.

[0006] Netherlands patent NL 1032983 describes a folding gate comprising a first gate segment which is hingeably connected to a post, a second gate segment which is hingeably connected to the first gate segment. In order to allow the first and second gate segment to hinge, the folding gate comprises first and second drive means, respectively, in the form of a first and second drum motor. The folding gate is furthermore provided with safety means, such as photosensors and/or contact sensors.

[0007] The object of the present invention now is to provide an alternative automated rotating or folding gate which is opened in a different way to the prior-art gates.

[0008] The object of the invention is achieved by providing a rotating or folding gate, comprising:

- a post;
- a first gate wing which is hingeably connected to the post;
- a second gate wing which is hingeably connected to the first gate wing;
- drive means configured to fold the first and second gate wing open or shut, wherein the drive means comprise a first drivable hinge which is configured to drive the first gate wing and a second drivable hinge which is configured to drive the second gate wing, and wherein the drive means furthermore comprise a first positioning sensor (angle sensor, encoder) which is configured to determine the position of the first gate wing with respect to the post, and a second positioning sensor (angle sensor, encoder) which is configured to determine the position of the second gate wing with respect to the first gate wing in order to fold the first and second gate wing open or shut synchronously in a controlled manner.

[0009] The driven hinges cause the first and the subsequent gate wings to fold open or shut and, in a preferred embodiment, each have a motor driver and positioning sensors, preferably encoders, which offer the possibility of driving the gate wings independently from each other, irrespective of torque, speed and rotation angle. This means that one wing may be opened to allow access to pedestrians or two-wheelers. By means of the software, the gate wings may be fully synchronized with one another. Such a rotating or folding gate may, in addition, be opened and closed in one smooth movement.

[0010] In a preferred embodiment of the rotating or folding gate according to the invention, the first and second hinges each comprise a motor and a reduction gearbox, a so-called motor/reductor assembly. The reduction gearbox or gearbox reduces the rotation speed of the motor to the desired number of revolutions per minute and will consequently increase the torque. The reduction gearbox in the gate according the present invention is preferably of narrow design, with a diameter = 140mm. In particular, the reduction gearbox has a torque of at least 800 Nm. More particularly, the torque is 800 Nm. In order to generate the high torque using a narrow embodiment, a special reduction gearbox was developed,

namely a derivative of a cycloid transmission. The high torque is required to move the weight of the gate wing, taking into account the wind load, and also to protect against the manual application of a load on the rotating or folding gate in the open or closed position (vandalism-proof).

[0011] When a gate opens and closes at great speed, there is a risk - particularly when the movement starts and when the movement stops - that the gate wings will start to wobble due to the mass of the gate. When the gate wings start to wobble, it becomes difficult to determine their exact position, so that it is no longer possible to fold the first and second gate wing open or shut synchronously in a controlled manner. In order to prevent this, the first and second positioning sensor, in a more advantageous embodiment of the rotating or folding gate according to the invention, are provided in a separate housing, each of which is attached to the gate in such a way that the first and second positioning sensor are situated axially with respect to the motor and reduction gearbox (motor/reductor) of respectively the first and second hinge. Said housings are preferably fitted to a hinge plate on the bottom side of the gate. By fitting the positioning sensors to the gate in this way, it is always possible to detect the exact position of the gate wings. Preferably, each housing comprises a damper and stabilizer body. The damper and stabilizer body will prevent the gate wings from wobbling and help to detect the exact position of the gate wings.

[0012] Furthermore, it is possible to fit a gate with more than two connected successive gate wings, preferably three or four. Thus, in an embodiment comprising several gate wings, the gate comprises a driven hinge which may be synchronized with the other gate wings (see robot arm) for each gate wing. In a rotating or folding gate comprising several gate wings, said hinges are electrically, pneumatically or hydraulically drivable.

If the rotating or folding gate comprises a third gate wing which is connected to the second gate wing, the drive means obviously comprise a third positioning sensor which is configured to determine the position of the third gate wing with respect to the second gate wing.

[0013] According to a particular embodiment of the rotating or folding gate according to the invention, the folding gate comprises a processing unit which is configured to drive the first and second hinge on the basis of the signals of the first and second positioning sensors, so that the first and second gate wing are folded open or shut synchronously in a controlled manner. The processing unit is preferably provided in the post.

[0014] The positioning sensors used are preferably Hall sensors. Such Hall sensors are able to measure the position of the gate wing to an accuracy of 0.05° at any moment. Using the measured position, the motor may be adjusted by means of software in order to allow the gate to open safely and quickly.

