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(54) **DRUM FOR LONG OBJECT, COMPUTER FOR MANAGEMENT, AND LONG-OBJECT MANAGEMENT SYSTEM**

(57) [Problem] To enable easy management of an elongated object.

[Solution] An elongated-object drum, includes: a drum on which to wind an elongated object; and a management module attached to the drum, wherein the management module includes an acceleration sensor configured to detect acceleration of the drum, a computation

device configured to perform computation based on a detection result from the acceleration sensor, and a storage device configured to store therein a computation result obtained by the computation device by performing the computation based on the detection result from the acceleration sensor.

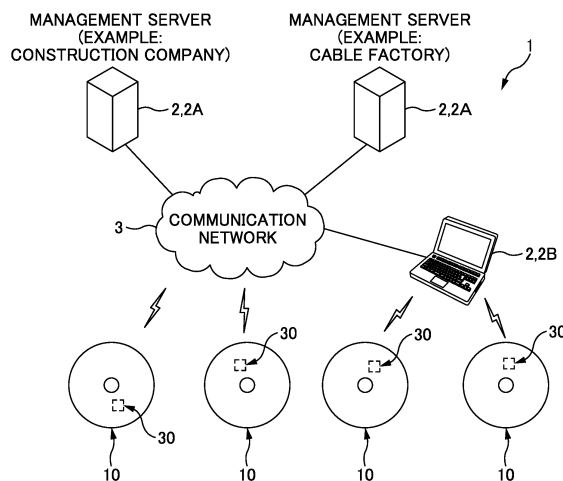


FIG. 1A

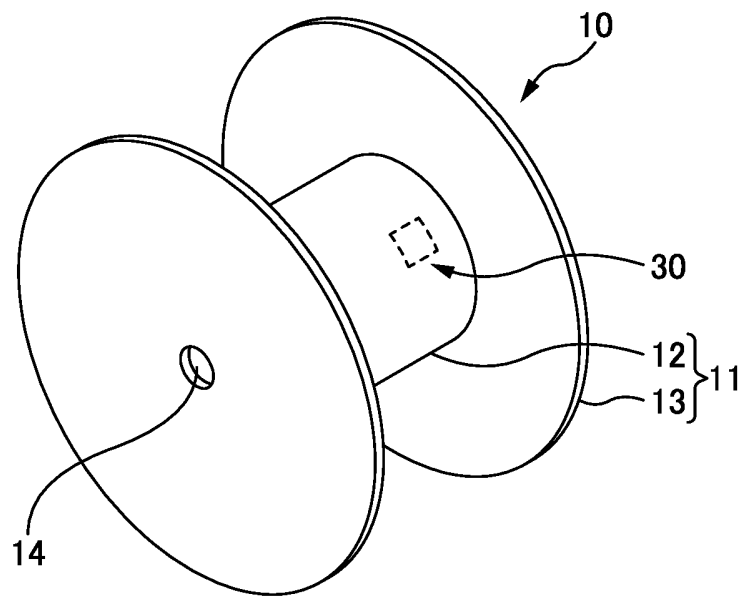


FIG. 1B

Description

Technical Field

[0001] The present invention relates to an elongated-object drum, a management computer, and an elongated-object management system.

Background Art

[0002] Japanese Literatures 1 to 3 describe detecting rotation and vibration of a drum (including a reel, a bobbin, and a paper tube) around which a cable, roll paper, or a wire is wound. Patent Literature 1 describes locating an acceleration sensor to a reel apparatus (but does not describe providing the acceleration sensor to a reel main body). Patent literatures 2 and 3 describe disposing an acceleration sensor at a bobbin (or a paper tube) (see paragraph 0089 in Patent Literature 2 and paragraph 0023 in Patent Literature 3). However, the techniques described in these Patent Literatures 1 to 3 are techniques for controlling the movement of a drum (what is called feedback control) and do not manage the usage history or the like of the drum or an elongated object wound around the drum.

[0003] In conventional practice, in order to manage an elongated cable such as an electric line cable or an optical fiber cable, a tag or label is attached to a cable, or the surface of a cable is marked by printing. However, the management method involving tagging, labelling, printing, or the like may cause the management data to be lost due to loss or wear. For this reason, Patent Literatures 4 and 5 describe embedding, in a cable, a storage element (e.g., an IC tag or an RFID element) having management data stored therein.

Citation List

Patent Literature

[0004]

[PTL 1] Japanese Patent Application Publication No. 2008-254927

[PTL 2] Japanese Patent Application Publication No. 2017-165540

[PTL 3] Japanese Patent Application Publication No. H11-58208 [PTL 4] Japanese Patent Application Publication No. 2003-203527

[PTL 5] Japanese Patent Application Publication No. 2004-266993

Summary of Invention

Technical Problem

[0005] The techniques of Patent Literatures 4 and 5 require a storage element to be embedded in a cable and

thus has problems such as an increase in the thickness of the cable and an increase in the costs for the cable. Also, to read the management data from the storage element in the cable, the techniques of Patent Literatures 4 and 5 require going over to the place where the cable is installed and read the data from the storage element, which makes cable management inconvenient. This management inconvenience due to storage of management data in an elongated object is existent in management of not only cables but also other elongated objects (including wires and roll paper).

[0006] The present invention has an object to enable easy management of an elongated object.

15 Solution to Problem

[0007] A main aspect of the invention to achieve the above object is an elongated-object drum, comprising: a drum on which to wind an elongated object; and a management module attached to the drum, wherein the management module includes an acceleration sensor configured to detect acceleration of the drum, a computation device configured to perform computation based on a detection result from the acceleration sensor, and a storage device configured to store therein a computation result obtained by the computation device by performing the computation based on the detection result from the acceleration sensor.

[0008] Other features of the present invention will be demonstrated by the description to be described later and the drawings.

Advantageous Effects of Invention

35 **[0009]** The present invention enables easy management of an elongated object.

Brief Description of Drawings

40 **[0010]**

[Fig. 1] Fig. 1A is a diagram illustrating a management system 1 of the present embodiment, and Fig. 1B is a diagram illustrating a cable drum 10 of the present embodiment.

[Fig. 2] Fig. 2A is a diagram illustrating the hardware configuration of a management module 30 of the present embodiment, and Fig. 2B is a block diagram of various functions of the management module 30.

[Fig. 3] Fig. 3 is a flowchart of remaining amount detection processing performed by a controller 36. [Fig. 4] Figs. 4A to 4C are diagrams illustrating an example state of the cable drum 10 at the time of acceleration detection.

[Fig. 5] Fig. 5 is a flowchart of different remaining amount detection processing by the controller 36.

[Fig. 6] Figs. 6A to 6C are diagrams illustrating an example state of the cable drum 10 at the time of

acceleration detection.

[Fig. 7] Fig. 7 is a diagram illustrating installment history data.

[Fig. 8] Fig. 8A is a diagram illustrating abnormality history data, and Fig. 8B is a diagram illustrating a state of the cable drum 10 at the time of abnormality detection.

[Fig. 9] Fig. 9A is a diagram illustrating an installment history database created by a management computer 2, and Fig. 9B is a diagram illustrating an example usage of the installment history database.

[Fig. 10] Figs. 10A and 10B are diagrams illustrating another usage of the installment history database.

Description of Embodiments

[0011] At least the following points will be demonstrated by the description to be described later and the drawings.

[0012] An elongated-object drum will become clear, comprising: a drum on which to wind an elongated object; and a management module attached to the drum, wherein the management module includes an acceleration sensor configured to detect acceleration of the drum, a computation device configured to perform computation based on a detection result from the acceleration sensor, and a storage device configured to store therein a computation result obtained by the computation device by performing the computation based on the detection result from the acceleration sensor. Such an elongated-object drum enables easy management of the elongated object.

[0013] It is desirable that based on the detection result from the acceleration sensor, the computation device is configured to determine whether a rotation direction of the drum is a direction for unreeling the elongated object. This enables checking of whether the elongated object is unreeled from a drum or reeled onto the drum.

[0014] It is desirable that the computation device is configured to detect a rotation angle of the drum based on the detection result from the acceleration sensor. This enables calculation and easy management of the usage amount and the remaining amount of the elongated object.

[0015] It is desirable that the computation device is configured to calculate a usage amount of the elongated object based on the rotation angle of the drum. This enables easy management of the usage amount of the elongated object.

[0016] It is desirable that the computation device is configured to acquire an unreeling diameter of the elongated object wound on the drum and also to detect the rotation direction of the drum based on the detection result from the acceleration sensor, the computation device is configured to calculate an amount of the elongated object unreeled based on the rotation angle of the drum and the unreeling diameter in a case where the rotation direction of the drum is same as a direction for unreeling the elongated object, the computation device is config-

ured to calculate an amount of the elongated object reeled based on the rotation angle of the drum and the unreeling diameter in a case where the rotation direction of the drum is same as a direction for reeling the elongated object, and the computation device is configured to calculate a usage amount of the elongated object based on the amount of the elongated object unreeled and the amount of the elongated object reeled. This enables more accurate management of the usage amount of the elongated object.

[0017] It is desirable that the computation device is configured to calculate a remaining amount of the elongated object based on the rotation angle of the drum. This enables easy management of the remaining amount of the elongated object.

[0018] It is desirable that the computation device is configured to acquire the remaining amount of the elongated object wound on the drum before use of the elongated object from the storage device, by subtracting a usage amount of the elongated object from the remaining amount of the elongated object, the computation device is configured to calculate a new remaining amount of the elongated object, and the storage device is configured to store therein the new remaining amount of the elongated object. This enables easy management of the remaining amount of the elongated object.

[0019] It is desirable that the computation device is configured to detect an abnormality in the drum based on the detection result from the acceleration sensor. This enables easy management of drum abnormalities.

[0020] It is desirable that the management module has a location measurement device capable of acquiring location data on the drum. This enables more detailed management of the elongated object because, for example, the installed location of the elongated object can be stored in the storage device or the current location of the elongated-object drum can be known.

[0021] It is desirable that the storage device is configured to store therein the computation result and the location data on the drum in association with each other. This enables easy, real-time management and follow-up checking of, for example, the usage status of the elongated object.

