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(54) **SUPPLY CHAIN SYSTEM AND
NON-TRANSITORY COMPUTER-READABLE
RECORDING MEDIUM STORING
PROGRAM**

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(57)

ABSTRACT

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A supply chain system is provided. The supply chain system includes a server that manages at least a right of ownership of an article. The article is an actual object. A container is provided with a lock. The lock is configured to at least open through an electronic process. The container is capable of physically storing the article. At least one of a processor or a circuit, when an opening request to open the lock is received, determines whether a user who has issued the opening request and a user who has the right of ownership of the article match. When the user who has issued the opening request and the user who has the right of ownership of the article match, the lock is opened for allowing the article to be removed from the container. The server is notified that the lock has been opened.

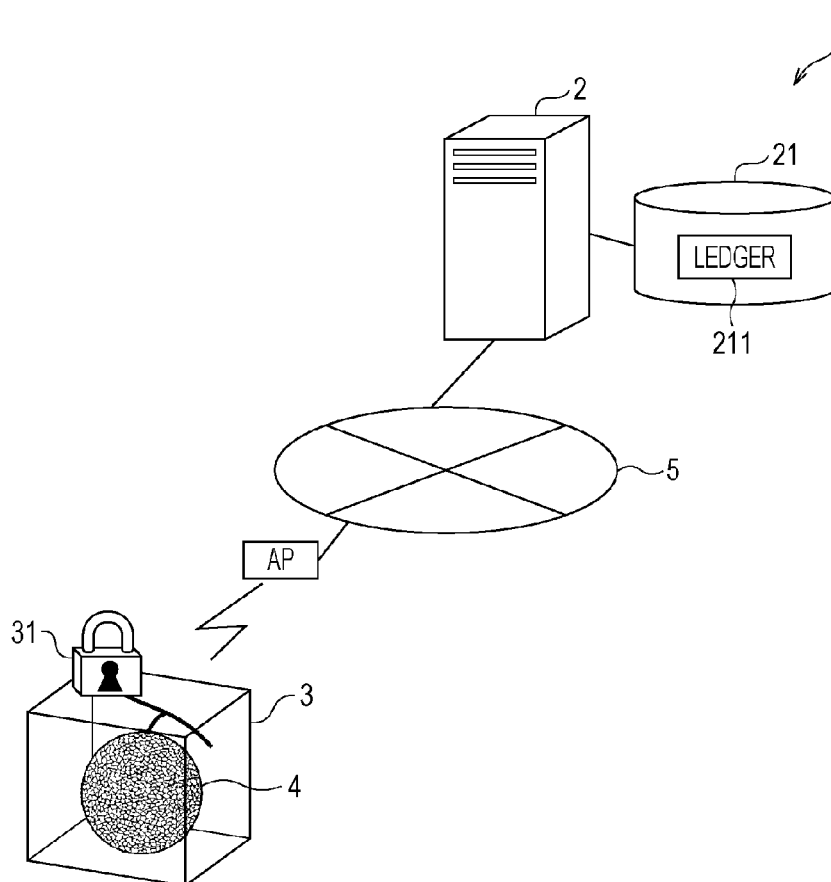


FIG. 1

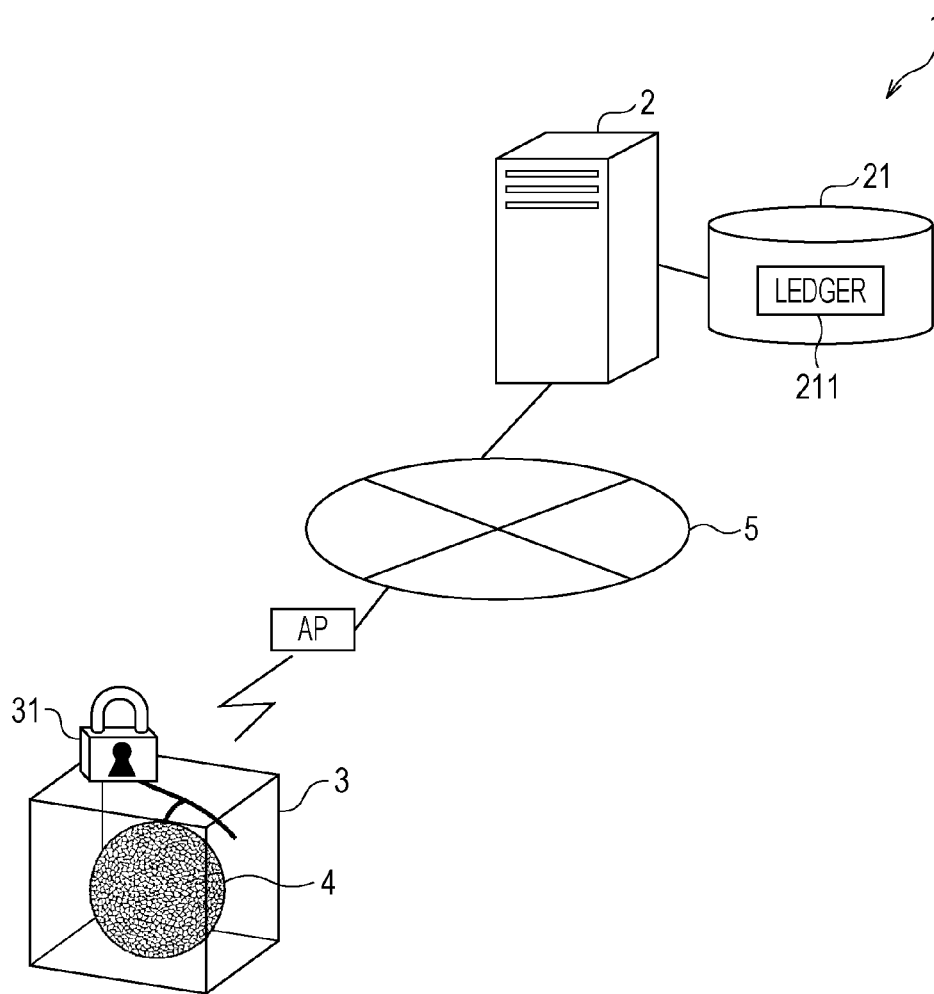


FIG. 2

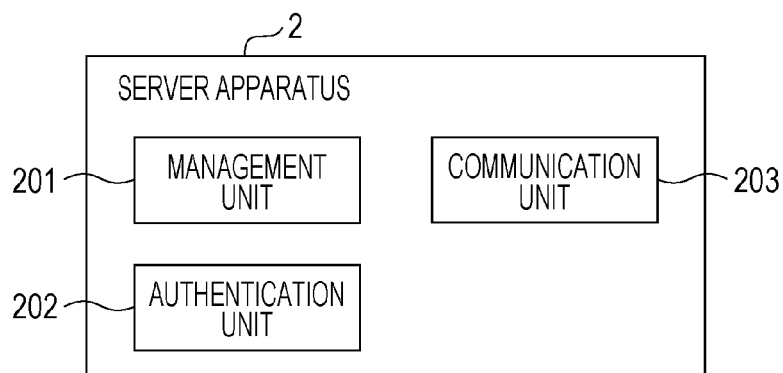


FIG. 3

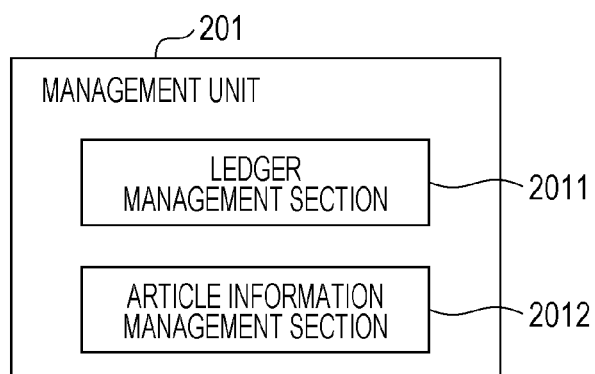


FIG. 4

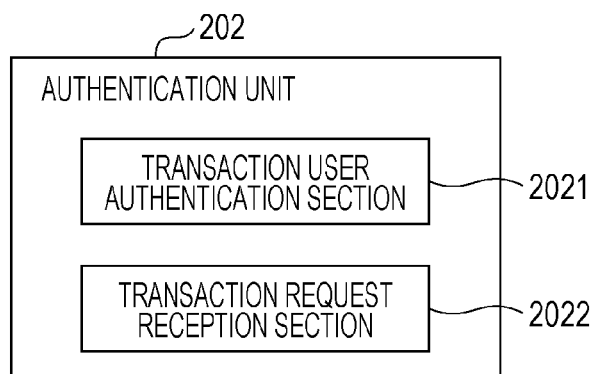


FIG. 5

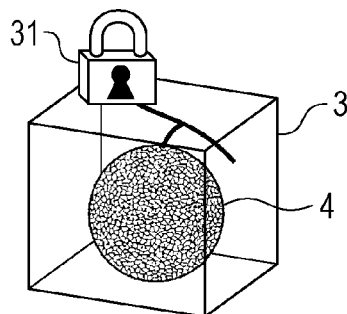


FIG. 6

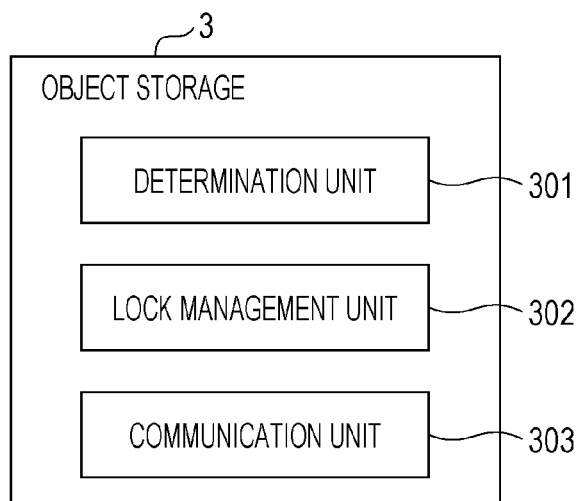


FIG. 7

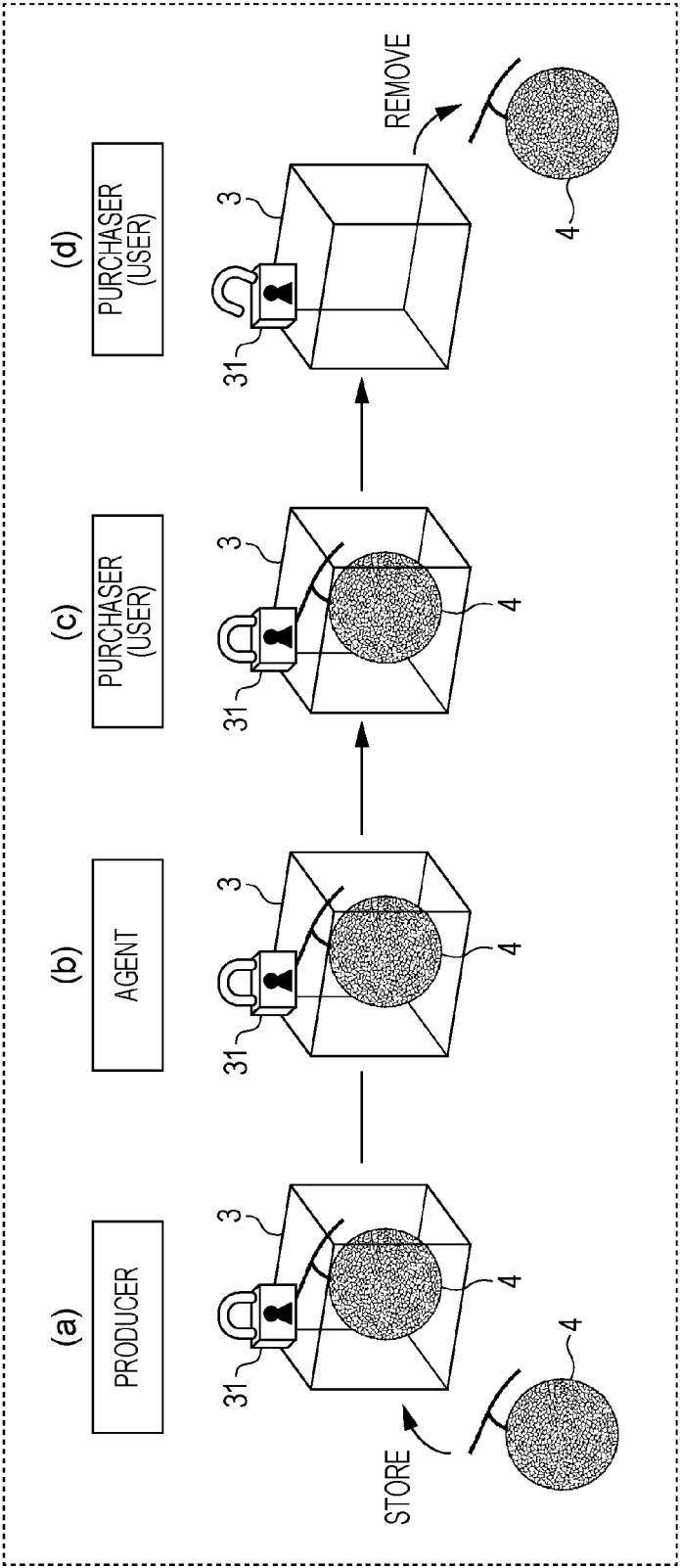


FIG. 8

	SITUATION 1	SITUATION 2	SITUATION 3	SITUATION 4
TRANSACTION USER	PRODUCER	AGENT	PURCHASER (CUSTOMER)	PURCHASER (CUSTOMER)
RIGHT OF OWNERSHIP (RIGHT TO OPEN)	PRODUCER	AGENT	PURCHASER (CUSTOMER)	PURCHASER (CUSTOMER)
OPENING HISTORY	NO	NO	NO	YES
ARTICLE INFORMATION	MELON	MELON	MELON	MELON
ARTICLE IDENTIFICATION INFORMATION	IDENTIFIER OF OBJECT STORAGE	IDENTIFIER OF OBJECT STORAGE	IDENTIFIER OF OBJECT STORAGE	IDENTIFIER OF OBJECT STORAGE