[0015] In a particular embodiment of the rotating or folding gate according to the invention, said driven hinges comprise a slip ring for transmitting the electrical and/or data signals from one hinge to the other. The electrical signals and data signals may be used to drive the hinges or to transmit data to the processing unit, respectively. By using slip rings, there is no need to install any visible cables.

[0016] In order to equip the rotating or folding gate in accordance with the standards, one of more photocell sensors may be provided. The photocell sensors contribute to the safety of people and vehicles. When the photocell sensors detect an obstacle in close vicinity of the gate, a signal may be sent to the motor driver which can then decide to close or not to close the gate. In addition, the legally required safety strips may also be provided in each gate wing and be incorporated in the safety system. Other detection means, such as for example: vehicle loops installed in the ground, photocells, radar systems, etc. may furthermore be added to the rotating or folding gate according to the invention.

[0017] The present invention will now be explained in more detail by means of the following detailed description of possible embodiments of the rotating or folding gate. The sole aim of this description is to give an illustrative example and can therefore by no means be interpreted as a limitation of the area of application of the invention or of the patent rights defined in the claims.

[0018] In this description, reference numerals are used to refer to the attached figures, in which:

- ***Fig. 1*** *shows a perspective view of a folding gate according to the invention in the closed position;*
- ***Fig. 2*** *shows a view of a folding gate according to the invention in an open position;*
- ***Fig. 3*** *shows a top view of the folding gate according to the invention during opening or closing of the gate;*
- ***Fig. 4*** *shows a front view of the folding gate illustrated in Fig. 1;*
- ***Fig. 5*** *shows a top view of the folding gate according to the invention shown in Fig. 4;*
- ***Fig. 6*** *shows a top view of the folding gate illustrated in Fig. 2;*
- ***Fig. 7*** *shows a part of the gate, in particular the post and a part of the first gate wing;*
- ***Fig. 8*** *show a cross section along line C-C;*
- ***Fig. 9*** *shows a detail view of the area A circled in Fig. 8;*
- ***Fig. 10*** *shows a detail view of the area B circled in Fig. 8.*

[0019] The folding or rotating gate (1) illustrated in the figures comprises two spaced-apart posts (2), wherein each post (2) is connected to a first gate wing (3) by means of (bottom and top) hinge plates (11). The first gate wing (3) is furthermore (hingedly) connected to a second gate wing (4) by means of hinge plates (11). Each gate wing (3, 4) can pivot about a hinge pin which extends vertically. The entire gate (1) can swing open or shut and can thus be moved from an open position, as illustrated

in Fig. 2, to a closed position, as is illustrated, inter alia, in Figs. 1 and 4. In the illustrated embodiment, the first gate wing can swing through 90° and the second gate wing can swing through 180°.

[0020] The posts (2) are fixable to a permanent structure, such as the ground or a wall. Every post (2) is configured as a hollow metal or aluminium column. A gate wing (3, 4) may be composed of one or more panel-shaped elements which are attached to a support structure or may be composed of a hollow upper and lower girder, between which a number of (hollow) gate pillars are provided, as is illustrated in the attached figures. Preferably, the gate (1) is made from metal or aluminium.

[0021] In order to automatically open or close the gate (1), the rotating or folding gate (1) also comprises drive means which are configured for, preferably simultaneously, folding the first (3) and second (4) gate wing open or shut. The drive means are fitted in such a manner they can open and close the gate quickly, preferably at a speed of 1 m/sec. To this end, the drive means inter alia comprise a first electrically driven hinge (5) which is configured to drive the first gate wing (3), and a second electrically driven hinge (6) which is configured to drive the second gate wing (4). Instead of electrically drivable hinges, it is also possible to use pneumatic or hydraulic hinges or a combination of the aforementioned.

[0022] Every hinge (5, 6) comprises a motor (7) (actuator) and a cycloid reduction gearbox (8) with a high torque, namely 800 Nm. Between the motor (7) and the reduction gearbox (8), there is a motor flange (15). The hinges (5, 6) used according to the invention are compact and comprise slip rings for transmitting electrical signals (power for the motors) and data signals (for safety and positioning sensors). By using slip rings, there is no longer any need to fit visible cables.

[0023] The drive means furthermore comprise a first positioning sensor (9), preferably an encoder which is configured to determine the position of the first gate wing (3) with respect to the post (2), and a second positioning sensor, preferably an encoder, which is configured to determine the position of the second gate wing (4) with respect to the first gate wing (3). In case the rotating or folding gate (1) comprises a third gate wing connected to the second gate wing, the drive means obviously comprise a third positioning sensor, preferably an encoder, which is configured to determine the position of the third gate wing with respect to the second gate wing (4).