[0022] It is desirable that in a case where determining based on detection results from the acceleration sensor and the location measurement device that the drum is rotated and is not in motion, the computation device is configured to calculate a usage amount of the elongated object, and in a case where determining based on the detection results from the acceleration sensor and the location measurement device that the drum is rotated and is in motion, the computation device is configured to calculate the usage amount of the elongated object when the rotation direction of the drum is same as a direction for unreeling the elongated object and is configured not to calculate the usage amount of the elongated object when the rotation direction of the drum is same as a direction for reeling the elongated object. This enables

more accurate management of the usage amount of the elongated object.

[0023] It is desirable that the management module has a communication device configured to communicate with an outside. This enables easy management of the elongated object because data can be acquired without going over to, e.g., the site where the elongated object is installed or the place where the elongated-object drum is stored.

[0024] It is desirable that the management module is detachably attached to the drum. This enables effective use of the management module. This also prevents the management module from becoming damaged by, e.g., fumigation performed on the drum.

[0025] It is desirable that the elongated object is a cable. When the elongated object is a cable, it is particularly advantageous when the management module having an acceleration sensor is provided to the drum.

[0026] A management computer will become clear comprising: a communication part capable of communicating with an elongated-object drum on which an elongated object is wound; and a storage part configured to store management data, wherein the management computer is configured to receive via the communication part, from the elongated-object drum having an acceleration sensor, a computation result which is based on a detection result from the acceleration sensor, and the management computer is configured to store, in the storage part, the management data in which the elongated-object drum and the computation result are associated with each other. Such a management computer enables easy management of the elongated object.

[0027] It is desirable that the management computer is configured to receive the computation result from a plurality of the elongated-object drums, and the management computer is configured to store, in the storage part, a database in which each of the elongated-object drums is associated with the corresponding computation result as the management data. Thus, inventory management of the elongated object (e.g., a cable) or evaluation for a logistics system can be performed based on the database easily.

[0028] It is desirable that based on the database and a condition inputted regarding the elongated-object drum, the management computer is configured to determine the elongated-object drum that meets the condition. Thus, inventory management of the elongated object (e.g., a cable) and evaluation for a logistics system can be performed based on the database more easily.

[0029] An elongated-object management system will become clear comprising: an elongated-object drum; and a management computer communicatively coupled to the elongated-object drum, wherein the elongated-object drum has a drum onto which to wind an elongated object and a management module attached to the drum, and the management module has an acceleration sensor configured to detect acceleration of the drum, a computation device configured to perform computation based

on a detection result from the acceleration sensor, a storage device configured to store therein a computation result obtained by the computation device by performing the computation based on the detection result from the acceleration sensor, and a communication device configured to communicate with the management computer. Such an elongated-object management system enables easy management of the elongated object.

===Embodiment===

<<Overall Configuration of Management System 1>>

[0030] Fig. 1A is a diagram illustrating a management system 1 of the present embodiment.

[0031] The management system 1 of the present embodiment includes management computers 2 and cable drums 10 as elongated-object drums. Although it is assumed here that the management system 1 includes a plurality of cable drums 10, the management system 1 may include one cable drum 10. As will be described later, the cable drum 10 acquires various kinds of data using an acceleration sensor, and the management computers 2 manage the various kinds of data (such as, e.g., the remaining amount) on the cable drum 10.

[0032] An elongated-object drum is a drum around which to wind an elongated object. An elongated object is an elongated member and may be a line-shaped member such as a cable or a wire or a band-shaped (sheet-shaped) member such as roll paper, a film, or a web. In the present embodiment, the elongated object is a cable, and the cable is wound on the cable drum 10, which is an elongated-object drum.

[0033] The management computers 2 are computers that manage elongated objects and the elongated-object drums. In the present embodiment, the management computer 2 manages cables and the cable drums 10. The management computers 2 are computers such as, e.g., a personal computer or a server. The management computer 2 (a management server or a management terminal) includes a CPU, a memory (a storage device), a communication device, a display (a display unit), and the like. A management program is preinstalled in the management computer 2. By executing the management program, the management computer 2 acquires data (e.g., cable data and drum data) from the cable drums 10 and manages the cables and the cable drums 10.

[0034] The management system 1 may include at least one of a management server 2A and a management terminal 2B as the management computer 2.

[0035] The management server 2A acquires data from the cable drums 10 via a communication network 3. Examples of the management server 2A include a server of a telecommunications carrier, a server of a construction company, and a server at a manufacturing factory that manufactures the cables.

[0036] The management terminal 2B is a terminal (e.g., a personal computer) used at the site where the cable is

installed. The management terminal 2B may be communicatively coupled to the cable drums 10 in a wired manner and acquire data, or may be communicatively coupled to the cable drums 10 via the communication network 3 and acquire data.

[0037] The communication network 3 is, for example, a telephone network (a public telephone network, a mobile telephone network), a wireless communication network, the Internet, a LAN, a WAN, or the like, and is assumed to be the Internet here.

<<Configuration of the Cable Drum 10>>

[0038] Fig. 1B is a diagram illustrating the cable drum 10 of the present embodiment. The cable drum 10 of the present embodiment has a drum 11 and a management module 30.

[0039] The drum 11 is a member on which to wind a cable. The drum 11 has a body portion 12 and flange portions 13. The body portion 12 is a part on which to wind a cable. Note that The diagram shows an empty drum, and no cable is wound on the body portion 12. The body portion 12 is tubular-shaped, and a cable is to be wound on the circumference thereof. The flange portions 13 are parts located at the end portions of the body portion 12 to prevent a cable from coming off from the body portion 12. The flange portions 13 are disk-shaped rims projecting from the ends of the body portion 12. A shaft hole 14 is formed in the center of the flange portions 13. The drum 11 rotates about the shaft hole 14.

[0040] The management module 30 is a module attached to the drum 11 to acquire data on a cable or the drum 11. In the present embodiment, the management module 30 is attached to the inner side of the tubular body portion 12. Attaching the management module 30 to the inner side of the body portion 12 helps prevent the management module 30 from being exposed to rain and wind and therefore from being damaged. Note, however, that the attachment location of the management module 30 is not limited to the inner side of the body portion 12. For example, the management module 30 may be attached to the outer side of the body portion 12 or to the flange portions 13.

<<Configuration of Management Module 30>>

[0041] Fig. 2A is a diagram illustrating the hardware configuration of the management module 30 of the present embodiment. The management module 30 includes a computation device 31, a storage device 32, an acceleration sensor 33, a location measurement device 34, and a communication device 35.

[0042] The computation device 31 is, for example, a CPU or an MPU and is a device that performs various kinds of processing to be described later. The storage device 32 is memory such as a main storage device 321 and a secondary storage device (an auxiliary storage device) 322, and has stored therein programs for perform-

ing the various kinds of processing to be described later and various kinds of data to be described later. The computation device 31 performs various kinds of processing by performing computation processing in accordance with the programs in the storage device 32. The computation device 31 also performs computations using the various kinds of data in the storage device 32 and stores results of the computations in the storage device 32.

[0043] The acceleration sensor 33 is a sensor that detects an acceleration. Since the management module 30 is attached to the drum 11, the acceleration sensor 33 detects acceleration of the drum 11. A six-axis acceleration sensor is used here as the acceleration sensor 33. Thus, the acceleration sensor 33 can detect accelerations of the drum 11 in six axis directions and is, as will be described later, capable of detecting the rotation direction, rotation angle, and the like of the drum 11. The acceleration sensor 33 is coupled to the computation device 31 via a bus and an interface (not shown). The computation device 31 performs computations based on the acceleration detected by the acceleration sensor 33 and stores the results of the computations in the storage device 32 as acceleration-related data.

[0044] The location measurement device 34 is a module (a receiver) that acquires location data. Since the management module 30 is attached to the drum 11, the location measurement device 34 can acquire the location data on the drum 11. The location measurement device 34 is, for example, a GPS module. The location measurement device 34 is coupled to the computation device 31 via a bus and an interface (not shown). Note that the management module 30 does not have to include the location measurement device 34. Also, the management module 30 may include the location measurement device 34 which is other than a GPS module.

[0045] The communication device 35 is a device that communicates data to and from the outside (e.g., the management computer 2). In the present embodiment, the communication device 35 is, for example, an LPWA communication module and is capable of long-distance communications using a wireless communication scheme. Note, however, that the communication device may be a communication module using a different wireless communication scheme, and may be a wired communication module such as USB or Ethernet (registered trademark).

[0046] Fig. 2B is a block diagram of various functions of the management module 30. The management module 30 has a controller 36 and a data storage part 37.

[0047] The controller 36 performs various kinds of control of the management module 30. The controller 36 is implemented when the computation device 31 executes a control program in the storage device 32 and thereby performs various kinds of control. The controller 36 has, for example, a communication controller 38 and a detector 39.

[0048] The communication controller 38 controls communications with the outside via the communication de-

vice 35. The communication controller 38 mainly transmits data to the outside (the management computer 2), but is also capable of receiving data from the outside. The communication controller 38 is implemented when the computation device 31 executes the control program in the storage device 32 and thereby controls the communication device 35.

[0049] The detector 39 detects various kinds of data via the acceleration sensor 33, the location measurement device 34, and the like. The detector 39 is implemented when the computation device 31 executes the control program in the storage device 32 and thereby processes signals from the acceleration sensor 33 and the location measurement device 34 and data stored in the storage device 32. The data detected by the detector 39 may be stored in the storage device 32 (the data storage part 37). Here, the detector 39 includes an acceleration detector 391, a location detector 392, a rotation direction detector 393, a rotation angle detector 395, a usage amount detector 394, a remaining amount detector 396, an installment detector 397, an abnormality detector 398, and the like.

[0050] The acceleration detector 391 detects acceleration of the drum 11 based on a signal from the acceleration sensor 33. The location detector 392 detects the location of the drum 11 based on signals from the acceleration sensor 33 and the location measurement device 34. The rotation direction detector 393 detects the rotation direction of the drum 11 based on a signal from the acceleration sensor 33. The rotation angle detector 395 detects the rotation angle of the drum 11 based on a signal from the acceleration sensor 33. The usage amount detector 394 detects the usage amount of a cable based on a signal from the acceleration sensor 33 and data stored in the storage device 32. The remaining amount detector 396 detects the remaining amount of the cable wound on the drum 11 (hereinafter referred to as the remaining amount of cable) based on a signal from the acceleration sensor 33 and the data stored in the storage device 32. The installment detector 397 detects the installment state of the cable based on signals from the acceleration sensor 33 and the location measurement device 34 and on data stored in the storage device 32. The abnormality detector 398 detects an abnormality in the drum 11 based on a signal from the acceleration sensor 33. Processing performed to implement each of these detectors 39 will be described later. The management module 30 does not have to include all the detectors 39 described above.

