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(54) ADJUSTMENT DEVICE FOR A MECHANICAL DOOR CLOSER, DOOR CLOSER, SECURITY DOOR OR SAFETY DOOR, FACILITY, AND METHOD FOR OPERATING A DOOR CLOSER

(57) An adjustment device (1) for a mechanical, non-motorized door closer (3) with at least one mechanical adjustment interface (31) configured to modify the closing kinematics of the door closer such as closing velocity and/or closing force, comprises at least one kinematics sensor (15) configured for monitoring at least one kinematic parameter of the door and/or door closer; at least one electromotor (13) with a coupling means (11) configured for engaging the adjustment interface (31); control electronics (17) operatively coupled with the at least one kinematics sensor (15) and configured to emit at least one status signal and/or control signal dependent on the monitored at least one kinematic parameter; and at least one cover (19) configured to at least partially surround the electromotor (13), control electronics (17) and the door closer (3), in particular the adjustment interface (31).

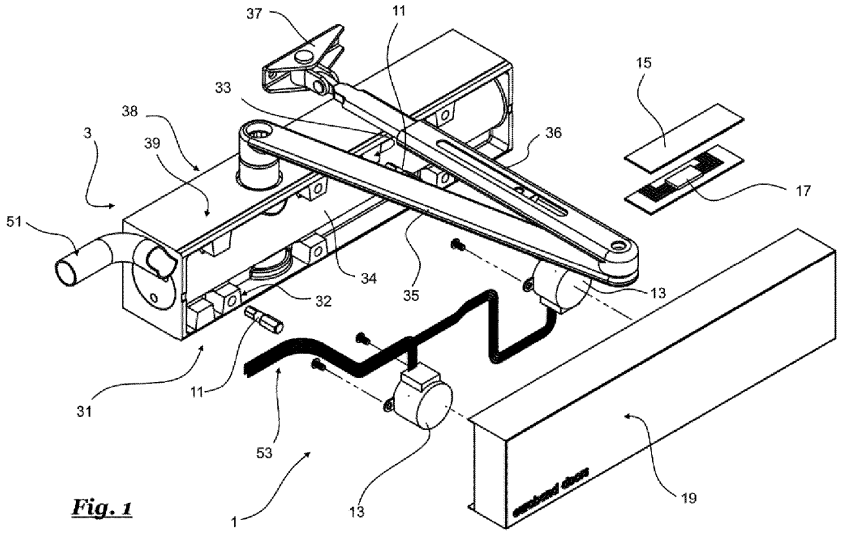

Fig. 1

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Description

[0001] The invention relates to an adjustment device for a mechanical, in particular non-motorized, door closer. Furthermore, the invention relates to a door closer which comprises an adjustment device. The invention also relates to a door, in particular a security door or a safety door, with a door closer and to an in particular secure facility comprising such doors. The invention also relates to a method for operating a door closer.

[0002] Secure facilities such as office buildings in which sensitive information is processed, banks, or data centers are commonly equipped with a multitude of security doors in order to ascertain that only specifically authorized personnel has physical access to otherwise prohibited areas. Maintenance services are required for these security doors at regular intervals. Common door systems and their door closers have casings in which their operators are encased. The casing must be opened and the operating parameters must be set by pushing buttons, potentiometers, dip switches or various hardware devices of the respective adjustment interface. This requires the installer to manually access the door system operator or the door closer, typically on a ladder, to open the casing and to manually set the operating parameters for each door at the respective adjustment interface. For many secure facilities which have dozens or even hundreds of security doors, maintenance through contractors is a time-consuming and costly event, as the maintenance work has to be aligned with the security protocols in place at the secure facility.

[0003] Security doors are generally equipped with a door closer. The door closer is provided and configured such that the security door automatically and reliably closes after having been opened to allow access for an authorized person. The door closer defines the speed and force with which the security door closes. Door closers which are not adequately tuned are a major cause for security door malfunctioning. It is not unusual that door closers and consequently doors function poorly due to poor maintenance or a lack thereof. If a malfunctioning door closer does not close a security door within a predetermined, short amount of time, or if the malfunctioning door closer fails to completely close the security door so that latches are unable able engage their respective receptions, a security alert is triggered. In accordance with the security protocols of the secure facility, the processing of a security alert due to a faulty security door may cause significant administrative workload, leading to additional expenses. False alerts are also problematic in that they desensitize security personnel with regard to actual threats to the integrity of the secure facility.

[0004] Many facilities are equipped with safety doors which allow emergency egress for example in case of a fire, but which shall close to serve as a fire barrier. Such safety doors, which are sometimes referred to as fire doors, include a door closer. The fire doors including the door closers are inspected at regular intervals. In spite of regular inspection and maintenance, which is typically conducted annually, there remains a risk of failure in the meantime.

[0005] WO 2021/061727 A1 describes a complex door system with a motor assembly for rotating an output shaft to drive the linkage assembly to open and/or close a door or to assist in the opening and/or closing of the door. The system may also comprise a door closer assembly including a spring system, hydraulic system, or pneumatic system for returning the door to the closed position after it has been opened. The door system may further comprise sensors for data collection. A user may be able to access the door system through a control located on the door system or through a remote access, to run diagnostics, troubleshoot a door system issue, perform a security review, or send or receive requests, such as a request for replacement or maintenance. The door system may communicate through a network with a computer system which for control of the door system and also to track and monitor operation thereof. The door system may be controlled to adjust the opening and closing speed of the door and for latch retry. It may also be controlled to adjust for the size and weight for the door, and even for wind or stack pressure. The system may be controlled for obstruction detection, and delay sensitivity may be set and/or adjusted. Notifications may be sent by the door system to an on-site or off-site user when the sensor data (orientation, operation, or the like) identifies that the door simply operates outside of installation requirements. The door system may be capable of determining if service is required or if even a potential security issue exists. The complex door system described in WO 2021/061727 A1 may be employed in new secure facilities. For presently existing and operating secure facilities, it is impossible or at least prohibitively expensive to replace existing safety doors with the security door systems of WO 2021/061727 A1, especially in view of the security protocols required for running the secure facility.

