US012385286B2

(12) **United States Patent**
Kusanale et al.

(10) **Patent No.: US 12,385,286 B2**
(45) **Date of Patent: Aug. 12, 2025**

(54) **SENSING AND CONTROL OF ACCESS CONTROL DEVICES**

(71) Applicant: **Schlage Lock Company LLC**, Carmel, IN (US)

(72) Inventors: **Vishal S. Kusanale**, Bangalore (IN); **Avinash K. Vedamurthy**, Bangalore (IN); **John C. Carpenter**, Ingalls, IN (US)

(73) Assignee: **Schlage Lock Company LLC**, Carmel, IN (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 139 days.

(21) Appl. No.: **18/231,536**

(22) Filed: **Aug. 8, 2023**

(65) **Prior Publication Data**

US 2024/0183197 A1 Jun. 6, 2024

Related U.S. Application Data

(62) Division of application No. 16/532,999, filed on Aug. 6, 2019, now Pat. No. 11,719,021.

(51) **Int. Cl.**
E05B 47/00 (2006.01)
E05B 65/10 (2006.01)
(Continued)

(52) **U.S. Cl.**
CPC ***E05B 47/0012*** (2013.01); ***G07C 9/00571*** (2013.01); ***H02K 7/06*** (2013.01);
(Continued)

(58) **Field of Classification Search**
CPC E05B 47/0012; E05B 65/108; E05B 2047/0016; E05B 2047/0024;
(Continued)

(56) **References Cited**

U.S. PATENT DOCUMENTS

4,189,712 A 2/1980 Lemelson
5,640,862 A 6/1997 Remenicky
(Continued)

FOREIGN PATENT DOCUMENTS

DE 19710834 A1 11/1997
WO 2004020769 A1 3/2004
(Continued)

OTHER PUBLICATIONS

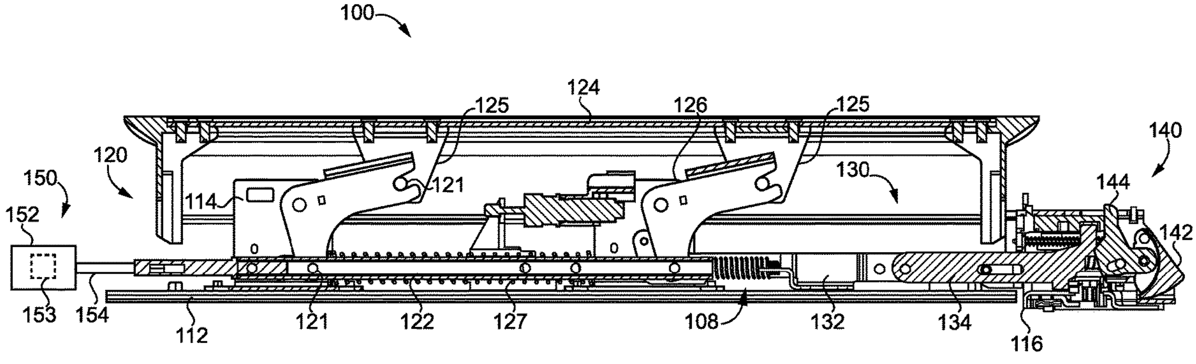
Extended European Search Report; European Patent Office; European Patent Application No. 20850228; Jul. 31, 2023; 10 pages.
(Continued)

Primary Examiner — Kristina R Fulton
Assistant Examiner — Steven A Tullia
(74) *Attorney, Agent, or Firm* — Taft Stettinius & Hollister LLP

(57) **ABSTRACT**

An exemplary method generally relates to operating an access control device including a motor, a locking member, and a target component operably connected with the locking member. The motor may be operated to drive the locking member in a first direction from an initial position toward a desired position. When the locking member is blocked from moving beyond a blockage position, a target location of the target component is detected. The motor may then be operated to drive the locking member in a second direction opposite the first direction. The motor may then be operated to drive the locking member in the first direction toward the blockage position while monitoring the location of the target component. As the target component reaches the target location, the motor is supplied with a boost current to drive the locking member beyond the blockage position and toward the desired position.

22 Claims, 8 Drawing Sheets



(51) **Int. Cl.**
G07C 9/00 (2020.01)
H02K 7/06 (2006.01)

(52) **U.S. Cl.**
CPC *E05B 2047/0016* (2013.01); *E05B 2047/0057* (2013.01); *E05B 2047/0067* (2013.01); *E05B 65/108* (2013.01)

(58) **Field of Classification Search**
CPC E05B 2047/0067; E05B 2047/0057; G07C 9/00571; H02K 7/06; Y10T 70/5159; Y10T 70/8946; Y10T 70/0822; Y10T 70/0908
USPC 70/280, 16, 532, 999
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

6,104,594	A *	8/2000	Frolov	E05B 65/1073 361/139
7,536,885	B1 *	5/2009	Ross	E05B 65/1073 70/92
8,182,003	B2 *	5/2012	Dye	E05B 65/1053 292/216
8,495,836	B2 *	7/2013	Lowder	E05B 65/1053 49/394
9,995,065	B2	6/2018	Witte et al.	
10,030,426	B2	7/2018	Langenberg	
10,060,157	B1	8/2018	Sharp	
10,174,525	B2 *	1/2019	Arlinghaus	E05B 65/1053
10,612,272	B2 *	4/2020	Wu	E05B 47/026
11,424,061	B2 *	8/2022	Shaffer	H02M 3/33523
11,719,021	B2 *	8/2023	Kusanale	H02P 29/028 70/280
2005/0206499	A1	9/2005	Fisher	
2006/0082162	A1 *	4/2006	Escobar	E05B 47/023 292/201
2008/0012350	A1 *	1/2008	Condo	E05B 65/1093 292/92
2008/0048600	A1	2/2008	Dejohn	
2010/0045053	A1 *	2/2010	Dye	E05B 65/1053 292/201
2011/0047874	A1 *	3/2011	Lowder	E05B 65/1053 49/31
2012/0261928	A1 *	10/2012	Dye	E05B 65/1053 292/201
2014/0109479	A1 *	4/2014	Morstatt	E05B 65/1093 292/144
2015/0097380	A1	4/2015	Nye-Hingston et al.	
2015/0240529	A1 *	8/2015	Dore Vasudevan	E05B 17/0091 70/277
2015/0247345	A1 *	9/2015	Carpenter	E05B 55/00 70/277
2017/0167164	A1 *	6/2017	Baty	E05B 47/0001
2017/0226778	A1 *	8/2017	McKibben	E05B 65/1053
2017/0321453	A1	11/2017	Zheng et al.	
2018/0044949	A1	2/2018	Frello et al.	
2018/0209182	A1	7/2018	Beck et al.	
2018/0245375	A1	8/2018	Arlinghaus et al.	
2020/0048935	A1 *	2/2020	Carpenter	E05C 1/12
2021/0010294	A1 *	1/2021	Shaffer	E05B 47/0001
2021/0040775	A1 *	2/2021	Kusanale	E05B 47/0012

FOREIGN PATENT DOCUMENTS

WO	2017009078	A1	1/2017	
WO	WO-2021026348	A2 *	2/2021	E05B 47/0012

OTHER PUBLICATIONS

Australian Examination Report; Australia IP; Australian Patent Application No. 2020325216; Apr. 26, 2023; 5 pages.

Canadian Examination Report; Canadian Intellectual Property Office; Canadian Application No. 3,150,013; Mar. 2, 2023; 4 pages.

International Search Report; International Searching Authority; International Patent Application No. PCT/US2020/045196; Mar. 4, 2021; 5 pages.

Written Opinion; International Searching Authority; International Patent Application No. PCT/US2020/045196; Mar. 4, 2021; 8 pages.

Australian Examination Report; IP Australia; Australian Application No. 2024203879; May 21, 2025; 3 pages.