[0051] The data storage part 37 is a storage part in which to store predetermined data. The data storage part 37 is implemented by part of a storage region in the storage device 32. Here, the data storage part 37 stores therein drum data, cable data, acceleration-related data, and the like. Note, however, that data stored in the data storage part 37 is not limited to the above.

[0052] Note that the storage device 32 may be able to read and write various kinds of data from and to a storage

medium (such as, e.g., an SD card or a USB memory drive) attachable to and detachable from the management module 30. In this case, the data storage part 37 may store the drum data, the cable data, the acceleration-related data, and the like in a detachable storage medium.

[0053] The drum data is data related to the drum 11. Examples of the drum data include data on the identification number of the drum 11 (a drum ID), the type of the drum 11, the manufacturing time (the date of manufacturing) of the drum 11, and the like. In the present embodiment, the drum data also includes data on the diameter of the body portion 12 of the drum 11 (a drum diameter).

[0054] The cable data is data related to a cable. Examples of the cable data include data on the identification number of a cable (a cable ID), the type of the cable, the manufacturing time of the cable, and the like. In the present embodiment, the cable data also includes data on the thickness of the cable (a cable diameter).

[0055] The acceleration-related data is various kinds of data (computation results) obtained by the controller 36 (the computation device 31) by performing computations based on a signal from the acceleration sensor 33. Examples of the acceleration-related data include rotation angle data, usage amount data, remaining amount data, installment history data, and abnormality history data.

[0056] The rotation angle data is data indicative of the rotation angle of the drum 11 and detected by the rotation angle detector 395 based on a signal from the acceleration sensor 33. The usage amount data is data indicative of the usage amount of cable and detected by the usage amount detector 394 based on a signal from the acceleration sensor 33 (and data in the data storage part 37). The remaining amount data is data indicative of the remaining amount of cable and is detected by the remaining amount detector 396 based on a signal from the acceleration sensor 33 (and data in the data storage part 37). The installment history data is data indicative of a history of cable installment and detected by the installment detector 397 based on, e.g., a signal from the acceleration sensor 33 (and the location measurement device 34). The abnormality history data is data indicative of an abnormality history of the drum 11 and detected by the abnormality detector 398 based on a signal from the acceleration sensor 33.

[0057] As described above, the management module 30 attached to the drum 11 has the acceleration sensor 33, the computation device 31 that performs computations based on a signal (a detection result) from the acceleration sensor 33, and the storage device 32 in which to store the results of the computations.

[0058] Thus, compared to a case where, for example, a storage element is embedded in the cable, the cable can be reduced in thickness, and an increase in costs for the cable can be reduced. Also, there is less risk of the storage device 32 becoming damaged due to the

handling of the cable at the time of installment of the cable or due to the environment where the cable is installed. Providing the management module 30 to the drum 11 increases the costs for the drum 11, but unlike a cable, the drum 11 is reusable. In other words, after the entire cable is unreeled from the drum 11, a new cable can be wound on that drum 11. Thus, the management module 30 can be put to effective use. Also, the data stored in the storage device 32 is unlikely to be lost, unlike data printed on a cable or data on a tag attached to the drum. It is also possible to reduce incorrect inputs being made into the management computer 2 due to human error. Thus, more reliable cable management can be done easily.

[0059] Also, since the acceleration sensor 33 is attached to the drum 11, the controller 36 (the computation device 31) of the management module 30 can detect the rotation angle (and the rotation direction) of the drum 11 based on a signal from the acceleration sensor 33. In addition, based on the rotation angle (and the rotation direction) of the drum 11, the controller 36 can calculate the usage amount of cable and the remaining amount of cable (details will be given later). Thus, the usage amount of cable and the remaining amount of cable can be acquired in real time with high accuracy based on a signal provided by the acceleration sensor 33 when the drum 11 is actually rotated.

[0060] In one method of detecting rotation of a drum, the rotation amount of the drum may be detected indirectly by detecting the driving amount of a motor that rotates the drum. However, in a case where the elongated object wound on the drum 11 is a cable (an electric line cable or an optical cable), the drum may be rotated when the cable is unreeled from the drum 11 without use of power (as will be described later), and rotation of the drum may therefore be undetectable based on the driving amount of the motor. In a different method of detecting rotation of a drum, a sensor located to an outer part of the drum (e.g., a rotary encoder) may be used to detect rotation of the drum. However, in a case where the elongated object wound on the drum 11 is a cable (an electric line cable or an optical cable), the drum may be rolled over when the cable is unreeled from the drum 11 (as will be described later), which may make it not possible to dispose the sensor at the outer part of the drum 11. Thus, in a case where the elongated object wound on the drum 11 is a cable (an electric line cable or an optical cable), it is particularly advantageous to provide the management module having the acceleration sensor to the drum.

[0061] Additionally, at the site where the cable is installed, a necessary amount of cable can be easily unreeled based on the rotation angle and the rotation direction of the drum 11. Thus, wasteful cable unreeing can be reduced. Note that the methods for calculating the rotation angle and the rotation direction of the drum 11 based on a signal from the acceleration sensor 33 are publicly known and are therefore not described in detail

here.

[0062] Even in a case where the management module 30 does not have the acceleration sensor 33, the storage device 32 can have stored therein, for example, the cable's type, date of manufacturing, manufacturing number, lot number, and the like. However, when the management module 30 has the acceleration sensor 33, results of computations based on a signal from the acceleration sensor 33 (acceleration-related data such as the usage amount of cable, the remaining amount of cable, and an abnormality history of the drum) can also be stored in the storage device 32. Thus, more detailed cable management can be done easily.

[0063] Also, the management module 30 of the present embodiment has the communication device 35 that communicates with the outside. Thus, the management computer 2 communicatively coupled to the cable drum 10 can acquire the data stored in the data storage part 37 via the communication device 35. Unlike in a case where a storage element is embedded in the cable for example, an administrator does not need to go over to the place where the cable is installed to read data. This enables easy real-time management and follow-up checking of the usage situation of the cable or the cable drum 10.

[0064] Note, however, that the present invention is not limited to the above, and the management module 30 does not have to have the communication device 35. In this case as well, for example, data can be acquired at the site where the cable is installed or the place where the cable drum 10 is stored by coupling the management computer 2 to the cable drum 10 in a wired manner or from a storage medium attachable to and detachable from the management module 30. Also there are cases where the cable drums 10 having no communication device 35 are used in a plurality of sites. To do a follow-up check on these cable drums 10, the data can be acquired by going over only to the place where the cable drums 10 are stored. Thus, unlike a case where data is embedded in a cable, there is no need to go over to each of the installed places, allowing the follow-up check to be done easily.

[0065] In addition, preferably, the management module 30 is detachably attached to the drum 11. Thus, for example, the management module 30 can be removed from a damaged drum 11 and attached to a different drum 11, so that the management module 30 can be put to effective use. Also, there are countries and districts where fumigation is mandatory for the export and import of wooden drums 11. In such a case, fumigation can be performed with the management module 30 removed from the drum 11, and thus the management module 30 can be prevented from being damaged by the fumigation. Note, however, that the present invention is not limited to the above, and the management module 30 can be attached to the drum 11 in an unremovable manner.

<<Method for Managing the Cable Drum 10>>

[0066] Next, descriptions are given of the cable drum 10 and of how the cable management system 1 manages the cable drum 10.

<Management Method 1: Cable Remaining Amount Detection Method 1>

[0067] Fig. 3 is a flowchart of remaining amount detection processing performed by the controller 36 (the remaining amount detector 396). Figs. 4A to 4C are diagrams illustrating an example state of the cable drum 10 at the time of acceleration detection. Note that the remaining amount detection processing also includes acceleration detection processing, rotation direction detection processing, rotation angle detection processing, usage amount detection processing, and the like.

[0068] To install a cable 40 (see Fig. 4A), the cable drum 10 is rotated about the shaft hole 14 to unreel the cable 40 from the cable drum 10. In the descriptions below, the rotation direction of the drum 11 shown in Fig. 4A may be referred to as an "unreeling direction." To cause the cable 40 which has been drawn to be collected onto the cable drum 10 (see Fig. 4B), the cable drum 10 is rotated about the shaft hole 14. In the descriptions below, the rotation direction of the drum 11 shown in Fig. 4B may be referred to as a "reeling direction."

[0069] First, the controller 36 (the rotation direction detector 393 and the rotation angle detector 395) detects the rotation angle and the rotation direction of the drum 11 based on a signal from the acceleration sensor 33 (S101). It is determined herein that the drum 11 is rotated in the unreeling direction when the rotation angle of the drum 11 is a positive value. This is preset in the storage device 32 of the management module 30 (a program for performing the rotation direction detection processing) based on the direction in which the cable 40 is wound on the drum 11 and the position where the acceleration sensor 33 is attached. Thus, the rotation direction detector 393 determines that the drum 11 is rotated in the unreeling direction when the rotation angle of the drum 11 detected is a positive value, and conversely, the rotation direction detector 393 determines that the drum 11 is rotated in the reeling direction when the rotation angle of the drum 11 is a negative value.

[0070] Next, the controller 36 calculates an unreeling diameter R1 (see Fig. 4A) based on remaining amount data stored in the data storage part 37 (the storage device 32) (S102). Specifically, first, the controller 36 acquires data on the drum diameter (the diameter of the body portion 12 of the drum 11), data on the cable diameter, and remaining amount data indicative of the remaining amount of cable which are stored in the data storage part 37. Next, based on the cable diameter data and the remaining amount data, the controller 36 calculates the thickness T of the cable 40 wound around the body portion 12. Then, the controller 36 calculates the unreeling

diameter R1 by adding a drum diameter Rd and the thickness T.

[0071] Note that the present invention is not limited to a mode where the controller 36 calculates the unreeling diameter R1 based on the remaining amount of cable. For example, when the drum 11 is relatively small in size, the unreeling diameter R1 may be constant. Also, for example, the data storage part 37 may store a table in which the remaining amount of cable and the unreeling diameter R1 are associated with each other, and the controller 36 may refer to the table and acquire the unreeling diameter R1 in association with the remaining amount of cable.