[0024] The positioning sensors may be provided in the housing of the hinge, but may, in an alternative embodiment, be provided in a separate housing (10) at the bottom of the gate wing in the axis of the motor reductor, as is illustrated in Fig. 10. The positioning sensor is always situated in line with the hinge pin of the motor reductor. The positioning sensor is preferably a Hall sensor which employs a magnet. The magnet (N/S) rotates about the axis of the driven hinge and it is the position of the magnet which is accurately measured by the positioning sensor. The positioning sensor is also positioned in the axis of the driven hinge.

[0025] Due to the mass of the gate wings, the speed of opening and closing and the fact that there is certain amount of play between the teeth of the gear wheel(s) in the reduction gearbox, the gate wings (3, 4) may start to wobble when the movement starts and when the movement stops. The wobbling of the gate has an adverse effect with regard to correctly detecting the exact position of the gate wings. In order to prevent this, a damper and stabilizer body (16) is also provided in the housing (10) in which the positioning sensor is accommodated, as is illustrated in Fig. 10. The damper and stabilizer body (16) will prevent the gate wings from wobbling. Such an embodiment in which the housing (10) provided with the respective positioning sensor (9) (first, second, ..), a damper and stabilizer body (16), is placed axially with respect to the motor (7) and reduction gearbox (8) of the hinge cooperating therewith, offers the considerable advantage that the position of the gate wings (3; 4) may be detected (determined) exactly at any point in time during opening or closing of the gate, as a result of which the gate will open and close in a perfectly synchronous manner.

[0026] The first driven hinge (5) is configured to be fitted to or, as is illustrated in Fig. 7, in the post (2). The second driven hinge (6) is configured to be fitted between the first (3) and second gate wing (4).

The first hinge (5) also comprises an engagement unit (clutch disc) (12) which, on the one hand, engages with the reduction gearbox and, on the other hand, engages with the (top) hinge plate (11) of the first gate (driving) wing (3), in such a way that the motor (7) driving the hinge (5) results in rotation of the hinge and the first gate wing (3). Rotation will take place about the bottom and top hinge point, denoted by reference numerals 13 and 14 in Figs. 9 and 10. The second hinge (6) also comprises an engagement unit which engages, on the one hand, with the reduction gearbox of the second hinge and engages, on the other hand, with the hinge plates of the second gate wing (the follower wing), in such a way that the motor driving the hinge results in rotation of the follower wing.

[0027] The folding gate (1) is furthermore equipped with a processing unit which is configured to drive the first (5) and second hinge (6) on the basis of the signals from the first (9) and second positioning sensors, so that the first (3) and second gate wing (4) fold open or shut in a controlled manner. All motors are thus completely synchronized. In practice, the processing unit is provided in the post and is thus protected. The processing unit has a memory, electrical circuits and is ready for Industry 4.0.

[0028] In order to detect obstacles which are situated, for example, in the area of movement of the gate (1), the folding gate (1) may additionally be equipped with photocell sensors and safety strips or other detection means. In case of emergency, for example a power failure, it is possible to provide access, at the bottom of the motor, by means of a key in order to operate the gate manually.

Claims

1. Folding or rotating gate (1) with two of more gate wings (1) comprising:

   - a post (2);
   - a first gate wing (3) which is hingeably connected to the post (2);
   - a second gate wing (4) which is hingeably connected to the first gate wing (3);
   - drive means configured to fold the first (3) and second gate wing (4) open or shut, wherein the drive means comprise a first drivable hinge (5) configured to drive the first gate wing (3) and a second drivable hinge (6) configured to drive the second gate wing (4),

   characterized in that the drive means furthermore comprise a first positioning sensor (9) which is configured to determine the position of the first gate wing (3) with respect to the post (2), and a second positioning sensor which is configured to determine the position of the second gate wing (4) with respect to the first gate wing (3) in order to fold the first (3) and second gate wing (4) open or shut synchronously in a controlled manner.

2. Folding or rotating gate (1) according to Claim 1, **characterized in that** the first (5) and second (6) hinge each comprise a motor (7) and a reduction gearbox (8) to drive the hinge.

3. Folding or rotating gate (1) according to Claim 2, **characterized in that** the reduction gearbox (8) has a torque of at least 800 Nm.

4. Folding or rotating gate (1) according to Claim 2 or 3, **characterized in that** the first and second positioning sensor are provided in a separate housing (10) each of which is attached to the gate (1) in such a way that the first and second positioning sensor are situated axially with respect to the motor (7) and reduction gearbox (8) of respectively the first (5) and second (6) hinge.

5. Folding or rotating gate (1) according to Claim 4, **characterized in that** each housing furthermore comprises a damper and stabilizer body (16).

