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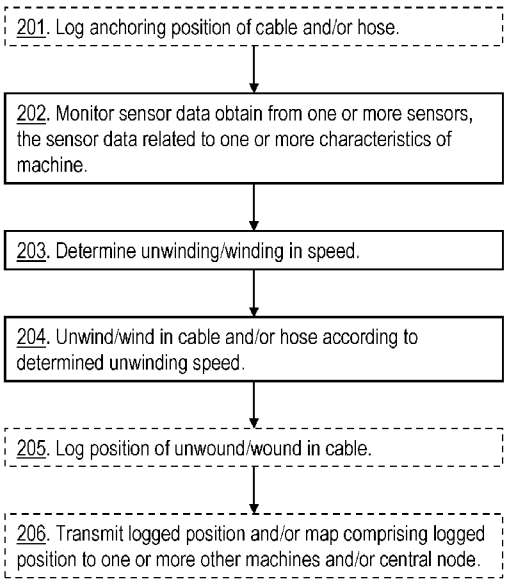

Fig. 2

(57) Abstract: A method performed by a controller unit for controlling an unwinding of a cable and/or hose is provided. The cable and/or hose is stored on a cable and/or hose reel mounted on a machine. The controller unit monitors (202) sensor data obtained from one or more sensors comprised in the machine. The sensor data is related to one or more characteristics of the machine. The controller unit determines (203), based on the one or more characteristics, an unwinding speed to use for unwinding the cable and/or hose. The controller unit unwinds (204) the cable and/or hose by controlling a rotational speed of the cable and/or hose reel upon which the cable and/or hose is stored such that the cable and/or hose is unwound according to the determined unwinding speed.

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MACHINE, CONTROLLER UNIT AND METHOD THEREIN FOR UNWINDING AND/OR WINDING IN A CABLE AND/OR HOSE

TECHNICAL FIELD

Embodiments herein relate to a method and arrangement for controlling unwinding and/or winding in of a cable and/or hose stored on a cable and/or hose reel comprised on machine.

BACKGROUND OF THE INVENTION

When using a cable and/or hose reel and winding out or in a cable and/or hose on the ground when operating a machine, the cable and/or hose lays on the ground without any control of where the cable/hose is located. The winding in and out of the cable and/or hose is predominantly made manually by the operator. This may increase the risk of tangling and/or destroyed or damage to the unwound cable and/hose.

Consequently, there is a need for improvements of the cable and/or hose unwinding and/or winding in control.

SUMMARY OF THE INVENTION

As part of developing embodiments herein a problem has been identified and will first be discussed.

When the cable and/or hose is on the ground there is always a risk of driving over the cable and/or hose and damaging, destroying it and/or creating a hazardous situation. The cable and/or hose may be difficult to see on the ground. Further, when the cable and/or hose reel is maneuvered, if the operator is not very observant, there may be a risk of asserting to high tension on the cable and/or hose or the mechanical structure guiding the cable/hose on the machine, causing hazards and machine failures. Operating the cable and/or hose reel manually increases the workload on the operator. Further, there a risk of winding out too much cable and/or hose, which may cause tangle on the reel or not enough tension for the cable and/or hose.

An object of embodiments herein is to provide a mechanism that increases the control of cable and/or hose handling, such as unwinding and/or winding in the cable and/or hose. The object is achieved by the independent claims.

Though the aspects described below are related to unwinding a cable and/or hose the aspects are equally suitable for winding in a cable and/or hose. Thus, during the following, "unwinding" may be replaced or supplemented with "winding in", thereby adapting the aspects to controlling an unwinding and/or winding in of the cable and/or hose.

According to a first aspect, a method performed by a controller unit for controlling an unwinding of a cable and/or hose is provided. The cable and/or hose is stored on a cable and/or hose reel mounted on a machine.

The controller unit monitors sensor data obtained from one or more sensors comprised in the machine. The sensor data is related to one or more characteristics of the machine.

The controller unit determines, based on the one or more characteristics, an unwinding speed to use for unwinding the cable and/or hose.

The controller unit unwinds the cable and/or hose by controlling a rotational speed of the cable and/or hose reel upon which the cable and/or hose is stored such that the cable and/or hose is unwound according to the determined unwinding speed.

By providing the method as disclosed herein, an improved control for unwinding a cable and/or hose is provided, for which an unwinding speed is determined based on a characteristic of the machine, and the cable and/or hose is unwound by controlling a rotational speed of the cable and/or hose reel. In particular, it has been realized that by controlling the rotational speed of the cable and/or hose reel such that the cable and/or hose is unwound according to the determined unwinding speed, which is based on the monitored sensor data related to the one or more characteristics, the cable and/or hose unwinding can be accurately controlled. Further, it has been realized that by automating the unwinding and/or winding in of the cable and/or hose, the manual task performed by one or more operators are reduced, thereby increasing the operational efficiency. Thereby, as the controller unit determines the unwinding speed based on monitored the sensor data obtained from the one or more sensors, a more accurate control of the unwinding of the cable and/or hose is achieved in an efficient manner. The one or more characteristics may e.g., comprise a velocity of the machine, a direction of movement, a

tension of the cable and/or hose, a position of the machine, an oil flow and/or pressure in a hydraulic system, such as a hydraulic pump and/or hydraulic motor, a cable and/or hose position, a cable and/or hose reel position, an electric motor speed and/or torque, a cable and/or hose rotational speed and/or torque, a swash plate position, and/or a hydraulic system rotational speed and/or torque.

By unwinding speed of the cable and/hose as used herein, is meant the speed by which the cable and/or hose is unwound from the cable and/or hose reel. This may be expressed in a length of cable and/or hose unwound per time unit, e.g., meters per seconds (m/s). This should not be confused with rotational speed of the cable and/or hose reel as used herein, by which the speed of rotation of the cable and/or hose reel rotated when the cable and/or hose is unwound. The rotational speed may be expressed in rotations of the reel per time units, e.g., rotations per seconds (r/s). As will be disclosed further in this disclosure, the rotational speed may vary for a determined unwinding speed depending on the dimensions of the reel and/or the amount of cable and/or hose currently wounded on the reel. Controlling the rotational speed may e.g., mean that the controller unit operates the cable and/or hose reel to rotate the reel according to the rotational speed in order to unwind the cable and/or according to the determined unwinding speed.

According to an exemplary embodiment, the one or more sensors may comprise any one or more out of: a velocity sensor, a direction of movement sensor, a pressure sensor, a tension sensor, a flow sensor, a rotational speed sensor, a torque sensor, a position sensor, and a swash plate position sensor. The one or more sensors may provide the sensor data to the controller unit.

The velocity sensor may e.g., provide sensor data related to the velocity of the machine. The velocity is preferably the actual velocity of the machine, meaning e.g., the actual velocity of the movement of the machine. E.g., the velocity may be determined based on a positioning change of the machine. The positioning change of the machine may be determined based on e.g., the Global Positioning System (GPS), or any other positioning system.

The direction of movement sensor may e.g., provide sensor data related to the direction of movement of the machine. The direction of movement sensor may e.g., be gyroscopic sensor. Alternatively, the direction of movement may be determined from changes in position of the machine. In such an example, the direction of movement sensor may be the same sensor as the velocity sensor.