[0006] It is desired to provide capabilities to enhance presently installed security or safety doors in order to improve their reliability and to decrease their overall operating costs, in particular due to malfunctioning, maintenance and false alarms.

[0007] It is an object of the invention to overcome the disadvantages of the prior art, in particular to provide an adjustment device for a door closer, a door closer, or a security or safety door, which may easily be retrofitted to pre-installed doors, which simplifies maintenance, and/or which increases reliability of the door, preferably enabling predictive maintenance and/or remote adjustment. This objective is solved with the subject matter of the independent claims.

[0008] Accordingly, an adjustment device is provided for a mechanical, in particular non-motorized, door closer with at least one mechanical adjustment interface configured to modify the closing kinematics of the door closer such as closing velocity and/or closing force. Mechanical door closers have a mechanical actuator, such as a pneu-

matic actuator and/or a spring actuator, which define the closing kinematics in conjunction with properties of the door, such as its weight or friction at the hinges. The mechanical door closer has a mechanical adjustment interface for setting the mechanical actuator or actuators thereof, for example to achieve the desired closing velocity and/or closing force. Many mechanical door closers have a mechanical adjustment interface for setting the closing velocity in several distinct intervals, for example a first interval in which the door wing is oriented and an large opening angle in comparison to a threshold angle of for instance at least 5° and in which the door shall move rapidly, and a second interval in which the door wing is oriented at a small opening angle in comparison to the threshold angle and in which the door shall move at a slower speed and reliably reach a latching position in which the security door or safety door can be locked. The adjustment interface typically comprises at least one adjustment member, for example one or more nuts, such as hex nuts, for adjusting the mechanical actuator of the door closer in order to modify its behavior, in particular in the first or second interval. The at least one adjustment member of the adjustment interface may be configured to be driven by a manually operated tool, such as a screwdriver, or the like.

[0009] The adjustment device comprises at least one kinematics sensor configured for monitoring at least one kinematic parameter of the door and/or door closer. Preferably, the kinematic parameter may be a kinematic closing parameter related to the closing function of the door. The kinematic parameter of the door may comprise at least one of a current opening angle of the door, a maximal opening angle of the door before commencing its closing motion, current angular velocity of the door, current tilt angle of the door with respect to a horizontal plane, or the like. The kinematic parameter of the door closer may comprise at least one of an opening angle of the door closer, a maximal opening position of the door closer before commencing its closing motion, current angular velocity of the door closer, current closing force of the door closer, current force of at least one mechanical actuator, current stress of at least one mechanical actuator, current strain of at least one mechanical actuator, or current velocity of at least one mechanical actuator, or the like.

[0010] The adjustment device comprises at least one electromotor with the coupling means configured for engaging the adjustment interface of the mechanical, in particular non-motorized, door closer. In particular, the adjustment device comprises at least one coupling means corresponding to the adjustment interface. Preferably, the coupling means is configured to engage the adjustment member, wherein multiple coupling means may be provided for engaging a corresponding number of adjustment members. For example, for the previously mentioned door closer having an adjustment interface comprising an adjustment member in form of a hex nut, the coupling means may comprise correspondingly dimensioned and arranged coupling means in the form of a hex bit or the like. Preferably, the coupling means is driven or drivable by said electromotor. The coupling means may for example act as an output shaft of the electromotor. The electromotor may for example be a stepper motor, in particular a low voltage stepper motor. The number of electro-motors may correspond to the number of coupling means of the adjustment device and/or to the number of adjustment members of the adjustment interface. It shall be clear that the electromotor of the adjustment device is not configured to propel the door closer nor the door. It may be preferred that the control electronics are configured to operate the electromotor exclusively in a stationary state of the door and/or door closer, during the door and/or door closer remains in a predefined position, such as the closed position.

[0011] The adjustment device also comprises control electronics operatively coupled with the at least one kinematics sensor and configured to emit at least one status signal and/or control signal dependent on the monitored at least one kinematic parameter, preferably on the at least one kinematic closing parameter related to the closing function of the door. A status signal may be a signal indicating the status of the door or a status of the door closer. A status of the door may be a closed status, an opened status, in particular at or above a predetermined opening angle, or another door status related to the kinematics of the door, an error status, or the like. A status of the door closer may relate to a setting of the mechanical adjustment interface, a kinematic status related to the kinematics of the door closer, or the like. The adjustment device may preferably be operatively coupled with the at least one electromotor of the adjustment device. A control signal may preferably be provided to the at least one electromotor of the adjustment device having coupling means for engaging or engaging the adjustment interface.

[0012] Furthermore, the adjustment device comprises at least one cover configured to at least partially surround the electromotor, control electronics and the door closer, in particular the adjustment interface. It may be preferred that the adjustment device including its cover is configured to replace an original lid or casing of the mechanical, in particular non-motorized, door closer with which it interacts. Preferably, the cover of the adjustment device completely surrounds the electromotor, the control electronics, and the adjustment interface. Preferably, the cover of the adjustment device may have a cover height corresponding to the height of the casing of the door closer. Alternatively or additionally, the cover of the adjustment device has a cover width corresponding to the width of the casing of the door closer.

[0013] In a preferred embodiment, the adjustment device has coupling means configured for engaging the adjustment interface, in particular the adjustment member or adjustment members, of the door closer in a positive connection. For example, the adjustment interface may comprise an adjustment member in the form of the nut,

such as a hex-nut, and the adjustment device may have a coupling means in the form of a corresponding bit, such as a hex-bit. The coupling means may be rigidly attached to or attachable to a drive shaft of the at least one electromotor. In particular, the drive shaft or output shaft of the electromotor may comprise a reception for the coupling means, in particular for positively engaging the coupling means in a torque-transmitting manner.