6. Folding or rotating gate (1), **characterized in that** said hinges (5, 6) are electrically, pneumatically or hydraulically drivable.

7. Folding or rotating gate (1) according to one of the preceding claims, **characterized in that** the first (3) and second (4) gate wing are drivable independently from each other.

8. Folding or rotating gate (1) according to one of the preceding claims, **characterized in that** the first and second positioning sensors are Hall sensors.

9. Folding or rotating gate (1) according to one of the preceding claims, **characterized in that** the folding or rotating gate (1) comprises a processing unit which is configured to drive the first (5) and second (6) hinge on the basis of the signals of the first and second positioning sensors, so that the first (3) and second (4) gate wings are folded open or shut synchronously in a controlled manner.

10. Folding or rotating gate (1) according to Claim 9, **characterized in that** the processing unit is provided in the post (2).

11. Folding or rotating gate (1) according to one of the preceding claims, **characterized in that** said hinges (5, 6) comprise a slip ring for transmitting the electrical and/or data signals from one hinge to the other.

12. Folding or rotating gate (1) according to one of the preceding claims, **characterized in that** the folding or rotating gate (1) comprises one or more photocell sensors and/or safety strips.

13. Folding or rotating gate (1) according to one of the preceding claims, **characterized in that** the gate (1) comprises a third gate wing which is hingeably connected to the second gate wing (4), and **in that** the drive means comprise a third electrical drivable hinge configured to drive the third gate wing.