* cited by examiner

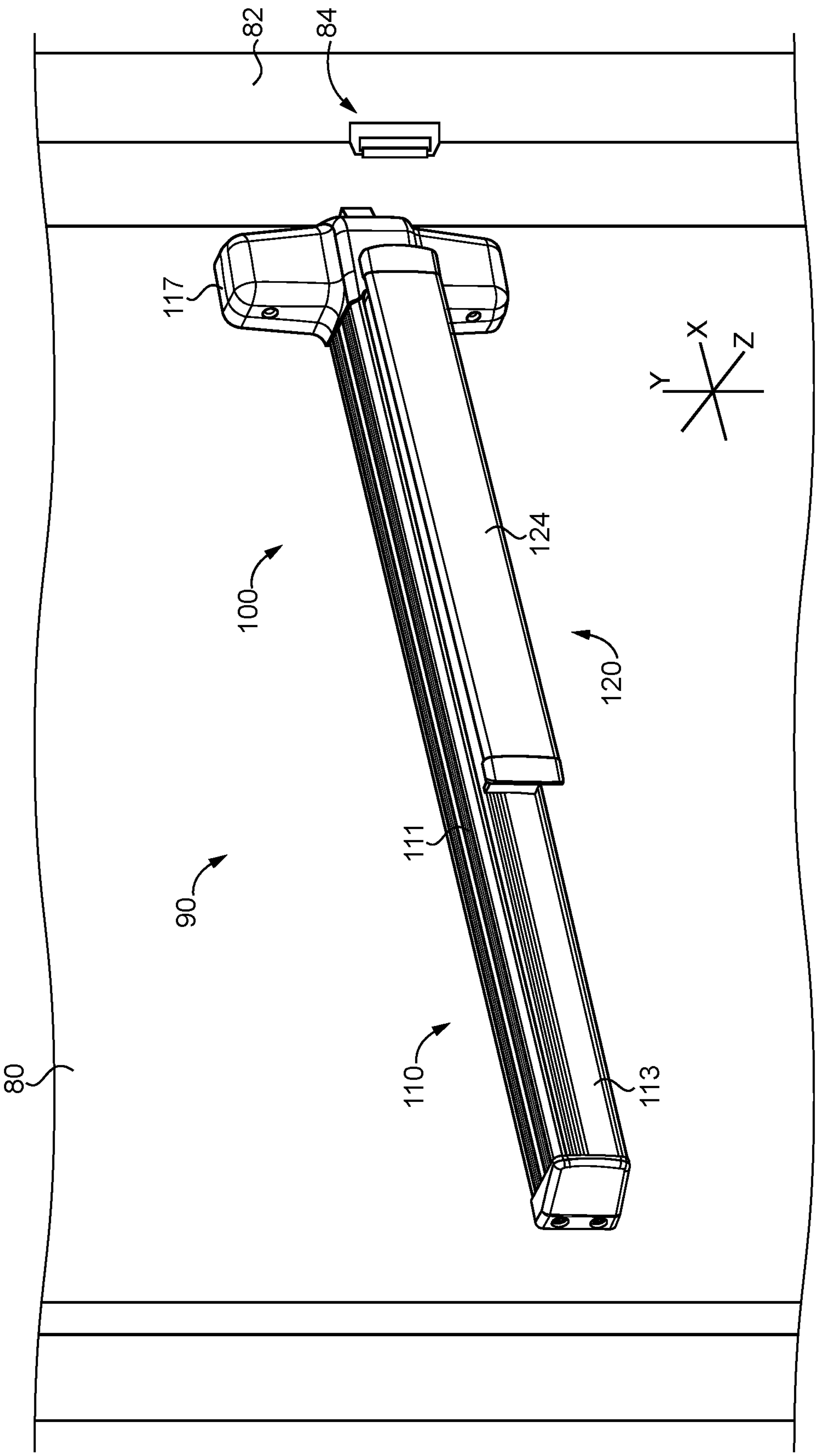


FIG. 1

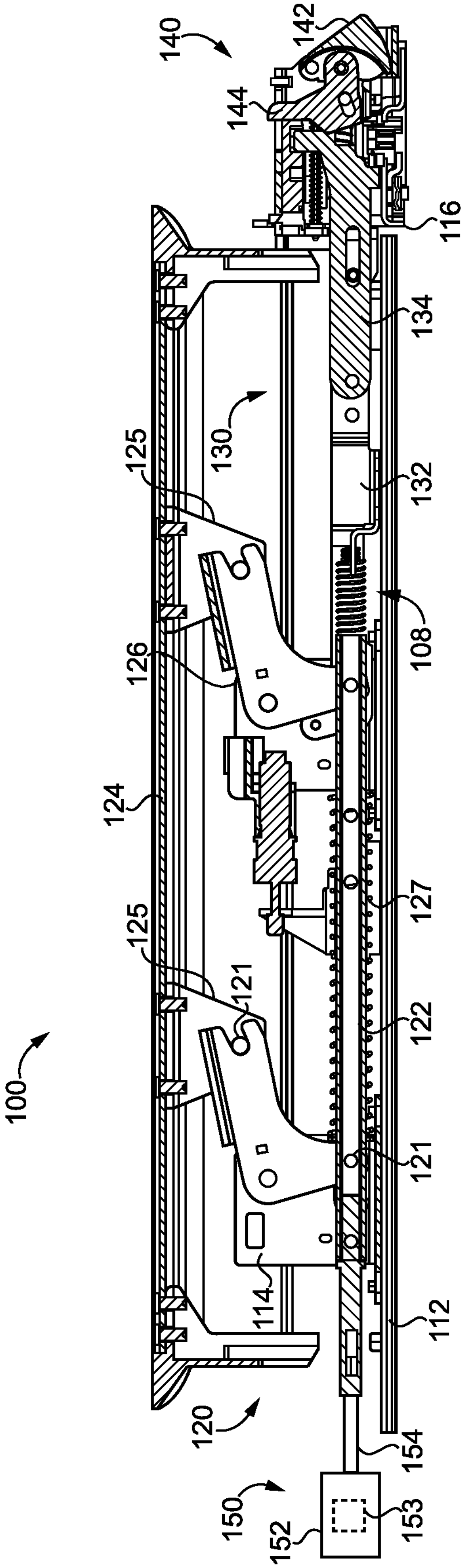

100
140
142
144
116
134
130
132
125
108
126
124
127
125
121
122
121
114
112
120
154
150
152
153

FIG. 2

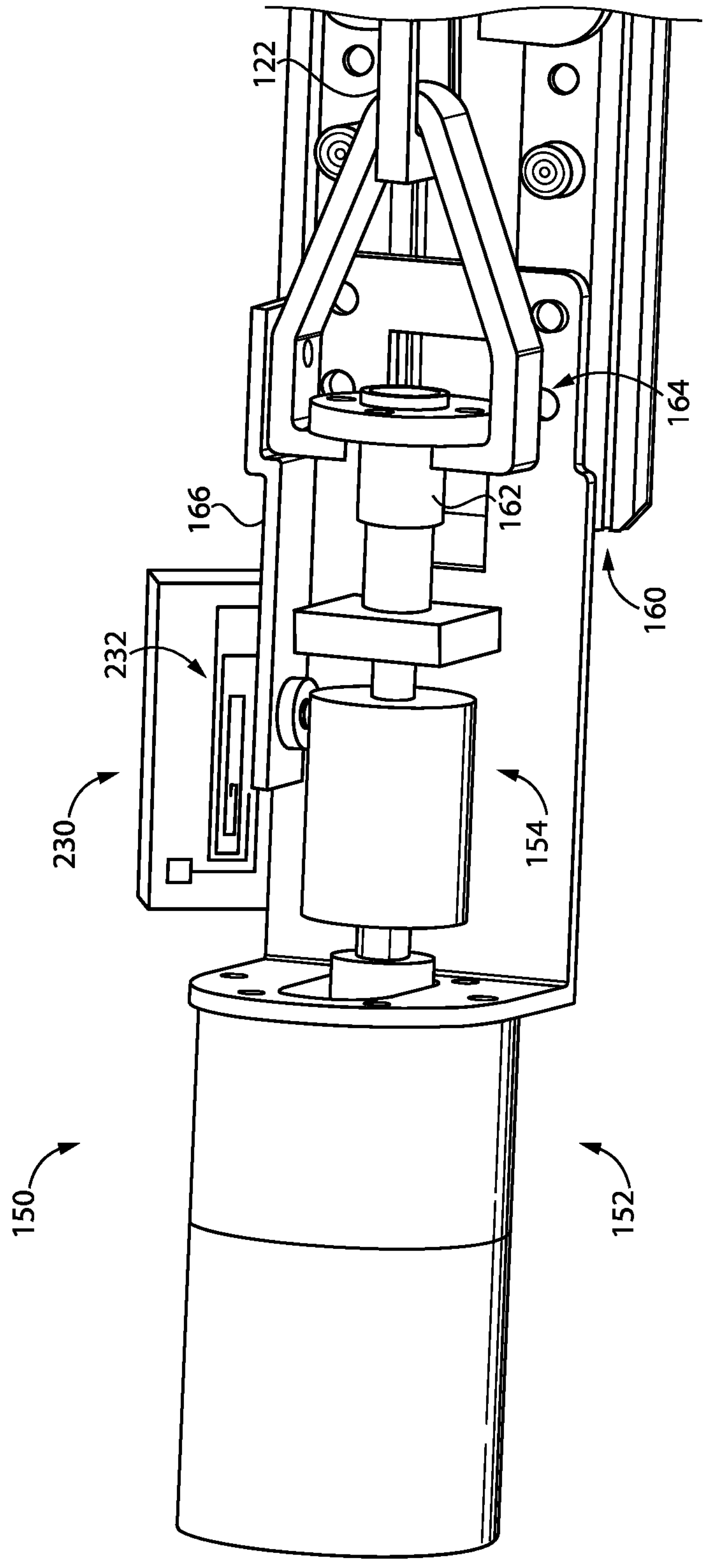
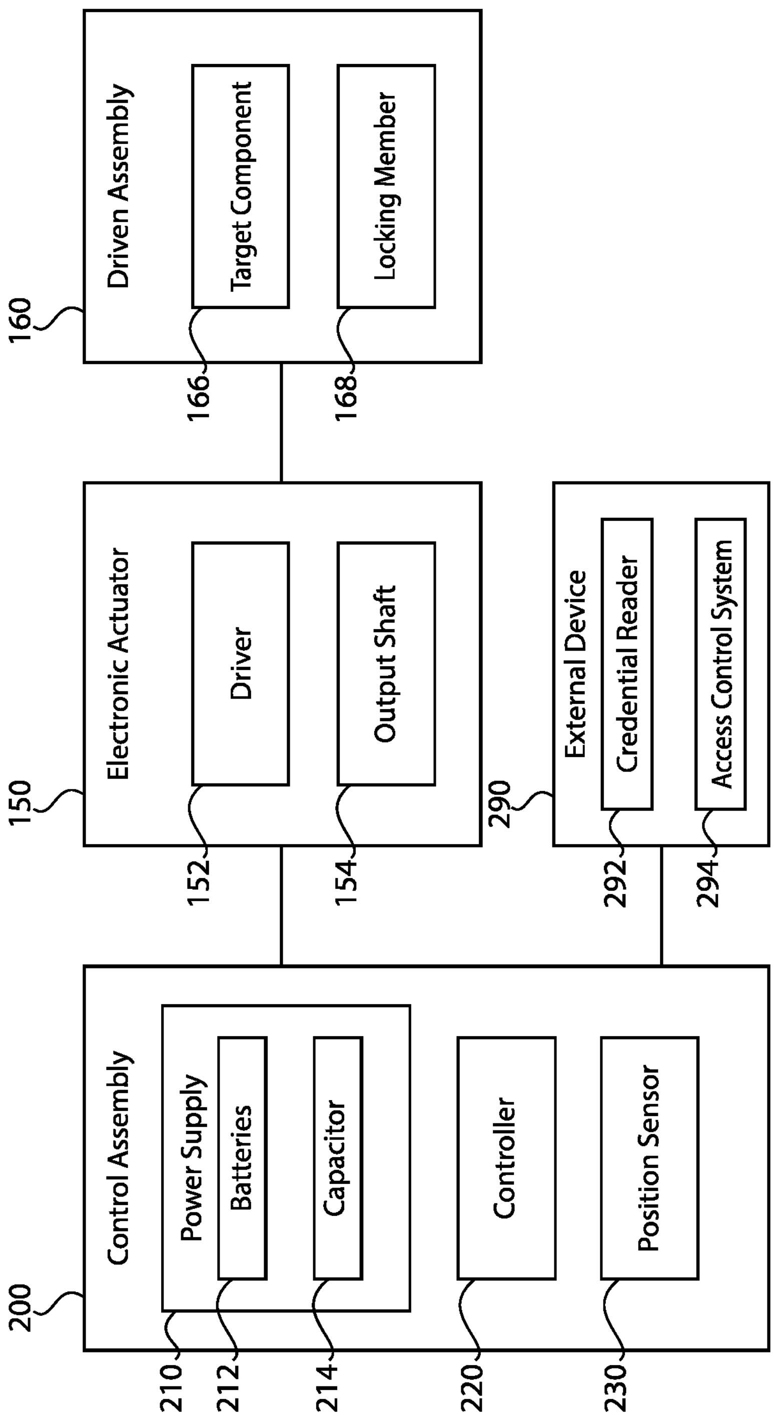