[0014] According to another embodiment, the at least one kinematics sensor monitors at least one kinematic parameter, in particular kinematic closing parameter, comprising or consisting of, preferably comprising: (i) door position, in particular door angle, preferably door opening angle, and/or angle between door frame and door leaf; (ii) door velocity, in particular door closing velocity; and/or (iii) closing force. Preferably, the kinematics sensor comprises a gyroscopic sensor. The at least kinematic parameter may be monitored in comparison to a desired value, such as a threshold value, and/or in comparison to a predefined table or function, optionally considering a tolerance span, in particular with the aid of the control electronics. The door opening angle may for example be monitored in comparison an angle threshold related to a minimal opening angle assumed to be required for a reliable closing of the door of for example 20°. The gyroscopic sensor or another accelerometer may be rigidly attached to the door leaf or to a member of the door closer attached to the door leaf. The adjustment device may comprise multiple kinematics sensors firmly attached to the door, in particular the door leaf and/or the door frame, the adjustment device, in particular the adjustment device cover, and/or the door closer.

[0015] In a further embodiment of an adjustment device, the control electronics are configured to process monitoring data determined by at least one kinematics sensor and compare said monitoring data with at least one reference data set in order to determine at least one stator signal and/or control signal. The control electronics may determine the at least one kinematic parameter in relation to at least one predetermined reference parameter. The control electronics may for example be calibrated in such a way that at least one, at least two, or more predetermined reference positions of the door, in particular of the door in relation to the door frame, or of the door closer, are known. A predetermined reference position may for instance be a fully closed latching position of the door leaf with regard to the door frame. Another predetermined reference position may for instance be a fully opened position of the door leaf with regard to the door frame. A further predetermined reference position of the door leaf with regard to the door frame may be defined at a predetermined opening angle, such as 45°. For example, the control electronics may be configured to determine a warning signal or an error signal as a status signal in case a monitored kinematic parameter falls outside of a corresponding predetermined allowable parameter range.

[0016] In a preferred embodiment, the control electronics is operatively coupled with the at least one electromotor to operate the electromotor in accordance with the at least one control signal. For instance, the control electronics may be configured to determine a control signal for controlling the door closer to accelerate or decelerate the closing motion of the door, if the kinematic parameter falls into a predetermined range, in particular above or below a predetermined threshold.

[0017] According to another embodiment, the adjustment device further comprises a communication interface configured to transmit monitoring data, status signal and/or control signal to a central diagnostics device. The communication interface may be adapted to utilize wireless or wire bound communication for transmitting the data to the central diagnostics device. The central diagnostics device may be arranged inside of the adjustment device be configured conduct one or more diagnostic routines processing the at least one monitoring data, status signal and/or control signal gathered by the adjustment device. The central diagnostics device may be a computer or server coupled to a user interface inside of the secure facility or at a remote maintenance facility. The central diagnostic device may be configured to provide diagnostic data at an output, for example through a visual output, such as a screen or indicator light, or through an electronic output, such as a RS232-connection, USB connection or the like. The central diagnostics device may be coupled to a multitude of adjustment devices attached to a multitude of different doors, such as security doors within one or more secure facilities. The central diagnostics device may be configured to run at least one or more diagnostic routines to process the monitoring data, stator signals and/or control signal received from the at least one adjustment device.

[0018] In a further embodiment, the adjustment device comprises at least one local signal emitter, in particular an optical signal emitter and/or acoustic signal emitter, operatively coupled to the control electronics configured to emit a warning or alert signal in response to a corresponding status signal from the control electronics, wherein in particular the local signal emitter is arranged in or on the cover.

[0019] The invention also relates to a door closer comprising a non-motorized actuator, such as a pneumatic piston and/or a mechanical spring, configured to urge a security door or safety door into a closed position. The actuator includes at least one mechanical adjustment interface configured to modify the closing kinematics of the door closer. The adjustment interface comprises one, two or more adjustment members. It may be preferred that the adjustment interface comprises precisely two adjustment members or precisely one adjustment member. For example, the adjustment members may comprise a first adjustment knob and a second adjustment knob. An adjustment member may for example be an adjustment knob like a nut, such as a hex nut. The adjustment member may for example be configured to modify the closing kinematics of the door closer for a door closer comprising

a pneumatic piston by controlling one or more valves for pressurizing or venting said pneumatic piston. Alternatively or additionally, the at least one adjustment member may be configured to modify the closing kinematics of the door closer for a door closer comprising a mechanical spring by setting a biasing force of the spring to a desired level. The door closer further comprises an adjustment device as described above, wherein the coupling means engages the adjustment means. Preferably, the adjustment device comprises a number of coupling means corresponding to the number of adjustment members of the door closer.

[0020] In a preferred embodiment, the door closer includes an electronic power supply, such as a battery or a power line, connected to the adjustment device control electronics and to door closer electronics. The powerline may preferably be a powerline of the secure facility connected to the door closer, in particular a powerline running along the door frame or inside of the door frame. The same electronic power supply, in particular powerline, or different electronic power supplies, in particular different power lines, may be connected, on the one hand to the adjustment device control electronics and on the other hand to the door closer electronics. Preferably, the same electronic power supply is connected to the control electronics and the at least one electromotor of the adjustment device. Alternatively, a first electronic power supply may be connected to the control electronics and a second electronic power supply may be connected to the at least one electromotor.

[0021] According to another embodiment, which may be combined with the above-mentioned ones, the door closer comprises a housing a shell surrounding the, in particular non-motorized, actuator and possibly the door closer electronics and a cover surrounding the at least one kinematics sensor, the at least one electromotor and the control electronics. Preferably, the shell and the cover define a plane of engagement through which the coupling means extend.

[0022] The invention also relates to a security door or safety door equipped with a door closer, in particular as described above, and/or with an adjustment device as described above or a monitoring device as described below. Preferably, the security door is installed in a secure facility. Furthermore, the invention relates to a facility with a multitude of such security doors and/or safety doors.

