US 20250265885A1

(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2025/0265885 A1**

Roper et al. (43) **Pub. Date: Aug. 21, 2025**

(54) **INTELLIGENT INTEGRATED LOCKING DEVICES AND SYSTEMS**

(71) Applicant: **Acuity Technical Designs, LLC**, Phoenix, AZ (US)

(72) Inventors: **Brian K. Roper**, Phoenix, AZ (US); **Todd K. Roper**, Glendale, AZ (US); **Daniel Blanc-Gonnet**, Phoenix, AZ (US)

(73) Assignee: **Acuity Technical Designs, LLC**, Phoenix, AZ (US)

(21) Appl. No.: **19/197,225**

(22) Filed: **May 2, 2025**

Related U.S. Application Data

(63) Continuation of application No. 18/104,762, filed on Feb. 1, 2023, now Pat. No. 12,307,849, which is a continuation of application No. 17/397,450, filed on Aug. 9, 2021, now Pat. No. 11,580,807, which is a continuation of application No. 16/930,286, filed on Jul. 15, 2020, now Pat. No. 11,170,597.

(60) Provisional application No. 62/874,439, filed on Jul. 15, 2019.

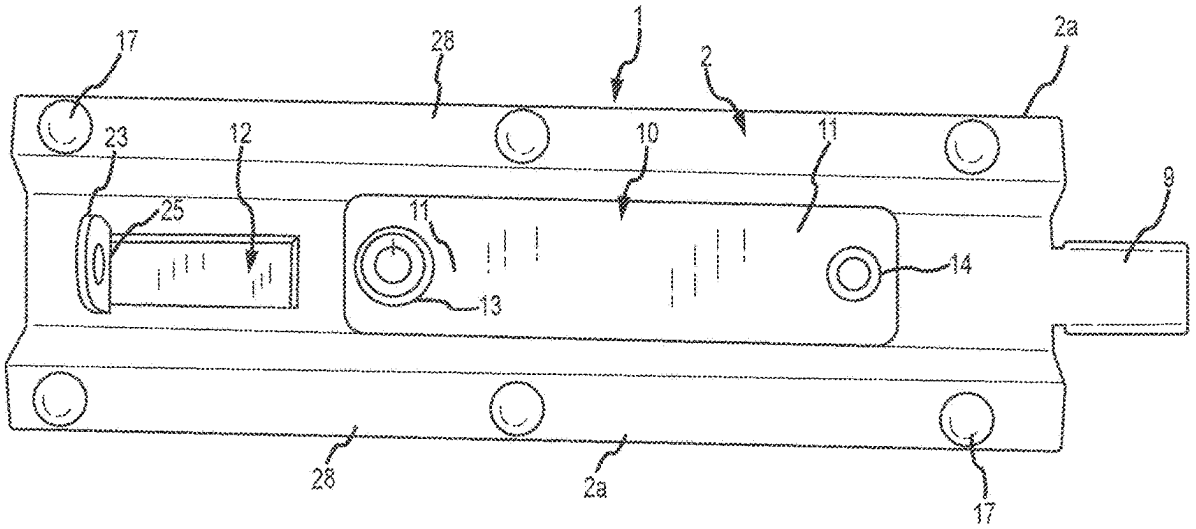
Publication Classification

(51) **Int. Cl.**
G07C 9/37 (2020.01)
G07C 9/00 (2020.01)

(52) **U.S. Cl.**
CPC ***G07C 9/37*** (2020.01); ***G07C 9/00182*** (2013.01)

(57) **ABSTRACT**

An intelligent locking system can include a lock having a lock body, a locking mechanism moveable between a locked position and an unlocked position, and a transceiver configured to transmit and receive data. The locking system can further include a controller configured to perform lock operations and authenticate a user for access to the lock. The controller can be configured to receive a first authorization token from a lock-control server, receive a second authorization token from a personal device of the user, and transition the locking mechanism between the locked position and the unlocked position upon verification of both the first authorization token and the second authorization token.