The tension sensor may e.g., provide sensor data related to the tension of the cable and/or hose.

The flow sensor may e.g., provide sensor data related to the oil flow in a hydraulic system, such as a hydraulic pump and/or hydraulic motor driving, or propelling, the cable and/or hose reel and/or tracks for moving the machine.

The pressure sensor may e.g., provide sensor data related to the oil pressure in a hydraulic system, such as a hydraulic pump and/or hydraulic motor driving, or propelling, the cable and/or hose reel and or tracks for moving the machine.

The rotational speed sensor may e.g., provide sensor data related to the rotational speed of an electric motor driving, or propelling, the machine and/or the cable and/or hose reel. Alternatively, or additionally, the rotational speed sensor may e.g., provide sensor data related to the rotational speed of the cable and/or hose reel.

The torque sensor may e.g., provide sensor data related to the torque of the electric motor driving, or propelling, the machine and/or the cable and/or hose reel. Alternatively, or additionally, the torque sensor may e.g., provide sensor data related to the torque of the cable and/or hose reel.

The position sensor may e.g., provide sensor data related to the position of the machine. Alternatively, or additionally, the position sensor may e.g., provide sensor data related to the position of the cable and/or hose reel. The position of the cable and/or hose reel may comprise the position of where the cable and/or hose exits the cable and/or hose reel, which may vary if the cable and/or hose reel is rotated. The position of the cable and/or hose reel may further comprise the rotational angle of the cable and/or hose reel in relation to the machine.

The swash plate position sensor may e.g., provide sensor data related to the position of the swash plate of a hydraulic system, such as a hydraulic pump and/or hydraulic motor driving, or propelling, the cable and/or hose reel and or tracks for moving the machine. The swash plate sensor data may e.g., be used to measure a displacement angle in a hydraulic pump which, together with the rotational speed, may be used to calculate the oil flow from the hydraulic pump.

According to an exemplary embodiment, the controller unit may log an anchoring position of the cable and/or hose. The anchoring position may be in close proximity to a connection of the cable and/or hose to a main grid. The unwinding speed may further be determined based on the logged anchoring position. By logging the anchoring position of the cable and/or hose, the controller unit may take this position into account when determining the unwinding speed. This may be advantageous since the unwinding speed may be adapted to the anchoring point of the cable and/or hose. The controller unit may log the anchoring position on a map and/or store the position in a memory.

According to an exemplary embodiment, the controller unit may, while unwinding the cable and/or hose, log a position of the unwound cable and/or hose according to a configured interval. This may mean that the position of the unwound cable and/or hose is stored. By this, the machine knows the position of the unwound cable and/or hose, which may enable the machine to avoid driving over the cable and/or hose. The position of the cable and/or hose may e.g., be determined by using a positioning sensor. In some examples, the position of the cable and/or hose reel on the machine is used in combination with the position of the machine e.g., obtained from the positioning sensor. This may provide a more accurate position of the unwound cable and/or hose.

According to an exemplary embodiment, logging the position may further comprise plotting the position of the cable and/or hose on a map. The map may, e.g., be a map of the work site where the machine operates.

According to an exemplary embodiment, the controller unit may transmit the logged position and/or the map comprising the logged position to one or more other machines and/or a central node, enabling the one or more other machines to avoid the unwound cable and/or hose. By this, the other machines may become aware of the position of the unwound cable and/or hose. This may be advantageous since the other machines may avoid driving over the unwound cable and/or hose, reducing the risk of damaging it. When the controller unit transmits the logged position and/or map to the central node, the central node may in turn distribute, such as transmit, the logged position and/or map to the other machines.

According to an exemplary embodiment, unwinding the cable and/or hose may further comprise calculating the rotational speed such the cable and/or hose is unwound according to the determined unwinding speed. As mentioned above, the rotational speed may be expressed in rotations of the reel per time units, e.g., rotations per seconds (r/s). Since this measuring unit differs from the measuring unit used for the unwinding speed, which may be expressed in a length of cable and/or hose unwound per time unit, e.g., meters per seconds (m/s), the rotational speed may need to be calculated to obtain the correct unwinding speed of the cable and/or hose. The rotational speed may e.g., be calculated based on e.g., the length of cable and/or hose unwound during one rotation of the reel. As an example, the determined unwinding speed may be 2 m/s and the length of cable and/or hose unwound during one rotation is 1 meter. To be able to unwind 2 meters of cable and/or hose during 1 second, the rotational speed is calculated to 2 r/s. The rotational speed may further need to be adapted during the unwinding procedure. This since the length of cable and/or hose unwound during one rotation of the reel will

decrease the more cable and/or hose that is unwound from the reel. Thus, in some examples, the rotational speed of the reel may be continuously, or repeatedly, calculated during the unwinding of the cable and/or hose.

According to an exemplary embodiment, the controller unit may repeatedly perform the steps of monitoring and determining while unwinding the cable and/or hose, and adapt the rotational speed of the of the cable and/or hose reel upon which the cable and/or hose is stored in accordance with the latest determined unwinding speed. Repeatedly may e.g., mean continuously performing said steps, or performing said steps at certain time and/or distance intervals. The intervals may e.g., be configured in controller unit. By repeatedly performing the steps of monitoring the sensor data and determining the unwinding speed, the control of unwinding the cable and/hose may be increased. This since the unwinding speed may be adapted to changes in the monitored sensor data, e.g., a change of velocity and/or direction of the machine.

According to an exemplary embodiment, the controller unit may, when the velocity of the machine is zero, determine the unwinding to be zero. This may reduce the risk of cable and/or hose tangle. Alternatively, or additionally, the controller unit may in some examples allow a certain amount of cable and/or hose to be unwound when the velocity of the machine is zero. This may be based on monitored sensor data and/or a knowledge of a future movement and/or change of movement direction of the machine.

According to an exemplary embodiment, monitoring the sensor data may comprise determining the velocity and direction of movement of the machine.

According to an exemplary embodiment, the unwinding speed is measured in length per time unit. As mentioned above, the unwinding speed may be expressed, or measured in meters per second (m/s).

The exemplary embodiments above may be combined in any suitable way.

According to a second aspect, a controller unit configured to control an unwinding of a cable and/or hose is provided. The cable and/or hose is adapted to be stored on a cable and/or hose reel adapted to be mounted on a machine.

The controller unit is further configured to monitor sensor data obtained from one or more sensors. The sensor data is adapted to be related to one or more characteristics of the machine.

The controller unit is further configured to determine, based on the monitored sensor data, an unwinding speed to use for unwinding the cable and/or hose.

The controller unit is further configured to unwind the cable and/or hose by controlling a rotational speed of the cable and/or hose reel upon which the cable and/or

hose is adapted to be stored such that the cable and/or hose is unwound according to the determined unwinding speed.

The controller unit may further be configured to perform any of the above mentioned embodiments of the first aspect of the invention.

According to a third aspect, a machine adapted to comprise controller unit configured to control an unwinding of a cable and/or hose according to the second aspect above is provided. The machine is further adapted to comprise a cable and/or hose stored on a cable and/or hose reel and one or more sensor adapted to provide sensor data to the controller unit. The sensor data is adapted to be related to one or more characteristics of the machine.