FIG. 3



160
Driven Assembly
Target Component
Locking Member
166
168
150
Electronic Actuator
Driver
Output Shaft
152
154
290
External Device
Credential Reader
Access Control System
292
294
200
Control Assembly
Power Supply
Batteries
Capacitor
Controller
Position Sensor
210
212
214
220
230

FIG. 4

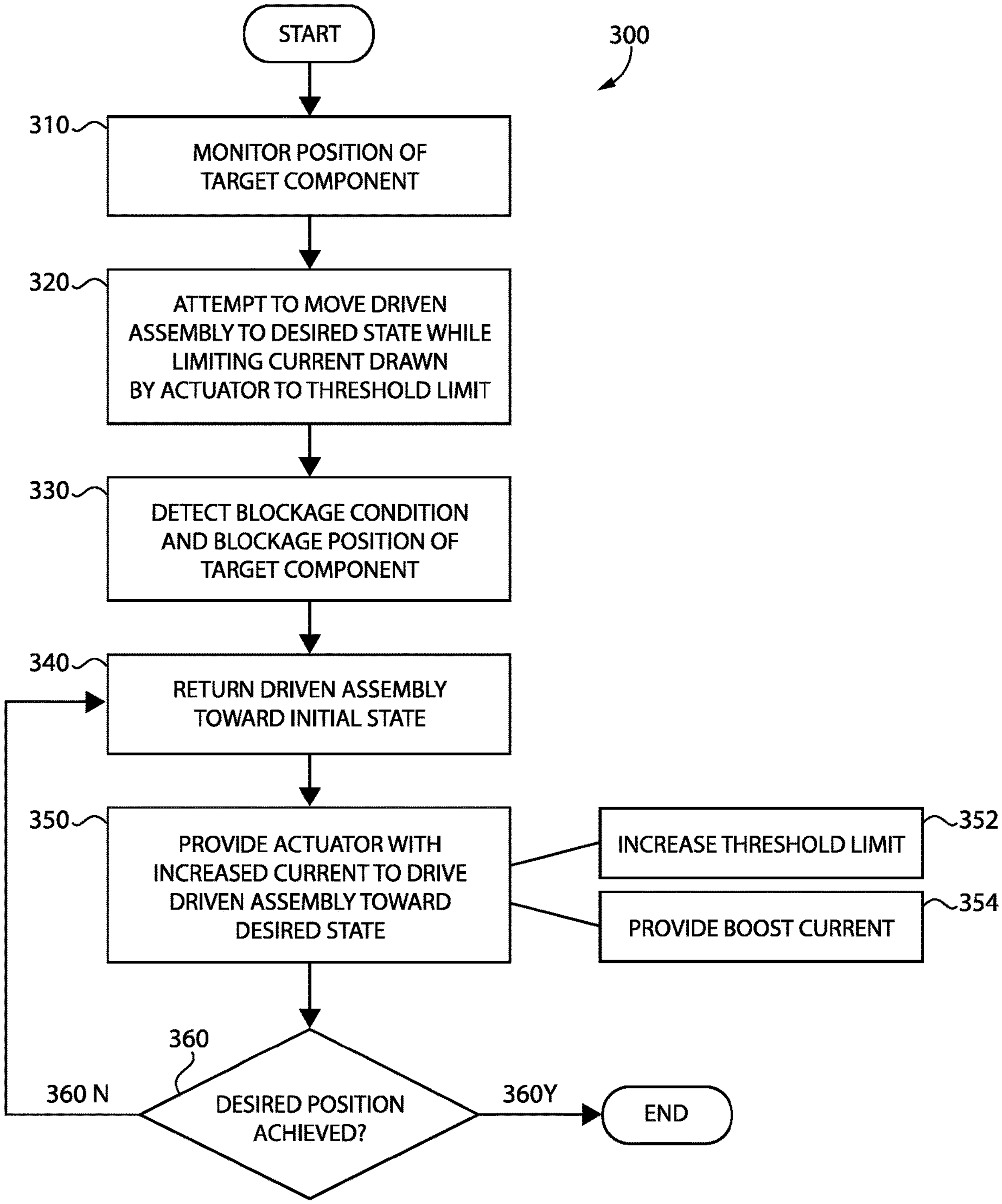

START
300
310
MONITOR POSITION OF TARGET COMPONENT
320
ATTEMPT TO MOVE DRIVEN ASSEMBLY TO DESIRED STATE WHILE LIMITING CURRENT DRAWN BY ACTUATOR TO THRESHOLD LIMIT
330
DETECT BLOCKAGE CONDITION AND BLOCKAGE POSITION OF TARGET COMPONENT
340
RETURN DRIVEN ASSEMBLY TOWARD INITIAL STATE
350
PROVIDE ACTUATOR WITH INCREASED CURRENT TO DRIVE DRIVEN ASSEMBLY TOWARD DESIRED STATE
352
INCREASE THRESHOLD LIMIT
354
PROVIDE BOOST CURRENT
360
360 N
DESIRED POSITION ACHIEVED?
360Y
END

