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(54) **Title:** SYSTEM AND METHOD FOR ADMINISTERING PHYSICAL SECURITY ACCESS TO COMPONENTS OF A PROCESS CONTROL SYSTEM

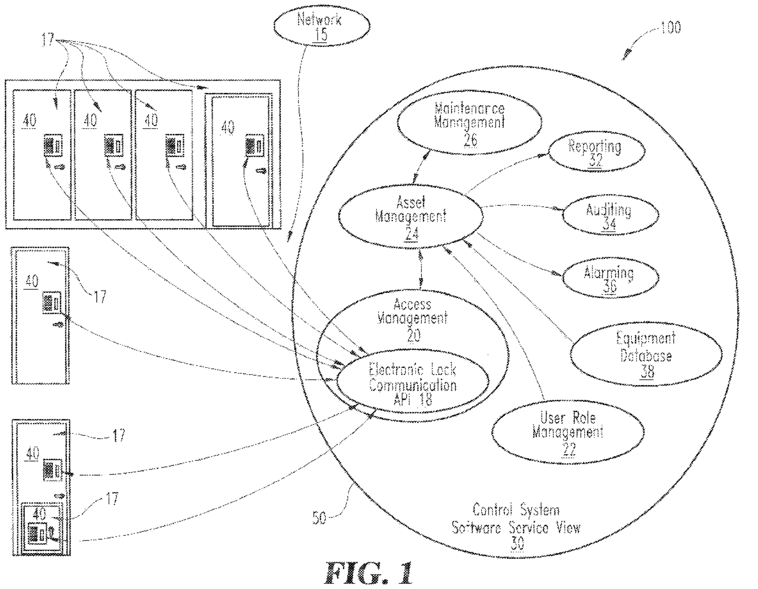


FIG. 1

(57) **Abstract: A** system for restricting physical access to at least one component process controI system component has a locking device that is integrated with process control system security administration data. The locking device accesses the process control system security data when authenticating a user. Upon authentication of a user for physical access to the particular process control component, the user may directly access the component for which the user is authorized. The system provides tracking of all authenticated users and attempts to access the various control system components,

# SYSTEM **AND** METHOD FOR ADMINISTERING PHYSICAL SECURITY **ACCESS TO** COMPONENTS OF A PROCESS CONTROL SYSTEM

## TECHNICAL FIELD

The present disclosure generally relates to a system for restricting physical access to components of a process control system.

## BACKGROUND

Process control systems have user authentication that prevents unauthorized users from accessing the system software to make changes to data or parameters, such as set points. However, most of the physicai equipment associated with the process control system is in a single location. When a user is authorized to access this single location, all process control system components, including the associated communications equipment, are often available to the user.

In other installations, each component of the control system may be locked in a separate enclosure. The cabinets may all share a common key or require different keys for access. Therefore, there is a need in the art for improved management of the physicai security of process control system components.

## SUMMARY

A system for administering physical access to at least one component of a process control system has an electronic lock for restricting access to an enclosure containing the at least one component by associating a physical access permission with an enclosure and providing a first level of user authentication, a communication API for transmitting open and close requests between an asset management component of the control system and the electronic lock, an access management component for managing user roles and associated permissions in the process control system, and wherein the asset management component of the process control system for provides a second level of user authentication by comparing the electronic lock physical access permission with process control system permissions defined in the access management component to determine whether a user is granted or denied permission to contents of the respective enclosure.

A method for controlling access to at least one physical component of a process control system is provided. The method has the following steps: receiving user credentials by an electronic lock installed with an enclosure housing at least one component of the process control system; transmitting the user credentials and lock address from the electronic lock to an asset management component of the process control system; requesting user granted permissions by the asset management component from the process control system access management component; identifying the enclosure by using the locking system network address; receiving physical access permissions of the enclosure by the asset management component

from the electronic lock; validating by the asset management component whether the physical access permissions are equivalent to the user access permissions in the control system; and providing access to at least one component inside the enclosure if the user is validated for access to the enclosure contents, and preventing access if the user is not validated for access to the enclosure.

Further, the tracking of issues back to individuals accessing the control system enclosure at the time of an issue with the corresponding at least one physical component of the process control system is provided.

## BRIEF DESCRIPTION OF THE FIGURES

In the accompanying drawings, structural embodiments are illustrated that, together with the detailed description provided below, describe exemplary embodiments of a system for restricting access to process control components. One of ordinary skill in the art will appreciate that a component may be designed as multiple components or that multiple components may be designed as a single component.

Further, in the accompanying drawings and description that follow, like parts are indicated throughout the drawings and written description with the same reference numerals, respectively. The figures are not drawn to scale and the proportions of certain parts have been exaggerated for convenience of illustration.

FIG. 1 is a schematic of electronic locks in communication with components of a process control system;

FIG, 2 is a schematic of a system for integrating physical access security with a process control system in which a user is granted access to an enclosure housing of at least one process control system physical component;

FIG. 3 is a schematic of the system of FIG. 2 in which a user is denied access to enclosures containing at least one physical component of a process conirol system; and

FIG. 4 is a schematic of the system of FIG, 3 in which a motor control center is housed in the enclosure and is locked out under a lock/out tag out procedure.

## DETAILED DESCRIPTION OF THE ILLUSTRATIVE EMBODIMENTS

With reference to FIG. 1, a system 100 for integrating physical access security configuration, monitoring and reporting with the access management component 20 of a process controi system 50 is shown. The system 100 has at least one electronic lock 40 or 40a (FIGS. 2-4), a communication Application Programming interface (API )18 and a process controi system 50 having software components such as asset management 24, access management 20, user role management 22, maintenance management 26 and an equipment database 38.

The process control system 50 is a distributed controi system or another system for managing manufacturing processes such as chemical, pharmaceutical, power generation and power distribution processes as well any other applicable process. One example of a process controi system 50 that may be used with the present disclosure is the 8Q0xA system that is commercially available. The process control system 50 has software 30 for managing equipment and processes and hardware in the form of at least one physical component 19 (FIGS, 2-4) such as servers, network equipment, controllers, transmitters, field devices, final control elements, and wiring components. The control system 50, control system software components 20, 22, 24, 26, 38, and electronic lock 40 or 40a (FIGS. 2-4) have non-transitory computer readable program code for execution by a processor on a computer readable medium for carrying out the steps of linking physical security access to an enclosure containing contents that are accessible to a user according to the job function of the respective user and the contents of the enclosure 17. The enclosure 17 can be the single location or alternatively located in the single location, the single location being a room in a building.