According to a fourth aspect it is furthermore provided herein a computer program comprising instructions, which, when executed by a processing circuitry, causes the processing circuitry to perform method above, as performed by the controller unit.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will hereinafter be further explained by means of non-limiting examples with reference to the appended schematic figures where;

Fig. 1a shows a schematic view of a machine according to embodiments herein;

Fig. 1b shows a schematic view of a system according to embodiments herein;

Fig. 2 shows a flowchart depicting embodiments of a method in a controller unit;

Fig. 3 shows an overview of examples according to embodiments herein;

Figs 4a-b shows schematic block diagrams illustrating embodiments of a controller unit.

It should be noted that the drawings have not necessarily been drawn to scale and that the dimensions of certain features may have been exaggerated for the sake of clarity. Like reference signs in the drawings refer to the same or similar element, unless expressed otherwise.

DETAILED DESCRIPTION OF EMBODIMENTS

An object of embodiments herein is to provide a mechanism that increases the control of cable and/or hose handling, such as unwinding the cable and/or hose. The object is achieved by the independent claims.

Embodiments herein may bring the advantage of increased control of cable and/or hose handling, such as unwinding. This may be achieved by, as mentioned above making it possible to control the unwinding speed of the cable and/or hose based on monitored sensor data related to one or more characteristics of the machine 100, resulting in a improved control when unwinding of the cable and/or hose and e.g., keeping the tension of the cable and/or hose at suitable level. Further, embodiments herein may bring the advantage of knowing where the unwound cable is located, resulting in a reduced risk of damaging or destroying the cable and/or hose by driving over the cable and/or hose. Further, embodiments herein may bring the advantage of automating the unwinding and/or winding in of the cable and/or hose, thereby reducing the manual tasks performed by one or more operators, resulting in an increased the operational efficiency.

Fig.1a depicts a schematic view of a **machine 100** according to an example embodiment of the present invention. The machine 100 comprises a **controller unit 110**, one or more **sensors 111**, a **cable and/or hose reel 112** and a **cable and/or hose 113**. The controller unit 110 is configured to control the unwinding of the cable and/or hose 113 from the cable and/or hose reel 112, e.g., by monitoring sensor data obtained from the one or more sensors 111, determine an unwinding speed based on the monitored sensor data, and unwind the cable and/or hose by controlling the rotational speed such that the cable and/or hose is unwound according to the determined unwinding speed. The one or more sensors may e.g., comprise one or more out of a positioning sensor, a velocity sensor, direction of movement sensor, a pressure sensor, a tension sensor, a flow sensor, a swash plate position sensor, a rotational speed sensor, and/or a torque sensor.

By using sensors such as, but not limited to, positioning sensors, speedometer, pressure sensors, swash plate position, electric motor speed, electric motor torque, cable reel position and speed), the controller unit may monitor sensor data obtained the one or more sensors, such as if the machine is moving, and only wind out cable and/or hose when movement is detected. If the machine is standing still or if tracks/wheels are moving but slipping so the machine is not moving, the controller unit may detect this and stop

winding out or in cable and/or hose. The controller unit may also wind out or in cable and/or hose with a speed that is matching the speed of the machine during movement of the machine to ensure the correct tension of the cable and/or hose. The controller unit may also detect when the machine is turning and adjust tension, such as by winding in or out, the cable and/or hose if required. The controller unit may also log in what positions and/or paths that the machine has moved and winded out cable and/or hose and create a "map" of this. The controller unit may then prevent the machine from entering zones that are too close to the cable and/or hose that are on the ground. The cable and/or hose "map" may also be relayed, such transmitted or distributed, to other machines on the site and use the same restrictions for the zones that are too close to the cable and/or hose. The controller unit may also suggest an alternate path for the machines to get to the required point without passing over or too close to the cable and/or hose.

In some examples, the position of a connection point of the cable and/or hose to a main grid system is recorded and the trajectory of the machine is calculated in reference to this point. The machine trajectory is utilised by the controller unit to determine a correct movement of the cable/hose reel.

Fig 1b depicts a schematic view of a **system 150**, the system 150 comprises the machine 100, one or more other machines 100', e.g., as shown in Fig. 1a, and a **central node 120**. The machine comprises the controller unit 110, and the one or more other machines may each comprise a controller unit 110'. The system 150 may be configured to control the unwinding of the cable and/or hose 113, 113' stored on a respective cable and/or hose reel 112 comprised on the machine 100 and/or the one or more other machines 100'. Alternatively, or additionally, the system 150 may be configured to prevent one or more machines 100, 100' from driving over a cable and/or hose. This may be achieved by the controller unit 110, 110' performing the method as disclosed herein.

Fig. 2 shows an example embodiment of a method performed by a method performed by the controller unit 110 for controlling an unwinding of the cable and/or hose 113. The cable and/or hose 113 is stored on the cable and/or hose reel 112 mounted on the machine 100. Though the method described below is related to unwinding a cable and/or hose, such as the cable and/or hose 113, the method is equally suitable for winding in a cable and/or hose. Thus, during the following, "unwinding" may be replaced or supplemented with "winding in", thereby adapting the method to a method performed by the controller unit 110 for controlling an unwinding and/or winding in of the cable and/or

hose 113. The cable and/or hose 113 is stored on the cable and/or hose reel 112 mounted on the machine 100. The method comprises the following actions, which may be taken in any suitable order. Optional actions are referred to as dashed boxes in Fig. 2.

Action 201

In some embodiments, the controller unit 110 logs an anchoring position of the cable and/or hose. The anchoring position is in close proximity to a connection of the cable and/or hose to a main grid. The connection to the main grid may e.g., be a connection to a remote source of electrical energy or power, such as e.g., a main electricity grid, a battery station, and/or fuel cell station. Alternatively, connection to the main grid may e.g., be a connection to the main water grid.

Action 202

The controller unit 110 monitors sensor data obtained from the one or more sensors 111 comprised in the machine 100. The sensor data is related to one or more characteristics of the machine 100. The one or more characteristics may e.g., comprise a velocity of the machine, a direction of movement, a tension of the cable and/or hose, a position of the machine, a cable and/or hose position, a cable and/or hose reel position, an electric motor speed and/or torque, an oil flow and/or pressure in a hydraulic system, such as a hydraulic pump and/or hydraulic motor, a cable and/or hose position, an electric motor speed and/or torque, a cable and/or hose rotational speed and/or torque, a swash plate position, and/or a hydraulic system rotational speed and/or torque.

. E.g., monitoring the sensor data may comprise determining the velocity and direction of movement of the machine 100.

In some embodiments, the one or more sensors comprises any one or more out of a velocity sensor, a direction of movement sensor, a pressure sensor, a tension sensor, a flow sensor, a rotational speed sensor, a torque sensor, a position sensor and a swash plate position sensor.

The velocity sensor may e.g., provide sensor data related to the velocity of the machine. The velocity is preferably the actual velocity of the machine, meaning e.g., the actual velocity of the movement of the machine. E.g., the velocity may be determined based on a positioning change of the machine. The positioning change of the machine may be determined based on e.g., the Global Positioning System (GPS), or any other positioning system.

