

Endless cable winch

[0001] The invention relates to an endless cable winch, in particular for a service lift, in particular for wind power plants, comprising a working cable and a safety cable, a driving cable pulley around at least a part of which the working cable is wrapped, a drive for driving the driving cable pulley, and further comprising a safety device for the safety cable.

[0002] Endless cable winches of this type are widely used for person transport applications. It is generally the case here that a lift cage, a platform or the like for receiving one or more persons is moved in an upward or downward direction by means of the endless cable winch. To provide a fall arrestor in the event of a cable breakage of the working cable or in the event of a gearbox failure of the endless cable winch, the safety cable is provided which runs jointly with and independently of the working cable and which, if the safety cable moves downward at too high a speed, generates a blocking action at the safety device, such that the safety cable is abruptly halted and the lift cage, the platform etc. is caught.

[0003] The abrupt braking in the event of failure of the working cable however results in a high load being exerted on the safety cable, and furthermore, the persons situated in the lifting device moved by the cable winch are subjected to intense physical and psychological stress.

[0004] It is the object of the present invention to provide an endless cable winch which as far as possible eliminates the disadvantages described above.

[0005] This object is achieved according to the invention, in the case of an endless cable winch of the type mentioned at the outset, in that the safety device comprises a non-

driven cable pulley, which is rotatably mounted in a housing and around at least a part of which the safety cable is wrapped, and further comprises an arresting device which is coupled via a brake to the cable pulley and which blocks, and brakes the safety cable by means of the brake, at a predetermined speed of the safety cable at least in one direction.

[0006] The object of the invention is hereby fully achieved.

[0007] Specifically, the fact that the arresting device blocks, and brakes the safety cable by means of the brake, when the predetermined speed is reached, has the result, during the catching of the safety cable by means of the safety device, of considerably slower braking of the safety cable as compared with the blocking arresting device used in the prior art, which acts directly on the safety cable. Whereas it is the case in the prior art that *braking accelerations of the order of magnitude of approximately 3 to 5 g arise during the direct catching of the safety cable by means of an arresting device*, it is possible depending on the design of the brake device to realize a considerably lower braking acceleration, for example of the order of magnitude of approximately 2 g. This firstly has the result that the loading of the safety cable upon the response of the safety device is considerably reduced. Secondly, the physical and psychological stress on the personnel located in the person lifting device which is moved by means of the endless cable winch is reduced in this way.

[0008] In a preferred refinement of the invention, the arresting device comprises a ratchet wheel which interacts with a pawl mounted on the housing, in such a way that the pawl latches into the ratchet wheel at a predetermined speed of the safety cable.

[0009] In this way, an arresting device is provided which is highly robust and which is of simple and reliable design.

[0010] Here, in a preferred refinement of the invention, the pawl has a first pawl arm and a second pawl arm, between which the pawl is pivotably mounted on the housing, wherein the pawl is preloaded against the ratchet wheel in such a way that the first pawl arm can move along the ratchet wheel up to a predetermined speed, and latches

with its second pawl arm into the ratchet wheel if the predetermined speed is exceeded in the downward direction of the safety cable.

[0011] In this way, it is possible to ensure reliable blocking of the ratchet wheel by means of the pawl. The predetermined speed at which the blocking takes place can be finely adjusted by means of the preload of the pawl.

[0012] In a further embodiment of the invention, a sensor is provided for detecting a blocking of the arresting device, which sensor outputs a signal which indicates a blocking of the arresting device.

[0013] In this way, the signal can be utilized, in the event of blocking of the arresting device, for example to shut off the drive and if appropriate implement further measures such as for example the transmission of a fault signal to a remote monitoring unit.

[0014] Furthermore, means for targetedly activating the arresting device may be provided, in particular a button for moving the pawl into a latching position for latching into the ratchet wheel.

[0015] In this way, the arresting device can be targetedly activated manually, mechanically, electrically or in some other way, for example in order, if a critical situation is detected, to activate the arresting device in order to generate a braking action.

[0016] Here, the arrangement may be such that the arresting device, after an activation, is automatically released again during a subsequent movement of the safety cable in the upward direction.

[0017] In a further embodiment of the invention, the ratchet wheel and the cable pulley are rotatable about a common axis of rotation, and the ratchet wheel forms a friction brake with the cable pulley.

