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(54) **A LOWER PULLEY WITH A MECHANISM FOR TERMINATING WINDING OF A ROPE AND A WINCH COMPRISING THE SAID PULLEY**

(57) Bottom pulley with a stop switch and a forestry winch comprising the said pulley comprising:

- on a housing of the pulley (O), preferably in the upper or the lower part, at least one sensor or a switch (4) is installed, said sensor or a switch being arranged to terminate winding of a load upon touch of the load with an impact element (1);

- the impact element may have one or several parts and is attached to the housing of the pulley in a mounting (2), so that in its extreme position the impact element is pushed into or out from a sensing field of the sensor or switch, wherein:

◦ the impact element has a space, in which the pulling rope can run; and

◦ the impact element is due to amortization of force of the pulled load additionally mounted in an additional mounting (11);

- and the impact element is equipped with a suitable spring, which amortizes the pulling force and ensures a return movement of the impact element into its initial position, in which the pulling force of the load does not affect the impact element.

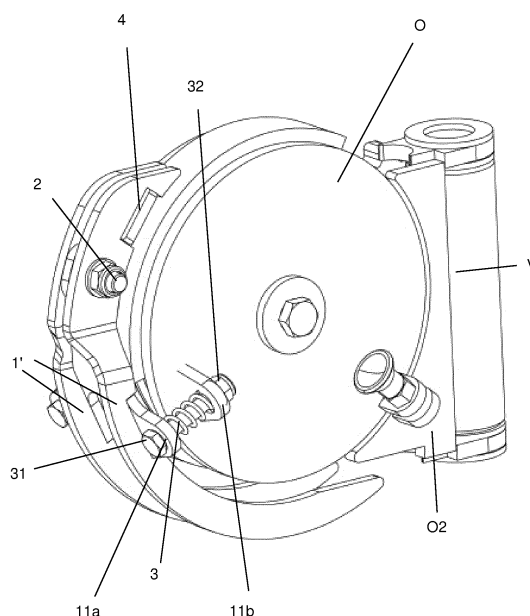


Figure 1

## Description

## Field of the invention

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

## Background of the invention and the technical problem

**[0002]** During use of a winch a situation may occur, in which safe and reliable termination or suspension of pulling of a load via winding a wire rope on a winch drum is required. 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]** In order to prevent said problems of belated termination of rope winding, several different systems for terminating winding have been developed, such as systems described in patent EP 3 095 748 B1, and also in documents SI 25045 and SI 25043. These solutions are adapted for upper pulleys of winches, which differ from the lower pulleys, as the rope is always installed in the upper pulley, while the rope has to be installed and uninstalled from the lower pulley depending on the needs during work.

**[0004]** Lower pulleys of winches serve to lower the centre of gravity of the pulling force during pulling of the load with the forestry winch and thus represent an important part of the winch that ensures reliable pulling of the load. Due to the sporadic use, the lower pulley has to be adapted to fast and simple use, meaning that it has to be quickly opened to insert the rope and afterwards closed. Timely termination of winding of the rope during load pulling is also required for lower pulleys to prevent their deformation, hence the technical problem, solved by the present invention, is a constructional design of a mechanism for terminating winding of the rope, said mechanism being suitable for lower pulleys. In fact, timely termination of winding is even more important in lower pulleys than in upper pulleys. During use of the upper pulley, most commonly load (logs) firstly hit the winch plate, which the user can see and terminate winding. In case of use of the lower pulley, the end part of the rope comes into contact with the pulley before the load hits the winch plate.

## State of the art

**[0005]** Patent EP 3 095 748 B1 discloses a winch with a safety mechanism for terminating winding of the rope, wherein the mechanism has an end switch or a sensor, which can be activated by a pushing element, which is pushed towards the switch with a washer, which is movably installed on the guide of the rope. The end part of the rope pushes the washer, which consequently pushes the pushing element towards the switch thereby terminating winding of the rope. The solution in this patent also allows a possibility that the washer is mounted on the pushing element or the end part of the rope is shaped so that it can directly push the pushing element towards the switch or the sensor.

