



(51) International Patent Classification:
G05B 23/02 (2006.01)

(21) International Application Number:
PCT/JP2024/009770

(22) International Filing Date:
13 March 2024 (13.03.2024)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
2023-042094 16 March 2023 (16.03.2023) JP

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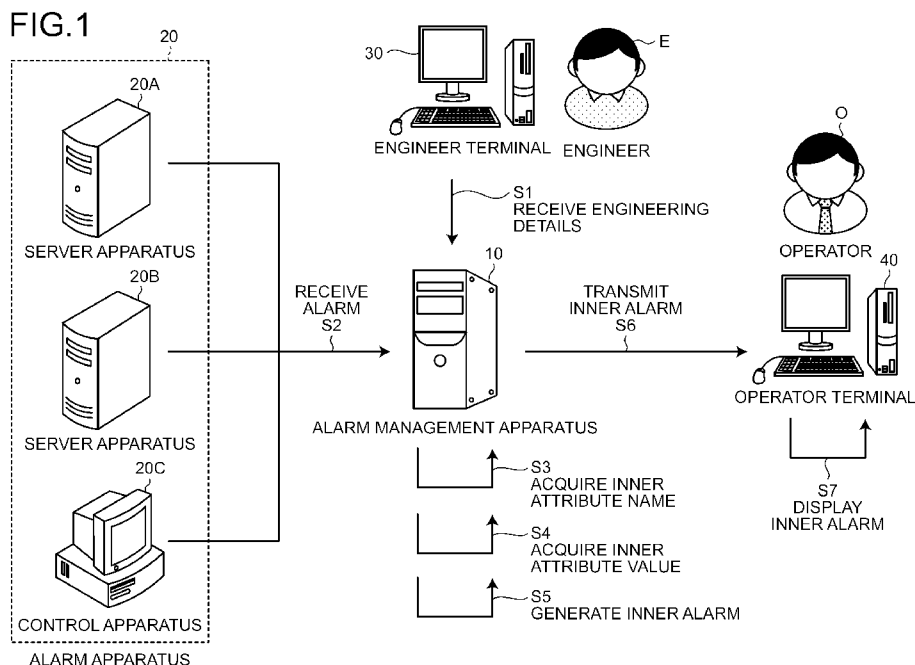
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(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CV, CZ, DE, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IQ, IR, IS, IT, JM, JO, KE, KG, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, MG, MK, MN, MU, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, WS, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, CV,

(54) Title: MANAGEMENT APPARATUS, MANAGEMENT METHOD, AND MANAGEMENT PROGRAM



(57) Abstract: An alarm management apparatus (10) stores therein, for each type of an alarm apparatus (20) that outputs a message, each of attributes of messages that indicate same or similar contents and an inner attribute that indicates the same or similar contents in an associated manner, and when receiving a message from the alarm apparatus (20), acquires the inner attribute that is associated with an attribute included in the received message from a storage unit, generates an inner message in which the attribute of the message is converted to the inner attribute, and outputs the inner message.

GH, GM, KE, LR, LS, MW, MZ, NA, RW, SC, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, ME, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Published:

— *with international search report (Art. 21(3))*

Description

Title of Invention: MANAGEMENT APPARATUS, MANAGEMENT METHOD, AND MANAGEMENT PROGRAM

Technical Field

[0001] The embodiment discussed herein is related to a management apparatus, a management method, and a management program.

Background Art

[0002] In a plant control system, migration to Open Platform Communications Unified Architecture (OPC UA) that serves as a standard is accelerated; however, in existing systems, OPC Classic is still frequently used and mixed environments in which a plurality of standards are mixed are increasing. Further, environments in which OPC UA servers of a plurality of vendors coexist are increasing.

Citation List

Patent Literature

[0003] PTL 1: Japanese Laid-open Patent Publication No. 2022-177415

Summary of Invention

Technical Problem

[0004] In the mixed environments as described above, attributes of various kinds of messages that are generated in a plant control system are uniquely defined by respective vendors, and therefore, it is difficult for an operator or the like of the plant control system to promptly recognize details of the messages. In the mixed environments as described above, vendor defined attributes, such as "importance", "Alarm-Priority", and "Priority", are defined using unique names with respect to alarm attributes of the same meaning, so that if all of the alarm attributes are to be displayed, alarm data increases and it becomes difficult to compare attribute values among alarms.

[0005] The present invention has been conceived in view of the foregoing situation, and an object of the present invention is to efficiently output a message that is generated in a mixed environment in which a plurality of vendors are present.

Solution to Problem

[0006] According to an aspect of the embodiments, a management apparatus includes a storage unit that stores therein, for each type of an apparatus that outputs a message, each of attributes of messages that indicate same or similar contents and an inner attribute that indicates the same or similar contents in an associated manner, and a generating unit that, when receiving a message from the apparatus, acquires the inner

attribute that is associated with an attribute included in the received message from the storage unit, generates an inner message in which the attribute of the message is converted to the inner attribute, and outputs the inner message.

[0007] According to an aspect of the embodiments, a management method implemented by a computer, the management method includes storing, for each type of an apparatus that outputs a message, each of attributes of messages that indicate same or similar contents and an inner attribute that indicates the same or similar contents in an associated manner, acquiring, when receiving a message from the apparatus, the inner attribute that is associated with an attribute included in the received message, generating an inner message in which the attribute of the message is converted to the inner attribute, and outputting the inner message.

[0008] According to an aspect of the embodiments, a management program that causes a computer to execute a process includes storing, for each type of an apparatus that outputs a message, each of attributes of messages that indicate same or similar contents and an inner attribute that indicates the same or similar contents in an associated manner, acquiring, when receiving a message from the apparatus, the inner attribute that is associated with an attribute included in the received message, generating an inner message in which the attribute of the message is converted to the inner attribute, and outputting the inner message.

Advantageous Effects of Invention

[0009] According to the present invention, it is possible to efficiently output a message that is generated in a mixed environment in which a plurality of venders are present.

Brief Description of Drawings

[0010] [Fig.1]Fig. 1 is a diagram illustrating a configuration example and a processing example of an alarm management system according to one embodiment.

[Fig.2]Fig. 2 is a block diagram illustrating a configuration example of each of apparatuses in the alarm management system according to one embodiment.

[Fig.3]Fig. 3 is a diagram illustrating an attribute name storage unit of the alarm management apparatus according to one embodiment.

[Fig.4]Fig. 4 is a diagram illustrating an attribute value storage unit of the alarm management apparatus according to one embodiment.

[Fig.5]Fig. 5 is a diagram illustrating an inner alarm storage unit of the alarm management apparatus according to one embodiment.

[Fig.6]Fig. 6 is a diagram illustrating a specific example of an alarm attribute unifying process according to one embodiment.

[Fig.7]Fig. 7 is a flowchart illustrating an example of the entire flow of the alarm management system according to one embodiment.

[Fig.8]Fig. 8 is a flowchart illustrating an example of the flow of an engineering details reception process performed by the alarm management system according to one embodiment.

[Fig.9]Fig. 9 is a flowchart illustrating an example of the entire flow of an alarm attribute unifying process performed by the alarm management system according to one embodiment.

[Fig.10]Fig. 10 is a flowchart illustrating an example of the entire flow of an alarm notifying process performed by the alarm management system according to one embodiment.

[Fig.11]Fig. 11 is a diagram illustrating a hardware configuration example according to one embodiment.

Description of Embodiments

[0011] One embodiment of a management apparatus, a management method, and a management program according to the present invention will be described in detail below with reference to the drawings. The present invention is not limited by the embodiment described below.

[0012] A configuration and a process of an alarm management system 100 according to one embodiment, a configuration and a process of each of apparatuses of the alarm management system 100, and the flow of a process performed by the alarm management system 100 will be described in sequence, and effects of the embodiment will be lastly described.

[0013] 1. Configuration and process of alarm management system 100

A configuration and a process of the alarm management system 100 according to one embodiment will be described in detail below with reference to FIG. 1. FIG. 1 is a diagram illustrating a configuration example and a processing example of the alarm management system 100 according to one embodiment. In the following, a configuration example of the entire alarm management system 100, a processing example of the alarm management system 100, and problems with an alarm management system 100P according to a reference technology will be described in sequence, and effects of the alarm management system 100 will be lastly described. Meanwhile, in the embodiment, factory production remote monitoring using a plant apparatus that is a device installed in a plant will be described as one example; however, devices and fields of use are not specifically limited, and the technology is applicable to environmental measurement remote monitoring, such as a power monitor, wind-power generation, a water and sewage monitor, or river monitoring.

[0014] 1-1. Configuration example of entire alarm management system 100

The alarm management system 100 includes an alarm management apparatus 10,

alarm apparatus 20 (a server apparatus 20A, a server apparatus 20B, and a control apparatus 20C), an engineer terminal 30, and an operator terminal 40. The alarm management apparatus 10, the alarm apparatus 20, the engineer terminal 30, and the operator terminal 40 are communicably connected to one another via a predetermined communication network (network) (not illustrated) in a wired or wireless manner. Meanwhile, various kinds of communication networks, such as the Internet or a dedicated line, may be adopted as the predetermined communication network.

[0015] The alarm apparatus 20 will be described below. The alarm apparatus 20 are apparatuses that have alarm detection functions and detect an alarm that indicates an abnormality of a plant or a plant apparatus based on a sensor value, a process value, or the like in the plant. Here, the server apparatus 20A among the alarm apparatus 20 is an OPC US server. Further, the server apparatus 20B among the alarm apparatus 20 is an OPC A&E server. Furthermore, the control apparatus 20C among the alarm apparatus 20 is a controller that constitutes a distributed control system (DCS).

[0016] Moreover, the engineer terminal 30 is a terminal that is used by an engineer E who manages the alarm management apparatus 10. Furthermore, the operator terminal 40 is a terminal that is used by an operator O who manages the plant. Meanwhile, the alarm management system 100 illustrated in FIG. 1 may include the plurality of alarm management apparatuses 10, the plurality of engineer terminals 30, or the plurality of operator terminals 40.

[0017] 1-2. Example of entire process performed by alarm management system 100

An entire process performed by the alarm management system 100 as described above will be described below. Meanwhile, processes from S1 to S7 below may be performed in different order. Further, some of the processes from S1 to S7 may be omitted.

[0018] 1-2-1. Engineering details reception process

Firstly, the alarm management apparatus 10 receives engineering details (S1). For example, the alarm management apparatus 10 receives a definition of an apparatus in the plant (hereinafter, appropriately referred to as an "apparatus definition") from the engineer terminal 30, and stores therein the definition. Further, the alarm management apparatus 10 receives a definition of an attribute name (hereinafter, appropriately referred to as an "attribute name definition" or an "attribute name mapping definition") of an alarm that corresponds to an apparatus in the plant, and stores therein the definition. Furthermore, the alarm management apparatus 10 receives a definition of an attribute value (hereinafter, appropriately referred to as an "attribute value definition" or an "attribute value mapping definition") of an alarm that corresponds to an apparatus in the plant, and stores therein the definition.

[0019] Here, the apparatus definition is information that indicates a type of the alarm

apparatus 20 included in a plant control system of the plant, and is, for example, information that includes a vender name and an apparatus type of each of the alarm apparatus 20, such as {server apparatus 20A: vender A (OPC UA server), server apparatus 20B: vender B (OPC A&E server), control apparatus 20C: vender C (CENTUM FCS)}.