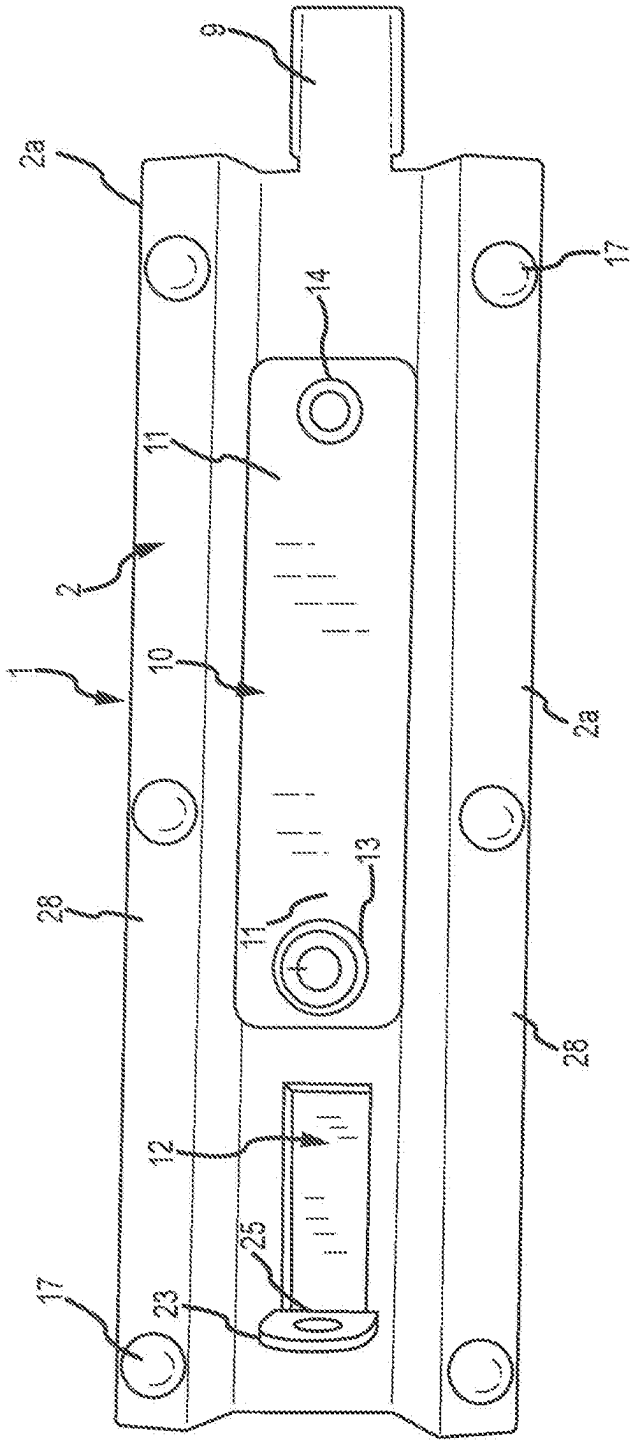


FIG. 1

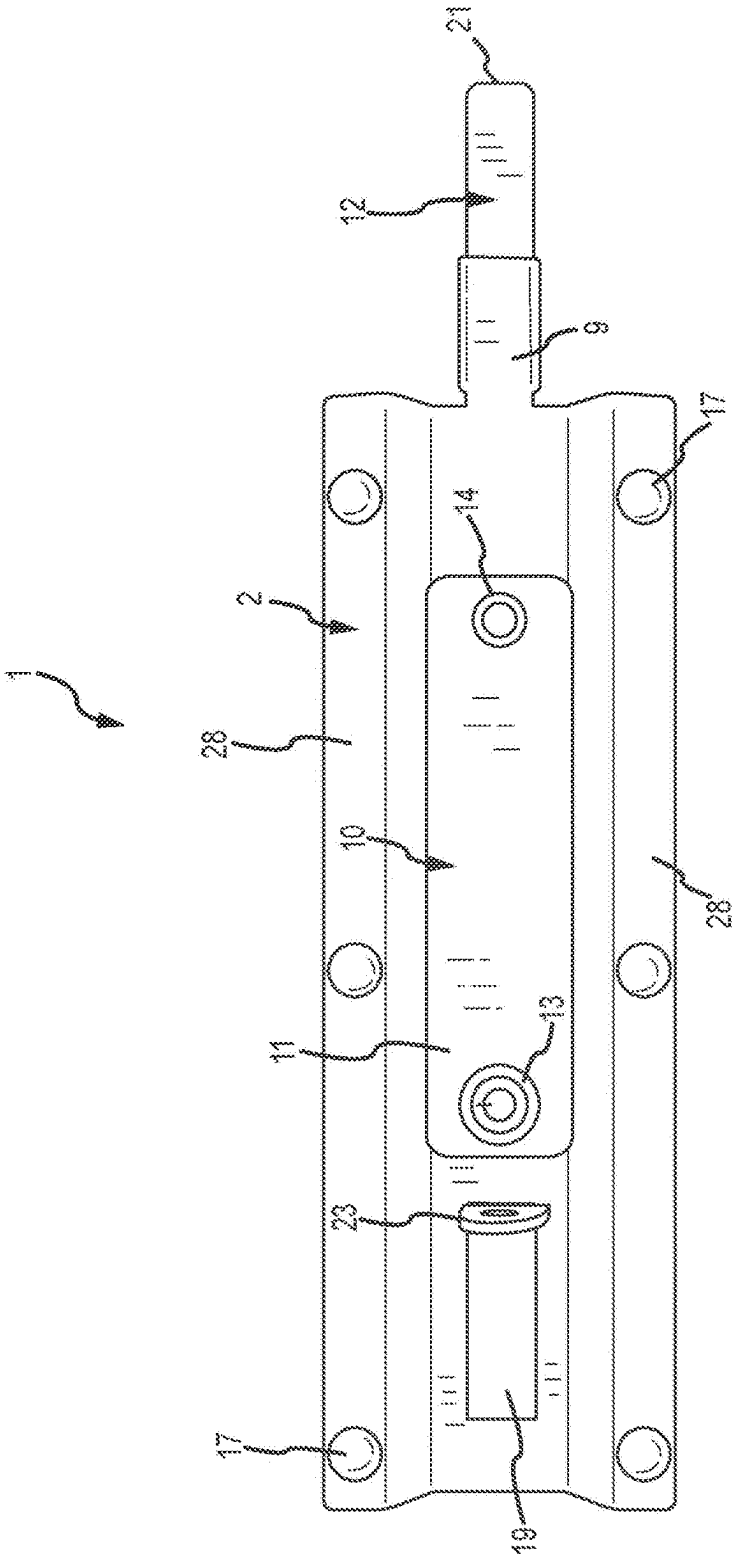


FIG. 2

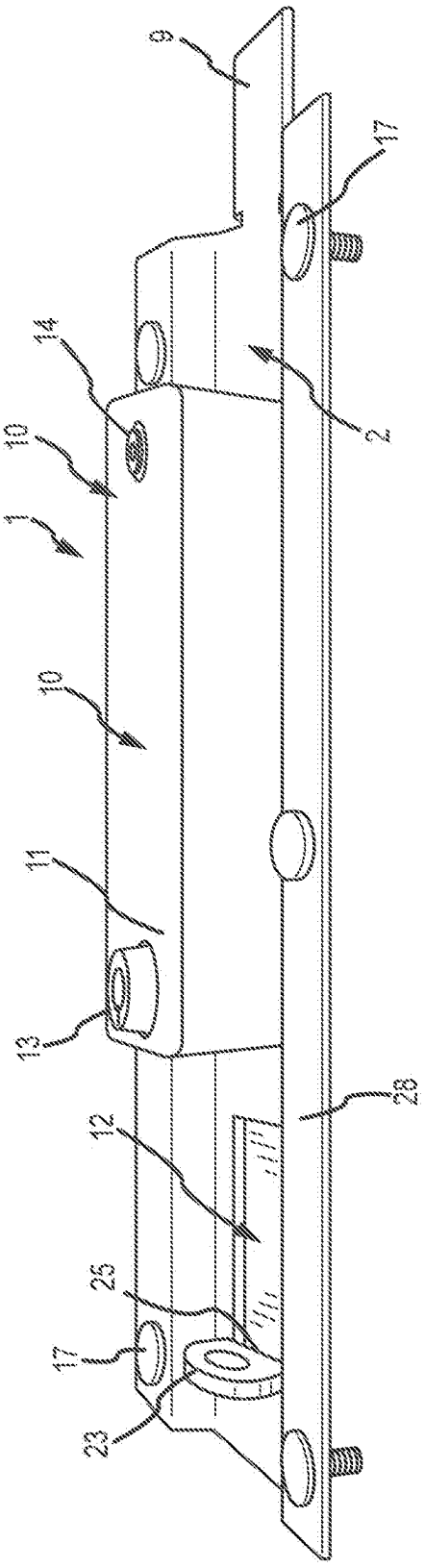


FIG. 3

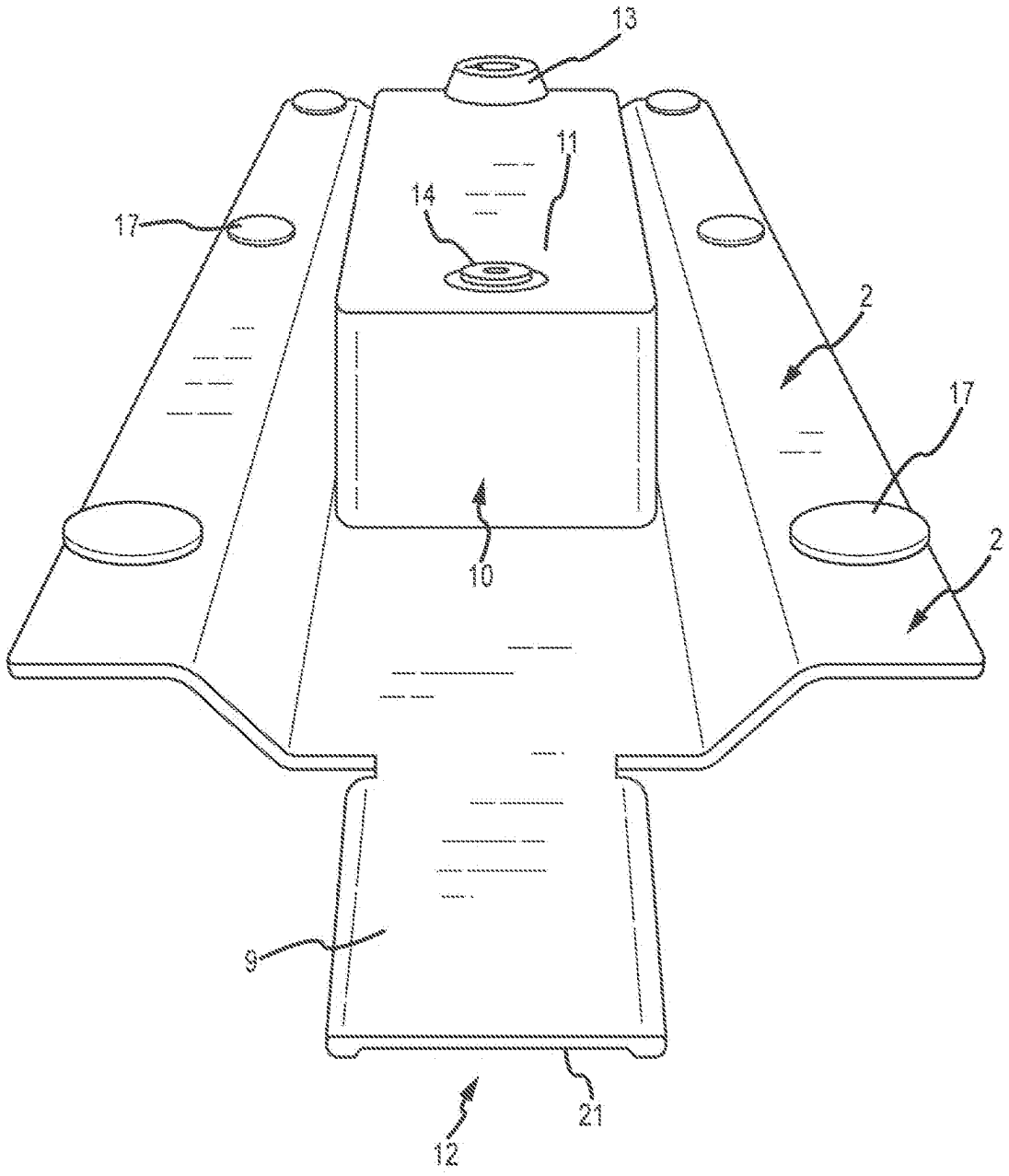


FIG.4

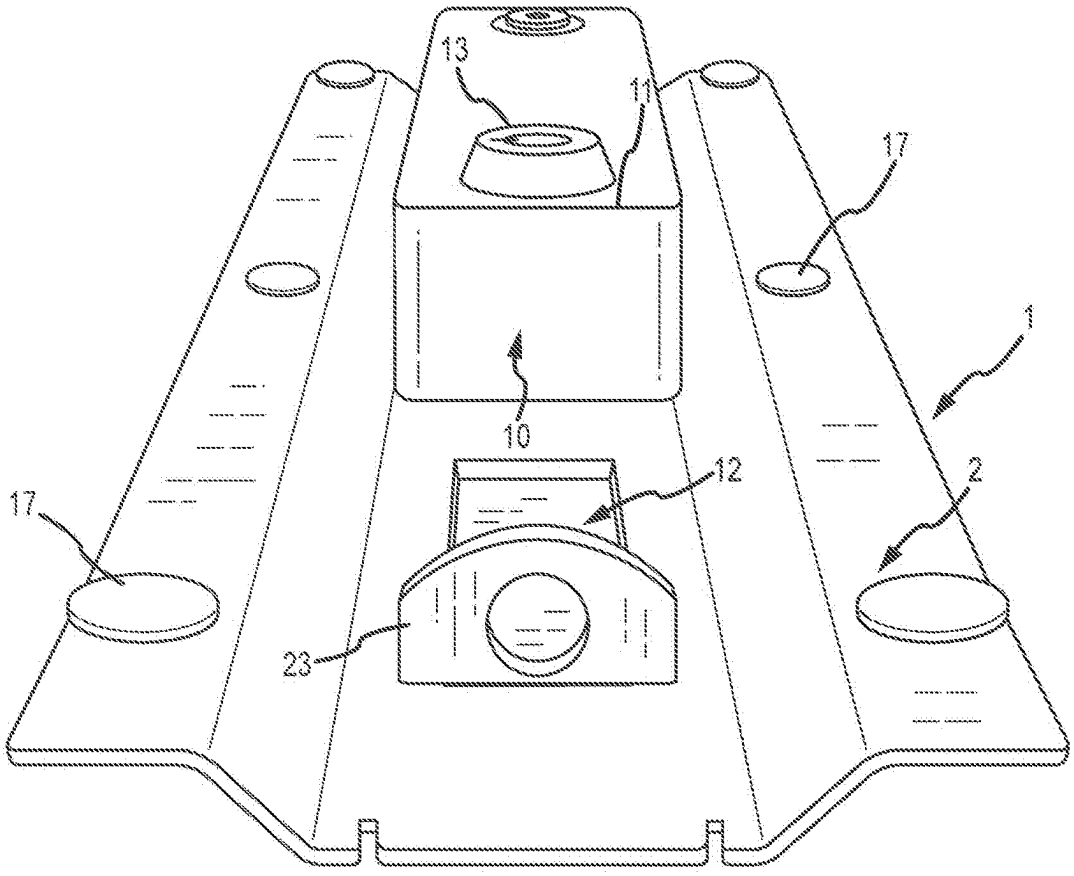


FIG.5

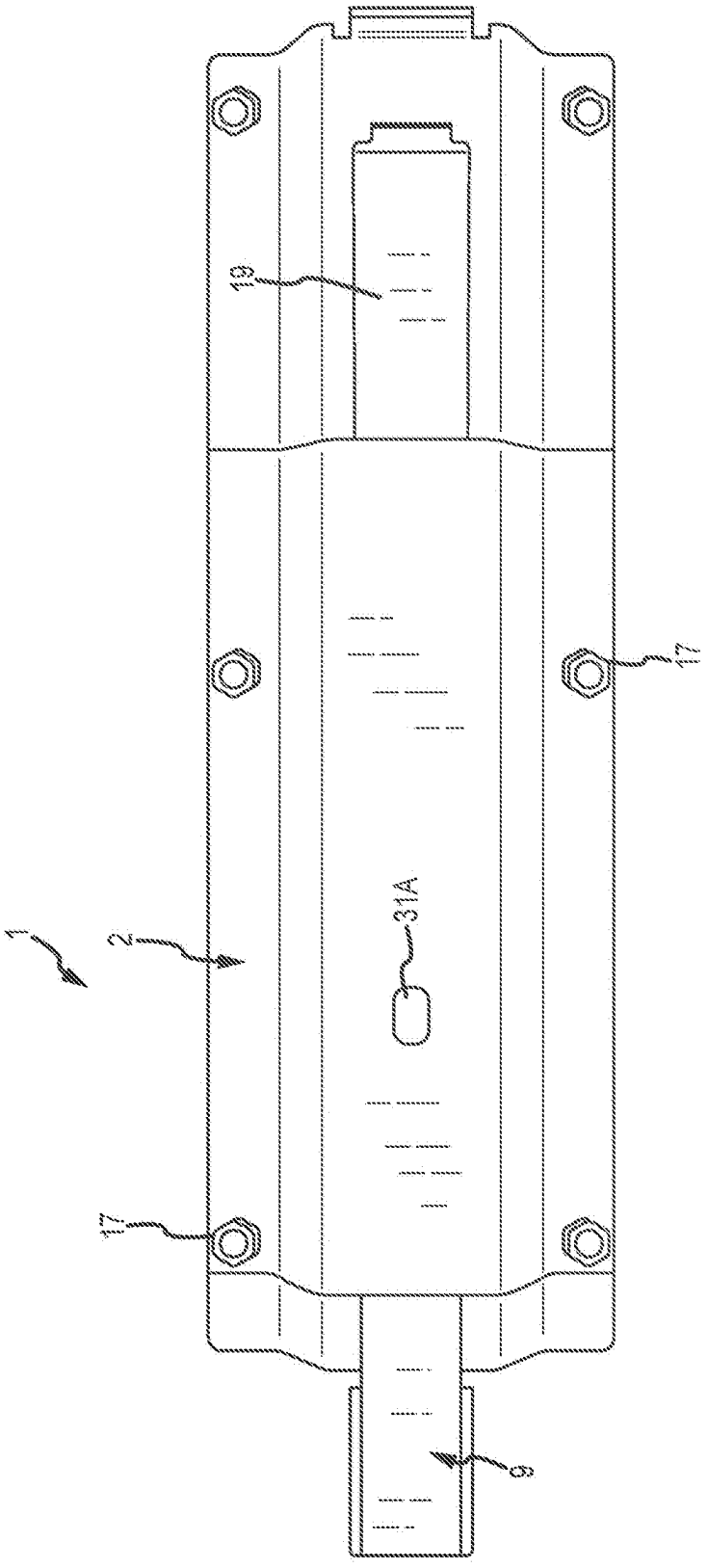


FIG.6

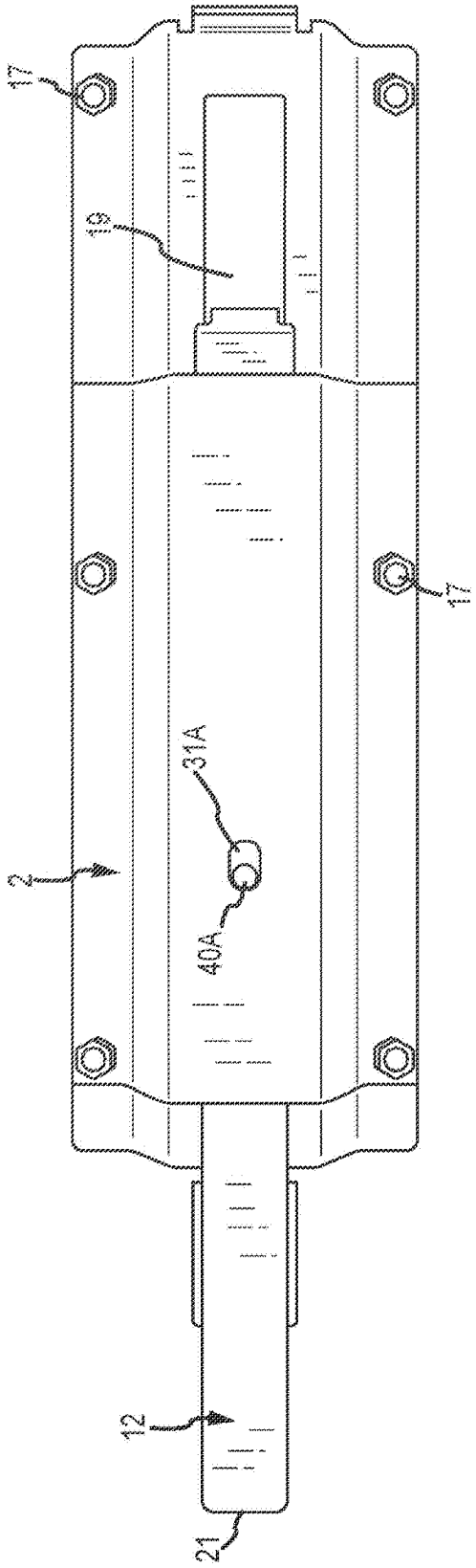


FIG. 7

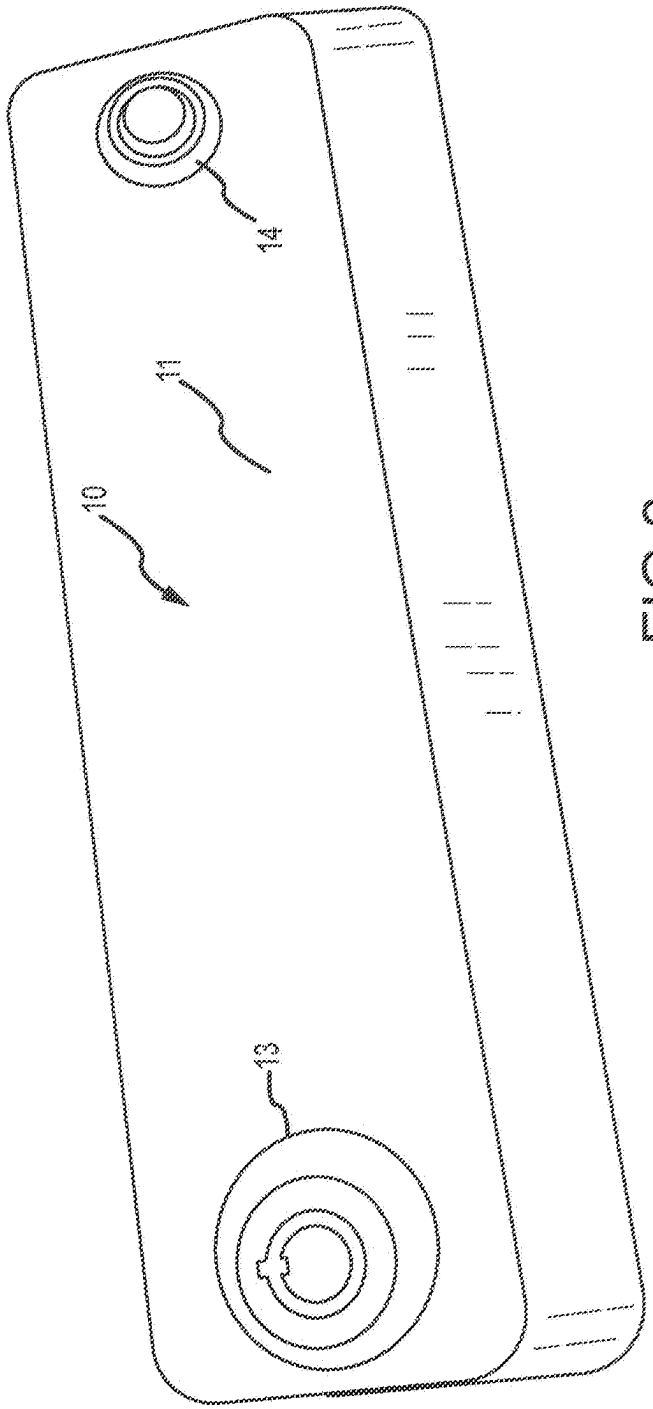


FIG.8

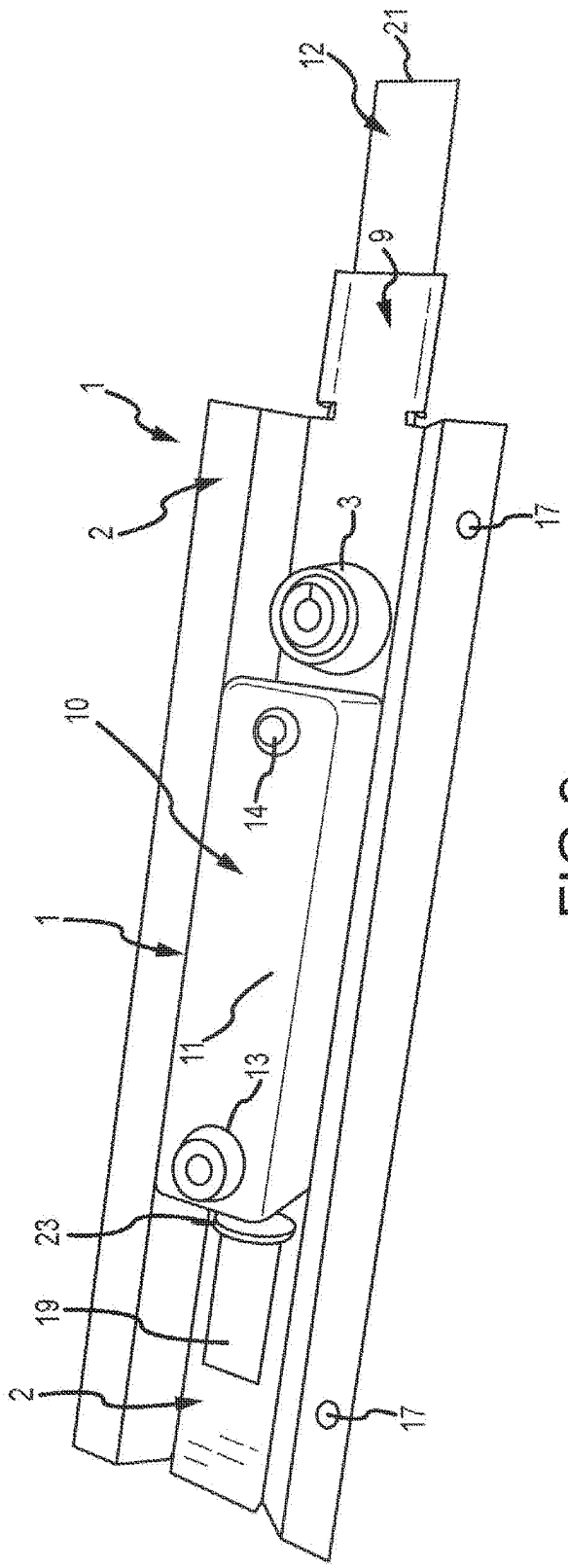


FIG.9

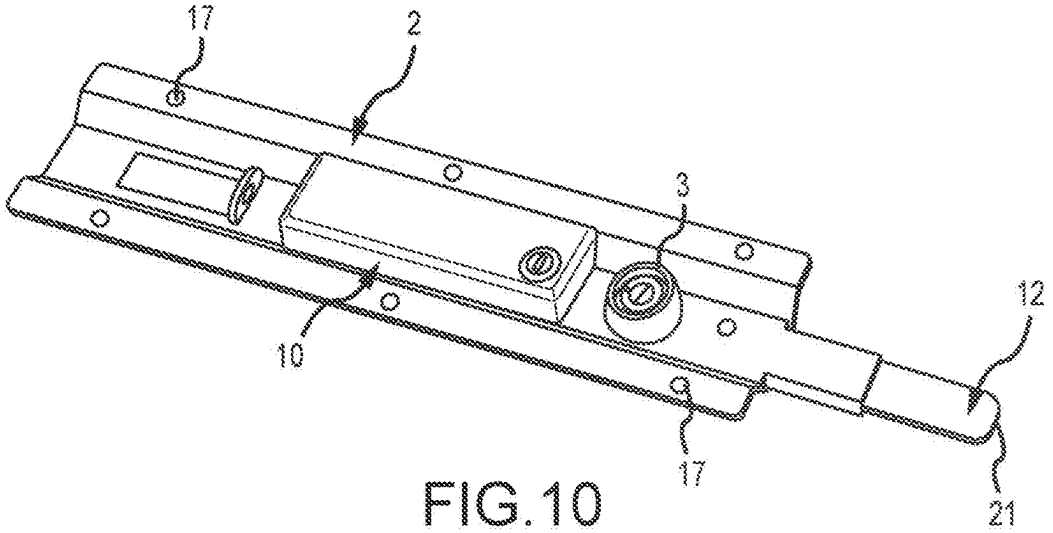


FIG.10

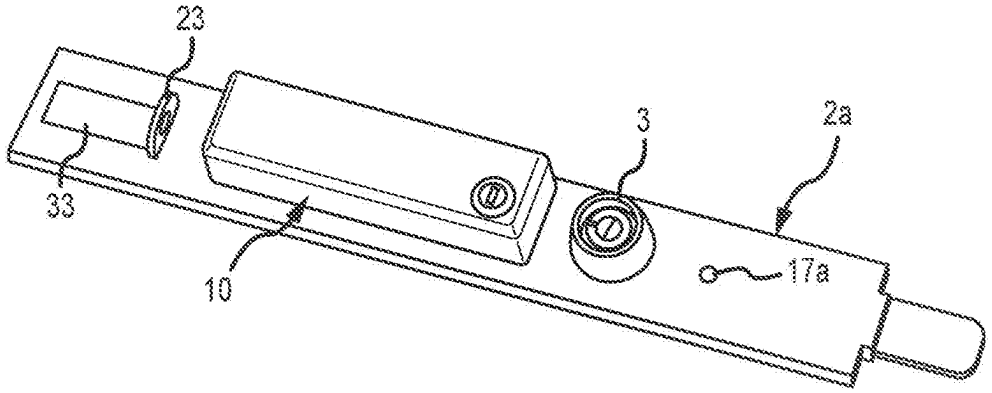


FIG.11

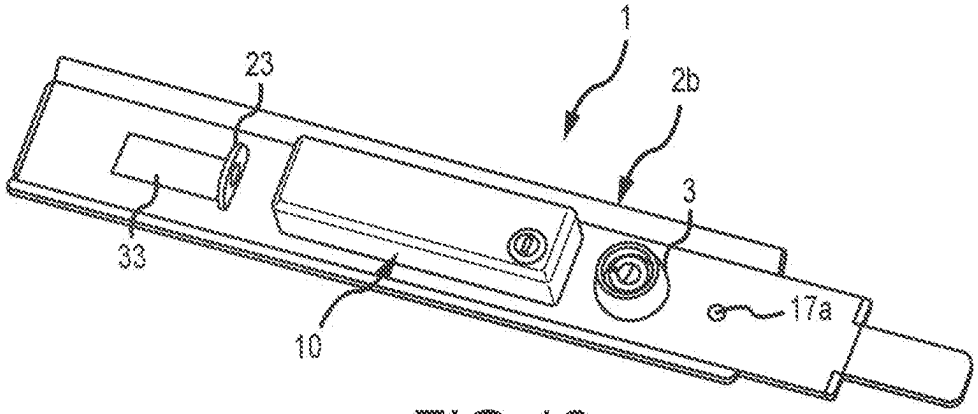


FIG.12

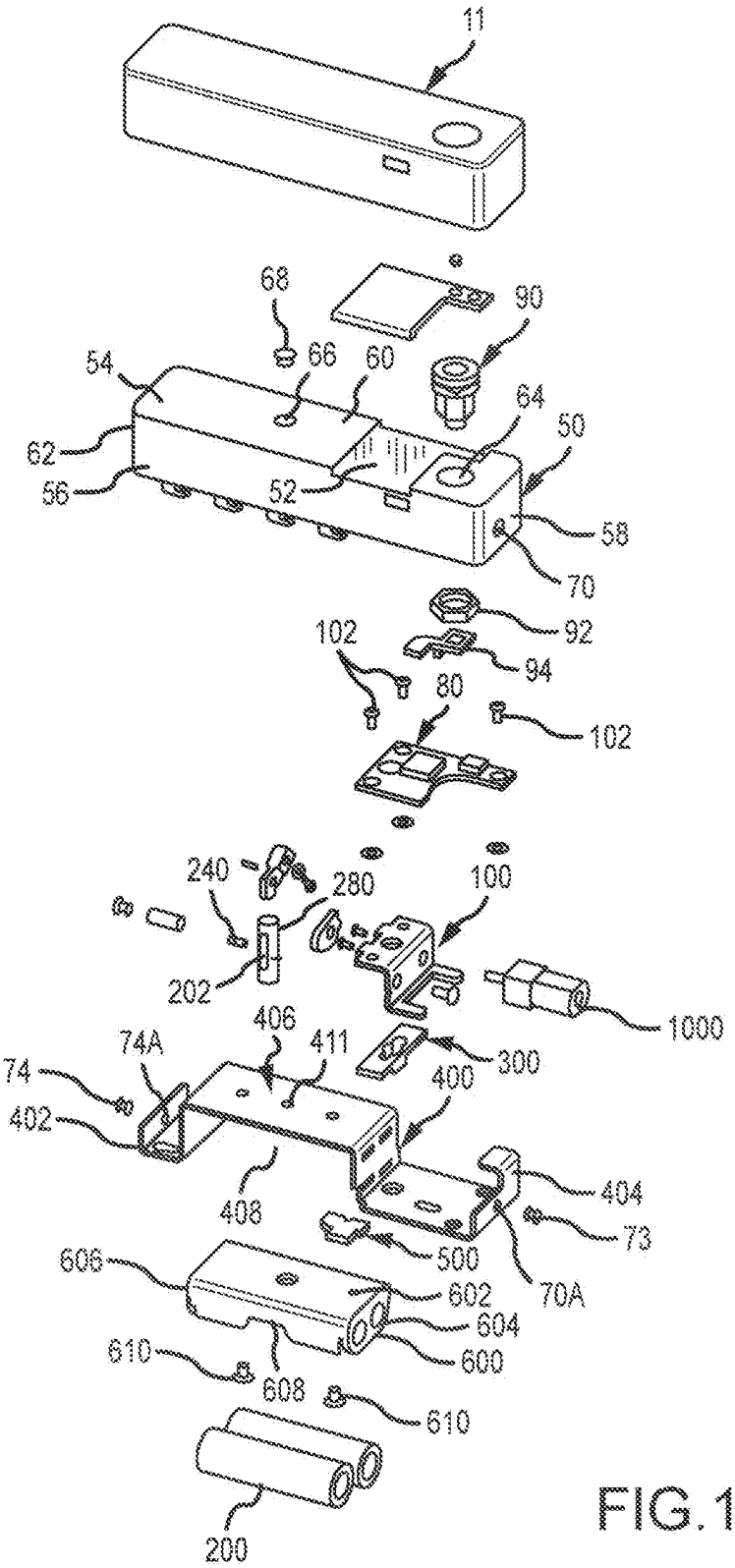

11
68
90
66
60
54
64
62
50
52
56
58
70
92
102
94
80
102
240
280
100
202
1000
406
411
74A
300
74
400
402
404
408
73
500
606
70A
602
604
610
600
608
610
200

