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(54) **A PULLEY WITH A MECHANISM FOR TERMINATING ROPE WINDING AND A WINCH WITH SAID PULLEY**

(57) A pulley (1) for a forestry winch, the pulley being provided with a mechanism for terminating winding of a rope, wherein said pulley (1) comprises:
- a housing (11) to which a guide (12) for a pulling rope is mounted, said guide (12) being movable in an axis (13a) of a drive sheave (13) of the pulley (1),
- the guide (12) is provided with an orifice (12a) having an opening along which the rope runs,

- a pushing element (14) having a smaller opening than an end part of the pulling rope, so that the end part of the pulling rope can hit the pushing element (14) arranged to be moved towards the orifice (12a) of the rope guide (12), and
- a switch or a sensor (17) arranged to terminate winding of the rope and consequently load pulling upon contact of the end part of the rope and the pushing element (14).

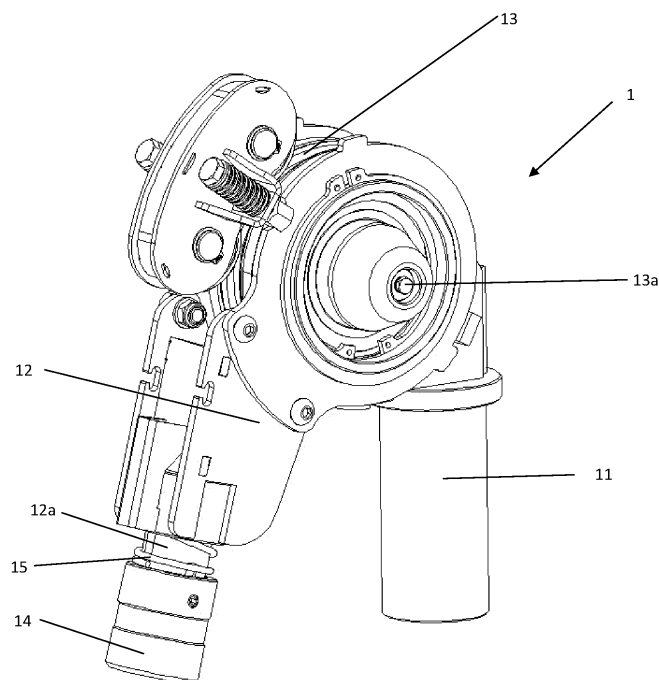


Figure 2

Description

Field of the invention

[0001] The present invention belongs to the field of forestry winches, more precisely to the field of constructional details for forestry winches, which are related to pulling of a load by winding a rope onto a drum via a pulley. The invention relates to a pulley with a mechanism for terminating winding of the rope (i.e., stop switch) for a forestry winch and a winch with said pulley.

Background of the invention and the technical problem

[0002] Situations, in which safe and reliable termination or suspension of pulling of a load via winding a wire rope on a winch drum is required, occur regularly during use of a winch. It is common that the user does not terminate winding timely, resulting in the rope being trapped in-between rope layers on the drum or the end part of the rope is damaged. At the same time, any other construction elements may be damaged, such as a guide of the wire rope or drive parts (chains, sprockets, lamellae, etc.). Consequently, work has to be suspended, as the damaged rope and/or any other element has to be replaced due to severe lasting deformation.

[0003] The technical problem, which is solved by the present invention, is design of a mechanism for timely and reliably terminating winding of the rope, which will ensure easier and safer work with a winch and will prevent damage of the machine and its equipment, thus decreasing winch maintenance costs.

Prior art

[0004] For preventing described damage due to untimely termination of winding of the wire rope to the drum different system for terminating winding have been developed, such as solutions described in patent EP 3095748, as well as in documents SI 25045 and SI25043.

[0005] Patent EP 3 095 748 describes a winch with a safety mechanism for switching off winding of a rope, wherein the mechanism has a switch that can be activated by a pushing element, which is pushed towards the switch with a washer movably mounted on an accessory of the rope guide. The end part of the rope pushes onto the washer, which consequently pushes the pushing element towards the end switch and thus terminates winding of the rope. The solution according to this patent also describes a possible embodiment according to which the washer is mounted on the pushing element, or the end part of the rope is shaped so that it directly pushes the pushing element. The pushing element is movable towards the switch inside a housing.