Alternatively, the enclosure 17 can be located in an outdoor environment. Furthermore one or more additional (secondary, tertiary, etc.) enclosures 17 can be located or otherwise disposed within an enclosure 17. in some embodiments each of the additional enclosures 17 may also have a computer component located therein such as a component of a process control system 50. Further$_s$each of the enclosures 17 may include an electronic lock 40 with a set of permissions associated therewith that may be differentiated relative to one another. Each of the computer components are accessible only when permissions associated with a user's credentials correspond with the permissions defined by an electronic lock 40 for the associated enclosure 17.

The asset management component 24 interfaces with the reporting 32, auditing 34, and alarming 36 sub-components of the process control system 50. The asset management component 24 of the process control system 50 has an equipment database 38 for storing the Identity of the enclosure, IP (internet protocol) address of the electronic lock securing the enclosure, enclosure type, and other data about equipment in an installed base, such as a set of equipment installed across an organization. By way of non-limiting example, enclosure types are controller, termination, networking, servers, motor control, safety system, and power distribution enclosures. It should be understood that other enclosure types are possible depending on the installation.

The access management component 20 in the process control system 50 ties physical components such as the enclosure 17, at least one component inside the enclosure, and the electronic lock 40 to logical representations 17a, 40a of the physical components within the control system 50. The asset management component 24

24 manages the logical representations of the equipment and is in communication with the user role management component 22.

The user roie management component 22 contains the definitions of the various roles in the system 1GO, such as the permissions to be described in further detail below. The interface between the asset 24 and user role management components 22 allows for the synchronization of changes in the user role database management component 22 with access management 20 device lists. Further, the asset management component 24 interfaces with the equipment database 38 to coordinate the grouping of the process control system 50 hardware components 19 with the appropriate access control device, such as electronic Sock 40, and enclosure 17.

User authentication occurs at a first level when a user 80 attempts to access an enclosure 17 or cabinet at step 1 shown in FIG. 2. The enclosure 17 housing at least one control system component 19 has an electronic lock 40. The user may present credentials to the electronic lock 40 such as an ID card having HID or HID iCLASS proximity, a magnetic strip, key fob, RFID credentials or an embedded chip. Alternatively, the user is authenticated by entering a PIN code, voice recognition, or biomefric information such as that obtained using a fingerprint, finger vein, or palm vein scanner for entry into the enclosure 17. It should be understood that the above authentication means are provided by way of non-limiting examples.

The electronic lock 40 can include a memory, a controlier, and a microprocessor circuit to receive the user authentication information and communicate the identity of the user 60a to the asset management component 24 of the process control system 50. In one embodiment, the electronic lock 40 can transmit the user ID and Network address of the electronic lock 40 installed with the enclosure 17 to the asset management component 24 of the process control system 50.

An example of an electronic lock 40 suitable for use with the physical access controi system 100 of the present disclosure is sold under the trademarks LockView® 4 CompX eLock© 200 or 300 series available from CompX® Security Products of Grayslake, IL. it should be understood that other electronic locks 40 may be suitable for use with the present disclosure and that the above products are provided by way of non-limiting example.

The electronic lock 40 can be mounted on or located in proximity to the respective enclosure housing 17 of at least one control system physical component 19, network switches, network servers and communication equipment. The control system components 19 may be grouped together, such as a basic controller consisting of a power supply module, a controller, and local I/O modules, that are housed in a single enclosure 17, Alternatively, a large system has several controllers that communicate over an Ethernet-based control network and are housed in a single enclosure or multiple enclosures 17. An example of a controller that may be employed in the present system 100 is the AC 800M controller that is -available commercially,

When a user 60a attempts to access an enclosure 17 using one of the above mentioned authentication means or another means, the electronic lock 40 then contacts the control system 50 with an open request at step 2. Further, at step 3, a communication API 18 associated with the electronic lock 40 sends an open request over the network 15 utilizing a wireless or wired protocol at step 2. By way of non-limiting example, the wireless protocol can be IEEE 802.11, CDMA, or GSM and the wired protocol can be wired Ethernet, RS232, RS485, or IEEE 802.3.

As is well known, application programming interfaces, such as communication API 18, are often software frameworks or libraries that include specifications for routines, data structures, object classes, and variables. In one embodiment, the communication API 18 is an implementation of a protocol for communication between the asset management component 24 of the process control system 50 and the electronics of the electronic lock 40.

The open request is sent to the asset management component 24 and the open request identifies the user ID of the individual attempting to access the enclosure 17 and the network address of the electronic lock 40 associated with the enclosure 17. By way of non-limiting example, the network address is an IP address, media access control (MAC) address, ESN, MEIM, IMEI, uniform resource locator (URL), telephone number or RS-485 bus ID. The network address of the electronic lock 40 is tied to a physicai location in the asset management component 24 of the process controi system 50.

At step 4a, representing the second level of user authentication, the asset management component 24 requests the granted permissions of the user attempting to access the enclosure 17 from the access management component 20 of the process control system 50. The hierarchy of user access in the process controi system 50 has roles at the highest level of the hierarchy assigned to the respective users. Each role has a permission or set of assigned permissions. By way of non-limiting example, a user may have the job of network administrator and is assigned the network **engineer rate.**

Further, **byway** of non-limiting example, **the** permissions associaied with the network engineer role in the access management component 20 are 'Access Servers/ 'Access Networking,' and 'Access Control Enclosure **n'**, **At step** 4b, the asset management component 24 identifies the enclosure 17 by the **electronic** lock 40 network address. The asset management component 24 identifies the enclosure by accessing the equipment database 38 which contains the enclosure network address, enclosure type, and enclosure contents. At step 4c, the asset management component 24 retrieves through the API 18 the required access permissions of the respective enclosure 17 from the electronic **lock 40.** In step 4d of the example of FIG. 2, **the** enclosure permission is equal to 'Access Control Enclosure n.'

At step 5, if the 'Access Control Enclosure n' permission from the electronic lock 40 and the control system 50 match in the comparison between granted and required permissions performed by the asset management component 24, such as both the user profile **and** required role associated with the enclosure 17, and 'AccessControlEnciosure n' permission, an open command is sent to the electronic lock communication APl 18 at step 6,

The user/cabinet combination access granted message is sent to the audit sub¬component 34 by the asset management component 24 at step 7. The audit system 34 records the date, time and enclosure name for which access was granted or denied to a user.

At step 8, the communication API 18 sends an open command to the electronic lock 40 over the network 15. At step 9, the lock opens and the user has access to the contents of the enclosure 17. Physical access to the contents of the enclosure 17 is tied to the particular job function of the user in this manner.