FIG. 9

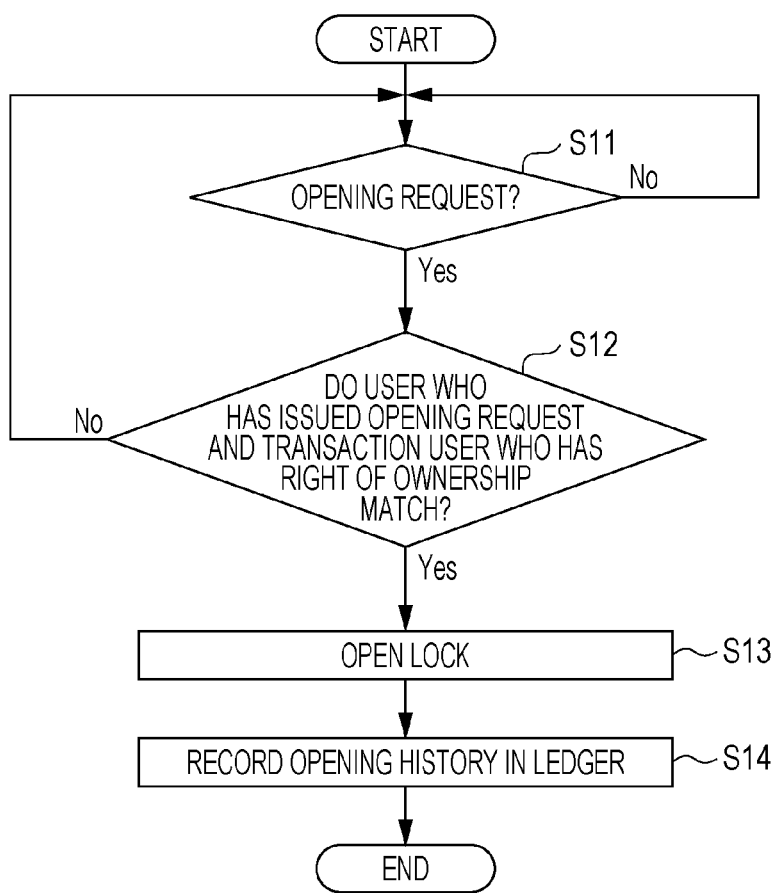


FIG. 10A

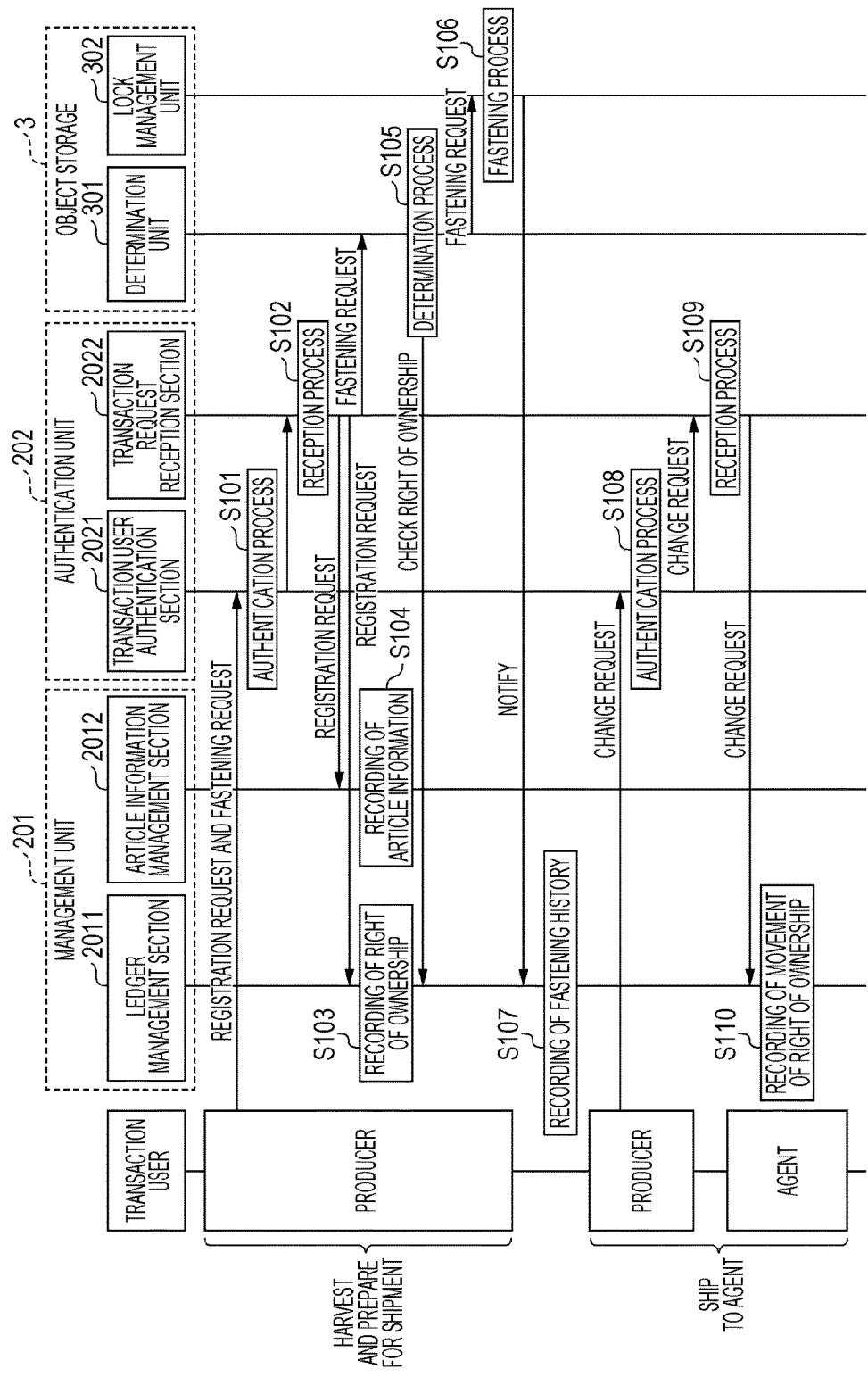


FIG. 10B

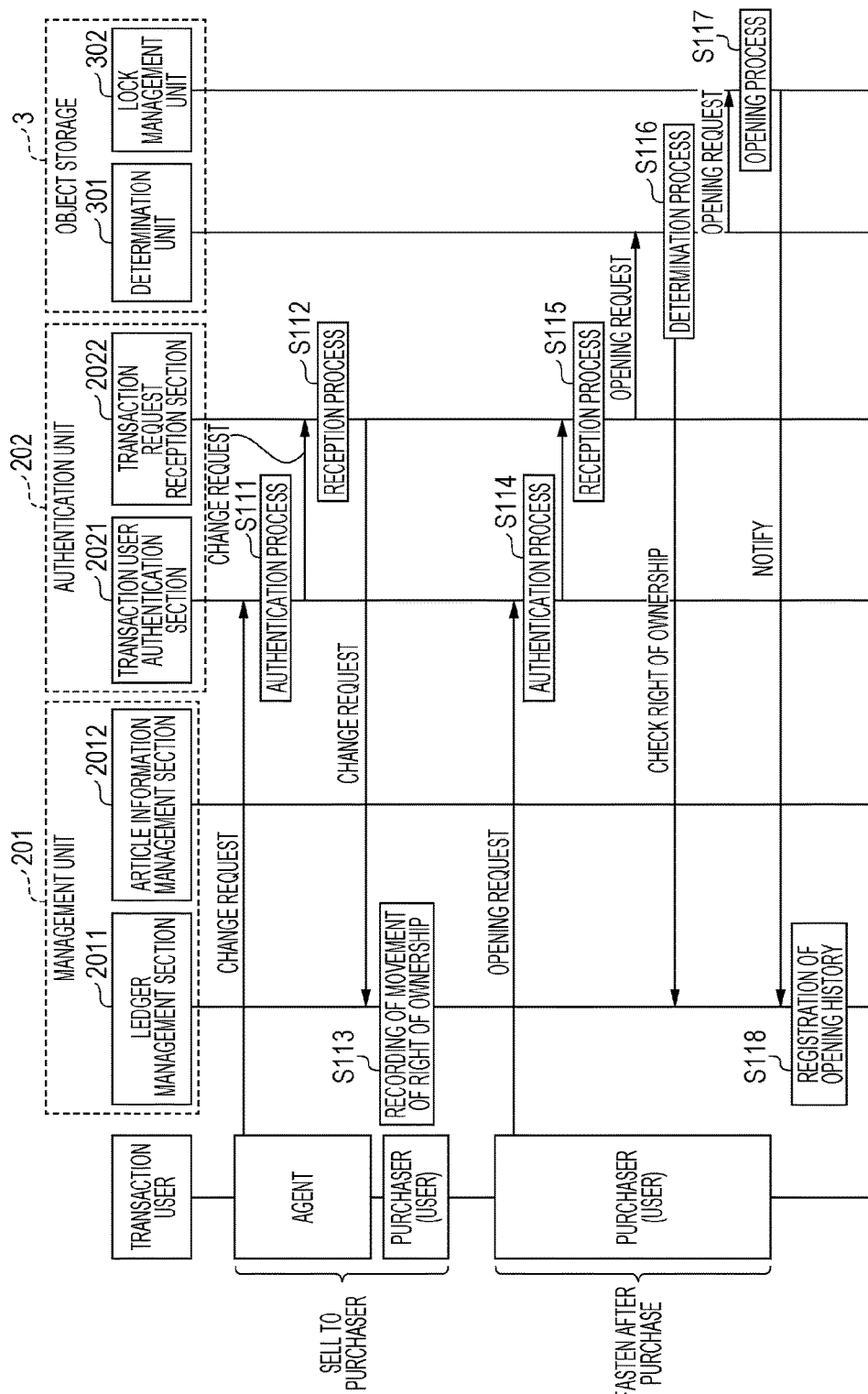


FIG. 11

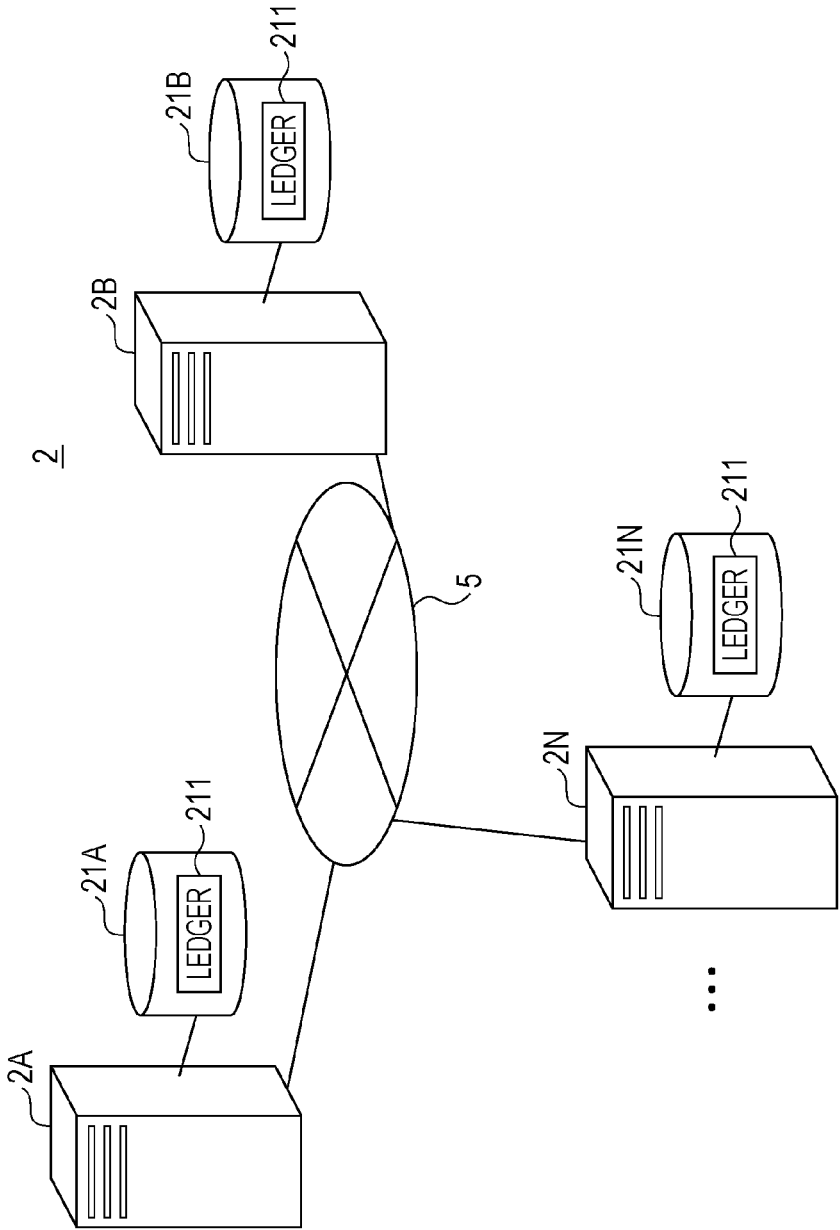
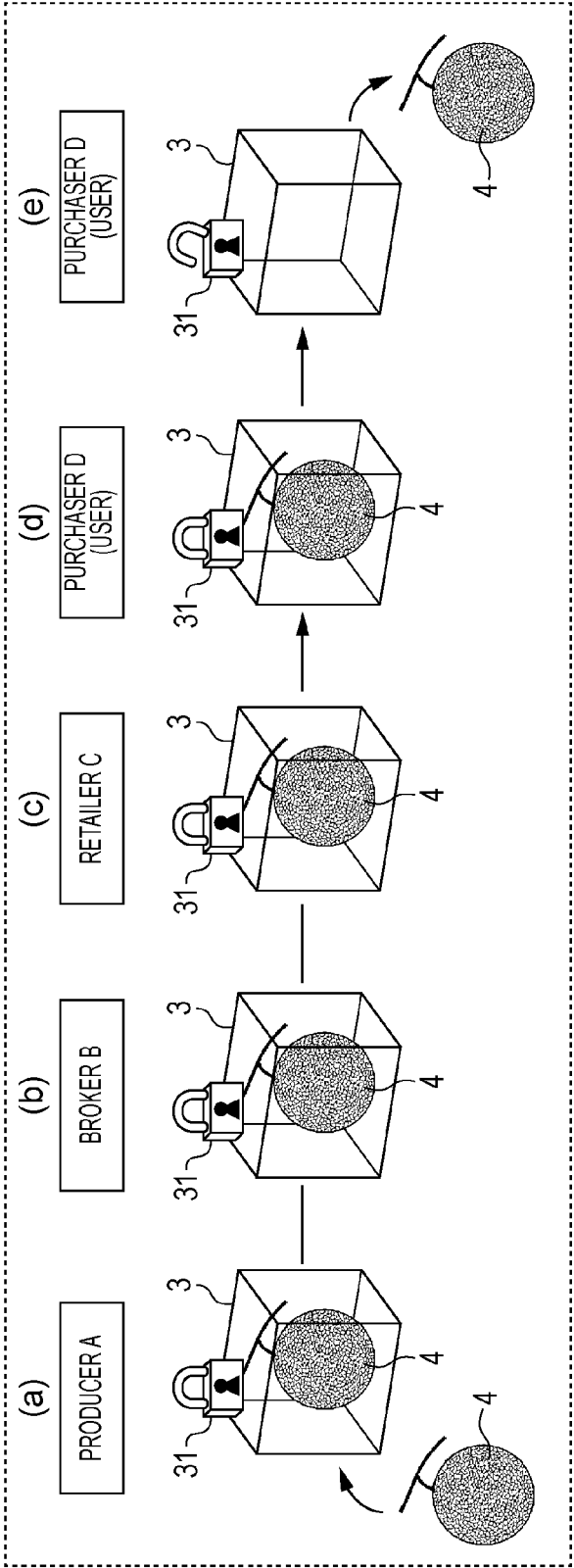