[0018] A simple and reliable construction is ensured in this way.

[0019] In a further embodiment of the invention, the brake is in the form of a conical brake.

[0020] The design of the brake as a conical brake yields a particularly effective braking action with a relatively small installation size.

[0021] It is furthermore preferable for the friction brake to comprise a first friction partner composed of a bronze alloy and a second friction partner composed of a steel alloy.

[0022] It has been found that such a design of a friction brake for the application according to the invention yields particularly expedient configuration parameters which permit in particular a high braking force. It is alternatively possible for two friction partners to be used, at least one of which is provided with a friction lining.

[0023] Here, the brake preferably has a cone angle of approximately 4° to 10° .

[0024] A particularly expedient configuration of the brake can be attained in this way.

[0025] It is also alternatively possible for a friction lining to be provided on at least one of the friction partners. It is then generally the case here that a larger cone angle is also used, of the order of magnitude of approximately 10° to 40° .

[0026] This counteracts possible wear or seizing.

[0027] In a further preferred embodiment of the invention, the ratchet wheel has an external cone which is spring-loaded against an internal cone of the cable pulley.

[0028] Here, the ratchet wheel may be preloaded against the internal cone of the cable pulley for example by means of a plate spring, the preload of which is preferably adjustable.

[0029] These measures yield a simple and reliable construction.

[0030] The use of a plate spring makes it possible to impart a very high pressing force, such that high braking forces can be transmitted.

[0031] In a further embodiment of the invention, at least the working cable or the safety cable are wrapped around the driving cable pulley or the cable pulley with a wrap angle of less than 300° , preferably of approximately 260° to 280° , particularly preferably of approximately 270° .

[0032] Whereas it is the case in conventional endless cable winches that the wrap angle is normally 360° , it has been recognized according to the invention that a smaller wrap angle may also be adequate. With a smaller wrap angle of in particular approximately 270° , it is possible to dispense with a diverting roller if, in the case of the endless cable winch being used with a person lifting device, the cable should not be guided through the service lift itself but rather should be diverted laterally past the service lift and downwards by means of diverting rollers.

[0033] In a preferred refinement of the invention, the predetermined speed for the braking of the safety cable is 20 to 40 meters/minute, preferably 25 to 35 meters/minute, preferably approximately 30 meters/minute.

[0034] In this way, adherence to the triggering speed predefined by the European standard EN 1808 can be ensured.

[0035] In a further embodiment of the invention, the driving cable pulley and the cable pulley are mounted in a common housing.

[0036] In this way, it is possible for both the winch and also the safety device to be of compact construction in a common housing.

[0037] It would however basically also be conceivable for the safety device to be formed as a separate unit with the arresting device and the brake.

[0038] In a further embodiment of the invention, the cable pulley has a biasing device for biasing the safety cable against the cable pulley.

[0039] In a further embodiment of the invention, the driving cable pulley has a biasing device for biasing the working cable against the driving cable pulley.

[0040] Here, the biasing device may be for example a spring-loaded pressing roller.

[0041] These measures concern additional safety measures which are basically not necessary if both cables are preloaded or are loaded with a weight, but which lead to a further increase in safety.

[0042] Furthermore, the ratchet wheel may be mounted on a journal of the cable pulley.

[0043] Finally, a rotationally conjoint connection of the driving cable pulley and cable pulley to one another is also conceivable.

[0044] These measures yield a more simplified construction and a compact design of the safety device and of the endless cable winch as a whole.

[0045] The invention also provides a person lifting device, in particular a service lift, in particular for wind power plants, which has an endless cable winch of the type described above.

[0046] It is possible here for the working cable and the safety cable to be guided laterally out of the endless cable winch at an angle of approximately 90° relative to the

upper strands, and diverted downward merely by means of in each case one diverting roller.

[0047] In this way, it is possible to attain simpler cable guidance while dispensing with further diverting rollers, and to attain a smaller structural height of the person lifting device, in particular of a hoisting cage.

[0048] It is self-evident that the features of the invention mentioned above and the features of the invention yet to be explained below can be used not only in the respectively specified combination but rather also in other combinations or individually, without departing from the scope of the present invention.