At step 10, the user accesses the enclosure 17 to perform maintenance or various other functions. At step 11, the user closes the enclosure 17. At step 12, the electronic lock 40 contacts the asset management component 24 over network 15 with a closed message, The communication API at step 13 sends the closed message to the asset management component 24. The closed message contains the user ID and the address of the electronic lock 40. At step 14, the user/cabinet combination access complete message is sent to the audit sub-component 34.

The electronic locks 40 installed with the respective enclosures 17 that house the network servers and associated hardware are configured with the required permission of 'AccessControi Enclosure η,' are accessible to the user having the network engineer role. in this manner, the electronic lock authentication is integrated with the process control system authentication, unifying the user's job function with access to physical control system components. Typically, the network administrator accesses the network servers via logging on to the distributed control system. The example of the definition of the roles and permissions provided herein is just one way that the access management component 20 defines customer specific permissions. It should be understood that other definitions are available in the access management component 20 and that the above is presented by way of non-limiting example.

Another example is a user having the job function of a technician as depicted in FIG. 4. The technician is responsible for checking wiring, changing out I/O cards, and generally maintaining the process controi system 50.

Using the system 100, access rights can delineate between enclosure housings and other types of components including but not limited to termination and safety system components. For example, a user is assigned the role of technician in the access management component 20 of the process control system 50 and the technician role contains a permission equal to 'Access Instrumentation.'

The technician role, as defined in the access management component 20, provides access to enclosures including a marshalling cabinet and a transmitter cabinet. The marshalling cabinet contains the terminations of all the field wires that can be connected to field hardware, such as a fieidbus. For example, the marshalling cabinet may employ sub-clustered input/output (I/O) assemblies connected to their host controllers via cable, fiber-optic or wireless industry-standard fieldbuses. The transmitter cabinet contains transmitters that have input/output circuitry for coupiing to a process control loop.

The asset management component 24 obtains the required permissions for the enclosure from the electronic lock 40. The asset management component 24 retrieves the required permission of AccessInstrumentation' from the electronic lock 40. The asset management component 24 compares the required permission for the technician role with the permission of the electronic lock and determines that the permissions are equivalent. The technician is granted access to the respective marshalling and transmitter cabinets.

With reference now to FIG. 3, a user authentication sequence is shown wherein a user is denied access to the enclosure 17. The user has the network engineer role with the permission of 'AccessContro!EncSosure n' and the required enclosure permission is 'AccessTransmitterEnclosure n.' The steps 1-5 are the same as the access granted scenario of FIG. 2 described previously.

However, in the present example, at step 5, the user permission of 'AccessContrplEnclosure n' is compared to the enclosure 17 permission 'AccessTransrnitterEnciosure n' by the access management component 20 and the permissions are determined to be different. At step 6, a denied command is sent by the asset management component 24 to the communication API 18. At step 7, the user/enclosure access denied message is sent to the audit system 34.

Further, at step 8, an unauthorized access attempt alarm is sent to the alarm system 36 from the asset management component 24, At step 9, an access denied message is sent from the access management component 20 via the communication API 18 over network 15 to the electronic lock 40. At step 10, the electronic lock 40 interface displays an access denied message to the user.

With reference now to FIG. 4, the maintenance management component 26 of the process control system 50 is depicted along with other process control system components 20, 22, 24, 38 and has the same steps 1-4 as the process of FiG. 3. The maintenance management component 26 has work orders associated with equipment and components contained in corresponding enclosures 17 as well as information on the lock out/tag out status of each enclosure 17. As is known by one skilled in the art, a lock out/tag out is a safety procedure which is used in industry and research settings to ensure thai dangerous machines are properly shut off and not started up again prior to the completion of maintenance or servicing work. The lock out/tag out procedure requires that hazardous power sources be "isolated and rendered inoperative" before any repair work is started. Equipment such as motor control centers, switchgear having cubicies housing circuit breakers and other electrical equipment have energized circuitry in enclosures that are managed by lock out/tag out procedures.

At step 5, (5a request lockout; 5b return Socked out) the asset management component 24 requests lock out/tag out information from the maintenance management component 26 for the enclosure 17. The maintenance management component 26 transmits the lock out/tag out data equal to 'yes' to the asset management component 24. The asset management component 24 at step 6, compares the electronic lock 40 permissions with the enclosure 17 permissions and determines that the user is denied or granted access to the enclosure 17. In the example shown in FIG. 4, the user would be granted access to the enclosure 17, however, the asset management component 24 additionally checks the lock out/tag out status of the enclosure 17 and determines that the enclosure 17 is under a 'lock out' status.

At step 7, a denied command is sent to the communication API 18. At step 8, a user/enclosure/lockouf access denied message is sent to audit sub-component 34, At step 9, an unauthorized access attempt alarm is sent to the alarm sub-component 36. At step 10, the communication API 18 sends an access denied message to the electronic lock 40 over the network 15. At step 11, the electronic lock 40 displays an access denied message to the user. The access denied message may also state thai the enclosure is locked out and refer to the work order number under which the enclosure 17 has received a 'lock out' or locked out' status in the maintenance management component 26. In one embodiment, the maintenance management component 26 is part of the process control system 50. In other embodiments, the maintenance management component 26 is a stand-alone system such as an SAP system having a plant maintenance (PM) module or a Maximo system that is interfaced with the process control system 50.

In one embodiment, the enclosure 17 has sub-enclosures and the enclosure 17 and sub-enclosures each have their own electronic lock 40. In that same embodiment, a job function/role electrician configured in the process control system 50 can access the main enclosure 17, but cannot access the sub-enclosures and a job function/role of technician would be able to access both the main enclosure 17 that houses circuit breakers and the sub-enclosures housing logic control circuit boards. It should be understood that the main enclosure 17 may be housed in the single location such as a room and that the sub-enclosure is housed inside the main enclosure 17. Each access point of entry for providing physical access to process control equipment and/or other equipment associated therewith includes the single location or room having a separate electronic lock installed at the access point to each of the main enclosure 17 and sub-enclosure.

In one aspect, the present disclosure discloses a system for administering physical access to at least one component of a process control system, having an electronic lock for restricting access to an enclosure containing said at least one component, said electronic lock associating a physical access permission with an enclosure and providing a first level of user authentication; a communication API for transmitting open and close requests between an access management component of the control system and the electronic lock; an asset managemeni component for managing user roles and associated permissions in the process control system; and wherein the asset management component of the process control system includes a second level of user authentication wherein the at least one component physical access permission as defined in the access management component s compared with process control system permissions defined in the asset management component.

!n refined aspect, the system further comprises an audit system for tracking date, time and enclosure name when access is granted to a user; an audit system for tracking date, time and enclosure name when access is denied to a user; wherein the enclosure is a single location in a building; wherein the enclosure has at least one sub-enclosure housed therein, the sub-enclosure having an electronic lock installed thereon for restricting physical access to at least one proeess control component inside the sub-enclosure; wherein the sub-enclosure includes a different permission criteria than the enclosure.