FIG. 12



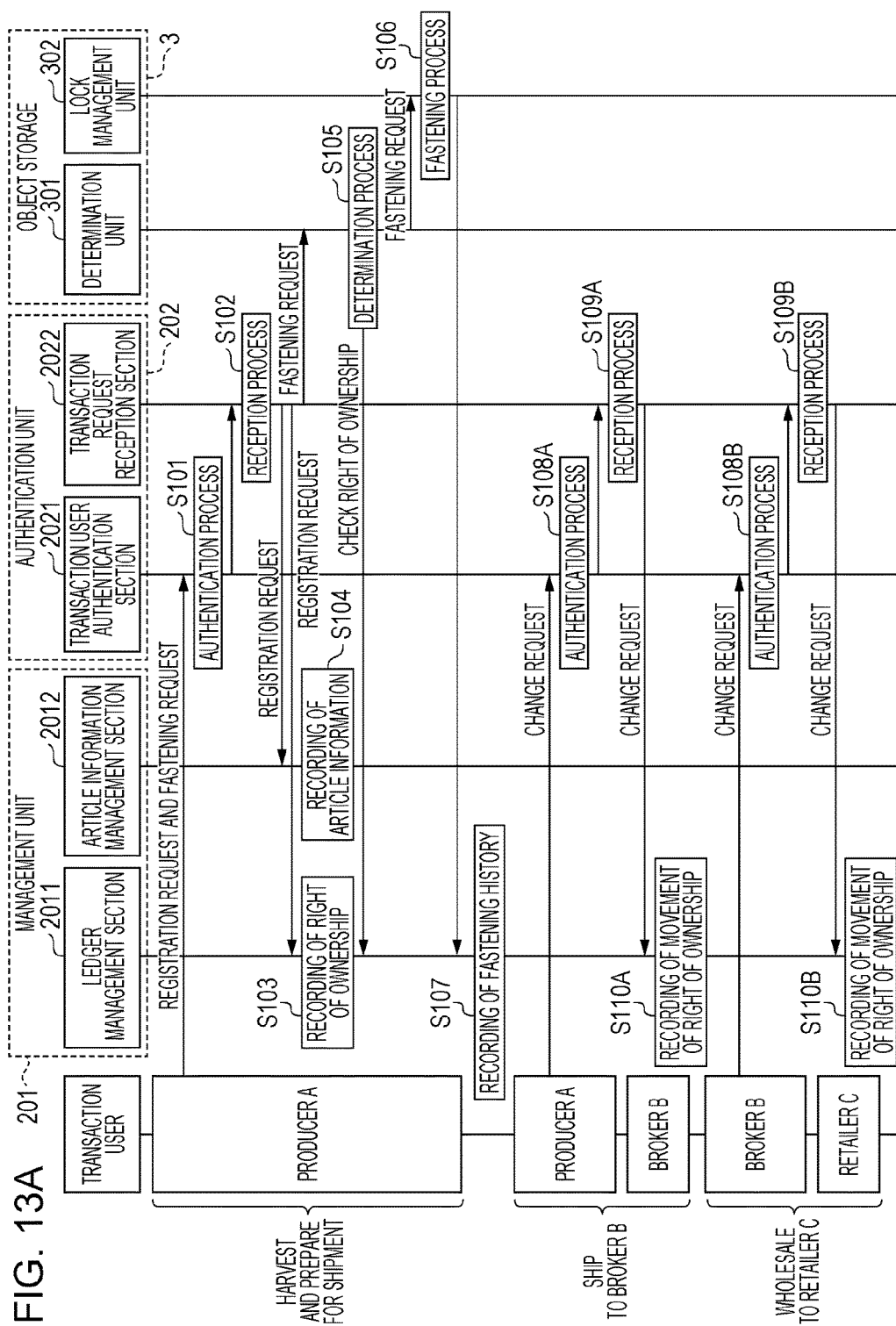


FIG. 13B

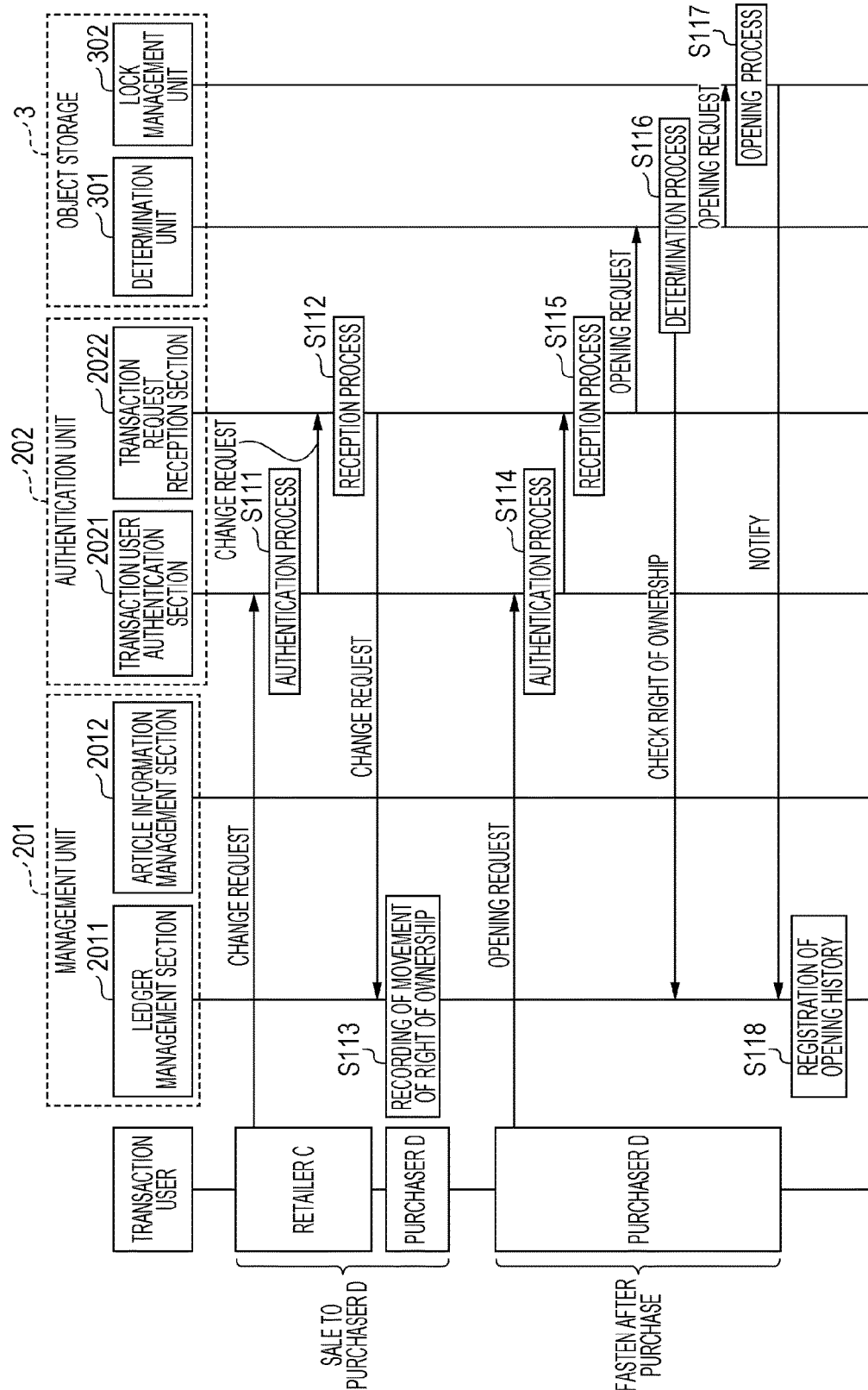


FIG. 14A

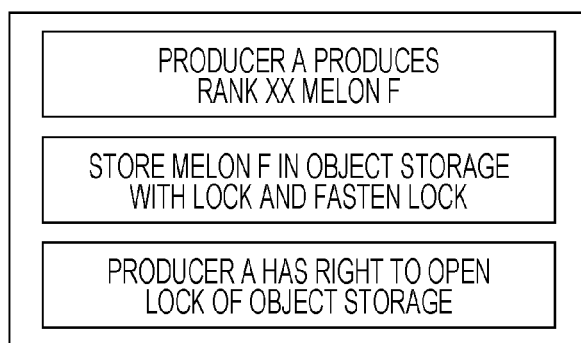


FIG. 14B

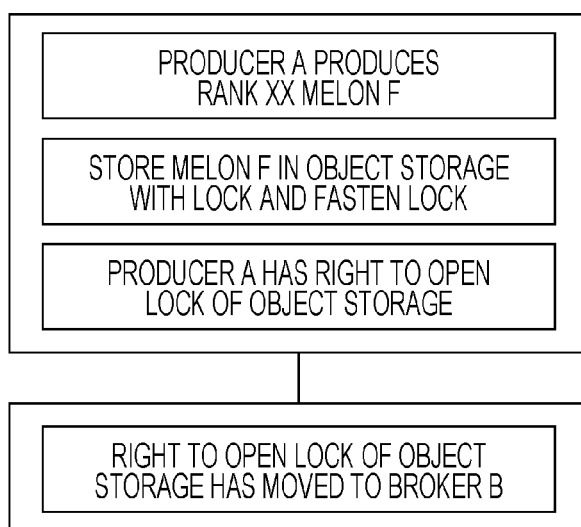


FIG. 14C

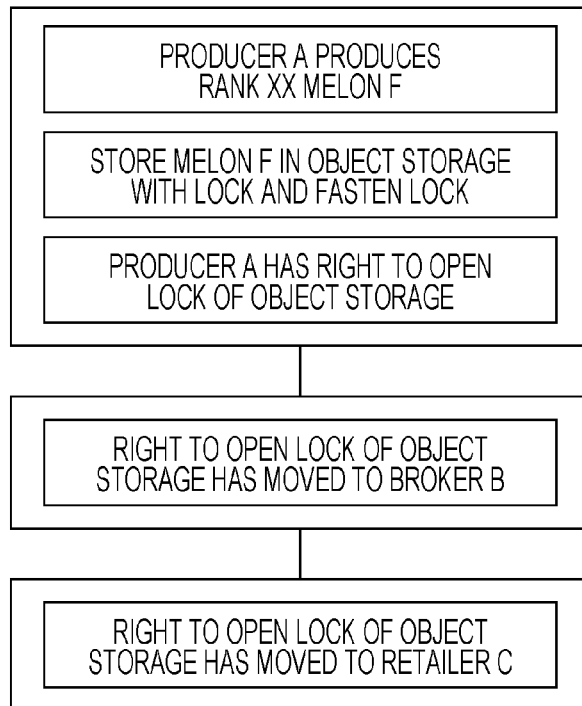


FIG. 14D

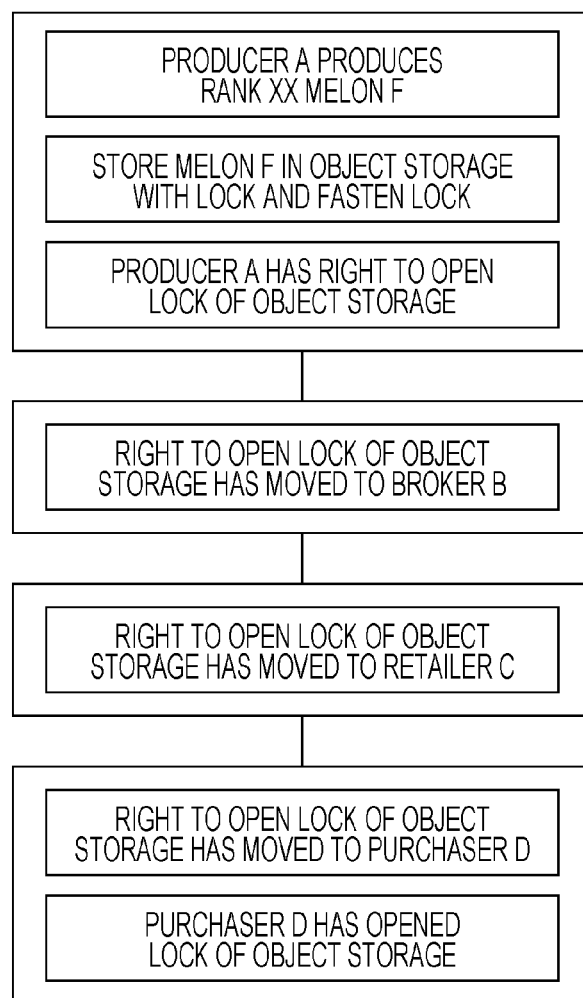


FIG. 15

TRANSACTION USER	ARTICLE	TRANSACTION
PRODUCER A	MELON F	REGISTRATION (OBJECT STORAGE 3)
PRODUCER A	MELON F	MOVEMENT OF RIGHT OF OWNERSHIP TO BROKER B
BROKER B	MELON F	MOVEMENT OF RIGHT OF OWNERSHIP TO RETAILER C
RETAILER C	MELON F	MOVEMENT OF RIGHT OF OWNERSHIP TO PURCHASER D
PURCHASER D	MELON F	OPENING OF LOCK (OBJECT STORAGE 3)

FIG. 16

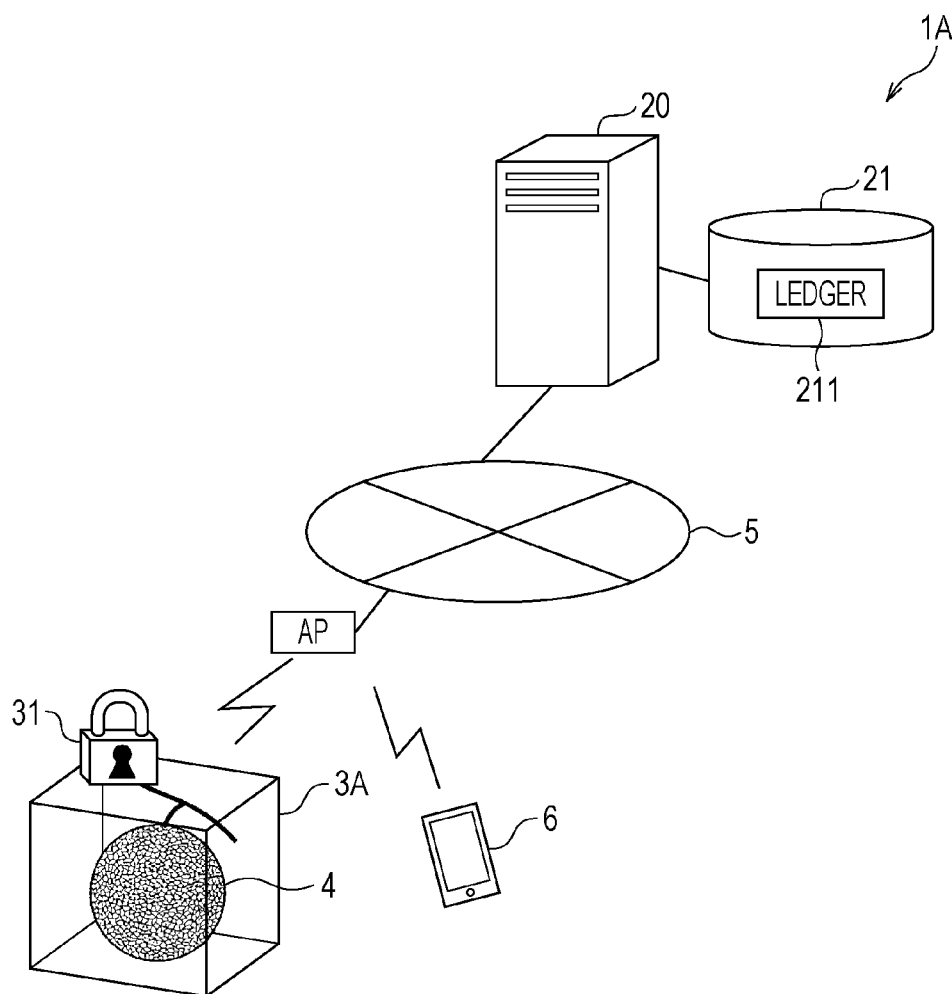


FIG. 17

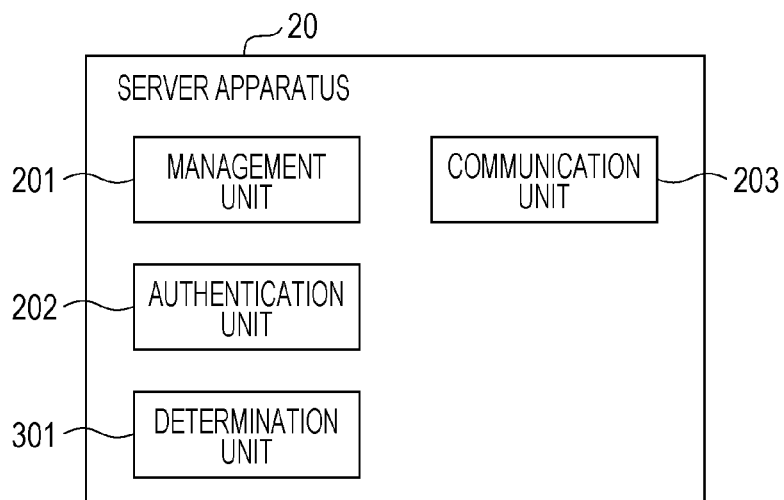
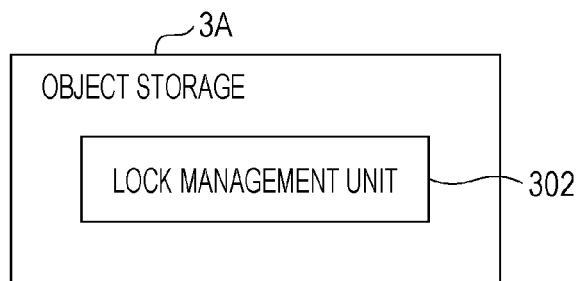


FIG. 18



SUPPLY CHAIN SYSTEM AND NON-TRANSITORY COMPUTER-READABLE RECORDING MEDIUM STORING PROGRAM

BACKGROUND

1. Technical Field

[0001] The present disclosure relates to a supply chain system and a non-transitory computer-readable recording medium storing a program.

2. Description of the Related Art

[0002] Unlawful acts such as false labeling of places of production of foods and imitations of paintings and the like are detected using traceability systems (e.g., refer to Japanese Unexamined Patent Application Publication No. 2015-138289).

[0003] Japanese Unexamined Patent Application Publication No. 2015-138289 discloses a traceability system capable of determining presence or absence of an unlawful act relatively easily.

SUMMARY

[0004] In Japanese Unexamined Patent Application Publication No. 2015-138289, however, image data regarding a product is only attached to a box storing the product, which is an actual object. That is, the actual object and the traceability system are connected to each other only through an identification label attached to the box storing the article, the identification label being used to check a history with the traceability system. With the technique disclosed in Japanese Unexamined Patent Application Publication No. 2015-138289, therefore, it is difficult to detect replacement of a product stored in a box by a lower quality product of the same type and determine whether an unlawful act has been performed on an article.

[0005] One non-limiting and exemplary embodiment provides a supply chain system and a non-transitory computer-readable recording medium storing a program capable of determining whether an unlawful act has been performed on an article.

[0006] In one general aspect, the techniques disclosed here feature a supply chain system including server that manages at least a right of ownership of an article, the article being an actual object, a container that is provided with a lock, the lock being configured to at least open through an electronic process, the container being capable of physically storing the article, and at least one of a processor or a circuit that, when an opening request to open the lock is received, determines whether a user who has issued the opening request and a user who has the right of ownership of the article match. When the user who has issued the opening request and the user who has the right of ownership of the article match, the lock is opened for allowing the article to be removed from the container, and the server is notified that the lock has been opened.

[0007] With the supply chain system and the like in the present disclosure, whether an unlawful act has been performed on an article can be determined.

[0008] It should be noted that general or specific embodiments may be implemented as a system, a method, an integrated circuit, a computer program, a computer-readable