FIG.13

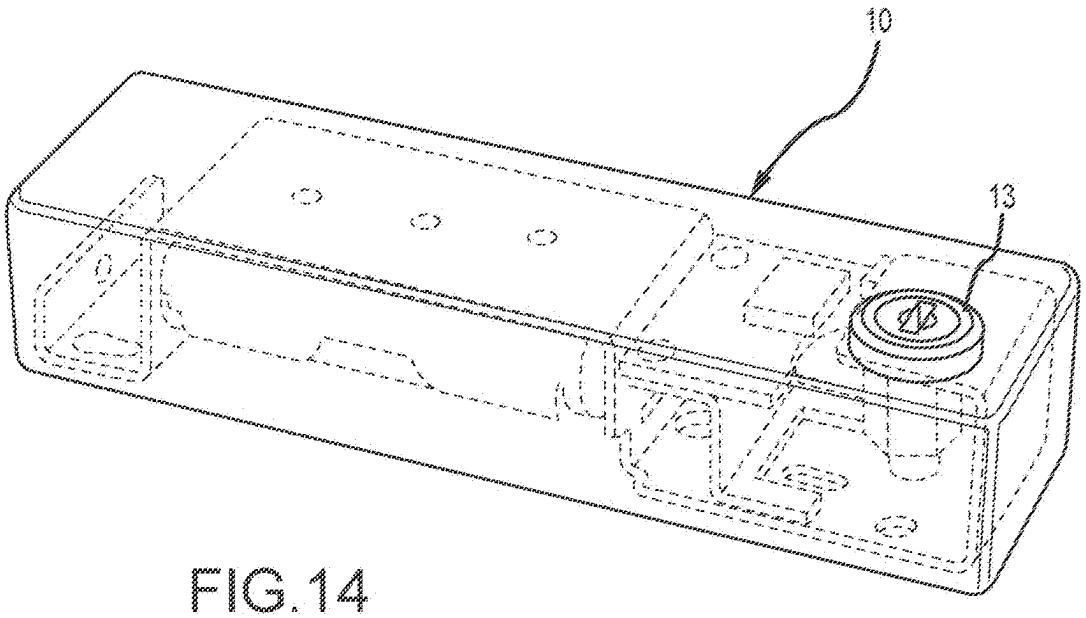


FIG.14

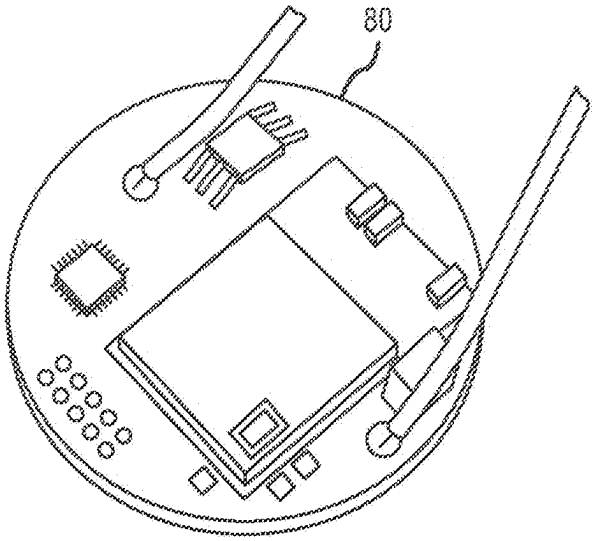


FIG.15

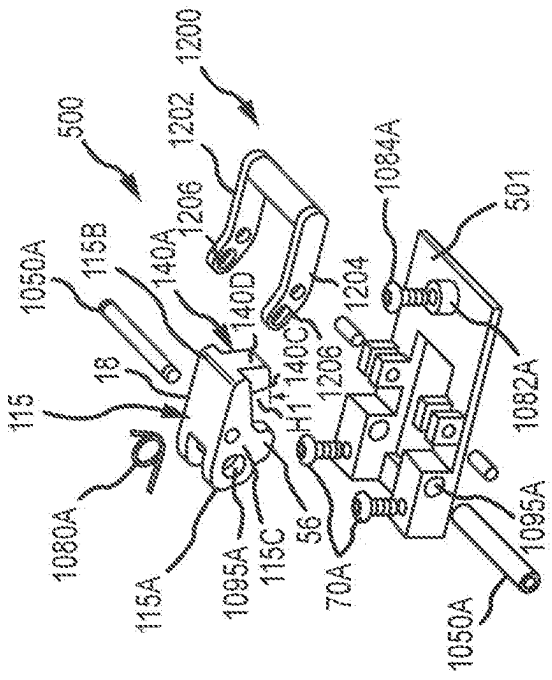


FIG. 16A

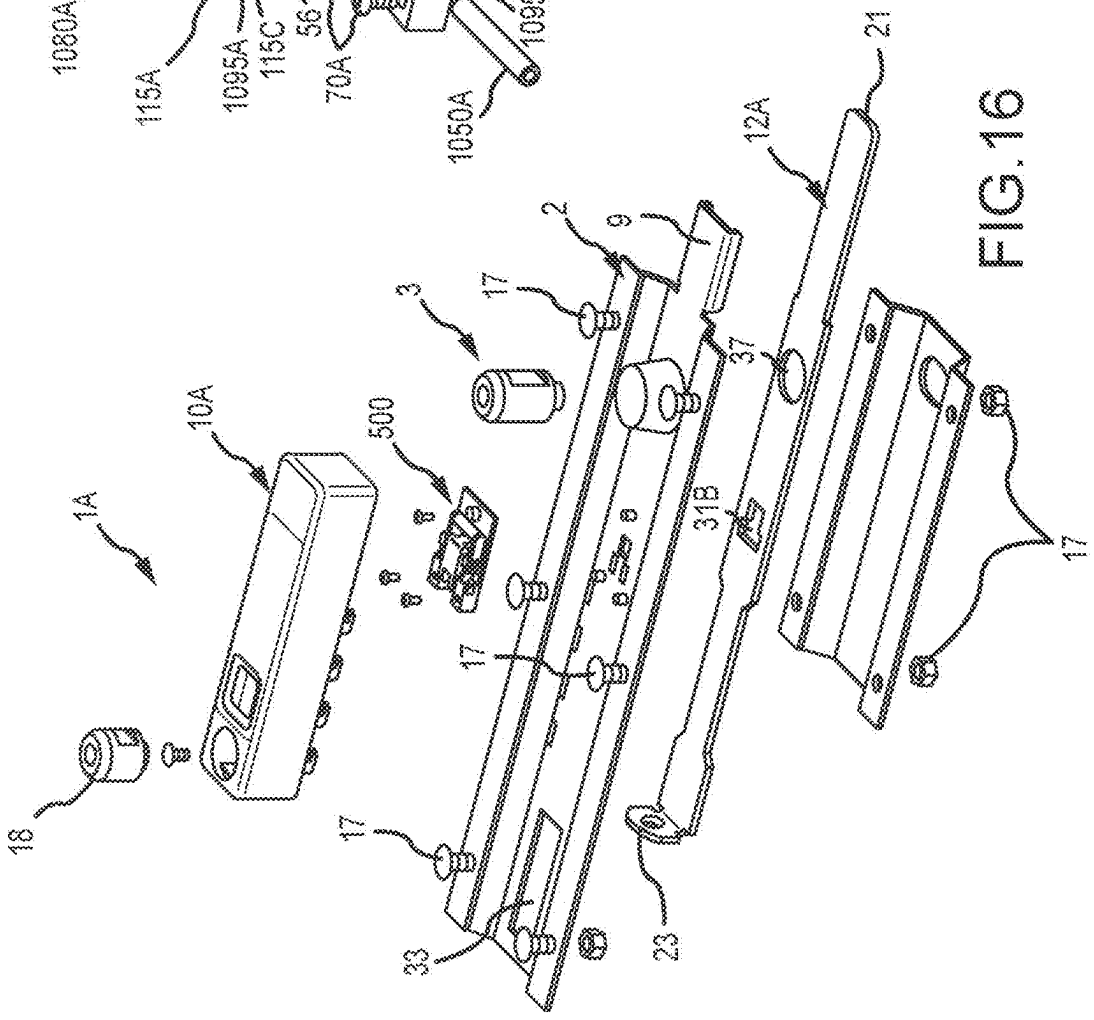


FIG. 16

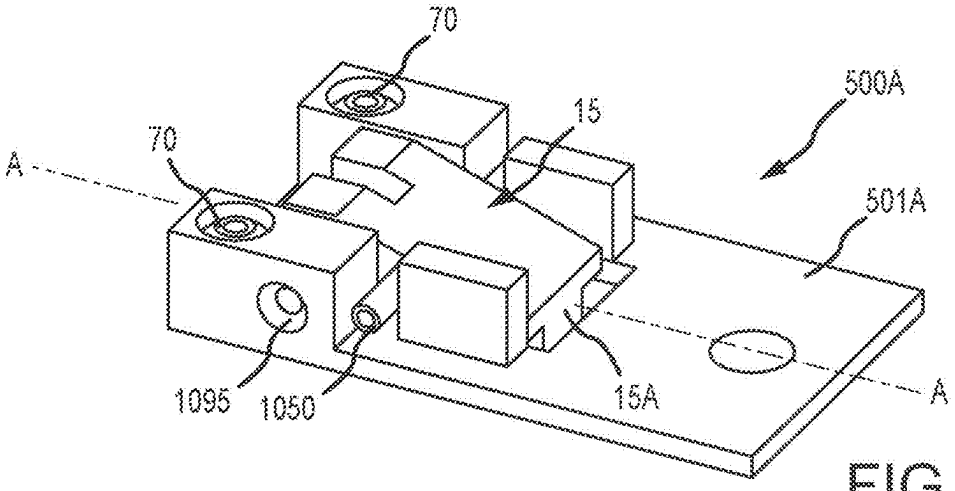


FIG.16B

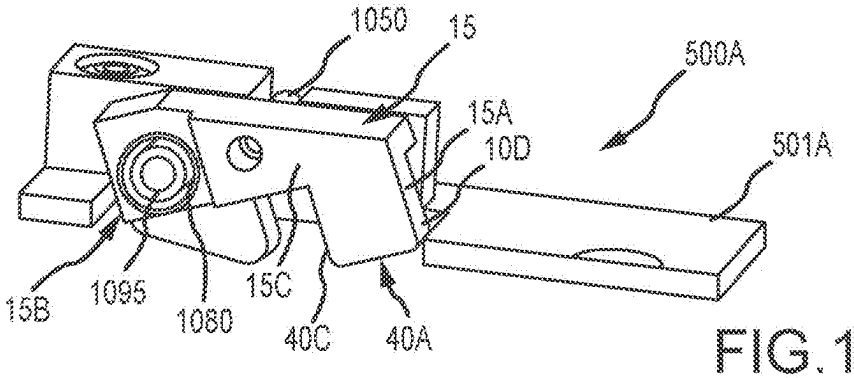


FIG.17

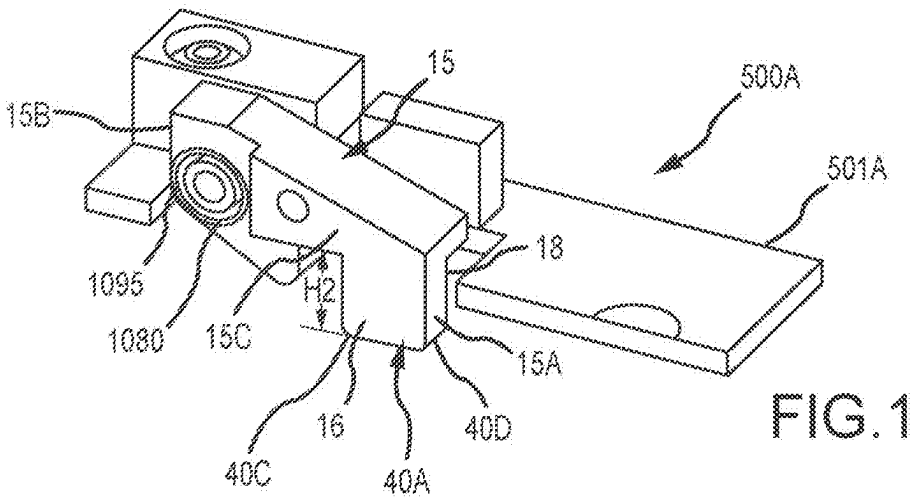


FIG.18

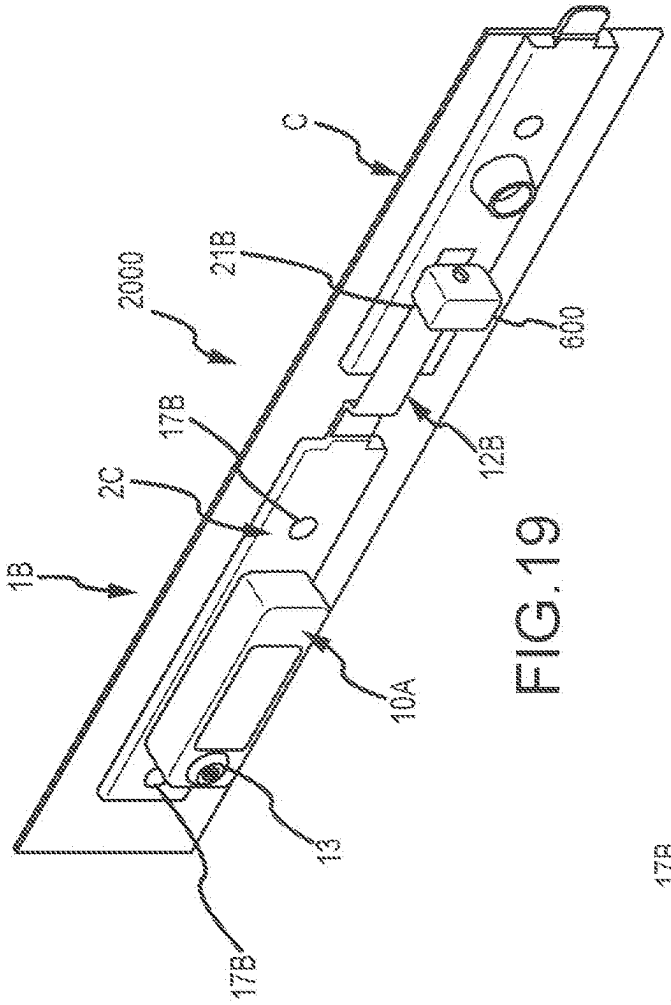


FIG.19

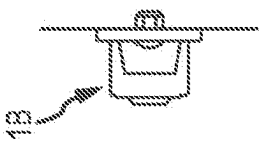


FIG.20

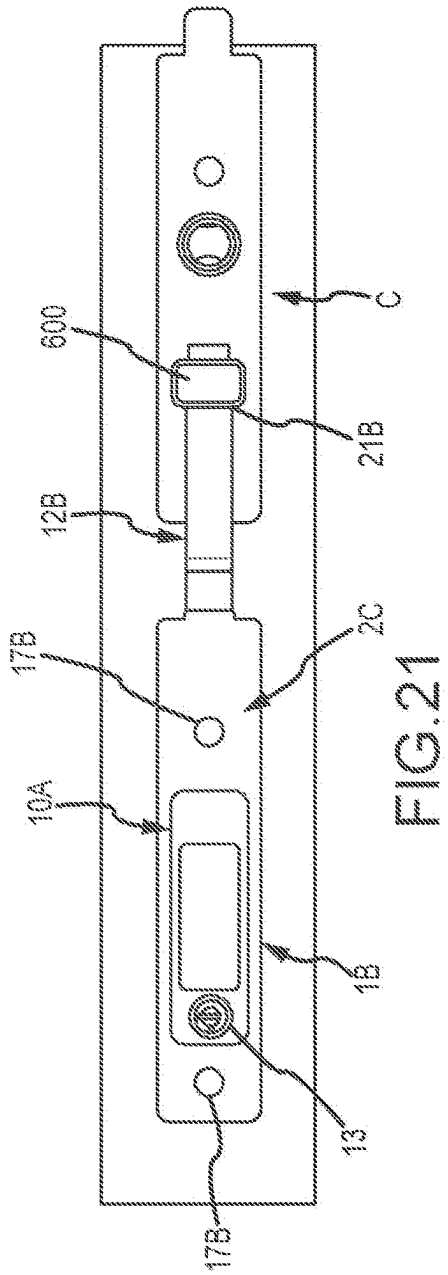


FIG.21

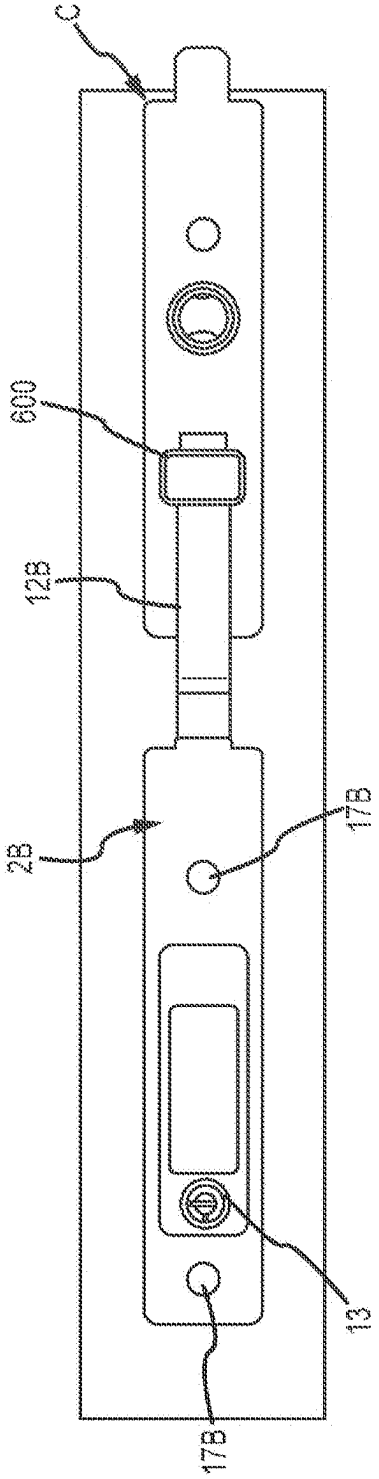


FIG. 22

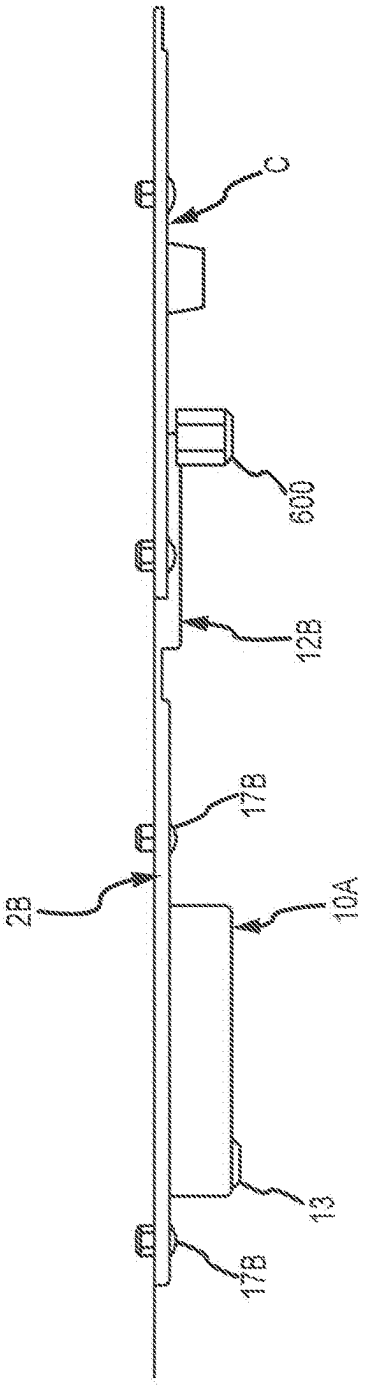


FIG. 23

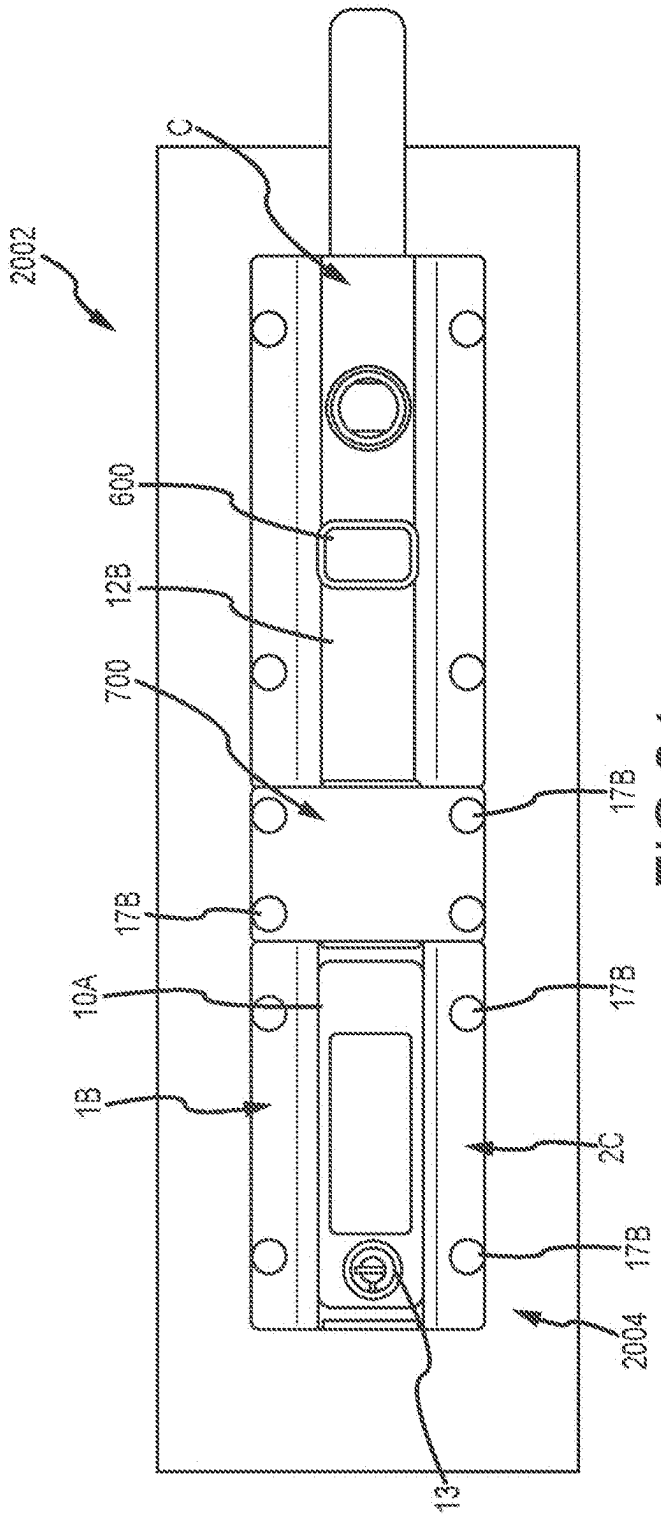

2002
C
600
12B
700
17B
17B
10A
17B
1B
2C
17B
2004
13

FIG.24

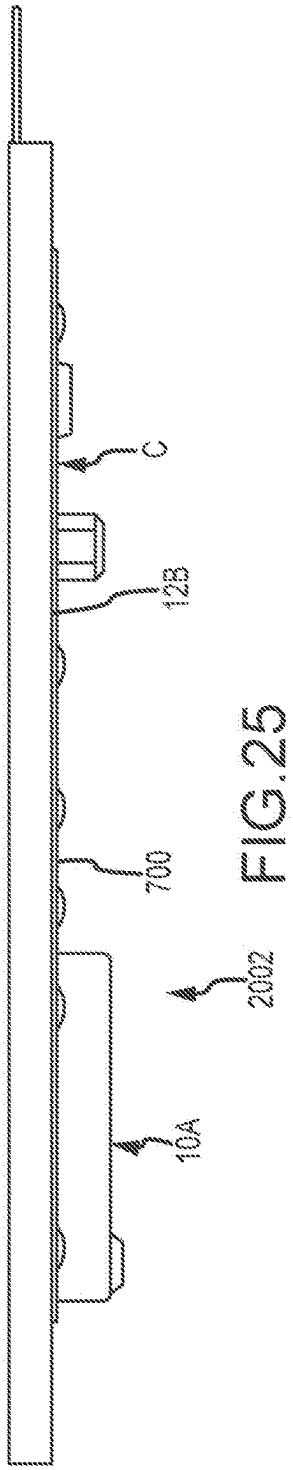

C
12B
700
2002
10A

FIG.25

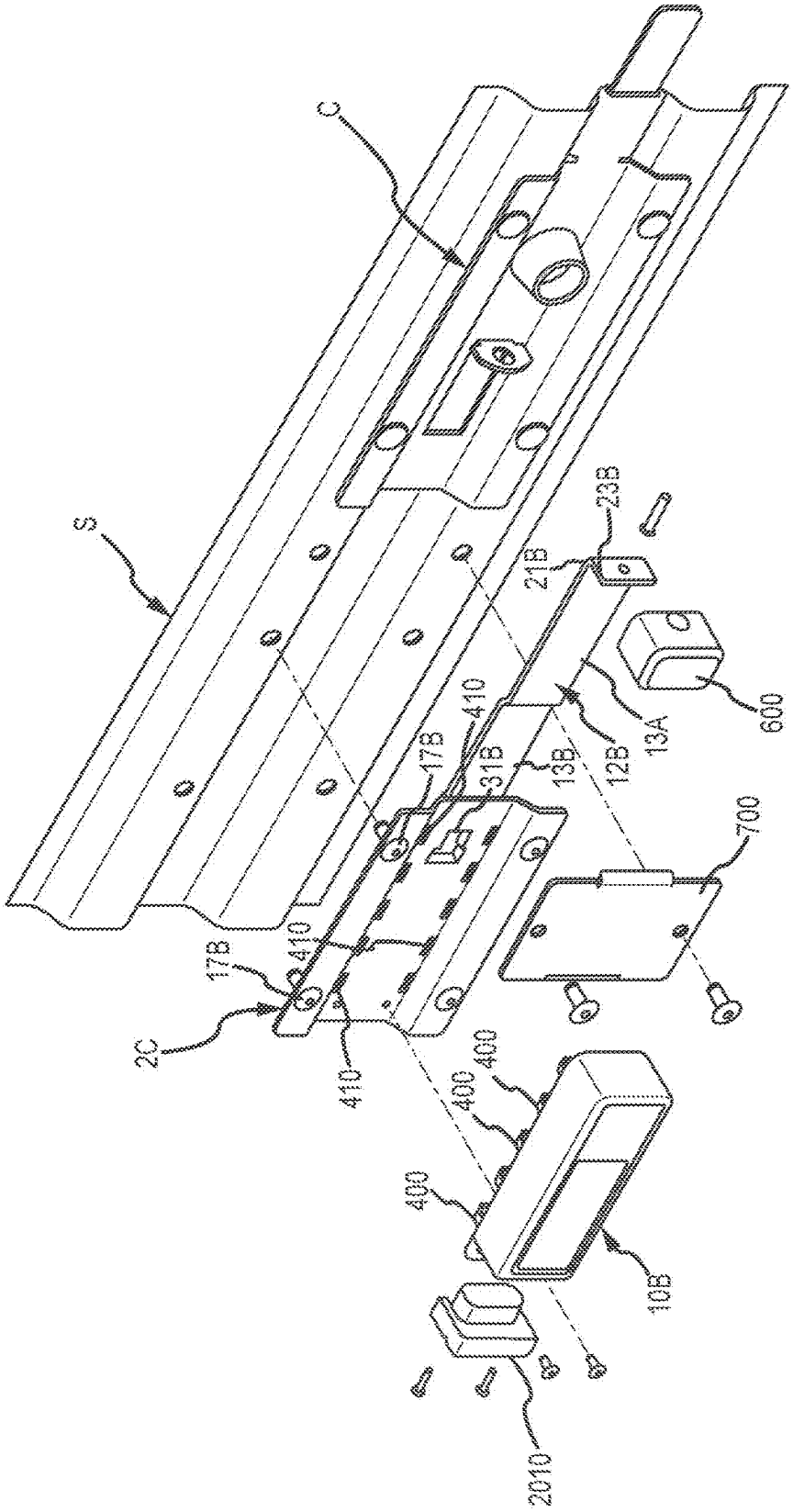


FIG. 26

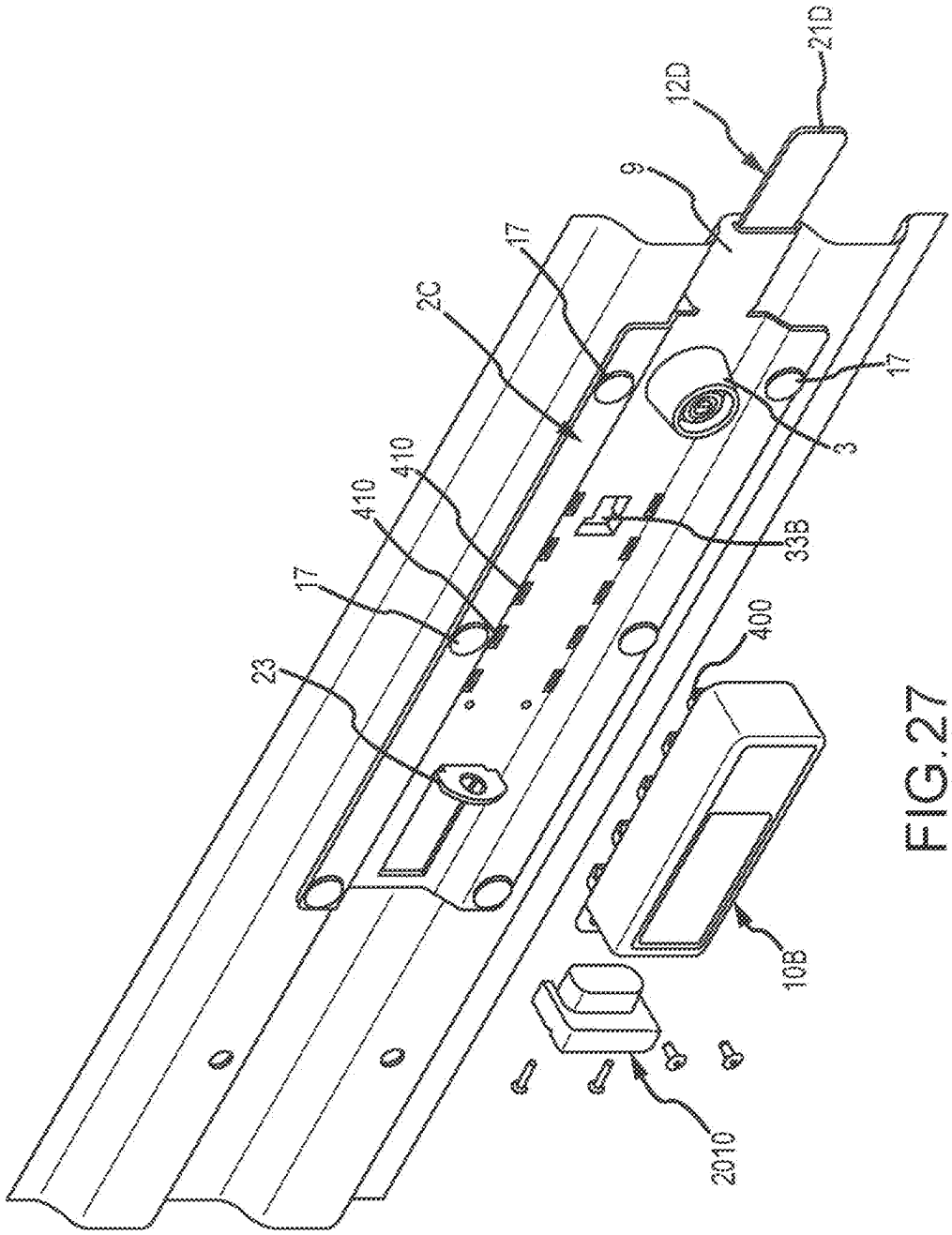


FIG.27

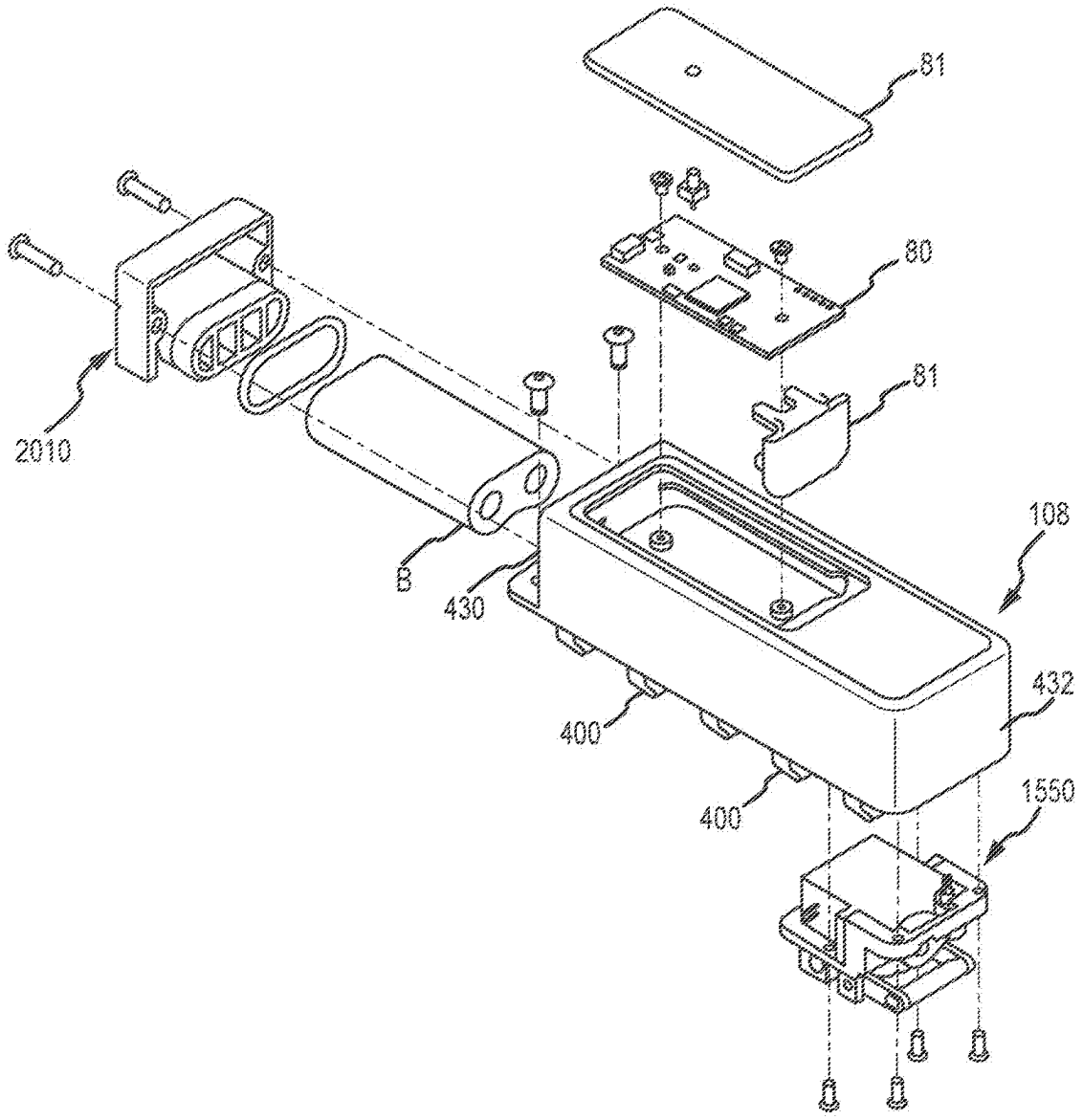


FIG.28

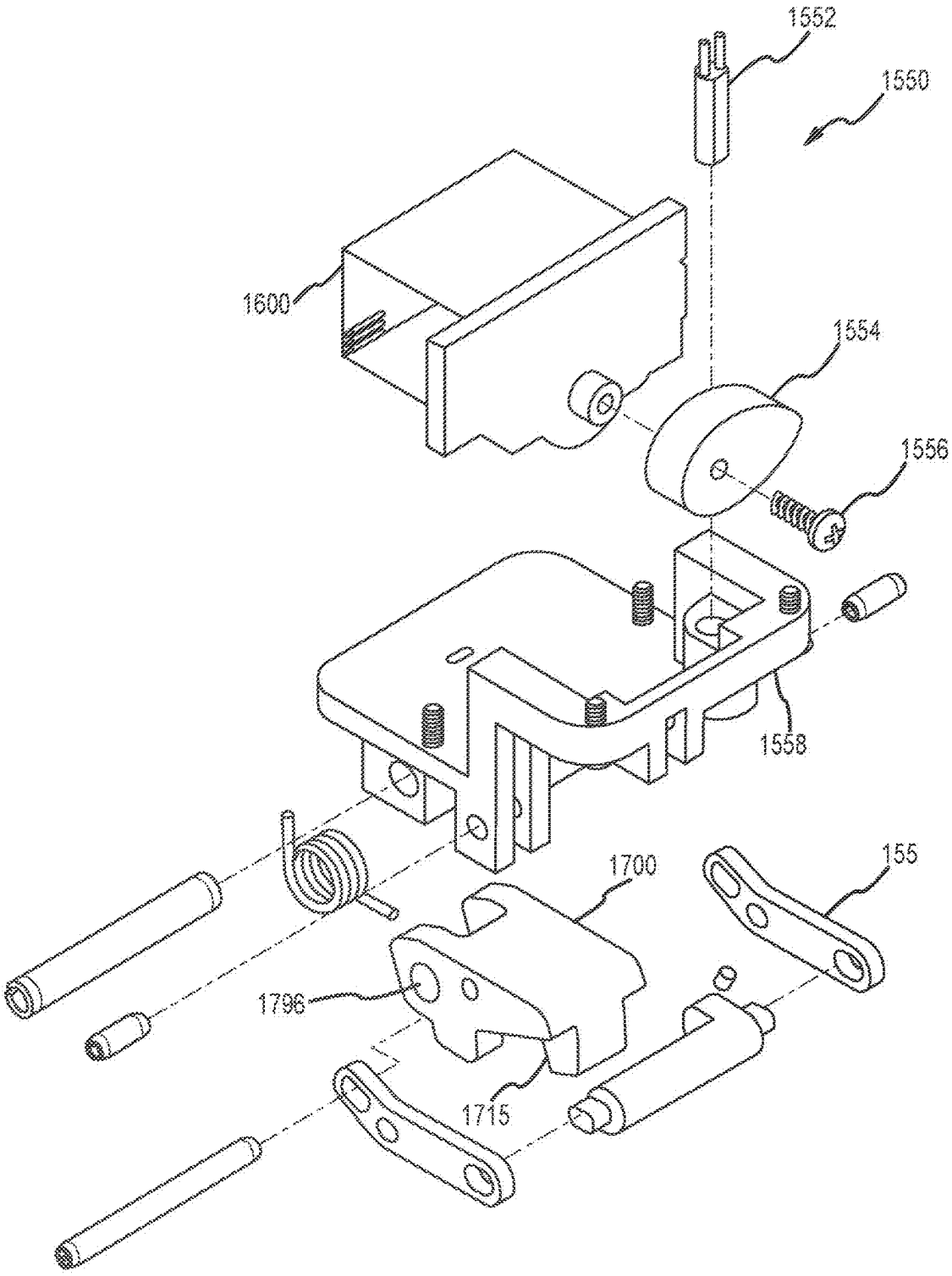


FIG.29

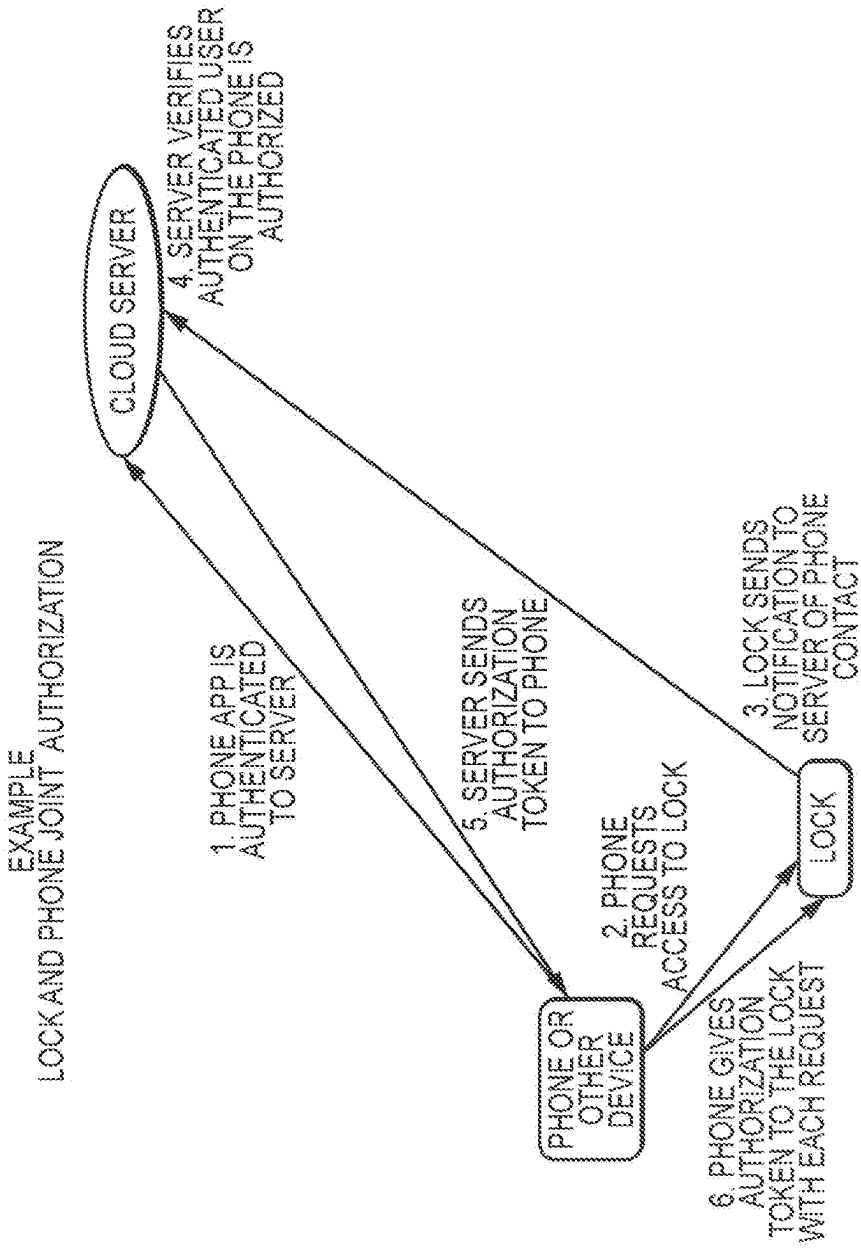

EXAMPLE