[0023] According to the invention, a method is provided for operating a door closer with a monitoring device, in particular an adjustment device, comprising the following steps. According to one step, which may preferably be a first step, a lid is removed from the housing of the door closer to free a mechanical adjustment interface of said door closer. Prior to commencing the method according to the invention, the door closer is typically initially provided with a lid covering the mechanical components of the door closer, optionally in conjunction with a shell. For example, the door closer may initially have been provided with an annular or cup-like shell attached to the door frame or door leaf and preferably circumferentially surrounding the members of the door closer while leaving one side of the door closer on which the adjustment interface is arranged open. The adjustment interface is typically initially covered by a, preferably substantially flat, lid. Alternatively, the lid may have a cup-like shape that may, in an initial closed state, extend not only over the adjustment interface but also circumferentially surround components of the door closer.

[0024] In another step, preferably a second step, an monitoring device, in particular an adjustment device as described above, may be provided. The second step may be conducted before the first step or simultaneously. The monitoring device is provided with at least one kinematics sensor configured for monitoring at least one kinematic parameter of the door and/or door closer, and with control electronics operatively coupled with the at least one kinematics sensor and configured to emit at least one status signal and/or control signal dependent on the monitored at least one kinematic parameter. The monitoring device may additionally be equipped with a communication interface and/or a local signal emitter. In one preferred embodiment which may be designated an active monitoring device, the monitoring device is realized as an adjustment device as described above, which includes at least one electromotor and at least one coupling means for engaging the adjustment interface of the door closer. In another preferred embodiment, which may be designated as a passive monitoring device, the monitoring device is free of an electromotor, preferably free of any mechanical any actuator, and/or free of coupling means. The monitoring device is preferably provided, in particular attached, to an, in particular fully functional, door or door closer. Preferably, the monitoring device is provided, in particular installed, to a door closer mounted on a security door or safety door. More preferably, the monitoring device is provided, in particular installed, to a door closer of a door firmly installed, preferably anchored, in a building, preferably a secure facility.

[0025] In an optional step, in particular a third step which is conducted after the second step, coupling means are arranged to transfer adjustment forces and/or motion from an electromotor of the adjustment device to the mechanical adjustment interface of the door closer. For example, in a case where the coupling means are bits and wherein the adjustment members are corresponding nuts, in a further step, in particular the optional third step, the bits are arranged in engagement with the nuts. In another step, in particular a fourth step which is conducted after the second and optionally the third step, the monitoring device, in particular an adjustment device, is firmly attached to the door closer. In the another step, in particular the fourth step, the monitoring device, in particular an adjustment device, may be screwed or otherwise firmly attached to the door closer.

[0026] In one embodiment of a method for operating a door closer with a monitoring device, in particular an adjustment device, a cover of the monitoring device, in par-

ticular an adjustment device, is put over the freed mechanical adjustment device. In particular, a cover may be installed in a fifth step after the attachment of the device to the door closer. Preferably, the cover is arranged onto the door closer such that it covers the area initially covered by the lid. In other words, in this embodiment of a method for operating a door closer with an monitoring device, in particular an adjustment device, the device and its cover are attached to a door closer such that they replace the initially present lid of the door closer.

[0027] According to a further embodiment of a method for operating a door closer with an adjustment device, at least one reference data set characterizing at least one desired kinematic parameter of the door closer is provided. The provision of the reference data set may at least in part be gathered during a calibration step, preferably immediately or shortly after attachment of the adjustment device to the door closer, in which a calibration routine is performed with the security door to which the door closer and the monitoring device, in particular the adjustment device, are attached. Furthermore, in the method for operating the door closer with a monitoring device, one or more kinematic sensors are used to monitor at least one kinematic parameter of the door closer. Therein, a comparison of actual kinematic parameters measured with the at least one kinematic sensor and the desired kinematic parameters is conducted. At least one control signal may then generated based on said comparison and provided for operating at least one electromotor of the adjustment device.

[0028] Further embodiments, features and technical aspects are described in the subclaims. Further details of the preferred embodiments of the invention are shown in the enclosed Figures.

Figure 1 shows an exploded view of a door closer with an adjustment device according to the invention;

Figure 2 shows a frontal view into the adjustment device according to Figure 1; and

Figure 3 shows a perspective view of the adjustment device according to Figure 1.

[0029] In the following description of preferred embodiments of the invention in accordance with the figures, the same or similar reference numerals are used to designate the same or similar components, the exemplary embodiment of an adjustment device as shown in the figures is intended to merely illustrate one particular embodiment of the invention as defined in the claims for a better understanding thereof, without implying any limitations to their scope.

[0030] An adjustment device in accordance with the invention is generally designated with reference numeral 1. As its main constituents, the adjustment device 1 comprises at least one kinematics sensor 15, at least one electromotor 13 with a coupling means 11, control electronics 17 and at least one cover 19. The preferred embodiment shows a monitoring device realized as an adjustment device. The skilled person will easily comprehend that the monitoring device might alternatively be provided without electromotor and coupling means.

[0031] The adjustment device 1 is adapted in accordance with a specific type or series of mechanical, preferably non-motorized, door closer 3. The door closer 3 in the example illustrated herein comprises a mechanical actuator realized as a piston 34, and further comprises levers 35, 36, a casing and a door bracket 37. The door closer 3 is configured to be attached on the one hand to a movable door leaf and on the other hand to a stationary structure, such as a wall or, preferably, a door frame. Preferably, the door bracket 37 is attached to the door leaf whereas the basis 38 of the door closer 3 is attached to the stationary structure. The first lever 35 of the second lever 36 or hingedly connected to one another. The first lever 35 is rotatably connected to the piston 34 or other mechanical actuator. The second lever 36 is hingedly connected to the door bracket 37. The piston 34 is configured to provide a force causing to urge the door leaf towards a closed position for latching engagement with the door frame. The force provided by the piston 34 is in the embodiment shown in Figure 1 transferred to the door frame (not shown) via the first lever 35, the second lever 36 and the door bracket 37. The piston rotates the first lever 35 which in turn causes the second lever 36 attached thereto to conduct a corresponding motion which is imparted onto the door leaf through the bracket 37 rigidly attached to the door leaf. The bracket 37 and the first and second levers 35, 36 realize an elbow-lever-like structure.