FIG. 5

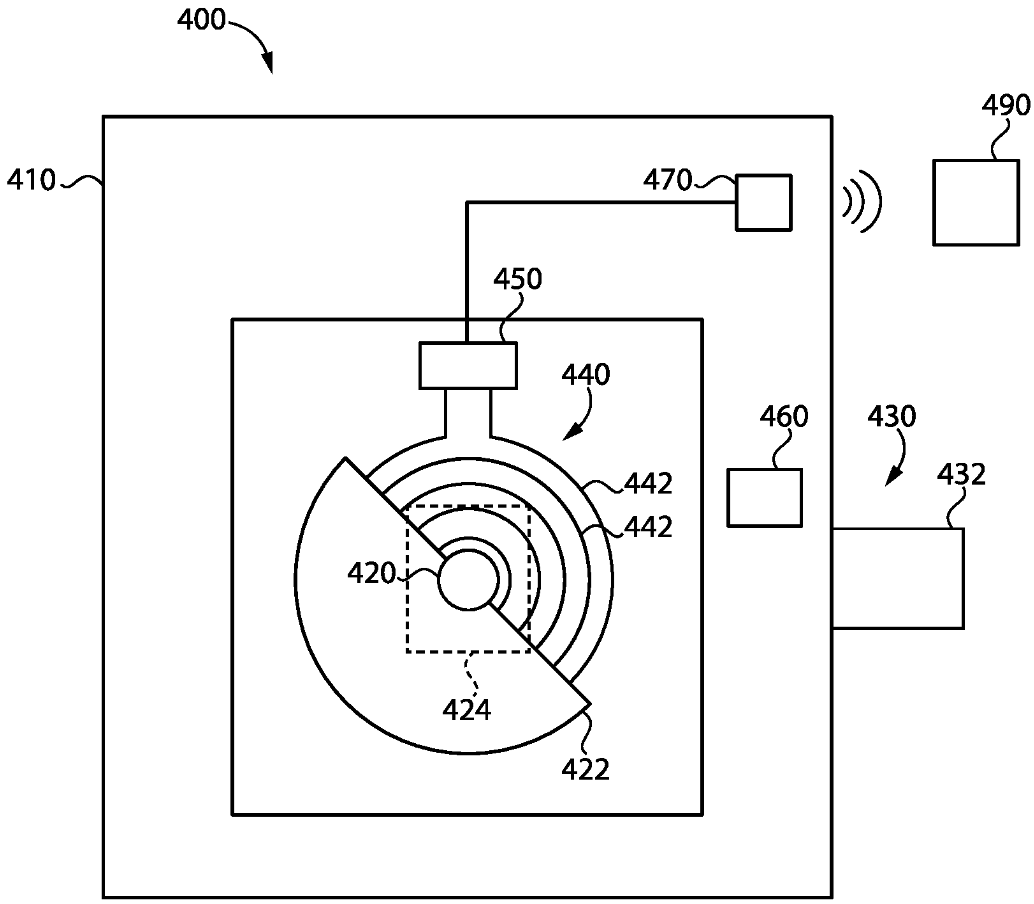


FIG. 6

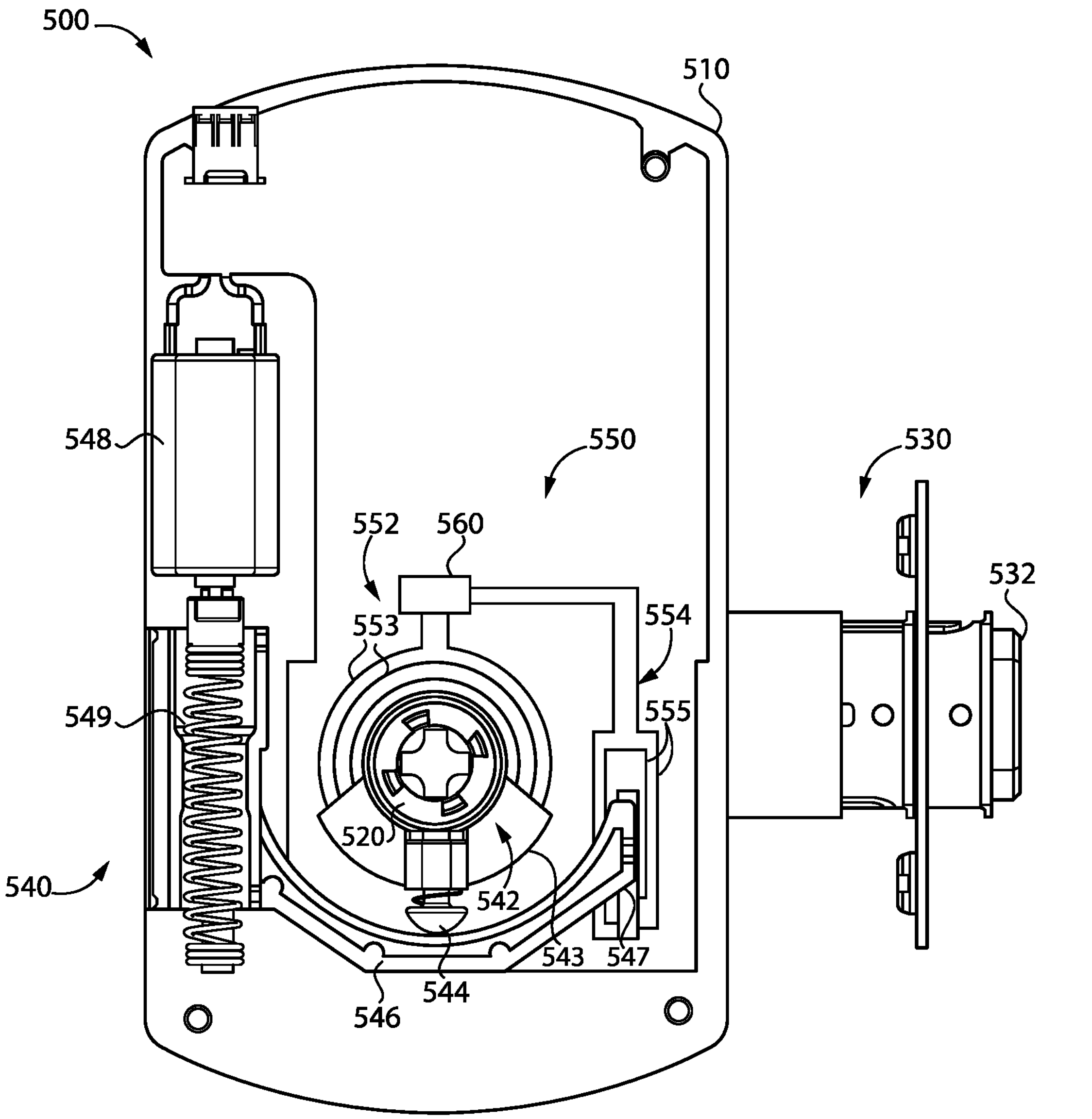

500
510
548
550
530
552
560
554
532
553
549
555
520
540
542
543
547
544
546

FIG. 7

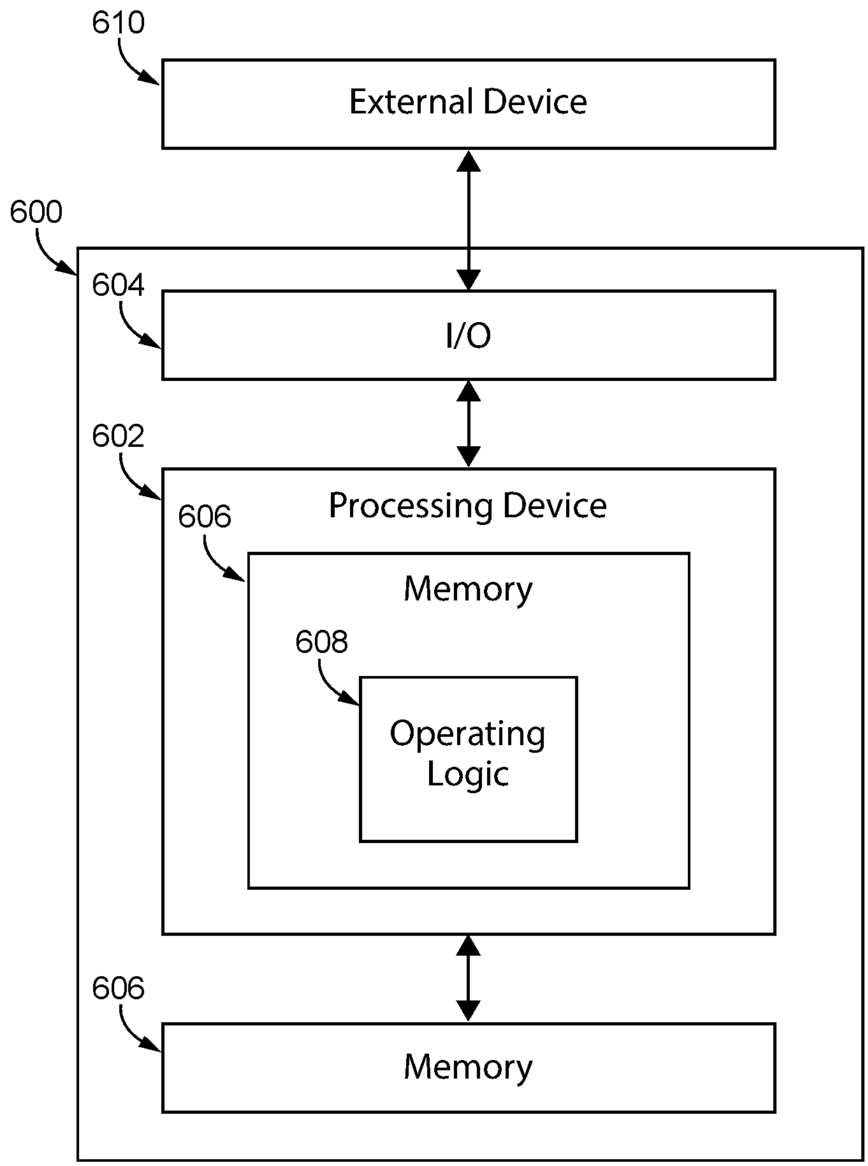

610
External Device
600
604
I/O
602
Processing Device
606
Memory
608
Operating Logic
606
Memory

FIG. 8

SENSING AND CONTROL OF ACCESS CONTROL DEVICES

CROSS REFERENCE TO RELATED APPLICATIONS

The present application is a divisional of U.S. patent application Ser. No. 16/532,999 filed Aug. 6, 2019 and issued as U.S. Pat. No. 11,719,021, the contents of which are incorporated by reference in their entirety.

TECHNICAL FIELD

The present disclosure generally relates to access control devices, and more particularly but not exclusively relates to methods of ensuring that the access control device adopts a selected or desired state.

BACKGROUND

Certain current approaches to access control suffer from various drawbacks and deficiencies, such as those relating to the sensing of a position of a movable component, and ensuring that the device reaches a selected or desired state when instructed to do so. For example, while certain access control devices attempt to sense the position of a movable component, the switches utilized to sense such positions are often incapable of providing the desired degree of fidelity. Regarding the latter difficulty, many conventional devices will provide power to the actuator for a predetermined period of time thought sufficient to cause the device to adopt its desired state. If there is a blockage, however, the device may not necessarily reach its desired state, and the actuator may draw excessive current in an attempt to move the device past the blockage. For these reasons among others, there remains a need for further improvements in this technological field.

SUMMARY

An exemplary method generally relates to operating an access control device including a motor, a locking member, and a target component operably connected with the locking member. The motor may be operated to drive the locking member in a first direction from an initial position toward a desired position. When the locking member is blocked from moving beyond a blockage position, a target location of the target component is detected. The motor may then be operated to drive the locking member in a second direction opposite the first direction. The motor may then be operated to drive the locking member in the first direction toward the blockage position while monitoring the location of the target component. As the target component reaches the target location, the motor is supplied with a boost current to drive the locking member beyond the blockage position and toward the desired position. Further embodiments, forms, features, and aspects of the present application shall become apparent from the description and figures provided herewith.

BRIEF DESCRIPTION OF THE FIGURES

FIG. **1** is a perspective illustration of an exit device according to certain embodiments.

FIG. **2** is a cross-sectional illustration of the exit device illustrated in FIG. **1**.

FIG. **3** is a perspective illustration of a portion of the exit device illustrated in FIGS. **1** and **2**.

FIG. **4** is a schematic block diagram of an access control device according to certain embodiments.

FIG. **5** is a schematic flow diagram of a process according to certain embodiments.

FIG. **6** is a schematic representation of an access control device according to certain embodiments.

FIG. **7** is a plan view of an access control device according to certain embodiments.

FIG. **8** is a schematic block diagram of a computing device that may be utilized in certain embodiments.

DETAILED DESCRIPTION OF ILLUSTRATIVE EMBODIMENTS

Although the concepts of the present disclosure are susceptible to various modifications and alternative forms, specific embodiments have been shown by way of example in the drawings and will be described herein in detail. It should be understood, however, that there is no intent to limit the concepts of the present disclosure to the particular forms disclosed, but on the contrary, the intention is to cover all modifications, equivalents, and alternatives consistent with the present disclosure and the appended claims.

References in the specification to "one embodiment," "an embodiment," "an illustrative embodiment," etc., indicate that the embodiment described may include a particular feature, structure, or characteristic, but every embodiment may or may not necessarily include that particular feature, structure, or characteristic. Moreover, such phrases are not necessarily referring to the same embodiment. It should further be appreciated that although reference to a "preferred" component or feature may indicate the desirability of a particular component or feature with respect to an embodiment, the disclosure is not so limiting with respect to other embodiments, which may omit such a component or feature. Further, when a particular feature, structure, or characteristic is described in connection with an embodiment, it is submitted that it is within the knowledge of one skilled in the art to implement such feature, structure, or characteristic in connection with other embodiments whether or not explicitly described.

As used herein, the terms "longitudinal," "lateral," and "transverse" are used to denote motion or spacing along three mutually perpendicular axes, wherein each of the axes defines two opposite directions. The directions defined by each axis may be referred to as positive and negative directions, wherein the arrow of the axis indicates the positive direction. In the coordinate system illustrated in FIG. **1**, the X-axis defines first and second longitudinal directions, the Y-axis defines first and second lateral directions, and the Z-axis defines first and second transverse directions. These terms are used for ease and convenience of description, and are without regard to the orientation of the system with respect to the environment. For example, descriptions that reference a longitudinal direction may be equally applicable to a vertical direction, a horizontal direction, or an off-axis orientation with respect to the environment.