LOCK AND PHONE JOINT AUTHORIZATION
CLOUD SERVER
1. PHONE APP IS AUTHENTICATED TO SERVER
4. SERVER VERIFIES AUTHENTICATED USER ON THE PHONE IS AUTHORIZED
5. SERVER SENDS AUTHORIZATION TOKEN TO PHONE
2. PHONE REQUESTS ACCESS TO LOCK
3. LOCK SENDS NOTIFICATION TO SERVER OF PHONE CONTACT
PHONE OR OTHER DEVICE
LOCK
6. PHONE GIVES AUTHORIZATION TOKEN TO THE LOCK WITH EACH REQUEST
8. LOCK VERIFIES AUTHENTICITY OF TOKEN BEFORE TAKING ACTION

FIG. 30

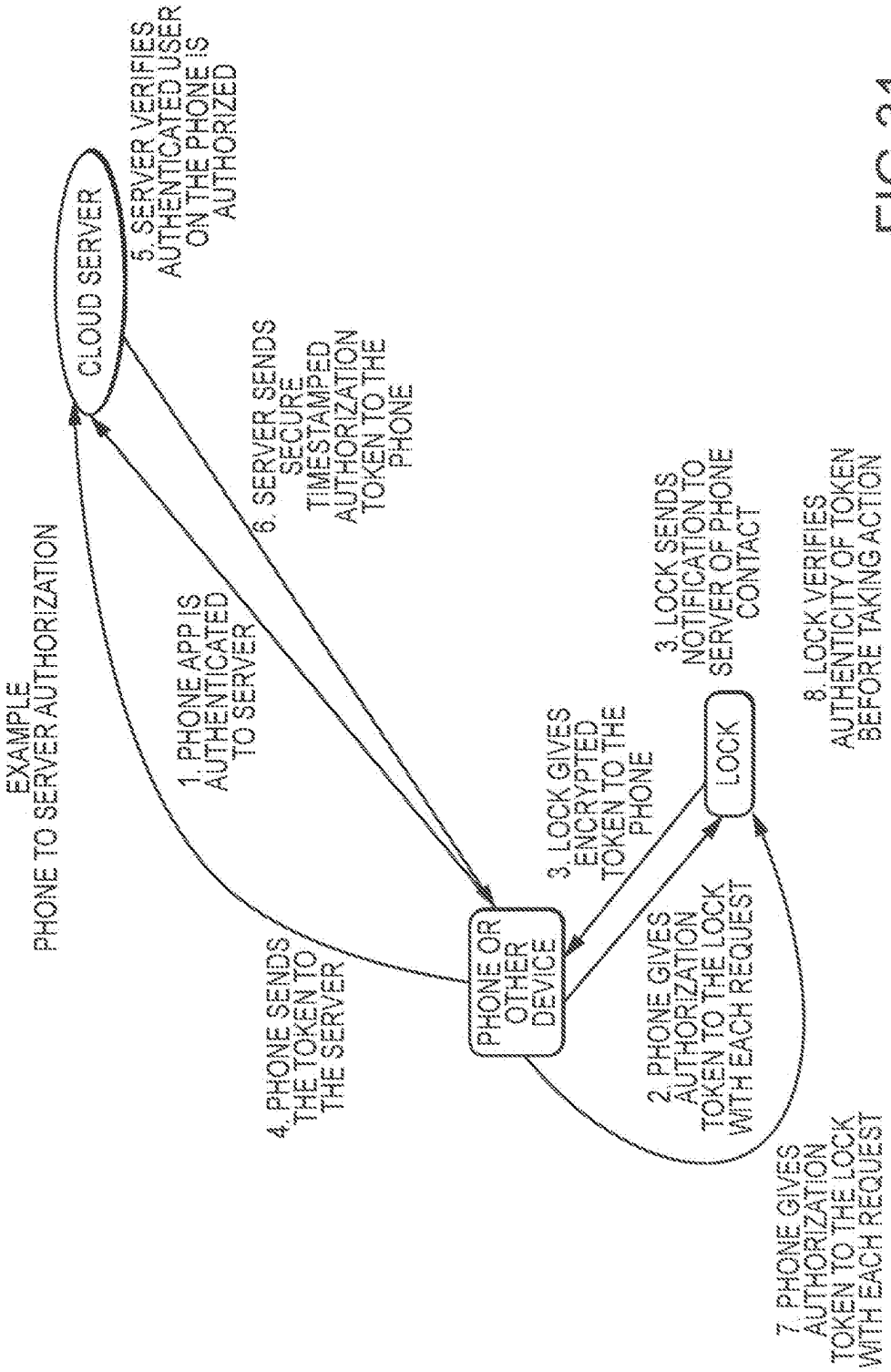

EXAMPLE
PHONE TO SERVER AUTHORIZATION
CLOUD SERVER
5. SERVER VERIFIES AUTHENTICATED USER ON THE PHONE IS AUTHORIZED
6. SERVER SENDS SECURE TIMESTAMPED AUTHORIZATION TOKEN TO THE PHONE
1. PHONE APP IS AUTHENTICATED TO SERVER
4. PHONE SENDS THE TOKEN TO THE SERVER
PHONE OR OTHER DEVICE
3. LOCK GIVES ENCRYPTED TOKEN TO THE PHONE
3. LOCK SENDS NOTIFICATION TO SERVER OF PHONE CONTACT
LOCK
2. PHONE GIVES AUTHORIZATION TOKEN TO THE LOCK WITH EACH REQUEST
8. LOCK VERIFIES AUTHENTICITY OF TOKEN BEFORE TAKING ACTION
7. PHONE GIVES AUTHORIZATION TOKEN TO THE LOCK WITH EACH REQUEST