In another aspect, the present disclosure includes a method for controlling physical access to at least one component of a process control system, comprising receiving user credentials by an electronic lock installed with an enclosure housing at least one component of the process control system; transmitting the user credentials and a lock address from the electronic lock to an access management component of a the process control system; requesting user granted permissions by the access management component from the process control system asset management component; identifying the enclosure by using the locking system network address;

receiving physical access permissions of the enclosure by the asset management component from the electronic lock; validating by the asset management component whether the received physical access permissions are equivalent to the user granted permissions in the control system; providing access to the at least one component inside the enclosure if the user is validated for access to the enclosure contents, and preventing access if the user is not validated for access to the enclosure.

In refined aspects, transmitting ah unauthorized access attempt alarm from the asset management component to an alarm system when a user is denied access to the enclosure; transmitting a user/enclosure access denied message to an audit system when a user is denied access to the enclosure; recording in an audit system the tracking date, time and enclosure name for when enclosure access is granted to a user; recording in an audit system the tracking date, time and enclosure name when enclosure access is denied to a user.

In yet another aspect, the present disclosure includes a system for restricting physical access to at least one process control component inside an enclosure, the system comprising the enclosure, an electronic lock installed with the enclosure, a process control system having an access management component and an asset management component stored on a computer readable medium having computer readable instructions thereon that when executed by a processor, carry out the following steps; receiving, by the access management system through an application programming interface, user credentials presented to the electronic lock and the corresponding electronic lock address; receiving, by the asset management system, the user credentials and electronic lock address from the access management component;

retrieving user role permissions defined by the asset management system using the user credentials; retrieving, by the asset management system, required permissions for accessing the at least one process control component housed in the enclosure; comparing, by the asset management system, the user role permission with the required access permissions for the at least one process control component; and transmitting an open request over the application programming interface to the electronic lock with the user roles and required permissions: and permitting access if the user roles are equivalent and denying access if they are not equivalent.

in refined aspects, the steps further comprise: retrieving a lockout status in the asset management system for the enclosure; and transmitting an open request to the enclosure electronic lock if the lockout status parameter is negative and restricting access to the enclosure if the lockout status parameter is affirmative.

In yet another aspect, the present disclosure includes a system comprising: a first enclosure having a first component for a computer system disposed therein; a first electronic lock configured to control physical access to the first component within the first enclosure; a first set of access permissions associated with the first electronic lock; a second enclosure disposed within the first enclosure, the second enclosure having a second component for a computer system disposed therein; a second electronic lock configured to control physical access to the second component within the second enclosure; and a second set of access permissions associated with the second electronic lock.

In refined aspects, the first set of access permissions is different from the second set of access permissions; user credentials operable to define access permissions for a user; physical access to the first and second enclosures is determined based on comparisons between the access permissions of the first and second sets respectively and the access permissions defined by the credentials; physical access to the component in the second enclosure is permitted if the access permission defined by the user credentials satisfies the permission requirements of the first and second sets of enclosure permissions; the user credentials operate to permit the user to electronically access the computer component located within the enclosure; additional enclosures with additional computer components disposed within the first and/or the second enclosures; an audit system operable for logging data related to both successful and unsuccessful access events into each enclosure ; including a control system; an access management component defined in the control system configured to tie the first enclosure, the first component and the first electronic lock to a first logical representation within the control system; wherein the access management component of the control system is configured to tie the second enclosure, the second component and the second electronic lock to a second logical representation.

While the invention has been illustrated and described in detail in the drawings and foregoing description, the same is to be considered as illustrative and not restrictive in character, it being understood that only the preferred embodiments have been shown and described and that all changes and modifications that come within the spirit of the inventions are desired to be protected. It should be understood that while the use of words such as preferable, preferably, preferred or more preferred utilized in the description above indicate that the feature so described may be more desirable, it nonetheless may not be necessary and embodiments lacking the same may be contemplated as within the scope of the invention, the scope being defined by the claims that follow. in reading the claims, it is intended that when words such as "a," "an," "at least one," or "at least one portion" are used there is no intention to limit the claim to only one item unless specifically stated to the contrary in the claim. When the language "at least a portion" and/or "a portion" is used the item can include a portion and/or the entire item unless specifically stated to the contrary,

Unless specified or limited otherwise, the terms "mounted," "connected," "supported," and "coupled" and variations thereof are used broadly and encompass both direct and indirect mountings, connections, supports, and couplings. Further, "connected" and "coupled" are not restricted to physical or mechanical connections or couplings.

## CLAIMS

What is claimed is:

1. A system for administering physical access to at least one component of a process control system, comprising:

an electronic lock for restricting access to an enclosure containing said at least one component, said electronic lock associating a physical access permission with an enclosure and providing a first level of user authentication;

a communication API for transmitting open and close requests between an access management component of the control system and the electronic lock;

an asset management component for managing user roles and associated permissions in said process control system; and

wherein said asset management component of said process control system includes a second level of user authentication wherein the at least one component physical access permission as defined in said access management component is compared with process control system permissions defined in said asset management component.

2. The system of claim 1 further comprising an audit system for tracking date, time and enclosure name when access is granted to a user.

3. The system of claim 1 further comprising an audit system for tracking date, time and enclosure name when access is denied to a user.

4. The system of claim 1 wherein the enclosure is a single location in a building.

5. The system of claim 1 wherein the enclosure has at least one sub-enclosure housed therein, said sub-enclosure having an electronic lock installed thereon for restricting physical access to at least one process control component inside said sub-enclosure.

6. The system of claim 5, wherein the sub-enclosure includes a different permission criteria than the enclosure.

7. A method for controlling physical access to at least one component of a process control system, comprising:

a. receiving user credentials by an electronic lock installed with an enclosure housing at least one component of said process control system;

b. transmitting said user credentials and a lock address from said electronic lock to an access management component of a said process control system;

c. requesting user granted permissions by said access management component from said process control system asset management component;

d. identifying said enclosure by using said locking system network address;

e. receiving physical access permissions of said enclosure by said asset management component from said electronic lock;

f. validating by said asset management component whether said received physical access permissions are equivalent to said user granted permissions in said control system;

g. providing access to the at least one component inside said enclosure if said user is validated for access to said enclosure contents, and preventing access if said user is not validated for access to said enclosure.

8. The method of claim 7, further comprising: h. transmitting an unauthorized access attempt alarm from said asset management component to an alarm system when a user is denied access to said enclosure,

9. The method of claim 7, further comprising: h. transmitting a user/enclosure access denied message to an audit system when a user is denied access to said enclosure.