**[0006]** Documents SI 25043 and SI 25045 describe a very similar solution for the pulley with active termination of rope winding in a forestry winch. The mechanism for terminating winding has a sliding bushing installed in the movable housing at the exit of the rope from the movable part of the pulley, wherein the sliding bushing is movable in the direction of the movement of the pulling rope. The sliding bushing is provided with a spring that ensures movement of the bushing at a certain force. A sensor is installed in the movable housing and is connected to the electronics of the winch. By moving the sliding bushing in the field of the sensor, the latter detects the change and sends information to the electronics to terminate winding of the rope.

## Description of the solution of the technical problem

**[0007]** The present invention is based on the lower pulley, which differs from the upper pulley in its design, shape and operation, as already described above. The technical problem is solved as defined in the independent claim, while preferred embodiments of the invention are defined in the depending claims.

**[0008]** For fast use of the lower pulley, when the pulling rope has to be installed, a specially designed construction is required, said construction usually having a movable part, which allows access to the interior of the housing of the lower pulley, thereby allowing installation or removal of the pulling rope or the wire rope. The mechanism for terminating winding of a rope has to be designed in such a way that it allows simple opening and closing of the movable part, thus allowing access to the rope without removal of the components of the mechanism for terminating winding of the rope. The essence of the lower pulley with the mechanism for terminating winding of the rope according to the invention is in that the said mechanism comprises:

- housing of the pulley, in which, preferably in the upper or the bottom part, an inductive switch or any other switch or sensor is installed, said sensor or switch being arranged to terminate pulling of a load upon contact of the load with at least one impact

element;

- at least one impact element, which may be made from one or more parts, preferably the said impact element comprises a left and a right impact handle, wherein the element or each of the preferred impact handles, respectively, is movably attached to the housing of the lower pulley in a mounting, so that in its extreme position the element or the handles come into the sensing field of the sensor or the switch or leave the sensing field of the sensor or the switch, depending on the settings of the sensor or the switch, wherein:

- the impact element is provided with a suitable opening for the pulling rope or between both handles a space is ensured, where the rope can move; and
- the handles are due to amortization of force of the pulled load mounted preferably in the middle of said handles;

- the impact element or each of the impact handles, respectively, is provided with a spring, preferably a tension, torsion, compression or gas spring, most preferably with a compression spring installed at the additional, preferably middle mounting of the handles, which amortizes the pulling force and ensures return of the impact element or the handles into their initial position, once the pulling force of the load does not affect the impact element or the impact handles.

**[0009]** Instead of the springs used for the return move of the impact element or the switching handles, which form the impact element, any other suitable element may be used, wherein the alternative element allows return of the element or the handles into their initial position, in which there is no interaction with the sensor or the switch for termination of winding. Alternatively, the return movement can be achieved with a suitably designed mounting of the impact element or the handles, for example by providing a torsion spring in the mounting, said torsion spring being arranged to return the impact element or the handles into their initial position, once the pulling force of the load does not affect the impact element or the handles. A possible embodiment of the return movement is also one or more springs installed above the upper mounting of the impact element or the impact handles, so that side springs in the additional, preferably middle mounting and consequently the whole additional middle mounting are not needed.

**[0010]** Switching handles are preferably reinforced, usually with reinforcement ribs that decrease the possibility of damage during impact with the end part of the rope. The reinforcement material may be any material known to a skilled person to be suitable for providing the reinforcement effect. Reinforcements may be present in the uniformly shaped impact element, which is made from a left and a right element, which are joined into a single

piece in their upper parts, said single piece being mounted in one axis.

**[0011]** The additional mounting of the switching handles, which is preferably in the centre, may be achieved using ears on both sides of the impact element or on any handle and using ears on both sides of the housing, wherein through holes in the said ears a screw with a spring is installed, wherein the position of the screw is secured with a nut. This additional mounting may be provided anywhere, not only in the point of the main mounting of the impact element.

**[0012]** Although a possible embodiment of the pulley with the stop switch is such that the switch or the sensor is installed in the bottom part, the preferred option is to instal the sensor or the switch in the upper part, provided that the mounting of the impact element suitably moved in order to enable movement of the impact element in the direction towards the switch or the sensor and in the direction away from the said switch/sensor. Termination of winding may namely occur in two different manners:

a) the impact element is during winding of the rope outside of the sensing field of the sensor, while upon pushing of the load on the impact element the impact element is moved into the sensing field of the sensor thus activating it, which triggers termination of rope winding;

b) the impact element is during winding of the rope inside the sensing field of the sensor, while upon pushing of the load on the impact element the impact element is moved outside the sensing field of the sensor thus activating it, which triggers termination of rope winding.