FIG. 31

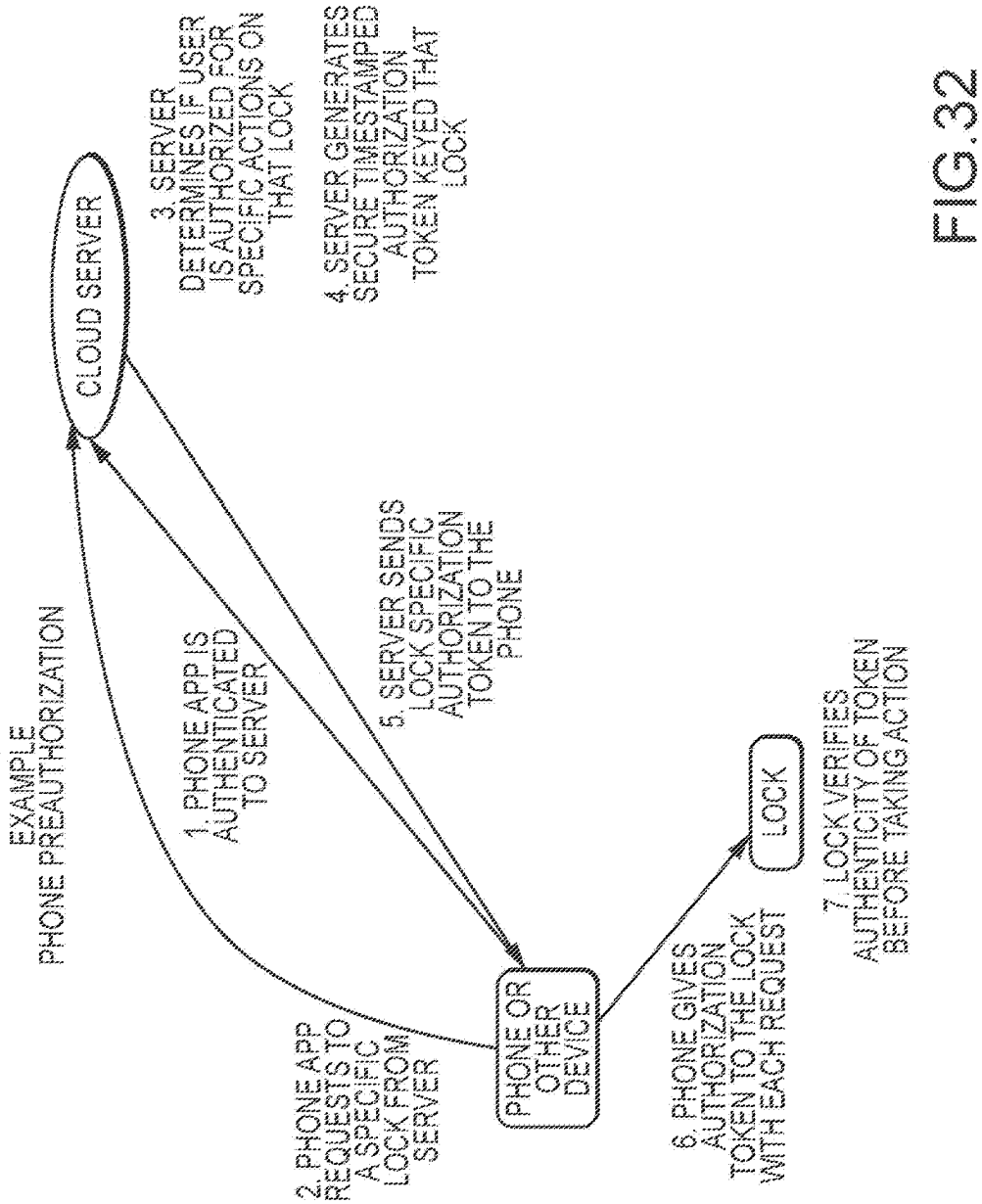

EXAMPLE
PHONE PREAUTHORIZATION
CLOUD SERVER
1. PHONE APP IS AUTHENTICATED TO SERVER
2. PHONE APP REQUESTS TO A SPECIFIC LOCK FROM SERVER
3. SERVER DETERMINES IF USER IS AUTHORIZED FOR SPECIFIC ACTIONS ON THAT LOCK
4. SERVER GENERATES SECURE TIMESTAMPED AUTHORIZATION TOKEN KEYED THAT LOCK
5. SERVER SENDS LOCK SPECIFIC AUTHORIZATION TOKEN TO THE PHONE
PHONE OR OTHER DEVICE
6. PHONE GIVES AUTHORIZATION TOKEN TO THE LOCK WITH EACH REQUEST
LOCK
7. LOCK VERIFIES AUTHENTICITY OF TOKEN BEFORE TAKING ACTION

FIG. 32

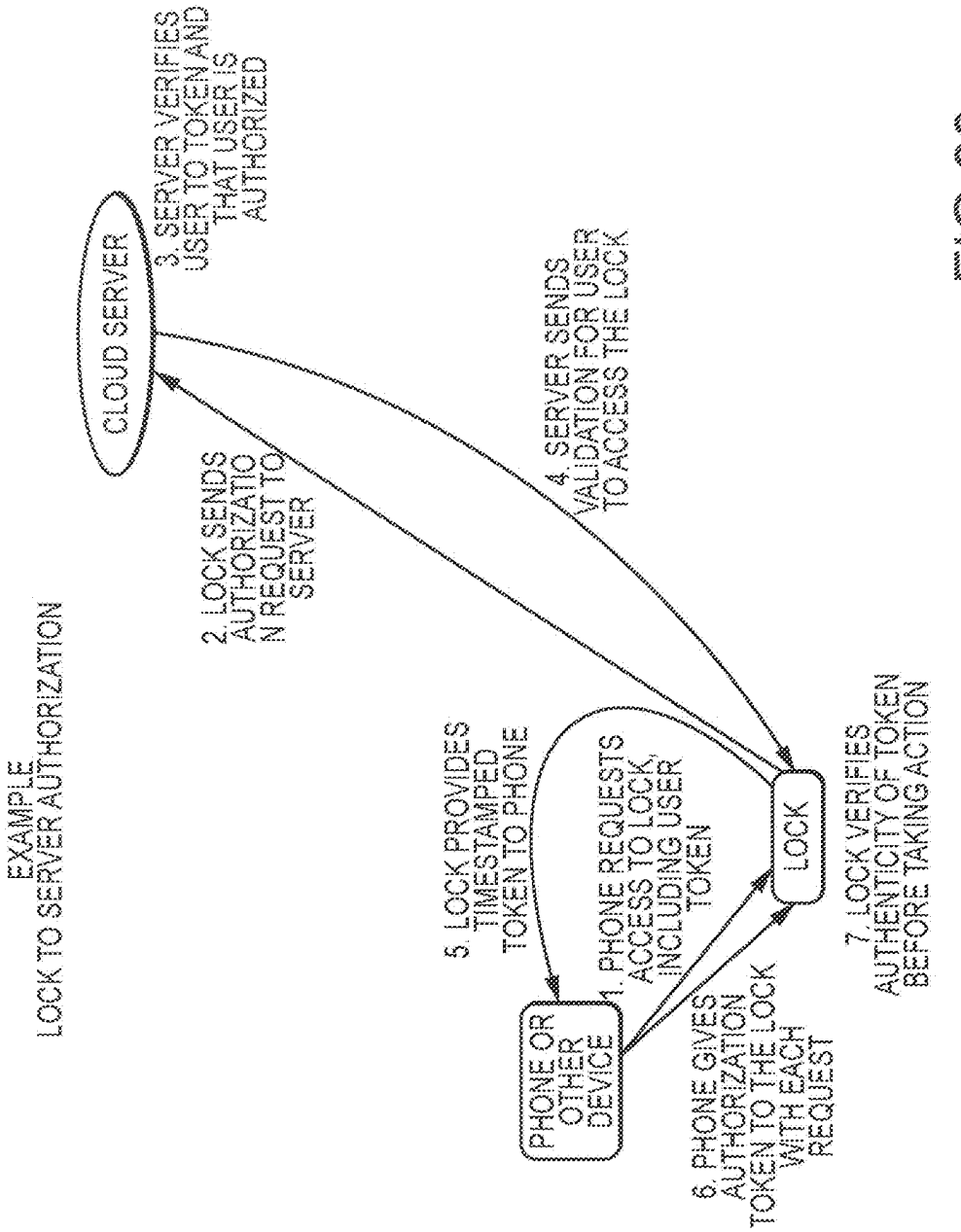

EXAMPLE
LOCK TO SERVER AUTHORIZATION
CLOUD SERVER
3. SERVER VERIFIES USER TO TOKEN AND THAT USER IS AUTHORIZED
2. LOCK SENDS AUTHORIZATIO N REQUEST TO SERVER
4. SERVER SENDS VALIDATION FOR USER TO ACCESS THE LOCK
5. LOCK PROVIDES TIMESTAMPED TOKEN TO PHONE
1. PHONE REQUESTS ACCESS TO LOCK, INCLUDING USER TOKEN
PHONE OR OTHER DEVICE
LOCK
6. PHONE GIVES AUTHORIZATION TOKEN TO THE LOCK WITH EACH REQUEST
7. LOCK VERIFIES AUTHENTICITY OF TOKEN BEFORE TAKING ACTION

FIG. 33

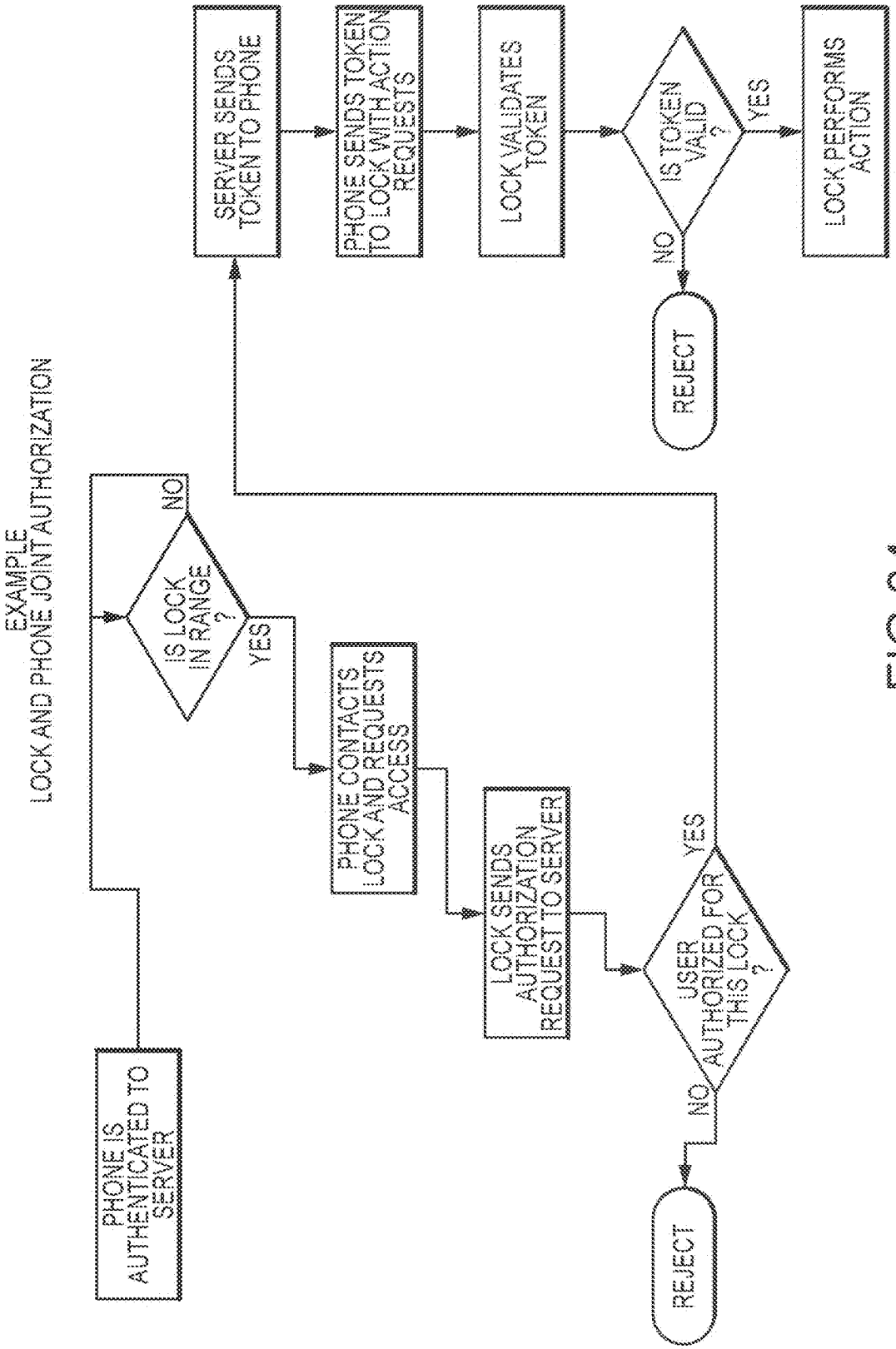

EXAMPLE
LOCK AND PHONE JOINT AUTHORIZATION
PHONE IS AUTHENTICATED TO SERVER
IS LOCK IN RANGE ?
NO
YES
PHONE CONTACTS LOCK AND REQUESTS ACCESS
LOCK SENDS AUTHORIZATION REQUEST TO SERVER
USER AUTHORIZED FOR THIS LOCK ?
YES
NO
REJECT
SERVER SENDS TOKEN TO PHONE
PHONE SENDS TOKEN TO LOCK WITH ACTION REQUESTS
LOCK VALIDATES TOKEN
IS TOKEN VALID ?
YES
NO
LOCK PERFORMS ACTION
REJECT

FIG. 34

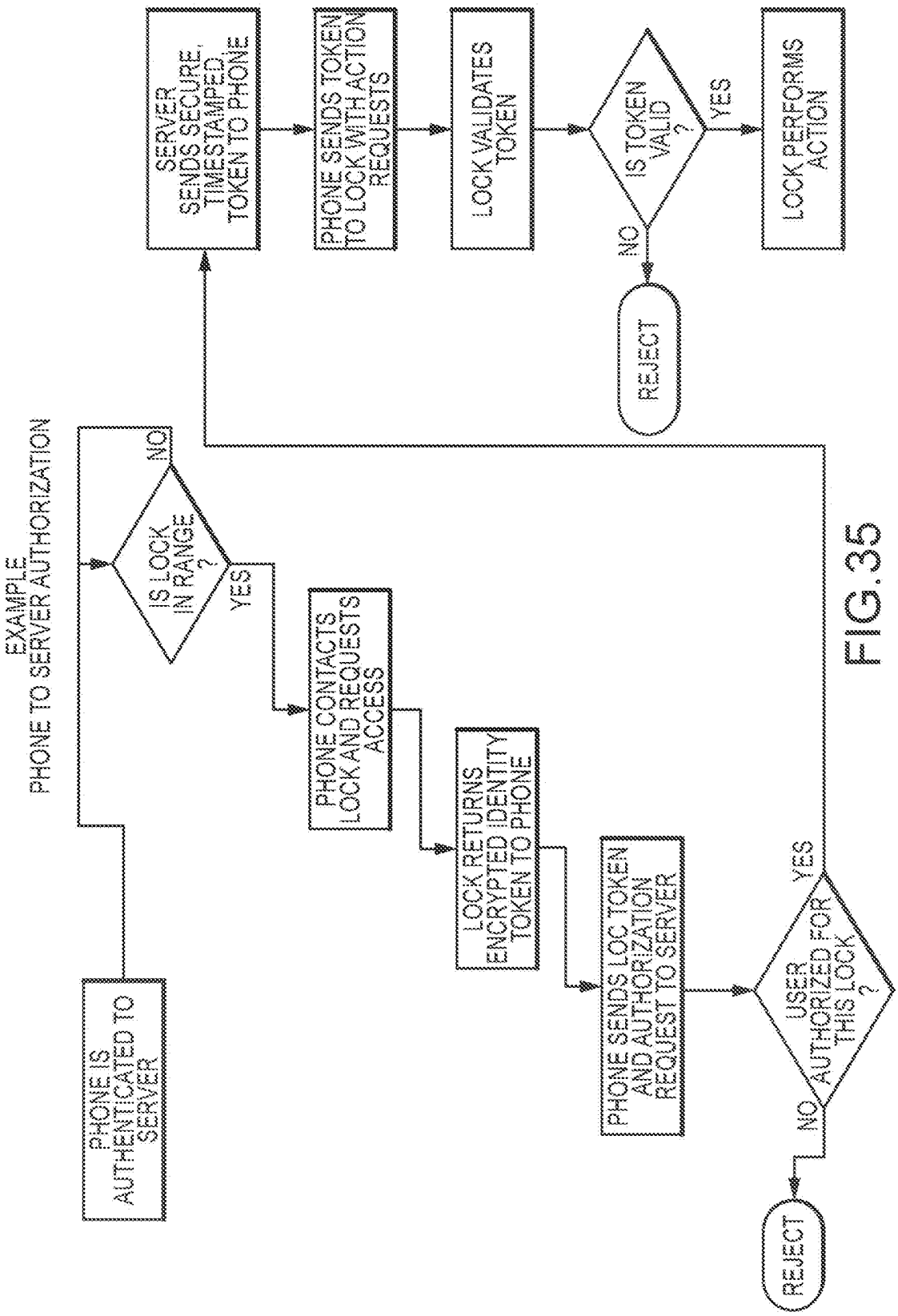

EXAMPLE
PHONE TO SERVER AUTHORIZATION
PHONE IS AUTHENTICATED TO SERVER
IS LOCK IN RANGE ?
NO
YES
PHONE CONTACTS LOCK AND REQUESTS ACCESS
LOCK RETURNS ENCRYPTED IDENTITY TOKEN TO PHONE
PHONE SENDS LOC TOKEN AND AUTHORIZATION REQUEST TO SERVER
USER AUTHORIZED FOR THIS LOCK ?
YES
NO
REJECT
SERVER SENDS SECURE, TIMESTAMPED, TOKEN TO PHONE
PHONE SENDS TOKEN TO LOCK WITH ACTION REQUESTS
LOCK VALIDATES TOKEN
IS TOKEN VALID ?
NO
YES
REJECT
LOCK PERFORMS ACTION

FIG. 35

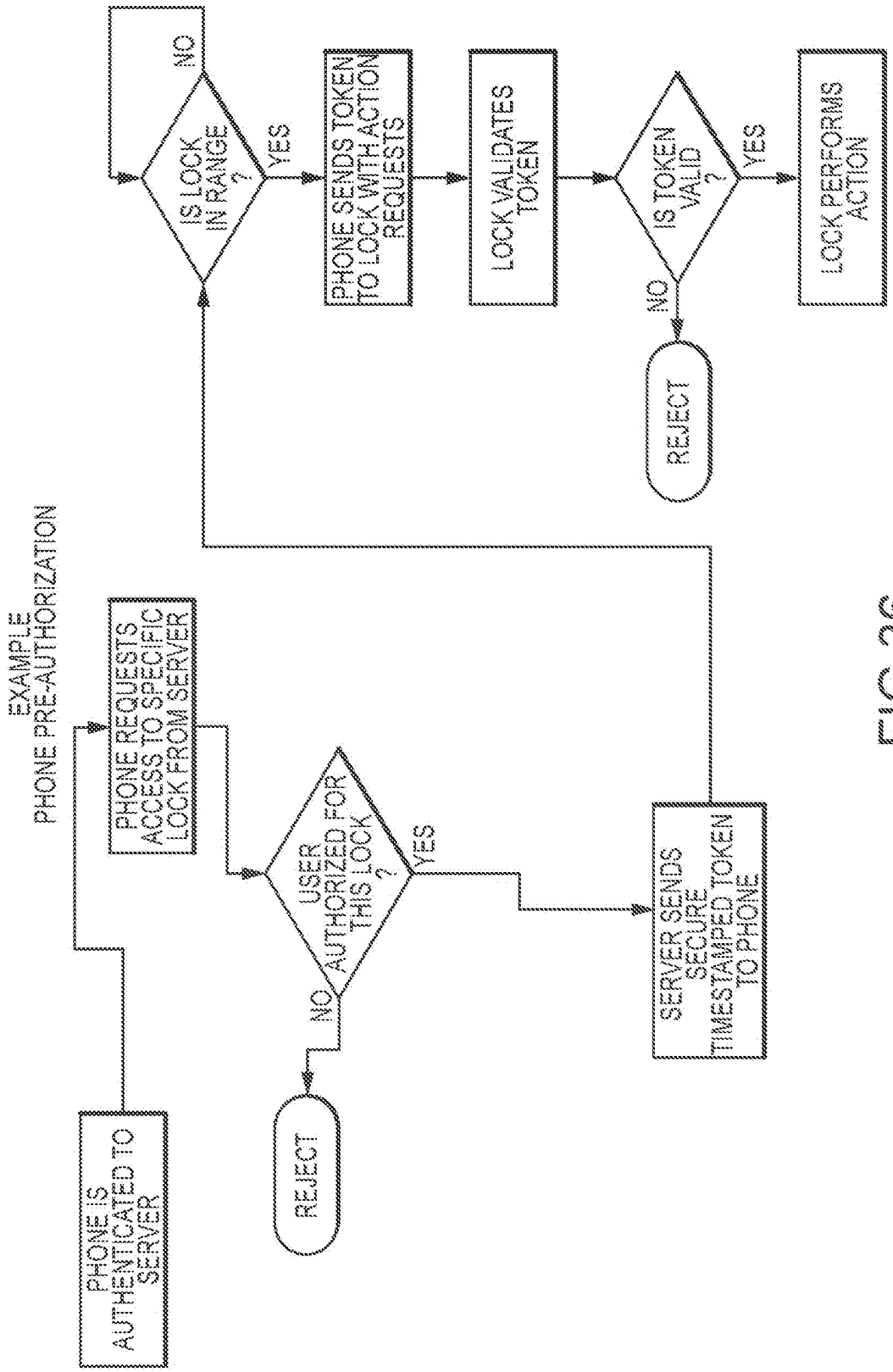

EXAMPLE
PHONE PRE-AUTHORIZATION
PHONE IS AUTHENTICATED TO SERVER
PHONE REQUESTS ACCESS TO SPECIFIC LOCK FROM SERVER
USER AUTHORIZED FOR THIS LOCK ?
NO
YES
REJECT
SERVER SENDS SECURE TIMESTAMPED TOKEN TO PHONE
IS LOCK IN RANGE ?
NO
YES
PHONE SENDS TOKEN TO LOCK WITH ACTION REQUESTS
LOCK VALIDATES TOKEN
IS TOKEN VALID ?
NO
YES
REJECT
LOCK PERFORMS ACTION

