

“AN ELECTRO-MECHANICAL LOCK”
CROSS REFERENCE TO RELATED APPLICATION

This application is based on and derives the benefit of Indian complete Application 201841019400 filed on 23rd May, 18, the contents of which are incorporated herein by reference.

TECHNICAL FIELD

[001] The embodiments herein generally relate to security systems, more particularly but not exclusively to an electro-mechanical lock that can be secured for securing one or more items.

BACKGROUND

[002] Electro-mechanical locks have been implemented wherein a combination of mechanical and electronic means are used to secure an object. The electro-mechanical lock typically includes one or more electronic circuits, which may include an electronically controlled mechanical lock mechanism that can be used to secure an object. Though electro-mechanical locks are available for a variety of applications with varying architecture, it typically comprises only one level of authentication, which may not provide adequate security. Further, the electro-mechanical locks do not provide a secure, but accessible override system.

SUMMARY

[002a] According to an aspect, there is provided an electro-mechanical lock including an electromagnetic circuit configured to create an electro-magnetic link, wherein the electromagnetic circuit comprises at least one magnet; at least one first electromagnetic connector mounted on a surface on which an object being secured is mounted or a first portion of the object being secured; a third electromagnetic connector mounted on the object being secured or on a second portion of the object being secured; and at least one sensor; wherein the third electromagnetic connector is electromagnetically linked with the first electromagnetic connector, the magnet and the sensor; a controller configured to raise an alert on detecting an unauthorized action based on input received from the electromagnetic circuit; and a mechanical override module comprises an exterior operating assembly; and an interior operating assembly, wherein the exterior operating assembly is configured to override a mechanical lock component by actuating the interior operating assembly by at least one of an

electromagnetic coil; and a magnet, and wherein the exterior operating assembly is configured to actuate the electromagnetic coil of the interior operating assembly.

[003] Embodiments disclosed herein provide an electro-mechanical lock for securing at least one item.

[004] Embodiments disclosed herein provide a method for detecting at least one of theft, unauthorized unlocking, vandalism, abuse and tinkering of the at least one item, wherein the item has been secured with the electro-mechanical lock.

[005] Embodiments disclosed herein provide a mechanical override mechanism for the electro-mechanical lock.

[006] These and other aspects of the embodiments herein will be better appreciated and understood when considered in conjunction with the following description and the accompanying drawings. It should be understood, however, that the following descriptions, while indicating at least one embodiment and numerous specific details thereof, are given by way of illustration and not of limitation. Many changes and modifications may be made within the scope of the embodiments herein without departing from the spirit thereof, and the embodiments herein include all such modifications.

BRIEF DESCRIPTION OF FIGURES

[007] Embodiments herein are illustrated in the accompanying drawings, through out which like reference letters indicate corresponding parts in the various figures. The embodiments herein will be better understood from the following description with reference to the drawings, in which:

[008] FIG. 1a illustrates the electro-mechanical lock, according to an embodiment as disclosed herein;

[009] FIG. 1b illustrates the mechanism for sensing the theft/ unauthorized unlocking/vandalism/removal/theft of an enclosure/structure, according to embodiments disclosed herein;

[0010] FIGs. 2a, 2b, 2c and 2d depict the mechanical override mechanism, according to an embodiment as disclosed herein;

[0011] FIG. 3 depicts a flowchart of a method for detecting theft or unauthorized unlocking of an enclosure or structure, according to an embodiment as disclosed herein; and

[0012] FIGs. 4a, 4b, 4c and 4d depict example designs of batteries with connectors, wherein the batteries can engage with a corresponding contact in the docking bays and the batteries are secured in the docking bay using the electro-mechanical lock, according to an embodiment as disclosed herein.

DETAILED DESCRIPTION

[0013] The embodiments herein and the various features and advantageous details thereof are explained more fully with reference to the non-limiting embodiments that are illustrated in the accompanying drawings and detailed in the following description. Descriptions of well-known components and processing techniques are omitted so as to not unnecessarily obscure the embodiments herein. The examples used herein are intended merely to facilitate an understanding of ways in which the embodiments herein may be practiced and to further enable those of skill in the art to practice the embodiments herein. Accordingly, the examples should not be construed as limiting the scope of the embodiments herein.