[0072] Next, the controller 36 (the usage amount detector 394) calculates the usage amount of the cable 40 (S103). Here, the controller 36 calculates the usage amount of the cable 40 (or the amount of cable collected in a case of a negative value) by multiplying the rotation angle detected in S101 by the unreeling diameter R1 calculated in S102 (or by the perimeter length of the cable 40 wound on the drum 11).

[0073] Specifically, when the rotation direction of the drum 11 agrees with the direction for unreeling the cable 40, the controller 36 calculates the amount of cable unreeling based on the rotation angle of the drum 11 and the unreeling diameter R1. When the rotation direction of the drum 11 agrees with the direction for reeling the cable 40, the controller 36 calculates the amount of the cable 40 reeled based on the rotation angle of the drum 11 and the unreeling diameter R1. Then, the controller 36 calculates the amount of the cable 40 used (or collected) based on the amount of the cable 40 unreeling and the amount of the cable 40 reeled.

[0074] Next, the controller 36 calculates the remaining amount of cable (S104). Specifically, the controller 36 calculates a new remaining amount of cable by subtracting the usage amount of cable (or the amount of cable collected) calculated in S103 from the remaining amount of cable acquired in S102 (i.e., the remaining amount of the cable 40 wound on the drum 11 before use of the cable 40).

[0075] Next, the controller 36 stores the new remaining amount of cable calculated in S104 in the data storage part 37, updating the remaining amount data in the data storage part 37 (S105). Thus, the controller 36 is to perform next remaining amount detection processing based on the remaining amount data thus updated. The controller 36 may also transmit the remaining amount of cable calculated to the management computer 2.

[0076] As described above, the remaining amount of cable on the cable drum 10 can be detected in real time based on a signal (the rotation angle of the drum 11) from the acceleration sensor 33 attached to the drum 11, and the remaining amount of cable in the data storage part 37 can be updated as needed.

[0077] Note, however, that the present invention is not limited to also calculating the remaining amount of cable. For example, the rotation angle (and the rotation direc-

tion) of the drum 11 and the usage amount of the cable 40 may be detected in real time, and those pieces of data may be stored in the data storage part 37. In that case, the management computer 2 may calculate the usage amount of cable based on the rotation angle of the drum and the remaining amount of cable based on the usage amount of cable.

[0078] In the cable remaining amount detection method described above, the controller 36 detects the rotation direction of the drum 11 based on a signal from the acceleration sensor 33, determines whether the rotation direction of the drum 11 is the cable unreeling direction, and calculates the amount of cable used (or collected). Thus, the usage amount of cable and the remaining amount of cable can be calculated more accurately than in a case where they are calculated based on, for example, the absolute value of the rotation angle of the drum 11 irrespective of the rotation direction of the drum 11.

[0079] Also, like in a case shown for example in Fig. 4C, the acceleration sensor 33 may possibly detect acceleration of the drum 11 due to vibration or the like caused when the cable drum 10 is transported by a truck 41. In this case, however, the controller 36 detects that the drum 11 is not rotated, and therefore can determine in this case that the cable 40 is not used and that there is no change in the remaining amount of cable.

<Management Method 2: Cable Remaining Amount Detection Method 2>

[0080] Fig. 5 is a flowchart of different remaining amount detection processing by the controller 36. Figs. 6A to 6C are diagrams illustrating an example state of the cable drum 10 at the time of acceleration detection. As shown in Fig. 6A, there are cases where the drum 11 is moved while rotating.

[0081] After detecting the rotation angle (and the rotation direction) of the drum 11 due to rotation of the drum 11 (S101), the controller 36 determines, based on signals (detection results) from the acceleration sensor 33 and the location measurement device 34, whether the drum 11 is in motion (S201). In the case where determining that the drum 11 is not in motion (NO in S201), the controller 36 performs the processing in S102 to S105 to calculate the usage amount of cable and the remaining amount of cable and update the remaining data, similarly with the remaining amount detection processing in Fig. 3 described above.

[0082] In the case where the drum 11 is in motion while rotating (YES in S201), the controller 36 determines whether the rotation direction of the drum 11 is the unreeling direction (S202). In the case where the rotation direction of the drum 11 agrees with the direction for unreeling the cable 40 (YES in S202), the controller 36 determines that the cable 40 is being installed as shown in Fig. 6B (S203), performs the processing in S102 to S105 to calculate the usage amount of cable and the remaining amount of cable and update the remaining amount data.

By contrast, in the case where the rotation direction of the drum 11 agrees with the direction for reeling the cable 40 (NO in S202), the controller 36 determines that the drum 11 is simply moving as shown in Fig. 6C (S204). Since the cable is not consumed, the processing ends without calculating the usage amount of cable and the remaining amount of cable and without updating the remaining amount data.

[0083] When the management module 30 has the location measurement device 34 for the drum 11, the remaining amount detection processing shown in Fig. 5 can be performed, so that not only the situations shown in Figs. 4A to 4C, but also the situations shown in Figs. 6A to 6C can be taken into account. Thus, the usage amount of cable and the remaining amount of cable can be calculated more accurately.

<Management Method 3: Method for Managing Installment History>

[0084] Fig. 7 is a diagram illustrating installment history data. As already described, the controller 36 can calculate the usage amount of cable based on a signal from the acceleration sensor 33 (see S103). Thus, upon detection of cable usage, the controller 36 (the installment detector 397) may create installment data by assigning an ID (#1, #2, ...) and associating the date and time of the detection, the location data on the drum 11 (i.e., the installed location of the cable) based on a signal from the location measurement device 34, and the usage amount of cable and the remaining amount of cable (i.e., computation results based on a signal from the acceleration sensor 33) with one another. The installment history data (Fig. 7) is created by accumulation of the installment data. The controller 36 stores the installment history data in the data storage part 37. Also, the controller 36 may transmit the installment history data to the management computer 2.

[0085] When installment history data is thus automatically created by the management module 30, real-time management and a follow-up check on the usage status of the cable can be performed easily. It is also possible to reduce incorrect inputs due to human error, and cable management can be done reliably.

[0086] Note that the installment history data shown in Fig. 7 is an example, and the present invention is not limited to this. For example, the data may be without the installment date and time, may have only either the usage amount of cable or the remaining amount of cable, or may have the rotation angle of the drum 11.

<Management Method 4: Method for Managing Abnormality History>

[0087] Fig. 8A is a diagram illustrating abnormality history data. Fig. 8B is a diagram illustrating a state of the cable drum 10 at the time of abnormality detection. As shown in Fig. 8B, in the case where a forklift 42 is erro-

neously operated (to, e.g., widen the width of the fork) during transportation of the cable drums 10, the cable drums 10 may fall and be damaged.

[0088] The controller 36 (the abnormality detector 398) can detect an impact on (an abnormality in) the drum 11 based on a signal from the acceleration sensor 33. Specifically, the controller 36 can detect vibration of the drum 11 based on a detection result from the acceleration sensor 33. Thus, it can be determined that the cable drum 10 has received an impact when vibration of the drum 11 is a threshold or greater. Note that the method for calculating vibration of the drum 11 based on a signal from the acceleration sensor 33 is publicly known and is therefore not described in detail here.

[0089] Upon detection of an impact on the drum 11, the controller 36 may create drum abnormality data by assigning an abnormality ID (#1, #2, ...) and associating the date and time of the detection with the location data on the drum 11 (i.e., the abnormality occurrence location where the drum 11 received the impact) based on a signal from the location measurement device 34. Note that the controller 36 may also associate the level of abnormality in accordance with the intensity of the impact (vibration) received by the drum. The abnormality history data (Fig. 8A) is created by accumulation of the drum abnormality data. The controller 36 stores the abnormality history data in the data storage part 37. The controller 36 may also transmit the abnormality history data to the management computer 2.

[0090] When the abnormality history data is thus automatically created by the management module 30, the administrator can determine how much the drum 11 is damaged and do a follow-up check on the place where the cable from the damaged drum 11 was installed. It is also possible to reduce incorrect inputs due to human error, and management of the cable and the drum 11 can be done reliably.

[0091] Note that the abnormality history data shown in Fig. 8A is an example, and the present invention is not limited to this. For example, the data may be without the abnormality occurrence date and time, or the data may be without the abnormality occurrence position and instead have stored therein only the fact that the drum 11 has received an impact.

[0092] Also, as shown in Fig. 1A, the management computer 2 may receive data from a plurality of cable drums 10. For this reason, when the controller 36 (the communication controller 38) of the management module 30 transmits the installment history data or the abnormality history data to the management computer 2 via the communication device 35, the data transmitted may have associated therewith data such as a drum ID and a cable ID.

<Management Method 5: Inventory Management Method>

[0093] Fig. 9A is a diagram illustrating an installment

history database created by the management computer 2. When communicatively coupled to a plurality of cable drums 10, the management computer 2 may create a database in which data received from the plurality of cable drums 10 (i.e., such as computation results based on signals from the acceleration sensor 33) are associated with the corresponding cable drums 10 and have the database stored therein. For example, the controller (not shown) of the management computer 2 may create an installment history database using the installment history data received and store the installment history database in the storage part (not shown) of the management computer 2. The plurality of cable drums 10 can thus be managed centrally.

[0094] In the installment history database shown in Fig. 9A, the installment history data is accumulated for each drum ID identifying the cable drum 10. The installment history data includes the ID and type of the cable wound on the cable drum 10, the remaining amount of cable, the current location of the cable drum 10, the installment date and time data, the installed location data, and the usage amount data. This installment history database can be used for inventory management. Also, based on the current location of the cable drum 10, the drum 11 from which the entire cable has been unreeled can be collected for reuse of the drum 11.

[0095] Fig. 9B is a diagram illustrating an example usage of the installment history database. The graph shown in Fig. 9B shows the progression of the usage amount of a given cable for each country (JP is Japan, US is the United States, and CN is China), the horizontal axis representing date and the vertical axis representing the usage amount of the cable. A graph showing the progression of the usage amount for each area (e.g., a country or a district) as shown in Fig. 9B can be easily created using the installment history database.

[0096] For example, the administrator can analyze based on the graph shown in Fig. 9B that the cable being analyzed is being used increasingly in China. As a result, a telecommunications carrier or a construction company can order more of the cable for China, or a cable manufacturing company can manufacture more of the cable for China. In this way, the installment history database can be used as a reference for evaluation of a logistics system for the cable. This consequently can prevent stagnation in the cable installment construction. It is also possible to lay an efficient cable production plan.