The direction of movement sensor may e.g., provide sensor data related to the direction of movement of the machine. The direction of movement sensor may e.g., be

gyroscopic sensor. Alternatively, the direction of movement may be determined from changes in position of the machine. In such an example, the direction of movement sensor may be the same sensor as the velocity sensor.

The tension sensor may e.g., provide sensor data related to the tension of the cable and/or hose.

The flow sensor may e.g., provide sensor data related to the oil flow in a hydraulic system, such as a hydraulic pump and/or hydraulic motor driving, or propelling, the cable and/or hose reel and/or tracks for moving the machine.

The pressure sensor may e.g., provide sensor data related to the oil pressure in a hydraulic system, such as a hydraulic pump and/or hydraulic motor driving, or propelling, the cable and/or hose reel and or tracks for moving the machine.

The rotational speed sensor may e.g., provide sensor data related to the rotational speed of an electric motor driving, or propelling, the machine and/or the cable and/or hose reel. Alternatively, or additionally, the rotational speed sensor may e.g., provide sensor data related to the rotational speed of the cable and/or hose reel.

The torque sensor may e.g., provide sensor data related to the torque of the electric motor driving, or propelling, the machine and/or the cable and/or hose reel. Alternatively, or additionally, the torque sensor may e.g., provide sensor data related to the torque of the cable and/or hose reel.

The position sensor may e.g., provide sensor data related to the position of the machine. Alternatively, or additionally, the position sensor may e.g., provide sensor data related to the position of the cable and/or hose reel. The position of the cable and/or hose reel may comprise the position of where the cable and/or hose exits the cable and/or hose reel, which may vary if the cable and/or hose reel is rotated. The position of the cable and/or hose reel may further comprise the rotational angle of the cable and/or hose reel in relation to the machine.

The swash plate position sensor may e.g., provide sensor data related to the position of the swash plate of a hydraulic system, such as a hydraulic pump and/or hydraulic motor driving, or propelling, the cable and/or hose reel and or tracks for moving the machine. The swash plate sensor data may e.g., be used to measure a displacement angle in a hydraulic pump which, together with the rotational speed, may be used to calculate the oil flow from the hydraulic pump.

Action 203

The controller unit 110 determines, based on the one or more characteristics, an unwinding speed to use for unwinding the cable and/or hose 113. As mentioned above, the unwinding speed of the cable and/hose as used herein may mean the speed at which the cable and/or hose is unwound from the cable and/or hose reel. This may be expressed in a length of cable and/or hose unwound per time unit, e.g., meters per seconds (m/s). In other words, the controller unit 110 determines the unwinding speed of the cable and/or hose 113 taking the one or more characteristics into account. As an example, the one or more characteristics may comprise a velocity of the machine 100. In such an example, the controller unit 110 may determine the unwinding speed based on the velocity of the machine 100. This may allow the controller unit 110 to e.g., detect when the machine 100 is not moving, such as the velocity of the machine 100 is zero, and stop unwinding of the cable and/or hose 113, such determine the unwinding speed to be zero. By this, it is possible to avoid unnecessary unwinding of the cable and/or hose 113 which may lead to cable and/or hose tangling.

In some embodiments, the unwinding speed is further determined based on the logged anchoring position. The controller unit 110 may log the anchoring position on a map and/or store the position in a memory. By logging the anchoring position of the cable and/or hose, the controller unit may take this position into account when determining the unwinding speed. This may be advantageous since the unwinding speed may be adapted to the anchoring point of the cable and/or hose. E.g., the anchoring position together with the velocity and direction of movement of the machine 100, may be used to determine the unwinding speed of the cable and/or hose.

Action 204

The controller unit 110 unwind the cable and/or hose 113 by controlling a rotational speed of the cable and/or hose reel 112 upon which the cable and/or hose 113 is stored such that the cable and/or hose 113 is unwound according to the determined unwinding speed. As mentioned above, the rotational speed of the cable and/or hose reel 112 as used herein, may mean the speed of rotation of the cable and/or hose reel 112 when the cable and/or hose 113 is unwound. The rotational speed may be expressed in rotations of the reel per time units, e.g., rotations per seconds (r/s). The rotational speed may vary for a determined unwinding speed depending on the dimensions of the cable and/or hose reel 112 and/or the amount of cable and/or hose 113 currently wounded on the cable and/or hose reel 112. Controlling the rotational speed may e.g., mean that the controller unit 110 operates the cable and/or hose reel 112 to rotate according to the

rotational speed in order to unwind the cable and/or hose 113 according to the determined unwinding speed. E.g., the controller unit 110 may operate, such as instruct, an electric motor driving the cable and/or hose reel 112 to rotate the cable and/or hose reel 112 according to the rotational speed.

In some embodiments, the controller unit 110 unwinds the cable and/or hose 113 by further calculating the rotational speed such the cable and/or hose 113 is unwound according to the determined unwinding speed. As mentioned above, the rotational speed may be expressed in rotations of the reel per time units, e.g., rotations per seconds (r/s). Since this measuring unit differs from the measuring unit used for the unwinding speed, which may be expressed in a length of cable and/or hose unwound per time unit, e.g., meters per seconds (m/s), the rotational speed may need to be calculated to obtain the correct unwinding speed of the cable and/or hose 113. The rotational speed may e.g., be calculated based on e.g., the length of cable and/or hose 113 unwound during one rotation of the cable and/or hose reel 113. As an example, the determined unwinding speed may be 2 m/s and the length of cable and/or hose 113 unwound during one rotation is 1 meter. To be able to unwind 2 meters of cable and/or hose during 1 second, the rotational speed is calculated to 2 r/s. The rotational speed may further need to be adapted during the unwinding procedure. This since the length of cable and/or hose 113 unwound during one rotation of the reel will decrease the more cable and/or hose 113 that is unwound from the reel. Thus, in some examples, the rotational speed of the cable and/or hose reel 112 may be continuously, or repeatedly, calculated during the unwinding of the cable and/or hose 113.

Thus, in some embodiments, the controller unit 110 repeatedly performs the steps of monitoring the sensor data (see Action 202) and determining the unwinding speed (see Action 203) while unwinding the cable and/or hose 113, and adapting the rotational speed of the of the cable and/or hose reel 112 upon which the cable and/or hose 112 is stored in accordance with the latest determined unwinding speed. Repeatedly may e.g., mean continuously performing said steps, or performing said steps at certain time and/or distance intervals. The intervals may e.g., be configured in controller unit. By repeatedly performing the steps of monitoring the sensor data and determining the unwinding speed, the control of unwinding the cable and/hose may be increased. This since the unwinding speed may be adapted to changes in the monitored sensor data, e.g., a change of velocity and/or direction of the machine.

Action 205

In some embodiments, the controller unit 110, while unwinding the cable and/or hose 113, logs a position of the unwound cable and/or hose 113 according to a configured interval. This may mean that the position of the unwound cable and/or hose 113 is stored. By this, the machine 100 knows the position of the unwound cable and/or hose 113, which may enable the machine 100 to avoid driving over the cable and/or hose 113. The position of the cable and/or hose 113 may e.g., be determined by using a positioning sensor. In some examples, the position of the cable and/or hose reel 112 on the machine 110 is used in combination with the position of the machine 100, e.g., obtained from the positioning sensor. This may provide a more accurate position of the unwound cable and/or hose 113. The interval may e.g., be a time and/or distance interval. Distance may mean a distance the machine 100 has moved.

