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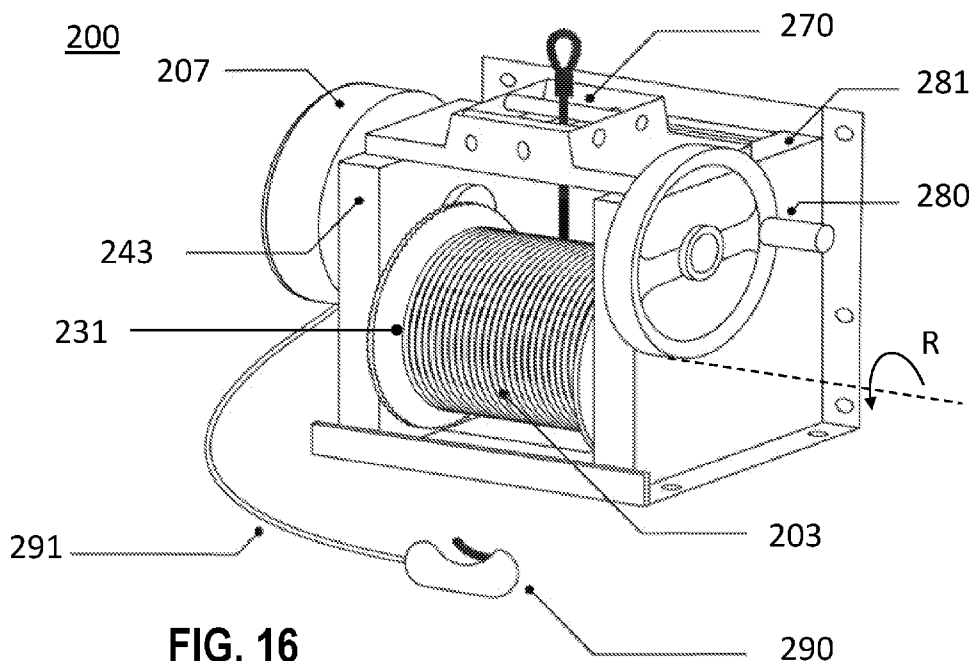


FIG. 16

(57) Abstract: A device for evacuating individuals from a structure during an emergency is provided that comprises a transmission axis, a drum with cable mounted around the transmission axis, and a locking unit configured for rotationally locking the transmission axis and the drum preventing the drum to rotate relative to the transmission axis in a first rotational direction. A rotation regulator is mechanically coupled to the transmission axis. The regulator is configured to limit a rotation speed thereof during unwinding of the cable from the drum. A braking unit can be used for stopping rotation of the transmission axis in the first rotational direction and for allowing rotation of the transmission axis in the second rotational direction. A second member is provided for rotating the transmission axis in the second rotational direction.

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DEVICE FOR EVACUATING INDIVIDUALS

The present invention relates to devices for evacuating individuals during an emergency from a structure, such as a tall structure. Specifically, the present invention relates to devices for safely lowering more than one individual, preferably irrespective of the weight of the individual, for instance during a fire from one of the higher floor levels of the tall structure, down to the ground level, more in particular at a lower than a predetermined maximum speed.

During emergencies such as fires, it becomes often necessary to rapidly evacuate persons from the affected structure such as a high-rise building. This can become difficult, dangerous and even impossible if access to the internal fire escapes is blocked; for example, by flames and/or smoke.

In such cases, the only available escape route may be along the exterior of the building, but ordinarily that route is, under the best of circumstances, available only to occupants of lower floors of the structure.

While floors at intermediate heights of the structure could be evacuated via ladders, provided that ladders are provided or arrive in time with or on fire trucks, occupants of the higher floors are in greater danger, unless the fire can be controlled in time before it reaches and/or spreads throughout such floors.

Prior art attempts have been made to provide occupants of high rise structures with a way to escape along the exterior of the building during emergencies.

US-260,422 discloses a fire escape device, comprising one or more drums for wire cables, which, being carried over pulleys, have attached to their free extremities cages, of which each cage is of capacity sufficient to hold one or more persons. In order to regulate and place under control the rapidity of descent of the loaded cages, an adjustable brake or governor is provided.