[0032] Door closers, specifically door closers suitable, in particular certified, to be used with safety doors and/or security doors in secure facilities, such as data centers, are readily available from a number of manufacturers, each of whom has provided the respective door closers 3 with a certain adjustment interface 31. Figure 1 illustrates one example of such an adjustment interface 31 which is typically initially hidden behind and protected by a lid (not illustrated) obfuscating the frontal opening of the door closer's 3 casing. The casing typically comprises a sleeve-like or cup-like shell 39 and the lid. The cover 19 is configured to be attached to the door closer 3, for example, as illustrated, on top of the shell 39, replacing the lid of the entire casing.

[0033] The door closer 3 is shown in figure 1 has an adjustment interface 31 comprising two adjustment members 32, 33 configured as nut-like receptions adapted to receive a typically manually operable tool, such as a screwdriver. The adjustment members 32, 33 of the adjustment interface 31 are provided to allow for manual modification of the kinematic properties of the door closer 3. For example, multiple adjustment members 32, 33 may be provided on an adjustment interface 31 in order to allow for modification of different kinematic properties or

to allow for modification of kinematic properties in different states, such as different orientations of the door leaf. For example, the first adjustment member 32 may allow for modification of the kinematic properties of the door closer 3 in a first state in which the door leaf is close to or has reached the closed orientation in which the door leaf and the door frame aligned for latching engagement, and the second adjustment member 33 may allow for modification of the kinematic properties of the door closer 3 in a second state in which the door leaf is arranged in a opened orientation at an opening angle beyond a predefined threshold, such as 10°, 20° or 45°.

[0034] The adjustment device 1 according to the invention addresses the problem that conducting maintenance on a multitude of dozens or even hundreds of security doors within a single secure facility is presently excessively burdensome and expensive because maintenance personnel has to physically enter the secure facility and manually access each security door and mainly its door closer 3 under the strict adherence to all security protocols in place at said secure facility. The adjustment device 1 being provided with the at least one kinematics sensor 15 allows to observe door closer 3 and/or security door kinematics without manual interaction between maintenance personnel and the door, possibly even remotely. Furthermore, the adjustment device 1 being provided with coupling means 11 engaging the adjustment interface 31 and being driven by at least one electromotor 13 controlled by control electronics 17 allows to perform manipulations to adjust the door closer 3 in order to optimize its kinematic properties automatically in accordance with rules, in particular rules implemented in the control electronics 17, semi-automatically by requesting permission from a manual operator, preferably in the secure facility, in particular in close proximity to said security door, or in accordance with manual instructions which may be provided to the adjustment device 1 locally in the secure facility, in particular in close proximity to said security door, or remotely. The adjustment device 1 allows to extend maintenance intervals by performing modifications to the door closer through its adjustment interface within a predetermined tolerated range, and allows to schedule maintenance of a malfunctioning security door in due time before it displays critical behavior. Likewise, the adjustment device 1 according to the invention helps to ascertain that safety doors continuously function properly between inspections. By employing the adjustment device 1 according to the invention, the number of false alerts due to a malfunctioning door closer 3 can be significantly reduced.

[0035] In the preferred embodiment of an adjustment device 1 shown the figures, control electronics 17 is operatively coupled to at least one kinematics sensor 15. The kinematic sensor 15 is attached to the cover 19. It shall be clear that further kinematic sensors may be provided to the monitoring device, door closer 3 and/or to the door, in particular to the door frame, the door leaf and/or the hinges attaching the door leaf to the door frame (not shown in further detail), which are operatively coupled to the control electronics 17. Through the at least one kinematics sensor 15, the control electronics 17 is rendered capable to monitor at least one kinematic parameter of the door and/or of the door closer. The kinematic sensor 15 may for instance be realized as a gyroscope. The kinematics sensor 15 may alternatively or additionally comprise an accelerometer. The kinematics sensor 15 may be configured to monitor or for example a door position, in particular a door angle, a door velocity, in particular the door closing velocity in which the door presently moves towards its closed position, and/or a force, such as a closing force with which the door leaf abuts against the door frame.

[0036] Power lines 53 running through a tunnel attached to the door may be provided and operatively coupled to the control electronics 17 and the at least one electromotor 13 for electric power supply of the monitoring device. In conjunction with or in addition to the power lines 53, data lines may be connected to the control electronics 17 which may be provided with the communication interface. The control electronics 17 may be configured to transfer information through a control interface via a wireless or wired connection. The control electronics 17 may for example be configured to transfer monitoring data based on monitoring information regarding at least one kinematic property obtained with the at least one kinematics sensor 15. The control electronics 17 may be equipped with further sensors, such as a temperature sensor, one or more pressure sensors or the like, to obtain monitoring information. Additionally or alternatively, the control electronics 17 may be configured to transfer at least one status signal through the communication interface, for example a status signal indicating that the adjustment device 1 and/or the door closer 3 works properly, for example within a predetermined first range, or that the door and/or door closer requires maintenance while working, for example within a predetermined second range, or a malfunctioning door and/or door closer requires immediate attention.

[0037] The control electronics 17 is operatively coupled to the at least one electromotor 13 provided with at least one coupling means 11. In the illustrated embodiment, the control electronics 17 is operatively coupled with two electro-motors 13, each provided with a respective coupling means 11 for engaging one respective adjustment member 32 or 33 of the door closer 3. The coupling means 11 is shown herein are a realized as hex-bits configured to positively engage the hex-nut-like adjustment members 32, 33. The hex-bits are positively received within a corresponding aperture in the output shaft of the respective electromotor 13. An adjustment force and/or adjustment motion provided by the electromotor 13 may thus be transferred through the coupling means 11 to the adjustment interface 31 in order to set the actuator of the door closer. The control electronics 17 may be configured to transfer at least one control signal or the like through the communication interface in order to

document said signal in a central diagnostics device. The control electronics 17 may be configured to provide a control signal in order to operate the at least one electromotor 13.