recording medium such as a compact disc read-only memory (CD-ROM), or any selective combination thereof.

[0009] Additional benefits and advantages of the disclosed embodiments will become apparent from the specification and drawings. The benefits and/or advantages may be individually obtained by the various embodiments and features of the specification and drawings, which need not all be provided in order to obtain one or more of such benefits and/or advantages.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] FIG. 1 is a diagram illustrating an example of the configuration of a supply chain system according to an embodiment;

[0011] FIG. 2 is a block diagram illustrating an example of the configuration of a server apparatus illustrated in FIG. 1;

[0012] FIG. 3 is a block diagram illustrating an example of the detailed configuration of a management unit illustrated in FIG. 2;

[0013] FIG. 4 is a block diagram illustrating an example of the detailed configuration of an authentication unit illustrated in FIG. 2;

[0014] FIG. 5 is a diagram conceptually illustrating the appearance of an object storage illustrated in FIG. 1;

[0015] FIG. 6 is a block diagram illustrating an example of the detailed configuration of the object storage illustrated in FIG. 5;

[0016] FIG. 7 is a diagram conceptually illustrating the operation of the supply chain system according to the embodiment;

[0017] FIG. 8 is a diagram illustrating transaction users, a right of ownership, and opening histories, and the like with respect to an article in a situation illustrated in FIG. 7;

[0018] FIG. 9 is a flowchart illustrating an example of a characteristic operation performed by the supply chain system according to the embodiment;

[0019] FIG. 10A is a sequence diagram illustrating an example of the operation of the supply chain system according to the embodiment;

[0020] FIG. 10B is a sequence diagram illustrating the example of the operation of the supply chain system according to the embodiment;

[0021] FIG. 11 is a diagram illustrating an example of the configuration of a server apparatus according to a first modification;

[0022] FIG. 12 is a diagram conceptually illustrating the operation of a supply chain system according to a first modification;

[0023] FIG. 13A is a sequence diagram illustrating an example of the operation of the supply chain system according to the first modification;

[0024] FIG. 13B is a sequence diagram illustrating the example of the operation of the supply chain system according to the first modification;

[0025] FIG. 14A is a diagram conceptually illustrating an example of the structure of data recorded in a ledger according to the first modification;

[0026] FIG. 14B is a diagram conceptually illustrating an example of the structure of data recorded in the ledger according to the first modification;

[0027] FIG. 14C is a diagram conceptually illustrating an example of the structure of data recorded in the ledger according to the first modification;

[0028] FIG. 14D is a diagram conceptually illustrating an example of the structure of data recorded in the ledger according to the first modification;

[0029] FIG. 15 is a diagram conceptually illustrating another example of the structure of data recorded in the ledger according to the first modification;

[0030] FIG. 16 is a diagram illustrating an example of the configuration of a supply chain system according to a second modification;

[0031] FIG. 17 is a block diagram illustrating an example of the configuration of a server apparatus illustrated in FIG. 16; and

[0032] FIG. 18 is a block diagram illustrating an example of the detailed configuration of an object storage illustrated in FIG. 16.