FIG.36

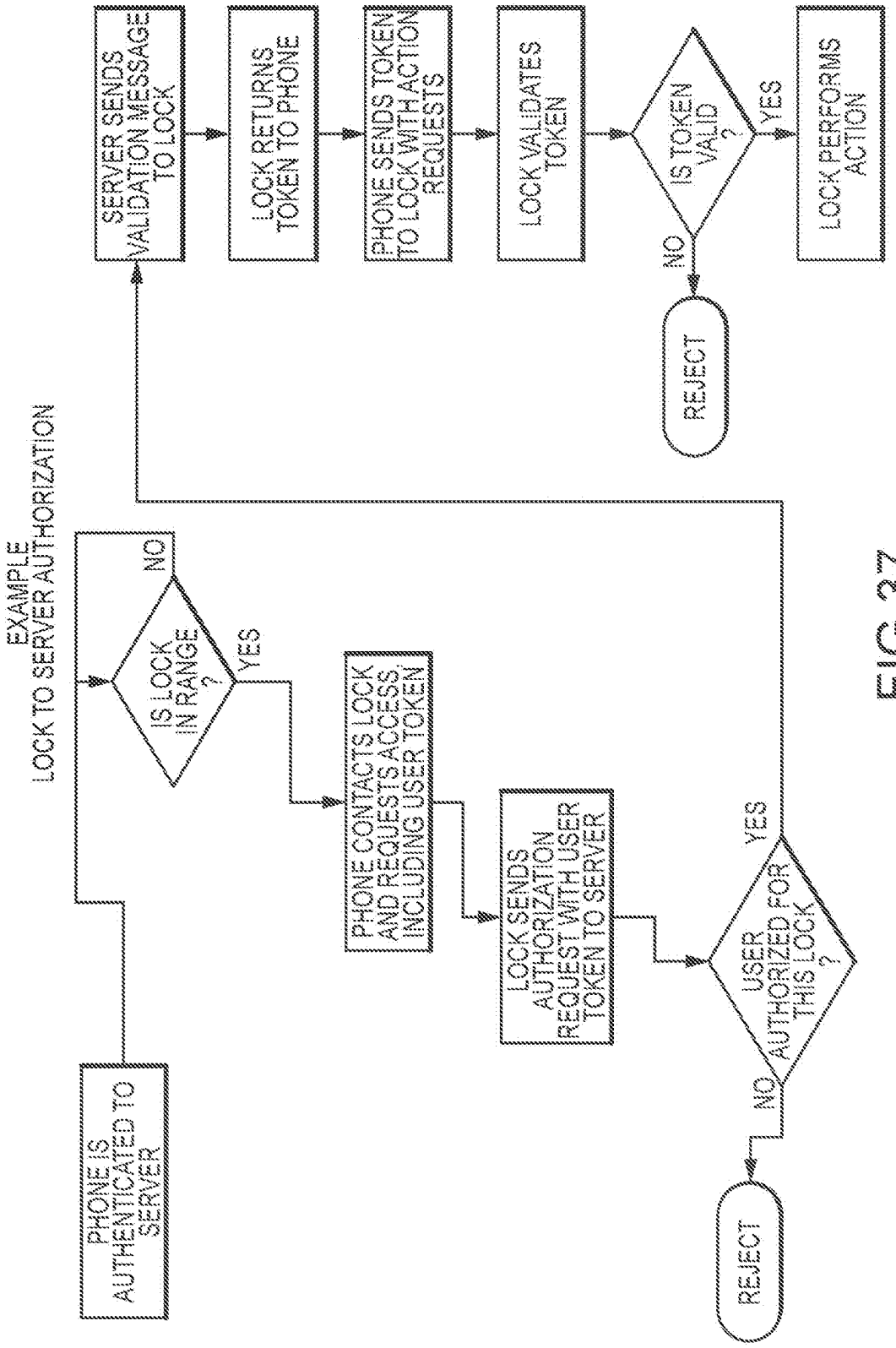

EXAMPLE
LOCK TO SERVER AUTHORIZATION
PHONE IS AUTHENTICATED TO SERVER
IS LOCK IN RANGE ?
NO
YES
PHONE CONTACTS LOCK AND REQUESTS ACCESS, INCLUDING USER TOKEN
LOCK SENDS AUTHORIZATION REQUEST WITH USER TOKEN TO SERVER
USER AUTHORIZED FOR THIS LOCK ?
NO
YES
REJECT
SERVER SENDS VALIDATION MESSAGE TO LOCK
LOCK RETURNS TOKEN TO PHONE
PHONE SENDS TOKEN TO LOCK WITH ACTION REQUESTS
LOCK VALIDATES TOKEN
IS TOKEN VALID ?
NO
YES
REJECT
LOCK PERFORMS ACTION

FIG. 37

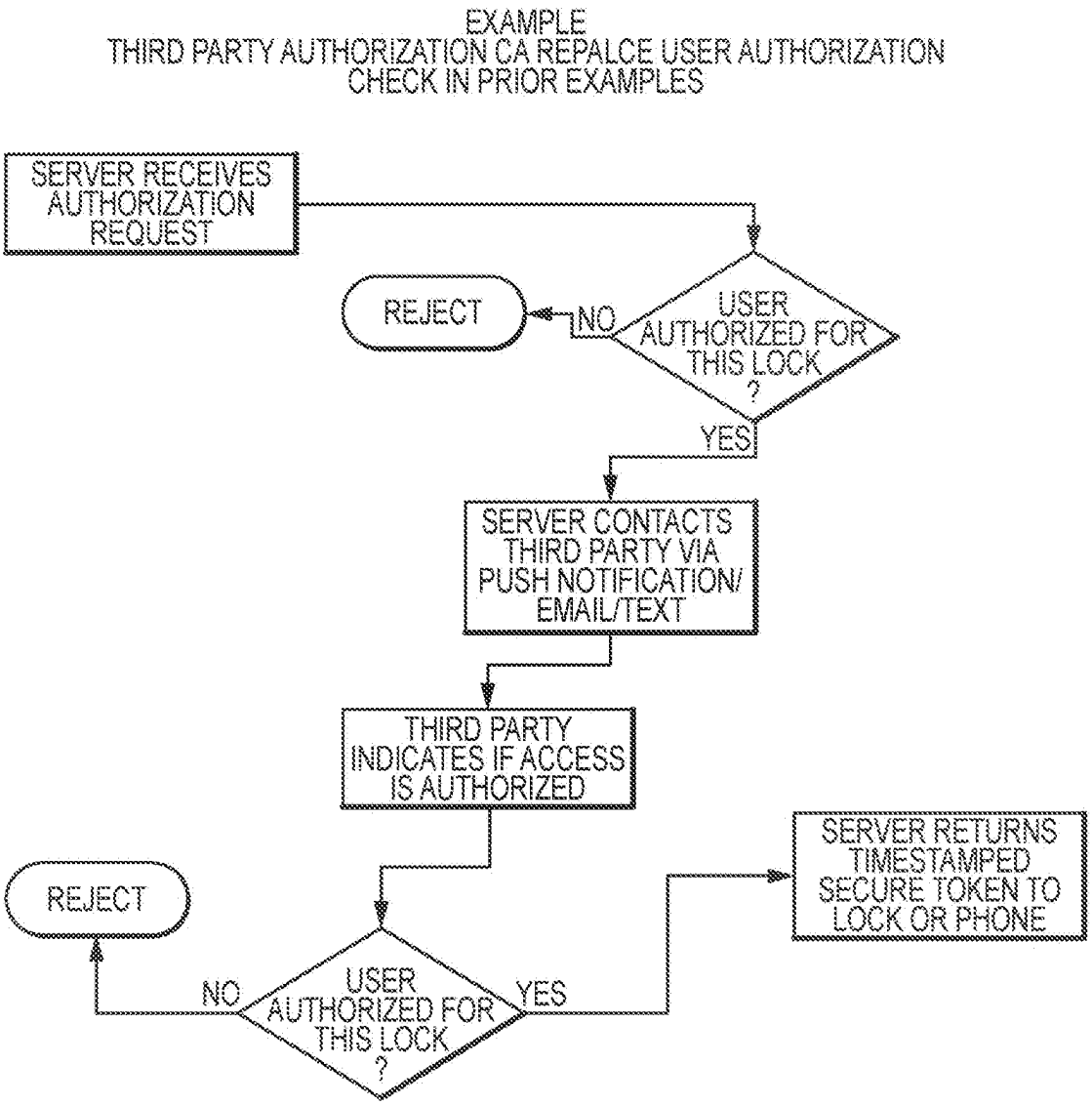

EXAMPLE
THIRD PARTY AUTHORIZATION CA REPALCE USER AUTHORIZATION CHECK IN PRIOR EXAMPLES
SERVER RECEIVES AUTHORIZATION REQUEST
USER AUTHORIZED FOR THIS LOCK ?
NO
REJECT
YES
SERVER CONTACTS THIRD PARTY VIA PUSH NOTIFICATION/ EMAIL/TEXT
THIRD PARTY INDICATES IF ACCESS IS AUTHORIZED
USER AUTHORIZED FOR THIS LOCK ?
NO
REJECT
YES
SERVER RETURNS TIMESTAMPED SECURE TOKEN TO LOCK OR PHONE

FIG.38

INTELLIGENT INTEGRATED LOCKING DEVICES AND SYSTEMS

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application is a continuation of U.S. patent application Ser. No. 18/104,762 filed Feb. 1, 2023, and entitled "Intelligent Integrated Locking Devices and Systems," which is a continuation of U.S. patent application Ser. No. 17/397,450 filed Aug. 9, 2021, now U.S. Pat. No. 11,580,807, and entitled "Intelligent Integrated Locking Devices and Systems," which is a continuation of U.S. patent application Ser. No. 16/930,286 filed Jul. 15, 2020, now U.S. Pat. No. 11,170,597, and entitled "Intelligent Integrated Locking Devices and Systems," which claims the benefit of U.S. Provisional Patent Application Ser. No. 62/874,439 filed Jul. 15, 2019, and entitled "Intelligent Integrated Locking System." The entire contents of each of the foregoing applications are hereby incorporated by reference in their entirety.

[0002] BACKGROUND

[0003] Physical locks, including electrically-controlled and remotely-controlled locks are suitable for numerous uses, including for: homes, vehicles, businesses, and storage units. Such locks can be used to protect essentially anything, such as, physical items, electronic files, documents, contracts, deeds, titles, certificates, insurance policies, photographs and negatives, jewelry, cash, heirlooms, collections (e.g., coins, or stamps), prescription medications, and firearms.

[0004] As technology advances, it is preferable to have an intelligent lock that can link to a personal device, such as a phone, computer, tablet or other personal electronic device. Such a lock may preferably also be linked to service providers that monitor the lock, and thereby monitor the items protected by the lock.

SUMMARY OF THE INVENTION

[0005] This disclosure is for intelligent locks and systems comprising multiple locks, such as a system with a primary lock and an overlock. Each may preferably be used in the self-storage industry, as well as in other industries and applications. Using a suitable communications methodology, preferably coupled with RF radio frequency methods of communicating with devices, the tracking, monitoring, and operating of multiple locks is feasible.

[0006] A lock according to this disclosure could include an engagement structure having: (1) a first position in which it can engage and retain a locking mechanism, such as a sliding locking arm ("slide bar" or "sliding bar"), and (2) a second position in which it does not engage the locking mechanism and the sliding bar can be moved to an open position and structure that was locked can then be opened.

[0007] In one embodiment, the engagement structure includes at least a first leg. When the engagement structure is in its first position, the leg is inside of the lock body and the locking mechanism is not locked. The engagement structure can be moved to a second, closed position wherein it engages an opening in the locking mechanism and locks the locking mechanism into a locked position. In this position, the locking mechanism cannot be moved to its open position and the structure is locked. When the engagement structure is in its first position the leg is positioned outside of the opening and does not restrict the locking mechanism from moving to its open position. The structure, such as a storage unit, that was locked can then be opened.

[0008] The engagement structure may also have more than one leg and/or multiple legs that are received in one or more openings in the locking mechanism, For example, an engagement structure may have two legs that each engages one of two separate openings when the legs are in their second, extended position.

[0009] The engagement structure can move from its first position to its second position in any suitable manner. For example, the engagement structure may move straight up and down, or move up and down at an angle, or rotate up and down around a pivot rod. The engagement structure most preferably moves in response to an electronic signal or command that operates an electric motor.

[0010] In one embodiment, the engagement structure has one leg. The leg has a proximal surface (which is closest to the opening in the locking mechanism when the locking mechanism is in its unlocked position). The leg also includes a distal surface, which is farthest from the opening when the locking mechanism is in its unlocked position. In one embodiment the proximal surface is either angled or curved so when the first end of the locking mechanism is moved into contact with the leg it presses against the proximal surface of the leg. The force applied by the first end of the locking mechanism pushes the leg of the engagement structure out of the way of the locking mechanism and moves the engagement structure to its first position. As the first end of the locking mechanism moves farther, the opening aligns with the leg, and the leg then moves back into its second position where it is positioned in the opening and retains the locking mechanism in its locked position.

[0011] The engagement structure can also, or instead, be moved from the first position to the second position, or from the second position to the first position. If moved electrically, an electric motor or other device is activated to physically move the engagement structure from its first position to its second position, or vice versa, and in this embodiment the engagement structure is preferably biased to its first, open position, As previously described, when the engagement structure is in its first position, it allows for passage of the locking mechanism to its unlocked position so the structure can be opened. When the engagement structure is in its second position it can engage the opening to maintain the locking mechanism in its locked position.

[0012] A lock according to this disclosure may be the sole lock for a structure, such as a storage unit, or function as an overlock for an existing ("primary") lock. The overlock is a secondary locking feature, which could be a separate lock or a second leg of the existing lock, which could be activated to provide an overlock. Or, the overlock could electronically disable the ability of a user to unlock the existing lock and access a structure. For example, if the user had not paid a bill, or if there was a legal dispute over the contents of the locked structure. Preferably, only the service provider, and not an individual user could override the overlock feature.

[0013] Both the smart lock system (as a sole lock) and the smart lock (as an overlock) are designed to be attached or installed on a structure, for example a self-storage rollup door, without requiring to open the structure thereby exposing the contents or requiring ingress into a private space. The smart lock system of this disclosure can be attached in any suitable manner, such as with rivets, screws, bolts, or a

combination of installing Rivnut® type hardware in conjunction with security screws or bolts after drilling holes in the structure.

[0014] Methods of electronically using and managing locks or lock systems are also disclosed herein.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015] FIG. **1** is a top view of an intelligent lock mounted to a base plate with a locking mechanism.

[0016] FIG. **2** is a top view of the intelligent lock of FIG. **1** with the locking mechanism extended.

[0017] FIG. **3** is a side view of the intelligent lock and locking mechanism of FIG. **1**.

[0018] FIG. **4** is an end, perspective view of the intelligent lock and locking mechanism of FIG. **1**.

[0019] FIG. **5** is an opposite end view of the intelligent lock and locking mechanism of FIG. **1**.

[0020] FIG. **6** is a bottom view of the intelligent lock and locking mechanism of FIG. **1** with the locking mechanism retracted.

[0021] FIG. **7** is a bottom view of the intelligent lock and locking mechanism of FIG. **2** with the locking mechanism extended.

[0022] FIG. **8** is a top view of an intelligent lock according to this disclosure.

[0023] FIG. **9** is a top, perspective view of the intelligent lock and locking mechanism of FIG. **1**.

[0024] FIG. **10** is a top, perspective view of a locking structure variant according to this disclosure.

[0025] FIG. **11** is top, perspective view of a locking structure variant according to this disclosure.

[0026] FIG. **12** is a top, perspective view of a locking structure according to this disclosure.

[0027] FIG. **13** is an exploded view of the lock of FIG. **8**.

[0028] FIG. **14** is a side, perspective, open view of a smart lock according to this disclosure.

[0029] FIG. **15** is a top view of a controller that may be used in a lock according to this disclosure.

[0030] FIG. **16** is an exploded view of an alternate intelligent lock according to this disclosure.

[0031] FIG. **16**A is an exploded, side perspective view of the engagement structure.

[0032] FIG. **16**B is an assembled, side, perspective view of an engagement structure according to this disclosure.

[0033] FIG. **17** is a partial, cut-away, side, perspective view of the engagement structure of FIG. **16**B in a first position.

[0034] FIG. **18** is a partial, cut-away, side, perspective view of the engagement structure of FIG. **16**B is a second position.

[0035] FIG. **19** is a perspective, side view of an overlock system according to this disclosure.

[0036] FIG. **20** is an end view of the overlock system of FIG. **19**.

[0037] FIG. **21** is a front view of the overlock system of FIG. **19**.

[0038] FIG. **22** is another front view of the overlock system of FIG. **19**.

[0039] FIG. **23** is a top view of the overlock system of FIG. **22**.

[0040] FIG. **24** is a front view of an overlock system that includes a protective structure.

[0041] FIG. **25** is a top view of the overlock system of FIG. **24**.

[0042] FIG. **26** is a partially exploded, perspective side view of an overlock system.

[0043] FIG. **27** is a partially exploded, side perspective view of a smart lock system according to this disclosure being used as a sole lock.

[0044] FIG. **28** is an exploded, perspective view of a smart lock according to FIG. **27**.

[0045] FIG. **29** is an exploded view of an engagement structure according to this disclosure.

[0046] FIG. **30** is a schematic drawing of a method utilizing a lock and an electronic device (showing the example of a cell phone) for joint authorization.

[0047] FIG. **31** is a schematic drawing of a method utilizing a lock and an electronic device (showing the example of a cell phone) for device to server authorization.

[0048] FIG. **32** is a schematic drawing of a method utilizing a lock and an electronic device (showing the example of a cell phone) for device preauthorization.

[0049] FIG. **33** is a schematic drawing of a method utilizing a lock and an electronic device (showing the example of a cell phone) for lock to server authorization.

[0050] FIG. **34** is a flow chart of logic steps (of FIG. **30**) for a lock and an electronic device (showing the example of a cell phone) for joint authorization.

[0051] FIG. **35** is a flow chart of logic steps (of FIG. **31**) for a lock and electronic device (showing the example of a cell phone) for device to server authorization.

[0052] FIG. **36** is a flow chart of logic steps (of FIG. **32**) for a lock and electronic device (showing the example of a cell phone) for device preauthorization.

[0053] FIG. **37** is a flow chart of logic steps (of FIG. **33**) for a lock and electronic device (showing the example of a cell phone) for lock to server authorization.

[0054] FIG. **38** is a flow chart of logic steps for a third-party authorization that can replace user authorization.

DETAILED DESCRIPTION

[0055] Turning now to the drawings, where the purpose is to describe preferred embodiments and not to limit the scope of the claims, FIGS. **1-14** show a lock system **1** with a lock **10** mounted to a base plate **2**. Lock system **1** is preferably attached to a structure to be locked, such as to the door of a storage unit. Base plate **2** may be attached to the structure to be locked in any suitable manner, such as by screws, bolts or rivets **17**. Lock **10** may be also attached in any suitable manner to base plate **2**, but preferably by screwing, bolting, or riveting it into position.

[0056] Lock system **1** has a base plate **2** and an intelligent, electronic lock **10**. Base plate **2** includes two raised flanges **28**, an extension sheath **9**, an opening **33**, and openings (not shown) to receive fasteners **17** that connect the base plate **2** to the structure, such as a storage unit, to be locked. A locking mechanism **12** is positioned in base plate **12** and has (as shown in FIG. **1**) a first, retracted, unlocked position and can be moved to (as shown in FIG. **2**) a second, extended, locked position. Locking mechanism **12** as shown is a sliding metal bar with a distal end **21**, a proximal end **25**, and an upwardly-extending tab **23** that can be grasped by a user in order to move locking mechanism **12**. Base plate **2** has an opening **19** that exposes the proximal end **25** and tab **23** of locking mechanism **12** to permit a user to access end **25** and tab **23** in order to move locking mechanism **12**.

[0057] Lock **10** has an outer cover **11**, an inner lock **13** that can be removed to access an inner cavity of lock **10**, and a radio **14** for transmitting and receiving electronic signals.

[0058] As can be seen in FIGS. **6-7**, the bottom of base plate **2** has an opening **31**A that is configured to receive dowel pin **40**A of an engagement structure (defined below). Dowel pin **40**A can only be received in opening **31**A when locking structure **12** is in its second, locked position. When dowel pin **40**A is positioned in opening **31**A, the lock system **1** is locked and cannot be opened until dowel pin **40**A is retracted to its first position in which it is not positioned in opening **31**A.

[0059] FIG. **9** shows the lock system **1** of FIGS. **1-8**, but further includes a manual lock **3**. Manual lock **3** has a first, unlocked position, in which a locking mechanism (preferably a dowel pin, which is not shown) extends into an opening (such as opening **37** of FIG. **16**) in locking mechanism **12**. Manual lock **3** is known in the art and will not be described in detail here, however, it is not known to use manual lock **3** in conjunction with an electronic lock as described herein, such as electronic lock **10**. The advantage of using the two locks is that in case of an electronic failure of an electronic lock according to this disclosure, such as lock **10**, or the failure of a system controlling an electronic lock according to this disclosure, the manual lock **3** can still be used to lock (or overlock) a structure.

[0060] Manual lock **3** is the property of the end user or whomever is renting the structure, such as a storage unit, that is locked. In the absence of a smart lock as described herein, lock **3** would protect the contents of the unit. Now, if an end user did not pay a bill, the site owner/operator/structure owner can insert a special lock block (not shown) in cavity **33**, and then manually overlock lock **3**—preventing movement of locking mechanism **12**—by placing a manual padlock (not shown) through the lock block and vertical flange with hole **23**. One application of a smart lock as disclosed herein is that the owner/operator/structure owner may remotely and electronically overlock the unit (e.g., using RF communications, other wireless communications, or wired communications), thereby not requiring the time or effort to manually overlock the unit.

[0061] FIGS. **10-12** show the locking system of FIG. **9** with different base plate configurations to attach base plate **2** to a structure to be locked. FIG. **10** shows the base plate of FIGS. **1-9**, which has between 4-6 fasteners. FIGS. **11** and **12** show alternate base plates, each of which utilize two (or more) fasteners, wherein each of the fasteners is preferably a rivet, screw, and/or bolt. The base plate **2***a* of FIG. **11** is preferably mounted to a flat structure. The base plate **2** of FIG. **10** and **2***b* of FIG. **12** is preferably mounted to a corrugated surface.

[0062] FIG. **13** is an exploded view of the lock **10** of FIGS. **1-12**. Lock **10** preferably has an outer casing **11**, which can be made of any suitable material, such as plastic or metal.

[0063] The RF top plastic cover is used so that RF radio communications can be received in and sent from the lock. An antenna is positioned below the RF plastic cover in order to optimize range and communications. The light pipe can be used for several things, such as for diagnostics or to show when the lock is sending/receiving data, or detecting low battery power conditions, as examples. The light pipe acts as a visual user interface when a user is near the lock.

[0064] Outer casing **11** can be made of any suitable material and fits over a body portion **50** that is preferably formed of aluminum although any suitable material would suffice. Body portion **50** defines any inner cavity **52** into which the components of lock **10** are received, a top surface **54**, a first, or proximal, end **62**, a first side **56**, a second side **60**, and a second, or distal end **58**. An opening **64** is formed in top surface **54** and leads to cavity **52**. A bore **66** is formed in top surface **54** and is configured to receive a flush rivet, which attaches to a bore in bracket **400**. A bore **70** is formed in end **58** and is designed to receive a flush rivet **73** that attaches to a bore **70**A in bracket **400**. A bore (not shown) is formed in end **62** and is configured to receive a flush rivet **74** that attaches to a bore **74**A in bracket **400**.

[0065] A controller **80** is configured to perform the lock operations described herein and to preferably receive and transmit electronic signals directly or indirectly to and from a user. A top view of controller **80** is shown in FIG. **15**. Controller **80** can be any suitable radio technology. Controller **80** is mounted to a motor bracket **100** by one or more, and as shown, three, screws **102**. An electric motor **1000** is typically a gearmotor, although any suitable motor may be used and it is connected to the motor bracket **100** in any suitable fashion.

[0066] A dowel pin **200** is mounted to motor bracket **100** on the side opposite motor **1000** and is movable upwards and downwards (relative the components in FIG. **13**) and is aligned by a slotted spring pin **210** that fits in slot **202**.

[0067] A main bracket **400** has a first side **402** that is connected to the body, a second side **404** that is connected to the body, and a top **406** that is connected to the body. An opening **408** is positioned under top **406**.