[0006] Documents SI 25043 and SI 25045 describes similar solutions for a pulley with active termination of winding of the rope in a forestry winch. The mechanism for terminating winding has a sliding bush installed inside

a housing of the rope guide, namely at the exit of the rope, wherein the bush is movable in the direction of the wire rope pulling. The sliding bush is provided with a spring that enables movement of the bush at a predetermined force. A sensor is installed in a movable housing of the guide and is connected to electronics. By movement of the sliding bush into the field of the sensor the status of the latter is changed, which is forwarded to electronics for termination of winding of the rope.

Description of the solution to the technical problem

[0007] The present invention differs from the known solutions in the construction. The aim of the invention is to construct alternative solutions of stop switches that will be reliable and more robust. The technical problem is solved as defined in the independent claim, while the preferred embodiments are defined in dependent claims.

[0008] The essence of the pulley with a mechanism for terminating winding of a rope according to the invention is in that it comprises:

- a housing of the pulley, onto which a guide of the pulling rope is mounted in a rotatable manner, wherein rotation is allowed around an axis of a driven sheave,
- said guide of the pulling rope has a fixed orifice having:
 - an opening through which the pulling rope runs,
 - a receiving part arranged to receive at least a part of a pushing element, and
 - at least one groove provided on an upper side of the orifice, said groove being arranged to receive a sensor, a switch, a magnet, or a similar element,
- the pushing element having an opening larger than the orifice, so that the pushing element is mounted on the orifice in a linearly movable manner, and said pushing element having a second opening smaller than the end part of the rope, which is arranged to impact the pushing element and push the element along the orifice towards the guide of the rope thereby compressing a spring, wherein the pushing element is installed on the said orifice in a linearly movable manner with a two-part safety-guiding assembly, which prevents rotation of the pushing element on said orifice, and wherein one part of the two-part assembly is on the orifice and the second part of the two-part assembly is on the pushing element,
- the spring installed between the pushing element and far end of the orifice, said spring ensuring return movement of the pushing element into its initial position, and
- the sensor or the switch arranged to terminate pulling of the load once the pushing element contacts the element installed in the groove on the upper side of

the orifice.

Alternatively, the sensor could be mounted on the pushing element, while the magnet would be provided on the orifice of the pulling rope guide, however, in this case the sensor would be movable, which is a demanding solution due to the need for protecting the cable which connects the sensor to a winch controller.

[0009] One part of the safety-guiding assembly may be a groove, a guide, a rail, or a similar element, while the second part of the safety-guiding assembly may be a screw, a pin, a cylinder, a snap, or a similar element. Preferably, the groove or any other similar guiding element is provided on the orifice, however, the groove or a similar guiding element may be made in the interior of the pushing element. Optimally, the left and right side of the orifice of the guide is provided with at least one groove arranged to receive the pushing element or suitably shaped screw, pin, cylinder, or similar element installed, welded or otherwise made on the pushing element, so that the second part of the safety-guiding assembly moves along the first part.

[0010] The pushing element is a movably mounted disc, a sliding bearing, a bush or a similar element that can be installed on the orifice of the rope guide and is attached to the orifice using a pressure spring and at least one groove, so that in its extreme position the element comes in the field of sensor or switch or leaves said field of the sensor or switch, depending on the settings of the sensor or switch, wherein the openings of the orifice and the pushing element are co-axial. There is at least one groove, preferably two, each on its side of the pushing element, along which a suitably shaped screw, pin, cylinder, or a similar element is mounted, welded or otherwise made on the pushing element. At least one groove could be provided on the pushing element, while the pin, snap or any other element could be mounted, welded, or otherwise made on the orifice of the rope guide. The pushing element has to be protected against rotation and against falling out of the orifice of the rope guide, which is ensured with at least one groove and screw, pin or any other element. The pushing element and the orifice of the guide are preferably co-axial, wherein at least one groove prevents rotation of the pushing element around its axis. In case the groove was not present, the pushing element could rotate, thus preventing the sensor from sensing movement of the end part of the rope towards the mechanism. In addition, the groove prevents the spring from pushing the pushing element from the orifice of the rope guide. Preferably the pushing element is in its bottom part provided with an additional cut-out or an opening, through which dirt may fall, said dirt being collected in the pushing element and with a potential to hamper termination of rope winding. The pushing element may have any shape, preferably it is shaped as a cylinder or a rectangular solid, depending on the shape of the guide orifice. The opening in the pushing element has to match the shape of the opening of the orifice, so that the

pushing element can be installed on the orifice. The shape of the opening along the rope runs is any suitable shape, preferably circular. The material for the pushing element is any suitable material, preferably metal or plastic.