DETAILED DESCRIPTION

[0033] Underlying Knowledge Forming Basis of Present Disclosure

[0034] A supply chain system according to an aspect of the present disclosure includes a server that manages at least a right of ownership of an article, the article being an actual object, a container that is provided with a lock, the lock being configured to at least open through an electronic process, the container being capable of physically storing the article, and at least one of a processor or a circuit that, when an opening request to open the lock is received, determines whether a user who has issued the opening request and a user who has the right of ownership of the article match. When the user who has issued the opening request and the user who has the right of ownership of the article match, the lock is opened for allowing the article to be removed from the container, and the server is notified that the lock has been opened.

[0035] With this configuration, the article stored in a physically locked object storage is distributed. When the lock provided for the object storage has not been opened, therefore, it can be seen that the article stored in the object storage has not been tampered with. That is, with this configuration, whether an unlawful act has been performed on the article can be determined. Furthermore, with this configuration, unlawful acts performed on the article, such as false labeling of a place of production of the article, can be suppressed, and cost efficiency can be achieved because there is no need to dispose of articles whose places of production have been falsely labeled.

[0036] The container may notify, through wireless communication, the server that the lock has been opened. Upon receiving a notification, the server may manage an opening history of the lock by adding an opening of the lock to the opening history.

[0037] With this configuration, whether the lock of the object storage storing the article has been opened can be determined. When the lock has not been opened at all until a user who consumes or uses the article opens the lock and removes the article, therefore, it can be seen that the article stored in the object storage has not been tampered with. Consequently, whether an unlawful act has been performed on the article can be determined more accurately.

[0038] In addition, for example, the server, when a change request to change the right of ownership of the article is received, may perform an authentication process to determine whether a user who has issued the change request is the user who has the right of ownership. The server may manage

the right of ownership of the article by accumulating change of the right of ownership of the article as a history. After the server performs the authentication process, the server may accumulate the change of the right of ownership of the article as the history by recording a user to which the right of ownership of the article has been granted.

[0039] Here, for example, the container may be a transparent case, an opaque latticed case, or a barred case.

[0040] In addition, for example, the container may further include a sensor for detecting a storage state of the article. The container may wirelessly transmit, to the server, information indicating the storage state of the article detected by the sensor. The server may manage a storage state history of the article by accumulating the information indicating the storage state of the article transmitted from the container.

[0041] The server may manage the right of ownership of the article by accumulating, as a history, change of the right of ownership of the article in distributed ledgers including a plurality of ledgers of same content constructed on a blockchain platform and manages the opening or the fastening of the lock as a history. The lock may be configured to open and fasten. The container may notify, through wireless communication, the server that lock has been opened or fastened. Upon receiving a notification, the server may manage an opening and fastening history of the lock by adding an opening or fastening of the lock to the opening and fastening history. The supply chain system may further include a lock manager configured to open and fasten the lock. The container may include the lock manager. The container may include the at least one of the processor or the circuit. The server may include the at least one of the processor or the circuit. According to another aspect of the present disclosure, a non-transitory computer-readable recording medium storing a program that, when executed by a computer, may cause the computer to perform operations comprising managing at least a right of ownership of an article, the article being an actual object, opening a lock of a container through an electronic process, the container being capable of physically storing the article, and determining, when an opening request to open the lock is received, whether a user who has issued the opening request and a user who has the right of ownership match. In the determining, when the user who has issued the opening request and the user who has the right of ownership managed match, the lock may be opened for allowing the article to be removed from the container, and a notification regarding an opening of the lock is issued. According to another aspect of the present disclosure, a method may include managing, by a server, at least a right of ownership of an article, the article being an actual object, opening a lock of a container through an electronic process, the container being capable of physically storing the article, and determining, by at least one of a processor or a circuit when an opening request to open the lock is received, whether a user who has issued the opening request and a user who has the right of ownership match. In the determining, when the user who has issued the opening request and the user who has the right of ownership managed match, the lock may be opened for allowing the article to be removed from the container, and a notification regarding an opening of the lock is issued. Embodiments that will be described hereinafter are specific examples of the present disclosure. Values, shapes, components, steps, the order of the steps, and the like mentioned in the following embodiments are examples, and do not limit the present disclosure. Among

the components described in the following embodiments, ones not described in the independent claims, which define broadest concepts, will be described as arbitrary components. Any embodiment may be combined with another embodiment.

Embodiment

[0042] A supply chain system **1** according to the embodiment will be described hereinafter with reference to the drawings.

[0043] Configuration of Supply Chain System **1**

[0044] FIG. **1** is a diagram illustrating an example of the configuration of the supply chain system **1** according to the present embodiment.

[0045] As illustrated in FIG. **1**, the supply chain system **1** includes a server apparatus **2** connected to a storage device **21** and an object storage **3** provided with a lock **31**. The server apparatus **2** and the object storage **3** are connected to each other through a network **5**. The supply chain system **1** is a kind of traceability system, which is a mechanism for identifying the movement of an article **4** to be traced by keeping a record of the article **4**. The article **4** is an actual object such as a product. The article **4** may be one of perishable foods including fruits such as a melon, aquatic products such as a fish, and livestock products such as a meat, or a processed food. Alternatively, the article **4** may be a one-of-a-kind item such as a painting or a jewel or an electronic device such as a game player.

[0046] The supply chain system **1** keeps a record of transactions conducted for the object storage **3** storing the article **4** and a record of opening and fastening of the lock **31** provided for the object storage **3**. As a result, a possibility of a physical action taken on the article **4** stored in the object storage **3** can be detected, and whether an unlawful act has been performed on the article **4** can be determined.

[0047] Server Apparatus **2**

[0048] FIG. **2** is a block diagram illustrating an example of the configuration of the server apparatus **2** illustrated in FIG. **1**. FIG. **3** is a block diagram illustrating an example of the detailed configuration of a management unit **201** illustrated in FIG. **2**. FIG. **4** is a block diagram illustrating the detailed configuration of an authentication unit **202** illustrated in FIG. **2**.

[0049] The server apparatus **2** is achieved by a computer or the like including a memory. As illustrated in FIG. **2**, the server apparatus **2** includes the management unit **201**, the authentication unit **202**, and a communication unit **203** and is connected to the storage device **21**. The server apparatus **2** may be connected to the storage device **21** through the network **5** and include the storage device **21** therein. The storage device **21** stores an electronically recordable ledger **211**.

[0050] Management Unit **201**

[0051] The management unit **201** manages the ledger **211** stored in the storage device **21**. The management unit **201** has a traceability function of tracing a history or a location of the article **4** to be traced. In the present embodiment, the management unit **201** includes a ledger management section **2011** and an article information management section **2012** as illustrated in FIG. **3**. Alternatively, the management unit **201** need not include the article information management section **2012**.

[0052] Ledger Management Section **2011**

[0053] The ledger management section **2011** manages at least the right of ownership of the article **4**, which is an actual object. More specifically, the ledger management section **2011** manages the right of ownership of the article **4** by accumulating the movement of the right of ownership of the article **4** and manages opening and fastening of the lock **31** as a history. After the authentication unit **202** performs an authentication process, which will be described later, the ledger management section **2011** accumulates the movement of the right of ownership of the article **4** as a history by recording users to which the right of ownership of the article **4** has been granted. The ledger management section **2011** may uniquely identify the article **4** stored in the object storage **3** using an identifier for uniquely identifying the article **4** or an identifier for uniquely identifying the object storage **3**.

[0054] In the present embodiment, the ledger management section **2011** manages the ledger **211** and accumulates the movement of the right of ownership of the article **4** as a history by recording, in the ledger **211**, reference to the article **4** and the movement of the right of ownership of the article **4**. If the ledger management section **2011** receives, from a transaction request reception section **2022**, a transaction request for the article **4**, such as a request to register or change the right of ownership of the article **4**, for example, the ledger management section **2011** records the right of ownership of the article **4** or the movement of the right of ownership of the article **4** in the ledger **211**. The ledger management section **2011** may also record article identification information, which is used to identify the article **4**, in the ledger **211**. As described above, the article identification information regarding the article **4** may be the identifier for uniquely identifying the article **4** or the identifier for uniquely identifying the object storage **3**.

[0055] The ledger management section **2011** accumulates opening and fastening of the lock **31** as a history by recording opening and fastening of the lock **31** in the ledger **211**. If the ledger management section **2011** receives a notification from a lock management unit **302** of the object storage **3**, which will be described later, for example, the ledger management section **2011** manages an opening and fastening history of the object storage **3** by accumulating opening or fastening of the lock **31** as a history. The opening and fastening history may be an opening history or a fastening history, instead. The ledger management section **2011** may uniquely identify the lock **31** using an identifier for uniquely identifying the lock **31** or the identifier for uniquely identifying the object storage **3** provided with the lock **31**.

[0056] The ledger management section **2011** thus manages the right of ownership of the article **4** and the opening and fastening history of the lock **31** by keeping records in the ledger **211**. A method used by the ledger management section **2011** to manage the opening and fastening history of the lock **31** is not limited to the above-described method in which the ledger **211** is used. The ledger management section **2011** may manage the opening and fastening history of the lock **31** by recording opening and fastening of the lock **31** in another ledger stored in the storage device **21** or an area of the storage device **21**, instead.

[0057] Although the ledger management section **2011** identifies the article **4** on the basis of the identifier of the object storage **3** by recording the identifier of the object storage **3** storing the article **4** in the ledger **211** in the present

embodiment, the method used by the ledger management section 2011 is not limited to this. For example, the ledger management section 2011 may identify the article 4 and the object storage 3 storing the article 4 by recording the identifier of the article 4 and the identifier of the object storage 3 storing the article 4 in the ledger 211 and managing an association between the article 4 and the object storage 3 storing the article 4. The ledger management section 2011 may also record the dealing of the object storage 3 or transactions for the object storage 3 in the ledger 211.

[0058] Article Information Management Section 2012

[0059] The article information management section 2012 manages article information, which is information regarding the article 4. More specifically, the article information management section 2012 manages the article information regarding the article 4 by recording information regarding the article 4 in an area prepared in the storage device 21 or in the ledger 211. Here, the article information regarding the article 4 is, for example, information indicating that the article 4 is a melon from Hokkaido that weighs 1 kg and that is graded as excellent. That is, the article information regarding the article 4 is information including attributes of the article 4 such as a place of production and quality. The article information management section 2012 may manage the article identification information for identifying the article 4 as part of the article information regarding the article 4. As described above, the article identification information for identifying the article 4 may be the identifier for uniquely identifying the article 4 or the identifier for uniquely identifying the object storage 3.

[0060] Authentication Unit 202

[0061] The authentication unit 202 performs at least the authentication process by which whether user who has issued a transaction request for the article 4 is an authenticated transaction user is determined. In the present embodiment, as illustrated in FIG. 4, the authentication unit 202 includes a transaction user authentication section 2021 and the transaction request reception section 2022. The authentication process is performed when a user has issued a registration request, a change request, an opening request, a fastening request, or the like to the server apparatus 2 through a terminal used or carried thereby. The authentication process may be performed, for example, using a public key infrastructure (PKI) employing a public key and a private key. The terminal may be a personal computer or a mobile terminal such as a tablet or a smartphone. A transaction user will also be simply referred to as a “user” hereinafter.

[0062] Transaction User Authentication Section 2021

[0063] The transaction user authentication section 2021 performs the authentication process for identifying an authenticated transaction user, that is, determines whether a user who has issued a transaction request for the article 4 is an authenticated transaction user. Here, the transaction user, that is, the user, may be a producer of the article 4, a distributor of the article 4, an agent such as a retailer of the article 4, or a purchaser of the article 4. Transactions for the article 4 include preparation for shipment of the article 4, shipment of the article 4, wholesaling of the article 4, selling of the article 4, and purchase of the article 4 and accompany registration or movement of the right of ownership of the article 4 stored in the object storage 3. Transactions for the article 4 may also include opening and fastening of the lock 31 provided for the object storage 3.

[0064] More specifically, if a user issues a request for the article 4 to the server apparatus 2 from the terminal such as a smartphone, the transaction user authentication section 2021 determines whether the user is an authenticated transaction user. In an example, the transaction user authentication section 2021 determines whether a user who has issued a change request to change the right of ownership of the article 4 is a user who has the right of ownership managed by the ledger management section 2011. The user who has the right of ownership is a user who has the right of ownership of the article 4 and who has the right of ownership of the article 4 uniquely identified using the identifier of the object storage 3 storing the article 4. After determining that the user is an authenticated transaction user, the transaction user authentication section 2021 issues a transaction request for the article 4 to the transaction request reception section 2022.

[0065] Transaction Request Reception Section 2022

[0066] If the transaction request reception section 2022 receives a transaction request for the article 4 from the transaction user authentication section 2021, the transaction request reception section 2022 performs a reception process by the transaction request for the article 4 is received. In an example, the transaction request reception section 2022 performs a reception process by which a change request to change the right of ownership of the article 4 is received. The transaction request reception section 2022 transmits the received transaction request for the article 4 to the ledger management section 2011 and a determination unit 301 of the object storage 3, which will be described later.

[0067] Communication Unit 203

[0068] The communication unit 203 is achieved by a processor, a communication interface, and the like and has a function of communicating with the object storage 3 storing the article 4 to be traced. In the present embodiment, the communication unit 203 communicates with a communication unit 303 of the object storage 3, which will be described later, through wired communication such as a wired local area network (LAN) or wireless communication. Technologies for achieving wireless communication include Bluetooth (registered trademark) Low Energy (BLE), low-power wide-area (LPWA), the fourth generation (4G) of mobile communication systems, and the fifth generation (5G) of mobile communication systems.