Typically, such prior art attempts involved providing a rope or cable that is suitably anchored to the building, which can be lowered alongside the building to hang from a higher floor of the

tall structure, and a mechanism frictionally engaging the rope and adapted to suspend the escaping person therefrom, and means operable by the escaping person for controlling friction to thereby lower himself at a controlled, sufficiently low speed to prevent injury upon the person's arrival on the ground. Such prior art attempts were based on principles comparable with the technique of "abseiling".

However, these attempts exhibit a common number of drawbacks, including their reliance on power from or strength of the person descending to slow down his or her rate of descent and the need for some skill on the part of the descending person to properly operate such devices, and especially the descent rate lowering parts thereof. Even in case that an individual to be evacuated is physically strong enough to slow down an excessive rate of decent and has sufficient skill to operate such a prior art device, the mere circumstances during an emergency, like for example panic and confusion, will make it difficult for such individual to safely reach ground level, if not properly trained.

From operational and safety points of view, it is therefore preferred if tall structures could be equipped with escape devices which, on demand, automatically lower a person at a safe, controlled speed, preferably independent of the weight of the individual, along the exterior of buildings without relying on the strength, dexterity, skill injury or even consciousness of the person being lowered.

Further, such device should be able to resist high temperatures, should be reliable and hence have a relatively simple but rather construction, and should be easy to use even under difficult circumstances, and/or even be suitable to lower unconscious individuals.

Such objectives as indicated above, and/or other benefits or inventive effects, are attained according to the present disclosure by the assembly of features in the appended independent device claim and in the appended independent method claim.

According to the present invention, a tall structure can be any structure such as a multi-story office building, a skyscraper,

an oil platform or a chemical plant, comprising higher floor levels which are difficult or impossible to reach from the exterior using for example ladders during an emergency such as a fire.

5 According to the present invention, the size of the drum is determined by the length of the cable to be wound about the drum.

 If, for example, the device according to the present invention is used in a multi-story office building comprising ten floors with a total height of approximately forty meters and the
10 device is fixed to the building on the tenth floor, then a cable of approximately forty meters is necessary to safely lowering the occupants of the tenth floor to the ground level of the building.

 Hence the size of the drum should be sufficient to accommodate at least approximately forty meters of cable wound
15 about it in order to reach ground level.

 In the above situation, if the device is fixed to the eighth floor, then the drum should be capable of at least accommodating a cable of approximately thirty two meters to reach ground level. Thus, the minimal requirement for the size of the drum is, amongst
20 others, determined by the length of the cable wound about it, which cable length in turn is at least determined by the height of the floor to be evacuated above a safe level, such as a ground level.

 Such safe level is not necessary ground level since it can
25 be envisaged that individuals to be saved can be lowered to a level above ground level and from this level use other emergency escape means such as emergency stairs, a fire truck ladder or an elevator to evacuate the building.

 Because of this, the phrase "a cable of sufficient length"
30 refers to a minimal cable length necessary to reach a safe or safer floor level allowing the individual to evacuate the tall structure. According to the present invention, the rotation regulating means for controlling the rotation speed allow for regulating the maximal rotation speed of the drum and hence the
35 descending speed of the individual to be saved, regardless of this individual being injured, unconscious, or even merely scared.

Since, the rotation speed of the drum is restricted by the rotation regulating means to a maximal rotation speed, the rate of descent of the individual to be saved is not determined by his weight, which determines only the gravitational acceleration of the descent. This means that compared to a person having less weight, the maximal rotation speed is only achieved sooner during the descent, because of the higher acceleration, but a relevant descent speed, determined by the prefixed maximal rotation speed of the drum, will not become any higher.

In an embodiment, the device comprises comprising at least one additional drum. Thereby it is made possible to lower more than one individual at a time or subsequently, before having to retract at least one cable associated each with one of the drum and/or the additional drum.

In an embodiment having the at least one additional drum, such an embodiment may further exhibit a selector or a switch arranged to selectively connect at least one of the drum and the additional drum with the rotation regulator. Such a switch or regulator may be used to determine which one of the drum and the additional drum is used at one time for lowering an individual, or a plurality of individuals simultaneously. Such a switch or selector can be formed in many different ways, for instance an active switch to be set by an operator, or a passive switch or selector, which may be responsive to weight suspended from a cable, corresponding with the weight of an individual to be lowered.