[0097] Also, the installment history database can be used to easily create, for example, a graph showing the progression of the usage amount of cable and the remaining amount of cable for each cable type, although such a graph is not shown. Such a graph can be used to analyze as to what type of cable should be ordered more or produced more.

[0098] Figs. 10A and 10B are diagrams illustrating another usage of the installment history database. Fig. 10A is a screen displayed by the management computer 2 for entering inventory search inputs, and Fig. 10B is a

screen displayed by the management computer 2 to show inventory search results. The management computer 2 having the installment history database (Fig. 9A) stored therein allows an administrator (such as, for example, a construction company) to make an inventory search by inputting information related to a cable that they want to use, as shown in Fig. 10A. Examples of information inputted include the type of the cable, an area for which the cable is wanted, the scheduled date for installment, and the estimated amount of cable to be used.

[0099] Once conditions are input, the management computer 2 extracts a cable drum 10 that meets the conditions from the installment history database. Specifically, the cable drum 10 extracted is one on which the cable of the type inputted is wound, whose current location is the same location as the area inputted, and on which the cable remaining is more than the estimated amount of cable to be used. Then, as shown in Fig. 10B, the management computer 2 displays the ID of the extracted cable drum 10 along with, for example, the cable ID, the remaining amount of cable, and the current location of the cable drum 10 (preferably a more specific location than the area inputted). Based on the results of the inventory search done by the management computer 2, the administrator can make evaluations about the cable drum 10 to use.

[0100] In this way, the management computer 2 can determine the cable drum 10 that meets the conditions as shown in Fig. 10B based on the inputted conditions for the cable drum 10 and the installment history database. As a result, the administrator can easily manage, e.g., plans for using the cable drums 10 owned by them.

===Other===

[0101] The embodiment described above has been provided to facilitate the understanding of the present invention, and not to give a limited interpretation of the present invention. It goes without saying that the present invention may be changed or modified without departing from the gist thereof and includes those equivalents as well.

[Reference Signs List]

[0102]

1 management system
2 management computer
2A management server
2B management terminal
3 communication network
10 cable drum
11 drum
12 body portion
13 flange portion
30 management module

31 computation device
32 storage device
321 main storage device
322 secondary storage device
33 acceleration sensor
34 location measurement device
35 communication device
36 controller
37 data storage part
40 cable
41 truck
42 forklift
R1 cable unreeling diameter

Claims

1. An elongated-object drum, comprising:

a drum on which to wind an elongated object;
and
a management module attached to the drum,
wherein
the management module includes

an acceleration sensor configured to detect acceleration of the drum,
a computation device configured to perform computation based on a detection result from the acceleration sensor, and
a storage device configured to store therein a computation result obtained by the computation device by performing the computation based on the detection result from the acceleration sensor.

2. The elongated-object drum according to claim 1, wherein
based on the detection result from the acceleration sensor, the computation device is configured to determine whether a rotation direction of the drum is a direction for unreeling the elongated object.

3. The elongated-object drum according to claim 1 or 2, wherein
the computation device is configured to detect a rotation angle of the drum based on the detection result from the acceleration sensor.

4. The elongated-object drum according to claim 3, wherein
the computation device is configured to calculate a usage amount of the elongated object based on the rotation angle of the drum.

5. The elongated-object drum according to claim 4, wherein

- the computation device is configured to acquire an unreeling diameter of the elongated object wound on the drum and also to detect the rotation direction of the drum based on the detection result from the acceleration sensor,
- the computation device is configured to calculate an amount of the elongated object unreeling based on the rotation angle of the drum and the unreeling diameter in a case where the rotation direction of the drum is same as a direction for unreeling the elongated object,
- the computation device is configured to calculate an amount of the elongated object reeling based on the rotation angle of the drum and the unreeling diameter in a case where the rotation direction of the drum is same as a direction for reeling the elongated object, and
- the computation device is configured to calculate a usage amount of the elongated object based on the amount of the elongated object unreeling and the amount of the elongated object reeling.
6. The elongated-object drum according to any one of claims 3 to 5, wherein the computation device is configured to calculate a remaining amount of the elongated object based on the rotation angle of the drum.
7. The elongated-object drum according to claim 6, wherein
- the computation device is configured to acquire the remaining amount of the elongated object wound on the drum before use of the elongated object from the storage device,
- by subtracting a usage amount of the elongated object from the remaining amount of the elongated object, the computation device is configured to calculate a new remaining amount of the elongated object, and
- the storage device is configured to store therein the new remaining amount of the elongated object.
8. The elongated-object drum according to any one of claims 1 to 7, wherein the computation device is configured to detect an abnormality in the drum based on the detection result from the acceleration sensor.
9. The elongated-object drum according to any one of claims 1 to 8, wherein the management module has a location measurement device capable of acquiring location data on the drum.
10. The elongated-object drum according to claim 9,
- wherein
- the storage device is configured to store therein the computation result and the location data on the drum in association with each other.
11. The elongated-object drum according to claim 9 or 10, wherein
- in a case where determining based on detection results from the acceleration sensor and the location measurement device that the drum is rotated and is not in motion, the computation device is configured to calculate a usage amount of the elongated object, and
- in a case where determining based on the detection results from the acceleration sensor and the location measurement device that the drum is rotated and is in motion, the computation device is configured to calculate the usage amount of the elongated object when the rotation direction of the drum is same as a direction for unreeling the elongated object and is configured not to calculate the usage amount of the elongated object when the rotation direction of the drum is same as a direction for reeling the elongated object.
12. The elongated-object drum according to any one of claims 1 to 11, wherein the management module has a communication device configured to communicate with an outside.
13. The elongated-object drum according to any one of claims 1 to 12, wherein the management module is detachably attached to the drum.
14. The elongated-object drum according to any one of claims 1 to 13, wherein the elongated object is a cable.
15. A management computer comprising:
- a communication part capable of communicating with an elongated-object drum on which an elongated object is wound; and
- a storage part configured to store management data, wherein
- the management computer is configured to receive via the communication part, from the elongated-object drum having an acceleration sensor, a computation result which is based on a detection result from the acceleration sensor, and
- the management computer is configured to store, in the storage part, the management data in which the elongated-object drum and the computation result are associated with each other.

16. The management computer according to claim 15, wherein

the management computer is configured to receive the computation result from a plurality of the elongated-object drums, and
the management computer is configured to store, in the storage part, a database in which each of the elongated-object drums is associated with the corresponding computation result as the management data.

17. The management computer according to claim 16, wherein

based on the database and a condition inputted regarding the elongated-object drum, the management computer is configured to determine the elongated-object drum that meets the condition.

18. An elongated-object management system comprising:

an elongated-object drum; and
a management computer communicatively coupled to the elongated-object drum, wherein the elongated-object drum, the management module has

an acceleration sensor configured to detect acceleration of the drum,
a computation device configured to perform computation based on a detection result from the acceleration sensor,
a storage device configured to store therein a computation result obtained by the computation device by performing the computation based on the detection result from the acceleration sensor, and
a communication device configured to communicate with the management computer.

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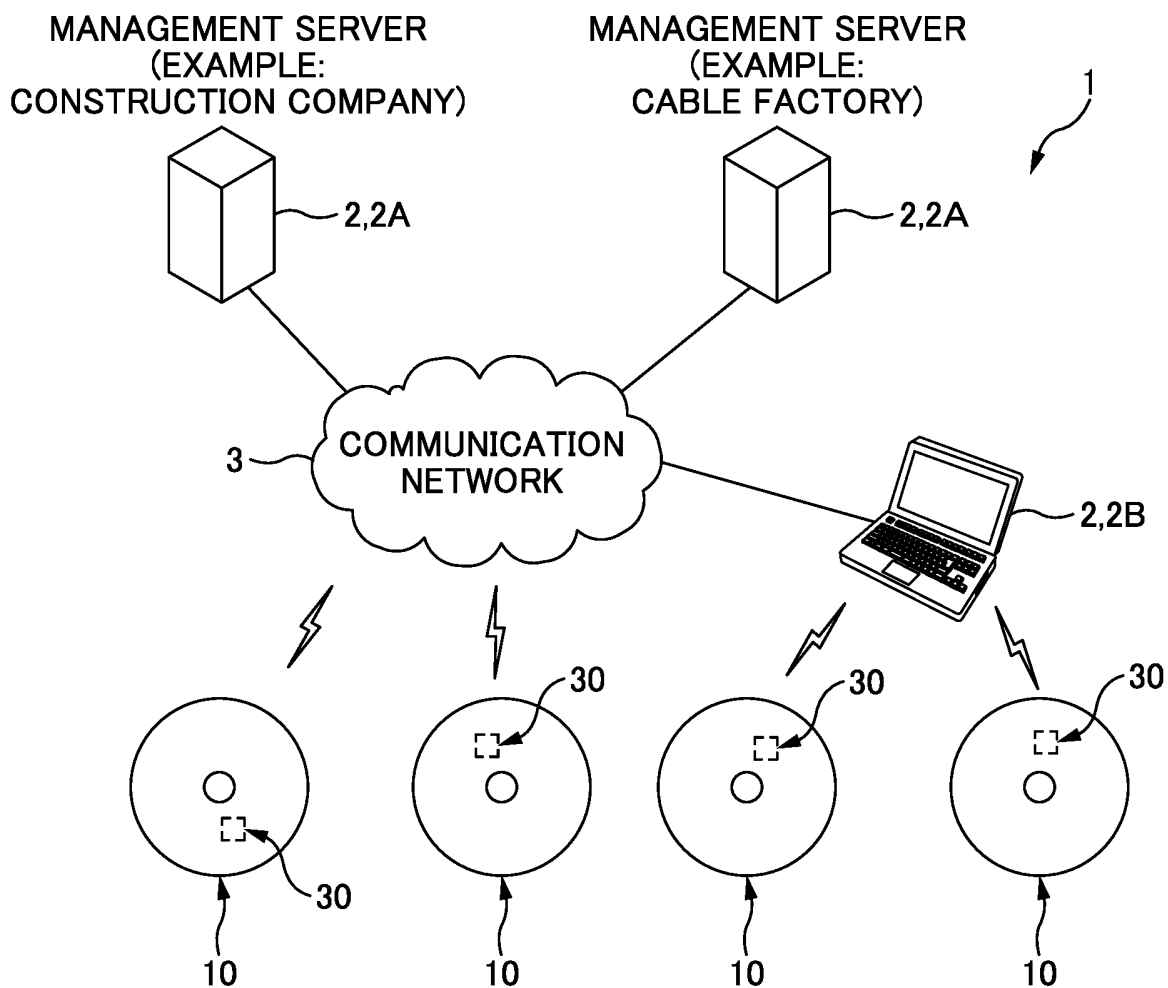