[0011] In the mechanism of the pulley according to the invention any type of sensor may be used, preferably a Hall sensor, an inductive switch, a magnetic sensor, a capacitive sensor, or an optical sensor. Sensors may be replaced with switches or similar elements arranged to terminate the winding function. At least one, but also two sensors or switches may be used, wherein operation is more reliable in case of two sensors. In case one has a malfunction, the other keeps being operative.

[0012] Termination of winding may be performed in two different manners, which depends on the type of the selected sensor or switch, respectively:

1. the disconnecting element is during winding of the rope outside of the sensing field of the sensor, while upon push of the load the element comes into the sensing field of the sensor thus activating it, which triggers termination of rope winding;
2. the disconnecting element is during winding of the rope in the sensing field of the sensor, while upon push of the load the element leaves the sensing field of the sensor thus interrupting the circuit and triggering termination of rope winding on the winch drum.

The second option is the absolute preferred solution, as it ensures better safety.

[0013] The preferred embodiment of the stop switch according to the invention comprises a Hall sensor and a magnet, which is installed in the upper part of the pushing element precisely above the Hall sensor installed on the upper part of the orifice of the rope guide. The Hall sensor is a contactless sensor of magnetic field comprising a plastic housing, electro microcircuit and a permanent magnet. The Hall sensor is attached in a fixed manner using screwing or similar method, wherein a cable connecting the sensor with the winch controller is installed in any suitable manner along the rope guide, preferably inside the protective housing. Thus, the cable is protected against damage. The permanent magnet is usually installed together with its plastic housing in any suitable manner. During movement of the pushing element the magnet is also moved, wherein the semiconductor microcircuit of the sensor loses the signal or the magnetic field due to movement of the magnet, respectively. At the outlet of the sensor the logical state is changed from 1 to 0, which is detected by the winch controller and terminates rope winding of the rope onto the drum and thus terminates load pulling. Via the sensed magnetic field, the Hall sensor notifies to the controller the status of the pushing element and correspondingly causes termination of rope winding, if necessary. The Hall sensor is a suitable sensor among the group of possible sensors, as it is precise and at the same time in-

sensitive to dirt, various liquids, and large temperature changes. Its operation is consequently insensitive to external conditions, which occur during work with the winch in a forest.

[0014] In case the switch or the sensor is an inductive switch, it is installed in the upper part of the orifice of the rope guide and termination of winding is performed in the following manner: upon movement of the pushing element the sensor senses movement of the metal at the space, where in embodiment with the Hall sensor the magnet is installed, thus causing an interruption in the circuit and triggering termination of winding of the rope on the drum of the winch. The inductive switch is connected to an electric wire to an electromagnetic valve, which in case of activation of the mechanism for terminating winding of the rope terminates winch operation or winding of the rope on the drum, respectively.

[0015] The pulley with the mechanism for terminating winding of the rope may be installed in any winch or a tractor, wherein the winch may have one or more drums.

[0016] The pulley with the mechanism for terminating winding of the rope will be described in further detail based on exemplary embodiment and figures, which show an elevation view and an explosion view of the pulley with the mechanism for terminating winding of the rope according to the possible embodiment from two angles.

[0017] The preferred embodiment of the pulley 1 with the mechanism for terminating winding as shown in figures 1 and 2 comprises the following components:

- a housing 11 of the pulley 1, on which a guide 12 of a pulling rope is installed, said guide 12 being movable in an axis 13a of a driven sheave 13,
- the guide 12 of the pulling rope having a fixed orifice 12a, wherein the orifice 12a has:
 - a part (circled in the figure 1b), onto which the pushing element 14 may be installed as shown in figure 2,
 - an opening along which the pulling rope runs,
 - on the left and right side one groove 16a arranged to receive the screw 16b of the pushing element 14, and
 - on the upper side at least one groove 12b, which is arranged for installation of a sensor 17, switch, magnet or a similar element,
- the pushing element 14 having an opening dimensioned larger than the orifice 12a, so that the pushing element 14 is installed in a linearly movable manner on the orifice 12a, while at the same time being smaller than the end part of the pulling rope, which may hit into the pushing element 14 and push it along the orifice 12a towards the rope guide 12, thereby compressing a spring 15,
- the spring 15, which is provided between the pushing element 14 and farthestmost end of the orifice 12a,

and which ensures return movement of the pushing element 14 into its initial position, and

- a Hall sensor 17, which is arranged to terminate load pulling upon contact of the end part of the rope with the pushing element 14.