In some embodiments, the controller unit 110 logs the position by further plotting the position of the cable and/or hose 113 on a map. The map may, e.g., be a map of the work site where the machine operates.

Action 206

In some embodiments, the controller unit 110 transmits the logged position and/or the map comprising the logged position to one or more other machines 100' and/or a central node 120. This may enable the one or more other machines 100' to avoid the unwound cable and/or hose 113. By this, the other machines 110' may become aware of the position of the unwound cable and/or hose 113. This may be advantageous since the other machines 110' may avoid driving over the unwound cable and/or hose 113, reducing the risk of damaging it. When the controller unit 110 transmits the logged position and/or map to the central node 120, the central node 120 may in turn distribute, such as transmit, the logged position and/or map to the other machines 110'. The central node 120 may further combine the logged position and/or map received from the machine 100 with logged positions and/or maps received from the other machines 100', and distribute the combined positions and/or maps to the machine 100 and the other machines 100'. This may allow all machines 100, 100' to know the position of unwound cable and/or hose.

Fig. 3 depicts an overview of examples according to embodiments herein. Though the examples described below is related to unwinding a cable and/or hose, such as the cable and/or hose 113, the examples is equally suitable for winding in a cable and/or hose. Thus, during the following, "unwinding" may be replaced or supplemented with "winding in", thereby adapting the examples to examples for controlling an unwinding

and/or winding in of the cable and/or hose 113. In the examples below, the machine 100 comprises a first sensor 111 and a second sensor 111'. This should however not be seen as limiting to the scope, any suitable number of sensors providing sensor data related different kinds of characteristics is possible.

According to a first example, the machine 100 moves at a velocity X in direction Y. The machine 100 comprises two sensors, a first sensor 111 providing sensor data related to a first characteristic of the machine 100 and a second sensor 111' providing sensor data related to a second characteristic of the machine 100. The first characteristic is a velocity of the machine 100, such as velocity X, and the second characteristic is a direction of movement of the machine 100, such as direction Y. The controller unit 100 comprised in the machine 100 monitors the sensor data obtained from the first and second sensors 111, 111'. Based on the first and second characteristics, the controller unit 110 determines an unwinding speed of the cable and/or hose 113 stored on the cable and/or hose reel 112. The controller unit 110 then unwinds the cable and/or hose 113 by controller the rotational speed of the cable and/or hose reel 112. Thus, the controller unit 110 controls the unwinding of the cable based on the current velocity and direction of movement of the machine 100.

According to a second example, the second characteristic is a tension of the cable and/or hose 113. Thus, the second sensor 111' in this example is a tension sensor. The controller unit 110 monitors the sensor data obtained from the first and second sensor 111, 111', such as first characteristic related to the velocity of the machine 100 and the second characteristic related to the tension of the cable and/or hose 113. The controller unit 110 may e.g., detect that the tension of the cable and/or hose 113 is above a first threshold. In order to reduce the tension, either the unwinding speed may be increased or the velocity of the machine 100 may be reduced. The controller unit 110 determines to increase the unwinding speed based on the tension of the cable and/or hose 113 and the velocity of the machine 100. E.g., the controller unit 110 determines an unwinding speed such that the tension is reduced to be under the first threshold, and unwinds the cable and/or hose according to the determined unwinding speed. The controller unit 110 may continue to monitor the sensor data. When the controller unit 110, based on the first and second characteristics, determines that the tension is under the first threshold, the controller unit 110 may determine a new unwinding speed. The new unwinding speed may e.g., be determined such that the tension is kept at the current level. The controller unit 110 then unwinds the cable and/or hose 113 according to the newly determined

unwinding speed. Thus, the controller unit 110 continuously, or repeatedly, adapts the unwinding speed based on the last sensor data from the first and second sensor.

Fig. 4a disclose an example configuration of the controller unit 110 configured to control an unwinding of the cable and/or hose 113. The cable and/or hose 113 is stored on the cable and/or hose reel 112 mounted on the machine 100. Though the controller unit 110 described below is related to unwinding a cable and/or hose, such as the cable and/or hose 113, the controller unit 110 is equally suitable for winding in a cable and/or hose. Thus, during the following, "unwinding" may be replaced or supplemented with "winding in", thereby adapting the controller unit 110 to a controller unit 110 configured to control an unwinding and/or winding in of the cable and/or hose 113. The cable and/or hose 113 is stored on the cable and/or hose reel 112 mounted on the machine 100. The controller unit 110 comprises a memory 460 operable to store instructions and processing circuitry 450 operable to execute the instructions.

The controller unit 110 may comprise **an input and output interface 400** configured to communicate with, e.g., the central node 120 and the one or more other machines 100'.

Fig. 4b also discloses an example configuration of processing circuitry for a central unit, e.g., the processing circuitry 450 disclosed in Fig. 4a. The processing circuitry may comprise a **determining unit 410**, a **monitoring unit 420**, an **unwinding unit 430**, a **logging unit 440** and a **transmitting unit 445** configured to perform the methods above.

The embodiments herein may be implemented through the processing circuitry 450 in the controller unit 110 depicted in Figure 4a, together with respective computer program code for performing the functions and actions of the embodiments herein. The processing circuitry 450 may comprise one or more processors and one or more memory units. The memory units may be the memory 460. The program code mentioned above may also be provided as a computer program product, for instance in the form of a data carrier carrying computer program code for performing the embodiments herein when being loaded into the controller unit 110. One such carrier may be in the form of a CD ROM disc, a USB flash drive, and/or an Over-the-Air (OTA) carrier. It is however feasible with other data carriers such as a memory stick. The computer program code may furthermore be provided as pure program code on a server and downloaded to the controller unit 110.

The memory 460 of the controller unit 110 may further comprise one or more memory units. The memory 460 is configured to store instructions executable by the processing circuitry 450. The memory 460 is arranged to be used to store e.g., information, messages, indications, configurations, unwinding speed, rotational speed, sensor data, characteristics, measurements, locations, positions, and applications to perform the methods herein when being executed in executed in the controller unit 110.

The controller unit 110 configured to control an unwinding of a cable and/or hose 113. The cable and/or hose 113 is stored on the cable and/or hose reel 112 mounted on a machine 100.

The controller unit 110 monitors sensor data obtained from one or more sensors 111, wherein the sensor data is adapted to be related to one or more characteristics of the machine 100,

The controller unit 110 determines, based on the one or more characteristics, an unwinding speed to use for unwinding the cable and/or hose 113.

The controller unit 110 unwinds the cable and/or hose 113 by controlling a rotational speed of the cable and/or hose reel 112 upon which the cable and/or hose 113 is adapted to be stored such that the cable and/or hose 113 is unwound according to the determined unwinding speed.

In some embodiments, a computer program 470 comprises instructions, which when executed by the processing circuitry 450, e.g., of the respective at least one processor of the processing circuitry 450, cause the processing circuitry 450 of the central node 10 to perform the actions above.

In some embodiments, a respective carrier 480 comprises the respective computer program 470, wherein the carrier 480 is one of an electronic signal, an optical signal, an electromagnetic signal, a magnetic signal, an electric signal, a radio signal, a microwave signal, or a computer-readable storage medium.