FIG. 1A

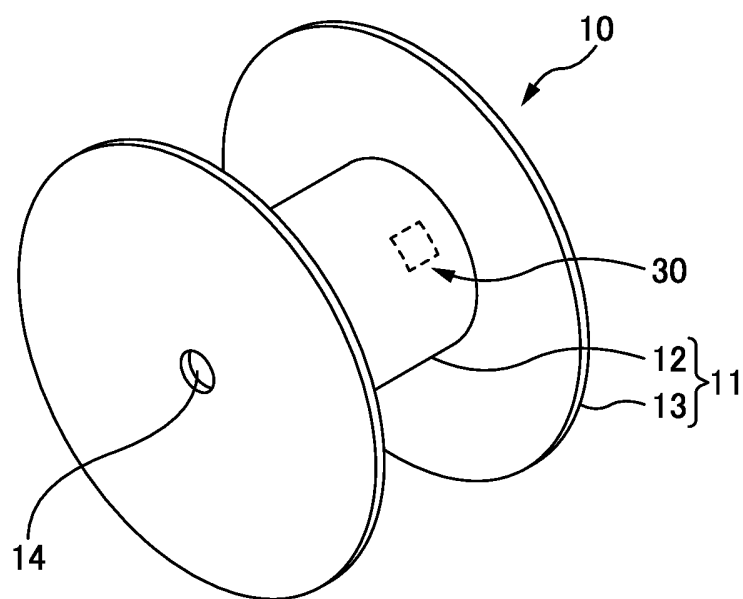


FIG. 1B

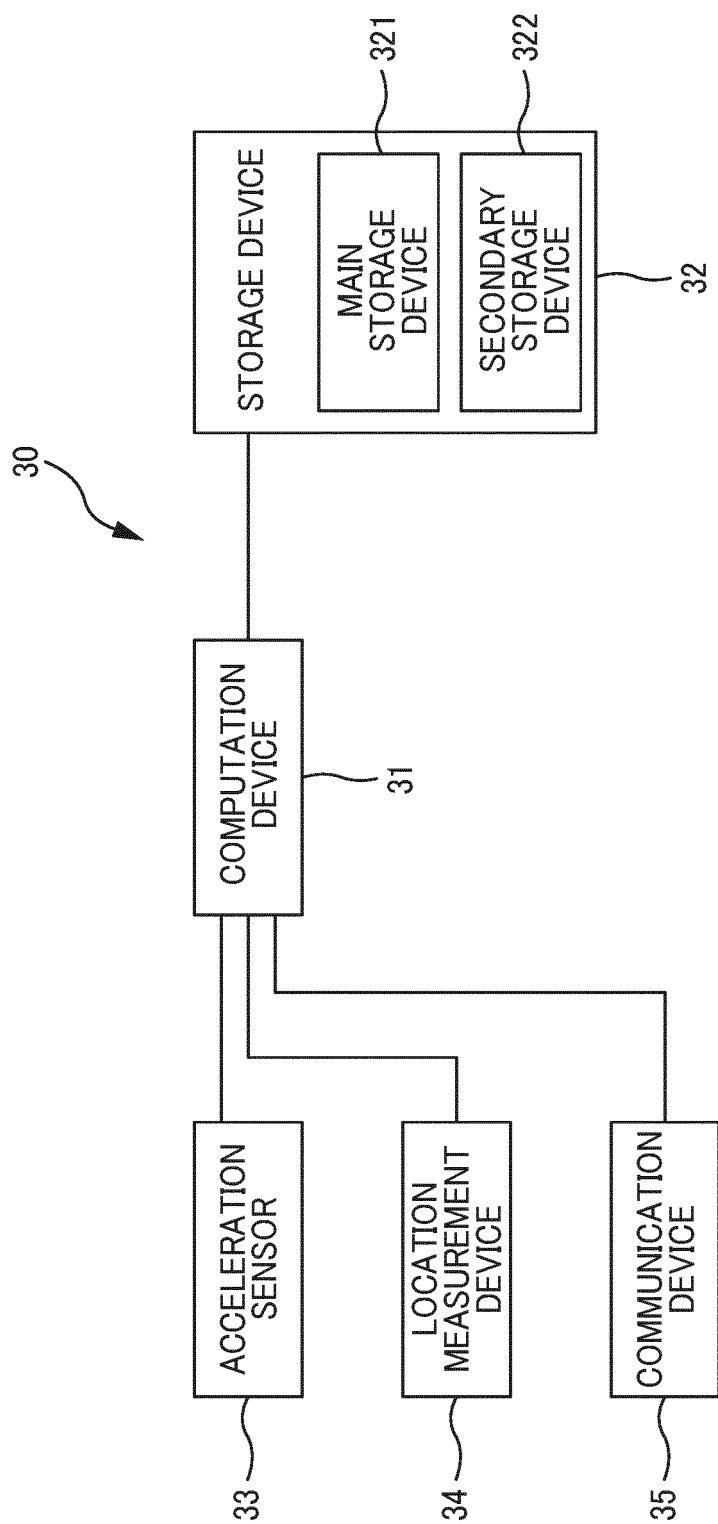


FIG. 2A

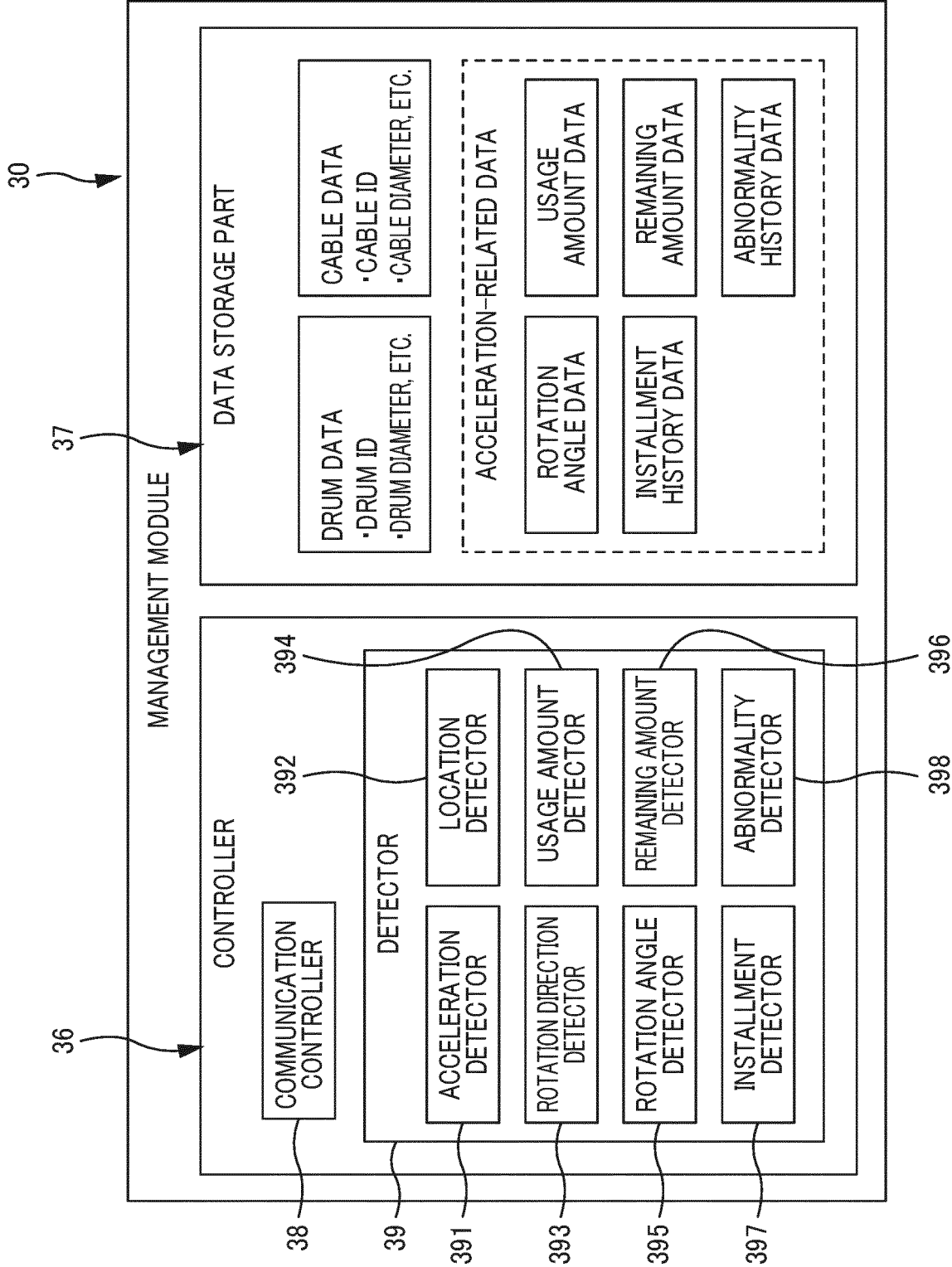


FIG. 2B