In yet a further embodiment, the device may comprise a transmission, which is provided between at least the drum and the rotation regulator and is arranged to selectively connect at least the drum with the rotation regulator. Such a transmission can be usefully employed to increase the rotational speed of a relevant one of the drum and the additional drum, if provided, and thereby enhance effectiveness of the rotation regulator. When the rotation regulator is subjected to a higher rotational speed, the effectiveness thereof is most likely to be enhanced.

In an embodiment having a switch or selector and a transmission, the transmission may comprise the switch or selector, or vice versa. In this manner even integration of the switch or selector into the transmission or integration of the transmission into the switch or selector is viable. Thereby, numbers of components can be reduced to yield an elegant and simple design.

In yet another embodiment, the device may exhibit the feature, that at least the drum is accommodated on a transmission axis. If provided, also the additional drum may be accommodated on the same transmission axis or a separate transmission axis. The transmission axis may comprise or accommodate a switch or selector to allow active or passive setting when each of the drum and, if provided, the additional drum is actually coupled to the transmission axis. In case of separate transmission axes for the drum and, if provided, the additional drum, independent control over which of the drum and the additional drum is braked is possible. The drum and, if provided, the additional drum can be associated with, if not coupled to, a singular rotation regulator or separate rotation regulators. In such an embodiment, with the device having a transmission axis to accommodate at least the drum, wherein the transmission axis may be rotatable within at least the drum, an comprises an assembly of an extendable arm and a recess, wherein the recess is shaped and designed to accommodate the arm in a predetermined rotational position of the transmission axis relative to the drum. Thereby, a more passive switch or selector can be embodied, where the extendable arm can turn or swivel to extend toward the recess, to be engaged thereby at the predetermined rotational position and link or couple the transmission axis and at least the drum. In such an embodiment, the arm may be accommodated in or on the axis and the recess is arranged in the drum, or vice versa. In any case, a coupling between the drum and the transmission axis can be realized, to be activated when the drum is rotated in a predetermined orientation.

In yet another embodiment with the drum arranged on the transmission axis, the device may exhibit the feature that the

transmission axis is connected to the rotation regulator, preferably via transmission, which transmission is arranged to increase the rotational speed of the axis for the rotation regulator. Consequently, the transmission axis is interposed
5 between the drum and the rotation regulator in conjunction with the transmission to increase the rotational speed of an axis on which the rotation regulator acts, to be able to limit the rotational speed of the drum in combination with the rotational speed of the axis on which the rotation regulator acts.

10 In yet another embodiment a guide sleeve in use to be arranged on the cable is arranged at a fixed distance from the device. Such a guide sleeve is intended to protect the cable itself, when being unwound over an edge, like an edge of a balcony, where friction may cause damage to the cable, especially
15 when the cable is repeatedly used for lowering individuals from the tall structure. In an embodiment having such a guide sleeve, the device preferably exhibits the feature that the guide sleeve is attached to a flexible retainer. Such a flexible retainer allows the guide sleeve to be repositioned or moved, also when any
20 individual is suspended from the cable and subject to a swinging movement. In such an embodiment the guide sleeve effectively continues to perform its function of protecting the cable.

In yet another embodiment, the device may exhibit the feature that the rotation regulator comprises a swivel brake shoe,
25 which is connected or connectable to at least the drum to rotate at a rotational speed corresponding with that of the drum during unwinding of the cable, and arranged to swivel relative to a rest position, when rotational speed of the drum approaches and/or exceeds a predetermined threshold. In the defined rest position
30 the brake shoe is inactive, and can be swiveled into an extended, outward oriented position to contact or engage a brake surface and thus brake a rotational speed of the drum.

To achieve such predetermined maximal rotation speed of the drum, the rotation regulation means may comprise a first member
35 encasing an expandable second member rotatable in said first member, wherein the expansion of said second member is controlled

by the rotation speed of said drum. According to the present invention, the rotation of the drum initiated by an individual engaging the device according to the present invention during an emergency is translated on the second member causing it to start
5 rotating within the first member. Said rotation of the second member will cause a centrifugal force on the second member causing it to expand in the direction of the inner surface of the first member.