10. The method of claim 7, further comprising; h. recording in an audit system the tracking date, time and enclosure name for when enclosure access is granted to a user.

11. The method of claim 7, further comprising: h, recording in an audit system the tracking date, time and enclosure name when enclosure access is denied to a user.

12. A method for restricting physical access to at least one process control component inside an enclosure, the system comprising the enclosure, an electronic lock installed with the enclosure, a process control system having an access management component and an asset management component stored on a computer readable medium having computer readable instructions thereon that when executed by a processor, comprising:

a. receiving, by the access management system through an application programming interface, user credentials presented to said electronic lock and the corresponding electronic lock address;

b, receiving, by the asset management system, the user credentials and electronic iock address from the access management component;

c. retrieving the user role permissions defined by the asset management system using the user credentials;

d. retrieving, by the asset management system, required permissions for accessing the at least one process control component housed in the enclosure;

e. comparing, by the asset management system, the user role permission with the required access permissions for the at least one process controi component;

f. transmitting an open request over the application programming interface to the eiectronic lock with the user roie required permissions; and

g. permitting access if the user roles are equivalent and denying access if they are not equivalent.

13, The system of claim 12, wherein the steps further comprise:

a. retrieving a lockout status in the asset management system for the enclosure from a maintenance management component; and

b. transmitting an open request to the enclosure electronic lock if the lockout status parameter is negative and restricting access to the enclosure if the lockout status parameter is affirmative.

14. A system comprising;

a first enclosure having a first component for a computer system disposed therein;

a first electronic lock configured to controi physical access to the first component within the first enclosure;

a first set of access permissions associated with the first electronic lock;

a second enclosure disposed within the first enclosure, the second enclosure having a second component for a computer system disposed therein;

a second electronic lock configured to control physical access to the second component within the second enclosure; and a second set of access permissions associated with the second electronic lock.

15. The system of claim 14, wherein the first set of access permissions is different from the second set of access permissions.

16. The system of claim 14 further comprising user credentials operable to define access permissions for a user.

17. The system of claim 18, wherein physical access to the first and second enciosures is determined based on comparisons between the access permissions of the first and second sets respectively and the access permissions defined by the user credentials.

18. The system of claim 17, wherein physical access to the component in the second enclosure is permitted if the access permission defined by the user credentials satisfies the permission requirements of the first and second sets of enclosure permissions,

19. The system of claim 18, wherein the user credentials operate to permit the user to electronically access the computer component located within the enclosure.

20. The system of claim 14 further comprising additional enclosures with additional computer components disposed within the first and/or the second enclosures.

21. The system of claim 20 further comprising an audit system operable for logging data related to both successful and unsuccessful access events into each enclosure.

22. The system of claim 14 further comprising:

a control system;

an access management component defined in the control system configured to tie the first enclosure, the first component and the first electronic lock to a first logical representation within the control system.

23. The system of claim 22 , wherein the access management component of the control system is configured to tie the second enclosure, the second component and the second electronic lock to a second logical representation.

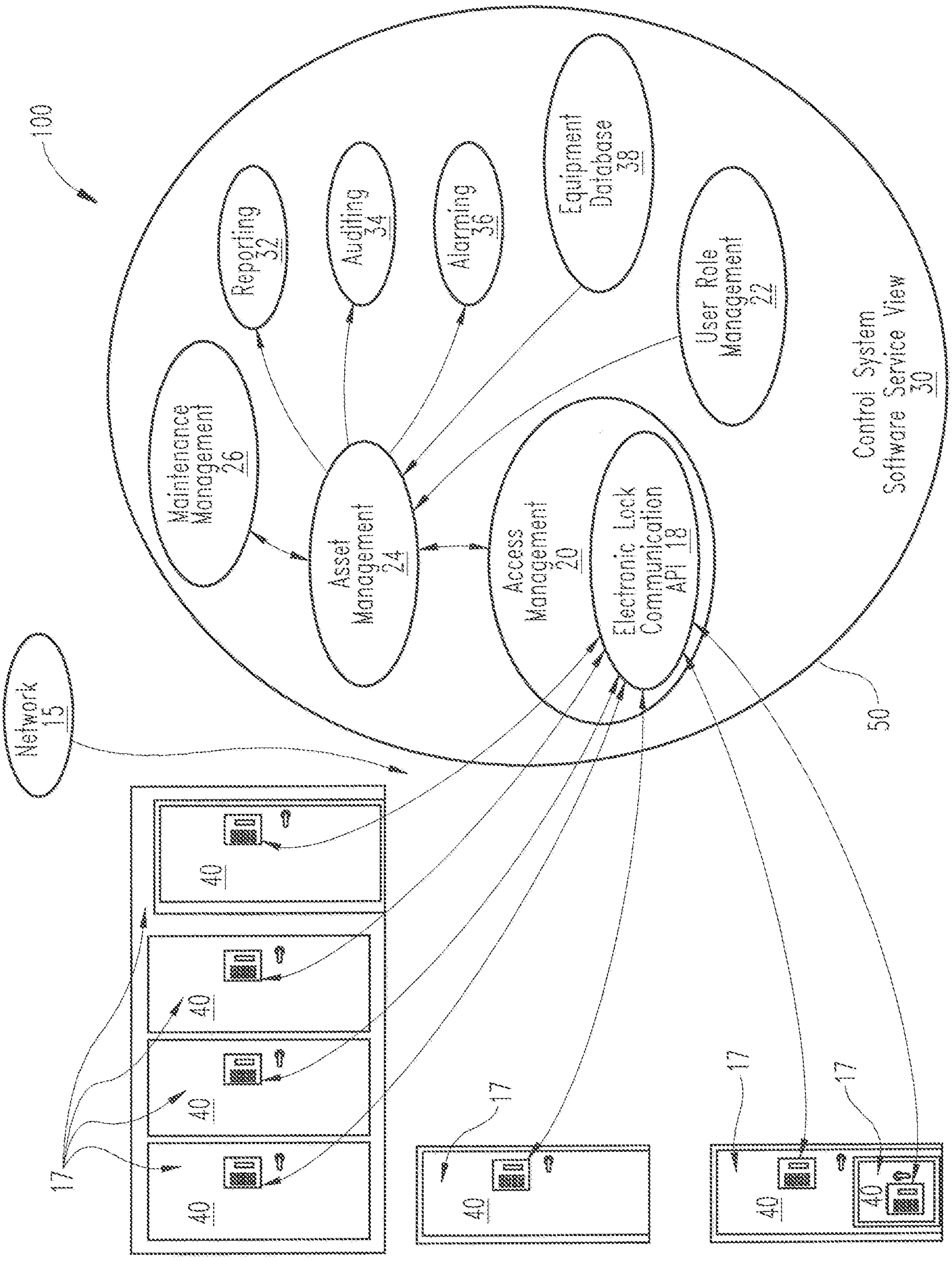

100
Reporting 32
Auditing 34
Alarming 36
Equipment Database 38
Maintenance Management 26
Asset Management 24
User Role Management 22
Access Management 20
Electronic Lock Communication API 18
Control System Software Service View 30
50
Network 15
17
40
17
40
17
17
40
40