[0018] The pushing element 14 is a movably attached bush, which is co-axially attached to the orifice 12a with grooves 16a, along which one screw 16b is movable, said screw 16b being installed through a suitably shaped hole at the sides of the bush 14, and a spring 15, so that in its extreme position the pushing element 14, which has a permanent magnet 18 installed on the orifice above the Hall sensor 17, exits the sensing field of the sensor. The position of the magnet 18 is shown in figure 1b. The pushing element 14 is in its bottom part provided with an additional cut-out or an opening, through which dirt may fall, said dirt collecting in the pushing element and possibly hampering termination of winding.

Claims

1. A pulley (1) for a forestry winch, the pulley being provided with a mechanism for terminating winding of a rope, wherein said pulley (1) comprises:

- a housing (11) of the pulley (1), to which a guide (12) of a pulling rope is mounted, said guide (12) being movable in an axis (13a) of a drive sheave (13) of the pulley (1),
- the guide (12) of the pulling rope with an orifice (12a) having an opening along which the rope runs,
- a pushing element (14) having a smaller opening than an end part of the pulling rope, so that the end part of the pulling rope can hit the pushing element (14) arranged to be moved towards the orifice (12a) of the rope guide (12), and
- a switch or a sensor (17) arranged to terminate winding of the rope and consequently load pulling upon contact of the end part of the rope and the pushing element (14),

and is **characterized in that**

- the guide (12) has the fixed orifice (12a) having:
 - at least a first part arranged to receive at least a part of the pushing element (14), and
 - on an upper side at least one groove (12b) arranged for installation of the sensor, the switch, a magnet or a similar element (17),
- the pushing element (14) is mounted in a linearly movable manner on said orifice (12a) with a two-part safety-guiding assembly (16a, 16b), which prevents rotation of the pushing element

- (14) on the orifice (12a), wherein one part of the two-part assembly is on the orifice (12a), and the second part is on the pushing element (14), - between the pushing element (14) and far end of the orifice (12a) a spring (15) is installed for ensuring return movement of the pushing element (14) into its initial position.
2. The pulley with the mechanism for terminating winding of the rope according to claim 1, wherein a first part (16a) of the safety-guiding assembly (16a, 16b) is a groove, a rail or a similar element, and a second part (16b) of the safety-guiding assembly (16a, 16b) is a screw, a pin, a cylinder, a snap or a similar element.
 3. The pulley with the mechanism for terminating winding of the rope according to claim 1 or claim 2, wherein the orifice (12a) of the guide (12) is provided with a groove, a guide or a rail (16a) of the safety-guiding assembly and the pushing element (14) is provided with a suitably shaped screw (16b), pin, cylinder or a similar element installed, welded or otherwise made on the pushing element (14), so that the second part (16b) of the safety-guiding assembly is movable along the first part (16a).
 4. The pulley with the mechanism for terminating winding of the rope according to any of the preceding claims, wherein the pushing element (14) is a disc, a sliding bearing, a bush, or a similar element.
 5. The pulley with the mechanism for terminating winding of the rope according to any of the preceding claims, wherein the orifice (12a) of the guide has two grooves (16a), provided on the left and on the right side, along which the suitably shaped screw (16b), pin, cylinder or similar element installed, welded, or otherwise made on the pushing element (14) is movable.
 6. The pulley with the mechanism for terminating winding of the rope according to any of the preceding claims, wherein the pushing element (14) is in its bottom part provided with an additional cut-out or an opening, through which dirt collected in the pushing element (14) with the potential to hamper termination of winding, can fall.
 7. The pulley with the mechanism for terminating winding of the rope according to any of the preceding claims, wherein termination of winding is achieved by the pushing element (14) during winding of the rope is in the field of the sensor (17), which allows winding of the rope, wherein upon push of a load on the pushing element (14) the latter is movable out of the field of the sensor (17), thereby causing interruption of the circuit and thus termination of winding of the rope.
 8. The pulley with the mechanism for terminating winding of the rope according to any of the preceding claims, wherein the switch or the sensor (17) is selected in the group consisting of a Hall sensor, an inductive switch, a magnet sensor, a capacitive sensor, or an optical sensor.
 9. The pulley with the mechanism for terminating winding of the rope according to claim 8, wherein the sensor is a Hall sensor (17), which is affixed by screwing or similar fixing manner installed in the groove (12b) on the upper side of the orifice (12), and a cable for connecting the sensor (17) with a winch controller is installed along the rope guide (12), preferably inside the protective housing, while a permanent magnet is installed in the pushing element (14) in an initial position above the Hall sensor (17).
 10. The pulley with the mechanism for terminating winding of the rope according to claim 9, wherein termination of winding is achieved due to movement of the pushing element (14) which is arranged to cause a movement of the magnet thereby causing the semiconductor circuit of the sensor (17) to lose signal or magnetic field due to magnet movement, respectively, and at an output of the sensor (17) is arranged to be changed from 1 to 0, which is sensible by a controller of a winch to terminate winding of the rope on the drum and thus pulling of the load.
 11. A forestry winch with a lower pulley, which is the pulley according to any of the preceding claims.