The latter option is easier to implement, as manufacturing of the winch is easier and also its operation is more reliable, as the sensor is not subjected to impact damage and dirt caused by the wire rope, which moves on the sheave.

**[0013]** Operation of the mechanism for terminating winding of the rope (i.e., the stop switch) of the lower pulley according to the above-described first variant is carried out in the following way: the pulled load is drawn nearer and touches the impact handles, which in turn begin to move due to the movable upper mounting. As the handles are moved towards the suitable sensor or switch, preferably to the inductive switch, onto a predefined distance with regards to the sensor or switch type, preferably to the distance from 2 to 5 mm, most commonly to 3 mm, the switch or sensor is activated and termination of rope winding is triggered. At the same time the winch ceases to operate, thus preventing possible damage to the winch or the wire rope.

**[0014]** In the mechanism of the pulley according to the invention any sensor may be used, preferably an inductive, a magnetic, a capacitive or an optical sensor. Sensors may be replaced by switches or similar elements for terminating a function. At least one has to be present,

preferably two are provided, as more reliable operation is enabled in case one of the sensors malfunctions. Two sensors may be present also because each of them can sense movement of at least one part of the impact element, wherein at least one of the sensors has to be activated in order to terminate winding. In order to prevent unwanted terminations due to interaction of other objects with the switch or the sensor, preferably inductive sensor of small dimensions is used, so that it can be entirely hidden in the housing of the pulley, thus protecting the sensor and simultaneously allowing only activation with the impact element or the handles, respectively. All other metal parts in this case do not interact.

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

**[0016]** The lower pulley with the mechanism for terminating winding of the rope will be described in further detail based on exemplary embodiments and figures, which show:

- Figure 1 Elevation view of the lower pulley with the mechanism for terminating winding of a rope according to a possible embodiment
- Figure 2 Side view of the lower pulley with the mechanism for terminating winding of a rope according to a possible embodiment
- Figure 3 The lower pulley with the mechanism for terminating winding of a rope according to a possible embodiment as viewed from the front

**[0017]** The preferred embodiment of the lower pulley with the mechanism for terminating winding is shown in figure 1, wherein the pulley comprises:

- housing O of the pulley, which is on one side provided with a locking element 01, which locks or unlocks a movable part 02 on the other side of the housing, wherein the movable part is approximately triangular part between the rotatable mounting V for installation to the winch and circularly shaped middle part of the housing, inside which a pulling rope is installed, wherein the side adjacent to the circularly shaped middle part is curved in order to correspond to the shape of the said middle part,
- a sensor or a switch 4, which is arranged to terminate winding of a load upon touch of the load with at least one of impact handles 1', which form an impact element 1, wherein the said switch 4 is installed in the upper part of the housing O of the pulley;
- left and right impact handles 1', which are movably attached to the housing I of the lower pulley in a mounting 2, so that in its extreme position the handles 1' are pushed out from a sensing field of the sensor 4, wherein:

- between both handles 1' a space 1a is provided, in which the pulling rope can run; and
- the handles 1' due to amortization of force of the pulled load are mounted in an approximate middle of both handles in an additional, preferably middle, mounting 11;

- each of the impact handles 1' is equipped with a suitable spring 3, preferably with a compression spring installed at the additional middle mounting 11, which amortizes the pulling force and ensures a return movement of the impact handles into their initial position, in which the pulling force of the load does not affect the handles 1'.

**[0018]** Said switch or sensor, respectively, which may be any suitable, wherein the most preferred option is inductive switch, is installed in the upper part and the termination of winding is performed in the following way: the impact handles are during winding of the rope in the sensing field of the sensor, which allows uninterrupted winding of the rope, while upon pushing of the load onto the impact handles, the latter are moved out from the sensing field of the sensor, which interrupts the circuit and triggers termination of winding of the rope onto the winch drum. The inductive switch is connected with an electric wire to the electromagnetic valve, which in case of activation of the mechanism for terminating winding of the rope interrupts operation of the winch or winding of the rope onto the drum, respectively.

**[0019]** A middle mounting 11 of the switching handles 1 is achieved with ears 11a on each handle 1 and ears 11b on each side of the housing O, wherein through the holes in said ears 11a, 11b a screw 31 with a spring 3 is installed, and the position of the screw 31 is secured with a nut 32.