Furthermore, motion or spacing along a direction defined by one of the axes need not preclude motion or spacing along a direction defined by another of the axes. For example, elements that are described as being "laterally offset" from one another may also be offset in the longitudinal and/or transverse directions, or may be aligned in the longitudinal and/or transverse directions. The terms are therefore not to be construed as limiting the scope of the subject matter described herein.

Additionally, it should be appreciated that items included in a list in the form of "at least one of A, B, and C" can mean (A); (B); (C); (A and B); (B and C); (A and C); or (A, B, and C). Similarly, items listed in the form of "at least one of A, B, or C" can mean (A); (B); (C); (A and B); (B and C); (A and C); or (A, B, and C). Items listed in the form of "A, B, and/or C" can also mean (A); (B); (C); (A and B); (B and C); (A and C); or (A, B, and C). Further, with respect to the claims, the use of words and phrases such as "a," "an," "at least one," and/or "at least one portion" should not be interpreted so as to be limiting to only one such element unless specifically stated to the contrary, and the use of phrases such as "at least a portion" and/or "a portion" should be interpreted as encompassing both embodiments including only a portion of such element and embodiments including the entirety of such element unless specifically stated to the contrary.

In the drawings, some structural or method features may be shown in certain specific arrangements and/or orderings. However, it should be appreciated that such specific arrangements and/or orderings may not necessarily be required. Rather, in some embodiments, such features may be arranged in a different manner and/or order than shown in the illustrative figures unless indicated to the contrary. Additionally, the inclusion of a structural or method feature in a particular figure is not meant to imply that such feature is required in all embodiments and, in some embodiments, may be omitted or may be combined with other features.

The disclosed embodiments may, in some cases, be implemented in hardware, firmware, software, or a combination thereof. The disclosed embodiments may also be implemented as instructions carried by or stored on one or more transitory or non-transitory machine-readable (e.g., computer-readable) storage media, which may be read and executed by one or more processors. A machine-readable storage medium may be embodied as any storage device, mechanism, or other physical structure for storing or transmitting information in a form readable by a machine (e.g., a volatile or non-volatile memory, a media disc, or other media device).

With reference to FIGS. **1** and **2**, illustrated therein is an exit device **90** according to certain embodiments. The exit device **90** is configured for mounting to a door **80**, and generally includes a pushbar assembly **100** and an electrical actuation assembly **200** operable to actuate the pushbar assembly **100**. The pushbar assembly **100** generally includes a mounting assembly **110**, a drive assembly **120** movably mounted to the mounting assembly **110** for movement between an actuated state and a deactuated state, a latch control assembly **130** operably coupled with the drive assembly **120** via a lost motion connection **108**, a latchbolt mechanism **140** connected with the drive assembly **120** via the latch control assembly **130**, and an electromechanical actuator **150** operably coupled with the drive assembly **120**.

As described herein, the drive assembly **120** is biased toward the deactuated state, and is operable to be driven to the actuated state when manually actuated by a user or when electrically actuated by the electromechanical actuator **150**. The latch control assembly **130** also has an actuated state and a deactuated state, and is operably connected with the drive assembly **120** such that actuation of the drive assembly **120** causes a corresponding actuation of the latch control assembly **130**. Additionally, the electromechanical actuator **150** is operable to actuate the drive assembly **120** to retract a latchbolt **142** of the latchbolt mechanism **140** via actuation of the latch control assembly **130**.

The mounting assembly **110** generally includes an elongated channel member **111**, a base plate **112** mounted in the channel member **111**, and a pair of bell crank mounting brackets **114** coupled to the base plate **112**. Each of the mounting brackets **114** includes a pair of laterally-spaced walls that extend away from the base plate **112** in the forward direction. The illustrated mounting assembly **110** also includes a faceplate **113** that encloses a distal end portion of the channel member **111**, a header plate **116** positioned adjacent a proximal end of the channel member **111**, and a header casing **117** mounted to the header plate **116**.

The drive assembly **120** includes a drive rod **122** extending along the longitudinal axis **102**, a pushbar **124** having a pair of pushbar brackets **125** mounted to the rear side thereof, and a pair of bell cranks **126** operably connecting the drive rod **122** with the pushbar **124**. As described herein, the drive rod **122** is mounted for movement in the longitudinal (X) directions, the pushbar **124** is mounted for movement in the transverse (Z) directions, and the bell cranks **126** couple the drive rod **122** and the pushbar **124** for joint movement during actuation and deactuation of the drive assembly **120**. Each bell crank **126** is pivotably mounted to a corresponding one of the bell crank mounting brackets **114**. Each bell crank **126** includes a first arm pivotably connected to the drive rod **122**, and a second arm pivotably connected to a corresponding one of the pushbar brackets **125**. The pivotal connections may, for example, be provided by pivot pins **121**. The drive assembly **120** further includes a return spring **127** that is engaged with the mounting assembly **110**, and which biases the drive assembly **120** toward its deactuated state.

Each of the drive rod **122** and the pushbar **124** has an actuated position in the actuated state of the drive assembly **120**, and a deactuated position in the deactuated state of the drive assembly **120**. During actuation and deactuation of the drive assembly **120**, the drive rod **122** moves in the longitudinal (X) directions between a proximal deactuated position and a distal actuated position, and the pushbar **124** moves in the transverse (Z) directions between a projected or forward deactuated position and a depressed or rearward actuated position. Thus, during actuation of the drive assembly **120**, the drive rod **122** moves in the distal (X^-) direction, and the pushbar **124** moves in the rearward (Z^-) direction. Conversely, during deactuation of the drive assembly **120**, the drive rod **122** moves in the proximal (X^+) direction, and the pushbar **124** moves in the forward (Z^+) direction. The bell cranks **126** translate longitudinal movement of the drive rod **122** to transverse movement of the pushbar **124**, and translate transverse movement of the pushbar **124** to longitudinal movement of the drive rod **122**.

With the drive assembly **120** in its deactuated state, a user may depress the pushbar **124** to transition the drive assembly **120** to its actuated state. As the pushbar **124** is driven toward its depressed position, the bell cranks **126** translate the rearward movement of the pushbar **124** to distal movement of the drive rod **122**, thereby compressing the return spring **127**. When the actuating force is subsequently removed from the pushbar **124**, the spring **127** returns the drive rod **122** to its proximal position, and the bell cranks **126** translate the proximal movement of the drive rod **122** to forward movement of the pushbar **124**, thereby returning the drive assembly **120** to its deactuated state.

The latch control assembly **130** includes a control link **132** and a yoke **134** that is coupled to a retractor **144** of the latchbolt mechanism **140** such that movement of the control link **132** in the distal direction (to the left in FIG. **3**) actuates the latchbolt mechanism **140** and retracts the latchbolt **142**. The control link **132** is coupled with the drive rod **122** via the lost motion connection **108** such that retraction of the drive rod **122** (i.e., movement of the drive rod from its proximal or extended position to its distal or retracted position) causes a corresponding retraction of the control link **132**.

The illustrated latchbolt mechanism **140** includes a pivotally mounted latchbolt **142** and a retractor **144** coupling the latchbolt **142** with the yoke **134**. Retraction of the yoke **134** by the control link **132** drives the retractor **144** and retracts the latchbolt **142**. Thus, retraction of the drive rod **122** by either the pushbar **124** or the electromechanical actuator **150** serves to actuate the latch control assembly **130** and retract the latchbolt **142**. In certain forms, the latchbolt **142** may be referred to as a locking member.

The electromechanical actuator **150** includes a driver **152** operable to extend and retract an output shaft **154** coupled with the drive rod **122** such that the actuator **150** is operable to actuate the drive assembly **120**. In the illustrated form, the electromechanical actuator is provided as a linear actuator in which the driver **152** is a rotary motor operable to rotate a rotor **153**. The output shaft **154** is threadedly engaged with a rotor **153** such that rotation of the rotor **153** linearly drives the output shaft **154** in the proximal and distal directions, depending upon the direction of the rotation of the rotor **153**. In other embodiments, the actuator **150** may be provided as a solenoid in which the driver **152** is an electromagnetic solenoid core that retracts the output shaft when energized.

In the illustrated form, the exit device **90** is provided as a rim-format exit device, in which the latchbolt mechanism **140** is positioned within the header casing **117** and is operable to engage a roller strike **84** mounted to the door-frame **82**. It is also contemplated that the exit device **90** may be provided in another format. For example, the exit device **90** may instead be provided in a mortise format, in which a latchbolt mechanism is mounted in a mortise assembly configured for mounting within the door **80**. As another example, the exit device **90** may be provided in a vertical format, in which one or more latchbolt mechanisms are mounted above and/or below the header casing **117**. Regardless of the precise location of the latchbolt mechanism, actuation of the latch control assembly **130** may nonetheless actuate the latchbolt mechanism to enable opening of the door **80**. Furthermore, while the illustrated access control device is provided in the form of an exit device, it is also contemplated that the access control device may take another form, certain illustrative examples of which are provided hereinafter.

With additional reference to FIG. **3**, the output shaft **154** is operably coupled with a driven assembly **160** such that actuation of the actuator **150** drives the driven assembly **160**. The driven assembly **160** includes a collar **162** mounted to the motor shaft **154**, a coupler **164** engaged between the collar **162** and the drive rod **122**, and a target component **166**, which in the illustrated form is mounted to the coupler **164**. Retraction of the output shaft **154** by the motor **152** retracts the collar **162** and the coupler **164**, thereby retracting the drive rod **122**, thereby actuating the drive assembly **120**, the latch control assembly **130**, and the latchbolt mechanism **140**, thereby retracting the latchbolt **142**. As such, the driven assembly **160** may be considered to further include the drive assembly **120**, the latch control assembly **130**, and the latchbolt mechanism **140**.

Each component of the driven assembly **160** that moves with actuation of the actuator **150** may be referred to as a movable component of the driven assembly **160**. While the illustrated target component **166** is mounted to the coupler **164**, it is also contemplated that the target component **166** may be mounted to another movable component of the driven assembly **160**, or may be provided as such a movable component of the driven assembly **160**. Additionally, the driven assembly **160** may include a locking member **168**, such as the latchbolt **142**. In other forms, the locking member **168** may take another form.