[0020] Further, the attribute name mapping definition is information in which an alarm attribute name that is defined for each of the alarm apparatus 20 and an inner attribute name for displaying the attribute name in a unified manner are associated with each other, and is, for example, information that includes an inner attribute name for each of the alarm attribute names of the alarm apparatus 20, such as {attribute name of server apparatus 20A: "importance", inner attribute name: "Priority"}, {attribute name of server apparatus 20B: "AlarmPriority", inner attribute name: "Priority"}, or {attribute name of control apparatus 20C: "Priority", inner attribute name: "Priority"}.

[0021] Furthermore, the attribute value mapping definition is information in which an alarm attribute value that is defined for each of the alarm apparatus 20 and an inner attribute value for displaying the attribute value in a unified manner are associated with each other, and is, for example, information that includes an inner attribute value for each of the alarm attribute values of the alarm apparatus 20, such as {attribute value of server apparatus 20A: "critical alarm", inner attribute value: "High"}, {attribute value of server apparatus 20B: "High", inner attribute value: "High"}, or {attribute value of control apparatus 20C: "M", inner attribute value: "Medium"}.

[0022] In the engineering details reception process as described above, the alarm management apparatus 10 may receive, from the engineer terminal 30, a definition of an alarm attribute type (hereinafter, appropriately referred to as an "attribute type definition" or an "attribute type mapping definition") that corresponds to an apparatus in the plant. Here, the attribute type mapping definition is information in which an alarm attribute type (for example, "String") that is defined for the alarm apparatus 20 and an inner attribute type for displaying the attribute name in a unified manner are associated with each other, and is information that includes an inner attribute type for each of the alarm attribute types of the alarm apparatus 20.

[0023] 1-2-2. Alarm reception process

Secondly, the alarm management apparatus 10 receives an alarm (S2). For example, the alarm management apparatus 10 receives, from the server apparatus 20A, an alarm A of {source: "EQP_A", message: "EQP_A HH", importance: "critical alarm"}. Further, the alarm management apparatus 10 receives, from the server apparatus 20B, an alarm B of {source: "EQP_B", message: "EQP_B HI", Alarm-Priority: "High"}. Furthermore, the alarm management apparatus 10 receives, from the control apparatus 20C, an alarm C of {source: "EQP_C", message: "EQP_C HI",

Priority: "M"}.

[0024] 1-2-3. Inner attribute name acquisition process

Thirdly, the alarm management apparatus 10 acquires an inner attribute name (S3). For example, the alarm management apparatus 10 acquires an inner attribute name of "Priority" that corresponds to the attribute name of "importance" of the alarm A received from the server apparatus 20A, by referring to the stored attribute name mapping definition. Further, the alarm management apparatus 10 acquires the inner attribute name of "Priority" that corresponds to the attribute name of "AlarmPriority" of the alarm B received from the server apparatus 20B, by referring to the stored attribute name mapping definition. Furthermore, the alarm management apparatus 10 acquires an inner attribute name of "Priority" that corresponds to the attribute name of "Priority" of the alarm C received from the control apparatus 20C, by referring to the stored attribute name mapping definition.

[0025] In the inner attribute name acquisition process as described above, the alarm management apparatus 10 may acquire an inner attribute type that corresponds to the alarm attribute type (for example, "String") received from the alarm apparatus 20, by referring to the stored attribute type mapping definition.

[0026] 1-2-4. Inner attribute value acquisition process

Fourthly, the alarm management apparatus 10 acquires an inner attribute value (S4). For example, the alarm management apparatus 10 acquires an inner attribute value of "High" that corresponds to the attribute value of "critical alarm" of the alarm A received from the server apparatus 20A, by referring to the stored attribute value mapping definition. Further, the alarm management apparatus 10 acquires an inner attribute value of "High" that corresponds to the attribute value of "High" of the alarm B received from the server apparatus 20B, by referring to the stored attribute value mapping definition. Furthermore, the alarm management apparatus 10 acquires an inner attribute value of "Medium" that corresponds to the attribute value of "M" of the alarm C received from the control apparatus 20C, by referring to the stored attribute value mapping definition.

[0027] 1-2-5. Inner alarm generation process

Fifthly, the alarm management apparatus 10 generates an inner alarm (S5). For example, the alarm management apparatus 10 generates an inner alarm A' in which the attribute name and the attribute value are unified by converting the attribute name of "importance" of the alarm A received from the server apparatus 20A to an inner attribute name of "Priority" and converting the attribute value of "critical alarm" of the alarm A received from the server apparatus 20A to the inner attribute value of "High", and stores the inner alarm A'. Further, the alarm management apparatus 10 generates an inner alarm B' in which the attribute name and the attribute value are unified by

converting the attribute name of "AlarmPriority" of the alarm B received from the server apparatus 20B to the inner attribute name of "Priority" and converting the attribute value of "High" of the alarm B received from the server apparatus 20B to the inner attribute value of "High", and stores the inner alarm B'. Furthermore, the alarm management apparatus 10 generates an inner alarm C' in which the attribute name and the attribute value are unified by converting the attribute name of "Priority" of the alarm C received from the control apparatus 20C to the inner attribute name of "Priority" and converting the attribute value of "M" of the alarm C received from the control apparatus 20C to the inner attribute value of "Medium", and stores the inner alarm C'.

[0028] 1-2-6. Inner alarm transmission process

Sixthly, the alarm management apparatus 10 transmits the inner alarm (S6). For example, the alarm management apparatus 10 transmits the generated inner alarm A', the generated inner alarm B', and the generated inner alarm C' to the operator terminal 40.

[0029] 1-2-7. Inner alarm display process

Seventhly, the operator terminal 40 controls display of the inner alarm (S7). For example, the operator terminal 40 controls display of the inner alarm A', the inner alarm B', and the inner alarm C', which are received from the alarm management apparatus 10, on a monitor.

[0030] 1-3. Effects of alarm management system 100

A background of the alarm management system 100P according to the reference technology and an overview and a problem with the alarm management system 100P will be described first below, and thereafter, effects of the alarm management system 100 will be described.

[0031] 1-3-1. Background of alarm management system 100P

In the alarm management system 100P, migration to OPC UA that serves as a standard has been started; however, in existing systems, OPC Classic is still frequently used and mixed environments in which a plurality of standards are mixed are increasing. Further, environments in which OPC UA servers of a plurality of vendors coexist are increasing. Therefore, in the alarm management system 100P, there is a need for normalization of the mixed environments as described above.

[0032] Specifically, in the alarm management system 100P, there is a need to unify display of alarm attributes with respect to facilities based on OPC UA and OPC Classic of a plurality of vendors. Further, in the alarm management system 100P, there is a need to unify display of the alarm attributes because vendor defined attributes are defined using unique names with respect to alarm attributes of the same meaning for each of third parties.

[0033] 1-3-2. Problem with alarm management system 100P

In the alarm management system 100P, in the mixed environments as described above, attributes of various kinds of messages that are generated in a plant control system are uniquely defined by respective vendors, and therefore, it is difficult for an operator or the like of the plant control system to promptly recognize details of the messages. For example, in the alarm management system 100P, in the mixed environments as described above, vendor defined attributes, such as "importance", "Alarm-Priority", and "Priority", are defined using unique names with respect to alarm attributes of the same meaning, so that if all of the alarm attributes are to be displayed, alarm data increases and it becomes difficult to compare attribute values among alarms.

[0034] 1-3-3. Overview of alarm management system 100

Firstly, the alarm management apparatus 10 receives engineering details (the apparatus definition, the attribute name mapping definition, the attribute value mapping definition, and the like) from the engineer terminal 30. Secondly, the alarm management apparatus 10 receives alarms from the alarm apparatus 20. Thirdly, the alarm management apparatus 10 acquires an inner attribute name that is stored at the time of engineering. Fourthly, the alarm management apparatus 10 acquires an inner attribute value that is stored at the time of engineering. Fifthly, the alarm management apparatus 10 generates an inner alarm by converting the alarm attribute name to the inner attribute name and converting the alarm attribute value to the inner attribute value. Sixthly, the alarm management apparatus 10 transmits the generated inner alarm to the operator terminal 40. Seventhly, the operator terminal 40 controls display of the inner alarm that is received from the alarm management apparatus 10.

[0035] 1-3-4. Effects of alarm management system 100

Effects of the alarm management system 100 will be described below. The alarm management system 100 has a mapping rule setting function to receive engineering details (the apparatus definition, the attribute name mapping definition, the attribute value mapping definition, and the like) at the time of engineering, and has an inner attribute function to generate an inner alarm based on the above-described engineering details at runtime, so that it is possible to commonly handle alarms independent of types of interfaces and servers. Therefore, with use of the inner attribute, the alarm management system 100 is able to reduce alarm data and easily compare attribute values among alarms.

[0036] Further, in the alarm management system 100, host-host binding or a Collaborative Information (CI) server serves as an OPC UA server, and when information is to be provided to a higher-level apparatus, it is satisfactory to transmit only a value of the inner attribute value. Therefore, the alarm management system 100 is able to reduce

an amount of information transmitted from a lower-level apparatus to a higher-level apparatus, so that it is possible to improve performance.

[0037] 2. Configuration and process of each of apparatuses in alarm management system 100

A configuration and a process of the alarm management apparatus 10 included in the alarm management system 100 illustrated in FIG. 1 will be described below with reference to FIG. 2. FIG. 2 is a block diagram illustrating a configuration example of each of the apparatuses included in the alarm management system 100 according to one embodiment. In the following, a configuration example of the entire alarm management system 100 according to one embodiment will be described first, and thereafter, a configuration example and a processing example of the alarm management apparatus 10, a configuration example and a processing example of the alarm apparatus 20, a configuration example and a processing example of the engineer terminal 30, and a configuration example and a processing example of the operator terminal 40 will be described in detail below.

[0038] 2-1. Configuration example of entire alarm management system 100

A configuration example of the entire alarm management system 100 illustrated in FIG. 1 will be described below with reference to FIG. 2. As illustrated in FIG. 2, the alarm management system 100 includes the alarm management apparatus 10, the alarm apparatus 20, the engineer terminal 30, and the operator terminal 40. The alarm management apparatus 10 is communicably connected to the alarm apparatus 20, the engineer terminal 30, and the operator terminal 40 by a communication network N that is realized by the Internet, a dedicated line, or the like.

[0039] 2-2. Configuration example and processing example of alarm management apparatus 10

A configuration example and a processing example of the alarm management apparatus 10 that is a management apparatus will be described below with reference to FIG. 2. The alarm management apparatus 10 includes a communication unit 11, a storage unit 12, and a control unit 13. Meanwhile, the alarm management apparatus 10 may include an input unit (for example, a keyboard, a mouse, or the like) that receives various kinds of operation from the engineer E or the like who is an administrator of the alarm management apparatus 10, or a display unit (for example, a liquid crystal display or the like) for displaying various kinds of information.

[0040] 2-2-1. Communication unit 11

The communication unit 11 controls data communication with a different apparatus. For example, the communication unit 11 performs data communication with each of communication apparatuses via a router or the like. Further, the communication unit 11 is able to perform data communication with an operator terminal (not

illustrated).