FIG. 1

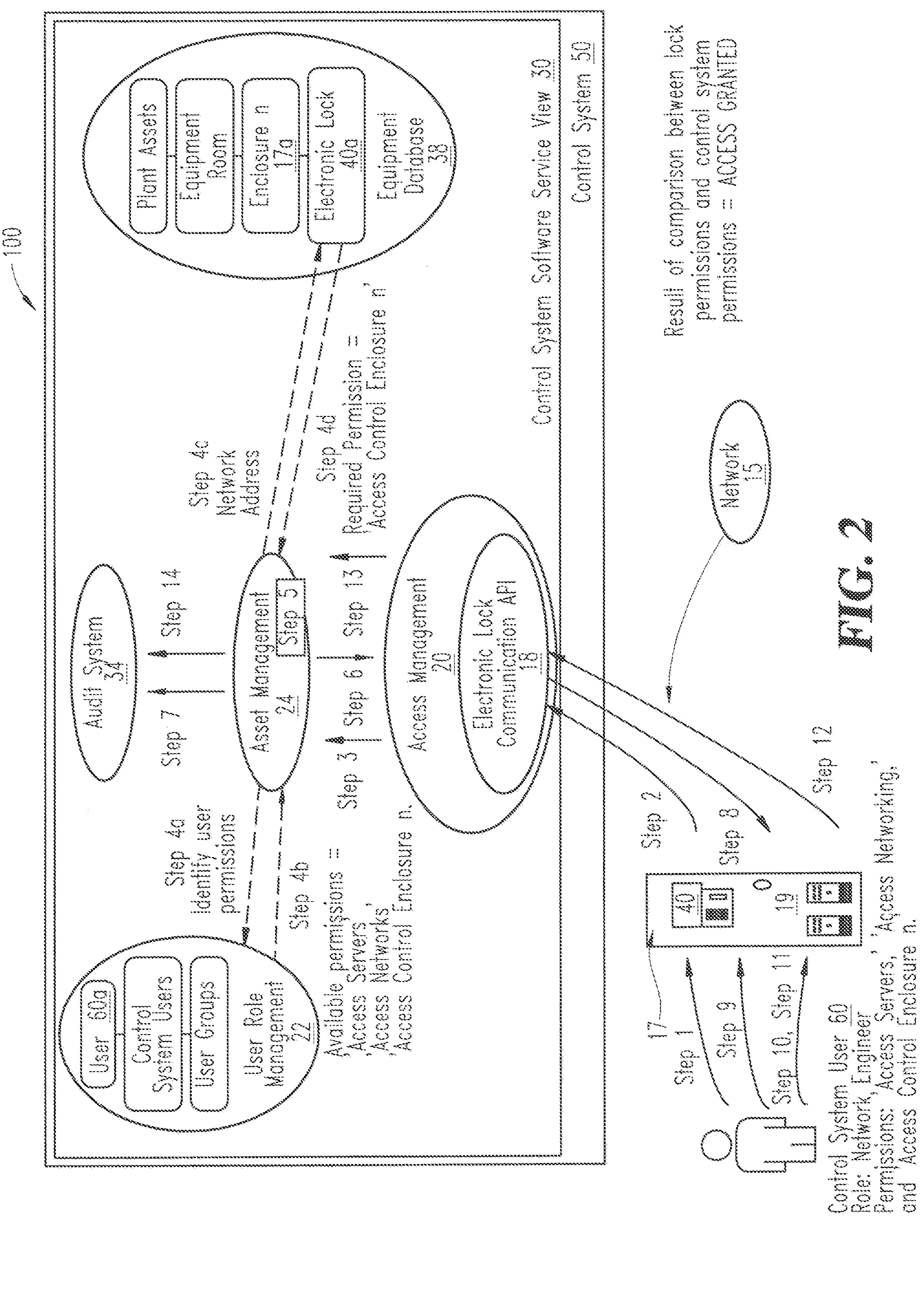

100
Control System 50
Control System Software Service View 30
Plant Assets
Equipment Room
Enclosure n 17a
Electronic Lock 40a
Equipment Database 38
Audit System 34
Asset Management 24
Step 5
Access Management 20
Electronic Lock Communication API 18
User 60a
Control System Users
User Groups
User Role Management 22
Step 4a identify user permissions
Step 4b
Available permissions = 'Access Servers,' 'Access Networks,' 'Access Control Enclosure n.
Step 3
Step 6
Step 13
Step 7
Step 14
Step 4c Network Address
Step 4d Required Permission = 'Access Control Enclosure n'
Network 15
Result of comparison between lock permissions and control system permissions = ACCESS GRANTED
Step 2
Step 8
Step 12
Step 1
Step 9
Step 10, Step 11
17
40
19
Control System User 60
Role: Network Engineer
Permissions: 'Access Servers,' 'Access Networking,' and 'Access Control Enclosure n.