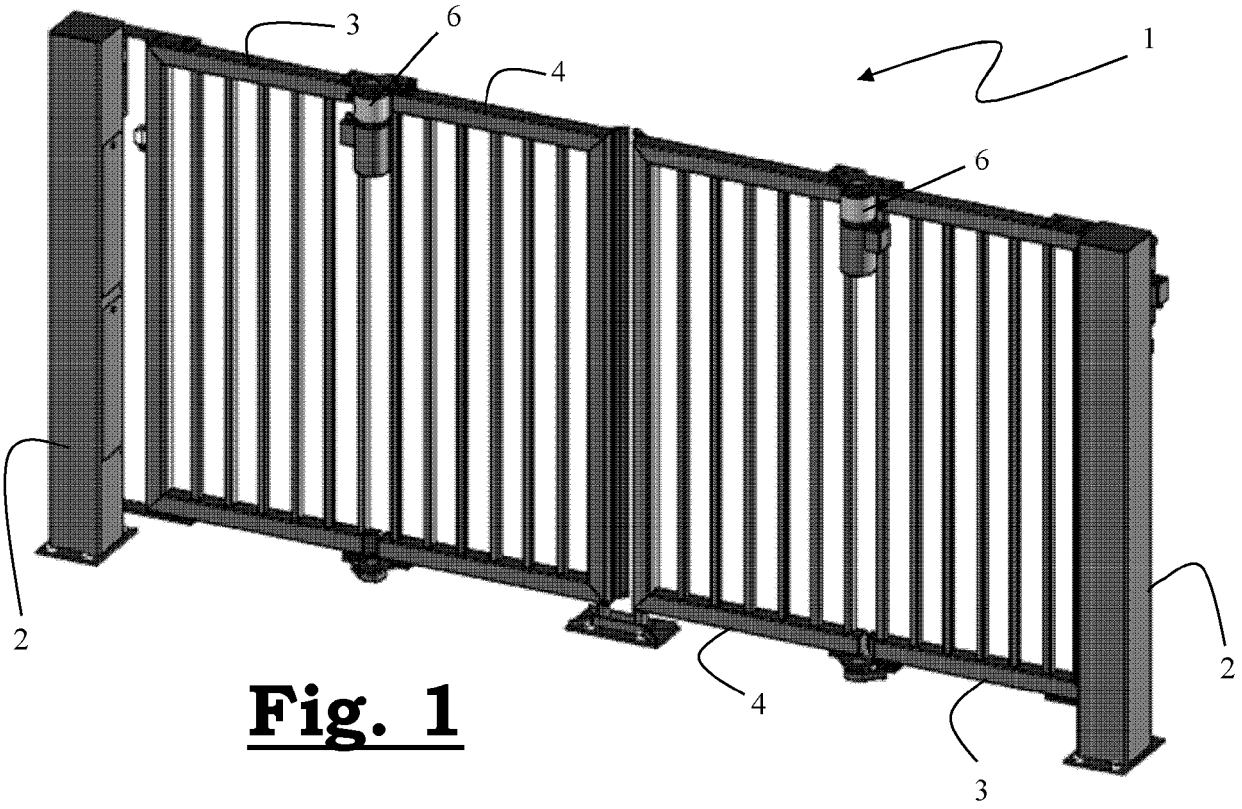


Fig. 1

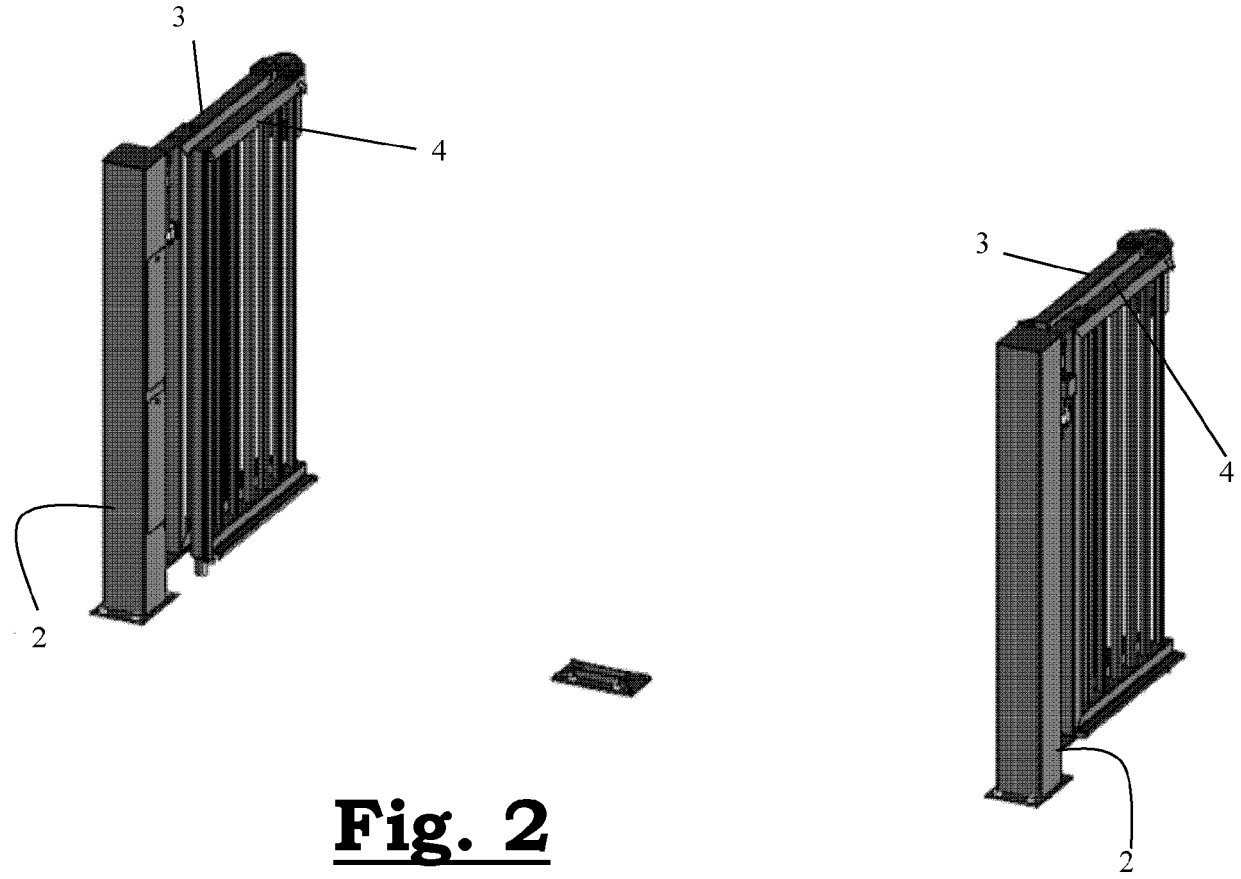


Fig. 2

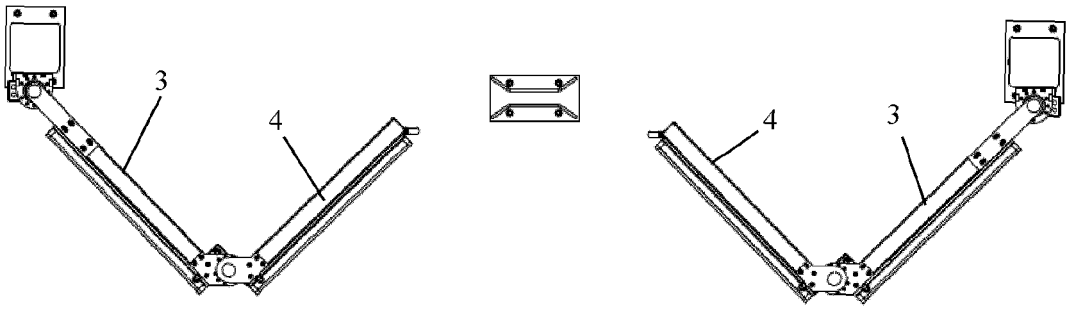


Fig. 3

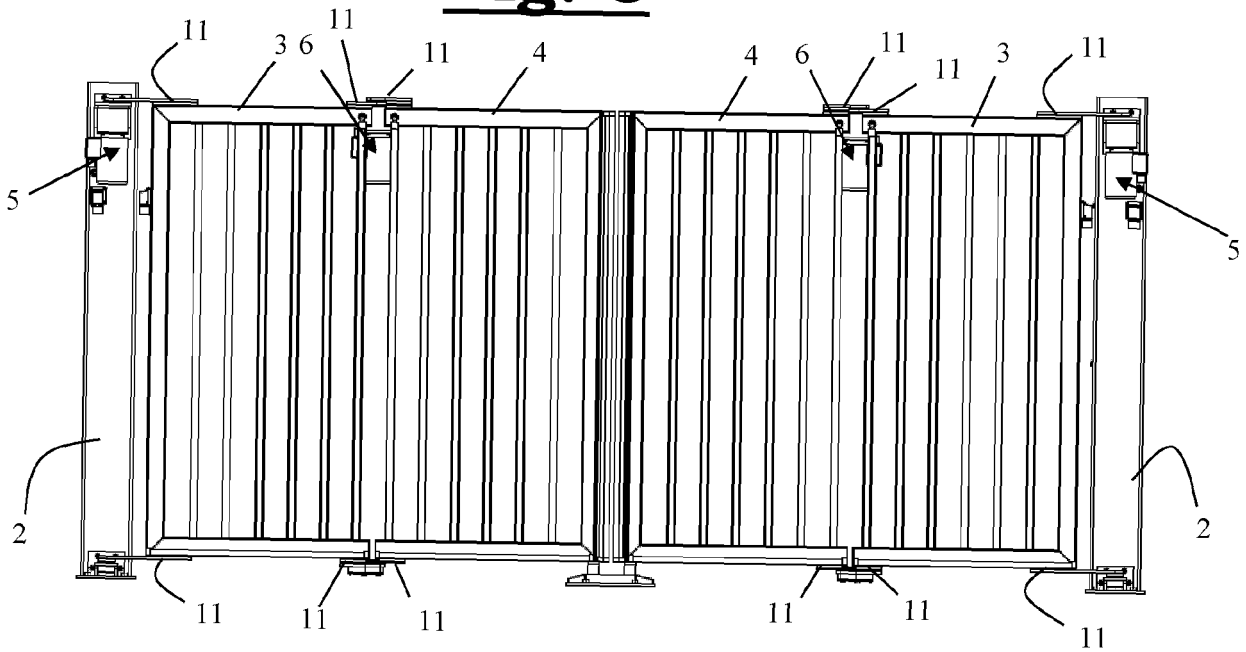


Fig. 4

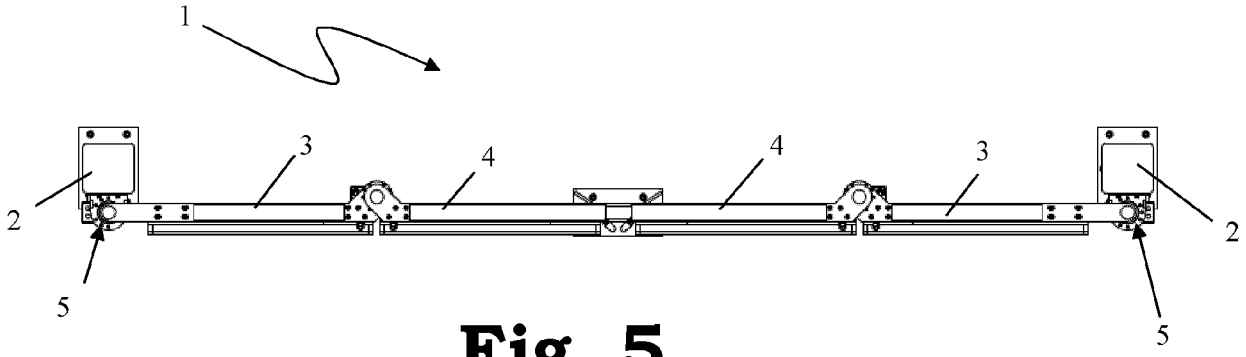


Fig. 5

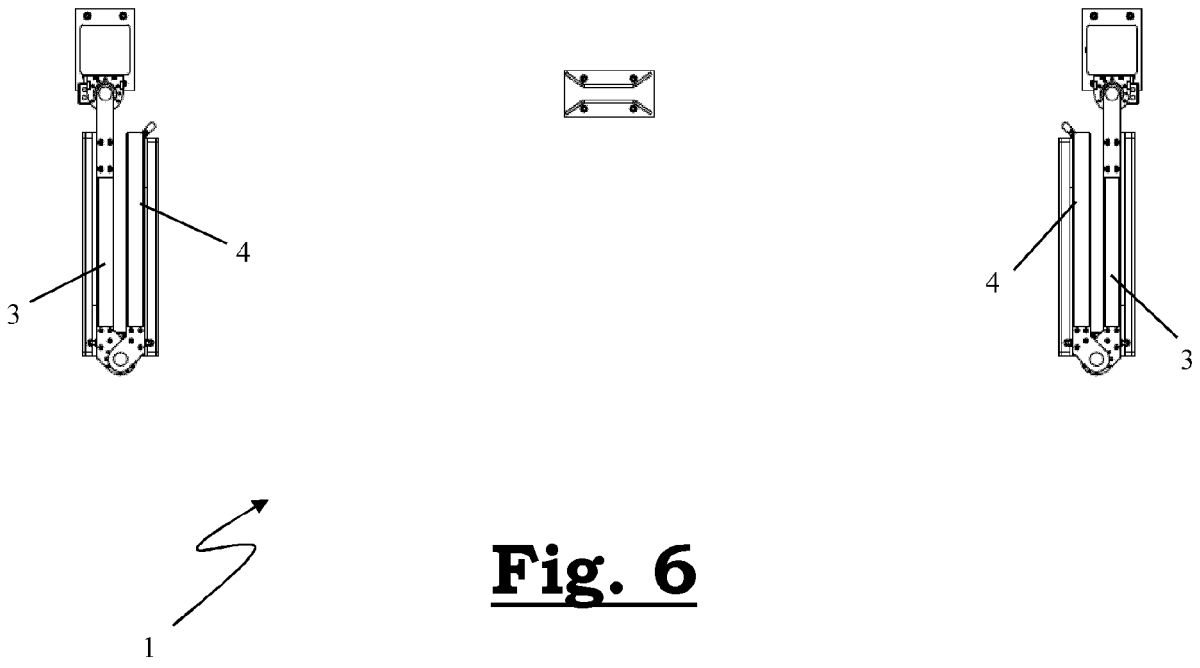


Fig. 6

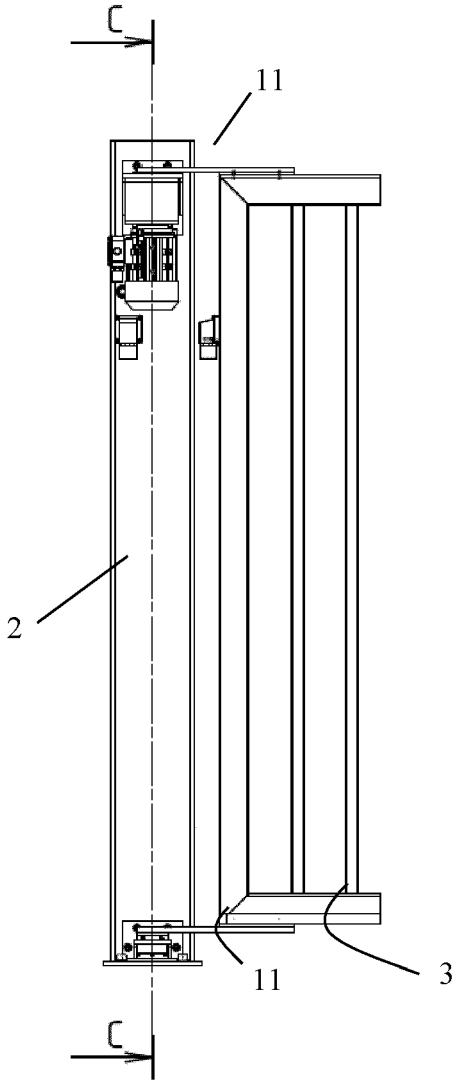


Fig. 7

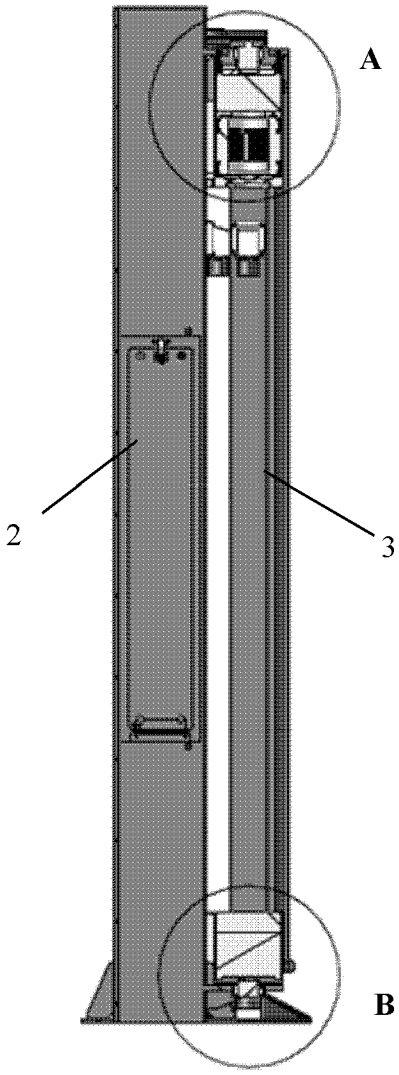


Fig. 8

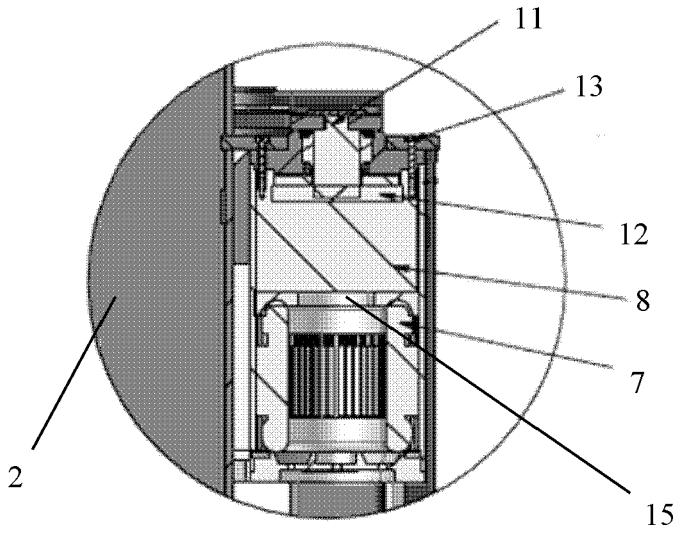