[0014] The embodiments herein disclose an electro-mechanical lock for securing at least one item. Embodiments herein also disclose a method for detecting theft or unauthorized unlocking of the at least one item, wherein the item has been secured with the electro-mechanical lock. Embodiments herein disclose a mechanical override mechanism for the electro-mechanical lock. Referring now to the drawings, and more particularly to FIGS. 1 through 4d, where similar reference characters denote corresponding features consistently throughout the figures, there are shown embodiments.

[0015] FIG. 1a illustrates the electro-mechanical lock. The electro-mechanical lock 100 can be mounted on an item, so as to secure the item. The item can be secured against unauthorized scenarios such as, but not limited to, unauthorized opening, unauthorized unlocking, unauthorized attempts to unlock, unauthorized movements, vandalism, theft, unauthorized removal, and so on. In an example herein, the electro-mechanical lock 100 can be used to secure two or more portions of an item, such as, but not limited to, a box, a window, a suitcase, a bag, and so on. In an example herein, the electro-mechanical lock 100 can be used to secure an item by attaching the item to another structure, such as, but not limited to, a battery in a vehicle, a battery in a battery docking bay, a door to a

frame, a safe to a wall/cupboard/frame, a frame to a wall, an object on a surface, and so on.

[0016] The electro-mechanical lock 100 comprises an enclosure 102, wherein the enclosure 102 houses a plurality of modules, such as a location
5 sensing module 104, at least one interface 106, an electromagnetic circuit 108, an alarm member 110, a controller 112, a memory 114, and a mechanical override module 116.

[0017] The location sensing module 104 can determine the location of the item being secured. The location sensing module 104 can use at least one location
10 sensing means such as, but not limited to, GPS (Global Positioning System), triangulation, Wi-Fi, and so on, to determine the location of the item being secured. In an example, if the item being secured is a battery in a vehicle, the location sensing module 104 can determine the location of the battery and/or the vehicle. On determining the location, the location determination module 106 can
15 provide the determined location to the interface 106.

[0018] The interface 106 can be a wireless interface or a physical interface. The interface 106 can comprise of one or more physical interfaces, such as USB (Universal Serial Bus), serial ports, parallel ports, and so on. The interface 106 can comprise one or more wireless interfaces such as Wi-Fi, cellular
20 communication, Bluetooth, Wi-Fi Direct, Bluetooth Low Energy, and so on. In an example herein, the interface 106 is configured to receive an indication from at least one external entity; such as a battery and/or the enclosure for indicating locked condition of battery, location of battery and/or location of enclosure and/or a user. The received indication can comprise of instructions to the lock, updates, and so on. In an embodiment, the wireless interface 106 is configured to transmit
25 at least one indication to at least one external entity (such as a pre-configured authorized user/administrator) indicating an unauthorized event related to the item being secured. The indication can be sent in the form of an email, SMS (Short Messaging Service), IM (Instant Messaging), a data log, and so on.

[0019] The interface 106 can comprise of additional interfaces for indicating status of the item being secured. The interface 106 can also comprise of a means for enabling the user to input information/passcode/passphrase/OTP (One Time Password)/biometric information, and so on. The means can comprise at least one of, but not limited to, a keypad, a touchscreen, at least one button/switch, a biometric sensor, and so on

[0020] The electromagnetic circuit 108 can secure the item by creating an electro-magnetic link to secure the object. The electromagnetic circuit 108 can form an electro-magnetic link between two or more portions of the item being secured. In an example herein, when the electro-mechanical lock 100 is being used to secure two or more portions of an item, the electromagnetic circuit 108 can form an electro-magnetic link between the two or more portions of the item being secured. In an example herein, when the electro-mechanical lock 100 is being used to secure an item by attaching the item to another structure, the electromagnetic circuit 108 can form an electro-magnetic link between the item being secured and the other structure.

[0021] FIG. 1b illustrates the mechanism for sensing the theft/unauthorized unlocking/vandalism/removal/theft of an enclosure/structure. The electromagnetic circuit 108 comprises at least one magnet 118 and at least one first electromagnetic connector 120 mounted or installed within the enclosure 102 (as depicted in the example in FIG. 1b). In an embodiment, the electromagnetic circuit 108 further includes at least one sensor 122 and a second electromagnetic connector 124 installed in the item being secured and electromagnetically communicating with the magnet 118 and the electromagnetic connector 120. Furthermore, the electromagnetic circuit 108 includes a third electromagnetic connector 126 disposed in the item being secured or in another portion of the item being secured. The third electromagnetic connector 126 can be connected with the first electromagnetic connector 120, the second electromagnetic connector 124, the magnet 118 and the sensor 122 through an electromagnetic link. In an embodiment, the first electromagnetic connector 120, the second electromagnetic

connector 124 and the third electromagnetic connector 126 are made up of one or more electromagnetic metals such as, but not limited to, steel and ferrous metals.