FIG. 2

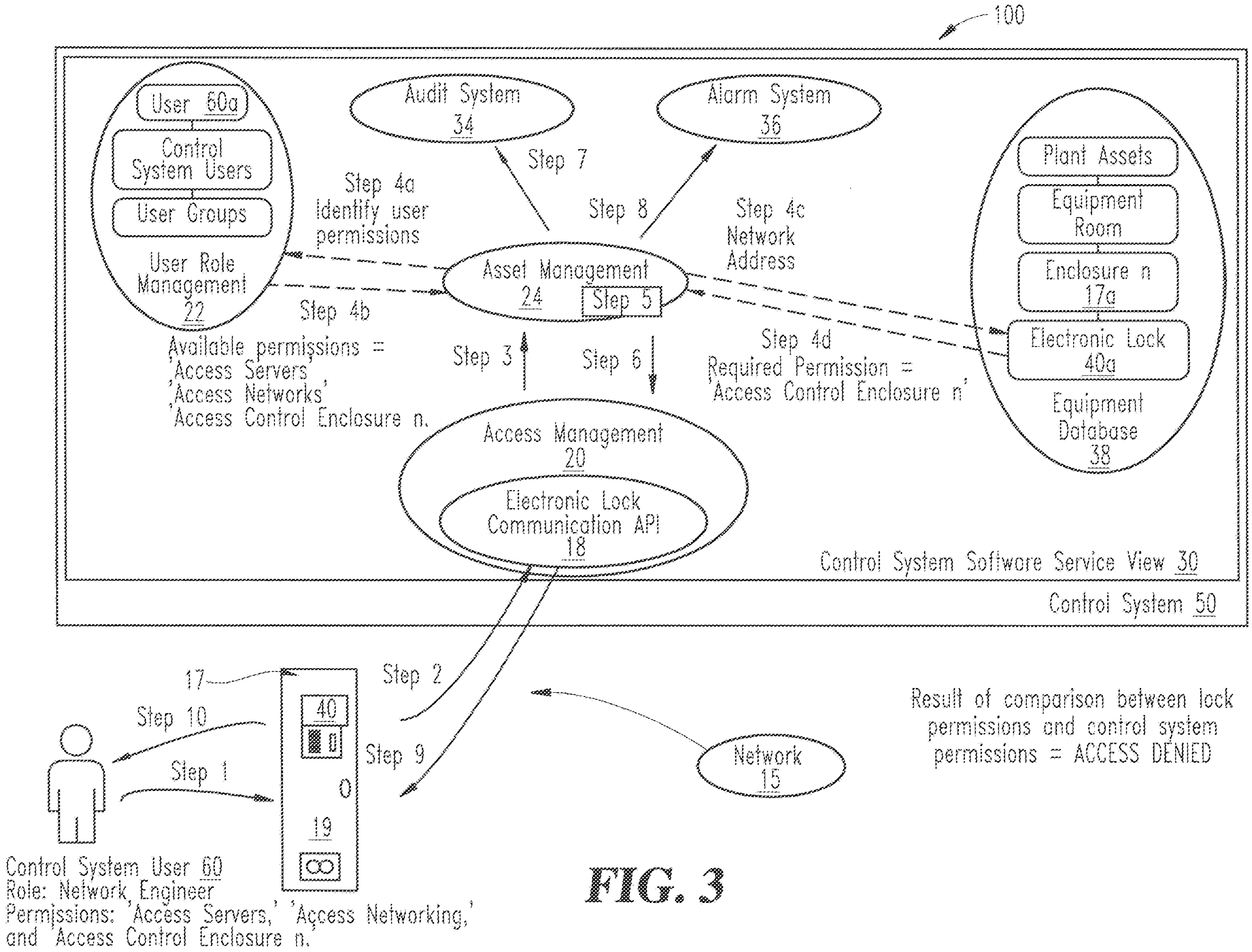
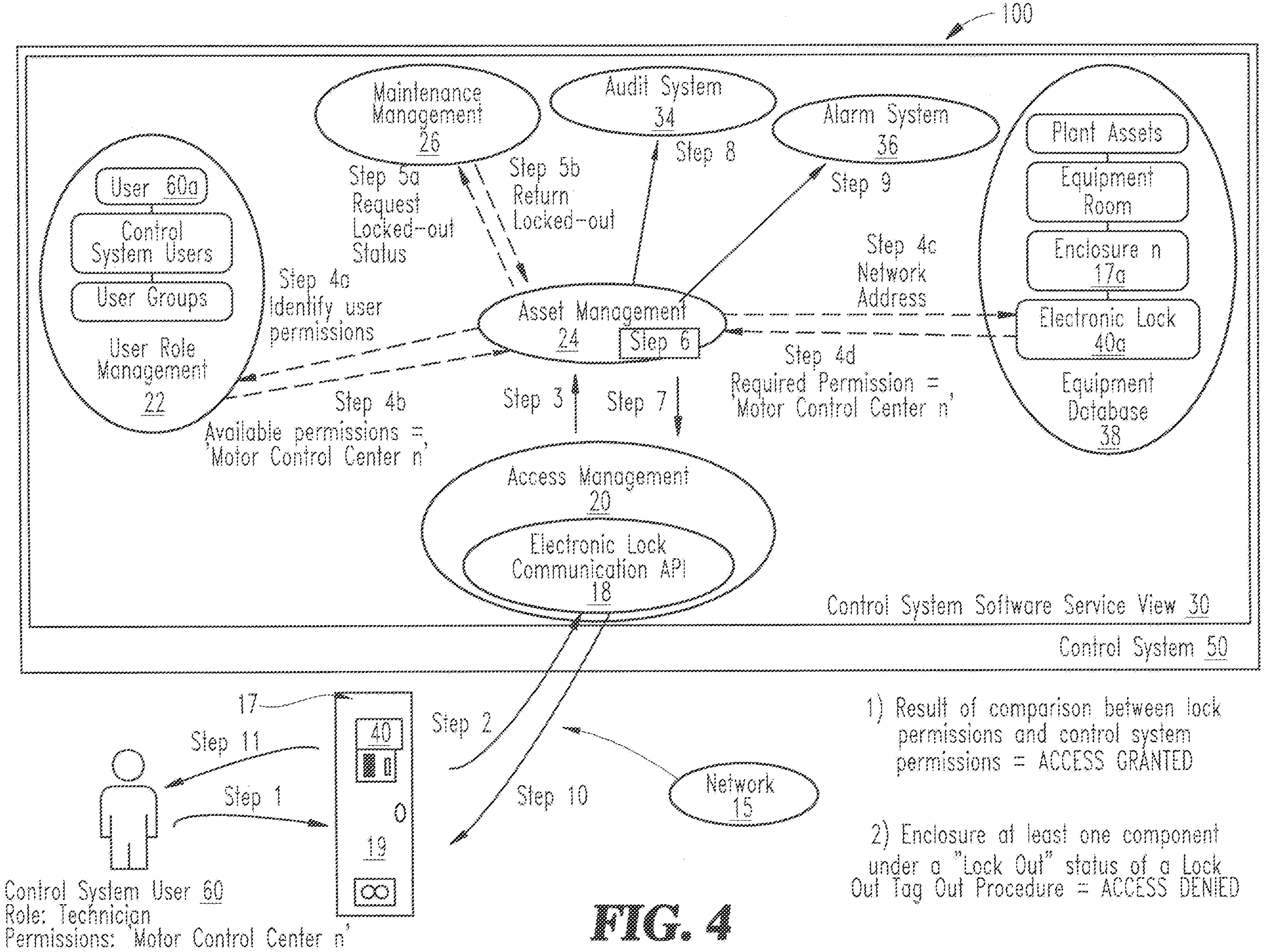