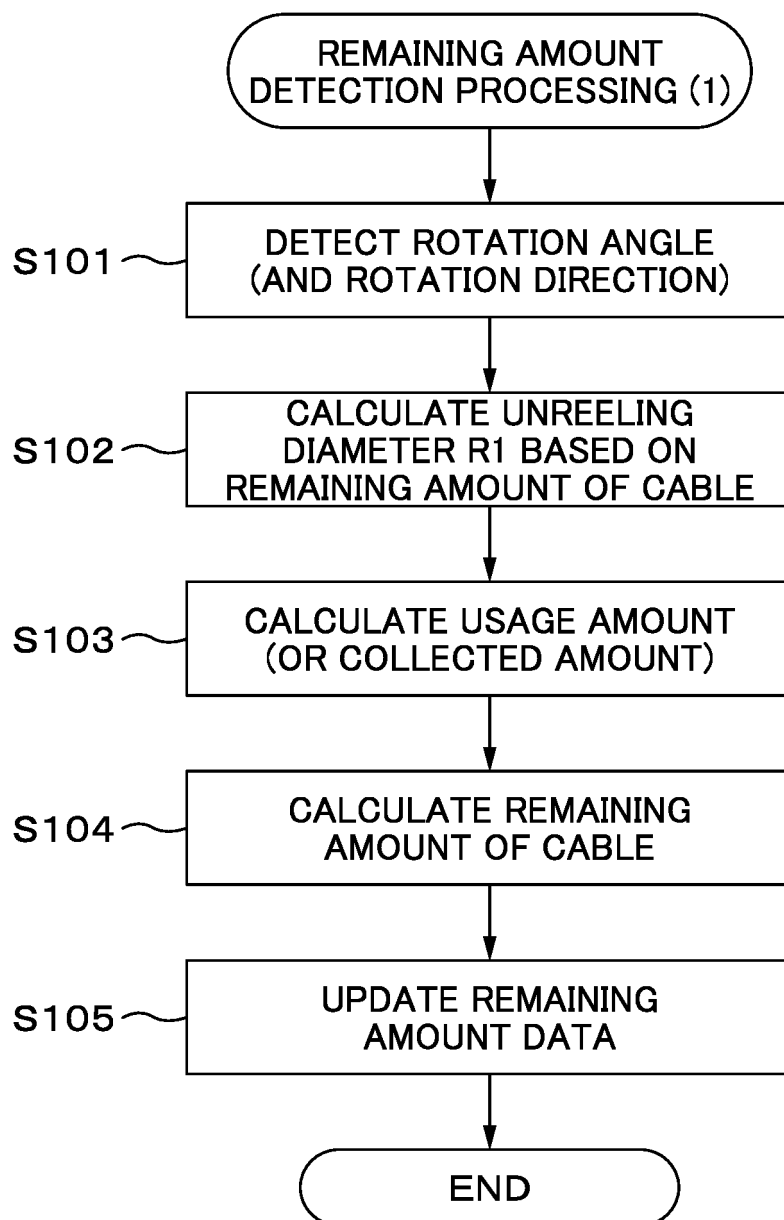
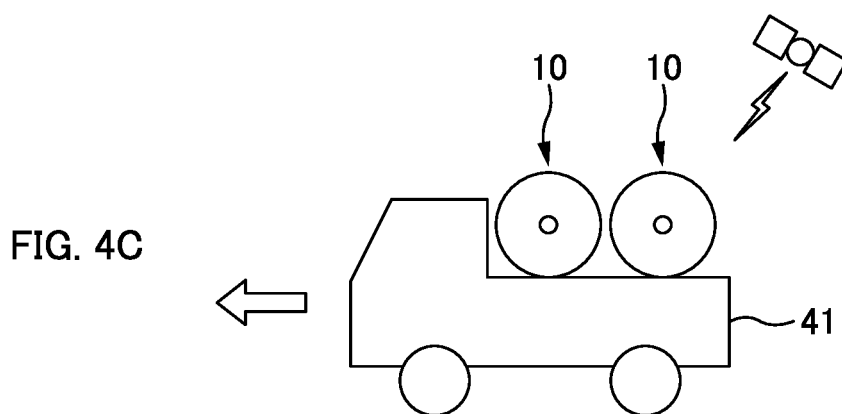
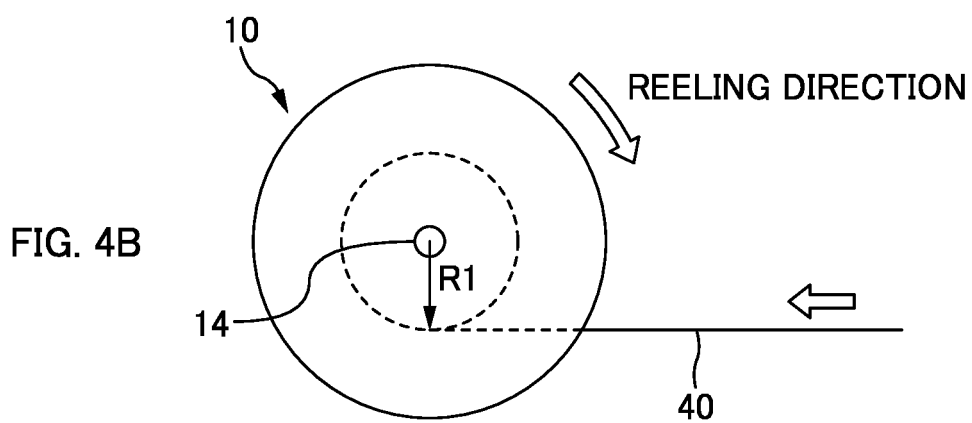
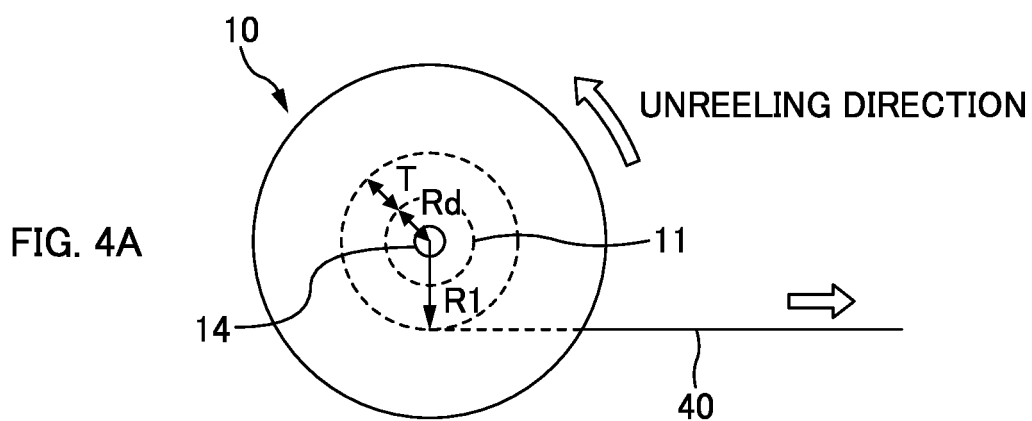