**[0020]** Figure 2 shows a lower pulley with a mechanism for terminating winding of a rope shown in figure 1, but with a visible position of the sensor or the switch 4, which is entirely hidden in the interior of the housing O of the pulley, in order to eliminate or reduce possibility of activation with any other element, which is not the switching handle 1. Figure 3 shows the front side of the lower pulley.

## Claims

1. A lower pulley for a forestry winch, **characterized in that** it is provided with a mechanism for terminating winding of a rope, wherein:
  - on a housing (O) of the pulley, preferably in the upper or the lower part, at least one sensor or a switch (4) is installed, said sensor or a switch (4) being arranged to terminate pulling of a load upon touch of the load with an impact element (1);
  - the impact element (1) may have one or several

parts and is attached to the housing (O) of the pulley in a mounting (2), so that in its extreme position the impact element (1) is pushed into or out from a sensing field of the sensor or switch (4), wherein:

- the impact element (1) has a space (1a), in which the pulling rope can run; and
- the impact element (1) is due to amortization of force of the pulled load additionally mounted in an additional mounting (11);

- and the impact element (1) is equipped with a suitable spring (3), which amortizes the pulling force and ensures a return movement of the impact element into its initial position, in which the pulling force of the load does not affect the impact element (1).

2. The lower pulley with the mechanism for terminating winding of a rope according to claim 1, **characterized in that** the spring (3) is installed at the additional mounting (11) or mounting (2) of the impact element (1) to the housing, wherein the spring may be a compression, a torsion, a gas or a tension spring, preferably the compression spring in case of installation at the additional mounting (11) or the torsion spring in case of installation in the mounting (2).
3. The lower pulley with a mechanism for terminating winding of a rope according to claim 1 or 2, **characterized in that** the impact element (1) comprises two handles (1'), between which a space (1a) is provided for receiving the rope, wherein both handles are mounted in the same mounting point (2).
4. The lower pulley with the mechanism for terminating winding of a rope according to any of the preceding claims, **characterized in that** the impact element is reinforced, preferably with reinforcement ribs.
5. The lower pulley with the mechanism for terminating winding of a rope according to any of the preceding claims, **characterized in that** the additional mounting (11) of the impact element or the handles (1) is achieved with ears (11a) on each side of the element or in each handle (1) and ears (11b) on each side of the housing (O), wherein through holes in said ears (11a, 11b) a screw (31) with the spring (3) is installed, while the position of the screw (31) is secured with a nut pa (32).
6. The lower pulley with the mechanism for terminating winding of a rope according to any of the preceding claims, **characterized in that** the sensor or the switch (4) is installed in the upper part of the housing (O) and termination of winding is achieved by that during winding the impact element (1) is arranged in

the field of the sensor (4), whereas upon pressure of the load the impact element (1) is arranged to be pushed out of the field of the sensor (4), which interrupts the circuit and consequently causes termination of winding of the rope onto the winch drum.

7. The lower pulley with the mechanism for terminating winding of a rope according to any claim from 1 to 4, **characterized in that** the sensor or the switch (4) is installed in the lower part of the housing (O) and termination of winding is achieved by that during winding the impact element (1) is arranged at a distance from the sensor (4), whereas upon pressure of the load the impact element (1) is arranged to be pushed into the field of the sensor (4) which becomes activated and consequently causes termination of winding of the rope.
8. The lower pulley with the mechanism for terminating winding of a rope according to any of the preceding claims, **characterized in that** the switch or the sensor is any suitable element for terminating winding of the rope, preferably an inductive, a magnetic, a capacitive or an optical sensor, most preferably inductive sensor.
9. The lower pulley with the mechanism for terminating winding of a rope according to any of the preceding claims, **characterized in that** it is provided with two sensors or switches (4) for more reliable function.
10. The lower pulley with the mechanism for terminating winding of a rope according to the preceding claim, **characterized in that** each of the two sensors or switches independently sense movement of at least one part of the impact element, wherein for termination of winding at least one of the sensors or switches has to be activated.
11. The lower pulley with the mechanism for terminating winding of a rope according to any of the preceding claims, **characterized in that** the switch or the sensor (4) is entirely hidden in the interior of the housing (O) of the pulley, in order to eliminate or at least reduce the possibility of activation with any other element that is not the switching handle (1).
12. The lower pulley with the mechanism for terminating winding of a rope according to any of the preceding claims, **characterized in that** an electric wire is used to connect the inductive sensor to an electromagnetic valve, which in case of activation of the mechanism for terminating winding of the rope interrupts operation of the winch or winding of the rope onto the drum, respectively.
13. The lower pulley with the mechanism for terminating winding of a rope according to any of the preceding