With additional reference to FIG. **4**, the electronic actuator **150** is in communication with a control assembly **200**. The control assembly **200** generally includes a power supply **210**, a controller **220**, and a position sensor **230**. The control assembly **200** may be in communication with an external device **290**, for example via a wired or wireless communication connection.

In the illustrated form, the power supply **210** is provided as an onboard power supply installed to the exit device **90**. The illustrated power supply **210** includes one or more batteries **212** and/or one or more capacitors **214**. In other forms, the power supply **210** may comprise line power, in which case the batteries **212** may be omitted. As described herein, the power supply **210** is operable to supply power to the electromechanical actuator **150**, the controller **220**, and the position sensor **230**.

The controller **220** is powered by the power supply **210**, is in communication with the position sensor **230**, and is configured to control operation of the electromechanical actuator **150**. Further details regarding such communication and control are provided herein.

The position sensor **230** is associated with the target component **166** such that the position sensor **230** is operable to sense the position of the target component **166**, and to output information relating to the sensed position of the target component. In the illustrated form, the target component **166** is provided as an electrically conductive target component, and the position sensor **230** is provided as a linear inductive position sensor including a plurality of coils **232**. When active, the sensor **230** is provided with an alternating current such that the coils **232** generate a magnetic field. The generated magnetic field induces eddy currents in the electrically conductive target component **166**, which affects the magnetic field generated by the coils and alters the output signal of the sensor **230**. As will be appreciated, the output of the sensor **230** varies as the inductive target component **166** traverses the coils **232** such that the output of the sensor is correlated with the absolute position of the inductive target component **166**. Thus, in contrast to switches, which provide a binary indication of the position of a target component, the inductive sensor **230** is operable to generate a signal indicative of the precise location of the target component **166** within a range of available positions. As described herein, this feature may provide for advantages in certain embodiments.

In the illustrated form, the sensor **230** is provided as an inductive position sensor, and is associated with an electrically conductive target component **166**. It is also contemplated that the sensor **230** may be provided in another form. For example, the sensor **230** may instead be provided as a Hall effect sensor, and the target component **166** may be provided as a magnet mounted to or integrally formed with a movable component of the driven assembly **160**.

The external device **290** may be provided as a credential reader **292** and/or an access control system **294**, each of which may be operable to provide the control assembly **200** with commands related to the operation of the electronic actuator **150**. For example, the credential reader **292** and/or the access control system may issue an unlock command to the control system **200**, and the controller **220** may cause the electromechanical actuator **150** to retract the latchbolt **142** in response to the unlock command.

When operating the actuator **150**, the control system **200** may limit the current drawn by the actuator **150** to a threshold limit. While limiting of the current drawn limits the force that the actuator **150** is operable to exert on the driven assembly **160**, such limiting can also aid in preserve the life and health of the batteries **212**. In certain circumstances, it may be the case that the limited force available to the actuator **150** is insufficient to drive the locking member **168** from a start position to a desired position, such as when a blockage prevents the locking member **168** from moving beyond a blockage position. For example, if a user is holding the pushbar **124** in its extended position in an attempt to tamper with operation of the exit device **90**, the actuator **150** may initially be unable to actuate the drive assembly **120** to retract the latchbolt **142**. In such circumstances, the control assembly **200** may perform a blockage overcoming operation such as those described herein.

With additional reference to FIG. **5**, illustrated therein is a process **300** according to certain embodiments. While the process **300** may be performed using the exit device **90** described above, it is also contemplated that the process **300** may be performed using access control devices of other types, such as those of the types illustrated in FIGS. **6** and **7**. Thus, while certain aspects of the process **300** are described herein with specific reference to the exit device **90**, it is to be appreciated that descriptions may also be applicable when the process **300** is utilized in connection with access control devices of other forms.

Operations illustrated for the processes in the present application are understood to be examples only, and operations may be combined or divided, and added or removed, as well as re-ordered in whole or in part, unless explicitly stated to the contrary. Unless specified to the contrary, it is contemplated that certain operations or steps performed in the process **300** may be performed wholly by the control assembly **200**, or that the operations or steps may be distributed among one or more of the elements and/or additional devices or systems that are not specifically illustrated in FIGS. **1-4**. Furthermore, while the operations are illustrated in a relatively serial fashion, it is to be appreciated that certain operations may be performed in parallel or concurrently with one another.

The process **300** includes an operation **310**, which generally involves monitoring the position of the target component **166**. Each component of the driven assembly **160** may begin the process **300** in a corresponding and respective start position, and may end the process **300** in a corresponding and respective desired position. Should a blockage arise during the performance of the process **300**, each component of the driven assembly **160** may be temporarily blocked at a corresponding and respective blockage position located between its start position and its desired position. Thus, the driven assembly **160** may be considered to have a start state, a blocked state, and a desired state, which respectively include the start positions, the blockage positions, and the desired positions of the movable components of the driven assembly **160**. In various forms, the operation **310** may be performed continually, continuously, or intermittently throughout the performance of the process **300**.

The process **300** also includes an initial attempt operation **320**, which generally involves operating the actuator **150** in a first manner in an initial attempt to move the locking member **168** from its start position to its desired position. For example, in response to a valid credential being presented to the credential reader **292**, the controller **220** may activate the actuator **150** in an attempt to move the latchbolt **142** from its extended position to its retracted position. The operation **320** generally involves supplying a first current to the actuator **150** while limiting the current drawn by the actuator **150** to a threshold limit having a first value. Such actuation causes the driven assembly **160** and the movable components thereof (including the locking member **168** and the target component **166**) to move in a first direction from their start positions toward their desired positions.

The process **300** further includes an operation **330**, which generally involves detecting a blockage condition that prevents the driven assembly **160** from reaching its desired state. In certain forms, the operation **330** may involve detecting that the actuator **150** is attempting to draw a current in excess of the threshold limit. In certain forms, the operation **330** may involve detecting, via the sensor **230**, that the target component **166** has stalled before reaching its desired position. The operation **330** further involves detecting, via the sensor **230**, a blockage position for the target component **166**. This blockage position and/or the sensor output corresponding to the blockage position is saved in memory for future reference.

Upon detecting the blockage condition and noting the blockage position for the target component **166**, the process **300** continues to an operation **340**. The operation **340** generally involves operating the actuator **150** in a second manner that causes the driven assembly **160** to return toward its start position by traveling in a second direction opposite the first direction. In certain embodiments, operating the actuator **150** in the second manner involves providing the actuator with a second current. The second current may have a nonzero value such that the actuator **150** positively drives at least a portion of the driven assembly **160** toward its start state. It is also contemplated that the second current may be of a zero value. For example, in embodiments in which the driven assembly **160** is biased toward its start state, the biasing forces may back-drive the motor **152** while returning the driven assembly **160** toward its start state. In certain embodiments, the operation **340** may involve causing the driven assembly **160** to return to its start state, while in other forms the operation **340** may involve only allowing the driven assembly **160** to return to an intermittent state between the start state and the blockage state.

After allowing the driven assembly **160** to approach or reach its start state, the process **300** may continue to an operation **350**. The operation **350** generally involves operating the actuator **150** in a third manner that causes the driven assembly **160** to again travel in the first direction, which is toward the blockage state and the desired state. The operation **350** may involve a block **352** and/or a block **354**, each of which generally involves supplying the actuator **150** with a current in excess of the initial threshold limit as the driven assembly **160** approaches its blockage state.

In certain forms, the operation **350** involves block **352**, which generally involves increasing the threshold limit from a first value to a second value greater than the first value as the driven assembly **160** approaches the blockage state. In such forms, the driver **152** may draw a greater current from the batteries **212**, thereby increasing the force with which the driver **150** urges the driven assembly **160** toward its desired state.

In certain forms, the operation **350** involves block **354**, which generally involves providing the driver **152** with a boost current as the driven assembly **160** approaches its blockage state. In such embodiments, the process **300** may further involve storing electrical power in the capacitor **214**, and discharging the stored electrical power to the driver **152** as the driven assembly **160** approaches its blockage state.

As noted above, the blockage state of the driven assembly **160** corresponds to the blockage position of each movable component, including the target component **166**. Thus, by monitoring the position of the target component **166** with the sensor **230**, it is possible to provide the current in excess of the initial threshold limit as the driven assembly **160** approaches its blockage state. In certain forms, the controller **220** may derive a threshold position between the start position and the blockage position of the target component **166**, and may perform the operation **350** to provide the increased current when the output from the sensor **230** indicates that the target component **166** has reached the threshold position. In certain forms, the controller **220** may perform the operation **350** to provide the increased current when the target component **166** reaches the blockage position. Thus, in certain embodiments, the controller **220** may first operate the actuator **150** with the first current limit until the target component **166** reaches the threshold position or the blockage position, and subsequently perform the operation **350** to provide the actuator **150** with the increased current.

In certain circumstances, the increased current provided in the operation **350** may be sufficient to overcome the blockage. The process **300** may include block **360**, which generally involves evaluating the information received from the sensor **230** to determine whether the target component **166** has reached its desired position, which would indicate that the locking member **168** has likewise reached its desired position. When the information from the sensor **230** indicates that the target component **166** has reached its desired position, block **360** results in a positive result **360**Y, and the process **300** may terminate. When the information from the sensor **230** indicates that the target component **166** has not reached its desired position, block **360** results in a negative result **360**N.

In response to the negative result **360**N, the process **300** may return to the operation **340** to return the driven assembly **160** toward its start state, followed by an additional iteration of the operation **350**. The additional iteration of the operation **350** may involve providing the actuator **150** with a further increased current greater than the increased current provided in the prior iteration of the operation **350**. For example, the additional iteration of the operation **350** may involve increasing the threshold limit to a value greater than the value of the threshold limit in the prior iteration of the operation **350**, thereby permitting the motor **152** to drawn an even greater current from the batteries **212**.

In the illustrated embodiment, the process **300** involves first moving the driven assembly **160** away from the blockage position and toward its start position in operation **340** before supplying the actuator **150** with the increased current in operation **350**. This allows the driven assembly to build up momentum as the driven assembly **160** approaches the blockage state. In addition to the increased current provided to the actuator **150**, this momentum may aid in overcoming the blockage to a greater extent than if the operation **340** were omitted and the increased current were provided without first backing the driven assembly toward its start state.