Those skilled in the art will appreciate that the units in the controller unit 110 described above may refer to a combination of analogue and digital circuits, and/or one or more processors configured with software and/or firmware, e.g., stored in the controller unit 110, that when executed by the respective one or more processors such as the processors described above. One or more of these processors, as well as the other digital hardware, may be included in a single Application-Specific Integrated Circuitry (ASIC), or several processors and various digital hardware may be distributed among several separate components, whether individually packaged or assembled into a system-on-a-chip (SoC).

It will be appreciated that the foregoing description and the accompanying drawings represent non-limiting examples of the methods and apparatus taught herein. As such, the apparatus and techniques taught herein are not limited by the foregoing description and accompanying drawings. Instead, the embodiments herein are limited only by the following claims and their legal equivalents.

CLAIMS

1. A method performed by a controller unit (110) for controlling an unwinding of a cable and/or hose (113), wherein the cable and/or hose is stored on a cable and/or hose reel (112) mounted on a machine (100), the method comprising:

monitoring (202) sensor data obtained from one or more sensors (111) comprised in the machine (100), wherein the sensor data is related to one or more characteristics of the machine (100),

determining (203), based on the one or more characteristics, an unwinding speed to use for unwinding the cable and/or hose (113), and

unwinding (204) the cable and/or hose (113) by controlling a rotational speed of the cable and/or hose reel (112) upon which the cable and/or hose (113) is stored such that the cable and/or hose (113) is unwound according to the determined unwinding speed.

2. The method according to claim 1, wherein the one or more sensors (111) comprises any one or more out of:

- a velocity sensor,
- a direction of movement sensor,
- a pressure sensor,
- a tension sensor,
- a flow sensor
- a rotational speed sensor,
- a torque sensor,
- a position sensor, and
- a swash plate position sensor.

3. The method according to any of claims 1-2, wherein the method further comprises:

logging (201) an anchoring position of the cable and/or hose (113), wherein the anchoring position is in close proximity to a connection of the cable and/or hose (113) to a main grid, and

wherein the unwinding speed is further determined based on the logged anchoring position.

4. The method according to any of claims 1-3, wherein the method further comprises:

while unwinding the cable and/or hose (113), *logging* (205) a position of the unwound cable and/or hose (113) according to a configured interval.

5. The method according to claim 4, wherein *logging* (205) the position further comprises plotting the position of the cable and/or hose (113) on a map.

6. The method according to any of claims 4-5, wherein the method further comprises:

transmitting (206) the logged position and/or the map comprising the logged position to one or more other machines (100') and/or a central node (120), enabling the one or more other machines (100') to avoid the unwound cable and/or hose (113).

7. The method according to any of claims 1-6, wherein *unwinding* (204) the cable and/or hose (113) further comprises calculating the rotational speed such the cable and/or hose (113) is unwound according to the determined unwinding speed.

8. The method according to any of claims 1-7, wherein the method further comprises repeatedly performing the steps of *monitoring* (202) and *determining* (203) while *unwinding* (204) the cable and/or hose (113), and adapting the rotational speed of the of the cable and/or hose reel (112) upon which the cable and/or hose (113) is stored in accordance with the latest determined unwinding speed.

9. The method according to any of claims 1-8, wherein when the velocity of the machine (100) is zero, *determining* (203) the unwinding to be zero.

10. The method according to any of claims 1-9, wherein the *monitoring* (202) comprises determining the velocity and direction of movement of the machine (100).

11. The method according to any of claims 1-10, wherein the unwinding speed is measured in length per time unit.

12. A computer program (470) comprising instructions, which when executed by a processing circuitry (450), causes the processing circuitry (450) to perform actions according to any of the claims 1-11.

13. A controller unit (110) configured to control an unwinding of a cable and/or hose (113), wherein the cable and/or hose (113) is stored on a cable and/or hose reel (112) mounted on a machine (100), the controller unit (110) further being configured to:

monitor sensor data obtained from one or more sensors (111), wherein the sensor data is adapted to be related to one or more characteristics of the machine (100),

determine, based on the one or more characteristics, an unwinding speed to use for unwinding the cable and/or hose (113), and

unwind the cable and/or hose (113) by controlling a rotational speed of the cable and/or hose reel (112) upon which the cable and/or hose (113) is adapted to be stored such that the cable and/or hose (113) is unwound according to the determined unwinding speed.

14. A machine (100) comprising controller unit (110) according to claim 13, wherein the machine (100) is further adapted to comprise a cable and/or hose (113) stored on a cable and/or hose reel (112) and one or more sensor (111) adapted to provide sensor data to the controller unit (110), wherein the sensor data is adapted to be related to one or more characteristics of the machine (100).