[0068] An optional sensor printed circuit **500** is positioned at any suitable place in housing **50** and is configured to receive and communicate information from one or more sensors that are part of printed circuit board **500**, such as a thermistor, accelerometer, thermocouple, VOC sensor, or other, which is described further herein.

[0069] A battery container **600** has a top **602**, a first end **604**, a second end **606**, and a bottom **608**. Fasteners **610** are received in opening in top **602** and in openings in top **406** to fasten battery container **600** to top **406** of main bracket **400**, and battery container **600** is positioned in bottom **408**. Batteries **700** are received in bottom **608** of battery container **600**.

[0070] A keyed-alike (or inner) lock **13** fits into opening **64** and can be removed using a tool to access cavity **52** and then reattached. Keyed-alike lock **13** is most preferably a Southco CM-9-ICI109-21B-KA, although any suitable lock may be used. A hex bolt **92** and catch **94** are used to position keyed-alike lock **13** in housing **50**.

[0071] FIG. **16** is an alternative embodiment of a lock system **1**A according to this disclosure which is the same as lock system **1** except that it includes a different engagement structure **500** and modified locking mechanism **12**A. Locking mechanism **12**A has an opening **31**B that, as shown in this example, is T-shaped to receive a pivot arm (or leg) **115**A of engagement structure **500**. In this embodiment, engagement structure **500** has a first, retracted, unlocked position in which leg **115**A is in its upward position, and a second, extended, locked position in which leg **115**A is in its downward position and is received in opening **31**B.

[0072] Engagement structure **500** has a front **115**A, a back **115**B, a body portion **115**C, a first side **116**, a second side **118**, and a leg **140**A. Engagement structure **500** can be comprised of any suitable material(s), such as metal.

[0073] Height H1 of leg **140**A is selected so that leg **140**A extends far enough when engagement structure **500** is in its second position for leg **140**A to be positioned in and engage opening **31**B. Accordingly, opening **31**B of locking mechanism **12**A can retain leg **140**A when locking mechanism **12**A is in its locked position.

[0074] If the leg **140**A is biased to its second position, end **21** of locking mechanism **12**A can be pushed past leg **140**A by: (1) forming leg **140**A so it is curved or angled and moves out of the path of locking mechanism **12**A when it is pressed against by first end **21**, or (2) using a motor (or other device) to move leg **140**A to its first position to allow first end **21** to pass leg **140**A. As shown in FIG. **16**A, leg **40**A has a proximal side **40**C (nearest the opening **31**B) and a distal side **140**D (farthest from the opening **31**B). Proximal side **140**C can be angled or curved and thus configured to move out of the path of end **21**, when the end **21** of locking mechanism **12**A is pressed against proximal side **140**C of leg **140**A.

[0075] As shown in FIGS. **13** and **29**, an electric motor, such as motor **1600**, can be operated to move an engagement structure, such as the engagement structure **500** with leg **140**A, radially around pivot rod **1050**A between its first position and its second position. In such an embodiment, the motor and engagement structure **500** are directly or indirectly connected and the motor preferably maintains the engagement structure in a biased position.

[0076] An optional biasing member **1080**A, such as spring, can be positioned in any suitable manner to bias engagement structure **500** to its first position or to its second position. As shown in FIGS. **16**-**16**A, one or more biasing members **1080**A may be utilized. As shown, the biasing member **1080**A is a spring that is at least partially retained in opening **1096**A. Biasing member **1080** applies pressure on engagement structure **500** to bias it towards it first position or towards its second position. Instead of a compression spring, an elastomeric structure, motor, or other structure may be used to bias engagement structure **115** to its first position or to its second position.

[0077] In this embodiment, engagement structure **115** has a support plate **501** that is fastened to base plate **2**. Plate **501** includes a screw boss **1082**A, which receives screw **1084**A, which is then screwed to base plate **2**, or it passes through base plate **2** and a nut is threaded to screw **1084**. Screws **70**A also pass through engagement structure **500** and fasten it to base plate **2**.

[0078] FIG. **14** is an alternate view of the lock of FIGS. **1**-**13** and FIG. **15** is a close up view of a controller that could be used with a lock according to this disclosure.

[0079] As shown in FIGS. **16**B-**18**, an alternative, exemplary engagement structure **500**A has a pivot arm (or leg) **15** with a front **15**A, a back **15**B, a body portion **15**C, a first side **16**, a second side **18**, and a leg **40**A. Engagement structure **500**A can be comprised of any suitable material(s), such as metal.

[0080] Height H2 of leg **40**A is selected so that leg **40**A extends far enough when engagement structure **500**A is in its second position for leg **40**A to be positioned in and engage opening **31**B. Accordingly, opening **31**B of locking arm **12**A will retain leg **40**A while locking mechanism **12**A is in its locked position.

[0081] If the leg **40**A is biased to its second position, end **21** can be pushed past leg **40**A by: (1) forming leg **40**A so it is curved or angled and moves out of the path of locking mechanism **12**A when it is pressed against by first end **21**, or (2) using a motor (or other device) to move leg **40**A to its first position to allow first end **21** to pass leg **40**A. As shown in FIGS. **16**B-**18**, leg **40**A has a proximal side **40**C (nearest the opening **31**B) and a distal side **40**D (farthest from the opening **31**B). Proximal side **40**C can be angled or curved and thus configured to move out of the path of end **21** when the end **21** of locking mechanism **12**A is pressed against proximal side **40**C of leg **40**A.

[0082] As shown in FIGS. **13** and **29**, an electric motor, such as motor **1600**, can be operated to move an engagement structure, such as the engagement structure **15** with leg **40**A, radially around pivot rod **1050** between its first position and its second position. In such an embodiment, the motor and engagement structure **500**A are directly or indirectly connected and the motor preferably maintains the engagement structure in a biased position.

[0083] An optional biasing member **1080**, such as spring, can be positioned in any suitable manner to bias the engagement structure **500**A to its first position or to its second position. As shown in FIGS. **16**B-**18**, one or more biasing members **1080** may be utilized. As shown, the biasing member **1080** is a spring that is at least partially retained in opening **1095**. Biasing member **1080** applies pressure on engagement structure **500**A to bias it towards it first position or towards its second position. Instead of a compression spring, an elastomeric structure, motor, or other structure may be used to bias engagement structure **15** to its first position or to its second position.

[0084] To release locking mechanism **12**A and allow it to move to an open position, the engagement structure **500**A is moved to its first position by operating a motor, such as motor **1000**.

[0085] In this embodiment, engagement structure **500**A has a support plate **501**A that is fastened to base plate **2** by suitable fasteners, such as screws, bolts, or rivets.

[0086] FIGS. **19**-**23** show an embodiment of this disclosure used in an overlock system **2000**. Lock **10**A, as an example, was previously described and any electronic lock according to this disclosure may be utilized in system **2000**. Lock **10**A is attached to a structure by fastener **17**B. Conventional lock C is known in the art and shall not be described in detail here. In an overlock application, the conventional lock C is already mounted to a structure to be locked and an electronic lock according to this disclosure is added to overlock conventional lock C for the reasons previously described.

[0087] Lock system **1**B is the same as previously described lock system **1** or lock system **1**A except that (a) engagement structure **12**B is moved manually or by a motor during normal usage, (b) there is no opening in base plate **2**C to manually grasp and move engagement structure **12**B, and (c) engagement structure **12**B has an angled tab **23**B (preferably formed at 90° relative the other portion of engagement structure **12**B), which is shown in FIG. **26**, at end **21**B and the tab is pressed against a tab (shown in FIG. **26**) on the engagement structure of conventional lock C. A hasp combiner **600** is then positioned over the two tabs and then the engagement structure of conventional lock C cannot move unless the engagement structure **12**B of lock structure **1**B moves. In other words, the locking mechanism of conventional lock C remains in the locked position when lock **10**A is locked. This is what "overlock" means—the additional locking structure **1**B ultimately determines whether the

structure on which locking structure **1**B and conventional lock C are positioned can be opened. If lock **10**A is locked, the structure cannot be opened even if conventional lock C is unlocked. If conventional lock C or lock **10**A, or both, are locked, the structure to which they are attached cannot be opened.

[0088] FIGS. **24-26** show an alternative embodiment **2002** that is the same as system **2000** but that further includes a protective structure **700**, which as shown is a metal plate positioned overlock locking mechanism **12**B. Structure **700** is fastened to either base plate **2**C and/or to the structure that is locked. The purpose of structure **700** is added security. It helps prevent someone from prying locking mechanism **12**B with a tool, such as a crow bar.

[0089] An alternate electric lock **10**B according to the invention is shown in FIG. **26** with system **2004**, which other than using a different lock has the same structure as system **2002**. Lock **10**B has a display and no inner lock on its face. It has an end cap **2010** that is removably mounted to an end of lock **10**B. Using this arrangement, end cap **2010** can be removed to access the inner cavity of lock **10**B to, for example, to install, remove, or replace batteries without having to remove lock **10**B from the structure S or from the base plate **2**C.

[0090] All of the electronic locks disclosed herein preferably have legs **400** and mating openings **410** to assist with the firm mounting of the lock to the base plate.

Alternate Lock/Overlock Structure

[0091] An alternate embodiment is shown in FIGS. **27-29**, which shows a lock being used as a stand-alone lock. In this embodiment, the batteries B are again accessible by end cap **2010** at second end **430** of lock **10**B. End cap **2010** is removably attached to second end **430** as previously described. The engagement mechanism **1550** (shown in detail in FIG. **29**, is self-contained in lock **10**B and does not fasten to base plate **2**C.

[0092] As shown in FIG. **28**, lock **10**B has a (1) radio frequency window, which has the same function as the previously described RF top plastic cover, (2) circuit board **80**, (3) battery contact assembly B**1**, (4) battery B, (5) end cap **2010**, and drive assembly **1550**.

[0093] Turning to FIG. **29**, drive assembly **1550** includes an electric motor **1600**, a servo cam **1554**, a drive bracket **1558**, and an engagement structure **1700**. Engagement structure has a first, retracted unlocked position, and a second, extended, locked position. Engagement structure functions in the same manner as previously described engagement structures **500** and **500**A except that it has no plate to mount to a base plate. It is self-contained in lock **10**B.

Sensors

[0094] Sensors that could be used with a lock or system include one or more sensors that detect one or more of (1) locking mechanism opened or locking mechanism closed; (2) engagement structure open or engagement structure closed; (3) vibration/G-force; (4) infrared (IR); (5) location via GPS; (6) asset tracking; and (7) geo-fencing; (8) or any other suitable sensors applicable to the smart lock environment.

[0095] The lock could contain or work in conjunction with one or more sensors. In one example, the lock provides its present status or change of status. For example, "lock or latch closed" or "lock or latch opened".

[0096] In another example, a lock on a self-storage unit rollup door may have an infrared (IR) sensor that can monitor temperatures inside of the storage unit, either by being in communication with the unit through an opening in the door or having the IR component inside of the unit and communicating with the lock or the system. The measured temperature may indicate a fire, or the presence of a person that gained access to the storage unit without permission.

[0097] In another example, the lock or system may include one or more accelerometers that could determine the amount of force striking a rollup door or other locked structure. This could help alert an owner or manager of a possible break-in attempt.

[0098] In another example, the lock or system could have a CCD or other camera so that contents of the storage unit could be remotely viewed by either the facility owner or by the individual(s) renting or leasing the locked structure.

[0099] In another example, the lock could have sensors to detect particular vapors or chemicals, whereby the sensor could alert the facility owner or the individual(s) renting or leasing the locked structure if a harmful or undesirable vapor or chemical, such as gasoline or chemicals used in illegal drug manufacturing, were detected. In a specific example, someone making methamphetamine in a storage unit could be identified by such a sensor, and the sensor, via the lock or otherwise, would communicate via wired or wireless methods. The examples below include embodiments with sensors.

Electronics and Communications

[0100] A lock and system may utilize a (1) one or more RF radio units; (2) a dual RF radio unit; (3) a motor controller circuit; and (4) a low power e, which means that the controller consumes low amounts of power so the battery life is longer.

[0101] A lock according to the disclosure can be powered in suitable manner, such as by a battery, batteries, being direct wired to a power source of direct current (DC) or alternating current (AC), by a solar charged power source, or by inductive charging of a power source.

[0102] A lock or system may communicate in any suitable manner, such as by (1) BLE Bluetooth low energy; (2) near field communications (NFC); (3) Zigbee; Beacon; and/or (4) Dust Network. The lock can transmit or receive data (a) via traditional communication wire methods, (b) via power wires connected to the lock, wherein the communication packets are carried on the AC or DC line voltage, or (c) by wireless methods such as radio frequency (RF). For example, a lock may include one or more RF radio units.

[0103] One RF radio unit of a lower frequency, e.g., about 900 MHz, or about 800 MHZ-1,000 MHz, or about 880 MHz to 920 MHz, may be used for carrying larger packets of data and communicating with a host via routers or repeaters (this would typically be the Backhaul unit).

[0104] One RF radio unit of a higher frequency, e.g., 2.4GHz, or about 2.3-2.5 GHz, may be used for communication, such as with smart devices, e.g., cell phones or tablets, within a relatively short range.

[0105] The lock or system may have one or more RF radio units of a higher frequency than the others, in order to communicate with a smart device, such as a cell phone or

computer, and whereby that smart device communicates and authenticates via a cellular phone network.

[0106] The lock may include one or more RF radio units that can link to another radio or radios via a network, whether using a proprietary protocol or using a standard protocol.

[0107] The lock may have an RF radio unit that can self-heal based upon other radios in the system. Self-heal means the ability to reroute packets based on known quality RF links within the system. The system establishes this by routing tables and known signal strength.

[0108] The lock may have an RF radio unit that will seek other RF radio units in the system to optimize the communication of data to itself or back to a host.

[0109] The lock may include at least one of its RF radio units that will seek other radios if its current or primary link to its previously established link is broken.

[0110] The lock may have one or more RF radio units that has a guaranteed packet delivery structure, which is a Dust network feature whereby the chip receives confirmation that the packet was delivered.

[0111] The lock may have two RF radio units that can be used for additional security or authentication in accessing an area or accessing an asset. For example, in a military depot with thousands of containers stored in close proximity, an attempt to access or open an individual container could require a dual acceptance and approval from both the local host (which could be a database, control center, or centralized database) via a first radio, while a second radio would solicit approval from a separate device (such as a smart device, internet, or other) in order to grant access. If the acceptance criteria are not met by one RF radio unit, the lock would not operate.

[0112] The lock may be paired to a smart device, such as a smartphone or tablet, via BlueTooth or Near Field Communication (NFC).

[0113] In one example, the lock can be remotely locked or unlocked based on criteria from the host (such as a computer), and the command to unlock may come from an APP, local database, local control center, centralized control center, or the cloud. In another example, the locking device may have fingerprint access.

[0114] The lock may communicate with, or is networked with, a host, either via wire or wireless as noted herein; wherein the host can be: (a) a smart device, e.g. a smartphone or tablet; (b) a local database or control center, e.g. the office of a self-storage facility; and (c) a centralized database or control center, e.g. using the "Internet" to coordinate transmitting and receiving data from the lock.

[0115] The lock can receive software or firmware updates via wired or wireless methods, or by a hardware port or connector whereby a user or manager can update software or firmware.

[0116] Some exemplary methods of implementing a system including a plurality of locks are shown in FIGS. **30-38**. FIGS. **30** and **34** show a method of operating an electric lock that includes the following steps:

[0117] (a) a user contacting a lock-control server;

[0118] (b) the server authenticating the user:

[0119] (c) the user requesting access to a lock having a radio;

[0120] (d) the lock radio sending a query to the server with the user information;

[0121] (e) the server verifying that the user is permitted to access the lock, or denying access to the lock;

[0122] (f) if access to the lock is permitted, the server sending the user an authorization token;

[0123] (g) the user sending the authorization token to the lock;

[0124] (h) the lock verifying the authenticity of the token and locking or unlocking if the token is authenticated.

[0125] FIGS. **31** and **35** show a method of operating an electric lock that includes the following steps:

[0126] (a) a user contacting a lock-control server;

[0127] (b) the server authenticating the user:

[0128] (c) the user requesting access to a lock having a radio;

[0129] (d) the lock radio sending the user a token;

[0130] (e) the user sending the token to the server;

[0131] (f) the server verifying the user is permitted to access the lock, or denying access to the lock;

[0132] (g) if access to the lock is permitted, the server sending the user an authorization token;

[0133] (h) the user sending the authorization token to the lock;

[0134] (i) the lock verifying the authenticity of the token and locking or unlocking if the token is authenticated.

[0135] FIGS. **32** and **36** show a method of operating an electric lock that includes the following steps:

[0136] (a) a user contacting a lock-control server;

[0137] (b) the server authenticating the user:

[0138] (c) the user requesting the server access to a lock having a radio;

[0139] (d) the server determining if the user is authorized to have access to the lock;

[0140] (e) the server verifying the user is permitted to access the lock, or denying access to the lock;

[0141] (f) if access to the lock is permitted, the server sending the user an authorization token;

[0142] (g) the user sending the authorization token to the lock;

[0143] (h) the lock verifying the authenticity of the token and locking or unlocking if the token is authenticated.

[0144] FIGS. **33** and **37** show a method of operating an electric lock that includes the following steps:

[0145] (a) a user contacting a lock to request access to the lock providing the lock with a user token;

[0146] (b) the lock sending an authorization request to a lock server;

[0147] (c) the server authenticating the token and that the user is authorized:

[0148] (d) the server verifying the user is permitted to access the lock, or denying access to the lock;

[0149] (e) if access to the lock is permitted, the server sending the lock an authorization token specific to the user;

[0150] (f) if access to the lock is permitted, the server sending the user an authorization token specific to the lock;

[0151] (g) the user sending the authorization token specific to the lock to the lock;

[0152] (h) the lock verifying the authenticity of the token and locking or unlocking if the token is authenticated.

[0153] FIG. **38** shows a method of operating an electric lock that includes the following steps:

[0154] (a) a user contacting a lock-control server;

[0155] (b) the server authenticating the user:

[0156] (c) the user requesting access to a lock having a radio;

[0157] (d) the lock radio sending a query to the server with the user information;

[0158] (e) the server verifying that the user is permitted to access the lock, or denying access to the lock;

[0159] (f) if access to the lock is permitted, the server sending the user an authorization token;

[0160] (g) the user sending the authorization token to the lock;

[0161] (h) the lock verifying the authenticity of the token and locking or unlocking if the token is authenticated.

[0162] Any of the methods herein could further include (1) the step of the lock opening, (2) the step of the user communicating with the lock and the server by using a cell phone or a computer, (3) the server being a cloud server, (4) the token including a time during which the user is authorized to operate the lock, (5) the step of the server determining if the lock is within a predetermined range, or (6) the step of the server contacting a third party.

[0163] Some exemplary non-limiting embodiments of the disclosure are set forth below:

[0164] Example 1: A lock comprising an engagement structure configured to engage an opening in a locking mechanism, wherein the lock comprises (a) a body; and (b) an engagement structure positioned at least partially in the body, the engagement structure having a first position in which it engages the locking mechanism and a second position in which it does not engage the locking mechanism.

[0165] Example 2: The lock of example 1, wherein the locking mechanism includes an opening configured to retain a leg of the engagement structure.

[0166] Example 3: The lock of any of examples 1-2, wherein the leg has a side that is curved or angled.

[0167] Example 4: The lock of any of examples 1-3, wherein the engagement structure is biased to the first position or to the second position.

[0168] Example 5: The lock of example 4, wherein the engagement structure is biased by a spring.

[0169] Example 6: The lock of any of examples 1-5 that further includes an electric motor, and wherein the engagement structure can be moved between its first position and its second position by the electric motor.

[0170] Example 7: The lock of example 6, wherein the motor is directly or indirectly connected to the engagement structure.

[0171] Example 8: The lock of any of examples 1-7 that further incudes a pivot rod around which the engagement structure pivots from its first position to its second position and its second position to its first position.

[0172] Example 9: The lock of any of examples 1-8, wherein the engagement structure is biased to the second position.

[0173] Example 10: The lock of example 9 that further includes an electric motor configured to bias the engagement structure to the second position.

[0174] Example 11: The lock of any of examples 1-9, wherein the locking mechanism is a sliding bar that is movable between a first, unlocked position to a second, locked position.

[0175] Example 12: The lock of any of examples 1-2 or 4-11, wherein the engagement structure is a dowel pin.

[0176] Example 13: The lock of example 12, wherein the dowel pin is vertically oriented inside of the body.

[0177] Example 14: The lock of any of examples 1-13, wherein the engagement structure is fully inside the body when in its first position and partially inside of the body when in its second position.

[0178] Example 15: The lock of any of examples 1-14 that further includes a base plate to which the body is connected.

[0179] Example 16: The lock of example 15, wherein the base plate has a top side to which the body is connected and a bottom side, and the locking mechanism is positioned primarily on the bottom side.

[0180] Example 17: The lock of any of examples 15-16, wherein the base plate has an opening through which the locking mechanism can be accessed.

[0181] Example 18: The lock of example 17, wherein the locking mechanism is a sliding bar.

[0182] Example 19: The lock of example 18, wherein the sliding bar further comprises an outwardly-extending tab that extends past the opening and is configured to be manually gripped by an operator in order to move the sliding bar.

[0183] Example 20: The lock of any of examples 1-19, wherein the second side of the base plate includes one or more structures configured to space the base plate from a structure to which the base plate is mounted.

[0184] Example 21: The lock of example 19, wherein the outwardly-extending tab is formed at a 90° angle from the sliding bar.

[0185] Example 22: The lock of any of examples 19-21, wherein the outwardly-extending tab includes an opening configured to receive the arm of a padlock.

[0186] Example 23: The lock of any of examples 1-23, wherein the engagement structure is mounted directly to the base plate.

[0187] Example 24: The lock of example 23, wherein the engagement structure is mounted directly to the base plate by one or more fasteners.

[0188] Example 25: The lock of example 24, wherein the engagement structure includes a support plate that rests on the base plate.

[0189] Example 26: The lock of any of examples 1-23, wherein the engagement structure is not mounted directly to the base plate.

[0190] Example 27: The lock of any of examples 1-26 that has fingerprint access.

[0191] Example 28: The lock of any of examples 1-27 that has an overlock feature.

[0192] Example 29: The lock of any of examples 1-28 that further includes an access lock on the body, wherein the access lock can be removed to expose an inner cavity of the body.

[0193] Example 30: The lock of example 29 that further includes a fastener that connects the body to the base plate, wherein the fastener is accessible in the inner cavity and can be removed to remove the body from the base plate.

[0194] Example 31: The lock of any of examples 1-30 that further includes a secondary manual lock that has a second engagement member configured to engage the locking mechanism.