[0038] The control electronics 17 of the monitoring device may furthermore be equipped with a communication interface for receiving information, in particular the control signal, for example from a central diagnostics device. For example in cases where monitoring data is transferred from the control electronics 17 to a central diagnostics device which performs at least one diagnostics routinely, the diagnostics device may be configured to control the at least one adjustment device 1 remotely. Such a setup may be advantageous for example if a central diagnostics device is addressable from a remote location inside of the secure facility or even outside of the secure facility, for example at the site of a maintenance contractor, in order to enable remote maintenance without requiring physical access of maintenance personnel to the secure facility.

[0039] The adjustment device 1 may be equipped with one or more local signal emitter, such as an optical signal emitter, like an LED, which is operatively coupled to the control electronics 17 in order to indicate, for example, status of the adjustment device 1, door closer 3 and/or door. A local LED signal emitter may for instance be visible on the face of the cover 19. Alternatively or additionally, the signal emitter may be realized as an electromagnetic signal emitter, such as a radio signal emitter or transmitter, like a Bluetooth transmitter, which may be configured to transfer information from the control electronics 17 to a nearby device capable of receiving the signals of the signal emitter (not shown in detail).

[0040] The monitoring device herein illustrated as an adjustment device 1 is, in accordance with a preferred embodiment, provided with control electronics 17 configured to process monitoring data and compare said monitoring data with at least one reference data set. The control electronics 17 may be further configured to determine at least one stator signal and/ or at least one control signal for the electromotor 13 as a result from the comparison of the monitored data to the reference data set. Alternatively or additionally, the above-mentioned central diagnostics device may be configured to process monitoring data and compare said monitoring data with the at least one reference data set.

[0041] Features disclosed in the above description, the figures and the claims may be significant for the realization of the invention in its different embodiments individually as well as in any combination thereof.

Claims

1. Adjustment device (1) for a mechanical, non-motorized door closer with at least one mechanical adjustment interface (31) configured to modify the closing kinematics of the door closer such as closing velocity and/or closing force, comprising:

   at least one kinematics sensor (15) configured for monitoring at least one kinematic parameter of the door and/or door closer;
   at least one electromotor (13) with a coupling means (11) configured for engaging the adjustment interface (31);
   control electronics (17) operatively coupled with the at least one kinematics sensor (15) and configured to emit at least one status signal and/or control signal dependent on the monitored at least one kinematic parameter; and
   at least one cover (19) configured to at least partially surround the electromotor (13), control electronics (17) and the door closer (3), in particular the adjustment interface (31).

2. Adjustment device (1) according to claim 1, wherein the coupling means (11)is configured for engaging the adjustment interface (31) of the door closer (3) in a positive connection, and wherein the coupling means (11) is rigidly attached or attachable to a drive shaft of the at least one electromotor (13).

3. Adjustment device (1) according to claim 1 or 2, wherein
   the at least one kinematics sensor (15), in particular continuously, monitors at least one of the following kinematic parameters:

   (i) door position, in particular door angle, preferably door opening angle, and/or angle between door frame and door leaf;
   (ii) door velocity, in particular door closing velocity; and/or
   (iii) closing force;

   wherein preferably the kinematics sensor (15) comprises a gyroscopic sensor.

4. Adjustment device (1) according to anyone of the preceding claims, wherein control electronics (17) are configured to process monitoring data determined by at least one kinematics sensor (15) and compare said monitoring data with at least one reference data set in order to determine at least one status signal and/or control signal.

5. Adjustment device (1) according to anyone of the preceding claims, wherein the control electronics (17) operatively coupled with the at least one electromotor (13) to operate the electromotor (13) in accordance with the at least one control signal.

6. Adjustment device (1) according to anyone of the preceding claims, further comprising
   a communication interface configured to transmit

monitoring data, status signal and/or control signal to a central diagnostics device.

7. Adjustment device (1) according to anyone of the preceding claims, comprising at least one local signal emitter, in particular an optical signal emitter and/or acoustic signal emitter, operatively coupled to the control electronics (17) configured to emit a warning or alert signal in response to a corresponding status signal from the control electronics (17), wherein in particular the local signal emitter is arranged in or on the cover (19).

8. Door closer (3) comprising

a non-motorized actuator, such as a pneumatic piston and/or mechanical spring, configured to urge a door into a closed position,
wherein the actuator includes at least one the mechanical adjustment interface (31) configured to modify the closing kinematics of the door closer (3), wherein the mechanical adjustment interface (31) comprises at least one, preferably two, adjustment members, for example a first and a second adjustment knob,
the door closer (3) further comprising an adjustment device (1) according to anyone of the preceding claims, wherein the coupling means (11) engages the adjustment members.

9. Door closer (1) according to claim 8 further including an electronic power supply, such as a battery or a power line, connected to the adjustment device (1) control electronics (17) and to door closer (3) electronics.

10. Door closer (1) according to claim 8 or 9, comprising a housing a shell surrounding the non-motorized actuator and possibly the door closer (3) electronics and a cover (19) surrounding the at least one kinematics sensor (15), the at least one electromotor (13) and the control electronics (17), wherein preferably the shell and the cover (19) define a plane of engagement through which the coupling means (11) extends.

11. Security door or safety door with a door closer (3), in particular according to anyone of claims 8 to 10, and/or an adjustment device (1) according to anyone of claims 1 to 7.

12. Facility, in particular secure facility, with a multitude of security doors and/or safety doors according to claim 11.

13. Method for operating a door closer (3) with a monitoring device, in particular an adjustment device (1), comprising the steps of

removing a lid from a housing of the door closer (3) to free a mechanical adjustment interface (31) of the door closer (3),
providing a monitoring device comprising at least one kinematics sensor (15) configured for monitoring at least one kinematic parameter of the door and/or door closer, and control electronics (17) operatively coupled with the at least one kinematics sensor (15) and configured to emit at least one status signal and/or control signal dependent on the monitored at least one kinematic parameter, in particular an adjustment device (1) according to anyone of claims 1 to 8,
optionally arranging coupling means (11) to transfer adjustment forces and/or motion from an electromotor (13) of the adjustment device (1) to the mechanical adjustment interface (31) of the door closer (3);
and, in particular, firmly attaching the monitoring device, in particular the adjustment device (1), to the door closer (3).