[0022] On detecting that the electro-magnetic link has been broken (which can be due to an unauthorized event), the electromagnetic circuit 108 can provide
5 an alert to the controller 112.

[0023] In an embodiment herein, the lock 100 may include at least one G force sensor and/or an accelerometer. In an embodiment, the G force sensor and/or an accelerometer can provide an alert to the controller 112 in case of the item being secured undergoing a physical stress (such as, but not limited to, drops,
10 shaking, prying, and so on). In an embodiment, the at G force sensor and/or an accelerometer communicate the alert indicating at least one predetermined parameter to the controller 112.

[0024] The controller 112 can also receive location information from the location sensing module 104. Based on the location, the controller 112 can
15 perform at least one action. For example, a geo-fenced area may be pre-defined and if the lock 100 exits the geo-fenced area, the controller 112 can for

[0025] The controller 112 can receive inputs from the various modules present in the lock 100. The controller 112 can receive indications from an external entity through the interface 106. The controller 112 can store the received
20 indications in the memory 114. The controller 112 can receive one or more alerts from the electromagnetic circuit 108, the location sensing module 104, and/or the G force sensor and/or an accelerometer. On receiving the alert, the controller 112 can check if the link is broken due to an unauthorized event (examples of the unauthorized event can be, but not limited to, theft/ unauthorized
25 unlocking/vandalism/removal/theft/moving the lock 100 from the geo-fenced area) or an authorized event. In an embodiment herein, the controller 112 can check if the link is broken due to an unauthorized event or authorized event using information stored in the memory 114. In an embodiment herein, the controller 112 can check if the link is broken due to an unauthorized event or an authorized

event with the help of a remote entity, such as a server, an authentication server, the cloud, and so on. If the controller 112 determines that the link was broken due to an unauthorized event (wherein an authorized user is attempting to access the secured item), the controller 112 can provide an alert to at least one external
5 entity, through the interface 108. The alert can be at least one of, but not limited to, an email, SMS (Short Messaging Service), IM (Instant Messaging), a data log, and so on. The controller 112 can provide the alert based on at least one pre-configured user preference, stored in the memory 114, or as provided by an external entity. The alert can comprise of information related to the unauthorized
10 event, such as, but not limited to, date and time of the unauthorized event, location of the item being secured, and so on. The controller 112 can also store this information in the memory 114.

[0026] The controller 112 can also provide an alarm using the alarm member 110. The alarm provided can be in the form of an audio means (such as a
15 pre-determined tone, a musical tone, and so on), a visual means (such as a light, a sequence of lights, and so on), or an audio-visual means (comprising of a visual means and an audio means).

[0027] In an embodiment herein, the controller 112 can be present outside the enclosure 102 and the controller 112 can communicate with the modules
20 present in the enclosure 102 using the interface 106.

[0028] In an embodiment herein, the controller 112 can communicate information to a monitoring station 101 through the interface 106 at pre-defined intervals. In an embodiment herein, the controller 112 can communicate information to a monitoring station 101 through the interface 106 on pre-defined
25 events occurring. The information provided to the monitoring station 101 can comprise of the status of the lock 100, the location of the lock 100 and so on. The controller 112 can also communicate the alert to the monitoring station 101. In an embodiment herein, the controller 112 can be a part of the monitoring station 101,

wherein the monitoring station 101 can perform the functions of the controller 112.

[0029] The mechanical override module 116 can comprise a means for overriding the locking mechanism (as depicted in FIGs. 2a, 2b, 2c and 2d). In an embodiment, the mechanical override module 116 includes a housing having a
 5 mechanical lock component and electromagnetic access security components, an interior operating assembly disposed in the housing and an exterior operating assembly.

[0030] The mechanical override module 116 includes a first head portion
 10 204a and a cylindrical member 204b coupled to the first head portion 204a. The first head portion 204a and the cylindrical member 204b can be unitary. The first head portion 204a and the cylindrical member 204b can be a long screw with a head. The first head portion 204a can be a magnet. The cylindrical member 204b can be an elongated member, which can be rotated within a predefined guide
 15 space. In an embodiment, the mechanical override module 116 further includes a lever 204c. The lever 204c is a mechanical lock component that can be engaged or disengaged with the cylindrical member 204b.