With reference to FIG. **6**, illustrated therein is a portion of another embodiment of an access control device **400**. The access control device **400** generally includes a housing **410**, a spindle **420** rotatably mounted to the housing **410**, a bolt mechanism **430** operably connected with the spindle **420**, an inductive rotary position sensor **440** mounted to the housing **410** and associated with the spindle **420**, and a controller **450** in communication with the sensor **440**. The access control device **400** may further include an electromechanical actuator **460** operable to actuate the bolt mechanism **430**, for example by rotating the spindle **420**.

The spindle **420** is rotatably mounted to the housing **410**, and includes an inductive target component **422** mounted thereon and within the housing **410**. Mounted to an end of the spindle **420** and outside the housing **410** is a manual actuator **424** by which the spindle **420** can be rotated to actuate the bolt mechanism **430**. The bolt mechanism **430** includes a locking member in the form of a bolt **432** having an extended position and a retracted position. The bolt mechanism **430** is engaged with the spindle **420** such that rotation of the spindle **420** extends and retracts the bolt **432**.

In certain forms, the bolt mechanism **430** may be provided in the form of a latchbolt mechanism in which the bolt **432** is provided as a latchbolt. In such forms, the manual actuator **424** may be provided as a handle such as a knob or lever, and the handle and the latchbolt may be biased toward home positions. For example, the latchbolt may be biased toward an extended position by a spring of the bolt mechanism **430**, and the handle may be biased toward a corresponding home position by a spring cage. In other forms, the bolt mechanism **430** may be provided in the form of a deadbolt mechanism in which the bolt **432** is provided as a deadbolt. In such forms, the manual actuator **424** may be provided as a thumbturn, and the thumbturn and the deadbolt may not necessarily be biased toward home positions.

The inductive rotary position sensor **440** is associated with the inductive target component **422**. The sensor **440** includes a plurality of coils **442**, portions of which are covered by the target component **422**. The coils **442** are arranged such that the sensor **440** is operable to sense the absolute rotational position of the target component **422**. As a result, the sensor **440** is operable to detect the rotational position of the spindle **420** and to output information relating to the same.

The controller **450** is in communication with the sensor **440** and is operable to determine the rotational position of the spindle **420** based upon the information output by the sensor **440**. In the illustrated form, the controller **450** is further in communication with the electromechanical actuator **460**, and is operable to control operation of the electromechanical actuator **460** along the lines set forth above.

As noted above, the manual actuator **424** may be provided in the form of a lever handle. Such lever handles are typically biased toward a home position in which the lever is substantially horizontal. One issue that can arise with such lever handles is a droop condition, in which the lever fails to return to its fully horizontal position, and instead droops toward the ground. In the illustrated form, the controller **450** is able to detect the droop condition based upon the information received from the inductive rotary position sensor **440**. Due to the fact that the sensor **440** detects the absolute rotary position of the spindle **420**, the controller **450** is able to distinguish between a state in which the lever is fully horizontal and one in which the lever is drooping. Upon detection of a droop condition, the controller **450** may log the droop condition and/or report the droop condition to an external device **490**, for example via a wireless communication device **470**.

In certain embodiments, the bolt mechanism **430** may be provided in the form of a deadbolt mechanism in which the bolt **432** is not biased to either of its extended or retracted positions. Due to the fact that the rotational position of the spindle **420** corresponds to the position of the bolt **432**, the absolute position of the bolt **432** can be detected based upon the rotational position of the spindle **420**.

With reference to FIG. **7**, illustrated therein is an access control device in the form of a deadbolt assembly **500**. The deadbolt assembly **500** generally includes a housing **510**, a spindle **520** rotatably mounted to the housing **510**, a deadbolt mechanism **530**, a clutch assembly **540** selectively coupling the deadbolt mechanism **530** with the spindle **520**, a sensor assembly **550** associated with the clutch assembly **540**, and a controller **560** in communication with the clutch assembly **540** and the sensor assembly **550**.

In the illustrated form, the spindle **520** is coupled with a thumbturn, and is selectively connected with the deadbolt mechanism **530** via the clutch assembly **540**. The clutch assembly **540** includes an adapter **542** operably coupled with the deadbolt mechanism, a locking member in the form of a pin **544** operable to couple the adapter **542** with the spindle **520**, a movable wall **546** operable to move the pin **544** between a coupling position and a decoupling position, and a motor **548** operable to drive the wall **546** upward and downward. The motor **548** is engaged with the wall **546** via a spring **549** such that rotation of the spring **549** urges the wall **546** between an upper position and a lowed position. In the upper position, the wall **546** places the pin **544** in the coupling position, in which the pin **544** extends into a notch formed in the spindle **520** to rotationally couple the spindle **520** with the adapter **542**, thereby enabling the thumbturn to drive the deadbolt **532** between its extended and retracted positions. In the lower position, the wall **546** allows the pin **544** to move to its decoupling position, in which the pin **544** decouples the spindle **520** from the adapter **542** such that the thumbturn is not operable to drive the deadbolt **532** between its extended and retracted positions.

The sensor assembly **550** includes a first sensor **552** including first coils **553** and a second sensor **554** including second coils **555**. The first sensor **552** is an inductive rotational position sensor, and is associated with a first target component **543** coupled with the adapter **542** such that the first sensor **552** is operable to sense the rotational position of the adapter **542**. As a result, the controller **560** is able to determine the absolute position of the deadbolt **532** based upon the output from the first sensor **552**. The second sensor is an inductive linear position sensor, and is associated with a second target component **547** defined by the movable wall **546** such that the second sensor is operable to sense the linear position of the wall **546**. As a result, the controller **560** is able to determine the absolute position of the wall **546** based upon the output from the second sensor **554**.

In the illustrated form, the motor **548** is connected to the movable wall **546** via the spring **549**. When the wall **546** is blocked from moving to its desired position, the spring **549** stores mechanical energy that is released when the wall **546** becomes free to move to its desired position. However, it is also possible that the above-described process **300** may obviate the spring **549** by facilitating movement of the wall **546** to its desired position when the wall **546** is initially blocked from doing so. As such, it is contemplated that in certain embodiments, the motor **548** may be provided as a linear actuator, the output shaft of which is rigidly engaged with the wall **546**.

There exist certain existing systems in which a motor is operably engaged with a locking member via a spring in a manner similar to that illustrated in FIG. **7**. However, systems of this type typically run the motor for a predetermined period of time intended to be sufficient to move the locking member to its desired position, and report that the locking member is in the desired position once the motor has been run for the predetermined period of time. However, it may be the case that the locking member has not yet reached the desired position, and that the mechanical energy has instead been stored in the spring due to the locking member being blocked from reaching its desired position. Such shortcomings may be addressed by the embodiments described herein, for example by waiting to transmit the signal that the pin **544** has reached its desired position until the second sensor **544** indicates that the moving wall has reached the corresponding desired position.

As should be evident from the foregoing, the present disclosure sets forth, among other concepts and features, inductive sensing of a target component in an access control device. The target component may be operably connected with a locking member of the access control device and/or a manual actuator of the access control device. While certain existing access control devices include mechanical contact switches that provide binary indications relating to the position of a movable component, the absolute position sensing provided by the subject disclosure may provide certain advantages not afforded by the prior art.

As one example, in contrast to existing contact sensors, the inductive position sensors of the illustrated embodiments do not require contact with the associated target component, and are instead provided as contactless position sensors. This reduces wear on the sensor and the target components, and increases the reliability of the sensed position. Additionally, unlike Hall effect sensors, inductive position sensors are immune to stray magnetic fields.

Additionally, the information provided by the sensors of the subject disclosure can be used in many applications, such as smart home or smart installation solutions. By way of illustration, the information can be analyzed for predictive maintenance and/or smart home solutions, such as when the information is wirelessly communicated to a cloud or a smart home hub, such as within an Internet of Things environment. As one example, the detection of a droop condition may indicate that maintenance is needed. As another example, the detection of a blockage condition may indicate that door warpage or tampering has occurred, and that inspection and/or maintenance is warranted. In certain forms, the control assembly may cause continuous streaming of information relating to the position of the target component, thereby enabling real-time analytics relating to the operation of the access control device.

Referring now to FIG. **8**, a simplified block diagram of at least one embodiment of a computing device **600** is shown. The illustrative computing device **600** depicts at least one embodiment of a controller that may be utilized in connection with the access control devices illustrated in FIGS. **1-4**, **6**, and **7**.

Depending on the particular embodiment, the computing device **600** may be embodied as a server, desktop computer, laptop computer, tablet computer, notebook, netbook, Ultrabook™ mobile computing device, cellular phone, smartphone, wearable computing device, personal digital assistant, Internet of Things (IoT) device, reader device, access control device, control panel, processing system, router, gateway, and/or any other computing, processing, and/or communication device capable of performing the functions described herein.

The computing device **600** includes a processing device **602** that executes algorithms and/or processes data in accordance with operating logic **608**, an input/output device **604** that enables communication between the computing device **600** and one or more external devices **610**, and memory **606** which stores, for example, data received from the external device **610** via the input/output device **604**.

The input/output device **604** allows the computing device **600** to communicate with the external device **610**. For example, the input/output device **604** may include a transceiver, a network adapter, a network card, an interface, one or more communication ports (e.g., a USB port, serial port, parallel port, an analog port, a digital port, VGA, DVI, HDMI, FireWire, CAT 5, or any other type of communication port or interface), and/or other communication circuitry. Communication circuitry may be configured to use any one or more communication technologies (e.g., wireless or wired communications) and associated protocols (e.g., Ethernet, Bluetooth®, Bluetooth Low Energy (BLE), Wi-Fi®, WiMAX, etc.) to effect such communication depending on the particular computing device **600**. The input/output device **604** may include hardware, software, and/or firmware suitable for performing the techniques described herein.

The external device **610** may be any type of device that allows data to be inputted or outputted from the computing device **600**. For example, in various embodiments, the external device **610** may be embodied as an access control device, a credential reader, a sensor, or another of the electronic components illustrated in the foregoing Figures. Further, in some embodiments, the external device **610** may be embodied as another computing device, switch, diagnostic tool, controller, printer, display, alarm, peripheral device (e.g., keyboard, mouse, touch screen display, etc.), and/or any other computing, processing, and/or communication device capable of performing the functions described herein. Furthermore, in some embodiments, it should be appreciated that the external device **610** may be integrated into the computing device **600**.