[0069] Object Storage 3

[0070] FIG. 5 is a diagram conceptually illustrating the appearance of the object storage 3 illustrated in FIG. 1. FIG. 6 is a block diagram illustrating an example of the detailed configuration of the object storage 3 illustrated in FIG. 5.

[0071] As illustrated in FIG. 5, the object storage 3 is a case or a box, for example, and provided with the lock 31 opened and fastened through an electronic process. The object storage 3 is capable of physically storing the article 4, which is an actual object such as a product. The object storage 3 may be a transparent case or an opaque latticed or barred case so that the article 4 can be seen with the lock 31 fastened. It is only required that the object storage 3 be made of a material with which the article 4 can be removed and stored using the lock 31, such as vinyl, corrugated cardboard, plastic, or cloth. It is needless to say that the object storage 3 may be made of iron or aluminum. Any material may be used insofar as the lock 31 can be provided and the article 4 can be removed and stored using the lock 31.

[0072] In the present embodiment, the object storage 3 also includes the determination unit 301, the lock management unit 302, and the communication unit 303 as illustrated in FIG. 6. Alternatively, the object storage 3 need not include the determination unit 301, and the server apparatus 2 may include the determination unit 301, instead.

[0073] Determination Unit 301

[0074] If the determination unit 301 receives an opening request to open the lock 31, the determination unit 301 determines whether a user who has issued the opening request and a user who has the right of ownership managed by the ledger management section 2011 match.

[0075] It is assumed in the present embodiment that the determination unit 301 receives, from the transaction request reception section 2022, an opening request to open the lock 31 provided for the object storage 3 as a transaction request for the article 4. In this case, the determination unit 301 determines whether the user who has issued the opening request has the right of ownership of the article 4 by communicating with the ledger management section 2011. If determining that the user who has issued the opening request has the right of ownership of the article 4, the determination unit 301 issues the request to the lock management unit 302 along with the result of the determination. The result of the determination may be information indicating that the user who has issued the opening request has a right to open the lock 31 or may be information indicating that the user who has issued the opening request is an authenticated transaction user who has a right to open the lock 31.

[0076] The same holds for a case where the determination unit 301 has received a fastening request to fasten the lock 31, and description of this case is omitted.

[0077] Lock Management Unit 302

[0078] The lock management unit 302 can open and fasten the lock 31. The lock management unit 302 notifies the ledger management section 2011 that the lock management unit 302 has opened or fastened the lock 31. If the determination unit 301 determines that a user who has issued an opening request and a user who has the right of ownership managed by the ledger management section 2011 match, for example, the lock management unit 302 opens the lock 31 to allow the article 4 to be removed from the object storage 3. In addition, that is, at the same time, the lock management unit 302 communicates with the ledger management section 2011 to notify the ledger management section 2011 that the lock management unit 302 has opened the lock 31.

[0079] In the present embodiment, if the determination unit 301 determines that the user who has issued the opening request has the right of ownership of the article 4, the lock management unit 302 determines that the user has a right to open the lock 31 and opens the lock 31. At the same time, the lock management unit 302 notifies, through the communication unit 303, the ledger management section 2011 that the lock management unit 302 has opened the lock 31 and causes the ledger management section 2011 to record the opening of the lock 31 in the ledger 211 as a history.

[0080] Communication Unit 303

[0081] The communication unit 303 is achieved by a processor, a communication interface, and the like and has a function of communicating with the server apparatus 2. In the present embodiment, the communication unit 303 communicates with the communication unit 203 of the server

apparatus 2, for example, through wireless communication. The technologies for achieving wireless communication are as described above.

[0082] Operation of Supply Chain System 1

[0083] The operation of the supply chain system 1 configured as above will be described hereinafter.

[0084] FIG. 7 is a diagram conceptually illustrating the operation of the supply chain system 1 according to the present embodiment. FIG. 8 is a diagram illustrating transaction users, the right of ownership, and opening histories, and the like with respect to the article 4 in a situation illustrated in FIG. 7. In FIGS. 7 and 8, the article 4 is assumed to be a melon. In FIG. 8, a case is illustrated in which the identifier of the object storage 3 is recorded in the ledger 211 as the article identification information, which is used to identify the article 4.

[0085] First, a producer of the melon harvests the melon and prepares for shipment of the melon. More specifically, as illustrated in FIG. 7(a), the producer of the melon stores the article 4, which is the melon, in the object storage 3. The producer then conducts, using the supply chain system 1, a transaction for, as indicated by situation 1 illustrated in FIG. 8 corresponding to FIG. 7(a), registering the producer as a transaction user and a person who has the right of ownership, the melon as article information regarding the article 4, and the identifier of the object storage 3 as the article identification information. The producer then conducts, using the supply chain system 1, a transaction for fastening the lock 31 provided for the object storage 3 storing the article 4. Since the producer of the melon has stored the article 4 in the object storage 3 for shipment and has not opened the lock 31 in situation 1 illustrated in FIG. 8, there is no opening history.

[0086] Next, the producer of the melon ships the melon. More specifically, as illustrated in FIG. 7(b), the producer of the melon conducts a transaction for shipping the article 4 stored in the object storage 3 to an agent such as a broker or a retailer. The producer then conducts, using the supply chain system 1, a transaction for, as indicated by situation 2 illustrated in FIG. 8 corresponding to FIG. 7(b), changing the transaction user and the person who has the right of ownership to the agent. Since the producer of the melon and the agent have only distributed the article 4 stored in the object storage 3 and have not opened the lock 31 in situation 2 illustrated in FIG. 8, there is no opening history.

[0087] Next, the agent sells the melon to a user, that is, a purchaser. More specifically, as illustrated in FIG. 7(c), the purchaser conducts a transaction for purchasing the article 4 stored in the object storage 3 from the agent. The agent then conducts, using the supply chain system 1, a transaction for, as indicated by situation 3 illustrated in FIG. 8 corresponding to FIG. 7(c), changing the transaction user and the person who has the right of ownership to the purchaser. The purchaser can check the opening history using the supply chain system 1 before and after purchasing the article 4 stored in the object storage 3. As a result, the purchaser can understand that no unlawful act has been performed on the article 4 shipped by the producer, and safely purchase or consume the article 4.

[0088] Next, the purchaser removes the article 4, which is the melon, from the object storage 3 and consumes the article 4. More specifically, the purchaser conducts, using the supply chain system 1, a transaction for, as indicated by situation 4 illustrated in FIG. 8 corresponding to FIG. 7(d),

opening the lock 31 provided for the object storage 3 storing the article 4. The purchaser then removes the article 4, which is the melon, from the object storage 3 and consumes the article 4. Since the purchaser has opened the lock 31 provided for the object storage 3 in situation 4 illustrated in FIG. 8, an opening history is recorded in the ledger 211.

[0089] FIG. 9 is a flowchart illustrating an example of a characteristic operation performed by the supply chain system 1 according to the present embodiment. FIG. 9 illustrates a process for opening the lock 31 using the supply chain system 1.

[0090] First, a computer of the supply chain system 1 determines whether there has been an opening request to open the lock 31 provided for the object storage 3 (S11).

[0091] If there has been an opening request to open the lock 31 in step S11 (YES in S11), the computer of the supply chain system 1 determines whether a user who has issued the request and a transaction user who has the right of ownership match (S12). As illustrated in FIG. 7(c), for example, the user who is a purchaser issues, to the supply chain system 1, the opening request provided for the object storage 3 using a terminal or the like. In this case, the computer of the supply chain system 1 determines that there has been an opening request, and then determines whether the user who is the purchaser and the transaction user who has the right of ownership match.

[0092] If the user who has issued the opening request and the transaction user who has the right of ownership match in step S12 (YES in S12), the supply chain system 1 opens the lock 31 provided for the object storage 3. The supply chain system 1 then records an opening history of the lock 31 in the ledger 211 (S14).

[0093] In the present embodiment, the lock management unit 302 included in the object storage 3 receives a result indicating that the user who has issued the opening request and the transaction user who has the right of ownership match. The lock management unit 302 then opens the lock 31 provided for the object storage 3 and notifies the server apparatus 2 of the opening. The server apparatus 2 records an opening history of the lock 31 in the ledger 211.

[0094] If there has been no opening request in step S11 (NO in S11), the computer of the supply chain system 1 returns to step S11 and repeats the operation. Similarly, if the user who has issued the opening request and the transaction user who has the right of ownership do not match in step S12 (NO in S12), the computer of the supply chain system 1 returns to step S11 and repeats the operation.

[0095] Next, the detailed operation of the supply chain system 1 according to the present embodiment will be described.

[0096] FIGS. 10A and 10B are sequence diagrams illustrating an example of the operation of the supply chain system 1 according to the present embodiment. FIG. 10A illustrates situation 1, where the producer harvests the article 4 and prepares for shipment, and situation 2, where the producer ships the article 4 to the agent. FIG. 10B illustrates situation 3, where the agent sells the article 4 to the purchaser, and situation 4, where the purchaser purchases the article 4 and opens the lock 31 provided for the object storage 3 storing the article 4.

[0097] First, situation 1 will be described.

[0098] The producer harvests the article 4 and stores the article 4 in the object storage 3. The producer then logs in the supply chain system 1 using a terminal or the like and issues

a registration request to register the producer as a transaction user and a person who has the right of ownership, the melon as article information regarding the article 4, and the identifier of the object storage 3 as the article identification information regarding the article 4 and a fastening request to fasten the lock 31 provided for the object storage 3.

[0099] Thereafter, first, the transaction user authentication section 2021 performs, in the supply chain system 1, an authentication process by which whether the producer is an authenticated transaction user is determined (S101). If the transaction user authentication section 2021 determines in step S101 that the producer is an authenticated transaction user, the transaction request reception section 2022 performs a reception process by which the registration request is received (S102). Next, the transaction request reception section 2022 transmits the registration request to the ledger management section 2011 and the article information management section 2012 and the fastening request to the determination unit 301.

[0100] Next, upon receiving the registration request, the ledger management section 2011 performs recording of the right of ownership, by which information indicating that the producer has the right of ownership of the article 4 is recorded in the ledger 211 (S103). Upon receiving the registration request, the article information management section 2012 performs registration of article information, by which information indicating that the article 4 is a melon and information indicating that the article identification information regarding the article 4 is the identification of the object storage 3 are recorded in the ledger 211 (S104). Steps S103 and S104 may be performed in any order. Although the article 4 is identified using the identifier of the object storage 3 in the following description, the identifier used is not limited to this. The article 4 may be identified using the identifier of the article 4, instead. In this case, information indicating the identifier of the article 4 is recorded as the article identification information regarding the article 4.

[0101] Next, upon receiving the fastening request, the determination unit 301 performs a determination process, in which the determination unit 301 communicates with the ledger management section 2011 and determines whether the producer who has issued the fastening request has the right of ownership of the article 4 (S105). If determining in step S105 that the producer who has issued the fastening request has the right of ownership of the article 4, the determination unit 301 transmits the fastening request to the lock management unit 302 along with the result of the determination.

[0102] Next, upon receiving the fastening request and the result of the determination, the lock management unit 302 determines that the producer has a right to fasten the lock 31, and performs a fastening process, by which the lock 31 is fastened (S106). At the same time, the lock management unit 302 notifies, through the communication unit 303, the ledger management section 2011 that the lock 31 has been fastened. That is, the ledger management section 2011 performs recording of a fastening history, by which the fastening of the lock 31 is recorded in the ledger 211 as a history (S107).

[0103] Next, situation 2 will be described.

[0104] After completing the preparation for shipment, the producer ships the object storage 3 storing the article 4 to the agent. At this time, the producer logs in the supply chain system 1 using a terminal or the like and issues a change

request to change the transaction user and the person who has the right of ownership from the producer to the agent.

[0105] Thereafter, first, the transaction user authentication section 2021 performs, in the supply chain system 1, an authentication process by which whether the producer is an authenticated transaction user is determined (S108). If the transaction user authentication section 2021 determines in step S108 that the producer is an authenticated transaction user, the transaction request reception section 2022 performs a reception process by which the change request is received (S109). Next, the transaction request reception section 2022 transmits the change request to the ledger management section 2011.

[0106] Next, upon receiving the change request, the ledger management section 2011 performs recording of the movement of the right of ownership, by which information indicating that the agent has the right of ownership of the article 4 is recorded in the ledger 211 (S110).

[0107] Next, situation 3 will be described.

[0108] The agent sells the object storage 3 storing the article 4 to a user who is a purchaser. At this time, the agent logs in the supply chain system 1 using a terminal or the like and issues a change request to change the transaction user and the person who has the right of ownership from the agent to the user who is the purchaser.

[0109] Thereafter, first, the transaction user authentication section 2021 performs, in the supply chain system 1, an authentication process by which whether the agent is an authenticated transaction user is determined (S111). If the transaction user authentication section 2021 determines in step S111 that the agent is an authenticated transaction user, the transaction request reception section 2022 performs a reception process by which the change request is received (S112). Next, the transaction request reception section 2022 transmits the change request to the ledger management section 2011.

[0110] Next, upon receiving the change request, the ledger management section 2011 performs recording of the movement of the right of ownership, by which information indicating that the purchaser has the right of ownership of the article 4 is recorded in the ledger 211 (S113).