[0031] FIG. 2b depicts the mechanical override module 116 comprising a first magnetic head 204a driven by an electromagnetic coil. FIG. 2c depicts the
 20 mechanical override module 116 comprising an electromagnetic coil driven by an actuator (wireless). FIG. 2d depicts the mechanical override module 116 comprising an interior operating assembly and an exterior operating assembly.

[0032] In an embodiment herein, the rotation provided to the magnet head rotates the cylindrical member 204b (as the cylindrical member 204b is integrated
 25 to the electromagnet head). In an embodiment herein, the mechanical override module 116 includes a plurality of gears (not shown) configured to override the mechanical lock component for at least one of locking or unlocking the predetermined structure.

[0033] In an embodiment, the interior operating assembly can be selected from a group comprising of a long bolt screw mechanism, a gear mechanism, a ratchet mechanism, a direct magnetic linkage, and combinations thereof.

5 [0034] In an embodiment, the exterior operating assembly can communicate with the interior operating assembly. In an embodiment, the exterior operating assembly can be configured to override the mechanical lock component by actuating the interior operating assembly by at least one of an electromagnetic coil and/or a magnet. In an embodiment, the exterior operating assembly comprises a second head portion 206a and a rotatable shaft 206b coupled to the
10 second head portion 206a.

[0035] In an embodiment, the second head portion 206a is made up of at least one magnet. In an embodiment herein, an electromagnetic coil C can replace the second head portion 206a. In an embodiment, the rotatable shaft 206b is an elongated member, which can be rotated within a predefined guide space. In an
15 embodiment, the exterior operating assembly can have an authentication to operate the interior operating assembly.

[0036] In an embodiment herein, the interior operating assembly and the exterior operating assembly further includes an electromagnetic coil C and an actuator (not shown) respectively. In an embodiment, the actuator is operated by
20 wireless power transmission. The wireless power transmission for the actuator can actuate the electromagnetic coil C provided in the interior operating assembly. In an embodiment, the exterior operating assembly can be operated in a changing frequency mode for power transfer.

[0037] In an embodiment herein, the mechanical override module 116
25 further includes at least one control unit (not shown). The control unit can provide authentication for accessing the mechanical override module 116. In an embodiment, the control unit includes multi-stage authentication. In an embodiment, the multi-stage authentication may comprise of, but not limited to, OTP, biometric authentication, keyword/key phrase, voice authentication, and so

on. In an embodiment, an authorized operator may be able to override the mechanical lock components by biometric authentication.

[0038] FIG. 3 depicts a flowchart of a method for detecting at least one unauthorized scenario being performed related to an item being secured. In an embodiment, a method 300 for detecting unauthorized scenarios related to an item being secured is provided. In an example herein, the electro-mechanical lock 100 can be used to secure two or more portions of an item. In an example herein, the electro-mechanical lock 100 can be used to secure an item by attaching the item to another structure.

10 [0039] On detecting (301) that at least one electro-magnetic link has been broken (which can be due to an unauthorized event), the electromagnetic circuit 108 provides (302) an alert to the controller 112. On receiving the alert, the controller 112 checks (304) if the link is broken due to an unauthorized event or an authorized event using information stored in the memory 114 and/or with the help of a remote entity. If the controller 112 determines that the link was broken due to an unauthorized event (wherein an authorized user is attempting to access the secured item), the controller 112 provides (306) an alert to at least one external entity, through the interface 108. The alert can comprise of information related to the unauthorized event, such as, but not limited to, date and time of the unauthorized event, location of the item being secured, and so on. The controller 112 can also store this information in the memory 114. The controller 112 also provides (308) an alarm using the alarm member 110. The alarm provided can be in the form of an audio means (such as a pre-determined tone, a musical tone, and so on), a visual means (such as a light, a sequence of lights, and so on), or an audio-visual means (comprising of a visual means and an audio means). The various actions in method 300 may be performed in the order presented, in a different order or simultaneously. Further, in some embodiments, some actions listed in FIG. 3 may be omitted.