claims, **characterized in that** for the return movement of the impact element or the impact handles one or more springs are provided above the upper mounting of the impact element or handles, so that the side springs in the additional, middle mounting and the whole additional mounting are not necessary. 5

14. A forestry winch with the lower pulley with the mechanism for terminating winding of a rope according to any of the preceding claims. 10

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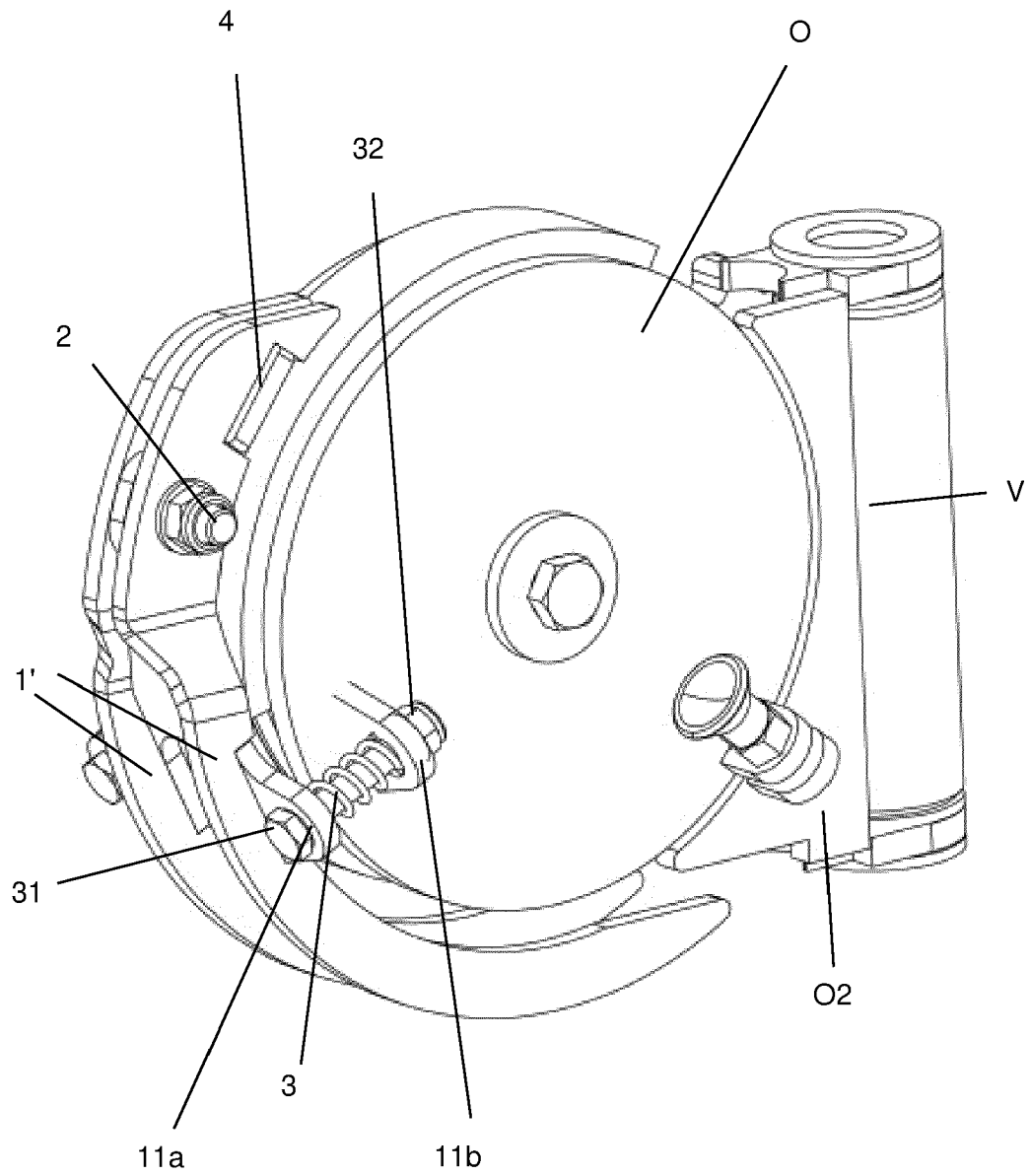