[0111] Lastly, a sequence in situation 4 will be described.

[0112] The purchaser removes the article 4, which is the melon, from the object storage 3 and consumes the article 4. At this time, the purchaser logs in the supply chain system 1 and issues an opening request to open the lock 31 provided for the object storage 3 storing the article 4. Thereafter, first, the transaction user authentication section 2021 performs, in the supply chain system 1, an authentication process by which whether the purchaser is an authenticated transaction user is determined (S114). If the transaction user authentication section 2021 determines in step S114 that the purchaser is an authenticated transaction user, the transaction request reception section 2022 performs a reception process by which the opening request is received (S115). Next, the transaction request reception section 2022 transmits the opening request to the determination unit 301.

[0113] Next, upon receiving the opening request, the determination unit 301 performs a determination process, in which the determination unit 301 communicates with the ledger management section 2011 and determines whether the purchaser who has issued the opening request has the right of ownership of the article 4 (S116). If determining in step S116 that the purchaser who has issued the opening

request has the right of ownership of the article 4, the determination unit 301 transmits the opening request to the lock management unit 302 along with the result of the determination.

[0114] Next, upon receiving the opening request and the result of the determination, the lock management unit 302 determines that the purchaser has a right to open the lock 31, and performs an opening process, by which the lock 31 is opened (S117). At the same time, the lock management unit 302 notifies, through the communication unit 303, the ledger management section 2011 that the lock 31 has been opened. The ledger management section 2011 performs recording of an opening history, by which the opening of the lock 31 is recorded in the ledger 211 as a history (S118).

Advantageous Effects

[0115] As described above, since the article 4 stored in the object storage 3 physically locked by the lock 31 is distributed in the supply chain system 1 according to the present embodiment, it can be seen that the article 4 stored in the object storage 3 has not been tampered with when the lock 31 provided for the object storage 3 has not been opened. That is, whether an unlawful act has been performed on the article 4 can be determined. With the supply chain system 1 according to the present embodiment, therefore, unlawful acts performed on the article 4, such as false labeling of a place of production, can be suppressed, and cost efficiency can be achieved because there is no need to dispose of articles whose places of production have been falsely labeled.

[0116] In addition, in the supply chain system 1 according to the present embodiment, opening and fastening of the lock 31, which is opened and closed through an electronic process, are accumulated as histories. As a result, whether the lock 31 of the object storage 3 storing the article 4 has been opened during distribution can be determined. When the lock 31 has not been opened at all until a user who consumes or uses the article 4 opens the lock 31 and removes the article 4, therefore, it can be seen that the article 4 stored in the object storage 3 has not been tampered with. Consequently, whether an unlawful act has been performed on the article 4 can be determined more accurately.

[0117] As described above, the object storage 3 included in the supply chain system 1 according to the present embodiment may be a transparent case or an opaque latticed or barred case. As a result, the article 4 can be checked with the lock 31 provided for the object storage 3 fastened, and whether an unlawful act has been performed on the article 4, such as whether the article 4 stored in the object storage 3 has been tampered with, can be determined more easily.

[0118] First Modification

[0119] Although only one ledger 211 is used in the above embodiment for the convenience of description, the number of ledgers 211 is not limited to this. Distributed ledgers including a plurality of ledgers 211 of the same content may be used, or distributed ledgers including a plurality of ledgers 211 of the same content constructed on a blockchain platform may be used, instead. This case will be described hereinafter as a first modification. Differences from the above embodiment will be mainly described.

[0120] Server Apparatuses

[0121] FIG. 11 is a diagram illustrating an example of the configuration of server apparatuses 2 according to the first

modification. The same components are given the same reference numerals, and detailed description thereof is omitted.

[0122] The server apparatuses **2** illustrated in FIG. **11** include a plurality of server apparatuses **2A**, **2B**, . . . , and **2N**. The plurality of server apparatuses **2A**, **2B**, . . . , and **2N** are connected to one another through a network **5** and connected to storage devices **21A**, **21B**, . . . , and **21N**. The storage devices **21A**, **21B**, . . . , and **21N** each include a ledger **211** of the same content.

[0123] It is assumed in the present modification that a management unit **201** of one of the plurality of server apparatuses **2A**, **2B**, . . . , and **2N** has performed recording in the ledger **211** stored in the storage device connected to the server apparatus. In this case, the management units **201** of the other apparatuses record, in the ledgers **211** stored in the storage devices **21A**, **21B**, . . . , and **21N**, the same content as that recorded in the ledger **211** stored in the foregoing storage device. The ledgers **211** may be constructed on a blockchain platform.

[0124] The configuration of the plurality of server apparatuses **2A**, **2B**, . . . , and **2N** is the same as that according to the above embodiment described with reference to FIGS. **2** to **4**, and description thereof is omitted. The plurality of server apparatuses **2A**, **2B**, . . . , and **2N** may be achieved by personal computers or cloud computers.

[0125] The appearance and configuration of the object storage **3** are as described in the above embodiment, and description thereof is omitted.

[0126] Operation of Supply Chain System **1** According to First Modification

[0127] FIG. **12** is a diagram conceptually illustrating the operation of a supply chain system **1** according to the first modification. The same components as those illustrated in FIG. **7** are given the same reference numerals, and detailed description thereof is omitted.

[0128] In FIG. **12(a)**, the producer illustrated in FIG. **7(a)** is represented as a producer **A**. The agent illustrated in FIG. **7(b)** is represented as a broker **B** and a retailer **C** in FIGS. **12(b)** and **12(b)**, respectively. The purchaser illustrated in FIG. **7(c)** is represented as a purchaser **D** in FIG. **12(d)**. FIG. **12** is the same as FIG. **7** except that the terms used are different and there are a plurality of agents, and description thereof is omitted.

[0129] FIGS. **13A** and **13B** are sequence diagrams illustrating an example of the operation of the supply chain system **1** according to the first modification. The same components as those illustrated in FIGS. **10A** and **10B** are given the same reference numerals, and detailed description thereof is omitted.

[0130] FIG. **13A** illustrates situation **11**, where the producer **A** harvests the article **4** and prepares for shipment, situation **12**, where the producer **A** ships the article **4** to the broker **B**, and situation **13**, where the broker **B** wholesales the article **4** to the retailer **C**. FIG. **13B** illustrates situation **14**, where the retailer **C** sales the article **4** to the purchaser **D** who is the user, and situation **15**, where the purchaser **D** opens the lock **31** of the object storage **3** storing the article **4** after purchasing the article **4**. That is, the agent illustrated in FIGS. **10A** and **10B** corresponds to the broker **B** and the retailer **C** illustrated in FIG. **13A**, and is described as the retailer **C** in FIG. **13B**. In addition, steps **S108** to **S110** are described as steps **S108A** to **S110A** and steps **S108B** to **S110B** for the broker **B** and the retailer **C**. Aside from these,

FIGS. **13A** and **13B** are the same as FIGS. **10A** and **10B** are the same, and description thereof is omitted.

[0131] Data in Ledger **211**

[0132] Now, an example of a data structure when the ledger **211** is constructed on a blockchain platform will be described.

[0133] FIGS. **14A** to **14D** are diagrams conceptually illustrating an example of the structure of data recorded in a ledger **211** according to the first modification. A melon **F** is an example of the article **4**.

[0134] FIG. **14A** illustrates an example of the structure of data recorded in the ledger **211** in the situation illustrated in FIG. **12(a)**, that is, after the preparation for shipment illustrated in FIG. **13A**. More specifically, FIG. **14A** illustrates a case in which data indicating that the producer **A** has produced a rank **XX** melon **F**, stored the melon **F** in the object storage **3** with the lock **31**, and fastened the lock **31** and has a right to open the lock **31** of the object storage **3** is recorded and accumulated chronologically in this order.

[0135] FIG. **14B** illustrates an example of the structure of data recorded in the ledger **211** in the situation illustrated in FIG. **12(b)**, that is, after the shipment illustrated in FIG. **13A**. More specifically, FIG. **14B** illustrates a case in which data indicating that the right to open the lock **31** of the object storage **3** has moved to the broker **B** is recorded and accumulated after the data illustrated in FIG. **14A**.

[0136] Similarly, FIG. **14C** illustrates an example of the structure of data recorded in the ledger **211** in the situation illustrated in FIG. **12(c)**, that is, after the wholesaling to the retailer **C** illustrated in FIG. **13A**. More specifically, FIG. **14C** illustrates a case in which data indicating that the right to open the lock **31** of the object storage **3** has moved to the retailer **C** is recorded and accumulated after the data illustrated in FIG. **14B**.

[0137] FIG. **14D** illustrates an example of the structure of data recorded in the ledger **211** in the situation illustrated in FIG. **12D**, that is, after the selling to the purchaser **D** and the opening of the lock **31** illustrated in FIG. **13B**. More specifically, FIG. **14D** illustrates a case in which data indicating that the right to open the lock **31** of the object storage **3** has moved to the purchaser **D** is recorded and accumulated after the data illustrated in FIG. **14B**.

[0138] FIG. **15** is a diagram conceptually illustrating another example of the structure of data recorded in the ledger **211** according to the first modification. FIG. **15** illustrates data that chronologically indicates transaction users, the article **4** to be dealt with, that is, the article **4** to be traced, and transactions and that is recorded and accumulated in the ledger **211**.

[0139] In FIG. **15**, data indicating that the transaction user is the producer **A**, the article **4** is the melon **F**, and the transaction is registration of the object storage **3** is recorded in a first row. This corresponds to the data recorded in the ledger **211** in the situation illustrated in FIG. **12(a)**, that is, after the preparation for shipment illustrated in FIG. **13A**.

[0140] In FIG. **15**, data indicating that the transaction user is the producer **A**, the article **4** is the melon **F**, and the transaction is movement of the right of ownership to the broker **B** is recorded in a second row. This corresponds to the data recorded in the ledger **211** in the situation illustrated in FIG. **12(b)**, that is, after the shipment illustrated in FIG. **13A**. In FIG. **15**, data indicating that the transaction user is the broker **B**, the article **4** is the melon **F**, and the transaction is movement of the right of ownership to the retailer **C** is

recorded in a third row. This corresponds to the data recorded in the ledger **211** in the situation illustrated in FIG. **12(c)**, that is, after the wholesaling to the retailer C illustrated in FIG. **13A**.

[0141] In FIG. **15**, data indicating that the transaction user is the retailer C, the article **4** is the melon F, and the transaction is movement of the right of ownership to the purchaser D is recorded in a fourth row. This corresponds to the data recorded in the ledger **211** in the situation illustrated in FIG. **12(d)**, that is, after the selling to the purchaser D illustrated in FIG. **13B**.

[0142] In FIG. **15**, data indicating that the transaction user is the purchaser D, the article **4** is the melon F, and the transaction is opening of the lock **31** of the object storage **3** is recorded in a fifth row. This corresponds to the data recorded in the ledger **211** in the situation illustrated in FIG. **12(d)**, that is, after the purchaser D illustrated in FIG. **13B** opens the lock **31**.

Advantageous Effects

[0143] As described above, with the supply chain system **1** according to the present modification, the ledger management section **2011** may manage the right of ownership of the article **4** by accumulating, as histories, the movement of the right of ownership of the article **4** in distributed ledgers including a plurality of ledgers **211** of the same content constructed on a blockchain platform, and manage opening and fastening of the lock **31** as histories. As a result, since the identical ledgers **211** are distributed in the supply chain system **1** according to the present modification, it becomes more difficult to alter the ledgers **211**. As a result, the reliability of the content recorded in the ledger **211** improves, and whether an unlawful act has been performed on the article **4** can be determined more accurately.

[0144] Second Modification

[0145] Although the object storage **3** includes the determination unit **301** in the embodiment and the first modification, the location of the determination unit **301** is not limited to this. A server apparatus may include the determination unit **301**, instead. This case will be described hereinafter as a second modification, and differences from the embodiment and the first modification will be mainly described.

[0146] Configuration of Supply Chain System 1A

[0147] FIG. **16** is a diagram illustrating an example of the configuration of a supply chain system **1A** according to the second modification. The same components as those illustrated in FIG. **1** and other drawings are given the same reference numerals, and detailed description thereof is omitted. As illustrated in FIG. **16**, the supply chain system **1A** includes a server apparatus **20** connected to the storage device **21** and an object storage **3A** provided with the lock **31**. The server apparatus **20** and the object storage **3A** are connected to each other through the network **5**.

[0148] The supply chain system **1A** illustrated in FIG. **16** is different from the supply chain system **1** illustrated in FIG. **1** in terms of the configuration of the server apparatus **20** and the functional configuration of the object storage **3A**. In addition, in the present modification, a user can open the lock **31** through near-field communication where a mobile terminal **6** comes into contact or becomes close to the lock **31** provided for the object storage **3A**. Other elements are the same as those described above, and description thereof is omitted.

[0149] Mobile Terminal 6

[0150] The mobile terminal **6** includes a processor and a memory and is capable of wirelessly communicating with the server apparatus **20** and performing near-field communication with the lock **31** provided for the object storage **3A**. The mobile terminal **6** is, for example, a tablet, a smart-phone, or the like.