14. Method according to claim 13, further comprising the step of putting a cover (19) of the monitoring device, in particular the adjustment device (1), over the freed mechanical adjustment interface (31).

15. Method according to claim 13 or 14, wherein

at least one reference data set characterizing at least one desired kinematic parameter of the door closer (3) is provided; and wherein
kinematic sensors (15) are used to monitor at least one actual kinematic parameter of the door closer (3); and wherein a comparison of the actual kinematic parameter and the desired kinematic parameter is conducted; and wherein
at least one control signal is generated based on the comparison and optionally provided for operating at least one electromotor (13).

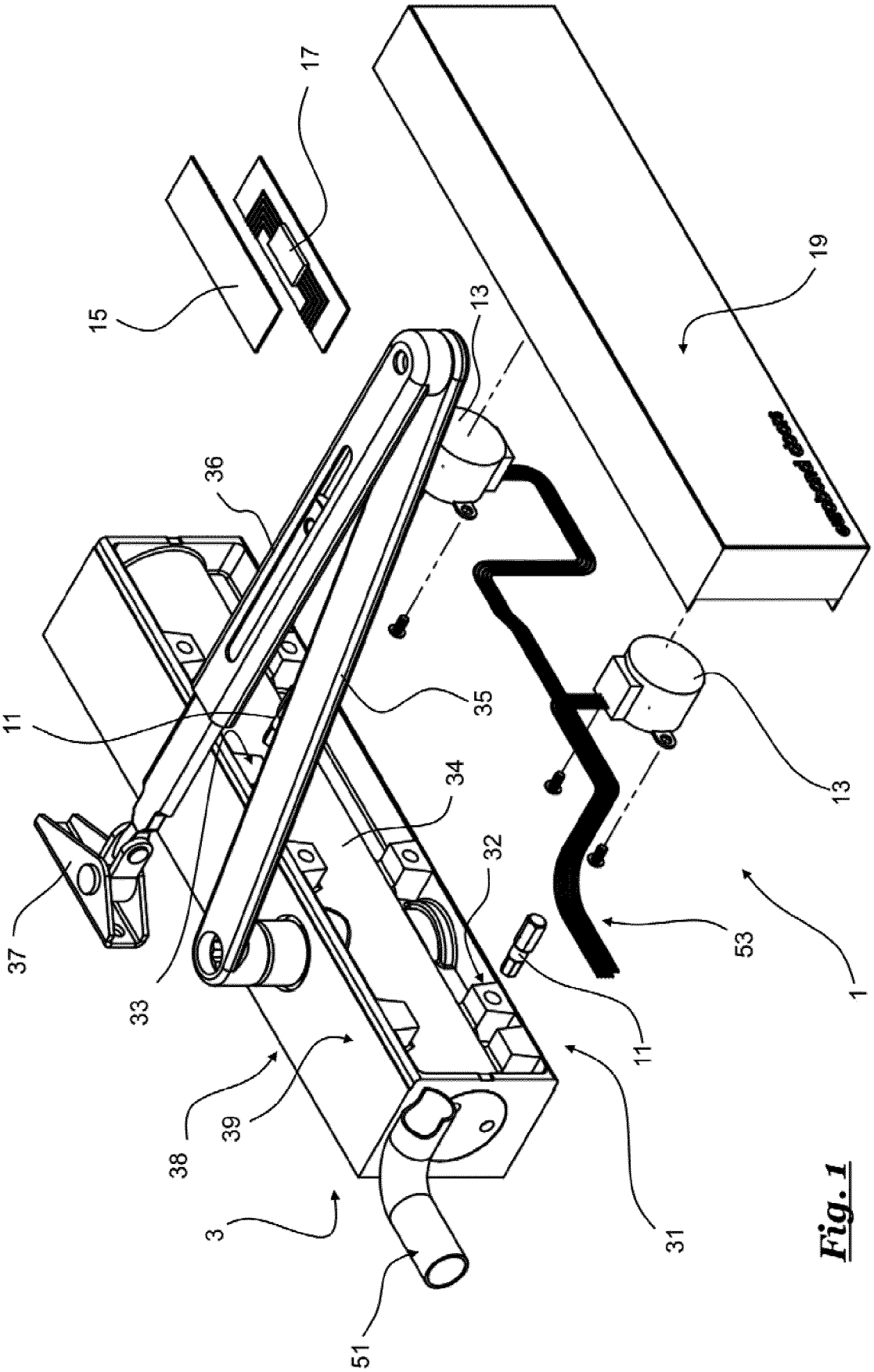

Fig. 1

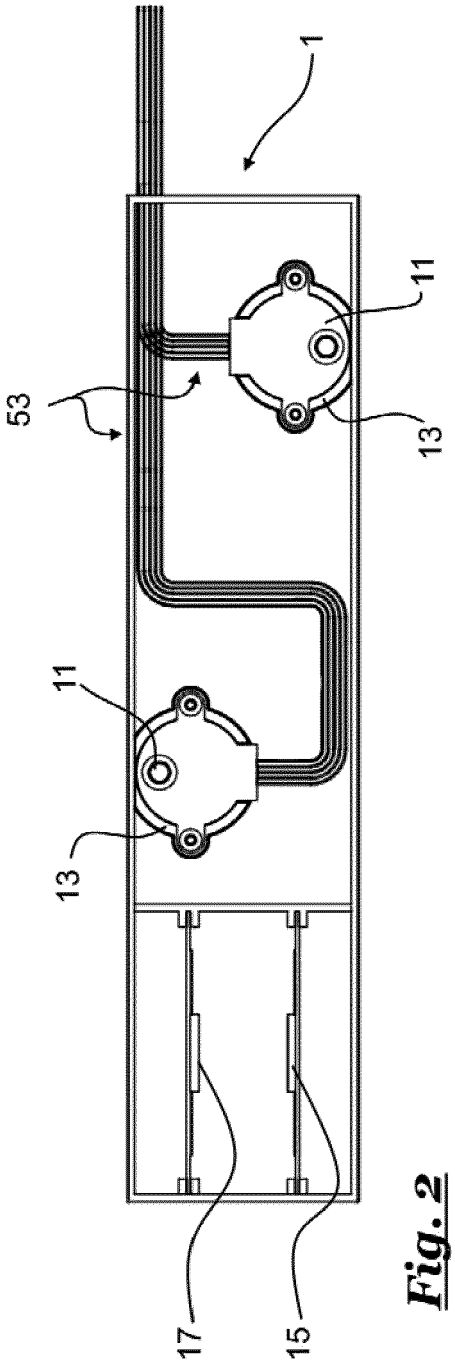

Fig. 2

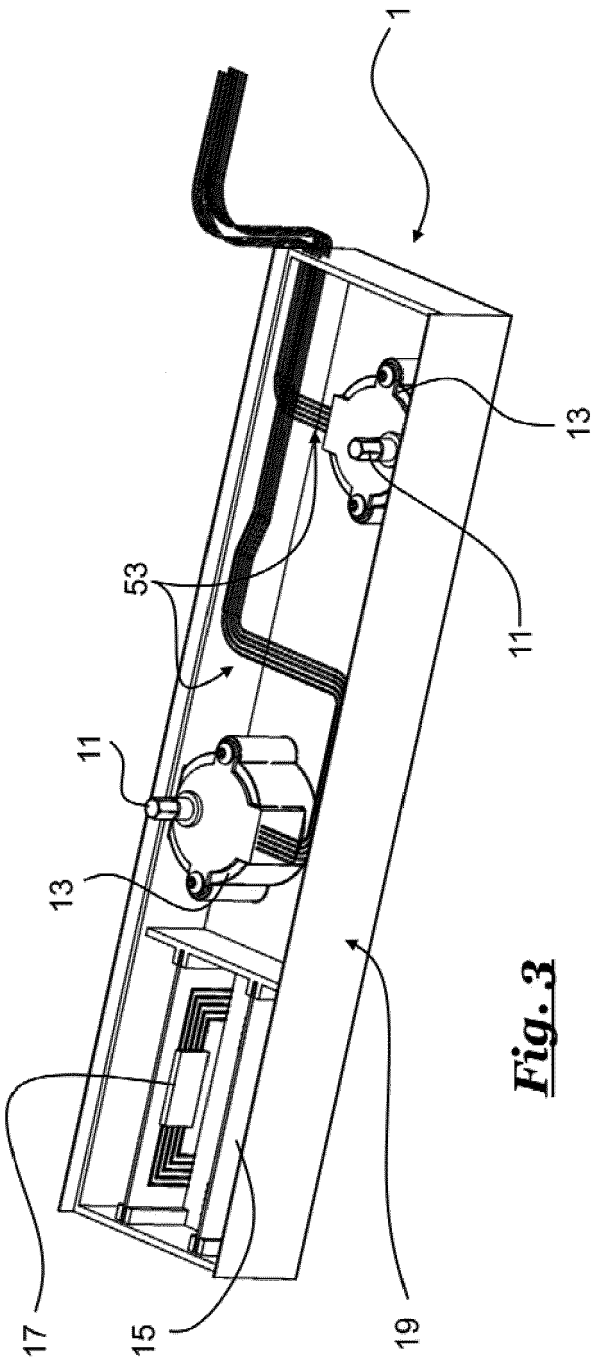

Fig. 3

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EUROPEAN SEARCH REPORT

Application Number
EP 21 21 4780

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 Y	WO 2008/134442 A1 (YALE SECURITY INC [US]; COPELAND II DAVID JAMES [US] ET AL.) 6 November 2008 (2008-11-06) * page 23, line 1 - page 26, line 30; figures 1-26 *	1-5,8-15 6,7	INV. E05F1/10 E05F3/04
X	WO 2021/050889 A1 (ASSA ABLOY ACCESS AND DOOR CONTROLS GROUP INC [US]) 18 March 2021 (2021-03-18) * paragraphs [0002], [0004], [0053]; figures 1,2 *	1-5,8, 10,11, 13-15	