[0041] 2-2-2. Storage unit 12

The storage unit 12 stores therein various kinds of information that are referred to by the control unit 13 at the time of operation, and various kinds of information that are acquired by the control unit 13 at the time of operation. The storage unit 12 includes an attribute name storage unit 12a, an attribute value storage unit 12b, and an inner alarm storage unit 12c. Here, the storage unit 12 may be implemented by, for example, a semiconductor memory device, such as a Random Access Memory (RAM) or a flash memory, or a storage apparatus, such as a hard disk or an optical disk. Meanwhile, in the example illustrated in FIG. 2, the storage unit 12 is installed inside the alarm management apparatus 10, but the storage unit 12 may be installed outside the alarm management apparatus 10 or a plurality of storage units may be installed.

[0042] The storage unit 12 stores therein, for each type of an apparatus that outputs a message, each of attributes of messages that indicate the same or similar contents and an inner attribute that indicates the same or similar content, in an associated manner. For example, the storage unit 12 stores therein each of alarm attributes, which are set by each of venders for each of vender apparatuses that collect alarms that are output from each of devices included in the system, and an inner attribute, which unifies the alarm attributes that are set by the respective venders, in an associated manner. Further, the storage unit 12 stores therein, for each type of the apparatus, each of attribute names as each of the attributes and an inner attribute name as the inner attribute in an associated manner. Furthermore, the storage unit 12 stores therein, for each type of the apparatus, each of attribute values as each of the attributes and an inner attribute value as the inner attribute in an associated manner. Moreover, the storage unit 12 may store therein, for each type of the apparatus, each of attribute types as each of the attributes and an inner attribute type as the inner attribute in an associated manner.

[0043] Furthermore, for example, the message as described above is an alarm that indicates an abnormality of one of the system and a device that is included in the system. Specifically, the message as described above is an alarm that indicates an abnormality of one of a plant control system that controls a plant and a plant apparatus that is included in the plant control system. Moreover, the apparatuses as described above are compliant with OPC UA or OPC Classic.

[0044] 2-2-2-1. Attribute name storage unit 12a

The attribute name storage unit 12a stores therein the attribute name definition (attribute name mapping definition) that is received by a reception unit 13a of the control unit 13 to be described later. An example of data that is stored in the attribute name storage unit 12a will be described below with reference to FIG. 3. FIG. 3 is a

diagram illustrating an example of the attribute name storage unit 12a of the alarm management apparatus 10 according to one embodiment. In the example illustrated in FIG. 3, the attribute name storage unit 12a stores therein items of a "source", an "attribute name", an "inner attribute name", and an "attribute type".

[0045] The "source" indicates identification information for identifying the alarm apparatus 20, e.g., an identification number or an identification symbol of the alarm apparatus 20. The "attribute name" indicates a name of an attribute that is included in an alarm of the alarm apparatus 20. The "inner attribute name" indicates a name of a converted alarm that is associated with the alarm apparatus 20. The "attribute type" indicates how to manage alarm data of the alarm apparatus 20.

[0046] Specifically, FIG. 3 illustrates an example in which the attribute name storage unit 12a stores therein data of {attribute name: "importance", inner attribute name: "Priority", attribute type: "String"} for the alarm apparatus 20 (the server apparatus 20A) that is identified by "EQP_A", data of {attribute name: "AlarmPriority", inner attribute name: "Priority", attribute type: "String"} for the alarm apparatus 20 (the server apparatus 20B) that is identified by "EQP_B", and data of {attribute name: "Priority", inner attribute name: "Priority", attribute type: "String"} for the alarm apparatus 20 (the control apparatus 20C) that is identified by "EQP_C".

[0047] 2-2-2-2. Attribute value storage unit 12b

The attribute value storage unit 12b stores therein the attribute value definition (attribute value mapping definition) that is received by the reception unit 13a of the control unit 13 to be described later. An example of data that is stored in the attribute value storage unit 12b will be described below with reference to FIG. 4. FIG. 4 is a diagram illustrating an example of the attribute value storage unit 12b of the alarm management apparatus 10 according to one embodiment. In the example illustrated in FIG. 4, the attribute value storage unit 12b stores therein items of a "source", an "attribute value", and an "inner attribute value".

[0048] The "source" indicates identification information for identifying the alarm apparatus 20, and is, for example, an identification number or an identification symbol of the alarm apparatus 20. The "attribute value" indicates a state value that corresponds to an attribute of an alarm of the alarm apparatus 20 that are apparatuses. The "inner attribute value" indicates a state value that corresponds to a converted attribute that is associated with each of the alarm apparatus 20 that are apparatuses.

[0049] Specifically, FIG. 4 illustrates an example in which the attribute value storage unit 12b stores therein data of {attribute value: "critical alarm", inner attribute value: "High"} for the alarm apparatus 20 (the server apparatus 20A) that is identified by "EQP_A", data of {attribute value: "High", inner attribute value: "High"} for the alarm apparatus 20 (the server apparatus 20B) that is identified by "EQP_B", and data of

{attribute value: "M", inner attribute value: "Medium"} for the alarm apparatus 20 (the control apparatus 20C) that is identified by "EQP_C".

[0050] 2-2-2-3. Inner alarm storage unit 12c

The inner alarm storage unit 12c stores therein an inner alarm that is generated by a generating unit 13c of the control unit 13 to be described later. An example of data that is stored in the inner alarm storage unit 12c will be described below with reference to FIG. 5. FIG. 5 is a diagram illustrating an example of the inner alarm storage unit 12c of the alarm management apparatus 10 according to one embodiment. In the example illustrated in FIG. 5, the inner alarm storage unit 12c stores therein items of a "source", a "message", and "Priority".

[0051] The "source" indicates identification information for identifying the alarm apparatus 20 that are apparatuses, and is, for example, an identification number or an identification symbol of each of the alarm apparatus 20. The "message" indicates an alarm message that is included in an alarm of the alarm apparatus 20 that are apparatuses and that is received by a receiving unit 13b. The "Priority" indicates a state value that corresponds to a name of a converted attribute that is associated with each of the alarm apparatus 20 that are apparatuses.

[0052] Specifically, FIG. 5 illustrates an example in which the inner alarm storage unit 12c stores therein data of {message: "EQP_A HH", Priority: "High"} for the server apparatus 20A as the alarm apparatus 20 that is identified by "EQP_A", data of {message: "EQP_B HI", Priority: "High"} for the server apparatus 20B as the alarm apparatus 20 that is identified by "EQP_B", and data of {message: "EQP_C HI", Priority: "Medium"} for the control apparatus 20C as the alarm apparatus 20 that is identified by "EQP_C".

[0053] 2-2-3. Control unit 13

The control unit 13 controls the entire alarm management apparatus 10. The control unit 13 includes the reception unit 13a, the receiving unit 13b, the generating unit 13c, and a transmitting unit 13d. The control unit 13 is implemented by, for example, an electronic circuit, such as a Central Processing Unit (CPU) or a Micro Processing Unit (MPU), or an integrated circuit, such as an Application Specific Integrated Circuit (ASIC) or a Field Programmable Gate Array (FPGA).

[0054] 2-2-3-1. Reception unit 13a

The reception unit 13a receives various kinds of information. Meanwhile, the reception unit 13a may store various kinds of the received information in the storage unit 12. For example, the reception unit 13a receives the engineering details from the engineer terminal 30. In the following, an apparatus definition reception process, an attribute name definition reception process, and an attribute value definition reception process will be described in this order.

[0055] Apparatus definition reception process

The reception unit 13a receives the apparatus definition as the engineering details. For example, the reception unit 13a receives the apparatus definition that is information indicating a type of the alarm apparatus 20 included in the plant control system of the plant and that includes a vender name and an apparatus type of the alarm apparatus 20 set by the engineer E.

[0056] As explanation of a specific example, the reception unit 13a receives an apparatus definition of, for example, {server apparatus 20A: vender A (OPC UA server), server apparatus 20B: vender B (OPC A&E server), control apparatus 20C: vender C (CENTUM FCS)}, or the like that is input in an engineering details setting screen of the engineer terminal 30.

[0057] Attribute name definition reception process

The reception unit 13a receives the attribute name definition (attribute name mapping definition) as the engineering details. For example, the reception unit 13a receives the attribute name definition that is information in which the alarm attribute name that is defined for each of the alarm apparatus 20 and an inner attribute name for displaying the attribute names in a unified manner are associated with each other, and that includes an inner attribute name for each of the alarm attribute names of the alarm apparatus 20 set by the engineer E, and stores the attribute name definition in the attribute name storage unit 12a.

[0058] As explanation of a specific example, the reception unit 13a receives an attribute name definition of, for example, {attribute name of server apparatus 20A: "importance", inner attribute name: "Priority"}, {attribute name of server apparatus 20B: "AlarmPriority", inner attribute name: "Priority"}, {attribute name of control apparatus 20C: "Priority", inner attribute name: "Priority"}, or the like that is input in the engineering details setting screen of the engineer terminal 30.

[0059] At this time, the reception unit 13a may receive the attribute type definition (attribute type mapping definition) as the engineering details. For example, the reception unit 13a may receive the attribute type definition that is information in which the alarm attribute type (for example "String") that is defined for the alarm apparatus 20 and an inner attribute type for displaying the attribute names in a unified manner are associated with each other, and that includes an inner attribute type for each of alarm attribute types of the alarm apparatus 20 set by the engineer E.

[0060] Attribute value definition reception process

The reception unit 13a receives an attribute value definition (attribute value mapping definition) as the engineering details. For example, the reception unit 13a receives an attribute value definition that is information in which an alarm attribute value that is defined for the alarm apparatus 20 and an inner attribute value for displaying the

attribute values in a unified manner are associated with each other, and that includes an inner attribute value for each of the alarm attribute values of the alarm apparatus 20 set by the engineer E, and stores the attribute value definition in the attribute value storage unit 12b.

[0061] As explanation of a specific example, the reception unit 13a receives an attribute value definition of, for example, {attribute value of server apparatus 20A: "critical alarm", inner attribute value: "High"}, {attribute value of server apparatus 20B: "High", inner attribute value: "High"}, {attribute value of control apparatus 20C: "M", inner attribute value: "Medium"}, or the like that is input in the engineering details setting screen of the engineer terminal 30.

[0062] 2-2-3-2. Receiving unit 13b

The receiving unit 13b receives various kinds of information. Meanwhile, the receiving unit 13b may store various kinds of the received information in the storage unit 12. For example, the receiving unit 13b receives alarms from the alarm apparatus 20 that have alarm detection functions.

[0063] As explanation of a specific example, the receiving unit 13b receives an alarm A of {source: "EQP_A", message: "EQP_A HH", importance: "critical alarm"} that is transmitted by the server apparatus 20A as the OPC UA server among the alarm apparatus 20. Further, the receiving unit 13b receives an alarm B of {source: "EQP_B", message: "EQP_B HI", AlarmPriority: "High"} that is transmitted by the server apparatus 20B as the OPC A&E server among the alarm apparatus 20. Furthermore, the receiving unit 13b receives an alarm C of {source: "EQP_C", message: "EQP_C HI", Priority: "M"} that is transmitted by the control apparatus 20C as a controller included in the DCS among the alarm apparatus 20.