[0151] The mobile terminal **6** logs in the supply chain system **1A**, that is, communicates with the server apparatus **20**, through a user operation. More specifically, the mobile terminal **6** logs in the supply chain system **1A** through a user operation and issues a registration request to register the right of ownership of the article **4** stored in the object storage **3A**, a change request to change the right of ownership, a fastening request to fasten the lock **31** of the object storage **3A**, or an opening request to open the lock **31** of the object storage **3A**. In the present modification, the mobile terminal **6** obtains an identifier of the object storage **3A** and issues an opening request to open the lock **31** of the object storage **3A** when in contact with or close to the lock **31** through a user operation. In response to the opening request, the mobile terminal **6** obtains an electronic key capable of opening the lock **31** along with a result of a determination that the lock **31** may be opened. Alternatively, a terminal different from the mobile terminal **6** may issue the opening request, and the mobile terminal **6** may obtain, in response to the opening request, the opening request and the result of the determination. In any case, the mobile terminal **6** can open the lock **31** by transmitting a result of a determination and the like obtained when in contact with or close to the lock **31** through a user operation.

[0152] Server Apparatus 20

[0153] FIG. **17** is a block diagram illustrating an example of the configuration of the server apparatus **2A** illustrated in FIG. **16**. The same components as those illustrated in FIGS. **2** and **6** and other drawings are given the same reference numerals, and detailed description thereof is omitted.

[0154] The server apparatus **20** is different from the server apparatus **2** illustrated in FIG. **2** in that the server apparatus **20** further includes the determination unit **301**.

[0155] In the present modification, the determination unit **301** receives an opening request to open the lock **31** from the mobile terminal **6** through the network **5**. As described above, upon receiving the opening request to open the lock **31**, the determination unit **301** determines whether a user who has issued the opening request and a user who has the right of ownership managed by the ledger management section **2011** match. If determining that the user who has issued the opening request has the right of ownership of the article **4**, the determination unit **301** may transmit an electronic key capable of opening the lock **31** to the mobile terminal **6** along with the result of the determination.

[0156] Alternatively, as in the above embodiment, the determination unit **301** may transmit the opening request and the result of the determination to the lock management unit **302**.

[0157] Object Storage 3A

[0158] FIG. **18** is a block diagram illustrating an example of the detailed configuration of the object storage **3A** illustrated in FIG. **16**. The same component as that illustrated in FIG. **6** and other drawings is given the same reference numeral, and detailed description thereof is omitted.

[0159] The object storage **3A** is different from the object storage **3** illustrated in FIG. **6** in that the object storage **3A**

does not include the determination unit **301**. The lock management unit **302** is different from that according to the embodiment in that the lock management unit **302** can perform near-field communication as wireless communication.

[0160] As described above, if the determination unit **301** determines that a user who has issued an opening request and a user who has the right of ownership managed by the ledger management section **2011** match, the lock management unit **302** may open the lock **31** to allow the article **4** to be removed from the object storage **3A**. In the present modification, the lock management unit **302** performs near-field communication with the mobile terminal **6** when the mobile terminal **6** is in contact with or close to the lock **31**. Upon receiving a result of the determination that the lock **31** may be opened and an electronic key capable of opening the lock **31** or the result of the determination and the opening request, the lock management unit **302** opens the lock **31** to allow the object storage **3A** to be removed from the article **4**.

[0161] As in the above embodiment, the lock management unit **302** opens the lock **31** and communicates with the ledger management section **2011** to notify the ledger management section **2011** that the lock **31** has been opened.

Advantageous Effects

[0162] As described above, with the supply chain system **1A** according to the present modification, the object storage **3A** storing the article **4** is physically locked and distributed. When the lock **31** has not been opened, therefore, it can be seen that the article **4** stored in the object storage **3A** has not been tampered with. That is, whether an unlawful act has been performed on the article **4** can be determined. With the supply chain system **1A** according to the present modification, therefore, unlawful acts performed on the article **4**, such as false labeling of a place of production, can be suppressed, and cost efficiency can be achieved because there is no need to dispose of articles whose places of production have been falsely labeled.

[0163] In addition, in the supply chain system **1A** according to the present modification, opening and fastening of the lock **31**, which is opened and closed through an electronic process, are accumulated as histories. As a result, whether the lock **31** of the object storage **3A** storing the article **4** has been opened during distribution can be determined. When the lock **31** has not been opened at all until a user who consumes or uses the article **4** opens the lock **31** and removes the article **4**, therefore, it can be seen that the article **4** stored in the object storage **3A** has not been tampered with. Consequently, whether an unlawful act has been performed on the article **4** can be determined more accurately.

[0164] Third Modification

[0165] Although the object storage **3** or **3A** is provided with the lock **31** and stores the article **4** in the above embodiment and the first and second modifications, the configuration of the object storage **3** or **3A** is not limited to this. The object storage **3** or **3A** may further include a sensor and continuously or regularly detect a storage state of the article **4**.

[0166] That is, the object storage **3** or **3A** may further include a sensor for detecting the storage state of the article **4** and notify, through wireless communication, the ledger management section **2011** of information indicating the storage state of the article **4** detected by the sensor. In this

case, the ledger management section **2011** manages storage state histories of the article **4** by accumulating, as histories, information indicating the storage state of the article **4** transmitted from the object storage **3** or **3A**. The sensor may be a sensor that detects the humidity, temperature, air pressure, or the like of the object storage **3** or **3A** or may be a sensor that measures a shock given to the object storage **3** or **3A**. Alternatively, the sensor may be a sensor that measures the sugar content of the article **4** stored in the object storage **3** or **3A**, or may be a sensor obtained by combining some of the above-mentioned sensors. Any sensor may be used insofar as the sensor can detect the storage state of the article **4**.

[0167] The information indicating the storage state may be, for example, information indicating presence or absence of the article **4**. In this case, it can be seen that the article **4** is certainly stored in the object storage **3** or **3A**. As a result, even when the object storage **3** or **3A** is an opaque case, whether an unlawful act has been performed on the article **4**, such as whether the article **4** has been tampered with, can be determined more easily.

[0168] If the article **4** is a food or the like and spoils over time, the information indicating the storage state may be information indicating quality. In this case, the quality of the article **4** can be checked as the storage state of the article **4**, and whether the article **4** stored in the object storage **3** or **3A** has spoiled can be determined. As a result, the supply chain system **1** or the like also achieves a function of tracing quality.

[0169] In addition, when the article **4** is easily deformable, the information indicating the storage state may be information indicating presence or absence of a change in shape. In this case, presence or absence of the shape of the article **4** can be checked as the storage state of the article **4**, and whether the article **4** stored in the object storage **3** or **3A** has spoiled can be determined. As a result, the supply chain system **1** or the like also achieves a function of tracing quality.

OTHER POSSIBLE EMBODIMENTS

[0170] Although the supply chain system and the like in the present disclosure have been described on the basis of the embodiment, a component or an apparatus that performs each process is not particularly limited. A processor or the like (described later) incorporated into a certain locally provided apparatus may perform each process, instead. Alternatively, a cloud server provided in a place different from a place where a local apparatus is provided may perform each process.

[0171] The present disclosure is not limited to the above embodiment. For example, another embodiment obtained by combining the components described herein with one another in any manner or excluding some of the above-described components may be established as an embodiment of the present disclosure. In addition, modifications obtained by modifying the above embodiment in various ways conceivable by those skilled in the art without deviating from the spirit of the present disclosure, that is, the meaning indicated by the text described in the claims, are also included in the present disclosure.

[0172] The present disclosure also includes the following cases.

[0173] (1) Each of the above-described apparatuses is specifically a computer system including a microprocessor,

a read-only memory (ROM), a random-access memory (RAM), a hard disk unit, a display unit, a keyboard, and a mouse. The RAM or the hard disk unit stores a computer program. When the microprocessor operates in accordance with the computer program, each apparatus achieves the functions thereof. The computer program is obtained by combining a plurality of instruction codes for issuing commands to a computer in order to achieve certain functions.

[0174] (2) Some or all of each of the components of the above-described apparatuses may be achieved by a single system large-scale integration (LSI) circuit. The system LSI circuit is a super-multifunctional LSI circuit fabricated by integrating a plurality of components on a single chip and is specifically a computer system including a microprocessor, a ROM, and a RAM. The RAM stores the computer program. When the microprocessor operates in accordance with the computer program, the system LSI achieves functions thereof.

[0175] (3) Some or all of the components of each of the above-described apparatuses may be achieved by an integrated circuit (IC) card or a separate module removably attached to the apparatus. The IC card or the module is a computer system including a microprocessor, a ROM, and a RAM. The IC card or the module may include the super-multifunctional LSI. When the microprocessor operates in accordance with the computer program, the IC card or the module achieves functions thereof. The IC card or the module may be tamper-resistant.

[0176] (4) The present disclosure may be one of the above-described methods. The present disclosure may be a computer program that achieves one of these methods using a computer, or may be a digital signal including the computer program.

[0177] (5) The present disclosure may be a computer-readable recording medium storing the computer program or the digital signal, such as a flexible disk, a hard disk, a compact disc read-only memory (CD-ROM), a magneto-optical (MO) disk, a digital versatile disc (DVD), a DVD-ROM, a DVD-RAM, a Blu-ray disc (BD; registered trademark), or a semiconductor memory. The present disclosure may be the digital signal stored in the recording medium.

[0178] The present disclosure may be the computer program or the digital signal transmitted through an electrical communication line, a wireless or wired communication line, a network typified by the Internet, datacasting, or the like.

[0179] The present disclosure may be a computer system including a microprocessor and a memory. The memory may store the computer program, and the microprocessor may operate in accordance with the computer program.

[0180] The present disclosure may be implemented by another independent computer system by recording the program or the digital signal on the recording medium and transporting the recording medium or by transporting the program or the digital signal through the network or the like.

[0181] The present disclosure can be used in a supply chain system or the like for tracing distributed products, especially in a supply chain system or the like for tracing distributed products in order to detect unlawful acts such as false labeling of places of productions of foods and imitations of paintings and the like.

What is claimed is:

1. A supply chain system, comprising:
 - a server that manages at least a right of ownership of an article, the article being an actual object;
 - a container that is provided with a lock, the lock being configured to at least open through an electronic process, the container being capable of physically storing the article; and
 - at least one of a processor or a circuit that, when an opening request to open the lock is received, determines whether a user who has issued the opening request and a user who has the right of ownership of the article match,
 wherein, when the user who has issued the opening request and the user who has the right of ownership of the article match, the lock is opened for allowing the article to be removed from the container, and the server is notified that the lock has been opened.
2. The supply chain system according to claim 1, wherein the container notifies, through wireless communication, the server that the lock has been opened, and wherein, upon receiving a notification, the server manages an opening history of the lock by adding an opening of the lock to the opening history.
3. The supply chain system according to claim 1, wherein the server, when a change request to change the right of ownership of the article is received, performs an authentication process to determine whether a user who has issued the change request is the user who has the right of ownership, wherein the server manages the right of ownership of the article by accumulating change of the right of ownership of the article as a history, and wherein, after the server performs the authentication process, the server accumulates the change of the right of ownership of the article as the history by recording a user to which the right of ownership of the article has been granted.
4. The supply chain system according to claim 1, wherein the container is a transparent case, an opaque latticed case, or a barred case.
5. The supply chain system according to claim 1, wherein the container includes a sensor for detecting a storage state of the article, wherein the container wirelessly transmits, to the server, information indicating the storage state of the article detected by the sensor, and wherein the server manages a storage state history of the article by accumulating the information indicating the storage state of the article transmitted from the container.
6. The supply chain system according to claim 1, wherein the server manages the right of ownership of the article by accumulating, as a history, change of the right of ownership of the article in distributed ledgers including a plurality of ledgers of same content constructed on a blockchain platform and manages the opening or the fastening of the lock as a history.
7. The supply chain system according to claim 1, wherein the lock is configured to open and fasten.
8. The supply chain system according to claim 6, wherein the container notifies, through wireless communication, the server that the lock has been opened or fastened, and

wherein, upon receiving a notification, the server manages an opening and fastening history of the lock by adding an opening or a fastening of the lock to the opening and fastening history.

9. The supply chain system according to claim 6, further comprising:

a lock manager configured to open and fasten the lock.

10. The supply chain system according to claim 9, wherein the lock manager is configured to perform near-field communication as wireless communication.

11. The supply chain system according to claim 10, wherein the container includes the lock manager.

12. The supply chain system according to claim 1, wherein the container includes the at least one of the processor or the circuit.

13. The supply chain system according to claim 1, wherein the server includes the at least one of the processor or the circuit.

14. A non-transitory computer-readable recording medium storing a program that, when executed by a computer, causes the computer to perform operations comprising:

managing at least a right of ownership of an article, the article being an actual object;

opening a lock of a container through an electronic process, the container being capable of physically storing the article; and

determining, when an opening request to open the lock is received, whether a user who has issued the opening request and a user who has the right of ownership match,

wherein, in the determining, when the user who has issued the opening request and the user who has the right of ownership managed match, the lock is opened for allowing the article to be removed from the container, and a notification regarding an opening of the lock is issued.

15. A method, comprising:

managing, by a server, at least a right of ownership of an article, the article being an actual object;

opening a lock of a container through an electronic process, the container being capable of physically storing the article; and

determining, by at least one of a processor or a circuit when an opening request to open the lock is received, whether a user who has issued the opening request and a user who has the right of ownership match,

wherein, in the determining, when the user who has issued the opening request and the user who has the right of ownership managed match, the lock is opened for allowing the article to be removed from the container, and a notification regarding an opening of the lock is issued.

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