[0049] Further features and advantages of the invention will be apparent from the following description of preferred exemplary embodiments with reference to the drawing, in which:

Fig. 1 shows, in a simplified side view, a person lifting device in the form of a service lift for a wind power plant;

Fig. 2 shows a perspective illustration of an endless cable winch according to the invention which is used in the person lifting device as per Fig. 1;

Fig. 3 shows a front view of the endless cable winch as per Fig. 2;

Fig. 4 shows a front view of the endless cable winch as per Fig. 3 in an enlarged illustration and after the housing cover has been removed;

Fig. 5 shows a section through the endless cable winch as per Fig. 2; and

Fig. 6 shows, in an enlarged illustration, a partial section as per Fig. 5 in the region of the winch and safety device.

[0050] Fig. 1 shows, in a side view and in a simplified illustration, a person lifting device in the form of a service lift for wind power plants.

[0051] The person lifting device denoted as a whole by 10 has a lift cage 12 with a frame 18, to the top end of which is fastened an endless cable winch 20.

[0052] The lift cage 12 hangs on a working cable which is guided through the endless cable winch 20 and which, laterally, is diverted downwards by means of a roller 14. Parallel to the working cable there runs a safety cable 16 which is likewise guided through the endless cable winch 20 and is guided laterally out of the endless cable winch 20 at an angle of 90° or 270° relative to the upper strand of the safety cable 16 and guided downwards by means of the diverting roller 14. In Fig. 1, it is possible to see only the course of the safety cable 16, because the working cable runs exactly parallel thereto and is thus hidden by the safety cable 16.

[0053] The construction and mode of operation of the endless cable winch 20 will now be explained in more detail below on the basis of Figs 2 to 6.

[0054] Fig. 2 shows a perspective view of the endless cable winch 20. The endless cable winch 20 moves the working part 28 upwards or downwards such that the lift cage 12 moves upwards or downwards on the working cable 28. The winch 22 comprises a drive 24 with a motor and a gearbox, and also comprises a controller 26. The endless cable winch 20 comprises a winch 22 which moves the working part 28, and also a safety device 30 through which the safety cable 16 is guided.

[0055] Fig. 3 shows the endless cable winch 20 in a front view, whereas Fig. 4 shows the endless cable winch 20 in a slightly enlarged front view after the housing cover of the safety device 30 has been removed.

[0056] Fig. 4 shows the construction of an arresting device 31 which is part of the safety device 30. The arresting device 31 comprises a ratchet wheel 32 which interacts with a pawl 34 which is held so as to be pivotable about a pivot axis 36. The pawl 34 has

a first pawl arm 38 and a second pawl arm 40 which protrude in opposite directions from the pivot axis 36. The pawl 34 is preloaded by a spring 46 in such a way that the first pawl arm 38 normally bears against the internal toothing of the ratchet wheel 32. In this position, the ratchet wheel can be moved both clockwise and also anticlockwise without the pawl leading to blocking against the ratchet wheel 32. If the ratchet wheel 32 moves anticlockwise as per the illustration in Fig. 4, the lift cage 12 moves downwards. Here, the pawl 34 runs with its first pawl arm 38 on the toothed inner surface of the ratchet wheel 32. The stress of the spring 46 is now set such that, when the downward speed of the safety cable 16 reaches approximately 30 meters per minute, the interaction of the first pawl arm 38 with the toothed inner surface of the ratchet wheel 32 causes the pawl 34 to lift from the inner surface of the ratchet wheel 32 and turn over, such that the pawl latches with a latching lug 42 at the end of the second pawl arm into the inner surface of the ratchet wheel 32, and the ratchet wheel 32 is thus blocked by means of the pawl 34 mounted in the housing 54. The arresting device 31 is thus arrested and causes the rotatably mounted ratchet wheel 32 to be fixed at the pawl 34.

[0057] In the arrested state, a switch 44 is actuated. The switch signals to the controller 26 that the drive 24 must be shut off. Furthermore, the switch 44 may also be utilized to output for example a fault signal, which is transmitted for example to a remote monitoring device, in the event of a response.

[0058] Fig. 4 also shows a pressing device 48 for a cable pulley over which the safety cable 16 is guided (cf. Fig. 5). The pressing device 48 has a pressing roller 50 which is pressed by means of a spring 52 against the safety cable 16 in order to press the latter into an associated guide groove of the cable pulley 68 as per Fig. 5.