The processing device **602** may be embodied as any type of processor(s) capable of performing the functions described herein. In particular, the processing device **602** may be embodied as one or more single or multi-core processors, microcontrollers, or other processor or processing/controlling circuits. For example, in some embodiments, the processing device **602** may include or be embodied as an arithmetic logic unit (ALU), central processing unit (CPU), digital signal processor (DSP), and/or another suitable processor(s). The processing device **602** may be a programmable type, a dedicated hardwired state machine, or a combination thereof. Processing devices **602** with multiple processing units may utilize distributed, pipelined, and/or parallel processing in various embodiments. Further, the processing device **602** may be dedicated to performance of just the operations described herein, or may be utilized in one or more additional applications. In the illustrative embodiment, the processing device **602** is of a programmable variety that executes algorithms and/or processes data in accordance with operating logic **608** as defined by programming instructions (such as software or firmware) stored in memory **606**. Additionally or alternatively, the operating logic **608** for processing device **602** may be at least partially defined by hardwired logic or other hardware. Further, the processing device **602** may include one or more components of any type suitable to process the signals received from input/output device **604** or from other components or devices and to provide desired output signals. Such components may include digital circuitry, analog circuitry, or a combination thereof.

The memory **606** may be of one or more types of non-transitory computer-readable media, such as a solid-state memory, electromagnetic memory, optical memory, or a combination thereof. Furthermore, the memory **606** may be volatile and/or nonvolatile and, in some embodiments, some or all of the memory **606** may be of a portable variety, such as a disk, tape, memory stick, cartridge, and/or other suitable portable memory. In operation, the memory **606** may store various data and software used during operation of the computing device **600** such as operating systems, applications, programs, libraries, and drivers. It should be appreciated that the memory **606** may store data that is manipulated by the operating logic **608** of processing device **602**, such as, for example, data representative of signals received from and/or sent to the input/output device **604** in addition to or in lieu of storing programming instructions defining operating logic **608**. As illustrated, the memory **606** may be included with the processing device **602** and/or coupled to the processing device **602** depending on the particular embodiment. For example, in some embodiments, the processing device **602**, the memory **606**, and/or other components of the computing device **600** may form a portion of a system-on-a-chip (SoC) and be incorporated on a single integrated circuit chip.

In some embodiments, various components of the computing device **600** (e.g., the processing device **602** and the memory **606**) may be communicatively coupled via an input/output subsystem, which may be embodied as circuitry and/or components to facilitate input/output operations with the processing device **602**, the memory **606**, and other components of the computing device **600**. For example, the input/output subsystem may be embodied as, or otherwise include, memory controller hubs, input/output control hubs, firmware devices, communication links (i.e., point-to-point links, bus links, wires, cables, light guides, printed circuit board traces, etc.) and/or other components and subsystems to facilitate the input/output operations.

The computing device **600** may include other or additional components, such as those commonly found in a typical computing device (e.g., various input/output devices and/or other components), in other embodiments. It should be further appreciated that one or more of the components of the computing device **600** described herein may be distributed across multiple computing devices. In other words, the techniques described herein may be employed by a computing system that includes one or more computing devices. Additionally, although only a single processing device **602**, I/O device **604**, and memory **606** are illustratively shown in FIG. **8**, it should be appreciated that a particular computing device **600** may include multiple processing devices **602**, I/O devices **604**, and/or memories **606** in other embodiments. Further, in some embodiments, more than one external device **610** may be in communication with the computing device **600**.

While the invention has been illustrated and described in detail in the drawings and foregoing description, the same is to be considered as illustrative and not restrictive in character, it being understood that only the preferred embodiments have been shown and described and that all changes and modifications that come within the spirit of the inventions are desired to be protected.

It should be understood that while the use of words such as preferable, preferably, preferred or more preferred utilized in the description above indicate that the feature so described may be more desirable, it nonetheless may not be necessary and embodiments lacking the same may be contemplated as within the scope of the invention, the scope being defined by the claims that follow. In reading the claims, it is intended that when words such as "a," "an," "at least one," or "at least one portion" are used there is no intention to limit the claim to only one item unless specifically stated to the contrary in the claim. When the language "at least a portion" and/or "a portion" is used the item can include a portion and/or the entire item unless specifically stated to the contrary.

What is claimed is:

1. A method of operating an access control device, the method comprising:
- supplying a first current to a motor of the access control device, wherein the motor is operably coupled with a locking member and a target component, wherein the motor drives the locking member from a start position to a blockage position in response to receiving the first current, wherein the blockage position is located between the start position and a desired position, and wherein supplying the first current comprises limiting the first current to a first threshold;
- generating, by a sensor of the access control device, a position signal indicative of a location of the target component when the locking member is in the blockage position;
- operating the motor to move the locking member from the blockage position toward the start position and away from the desired position; and
- supplying a second current to the motor to drive the locking member toward the blockage position and the desired position, wherein supplying the second current comprises limiting the second current to a second threshold greater than the first threshold;
- wherein one of the start position or the desired position is an unlocking position corresponding to an unlocked state of the access control device; and
- wherein the other of the start position or the desired position is a locking position corresponding to a locked state of the access control device.

2. The method of claim 1, further comprising raising a current limit for the motor from the first threshold to the second threshold as the target component approaches the location corresponding to the blockage position.

3. The method of claim 1, further comprising:
- storing electrical power in a capacitor; and
- discharging the electrical power from the capacitor to the motor as the target component approaches the location corresponding to the blockage position.

4. The method of claim 1, further comprising storing electrical power from an onboard power supply of the access control device in a capacitor of the access control device;
- wherein supplying the first current to the motor comprises drawing electrical power from the onboard power supply without drawing power from the capacitor; and
- wherein supplying the second current to the motor comprises drawing electrical power from both the onboard power supply and the capacitor.

5. The method of claim 4, wherein the onboard power supply comprises one or more batteries.

6. The method of claim 1, wherein operating the motor to drive the locking member from the blockage position toward the start position and away from the desired position comprises supplying a third current to the motor to cause the motor to drive the locking member toward the start position.

7. The method of claim 1, wherein operating the motor to drive the locking member from the blockage position toward the start position and away from the desired position comprises cutting power to the motor, and driving the locking member toward the start position with a biasing member, thereby back-driving the motor.

8. The method of claim 1, further comprising determining that the locking member remains in the blockage position after having supplied the second current to the motor, and in response thereto:
- operating the motor to move the locking member from the blockage position toward the start position and away from the desired position; and
- supplying a third current to the motor to drive the locking member toward the blockage position and the desired position, wherein the third current is greater than the second threshold.

9. A method of operating an access control device, the method comprising:
- operating a motor with an allowable current, thereby driving a locking member in a first direction from an initial position toward a desired position, wherein the locking member is blocked from moving in the first direction beyond a blockage position;
- with the locking member in the blockage position, detecting a location of a target component operably connected with the locking member, the target component having a target location corresponding to the blockage position;
- operating the motor to drive the locking member in a second direction opposite the first direction, thereby moving the target component away from the target location; and
- while operating the motor to drive the locking member in the first direction toward the blockage position:
  - monitoring the location of the target component; and
  - as the target component approaches the target location, supplying the motor with a boost current to drive the locking member beyond the blockage position and toward the desired position.

10. The method of claim 9, wherein monitoring the location of the target component comprises monitoring the location of the target component via an inductive position sensor of the access control device.

11. The method of claim 9, wherein supplying the motor with the boost current comprises discharging electrical power stored in a capacitor of the access control device.

12. The method of claim 9, wherein the locking member is a bolt;
- wherein one of the initial position or the desired position of the locking member is an extended position of the bolt; and
- wherein the other of the initial position or the desired position of the locking member is a retracted position of the bolt.

13. An access control device, comprising:
- a lock member having an initial position and a desired position;
- a target component operably connected with the lock member;
- an electromechanical actuator operably connected with the lock member and configured to drive the lock member between the initial position and the desired position; and
- a controller configured to control operation of the electromechanical actuator, the controller configured to:
  - operate the electromechanical actuator to drive the lock member in a first direction from the initial position toward the desired position;
  - detect a target location of the target component corresponding to a blocked position of the lock member between the initial position and the desired position;

in response to the detected target location corresponding to the blocked position of the lock member, move the lock member in a second direction opposite the first direction toward the initial position and away from the desired position which displaces the target component away from the target location;

operate the electromechanical actuator to drive the lock member in the first direction toward the blocked position;

monitor a location of the target component and as the target component approaches the target location, supply the electromechanical actuator with a boost current to drive the lock member beyond the blockage position and toward the desired position.

14. The access control device of claim **13**, wherein the electromechanical actuator comprises a motor.

15. The access control device of claim **13**, wherein one of the initial position or the desired position of the lock member corresponds to a locked state of the access control device, and wherein the other of the initial position or the desired position of the lock member corresponds to an unlocked state of the access control device.

16. The access control device of claim **13**, further comprising at least one sensor configured to detect the target location of the target component corresponding to the blocked position of the lock member.

17. The access control device of claim **16**, wherein the at least one sensor comprises an inductive position sensor.

18. The access control device of claim **16**, further comprising a capacitor that discharges electrical power stored in the capacitor to supply the electromechanical actuator with the boost current to drive the lock member beyond the blockage position and toward the desired position.

19. The access control device of claim **13**, wherein the controller is further configured to:

supply a first current to the electromechanical actuator to drive the lock member in the first direction from the initial position toward the desired position, the first current limited to a first threshold current; and

after the lock member is moved in the second direction toward the initial position and away from the desired position, supply a second current to the electromechanical actuator to drive the lock member in the first direction toward the blocked position, the second current limited to a second threshold current greater than the first threshold current.

20. The access control device of claim **19**, wherein the controller is further configured to raise the current limit for the electromechanical actuator from the first threshold current to the second threshold current as the target component approaches the target location corresponding to the blocked position of the lock member.

21. The access control device of claim **19**, wherein the controller is further configured to supply a third current to the electromechanical actuator to cause the electromagnetic actuator to move the lock member in the second direction toward the initial position and away from the desired position.

22. The access control device of claim **13**, further comprising a biasing member configured to move the lock member in the second direction toward the initial position and away from the desired position.

* * * * *