[0040] Consider an example scenario where a battery is placed in a docking bay. The battery can be secured in the docking bay, using the electro-mechanical lock 100. FIGs. 4a, 4b, 4c and 4d depict example designs of batteries with connectors, wherein the batteries can engage with a corresponding contact in the docking bays and the batteries are secured in the docking day using the electro-mechanical lock 100. FIGs. 4a, 4b, 4c and 4d depict example designs of connectors, wherein the battery connector 402a can engage with a docking bay connector 402b present in the bay. The engagement between the connectors can enable power to be fed to the battery, power to be drawn from the battery, capturing information related to the battery (such as a usage, battery condition, and so on), and so on. In an embodiment herein, the battery can be secured in place in the bay using the electro-mechanical lock 100.

[0041] The embodiments disclosed herein can be implemented through at least one software program running on at least one hardware device and performing network management functions to control the network elements. The network elements shown in FIG. 1 include blocks, which can be at least one of a hardware device, or a combination of hardware device and software module.

[0042] The foregoing description of the specific embodiments will so fully reveal the general nature of the embodiments herein that others can, by applying current knowledge, readily modify and/or adapt for various applications such specific embodiments without departing from the generic concept, and, therefore, such adaptations and modifications should and are intended to be comprehended within the meaning and range of equivalents of the disclosed embodiments. It is to be understood that the phraseology or terminology employed herein is for the purpose of description and not of limitation. Therefore, while the embodiments herein have been described in terms of embodiments and examples, those skilled in the art will recognize that the embodiments and examples disclosed herein can be practiced with modification within the spirit and scope of the embodiments as described herein.

CLAIMS

1. An electro-mechanical lock (100) comprising

an electromagnetic circuit (108) configured to create an electro-magnetic link, wherein the electromagnetic circuit (108) comprises

at least one magnet (118);

at least one first electromagnetic connector (120) mounted on a surface on which an object being secured is mounted or a first portion of the object being secured;

a third electromagnetic connector (126) mounted on the object being secured or on a second portion of the object being secured; and

at least one sensor (122);

wherein the third electromagnetic connector (126) is electromagnetically linked with the first electromagnetic connector (120), the magnet (118) and the sensor (122);

a controller (112) configured to raise an alert on detecting an unauthorized action based on input received from the electromagnetic circuit (108); and

a mechanical override module (116) comprises

an exterior operating assembly; and

an interior operating assembly, wherein the exterior operating assembly is configured to override a mechanical lock component by actuating the interior operating assembly by at least one of an electromagnetic coil (C); and a magnet, and wherein the exterior operating assembly is configured to actuate the electromagnetic coil (C) of the interior operating assembly.

2. The electro-mechanical lock, as disclosed in claim 1, wherein the electro-mechanical lock (100) further comprises a second electromagnetic connector (124) mounted on the surface on which the object being secured is mounted or the first portion of the object being secured, wherein the second electromagnetic connector (124) is electromagnetically linked to the third electromagnetic connector (126).

3. The electro-mechanical lock, as disclosed in claim 1, wherein the electro-mechanical lock (100) further comprises a location sensing module (104), wherein the location sensing module (104) provides current location of the electro-mechanical lock (100) to the controller (112).
4. The electro-mechanical lock, as disclosed in claim 1, wherein the electro-mechanical lock (100) further comprises a G force sensor.
5. The electro-mechanical lock, as disclosed in claim 1, wherein the electro-mechanical lock (100) further comprises an accelerometer.
6. The electro-mechanical lock, as disclosed in claim 1, wherein the controller (112) is configured to provide an alert.
7. The electro-mechanical lock, as disclosed in claim 1, wherein the controller (112) is configured to provide an alarm using an alarm member (110).
8. The electro-mechanical lock, as disclosed in claim 1, wherein the exterior operating assembly comprises a second head portion (206a); and a rotatable shaft (206b) coupled to the second head portion (206a), wherein the rotatable shaft (206b) is an elongated member, which can be rotated within a predefined guide space.
9. The electro-mechanical lock, as disclosed in claim 8, wherein the exterior operating assembly comprises an electromagnetic coil and an actuator, wherein the actuator is operated wirelessly.
10. The electro-mechanical lock, as disclosed in claim 8, wherein the exterior operating assembly is configured to be operated in a changing frequency mode for power transfer.
11. The electro-mechanical lock, as disclosed in claim 1, wherein the mechanical override module (116) further includes at least one control unit for providing authentication.