[0064] 2-2-3-3. Generating unit 13c

The generating unit 13c generates various kinds of information. Meanwhile, the generating unit 13c acquires various kinds of information that are received by the receiving unit 13b. Further, the generating unit 13c acquires various kinds of information that are stored in the storage unit 12. Furthermore, the generating unit 13c stores various kinds of the generated information in the storage unit 12. For example, when receiving a message from the apparatus, the generating unit 13c acquires an inner attribute that is associated with an attribute included in the received message from the storage unit 12, generates an inner message by converting the attribute of the message to the inner attribute, and outputs the inner message. Further, when receiving an alarm from any of vender apparatuses among the vender apparatuses, the generating unit 13c generates an inner message by converting an attribute of the received alarm to the inner attribute and outputs the inner message. In the following, an inner attribute name acquisition process, an inner attribute type acquisition process, an inner attribute value

acquisition process, and an inner alarm generation process will be described in this order.

[0065] Inner attribute name acquisition process

The generating unit 13c acquires an inner attribute name. For example, when receiving an alarm message from the alarm apparatus 20 that is an apparatus, the generating unit 13c acquires, from the attribute name storage unit 12a, an inner attribute name associated with an attribute name included in the received alarm message.

[0066] As explanation of a specific example, the generating unit 13c acquires an inner attribute name of "Priority" that is associated with the attribute name of "importance" of the alarm A received from the server apparatus 20A, by referring to the attribute name definition that is stored in the attribute name storage unit 12a. Further, the generating unit 13c acquires the inner attribute name of "Priority" that is associated with the attribute name of "AlarmPriority" of the alarm B received from the server apparatus 20B, by referring to the attribute name definition that is stored in the attribute name storage unit 12a. Further, the generating unit 13c acquires the inner attribute name of "Priority" that is associated with the attribute name of "Priority" of the alarm C received from the control apparatus 20C, by referring to the attribute name definition that is stored in the attribute name storage unit 12a.

[0067] Inner attribute type acquisition process

The generating unit 13c acquires an inner attribute type. For example, when receiving an alarm message from the alarm apparatus 20 that is an apparatus, the generating unit 13c acquires, from the storage unit 12, an inner attribute type that is associated with an attribute type included in the received alarm message.

[0068] Inner attribute value acquisition process

The generating unit 13c acquires an inner attribute value. For example, when receiving an alarm message from the alarm apparatus 20 that is an apparatus, the generating unit 13c acquires, from the attribute value storage unit 12b, an inner attribute value that is associated with the attribute value included in the received alarm message.

[0069] As explanation of a specific example, the generating unit 13c acquires the inner attribute value of "High" that is associated with the attribute value of "critical alarm" of the alarm A received from the server apparatus 20A, by referring to the attribute value definition that is stored in the attribute value storage unit 12b. Further, the generating unit 13c acquires the inner attribute value of "High" that is associated with the attribute value of "High" of the alarm B received from the server apparatus 20B, by referring to the attribute value definition that is stored in the attribute value storage unit 12b. Furthermore, the generating unit 13c acquires the inner attribute value of "Medium" that is associated with the attribute value of "M" of the alarm C received

from the control apparatus 20C, by referring to the attribute value definition that is stored in the attribute value storage unit 12b.

[0070] Inner attribute value acquisition process

The generating unit 13c generates an inner alarm. For example, the generating unit 13c generates an inner alarm that is an inner message in which the attribute name of the alarm message is converted to the inner attribute name, and outputs the inner alarm. Further, the generating unit 13c generates an inner alarm that is an inner message in which the attribute type of the alarm message is converted to the inner attribute type, and outputs the inner alarm. Furthermore, the generating unit 13c generates an inner alarm that is an inner message in which the attribute value of the alarm message is converted to the inner attribute value, and outputs the inner alarm.

[0071] As explanation of a specific example, the generating unit 13c generates the inner alarm A' in which the attribute name and the attribute value are unified by converting the attribute name of "importance" of the alarm A received from the server apparatus 20A to the inner attribute name of "Priority" and converting the attribute value of "critical alarm" of the alarm A received from the server apparatus 20A to the inner attribute value of "High", and stores the inner alarm A' in the inner alarm storage unit 12c. Further, the generating unit 13c generates the inner alarm B' in which the attribute name and the attribute value are unified by converting the attribute name of "AlarmPriority" of the alarm B received from the server apparatus 20B to the inner attribute name of "Priority" and converting the attribute value of "High" of the alarm B received from the server apparatus 20B to the inner attribute value of "High", and stores the inner alarm B' in the inner alarm storage unit 12c. Furthermore, the generating unit 13c generates the inner alarm C' in which the attribute name and the attribute value are unified by converting the attribute name of "Priority" of the alarm C received from the control apparatus 20C to the inner attribute name of "Priority" and converting the attribute value of "M" of the alarm C received from the control apparatus 20C to the inner attribute value of "Medium", and stores the inner alarm C' in the inner alarm storage unit 12c.

[0072] 2-2-3-4. Transmitting unit 13d

The transmitting unit 13d transmits various kinds of information. For example, the alarm management apparatus 10 acquires the inner alarm from the inner alarm storage unit 12c and transmits the acquired inner alarm to the operator terminal 40.

[0073] As explanation of a specific example, the transmitting unit 13d transmits, to the operator terminal 40, the inner alarm A' of {source: "EQP_A", message: "EQP_A HH", Priority: "High"}, the inner alarm B' of {source: "EQP_B", message: "EQP_B HI", Priority: "High"}, and the inner alarm C' of {source: "EQP_C", message: "EQP_C HI", Priority: "Medium"} that are generated by the generating unit 13c.

[0074] 2-3. Specific example of alarm attribute unifying process performed by alarm management system 100

A specific example of data related to an alarm attribute unifying process performed by the alarm management system 100 according to one embodiment will be described below with reference to FIG. 6. In the following, a non-unified alarm, the attribute name definition, an attribute name unified alarm, the attribute value definition, an attribute name and attribute value unified alarm will be described in this order.

[0075] 2-3-1. Non-unified alarm

FIG. 6(1) illustrates an example of non-unified alarms that the alarm management apparatus 10 has received from the alarm apparatus 20. In the example illustrated in FIG. 6(1), a non-unified alarm of {source: "EQP_A", message: "EQP_A HH", importance: "critical alarm"} of the server apparatus 20A, a non-unified alarm of {source: "EQP_B", message: "EQP_B HI", AlarmPriority: "High"} of the server apparatus 20B, and a non-unified alarm of {source: "EQP_C", message: "EQP_C HI", Priority: "M"} of the control apparatus 20C are illustrated as examples.

[0076] 2-3-2. Attribute name definition

FIG. 6(2) illustrates the attribute name definition that is stored in the alarm management apparatus 10. In the example illustrated in FIG. 6(2), the attribute name definition of {attribute name: "importance", inner attribute name: "Priority", attribute type: "String"} of the server apparatus 20A, the attribute name definition of {attribute name: "AlarmPriority", inner attribute name: "Priority", attribute type: "String"} of the server apparatus 20B, and the attribute name definition of {attribute name: "Priority", inner attribute name: "Priority", attribute type: "String"} of the control apparatus 20C are illustrated as examples.

[0077] 2-3-3. Attribute name unified alarm

FIG. 6(3) illustrates an example of the attribute name unified alarms in which the attribute names are unified and which are generated by the alarm management apparatus 10. In the example illustrated in FIG. 6(3), an attribute name unified alarm of {source: "EQP_A", message: "EQP_A HH", Priority: "critical alarm"} of the server apparatus 20A, an attribute name unified alarm of {source: "EQP_B", message: "EQP_B HI", Priority: "High"} of the server apparatus 20B, and an attribute name unified alarm of {source: "EQP_C", message: "EQP_C HI", Priority: "M"} of the control apparatus 20C are illustrated as examples.

[0078] 2-3-4. Attribute value definition

FIG. 6(4) illustrates the attribute value definition that is stored in the alarm management apparatus 10. In the example illustrated in FIG. 6(4), the attribute value definition of {attribute value: "critical alarm", inner attribute value: "High"} of the server apparatus 20A, the attribute value definition of {attribute value: "High", inner

attribute value: "High"} of the server apparatus 20B, and the attribute value definition of {attribute value: "M", inner attribute value: "Medium"} of the control apparatus 20C are illustrated as examples.

[0079] 2-3-5. Attribute name and attribute value unified alarm

FIG. 6(5) illustrates an example of the attribute name and attribute value unified alarms in which the attribute names and the attribute values are unified and which are generated by the alarm management apparatus 10. In the example illustrated in FIG. 6(5), an attribute name and attribute value unified alarm of {source: "EQP_A", message: "EQP_A HH", Priority: "High"} of the server apparatus 20A, an attribute name and attribute value unified alarm of {source: "EQP_B", message: "EQP_B HI", Priority: "High"} of the server apparatus 20B, and an attribute name and attribute value unified alarm of {source: "EQP_C", message: "EQP_C HI", Priority: "Medium"} of the control apparatus 20C are illustrated as examples.

[0080] 2-3-6. Others

In FIG. 6(5) described above, the examples of the attribute name and attribute value unified alarms in which the attribute names and the attribute values are unified are illustrated, but the alarm management apparatus 10 may generate an attribute value unified alarm in which only the attribute value is unified. Further, the alarm management apparatus 10 may generate an attribute type unified alarm in which only the attribute type is unified, an attribute type and attribute name unified alarm in which the attribute type and the attribute name are unified, an attribute type and attribute value unified alarm in which the attribute type and the attribute value are unified, or an attribute type/attribute name/attribute value unified alarm in which the attribute type, the attribute name, and the attribute value are unified.

[0081] 2-4. Configuration example and processing example of alarm apparatus 20

A configuration example and a processing example of the alarm apparatus 20 will be described below with reference to FIG. 2. The alarm apparatus 20 are, for example, the server apparatus 20A, the server apparatus 20B, the control apparatus 20C, and the like. The alarm apparatus 20 are apparatuses that have the alarm detection functions, and detect a sensor value, a process value, and the like of the plant and an alarm that indicates abnormality of the plant or the plant apparatus.

[0082] 2-4-1. Server apparatus 20A

The server apparatus 20A among the alarm apparatus 20 is, for example, an OPC UA server, collects a process value, such as temperature data, pressure data, or flow data, in the plant from a sensor apparatus, such as a temperature sensor, a pressure sensor, or a flow sensor, in the plant, generates the alarm A when the process value exceeds a threshold, and transmits the generated alarm A to the alarm management apparatus 10.

[0083] 2-4-2. Server apparatus 20B

The server apparatus 20B is, for example, an OPC A&E server, collects a process value, such as temperature data, pressure data, or flow data, in the plant from the sensor apparatus, such as a temperature sensor, a pressure sensor, or a flow sensor, in the plant, generates the alarm B when the process value exceeds a threshold, and transmits the generated alarm B to the alarm management apparatus 10.

[0084] 2-4-3. Control apparatus 20C

The control apparatus 20C is, for example, a controller that is included in the DCS, collects a process value, such as temperature data, pressure data, or flow data, in the plant from the sensor apparatus, such as a temperature sensor, a pressure sensor, or a flow sensor, in the plant, generates the alarm C when the process value exceeds a threshold, and transmits the generated alarm C to the alarm management apparatus 10.

[0085] 2-5. Configuration example and processing example of engineer terminal 30

A configuration example and a processing example of the engineer terminal 30 will be described below with reference to FIG. 2. The engineer terminal 30 is a terminal that is used by the engineer E who manages the alarm management apparatus 10, and includes an input-output unit 31, a transmitting-receiving unit 32, and a communication unit 33.