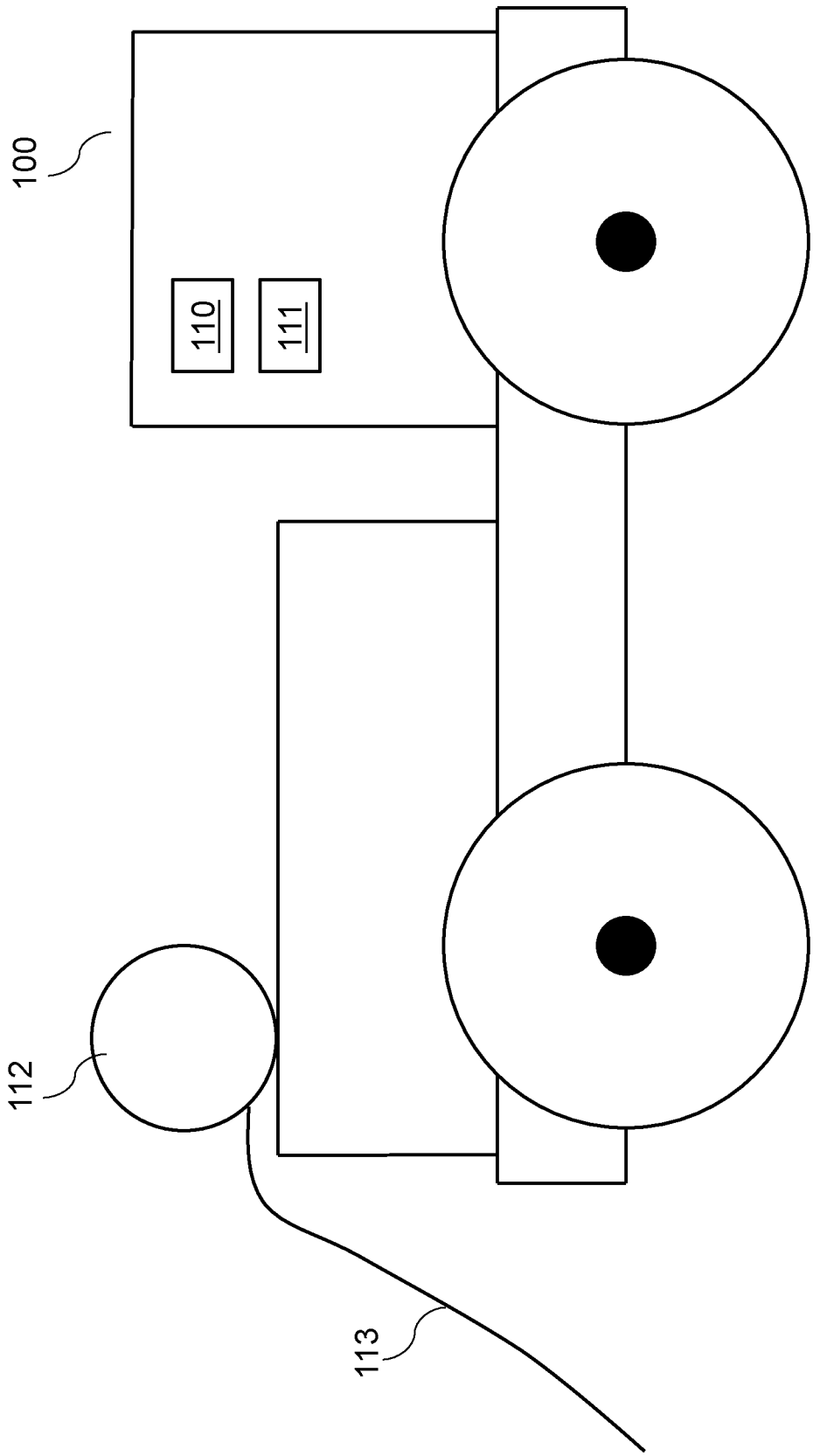

Fig. 1a

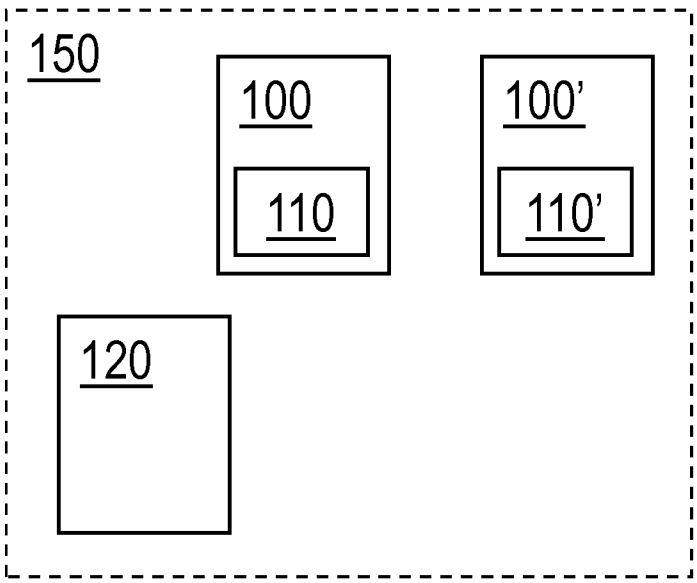

Fig. 1b

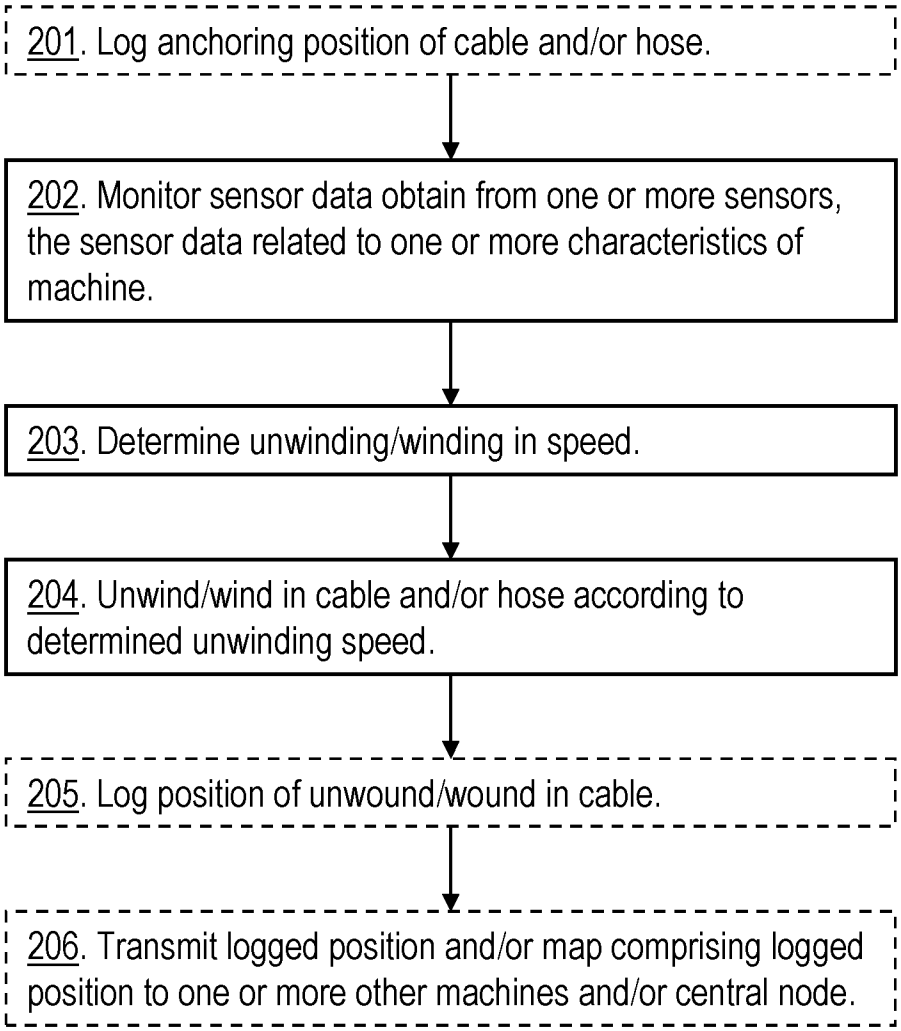
201. Log anchoring position of cable and/or hose.
202. Monitor sensor data obtain from one or more sensors, the sensor data related to one or more characteristics of machine.
203. Determine unwinding/winding in speed.
204. Unwind/wind in cable and/or hose according to determined unwinding speed.
205. Log position of unwound/wound in cable.
206. Transmit logged position and/or map comprising logged position to one or more other machines and/or central node.