[0195] Example 32: The lock of any of examples 1-31 that further includes a receiver configured to receive electronic signals.

[0196] Example 33: The lock of any of examples 1-32 that further includes a transmitter for sending electronic signals.

[0197] Example 34: The lock of example 32, wherein the receiver is a radio.

[0198] Example 35: The lock of example 33, wherein the transmitter is a radio.

[0199] Example 36: The lock of any of examples 1-35 that further includes a power source.

[0200] Example 37: The lock of example 36, wherein the power source is one or more batteries.

[0201] Example 38: The lock of any of examples 1-37, wherein the lock body has a first end and second end and an end cap on the first end or the second end.

[0202] Example 39: The lock of example 38, wherein the end cap is connected to the body by one or more fasteners.

[0203] Example 40: The lock of example 38 or 39, wherein the end cap has a first position in which it is connected to the body by the one or more fasteners, and a second position in which it is removed from the body and the inner cavity of the body is exposed, whereby batteries can be removed and/or added to the inner cavity when the end cap is removed.

[0204] Example 41: The lock of any of examples 1-40 that can communicate on multiple radio frequencies.

[0205] Example 42: The lock of example 41, wherein the lock can operate at either 2.4 GHz or 900 MHz or both.

[0206] Example 43: The lock of example 41 that comprises multiple radios, wherein each radio operates on a different frequency.

[0207] Example 44: The lock of example 42 or 43 that includes at least one radio operating at 2.4GHz and at least one radio operating at 900 MHz.

[0208] Example 45: The lock of any of examples 1-44 that is configured to be mounted to a structure without the need to enter or open the structure.

[0209] Example 46: The lock of example 45, wherein the structure is a self-storage unit.

[0210] Example 47: The lock of any of examples 1-46 that includes a backhaul unit to interface with the lock and/or with a central controller, such as a computer.

[0211] Example 48: The lock of any of examples 1-47 that meshes to a backhaul unit via RF communications at 2.4 GHz.

[0212] Example 49: The lock of any of examples 1-48, wherein there is a plurality of backhaul units and the backhaul units communicate with each other via RF transmissions at 900 MHz or by power-over-ethernet.

[0213] Example 50: The lock of any of examples 1-49, wherein there is at least one backhaul unit that communicates with a central controller either via a radio signal at 900 MHz or via power-over-ethernet.

[0214] Example 51: The lock of any of examples 1-50 that is configured to communicate via RF technology, an AC wired connection, a DC wired connection, power-over-ethernet, or through a backhaul unit.

[0215] Example 52: The lock of any of examples 1-51 that further includes one or more sensors, wherein the one or more sensors are one or more of: (a) a temperature sensor (such as an infrared detector, a thermistor, a thermocouple, or a laser); (b) a water sensor (such as a hygrometer or floor-leak sensor); (c) a chemical sensor (such as a smoke detector, CO sensor, CO_2 sensor, O_3 sensor, NO_x sensor, H_2S sensor, or methane sensor), (d) an environmental sensor (such as to measure air pollution, gas, O_3, methane or other gases), (e) a pressure sensor (such as a barometer or tactile sensor), and (f) a proximity sensor (such as an alarm, motion sensor, or infrared sensor).

[0216] Example 53: The lock of any of examples 1-52 that is configured to communicate with any of the sensors listed in example 51.

[0217] Example 54: The lock of example 53, wherein the sensors are remote from the lock.

[0218] Some further, non-limiting examples of the invention are as follows:

[0219] Example 1: A lock that is powered by one or more of a battery, wired electrical power, solar charging, or inductive charging.

[0220] Example 2: The lock of example 1 that can transmit or receive data via a (a) wired connection, (b) a power wire, where the communication packets are carried on an AC line voltage, or (c) wireless radio frequency protocol.

[0221] Example 3: The lock of example 1 that further includes one or more RF radio units.

[0222] Example 4: The lock of example 3 that has a plurality of RF radio units, wherein at least one RF radio unit operates at a lower frequency than the other of the plurality of RF radio units.

[0223] Example 5: The lock of example 4, wherein the at least one RF radio unit operating at a lower frequency operates at about 900 MHz.

[0224] Example 6: The lock of example 3 or 4, wherein the at least one RF radio unit operating at a lower frequency is configured to carry larger packets of data and communicate with a host via routers or repeaters.

[0225] Example 7: The lock of any of examples 3-6 that further includes one RF radio unit configured to operate at a higher frequency.

[0226] Example 8: The lock of example 7, wherein the RF radio unit configured to operate at a higher frequency operates at about 2.4 GHz for communication with smart devices such as a cell phone.

[0227] Example 9: The lock of example 7 or 8, wherein one or more RF radio units of a higher frequency communicates with a smart device, and wherein the smart device communicates and authenticates via a cellular phone network.

[0228] Example 10: The lock of any of examples 3-9, wherein one or more RF radio units can link to one or more radio units via a network, whether using a proprietary protocol or using a standard protocol.

[0229] Example 11: The lock of example 10, wherein the one or more radio units can self-heal based upon other RF radio units in a system.

[0230] Example 12: The lock of any of examples 3-11, wherein the one or more RF radio units will seek other RF radio units in the system to optimize the communication of data to itself or back to a host.

[0231] Example 13: The lock of any of examples 3-12, wherein the one or more RF radio units will seek other RF radio units if its current and primary link to its previously established link is broken.

[0232] Example 14: The lock of any of examples 3-13, wherein the one or more RF radio units has a guaranteed packet delivery structure.

[0233] Example 15: The lock of any of examples 3-14, wherein two RF radio units can be used for additional security or authentication in accessing an area or accessing an asset.

[0234] Example 16: The lock of example 15, wherein the asset is a military depot with thousands of containers stored in close proximity.

[0235] Example 17: The lock of any of examples 1-16 that requires approval from both the local host (database, control center, or centralized database) via a Radio #1, while a Radio #2 solicits approval from a separate entity (such as smart device, Cloud, or other) in order to grant access.

[0236] Example 18: The lock of any of examples 1-17 that can be paired to a smart device, e.g. to a smartphone, via BlueTooth or NFC Near Field Communication.

[0237] Example 19: The lock of any of examples 1-18 that is configured to communicate with or is networked with a host, either via wire or wireless as noted elsewhere; wherein the host can be:

[0238] (a) a smart device near the locking device, e.g. a smartphone or tablet;

[0239] (b) a local database or control center, e.g. the office of a self-storage facility; or

[0240] (c) a centralized database or control center, e.g. using the "cloud" to coordinate transmitting and receiving data from the locking device.

[0241] Example 20: The lock of any of examples 1-19 that can receive software or firmware updates via wired or wireless methods, or by a hardware port or connector whereby a user can update software or firmware.

[0242] Example 21: The lock of any of examples 1-20 that contains one or more sensors.

[0243] Example 22: The lock of example 20, wherein the one or more sensors are one or more of: (a) an infrared (IR) sensor; (b) one or more accelerometers; (c) a CCD or other camera; and (d) one or more chemical sensors.

[0244] Example 23: The lock of any of examples 1-22 that transmits its present status or change of status of 'lock or latch closed' or 'lock or latch opened',

[0245] Example 24: The lock of any of examples 1-23 that can be remotely locked or unlocked based on criteria from the host.

[0246] Example 25: The lock of example 24, wherein the host is an APP, local database, local control center, centralized control center, or cloud.

[0247] Example 26: The lock of any of examples 1-25 that has fingerprint access.

[0248] Example 27: The lock of any of examples 1-26 that has an overlock feature.

[0249] Example 28: The lock of any of examples 1-27 that further includes an access lock on the body, wherein the access lock can be removed to expose an inner cavity of the body.

[0250] Example 29: The lock of example 28 that further includes a fastener that connects the body to the base plate, wherein the fastener is accessible in the inner cavity and can be removed to remove the body from the base plate.

[0251] Example 30: The lock of any of examples 1-29 that further includes a secondary manual lock that has a second engagement member configured to engage the locking mechanism.

[0252] Example 31: The lock of any of examples 1-30 that further includes a receiver configured to receive electronic signals.

[0253] Example 32: The lock of any of examples 1-31 that further includes a transmitter for sending electronic signals.

[0254] Example 33: The lock of example 31, wherein the receiver is a radio.

[0255] Example 34: The lock of example 32, wherein the transmitter is a radio.

[0256] Example 35: The lock of any of examples 1-34 that further includes a power source.

[0257] Example 36: The lock of example 35, wherein the power source is one or more batteries.

[0258] Example 37: The lock of any of examples 1-36, wherein the lock body has a first end and second end and an end cap on the first end or the second end.

[0259] Example 38: The lock of example 37, wherein the end cap is connected to the body by one or more fasteners.

[0260] Example 39: The lock of example 38, wherein the end cap has a first position in which it is connected to the body by the one or more fasteners, and a second position in which it is removed from the body and the inner cavity of the body is exposed, whereby batteries can be removed and/or added to the inner cavity when the end cap is removed.

[0261] Example 40: The lock of any of examples 1-39 that can communicate on multiple radio frequencies.

[0262] Example 41: The lock of example 40, wherein the lock can operate at either 2.4GHz or 900 MHz or both.

[0263] Example 42: The lock of example 40 that comprises multiple radios, wherein each radio operates on a different frequency.

[0264] Example 43: The lock of example 41 or 42 that includes at least one radio operating at 2.4GHz and at least one radio operating at 900 MHz.

[0265] Example 44: The lock of any of examples 1-43 that is configured to be mounted to a structure without the need to enter or open the structure.

[0266] Example 45: The lock of example 44, wherein the structure is a self-storage unit.

[0267] Example 46: The lock of any of examples 1-45 that includes a backhaul unit to interface with the lock and/or with a central controller, such as a computer.

[0268] Example 47: The lock of any of examples 1-46 that meshes to a backhaul unit via RF communications at 2.4 GHz.

[0269] Example 48: The lock of any of examples 1-47, wherein there is a plurality of backhaul units and the backhaul units communicate with each other via RF transmissions at 900 MHz or by power-over-ethernet.

[0270] Example 49: The lock of any of examples 1-48, wherein there is at least one backhaul unit that communicates with a central controller either via a radio signal at 900 MHz or via power-over-ethernet.

[0271] Example 50: The lock of any of examples 1-49 that is configured to communicate via RF technology, an AC wired connection, a DC wired connection, power-over-ethernet, or through a backhaul unit.

[0272] Example 51: The lock of any of examples 1-50 that further includes one or more sensors, wherein the one or more sensors are one or more of: (a) a temperature sensor (such as an infrared detector, a thermistor, a thermocouple, or a laser); (b) a water sensor (such as a hygrometer or floor-leak sensor); (c) a chemical sensor (such as a smoke detector, CO sensor, CO_2 sensor, O_3 sensor, NO_x sensor, H_2S

sensor, or methane sensor), (d) an environmental sensor (such as to measure air pollution, gas, O_3, methane or other gases), (e) a pressure sensor (such as a barometer or tactile sensor), and (f) a proximity sensor (such as an alarm, motion sensor, or infrared sensor).

[0273] Example 52: The lock of any of examples 1-51 that is configured to communicate with any of the sensors listed in example 51.

[0274] Example 53: The lock of example 52, wherein the sensors are remote from the lock.

[0275] Example 54: The lock of example 51, wherein each of the one or more sensors can be removed and/or replaced with other sensors.

[0276] Some other, non-limiting examples of the invention follows:

[0277] Example 1: A method of operating an electric lock, the method comprising the steps of:

[0278] (a) a user contacting a lock-control server;

[0279] (b) the server authenticating the user:

[0280] (c) the user requesting access to a lock having a radio;

[0281] (d) the lock radio sending a query to the server with the user information;

[0282] (e) the server verifying that the user is permitted to access the lock, or denying access to the lock;

[0283] (f) if access to the lock is permitted, the server sending the user an authorization token;

[0284] (g) the user sending the authorization token to the lock;

[0285] (h) the lock verifying the authenticity of the token and locking or unlocking if the token is authenticated.

[0286] Example 2: The method of example 1 that further includes the step of the lock opening.

[0287] Example 3: The method of example 1 or example 2, wherein the user communicates with the lock and the server by using a cell phone or a computer.

[0288] Example 4: The method of any of examples 1-3, wherein the server is a cloud server.

[0289] Example 5: A method of operating an electric lock, the method comprising the steps of:

[0290] (a) a user contacting a lock-control server;

[0291] (b) the server authenticating the user:

[0292] (c) the user requesting access to a lock having a radio;

[0293] (d) the lock radio sending the user a token;

[0294] (e) the user sending the token to the server;

[0295] (f) the server verifying the user is permitted to access the lock, or denying access to the lock;

[0296] (g) if access to the lock is permitted, the server sending the user an authorization token;

[0297] (h) the user sending the authorization token to the lock;

[0298] (i) the lock verifying the authenticity of the token and locking or unlocking if the token is authenticated.

[0299] Example 6: The method of example 5 that further includes the step of the lock opening.

[0300] Example 7: The method of example 5 or example 6, wherein the user communicates with the lock and the server by using a cell phone or a computer.

[0301] Example 8: The method of any of examples 5-7, wherein the server is a cloud server.

[0302] Example 9: A method of operating an electric lock, the method comprising the steps of:

[0303] (a) a user contacting a lock-control server;

[0304] (b) the server authenticating the user:

[0305] (c) the user requesting the server access to a lock having a radio;

[0306] (d) the server determining if the user is authorized to have access to the lock;

[0307] (e) the server verifying the user is permitted to access the lock, or denying access to the lock;

[0308] (f) if access to the lock is permitted, the server sending the user an authorization token;

[0309] (g) the user sending the authorization token to the lock;

[0310] (h) the lock verifying the authenticity of the token and locking or unlocking if the token is authenticated.

[0311] Example 10: The method of example 9 that further includes the step of the lock opening.

[0312] Example 11: The method of example 9 or example 10, wherein the user communicates with the lock and the server by using a cell phone or a computer.

[0313] Example 12: The method of any of examples 9-11, wherein the server is a cloud server.

[0314] Example 13: A method of operating an electric lock, the method comprising the steps of:

[0315] (a) a user contacting a lock to request access to the lock providing the lock with a user token;

[0316] (b) the lock sending an authorization request to a lock server;

[0317] (c) the server authenticating the token and that the user is authorized:

[0318] (d) the server verifying the user is permitted to access the lock, or denying access to the lock;

[0319] (e) if access to the lock is permitted, the server sending the lock an authorization token specific to the user;

[0320] (f) if access to the lock is permitted, the server sending the user an authorization token specific to the lock;

[0321] (g) the user sending the authorization token specific to the lock to the lock;

[0322] (h) the lock verifying the authenticity of the token and locking or unlocking if the token is authenticated.

[0323] Example 14: The method of example 13 that further includes the step of the lock opening.

[0324] Example 15: The method of example 13 or example 14, wherein the user communicates with the lock and the server by using a cell phone or a computer.

[0325] Example 16: The method of any of examples 13-15, wherein the server is a cloud server.

[0326] Example 17: A method of operating an electric lock, the method comprising the steps of:

[0327] (a) a user contacting a lock-control server;

[0328] (b) the server authenticating the user:

[0329] (c) the user requesting access to a lock having a radio;

[0330] (d) the lock radio sending a query to the server with the user information;

[0331] (e) the server verifying that the user is permitted to access the lock, or denying access to the lock;

[0332] (f) if access to the lock is permitted, the server sending the user an authorization token;

[0333] (g) the user sending the authorization token to the lock;

[0334] (h) the lock verifying the authenticity of the token and locking or unlocking if the token is authenticated.

[0335] Example 18: The method of example 1 that further includes the step of the lock opening.

[0336] Example 19: The method of example 1 or example 2, wherein the user communicates with the lock and the server by using a cell phone or a computer.

[0337] Example 20: The method of any of examples 1-3, wherein the server is a cloud server.

[0338] Example 21: The method of any of examples 1-20, wherein the token includes a time during which the user is authorized to operate the lock.

[0339] Example 22: The method of any of examples 1-21 that further includes the step of the server determining if the lock is within a predetermined range.

[0340] Example 23: The method of any of examples 1-22 that further includes the step of the server contacting a third party.

[0341] Some other, non-limiting examples of this disclosure follows:

[0342] Example 1: A locking system comprising:

[0343] (a) a primary lock that includes a primary locking mechanism moveable between a first, open position and a second, locked position; and

[0344] (b) an overlock that includes an overlock locking mechanism moveable between a first position in which it does not contact the primary locking mechanism, and a second position in which it contacts the primary locking mechanism and prevents the primary locking mechanism from moving from the second, locked position to the first, open position.

[0345] Example 2: The locking system of example 1, wherein the primary locking structure and the overlock locking structure are attached.

[0346] Example 3: The locking system of example 1 or example 2, wherein the primary locking structure is a sliding bar and the overlock locking structure is a sliding bar.

[0347] Example 4: The locking system of example 3, wherein the primary locking structure has a first end proximal the overlock and a second end distal the overlock, and a raised tab at the first end, and the overlock locking structure has a first end proximal the primary lock and a second end distal the primary lock, and a raised tab at the first end.

[0348] Example 5: The locking system of example 4, wherein the raised tab of the overlock locking structure is attached to the raised tab of the primary locking structure.

[0349] Example 6: The locking system of any of examples 1-5 that further includes a space between the primary lock and the overlock and the primary lock has a housing and the overlock has a housing, and the primary locking mechanism extends from the primary lock housing and into the space, and the overlock locking mechanism extends from the overlock housing and into the space.

[0350] Example 7: The locking system of example 6 that further includes a protective structure that covers at least part of the overlock locking mechanism in the space.

[0351] Example 8: The locking system of example 7, wherein the protective structure is a metal plate.

[0352] Example 9: The locking system of any of examples 1-8, wherein the overlock has one of the lock structures set forth in the previous lock examples herein.

[0353] Having thus described different embodiments, other variations and embodiments that do not depart from the spirit of this disclosure will become apparent to those skilled in the art. The scope of the claims is thus not limited to any particular embodiment, but is instead set forth in the claims and the legal equivalents thereof. Unless expressly stated in the written description or claims, the steps of any method recited in the claims may be performed in any order capable of yielding the desired product. No language in the specification should be construed as indicating that any non-claimed limitation is included in a claim. The terms "a" and "an" in the context of the following claims are to be construed to cover both the singular and the plural, unless otherwise indicated herein.

What is claimed is:

1. A locking system comprising:

(a) a lock having a lock body, a locking mechanism moveable between a locked position and an unlocked position, and a transceiver configured to transmit and receive data;

(b) a controller configured to (i) perform lock operations and (ii) authenticate a user for access to the lock; and

(c) wherein the controller is configured to:

(i) receive a first authorization token from a lock-control server;

(ii) receive a second authorization token from a personal device of the user; and

(iii) transition the locking mechanism between the locked position and the unlocked position upon verification of both the first authorization token and the second authorization token.

2. The locking system of claim **1**, wherein the transceiver comprises a first radio unit and a second radio unit, and the controller is configured to receive the first authorization token via the first radio unit and receive the second authorization token via the second radio unit.

3. The locking system of claim **2**, wherein the first radio unit operates at a first frequency and the second radio unit operates at a second frequency that is different from the first frequency.

4. The locking system of claim **1**, wherein the controller is further configured to:

determine that the lock is within a predetermined range of the personal device; and

deny access to the lock if the lock is not within the predetermined range.

5. The locking system of claim **1**, wherein the controller is further configured to:

authenticate the first authorization token; and

in response to authenticating the first authorization token, transmit an authorization request to the personal device of the user to prompt the user to send the second authorization token.

6. The locking system of claim **1**, wherein the lock further includes one or more sensors selected from a group consisting of: a temperature sensor, a water sensor, a chemical sensor, an environmental sensor, a pressure sensor, a fingerprint sensor, and a proximity sensor.

7. The locking system of claim **1**, wherein the lock-control server is a cloud-based server.

8. The locking system of claim **1**, wherein the lock further comprises an overlock mechanism configured to selectively block operation of the locking mechanism.

9. A method of operating an electric lock, the method comprising:

(a) a user contacting a lock-control server via a personal device;

(b) the lock-control server authenticating the user via the personal device:

(c) the user requesting, via the personal device, access to a lock having a lock body, a locking mechanism moveable between a locked position and an unlocked position, and a radio;

(d) the user sending an authorization token to the lock;

(e) the lock verifying an authenticity of the authorization token and at least one of locking or unlocking if the authorization token is authenticated.

10. The method of claim **9**, further comprising the lock moving from the locked position to the unlocked position in response to verifying the authenticity of the authorization token.

11. The method of claim **10**, further comprising:

the radio sending a query to the lock-control server with user information;

the lock-control server verifying that the user is permitted to access the lock, or denying access to the lock; and

in response to access to the lock being permitted, the lock-control server sending the user the authorization token.

12. The method of claim **11**, wherein the authorization token includes a time during which the user is authorized to operate the lock.

13. The method of claim **11**, further comprising:

the lock-control server determining if the lock is within a predetermined range of the personal device; and

denying access to the lock if the lock is not within the predetermined range.

14. The method of claim **10**, that further includes the lock-control server contacting a third party.

15. The method of claim **10**, further comprising:

the radio sending the user a token;

the user sending the token to the lock-control server;

the lock-control server verifying the user is permitted to access the lock; and

in response to the lock-control server verifying the user is permitted to access the lock, the lock-control server sending the user the authorization token.

16. The method of claim **10**, wherein the user requesting access to the lock includes sending a request to the lock-control server requesting access to the lock.

17. The method of claim **16**, further comprising:

in response to receiving the request at the lock-control server, the lock-control server determining that the user is authorized to have access to the lock;

in response to the lock-control server determining that the user is authorized to have access to the lock, the lock-control server sending the user the authorization token prior to the user sending the authorization token to the lock.

18. The method of claim **17**, wherein the user communicates with the lock and the lock-control server with the personal device.

19. The method of claim **10**, wherein the lock-control server is a cloud server.

20. A method of operating an electric lock, the method comprising:

(a) a user contacting a lock using a personal device to request access to the lock, including providing the lock with a user token;

(b) the lock sending an authorization request to a lock-control server;

(c) the lock-control server authenticating the user token and that the user is authorized:

(d) the lock-control server verifying the user is permitted to access the lock;

(e) in response to the lock-control server verifying the user is permitted to access the lock, the lock-control server sending the lock a first authorization token specific to the user;

(f) in response to the lock-control server verifying the user is permitted to access the lock, the lock-control server sending the user a second authorization token specific to the lock;

(g) the user sending the second authorization token specific to the lock to the lock;

(h) the lock verifying an authenticity of the second authorization token; and

(i) moving the lock from a locked position to an unlocked position in response to the lock verifying the authenticity of the second authorization token.

* * * * *