[0086] 2-5-1. Input-output unit 31

The input-output unit 31 controls input of various kinds of information to the engineer terminal 30. For example, the input-output unit 31 is implemented by a mouse, a keyboard, a touch panel, or the like, and receives input of setting information or the like to the engineer terminal 30. Further, the input-output unit 31 controls display of various kinds of information from the engineer terminal 30. For example, the input-output unit 31 is implemented by a display or the like and controls display of the setting information or the like that is stored in the engineer terminal 30.

[0087] The input-output unit 31 controls display of the engineering details setting screen for setting the engineering details on the alarm management apparatus 10.

[0088] 2-5-2. Transmitting-receiving unit 32

The transmitting-receiving unit 32 transmits various kinds of information. For example, the transmitting-receiving unit 32 transmits the engineering details, such as the apparatus definition, the attribute name definition, or the attribute type definition, which are input by the engineer E to the engineering details setting screen, to the alarm management apparatus 10. Further, the transmitting-receiving unit 32 receives various kinds of information.

[0089] 2-5-3. Communication unit 33

The communication unit 33 controls data communication with a different apparatus. For example, the communication unit 33 performs data communication with each of communication apparatuses via a router or the like. Further, the commu-

nication unit 33 is able to perform data communication with an operator terminal (not illustrated).

[0090] 2-6. Configuration example of operator terminal 40

A configuration example and a processing example of the operator terminal 40 will be described below with reference to FIG. 2. The operator terminal 40 is a terminal that is used by the operator O who manages the plant, and includes an input-output unit 41, a transmitting-receiving unit 42, and a communication unit 43.

[0091] 2-6-1. Input-output unit 41

The input-output unit 41 controls input of various kinds of information to the operator terminal 40. For example, the input-output unit 41 is implemented by a mouse, a keyboard, a touch panel, or the like, and receives input of setting information or the like to the operator terminal 40. Further, the input-output unit 41 controls display of various kinds of information from the operator terminal 40. For example, the input-output unit 41 is implemented by a display or the like and controls display of the setting information or the like that is stored in the operator terminal 40.

[0092] The input-output unit 41 controls display of the inner alarm that is transmitted from the alarm management apparatus 10. For example, the input-output unit 41 controls display of the inner alarm A', the inner alarm B', and the inner alarm C' that are transmitted from the alarm management apparatus 10.

[0093] 2-6-2. Transmitting-receiving unit 42

The transmitting-receiving unit 42 transmits various kinds of information. Further, the transmitting-receiving unit 42 receives various kinds of information. For example, the transmitting-receiving unit 42 receives the inner alarm A', the inner alarm B', and the inner alarm C' that are transmitted from the alarm management apparatus 10.

[0094] 2-6-3. Communication unit 43

The communication unit 43 controls data communication with a different apparatus. For example, the communication unit 43 performs data communication with each of communication apparatuses via a router or the like. Further, the communication unit 43 is able to perform data communication with an operator terminal (not illustrated).

[0095] 3. Flow of each of processes performed by alarm management system 100

Flows of processes performed by the alarm management system 100 according to one embodiment will be described below with reference to FIG. 7 to FIG. 10. In the following, the flow of the entire process of the alarm management system 100 will be first described, and thereafter, an engineering details reception process, an alarm attribute unifying process, and an alarm notifying process will be described in this order.

[0096] 3-1. Flow of entire process performed by alarm management system 100

The flow of the entire process performed by the alarm management system 100 according to one embodiment will be described below with reference to FIG. 7. FIG. 7 is a flowchart illustrating an example of the flow of the entire process performed by the alarm management system 100 according to one embodiment. Meanwhile, the processes at S101 to S103 described below may be performed in different order. Further, some of the processes from S101 to S103 described below may be omitted.

[0097] Firstly, the alarm management apparatus 10 performs the engineering details reception process (S101). Secondly, the alarm management apparatus 10 performs the alarm attribute unifying process (S102). Thirdly, the alarm management apparatus 10 performs the alarm notifying process (S103).

[0098] 3-2. Flow of engineering details reception process

The flow of the engineering details reception process performed by the alarm management system 100 according to one embodiment will be described below with reference to FIG. 8. FIG. 8 is a flowchart illustrating an example of the flow of the engineering details reception process performed by the alarm management system 100 according to one embodiment. Meanwhile, the processes at S201 to S203 described below may be performed in different order. Further, some of the processes from S201 to S203 described below may be omitted.

[0099] Firstly, the alarm management apparatus 10 performs the apparatus definition reception process (S201). Secondly, the alarm management apparatus 10 performs the attribute name definition reception process (S202). Thirdly, the alarm management apparatus 10 performs the attribute value definition reception process (S203).

[0100] 3-3. Flow of alarm attribute unifying process

The flow of the alarm attribute unifying process performed by the alarm management system 100 according to one embodiment will be described below with reference to FIG. 9. FIG. 9 is a flowchart illustrating an example of the flow of the alarm attribute unifying process performed by the alarm management system 100 according to one embodiment. Meanwhile, the processes from S301 to S305 described below may be performed in different order. Further, some of the processes from S301 to S305 described below may be omitted.

[0101] Firstly, the alarm management apparatus 10 performs the attribute name acquisition process (S301). Secondly, the alarm management apparatus 10 performs the inner attribute name acquisition process (S302). Thirdly, the alarm management apparatus 10 performs the attribute value acquisition process (S303). Fourthly, the alarm management apparatus 10 performs the inner attribute value acquisition process (S304). Fifthly, the alarm management apparatus 10 performs the inner alarm generation process (S305).

[0102] 3-4. Flow of alarm notifying process

The flow of the alarm notifying process performed by the alarm management system 100 according to one embodiment will be described below with reference to FIG.

10. FIG. 10 is a flowchart illustrating an example of the flow of the alarm notifying process performed by the alarm management system 100 according to one embodiment. Meanwhile, the processes from S401 to S403 described below may be performed in different order. Further, some of the processes from S401 to S403 described below may be omitted.

[0103] Firstly, the alarm management apparatus 10 performs the inner alarm acquisition process (S401). Secondly, the alarm management apparatus 10 performs the inner alarm transmission process (S402). Thirdly, the operator terminal 40 performs the inner alarm display process (S403).

[0104] 4. Effects of embodiment

Lastly, effects of one embodiment will be described below. First to seventh effects corresponding to the processes of one embodiment will be described below.

[0105] 4-1. First effect

Firstly, in the process according to one embodiment as described above, the alarm management apparatus 10 stores therein, for each type of an apparatus that outputs a message, each of attributes of messages that indicate the same or similar contents and an inner attribute that indicates the same or similar content, in an associated manner, and when receiving a message from the apparatus, acquires the inner attribute that is associated with an attribute included in the received message, generates an inner message in which the attribute of the message is converted to the inner attribute, and outputs the inner message. Therefore, in this process, it is possible to efficiently output a message that is generated in a mixed environment in which a plurality of venders are present.

[0106] 4-2. Second effect

Secondly, in the process according to one embodiment as described above, the message is an alarm that indicates an abnormality of one of a system and a device that is included in the system, and, the alarm management apparatus 10 stores therein each of alarm attributes, which are set by each of venders for each of vender apparatuses that collect alarms that are output from each of devices included in the system, and an inner attribute, which unifies the alarm attributes that are set by the respective venders, in an associated manner, and when receiving the alarm from any of the vender apparatuses, generates the inner message in which the attribute of the received alarm is converted to the inner attribute and outputs the inner message. Therefore, in this process, it is possible to efficiently output a message that is generated in the mixed environment in which a plurality of venders are present, with respect to the generated

alarm.

[0107] 4-3. Third effect

Thirdly, in the process according to one embodiment as described above, the alarm management apparatus 10 stores therein, for each type of the apparatus, each of attribute names as each of the attributes and an inner attribute name as the inner attribute in an associated manner, and when receiving the message from the apparatus, acquires the inner attribute name that is associated with the attribute name included in the received message, generates the inner message in which the attribute name of the message is converted to the inner attribute name, and outputs the inner message. Therefore, in this process, by integrating the attribute names, it is possible to efficiently output a message that is generated in the mixed environment in which a plurality of venders are present.

[0108] 4-4. Fourth effect

Fourthly, in the process according to one embodiment as described above, the alarm management apparatus 10 stores therein, for each type of the apparatus, each of attribute types as each of the attributes and an inner attribute value as the inner attribute in an associated manner, and when receiving the message from the apparatus, the inner attribute type that is associated with the attribute type included in the received message, generates the inner message in which the attribute type of the message is converted to the inner attribute type, and outputs the inner message. Therefore, in this process, by integrating the attribute types, it is possible to efficiently output a message that is generated in the mixed environment in which a plurality of venders are present.

[0109] 4-5. Fifth effect

Fifthly, in the process according to one embodiment as described above, the alarm management apparatus 10 stores therein, for each type of the apparatus, each of attribute values as each of the attributes and an inner attribute value as the inner attribute in an associated manner, and when receiving the message from the apparatus, acquires the inner attribute value that is associated with the attribute value included in the received message, generates the inner message in which the attribute value of the message is converted to the inner attribute value, and outputs the inner message. Therefore, in this process, by integrating the attribute values, it is possible to efficiently output a message that is generated in the mixed environment in which a plurality of venders are present.

[0110] 4-6. Sixth effect

Sixthly, in the process according to one embodiment as described above, the apparatuses are compliant with OPC UA or OPC Classic. Therefore, in this process, with progress of international standardization, it is possible to efficiently output a message that is generated in the mixed environment in which a plurality of venders are present.

[0111] 4-7. Seventh effect

Seventhly, in the process according to one embodiment as described above, the message is an alarm that indicates an abnormality of one of a plant control system that controls a plant and a plant apparatus that is included in the plant control system. Therefore, in this process, in the plant control system, it is possible to efficiently output a message that is generated in the mixed environment in which a plurality of venders are present.

[0112] System

The processing procedures, control procedures, specific names, and information including various kinds of data and parameters illustrated in the above-described document and drawings may be arbitrarily changed unless otherwise specified.

[0113] Further, the components illustrated in the drawings are functionally conceptual and do not necessarily have to be physically configured in the manner illustrated in the drawings. In other words, specific forms of distribution and integration of the apparatuses are not limited to those illustrated in the drawings. That is, all or part of the apparatuses may be functionally or physically distributed or unified in arbitrary units depending on various loads or use conditions.

[0114] Furthermore, for each of processing functions performed by each of apparatuses, all or any part of the processing functions may be implemented by a CPU and a program that is analyzed and executed by the CPU or may be implemented as hardware by wired logic.

[0115] Hardware

A hardware configuration example of the alarm management apparatus 10 that is an alarm management apparatus will be described below. Meanwhile, other apparatuses may have the same hardware configuration. FIG. 11 is a diagram for explaining a hardware configuration example according to one embodiment. As illustrated in FIG. 11, the alarm management apparatus 10 includes a communication apparatus 10a, a storage 10b, a memory 10c, and a processor 10d. Further, all of the units illustrated in FIG. 11 are connected to one another via a bus or the like.

[0116] The communication apparatus 10a is a network interface card or the like and performs communication with a different server. The storage 10b stores therein a program and a database for implementing the functions illustrated in FIG. 2.