Because the centrifugal force is directly related to the
10 rotation speed of the drum, the higher the rotation speed of the drum, the larger the centrifugal force on the second member will be. Because there is also a positive correlation between the centrifugal force on the second member and the expansion of the second member, at a predetermined rotation speed of the drum, the
15 expansion of the second member will become large enough to frictionally engage the inner surface of the first member.

This frictional engagement of the second member with the first member will prevent a further increase in rotation speed of the second member and thereby the rotation speed of the drum,
20 limiting the descending speed of the individual engaging the device according to the present invention.

In an embodiment comprising the brake shoe, the swivel brake shoe may comprise a flexible restrainer, arranged to restrain the swivel brake shoe from swiveling at a rotation speed of the drum
25 below the predetermined threshold of the rotational speed of the drum. Such a flexible restrainer can serve to keep the brake shoe in the rest position as long as possible, until a rotational speed is developed, which approaches or exceeds the threshold value to start breaking the individual's descent.

According to a preferred embodiment of the present
30 invention, the first member has a cylindrical form, thereby providing a maximal inner surface area of the first member capable of frictionally engaging the expandable second member. This allows for an optimal counter force for the centrifugal force of the
35 second member, thereby, amongst others, minimalizing the size and weight of the rotation regulating means.

According to a more preferred embodiment of the present invention, also the second member has a cylindrical form to further maximalize the frictional engagement with the first member.

5 According to one preferred aspect of the present invention, the second member of the means for controlling the rotation speed of the drum comprises two or more break shoes connected by a spring mechanism to a rotational axis of the rotational regulator or to each other in an at least approximately symmetrical manner.
10 In such an embodiment, a balanced action of a plurality of brake shoes can be established and maintained.

 Upon sufficient expansion of the second member, the two or more brake shoes engage the inner surface of the first member thereby providing the counter force necessary to prevent further
15 expansion of the second member due to the centrifugal force.

 On the other hand, the spring mechanism connecting the two or more brake shoes, determines the rate of expansion of the second member in response to the centrifugal force created by the rotation speed of the drum.

20 Specifically, the stronger the spring force of the spring mechanism connecting the two or more break shoes, the higher centrifugal force, and hence rotation speed of the drum, is necessary before the second member frictionally engages the inner surface of the first member.

25 In other words, the spring force counteracts the centrifugal force thereby allowing to easily predetermine the maximal rotation speed of the drum by adjusting the strength of the springs employed. Usually, a rotation speed of the drum is predetermined to allow a descending speed of the individual to be saved of 2 to
30 20 km/h, preferably, 5 to 15 km/h, more preferably 5 to 10 km/h by adjusting the counter force provided by the spring mechanism. In a particularly preferred embodiment, the drum and cable are embodied in metal. Embodying these components of the device according to the present invention in metal provide maximal resistance to, for
35 example, high temperatures caused by a fire.

In addition, embodying the cable in metal allows for a reduction of the weight of the cable which is determined by both the necessary length of the cable for reaching a safe floor level and the weight of the individual it should be able carry without breaking. Metal provides, using relatively thin cables, a considerable weight reduction and loading capacity. Because of the resistance of metal to fire, also the regulating means for controlling the rotation speed are preferably embodied in metal. However, it can be envisaged that certain specific parts of the rotation speed regulation means are not embodied in metal such as for example the breaking shoes of the second member.

To facilitate attachment of the device according to the present invention to a tall structure, the device preferably comprises an attachment to fix the device to the tall structure such as a framework encasing the device according to the present invention.

Preferably, the device according to the present invention further comprises means for attachment of the individual to the end of the cable. Such means can for example be a hook, a harness, a seat, a cage, a loop, and a handle.

In one other preferred embodiment, the device according to the present invention comprises means, such as a handle or a motor, for rewinding the cable about the drum after the device has been used to evacuate one individual. This embodiment allows for the evacuation of multiple individuals using a single device.