X	GB 2 573 376 A (GEZE GMBH [DE]) 6 November 2019 (2019-11-06) * page 1 * * page 13 * * page 15 * * page 19 * * figures 3a, 3b *	1,2,8	
Y	WO 2011/130638 A1 (YALE SECURITY INC [US]; BURRIS CHARLES [US] ET AL.) 20 October 2011 (2011-10-20) * page 27, line 6 - page 28, line 10; figures 1-7, 30 *	6,7	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	27 May 2022	Klemke, Beate

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 21 21 4780

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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27-05-2022

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 2008134442 A1	06-11-2008	AU 2008245677 A1	06-11-2008
		BR PI0810505 A2	21-07-2015
		CA 2698634 A1	06-11-2008
		CA 2842521 A1	06-11-2008
		CN 101802335 A	11-08-2010
		EP 2148969 A1	03-02-2010
		EP 2716849 A1	09-04-2014
		HK 1147300 A1	05-08-2011
		IL 201749 A	31-07-2016
		US 2009093913 A1	09-04-2009
		US 2011231023 A1	22-09-2011
		US 2014330436 A1	06-11-2014
		WO 2008134442 A1	06-11-2008
WO 2021050889 A1	18-03-2021	CA 3151016 A1	18-03-2021
		US 2021079704 A1	18-03-2021
		WO 2021050889 A1	18-03-2021
GB 2573376 A	06-11-2019	DE 102018202812 A1	29-08-2019
		GB 2573376 A	06-11-2019
WO 2011130638 A1	20-10-2011	CA 2796183 A1	20-10-2011
		CA 2796185 A1	20-10-2011
		CA 2999432 A1	20-10-2011
		CA 2999439 A1	20-10-2011
		CA 2999444 A1	20-10-2011
		WO 2011130638 A1	20-10-2011
		WO 2011130643 A1	20-10-2011

EPO FORM P0459

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

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- WO 2021061727 A1 **[0005]**