[0117] The processor 10d reads programs that execute the same processes as those of each of the processing units illustrated in FIG. 2 from the storage 10b or the like, loads the read programs onto the memory 10c, and implements each of the functions described above with reference to FIG. 2 or the like. For example, the processes implement the same functions as those of each of the processing units included in the alarm management apparatus 10. Specifically, the processor 10d reads a program that has

the same function as the reception unit 13a, the receiving unit 13b, the generating unit 13c, the transmitting unit 13d, or the like from the storage 10b or the like. Further, the processor 10d performs a process that executes the same process as the reception unit 13a, the receiving unit 13b, the generating unit 13c, the transmitting unit 13d, or the like.

[0118] As described above, the alarm management apparatus 10 operates as an apparatus that reads a program, executes the program, and implements various kinds of processing methods. Further, the alarm management apparatus 10 may cause a medium reading apparatus to read the above-described program from a recording medium, executes the read program, and implement the same functions as those of the embodiment described above. Meanwhile, the program described in the different embodiment need not always be executed by the alarm management apparatus 10. For example, the present invention is similarly applicable in the case where a different computer or a different server executes a program or in the case where a different computer and a different server execute a program in a cooperative manner.

[0119] The programs may be distributed via a network, such as the Internet. Further, the programs may be recorded in a computer-readable recording medium, such as a hard disk, a flexible disk (FD), a compact disc (CD)-ROM, a Magneto-Optical disk (MO), or a Digital Versatile Disc (DVD), and may be implemented by causing a computer to read and execute the programs from the recording medium.

Reference Signs List

- [0120] 10 alarm management apparatus
- 11 communication unit
- 12 storage unit
- 12a attribute name storage unit
- 12b attribute value storage unit
- 12c inner alarm storage unit
- 13 control unit
- 13a reception unit
- 13b receiving unit
- 13c generating unit
- 13d transmitting unit
- 20 alarm apparatus
- 30 engineer terminal
- 31 input-output unit
- 32 transmitting-receiving unit
- 33 communication unit

- 40 operator terminal
- 41 input-output unit
- 42 transmitting-receiving unit
- 43 communication unit
- 100 alarm management system

Claims

[Claim 1]

A management apparatus comprising:

a storage unit that stores therein, for each type of an apparatus that outputs a message, each of attributes of messages that indicate same or similar contents and an inner attribute that indicates the same or similar contents in an associated manner; and

a generating unit that, when receiving a message from the apparatus, acquires the inner attribute that is associated with an attribute included in the received message from the storage unit, generates an inner message in which the attribute of the message is converted to the inner attribute, and outputs the inner message.

[Claim 2]

The management apparatus according to claim 1 wherein

the message is an alarm that indicates an abnormality of one of a system and a device included in the system,

the storage unit stores therein each of alarm attributes and an inner attribute in an associated manner, the alarm attributes being set by each of venders for each of vender apparatuses that collect alarms that are output from each of devices included in the system, the inner attribute unifying the alarm attributes that are set by the respective venders, and

the generating unit, when receiving the alarm from any of the vender apparatuses, generates the inner message in which the attribute of the received alarm is converted to the inner attribute and outputs the inner message.

[Claim 3]

The management apparatus according to claim 1, wherein

the storage unit stores therein, for each type of the apparatus, each of attribute names as each of the attributes and an inner attribute name as the inner attribute in an associated manner, and

the generating unit, when receiving the message from the apparatus, acquires the inner attribute name that is associated with the attribute name included in the received message from the storage unit, generates the inner message in which the attribute name of the message is converted to the inner attribute name, and outputs the inner message.

[Claim 4]

The management apparatus according to claim 1, wherein

the storage unit stores therein, for each type of the apparatus, each of attribute types as each of the attributes and an inner attribute type as the inner attribute in an associated manner, and

the generating unit, when receiving the message from the apparatus,

the inner attribute type that is associated with the attribute type included in the received message from the storage unit, generates the inner message in which the attribute type of the message is converted to the inner attribute type, and outputs the inner message.

[Claim 5]

The management apparatus according to claim 1, wherein
the storage unit stores therein, for each type of the apparatus, each of attribute values as each of the attributes and an inner attribute value as the inner attribute in an associated manner, and
the generating unit, when receiving the message from the apparatus, acquires the inner attribute value that is associated with the attribute value included in the received message from the storage unit, generates the inner message in which the attribute value of the message is converted to the inner attribute value, and outputs the inner message.

[Claim 6]

The management apparatus according to any one of claims 1 to 5, wherein the apparatus is compliant with one of Open Platform Communications Unified Architecture (OPC UA) and OPC Classic.

[Claim 7]

The management apparatus according to any one of claims 1 to 5, wherein the message is an alarm that indicates an abnormality of one of a plant control system that controls a plant and a plant apparatus that is included in the plant control system.

[Claim 8]

A management method implemented by a computer, the management method comprising:

storing, for each type of an apparatus that outputs a message, each of attributes of messages that indicate same or similar contents and an inner attribute that indicates the same or similar contents in an associated manner;

acquiring, when receiving a message from the apparatus, the inner attribute that is associated with an attribute included in the received message;

generating an inner message in which the attribute of the message is converted to the inner attribute; and

outputting the inner message.

[Claim 9]

A management program that causes a computer to execute a process comprising:

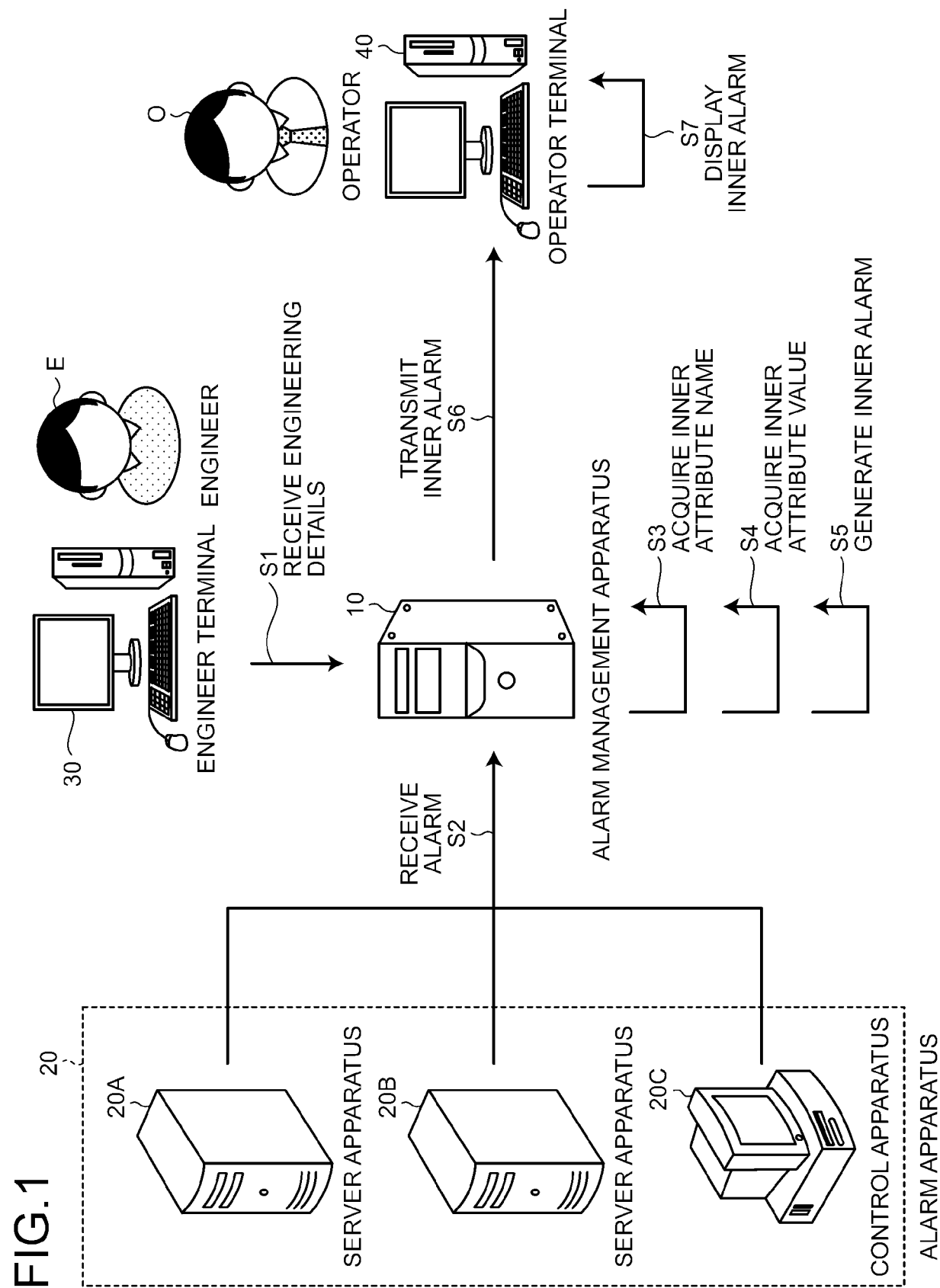
storing, for each type of an apparatus that outputs a message, each of attributes of messages that indicate same or similar contents and an inner attribute that indicates the same or similar contents in an associated manner;

acquiring, when receiving a message from the apparatus, the inner attribute that is associated with an attribute included in the received message;

generating an inner message in which the attribute of the message is converted to the inner attribute; and

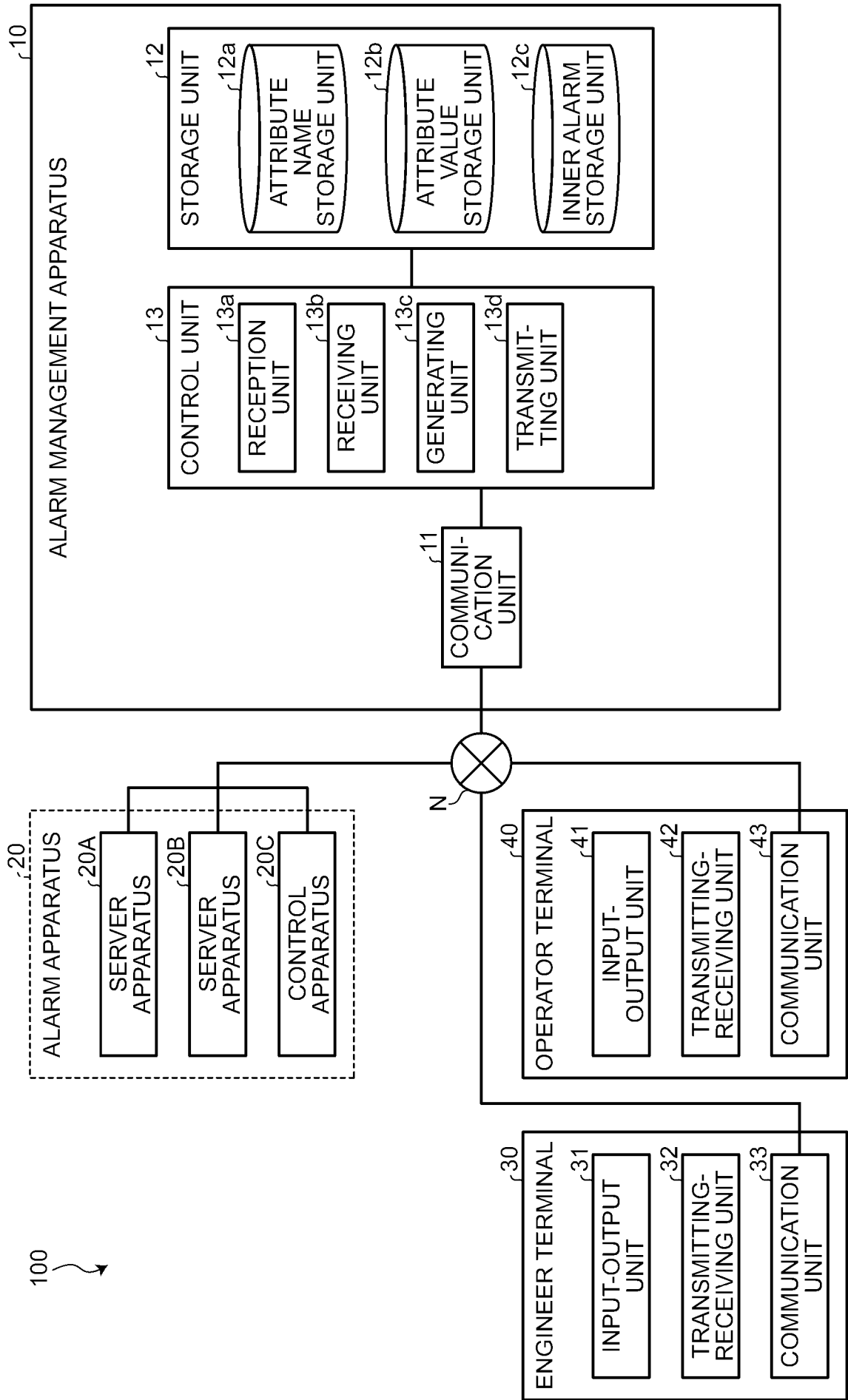
outputting the inner message.