FIG. 3



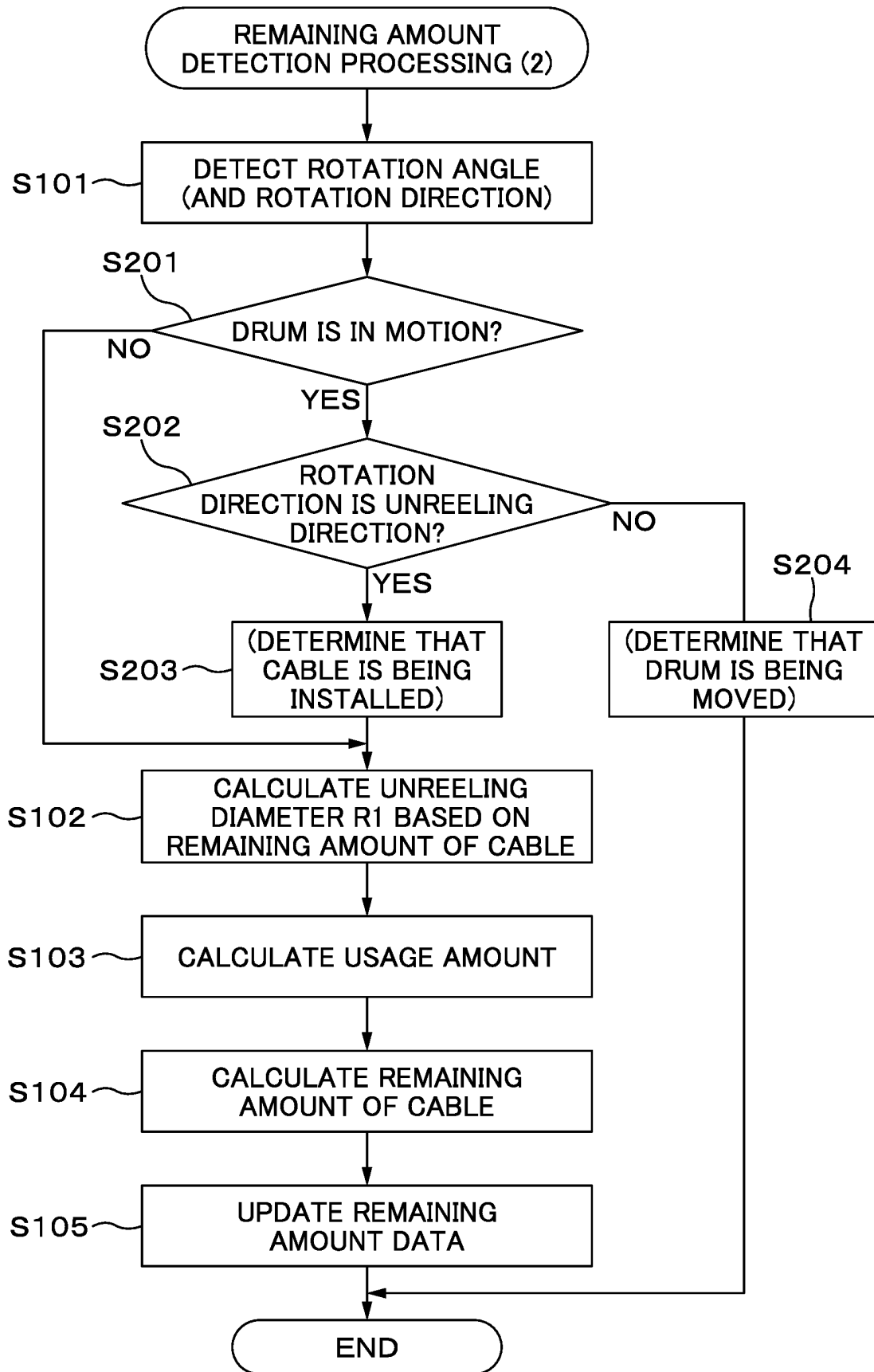


FIG. 5

FIG. 6A

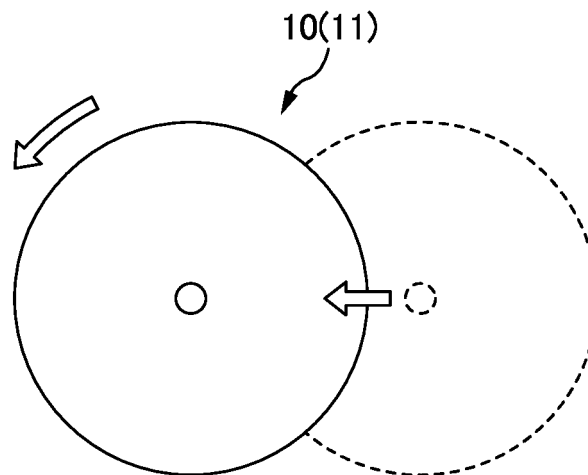


FIG. 6B

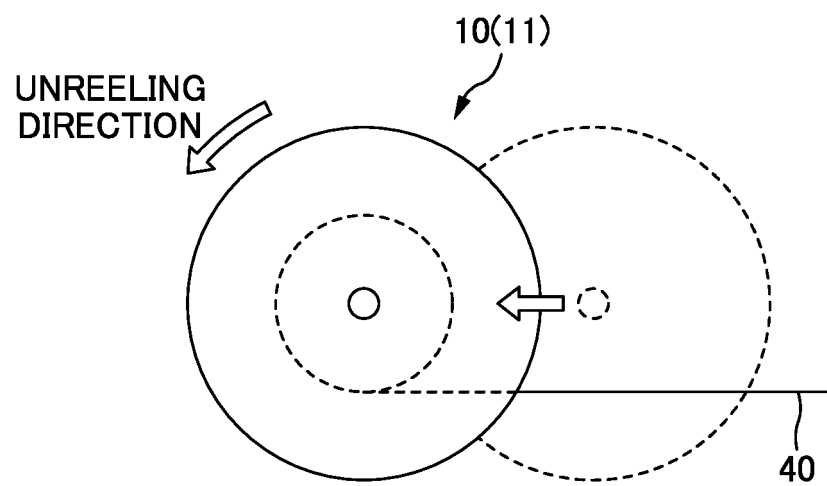
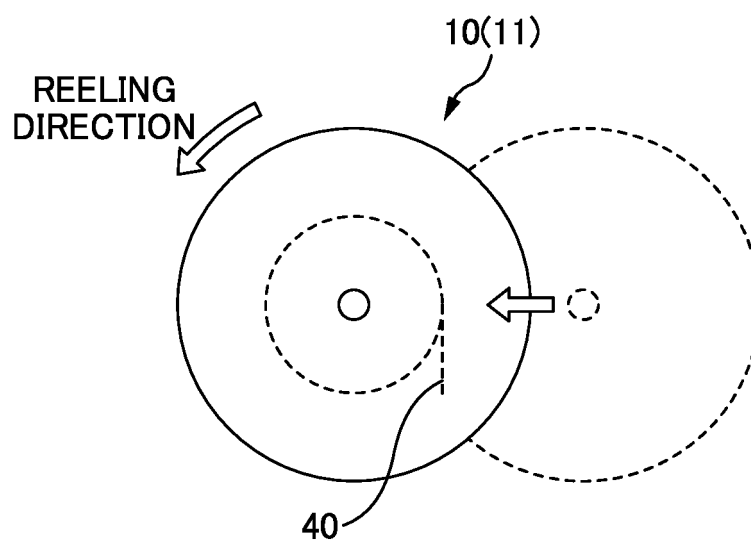


FIG. 6C



INSTALLMENT HISTORY DATA				
INSTALLMENT ID	INSTALLMENT DATE AND TIME	INSTALLED LOCATION	USAGE AMOUNT	REMAINING AMOUNT
# 1	2018-04-03 13:30	LATITUDE: 35.701292 LONGITUDE: 140.220595	1 140m	—
# 2	2018-04-04 09:15	LATITUDE: 35.668074 LONGITUDE: 139.803488	2 100m	2 760m

FIG. 7

ABNORMALITY HISTORY DATA			
ABNORMALITY ID	ABNORMALITY OCCURRENCE DATE AND TIME	ABNORMALITY OCCURRENCE LOCATION	LEVEL
#1	2018-04-05 11:45	LATITUDE: 35.641961 LONGITUDE: 139.742062	LEVEL 1
#2	2018-04-06 17:00	LATITUDE: 35.671027 LONGITUDE: 139.745847	LEVEL 2

FIG. 8A

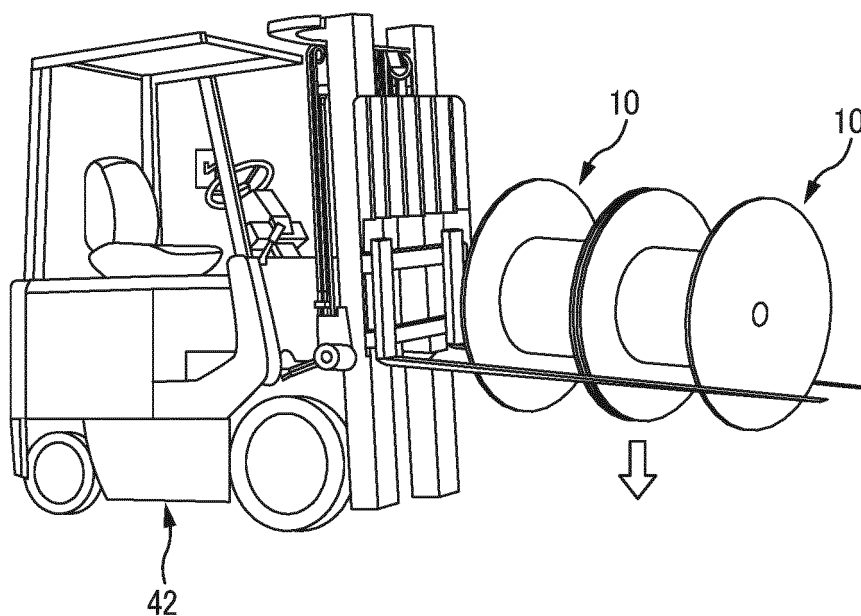


FIG. 8B

DRUM ID	CABLE ID	CABLE TYPE	REMAINING AMOUNT	CURRENT LOCATION	INSTALLMENT HISTORY DATA			
					INSTALLMENT ID	INSTALLMENT DATE AND TIME	INSTALLED LOCATION	USAGE AMOUNT
DRUM 01	CABLE 01	CABLE A	2760m	☆☆☆☆☆	# 1	2018-04-03 13:30	LATITUDE: 35.701292 LONGITUDE: 140.220595	1140m
					# 2	2018-04-04 09:15	LATITUDE: 35.668074 LONGITUDE: 139.803488	2100m
DRUM 02	CABLE 02	CABLE B	5210m	○○○	# 1	2018-04-05 10:00	LATITUDE: 35.641961 LONGITUDE: 139.742062	560m
					# 2	2018-04-06 15:00	LATITUDE: 35.671027 LONGITUDE: 139.745847	230m

FIG. 9A

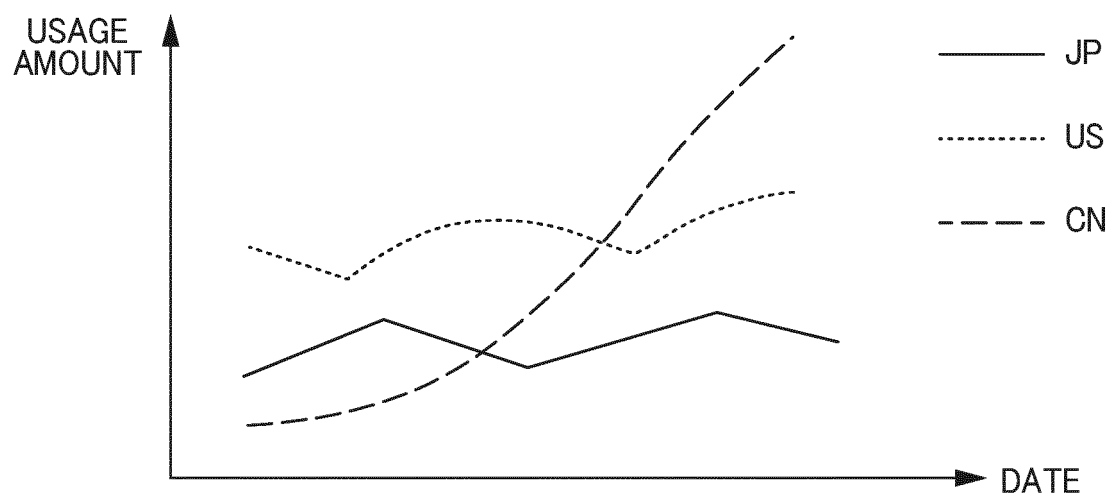


FIG. 9B

INVENTORY SEARCH		(INPUT CONDITIONS)	✕
CABLE TYPE CABLE ▽		AREA TOKYO: JP ▽	
SCHEDULED DATE FOR INSTALLMENT 2018 YEAR 4 MONTH 5 DAY			
ESTIMATED USAGE AMOUNT 1000 m			
START SEARCH			

FIG. 10A

INVENTORY SEARCH (SEARCH RESULTS)			×
DRUM ID	CABLE ID	REMAINING AMOUNT OF CABLE	CURRENT LOCATION
△△	□□	* * * *	☆☆☆☆
⋮	⋮	⋮	⋮

FIG. 10B

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2019/042513

A. CLASSIFICATION OF SUBJECT MATTER

Int.Cl. B65H75/14 (2006.01) i, B65H75/18 (2006.01) i
 FI: B65H75/18Z, B65H75/14

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)

Int.Cl. B65H75/00-75/50, B65H23/18-23/198, B65H26/00-26/08, B65H61/00-63/08

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	1971-2020
Registered utility model specifications of Japan	1996-2020
Published registered utility model applications of Japan	1994-2020

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 2013-220863 A (MS TECHNOLOGY KK) 28.10.2013	1, 8, 12-18
Y	(2013-10-28), paragraphs [0038]-[0102], fig. 1-13	1-4, 6-7, 12-18
A		5, 9-11
Y	JP 2017-165540 A (CASIO COMPUTER CO., LTD.) 21.09.2017	1-4, 6-8, 12-18
A	(2017-09-21), paragraph [0089] paragraphs [0021]-[0098], fig. 1-7	5, 9-11
Y	JP 2009-269713 A (CANON INC.) 19.11.2009 (2009-11-19),	8
A	paragraph [0019], entire text, all drawings	1-7, 9-18
E, X	JP 2019-218201 A (FUJIKURA LTD.) 26.12.2019	1-15
	(2019-12-26), claims 1-18	



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

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Information on patent family members

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PCT/JP2019/042513

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