Figure 1

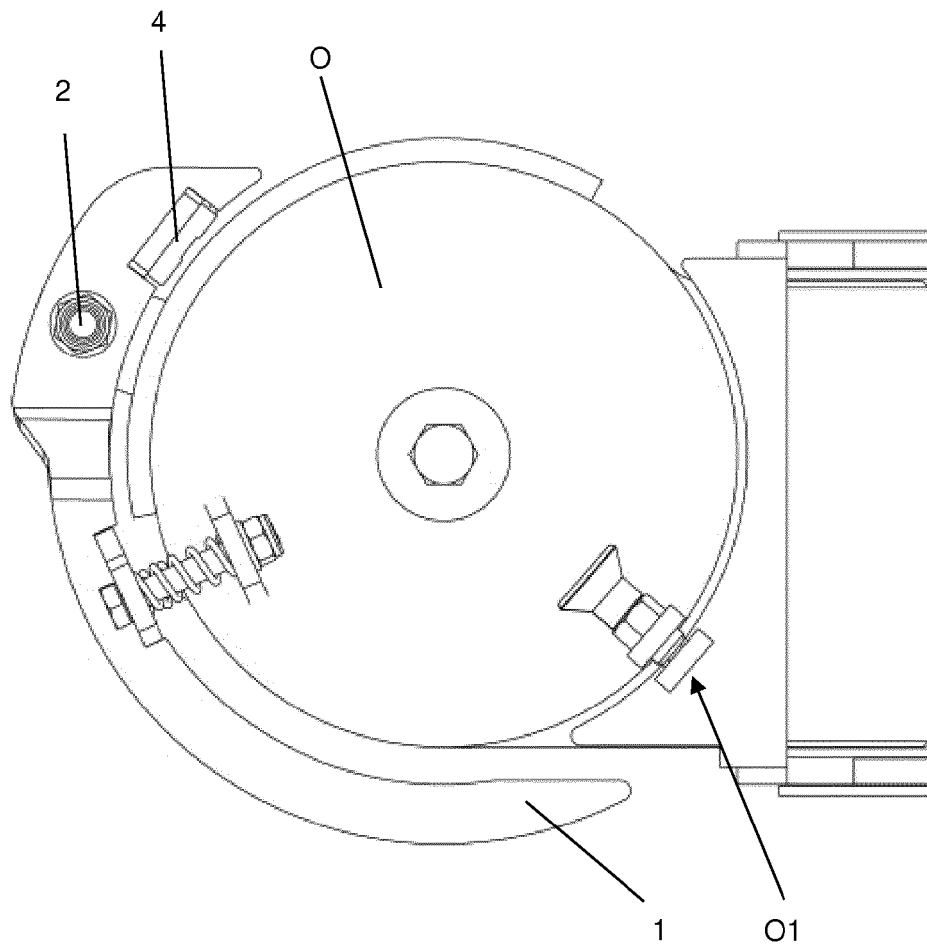


Figure 2

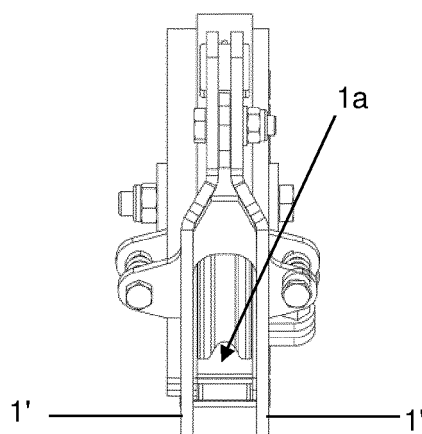


Figure 3





## EUROPEAN SEARCH REPORT

Application Number  
EP 21 17 4616

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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 25 October 2021	Examiner Verheul, Omiros
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This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.  
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25-10-2021

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

**REFERENCES CITED IN THE DESCRIPTION**

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