[0059] Fig. 5 furthermore shows the construction of the winch 22. The winch 22 has, in a way which is basically known, a driving cable pulley 58 over which the working cable 28 is guided with a wrap angle of approximately 270°. The driving cable pulley 58 has a guide groove 59 in which the working cable 28 runs. A pressing device 56 is also provided for pressing the working cable 28 into the guide groove 59. This pressing device involves a pressing roller combined with a spring. The working cable 28 emerges laterally

out of the winch 22, as can be seen from Fig. 2, after a wrap angle of approximately 270° , and is then diverted downwards by means of the diverting roller 14.

[0060] Fig. 5 also shows the drive 24 which comprises an electric motor and a gearbox. The output shaft 70 of the gearbox drives the driving cable pulley 58 via a shaft-type pinion (not illustrated).

[0061] As can be seen from the enlarged illustration of Fig. 6, both the driving cable pulley and also the cable pulley are mounted in the common housing 54 of the winch 22 and of the safety device 30 by means of in each case two bearings 60, 62, 64, 66.

[0062] The safety device 30 comprises the arresting device 31 discussed above on the basis of Fig. 4, this safety device being coupled by means of a brake, denoted as a whole by numeral 71, to the cable pulley 68 over which the safety cable 16 is guided. The ratchet wheel 32 has an external cone 72 which bears against an internal cone 74 of the cable pulley 68. The ratchet wheel 32 is preloaded against the cable pulley 68 by means of a plate spring 78 which is supported against a bearing ring 76 on a journal 73 of the cable pulley, such that there is frictional engagement between the external cone 72 of the ratchet wheel 32 and the internal cone 74 of the cable pulley 68. The preload of the plate spring 78 can be adjusted by means of a nut 82 which is screwed onto a thread 80 on the journal 73.

[0063] The function of the safety device 30 is as follows:

[0064] In the normal situation, the non-driven cable pulley 68 runs synchronously with the driving cable pulley 58. The safety cable 16 thus moves at the same speed as the working cable 28 over the cable pulley 68.

[0065] If, for any reason, the winch 22 fails, either as a result of breakage of the working cable 28 or gearbox failure in the drive 24, which would cause the lift cage 12 to fall downwards, the lift cage 12 moves downwards initially at an increased speed until the triggering speed of the arresting device 31 is reached. At approximately 30 meters per

minute, the pawl 34 blocks against the ratchet wheel 32, such that the previously rotating cable pulley 68 is now braked by means of the conical brake 71 until the lift cage 12 finally comes to a standstill.

[0066] The triggering speed for the arresting device 31 is approximately 30 meters per minute. The preload of the plate spring 78, the cone angle of the conical brake 71, which is approximately 5° to 8°, and the friction pairing of the materials of the internal cone 74 and external cone 72 (bronze alloy / steel alloy) are coordinated with one another such that, proceeding from the triggering speed of approximately 30 meters per minute, the lift cage 12 is braked with approximately 2 g. This constitutes considerably smoother braking than with conventional safety devices, by means of which the safety cable was immediately blocked, which led to catching of the lift cage 12 with approximately 5 g.

[0067] Instead of the direct material pairing of two metals (bronze alloy / steel alloy), it would also be possible for a friction lining to be provided on at least one friction partner in order to counteract possible wear as a result of corrosion or seizing. Here, it would then generally also be necessary to use a larger cone angle of the order of magnitude of approximately 10° to 40°, for example of approximately 30°.

[0068] By means of a button 45, the pawl 34 can also be moved into its arresting position manually, mechanically, electrically or in some other way (cf. Fig. 5). For this purpose, the button 45 is actuated once in order to pivot the pawl 34. The arresting position is automatically eliminated again if the safety cable 16 is moved in the upward direction again.