[Fig. 1]



[Fig. 2]

FIG.2



[Fig. 3]

FIG.3

12a

SOURCE	ATTRIBUTE NAME	INNER ATTRIBUTE NAME	ATTRIBUTE TYPE
EQP_A	IMPORTANCE	Priority	String
EQP_B	AlarmPriority	Priority	String
EQP_C	Priority	Priority	String
...	...	...	...

[Fig. 4]

FIG.4

12b

SOURCE	ATTRIBUTE VALUE	INNER ATTRIBUTE NAME
EQP_A	CRITICAL ALARM	High
EQP_B	High	High
EQP_C	M	Medium
...	...	...

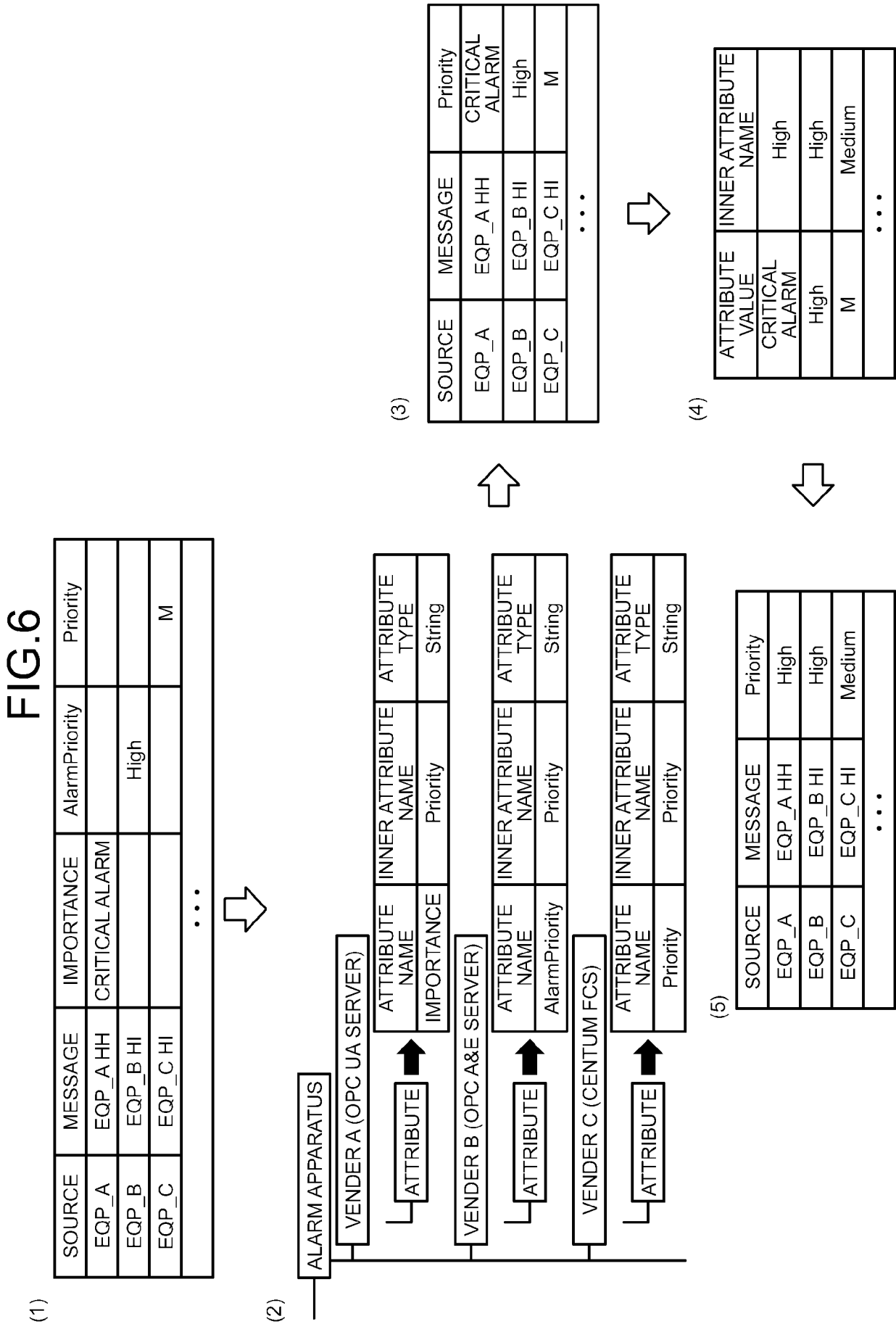
[Fig. 5]

FIG.5

12c

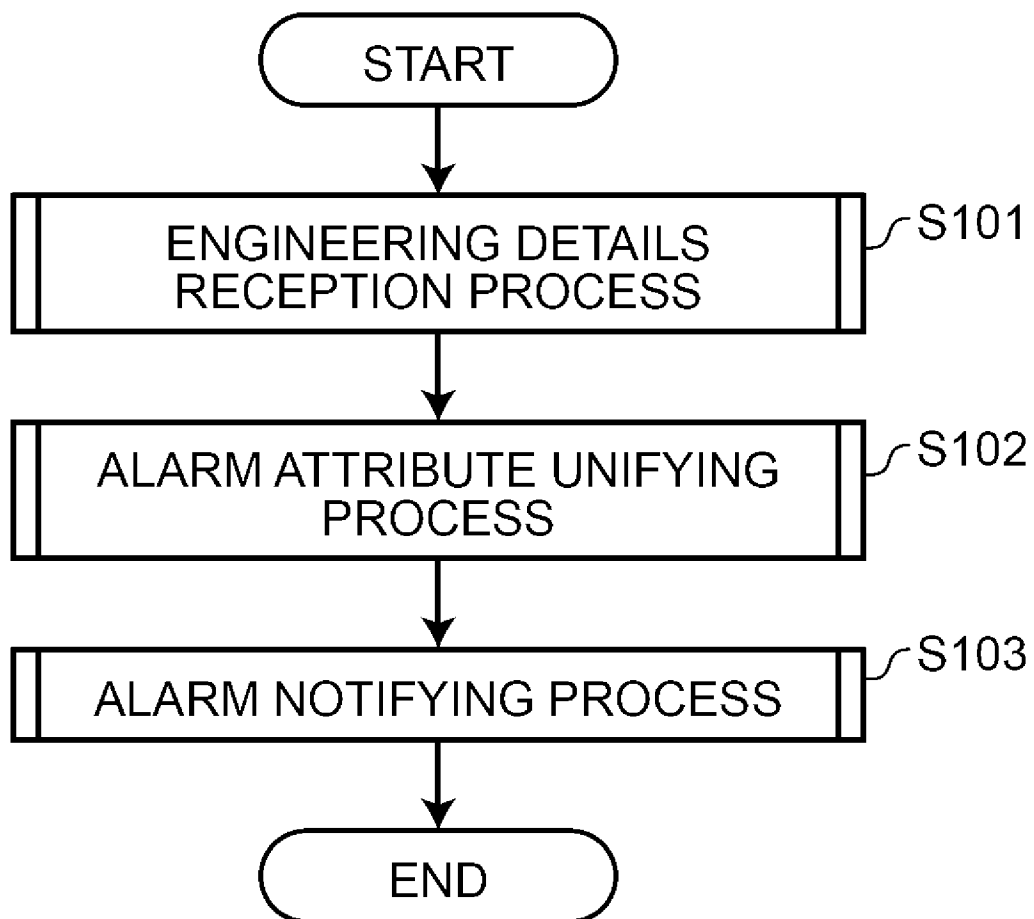
SOURCE	MESSAGE	Priority
EQP_A	EQP_A HH	High
EQP_B	EQP_B HI	High
EQP_C	EQP_C HI	Medium
...	...	...

[Fig. 6]



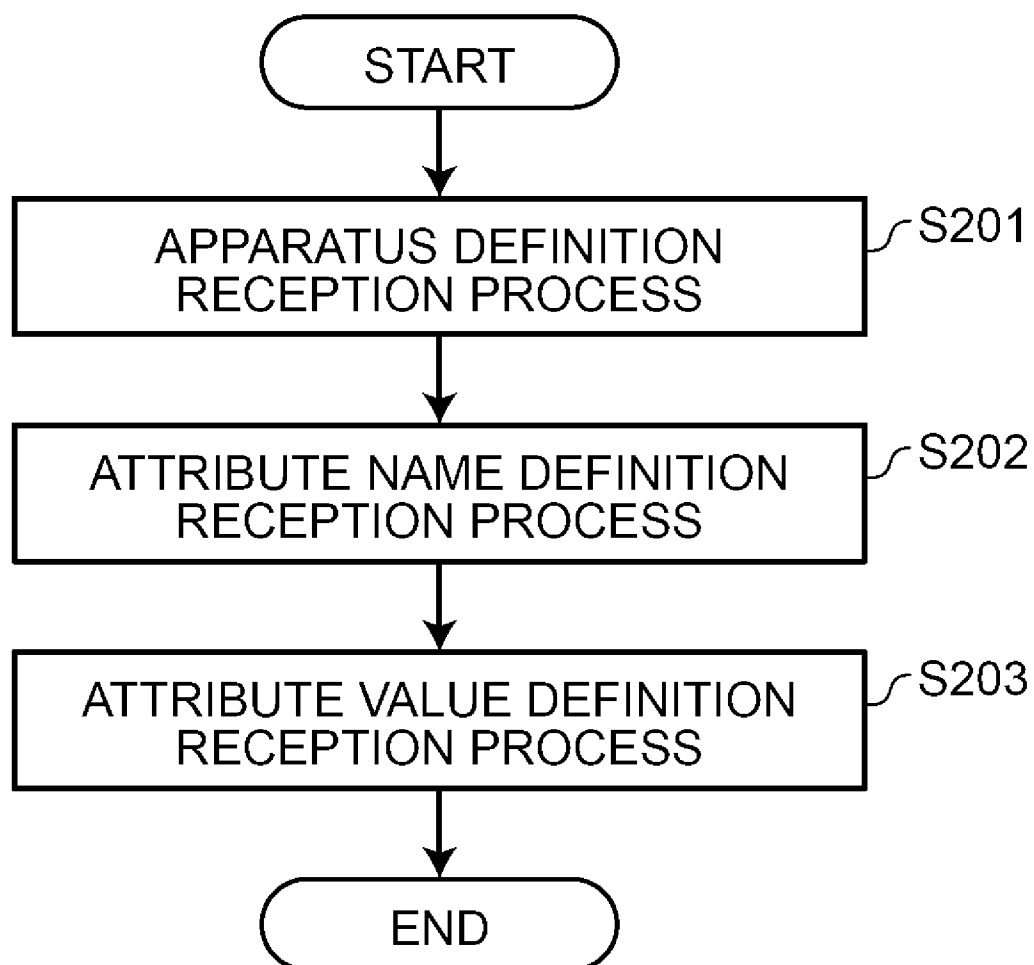
[Fig. 7]