Fig. 2

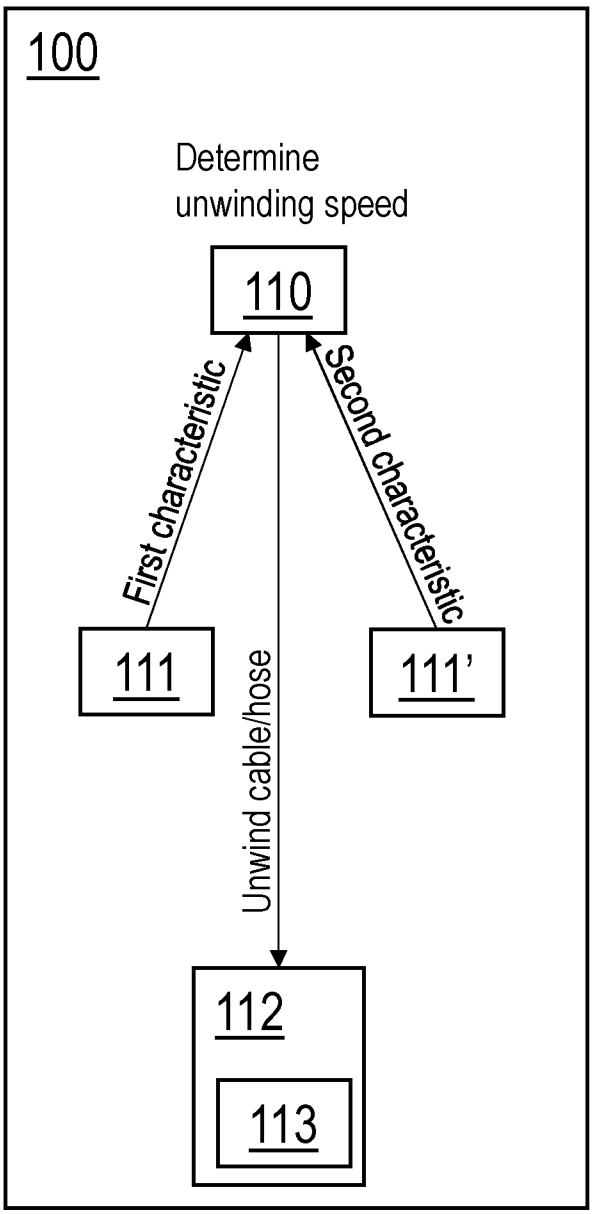
100
Determine unwinding speed
110
First characteristic
Second characteristic
111
111'
Unwind cable/hose
112
113

Fig. 3

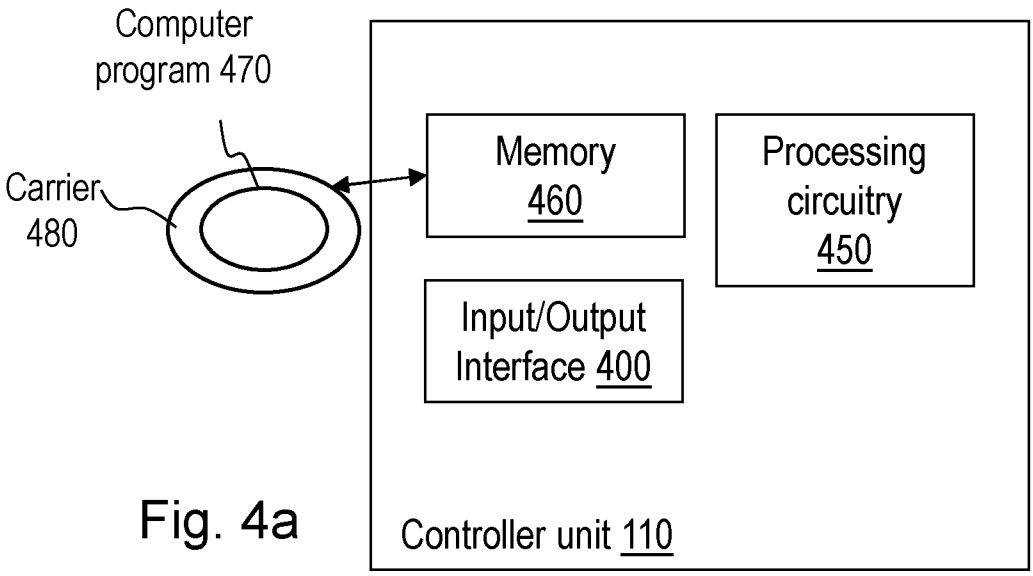
Computer program 470
Carrier 480
Memory 460
Processing circuitry 450
Input/Output Interface 400
Controller unit 110

Fig. 4a

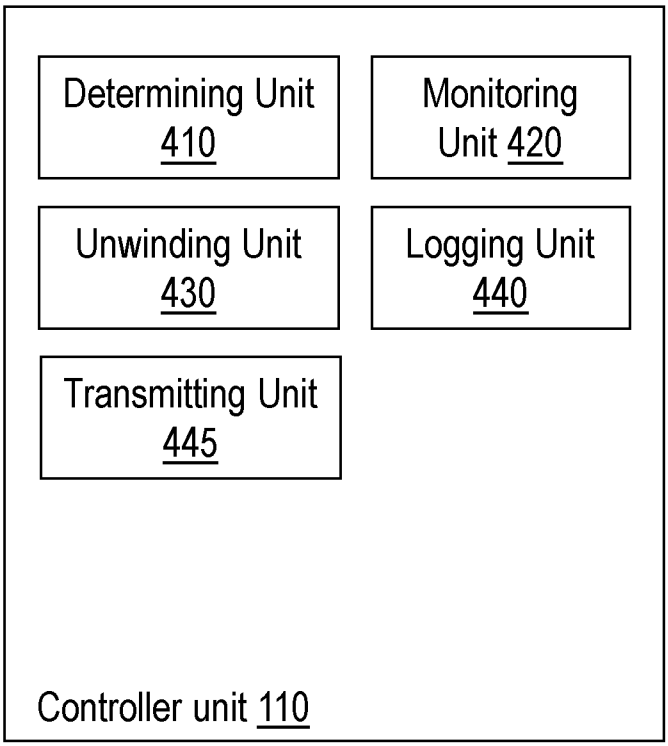
Determining Unit 410
Monitoring Unit 420
Unwinding Unit 430
Logging Unit 440
Transmitting Unit 445
Controller unit 110

Fig. 4b

INTERNATIONAL SEARCH REPORT

International application No
PCT/SE2023/050584

A. CLASSIFICATION OF SUBJECT MATTER
INV. B65H63/00 B65H75/42 B65H75/44
ADD.

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)
B65H

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

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2011/049747 A2 (CATERPILLAR INC [US]; YUET FU P [US] ET AL.) 28 April 2011 (2011-04-28) page 2, line 20 - page 3, line 22 page 4, line 27 - page 5, line 8 page 6, line 3 - line 19 page 6, line 25 - page 7, line 6 page 7, line 14 - page 10, line 10 page 10, line 20 - page 11, line 23 page 12, line 2 - line 19 page 14, line 24 - page 15, line 14 page 18, line 22 - line 27 figures 1-3	1-14

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[x] Further documents are listed in the continuation of Box C.

[x] See patent family annex.

* Special categories of cited documents :

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

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

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

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance;; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance;; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
13 December 2023	05/01/2024

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Guisan, Thierry

2

Form PCT/ISA/210 (second sheet) (April 2005)

INTERNATIONAL SEARCH REPORT

International application No
PCT/SE2023/050584

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 3 001 522 A1 (TOPY IND [JP]) 30 March 2016 (2016-03-30) paragraph [0021] paragraph [0031] paragraph [0043] - paragraph [0044] figures 1,3	1,2,7-14
X	WO 2012/145433 A1 (GREAT STUFF INC [US]) 26 October 2012 (2012-10-26) paragraph [0003] paragraph [0009] - paragraph [0013] figures 1B, 1C,3 paragraph [0080] paragraph [0086]	1,2,7-9, 11-14
X	WO 2016/193494 A1 (IPALCO BV [NL]) 8 December 2016 (2016-12-08) paragraph [0007] - paragraph [0010] paragraph [0030] - paragraph [0034]; figures 1,2	1,2,7-14

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
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		WO 2012145435 A2	26-10-2012
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