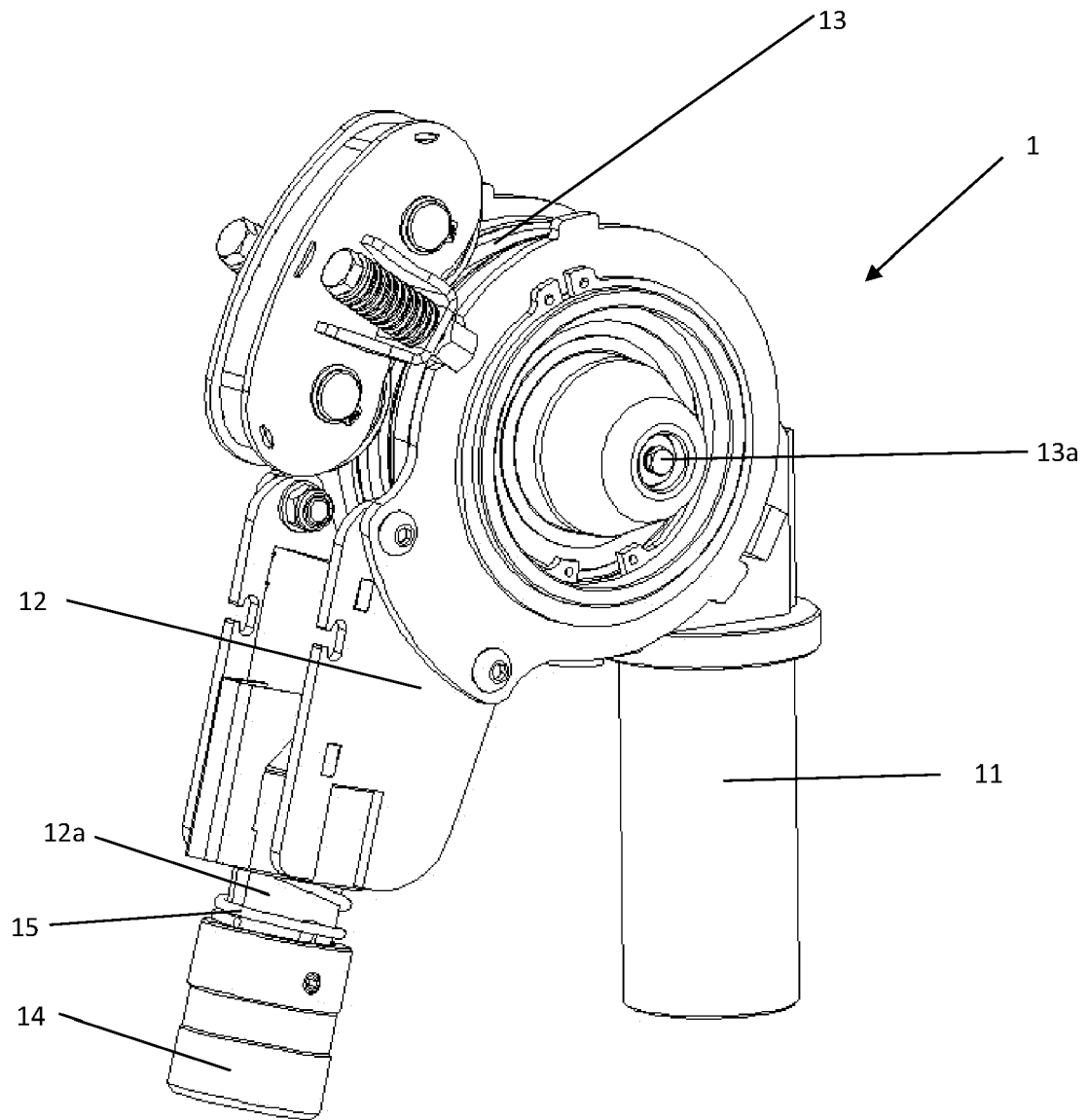


Figure 2



EUROPEAN SEARCH REPORT

Application Number

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			TECHNICAL FIELDS SEARCHED (IPC)
			B66D
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 17 April 2023	Examiner Popescu, Alexandru
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**ANNEX TO THE EUROPEAN SEARCH REPORT
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17-04-2023

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