100
User 60a
Control System Users
User Groups
User Role Management 22
Audit System 34
Alarm System 36
Plant Assets
Equipment Room
Enclosure n 17a
Electronic Lock 40a
Equipment Database 38
Step 7
Step 8
Step 4a Identify user permissions
Step 4b
Step 4c Network Address
Asset Management 24
Step 5
Step 3
Step 6
Step 4d Required Permission = 'Access Control Enclosure n'
Available permissions = 'Access Servers' 'Access Networks' 'Access Control Enclosure n.
Access Management 20
Electronic Lock Communication API 18
Control System Software Service View 30
Control System 50
17
40
19
Step 2
Step 9
Step 10
Step 1
Network 15
Control System User 60
Role: Network Engineer
Permissions: 'Access Servers,' 'Access Networking,' and 'Access Control Enclosure n.'
Result of comparison between lock permissions and control system permissions = ACCESS DENIED

FIG. 3



1) Result of comparison between lock permissions and control system permissions = ACCESS GRANTED

2) Enclosure at least one component under a "Lock Out" status of a Lock Out Tag Out Procedure = ACCESS DENIED

FIG. 4

# INTERNATIONAL SEARCH REPORT

International application No.
PCT/US16/21734

## A. CLASSIFICATION OF SUBJECT MATTER

IPC(8) - G06F 21/70; H04L 9/32 (2016.01)
CPC - G06F 9/00174, 21/70; H04L 9/32
According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC(8); H04L 9/32, G06F 21/00, 21/70; G07C 9/00 (2016.01)
CPC: H04L 9/32, G06F 21/00, 21/70; G07C 9/00, 9/00174

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

PatSeer (US, EP, WO, JP, DE, GB, CN, FR, KR, ES, AU, IN, CA, Other Countries (INPADOC), RU, AT, CH, TH, BR, PH); EBSCO; IEEE/IEEEXplore; Google/Google Scholar; Keywords: user, authentication, permission, role, credentials, lock, unlock, electronic lock, enclosure, cabinet, grant, access, deny, approve, date, time, audit, status

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|---|---|---|
| X<br>---<br>Y | US 2013/0125231 A1 (KUENZI, A.) 16 May 2013; paragraphs [0013], [0017], [0020], [0022]. | 7<br>-----<br>8-11 |
| Y | US 2014/0337930 A1 (HOYOS LABS CORP.) 13 November 2014; paragraphs [0137], [0138], [0219]; claim 27. | 1-6, 12-13 |
| Y | US 2012/0280783 A1 (GERHARDT et al.) 08 November 2012; paragraphs [0183], [0191]. | 1-6, 8, 12-13 |
| Y | WO 2012/047850 A2 (MASTER LOCK COMPANY LLC) 12 April 2012; paragraphs [0018], [0020]. | 2-3, 9-11 |
| Y | CN 204060321 U (BEIJING HUIZHI TECHNOLOGY CO., LTD) 31 December 2014; (see machine translation). | 5-6 |
| Y | US 2014/0123273 A1 (MATUS, J.) 01 May 2014; paragraphs [0040], [0055], [0060]. | 13 |

□ Further documents are listed in the continuation of Box C. □ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

| | |
|---|---|
| Date of the actual completion of the international search<br>20 May 2016 (20.05.2016) | Date of mailing of the international search report<br>26 JUL 2016 |
| Name and mailing address of the ISA/<br>Mail Stop PCT, Attn: ISA/US, Commissioner for Patents<br>P.O. Box 1450, Alexandria, Virginia 22313-1450<br>Facsimile No. 571-273-8300 | Authorized officer<br>Shane Thomas<br>PCT Helpdesk: 571-272-4300<br>PCT OSP: 571-272-7774 |

# INTERNATIONAL SEARCH REPORT

International application No.

PCT/US1 6/21 734

**Box No. II** Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. □ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. □ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. □ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

**Box No. III** Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:
Group I: Claims 1-13; Group II: Claims 14-23

-•"-Continued in extra sheet-***-

1. □ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. □ As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees

3. □ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:
1-13

Remark on Protest

□ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

□ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

□ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US16/21734

-•"-Continued from Box No. Ill - Observations where unity of inventions is lacking-***-

This application contains the following inventions or groups of inventions which are not so linked as to form a single general inventive concept under PCT Rule 13.1. In order for all inventions to be examined, the appropriate additional examination fee must be paid.

Group I: Claims 1-13 are directed towards a system for administering physical access to at least one component of a process control system

Group II: Claims 14-23 are directed towards a second enclosure disposed within the first enclosure.

The inventions listed as Groups l-ll do not relate to a single general inventive concept under PCT Rule 13.1 because, under PCT Rule 13.2, they lack the same or corresponding special technical features for the following reasons:

The special technical features of Group I are at least a. receiving, by an access management system through an application programming interface (API), user credentials presented to an electronic lock and a corresponding electronic lock address; b. receiving, by the asset management system, user credentials and electronic lock address from the access management component; c. retrieving user role permissions defined by the asset management system using the user credentials; d. retrieving, by the asset management system, required permissions for accessing the at least one process control component housed in the enclosure; e. comparing, by the asset management system, the user role permission with the required access permissions for the at least one process control component; f. transmitting an open request over the application programming interface to the electronic lock with the user role required permissions; and g. permitting access if the user roles are equivalent and denying access if they are not equivalent, wherein said asset management component of said process control system includes a second level of user authentication wherein the at least one component physical access permission as defined in said access management component is compared with process control system permissions defined in said asset management component, which are not present in Group II.

The special technical features of Group II are at least a second enclosure disposed within the first enclosure, the second enclosure having a second component for a computer system disposed therein; a second electronic lock configured to control physical access to the second component within the second enclosure; and a second set of access permissions associated with the second electronic lock, which are not present in Group I.

The common technical features of Groups I & II are at least a first enclosure having a first component for a computer system disposed therein; a first electronic lock configured to control physical access to the first component within the first enclosure; a first set of access permissions associated with the first electronic lock.

However, this common feature is previously disclosed by US 2013/0125231 A1 to KUENZI et al. (hereinafter "Kuenzi"). Kuenzi discloses at least a first enclosure having a first component for a computer system disposed therein (a lock box (enclosure housing) for an access terminal (first component) of a banking or machine operation system (computer system); paragraphs [001 1], [0013], [0017]); a first electronic lock configured to control physical access to the first component within the first enclosure (an electronic lock controlling access to a physical vicinity of an access terminal; paragraphs [0013], [0017]); a first set of access permissions associated with the first electronic lock (requesting digital credentials to validate user permissions for the electronic lock; paragraph [0013]).

Since the common technical feature is previously disclosed by the Kuenzi reference, this common feature is not special and so Groups l-ll lack unity.