FIG.7



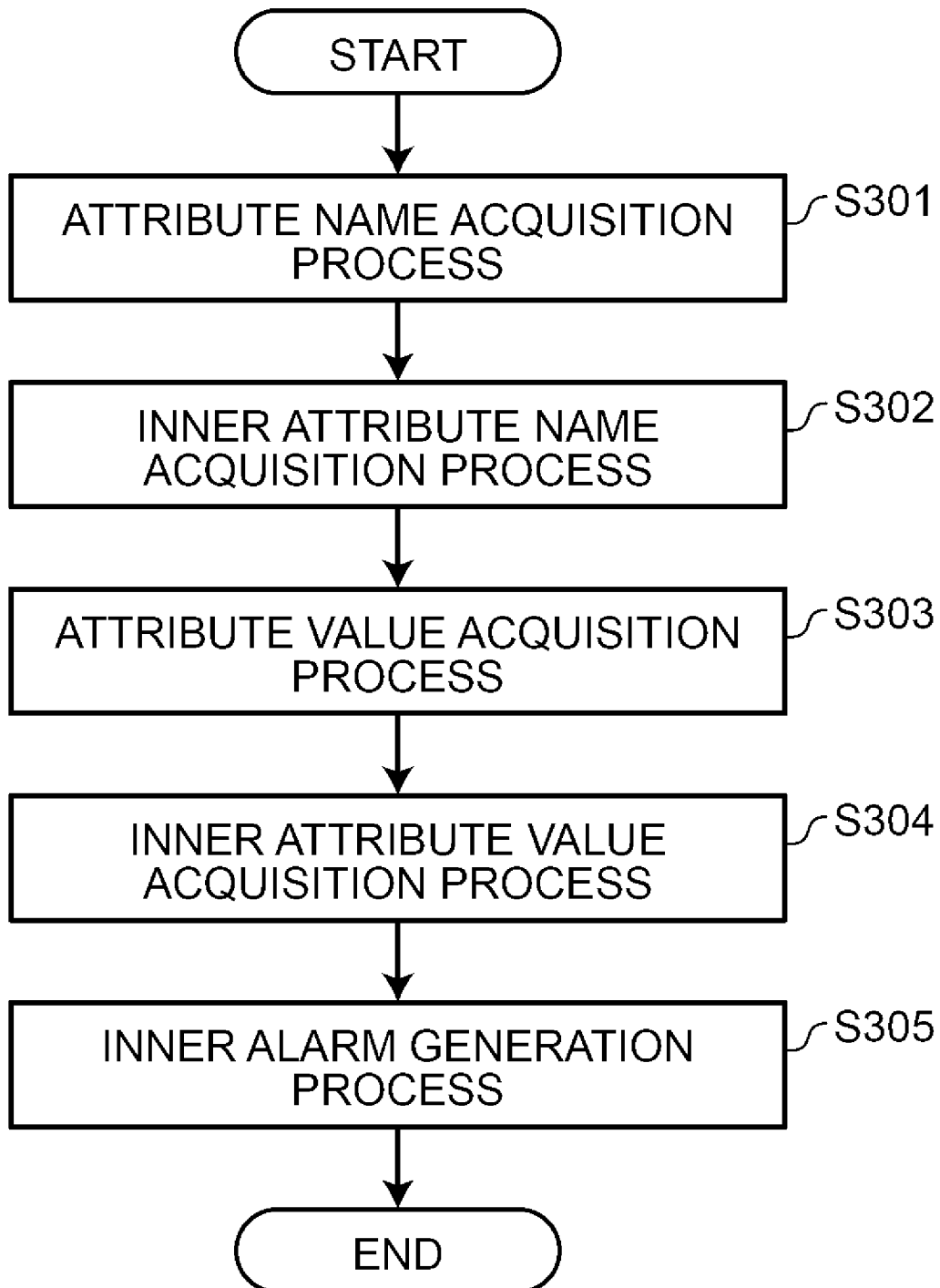
[Fig. 8]

FIG.8



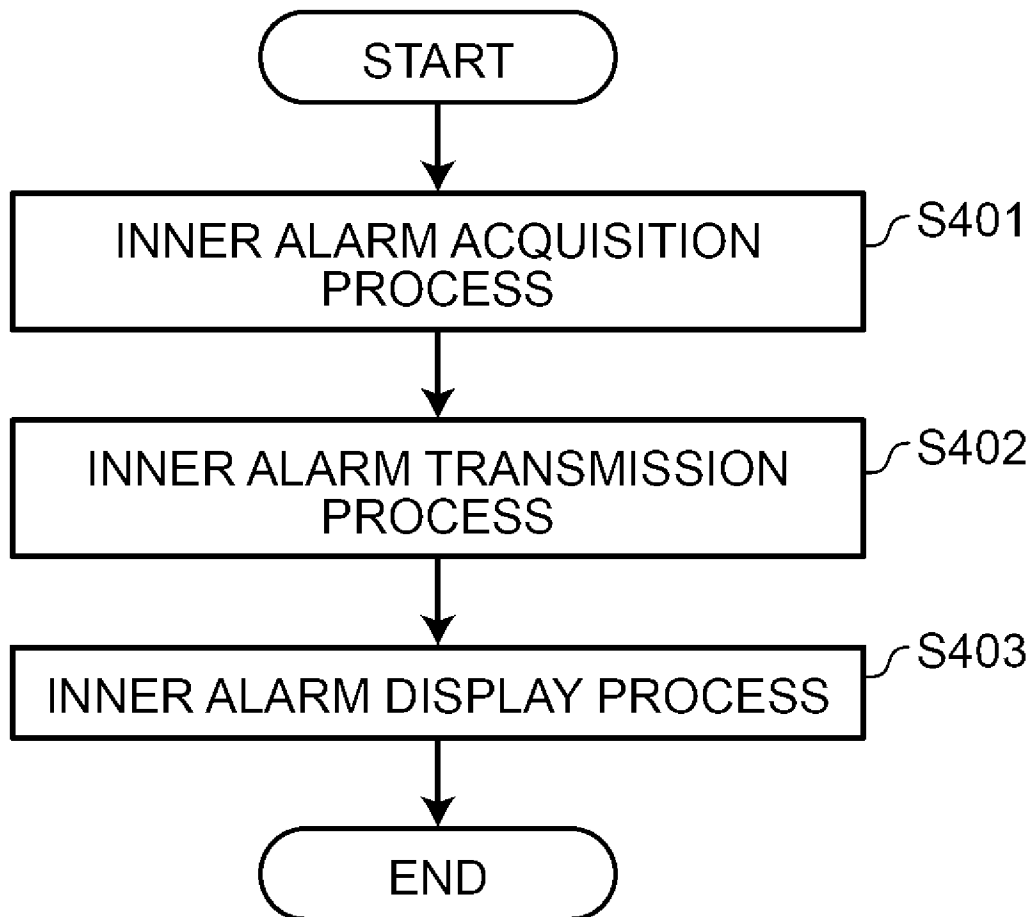
[Fig. 9]

FIG.9



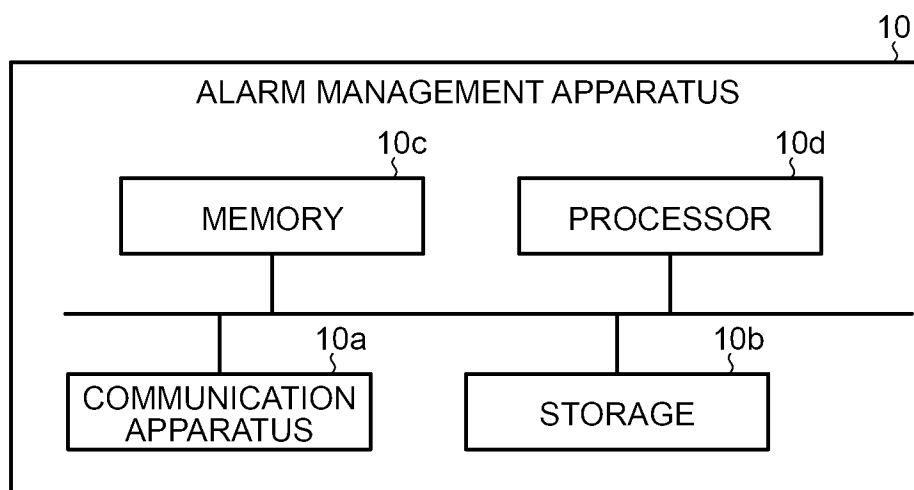
[Fig. 10]

FIG.10



[Fig. 11]

FIG.11



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2024/009770

A. CLASSIFICATION OF SUBJECT MATTER G05B 23/02 (2006.01)i FI: G05B23/02 301X 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) G05B23/02 Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched Published examined utility model applications of Japan 1922-1996 Published unexamined utility model applications of Japan 1971-2024 Registered utility model specifications of Japan 1996-2024 Published registered utility model applications of Japan 1994-2024 Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	JP 2011-186517 A (YOKOGAWA ELECTRIC CORPORATION) 22 September 2011 (2011-09-22) paragraphs 0048-0078, figs. 1-5	1-5,7-9
Y	paragraphs 0048-0078, figs. 1-5	6-7
Y	US 2006/0255926 A1 (YOKOGAWA ELECTRIC CORPORATION) 16 November 2006 (2006-11-16) paragraphs 0008, 0011, fig. 4	6-7
A	US 2017/0176968 A1 (FANUC CORPORATION) 22 June 2017 (2017-06-22) whole document	1-9
☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.		
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Date of the actual completion of the international search 10 May 2024		Date of mailing of the international search report 28 May 2024
Name and mailing address of the ISA/JP Japan Patent Office 3-4-3, Kasumigaseki, Chiyoda-ku, Tokyo 100-8915, Japan		Authorized officer OGATA, Hajime 3U 4654 Telephone No. +81-3-3581-1101 Ext. 3364

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/JP2024/009770

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US	2006/0255926	A1	16 November 2006	JP 2006-318147 A	paragraphs 0005, 0008, fig. 4
US	2017/0176968	A1	22 June 2017	JP 2017-116993 A	
				DE 102016124285 A1	
				CN 106896791 A	