Claims

1. An endless cable winch, in particular for a service lift (10), in particular for wind power plants, comprising a working cable (28) and a safety cable (16), a driving cable pulley (58) around at least a part of which the working cable (28) is wrapped, a drive (24) for driving the driving cable pulley (58), and further comprising a safety device (30) for the safety cable (16), wherein the safety device (30) comprises a non-driven cable pulley (68), which is rotatably mounted in a housing (54) and around at least a part of which the safety cable (16) is wrapped, and further comprises an arresting device (31) which is coupled via a brake (71) to the cable pulley (68) and which blocks and brakes the safety cable (16) by means of the brake (71), at a predetermined speed of the safety cable (16) at least in one direction, wherein the arresting device (31) comprises a ratchet wheel (32) which interacts with a pawl (34) mounted on the housing (54), in such a way that the pawl (34) latches into the ratchet wheel (32) at the predetermined speed of the safety cable (16), characterized in that the ratchet wheel (32) and the cable pulley (68) are rotatable about a common axis of rotation, and in that the ratchet wheel (32) forms a friction brake (71) with the cable pulley (68).
2. The endless cable winch according to claim 1, characterized in that a sensor (44) is provided for detecting a blocking of the arresting device (31), which sensor outputs a signal which indicates a blocking of the arresting device (31).
3. The endless cable winch according to any of claims 1 to 2, characterized in that the pawl (34) has a first pawl arm (38) and a second pawl arm (40), between which the pawl (34) is pivotably mounted on the housing (54), wherein the pawl (34) is preloaded against the ratchet wheel (32) in such a way that the first pawl arm (38) can move along the ratchet wheel (32) up to the predetermined speed, and latches with its second pawl arm (40) into the ratchet wheel (32) if the predetermined speed is exceeded in the downward direction of the safety cable (16).

4. The endless cable winch according to any of the preceding claims, characterized in that means (45) for targetedly activating the arresting device (31) are provided, in particular a button for moving the pawl (34) into a latching position for latching into the ratchet wheel (32).
5. The endless cable winch according to one of the preceding claims, characterized in that the brake (71) is in the form of a conical brake.
6. The endless cable winch according to claim 5, characterized in that the friction brake (71) comprises a first friction partner composed of a bronze alloy and a second friction partner composed of a steel alloy.
7. The endless cable winch according to claim 6, characterized in that the brake (71) has a cone angle of approximately 4° to 10° .
8. The endless cable winch according to any of claims 5 to 7, characterized in that the friction brake (71) comprises at least one friction lining.
9. The endless cable winch according to any of claims 5 to 8, characterized in that the ratchet wheel (32) has an external cone (72) which is spring-loaded against an internal cone (74) of the cable pulley (68).
10. The endless cable winch according to claim 9, characterized in that the ratchet wheel (32) is preloaded against the internal cone (74) of the cable pulley (68) by means of a plate spring (78), the preload of which is preferably adjustable.
11. The endless cable winch according to any of the preceding claims, characterized in that at least the working cable (28) or the safety cable (16) are wrapped around the driving cable pulley (58) or the cable pulley (68) with a wrap angle of less than 300° , preferably of approximately 260 to 280° , particularly preferably of approximately 270° .

12. The endless cable winch according to any of the preceding claims, characterized in that the predetermined speed for the braking of the safety cable is 20 to 40 meters/minute, preferably 25 to 35 meters/minute, preferably approximately 30 meters/minute.
13. The endless cable winch according to any of the preceding claims, characterized in that the driving cable pulley (58) and the cable pulley (68) are mounted in a common housing (54).
14. The endless cable winch according to any of the preceding claims, characterized in that the cable pulley (68) has a biasing device (48) for biasing the safety cable (16) against the cable pulley (68).
15. The endless cable winch according to any of the preceding claims, characterized in that the driving cable pulley (58) has a biasing device (56) for biasing the working cable (28) against the driving cable pulley (58).
16. The endless cable winch according to any of claims 13 or 14, in which the biasing device (48, 56) comprises a spring-loaded pressing roller (50).
17. The endless cable winch according to any of the preceding claims, characterized in that the ratchet wheel (32) is mounted on a journal (73) of the cable pulley (68).
18. A person lifting device, in particular a service lift, in particular for wind power plants, characterized by an endless cable winch (20) according to one of the preceding claims.
19. The person lifting device according to claim 18, in which the working cable (28) and the safety cable (16) are guided laterally out of the endless cable winch (20) at an angle of approximately 90° relative to the upper strands, and are diverted downward merely by means of in each case one diverting roller (14).