Fig. 9

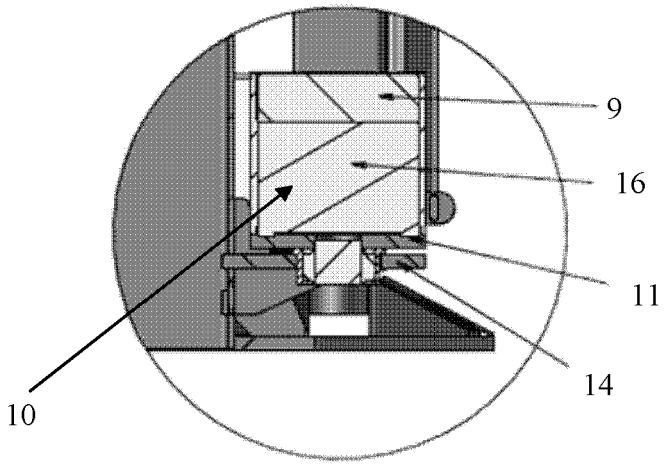


Fig. 10

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EUROPEAN SEARCH REPORT

Application Number
EP 20 16 9894

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	NL 1 032 983 C2 (ACCESS SOLUTIONS B V [NL]) 3 June 2008 (2008-06-03) * page 4, line 19 - page 5, line 13; claims 1,4,11; figures 1-2C * * page 6, line 1 - page 7, line 3 * * page 9, line 5 - line 30 *	1-13	INV. E05F15/605
X	WO 2009/117692 A2 (STRATTEC POWER ACCESS LLC [US]; WILCOX DAVID P [US] ET AL.) 24 September 2009 (2009-09-24) * paragraph [0025] - paragraph [0033]; figures 1-3 *	1-13	
A	US 4 429 264 A (RICHMOND MOSCOW K [US]) 31 January 1984 (1984-01-31) * column 4, line 44 - column 5, line 8; figures 1,2 *	1-13	
			TECHNICAL FIELDS SEARCHED (IPC)
			E05F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	31 August 2020	Berote, Marc

CATEGORY OF CITED DOCUMENTS

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31-08-2020

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
NL 1032983 C2	03-06-2008	NONE	
WO 2009117692 A2	24-09-2009	NONE	
US 4429264 A	31-01-1984	NONE	

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

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Patent documents cited in the description

- EP 1595050 B1 **[0004]**
- NL 1032983 **[0006]**