In yet another embodiment, the device may comprise a crank mechanism for winding the cable about the drum. Alternatively, a motor can be provided, on the condition that an independent power supply is furnished in combination there with. Especially in case of fire, a power supply from the mains power grid can be disconnected, and consequently, a battery or the like may be preferred to power such a motor. Even in case of a mechanical crank mechanism, the objective is to allow an operator or other individual to retract or withdraw the cable after having lowered another individual down to a safe level and thereby make the

device available for lowering yet another individual to the safe level.

The device according to the present invention provides on demand, automatically lowering of a person at a safe, controlled speed, independent of the weight of the individual, along the exterior of buildings without relying on the strength, dexterity, skill or consciousness of the person being lowered. Further, the device according to the present invention is resistant to high temperatures, is reliable resistant easy to use even under difficult circumstances.

Therefore, the present invention also relates to a method for safely evacuating an individual during an emergency from a tall structure comprising attachment of the individual to the device according to the present invention and lowering the individual to the ground level using the device.

Additionally, the present disclosure encompasses a method for safely evacuating individuals from a tall structure during an emergency comprising:

(a) attaching at least one first individual to a device of any preceding claim;

(b) lowering the at least one first individual to a safe level using the device;

(c) rewinding the cable about the drum;

(d) optionally, repeating steps (b) to (c).

Optionally, the method may comprise the step of subsequent or simultaneous lowering of more than one of the individuals prior to rewinding at least one cable.

The present invention equally relates to a modification of the device described above that is particularly well suited to be used on working platforms of offshore wind turbines.

Evacuating people or loads from these working platforms can be challenging in view of the dynamic environment in which wind turbines are used. For example, boats onto which persons or loads should be arranged may experience strong waves. More generally, situations may arise that require the evacuation process to be

stopped or reversed. In this latter case, instead of unwinding the cable from the drum, the cable must be wound back onto the drum.

According to a second aspect of the present invention, a device is provided, based on a modification of the device
5 described above, that is able to allow an evacuation process to be stopped and reversed.

To that end, the device comprises a transmission axis, and a drum with a cable of suitable length, wound thereon, wherein the drum is mounted around the transmission axis. The device further
10 comprises a locking unit configured for rotationally locking the transmission axis and the drum preventing the drum to rotate relative to the transmission axis in a first rotational direction that corresponds to an unwinding of the cable from the drum.

The device additionally comprises a rotation regulator that
15 is mechanically coupled to the transmission axis and that is configured to limit a rotation speed thereof during said unwinding of the cable from the drum. The device also comprises a braking unit for stopping rotation of the transmission axis in the first rotational direction and for allowing rotation of the transmission
20 axis in a rotational direction opposite to the first rotational direction. A first member is provided for operating the braking unit. A second member is provided for rotating the transmission axis or drum in the second rotational direction.

It is noted that the wording transmission axis may refer to
25 an axle, shaft, or the like.

During evacuating a person or load using the device described above, a user may use the first member for operating the braking unit. This will cause the descent to be stopped.

Thereafter, the user may use the second member for winding the
30 cable back onto the drum. This is possible because the braking unit allows rotation of the transmission axis in the second rotational direction, which direction corresponds to winding the cable back onto the drum. In this manner, the person or load may be safely recovered onto the working platform without risking

35 further descent.

The second member can be mechanically coupled to the transmission axis or drum using a mechanical coupling that causes the transmission axis or drum to rotate in the second rotational direction by engaging the second member, respectively.

5 Furthermore, the mechanical coupling can be configured to release or prevent a mechanical coupling between the second member and the transmission axis or drum for rotational movement of the transmission axis or drum in the first rotational direction, respectively. This has the advantage that the second member can
10 remain stationary and/or inactive when evacuating a person or load.

As an example, the second member may comprise a wheel and a first gear transmission by which the wheel is mechanically coupled to the transmission axis or drum. The gear transmission allows
15 relatively heavy persons or loads to be displaced using relatively small forces exerted on the wheel.

Instead of manual operating the wheel, the second member may comprise an electric motor of which a drive shaft is mechanically coupled to the transmission axis or drum either directly or
20 through a first gear transmission.

The device may further comprise a second gear transmission that is provided between the drum and/or transmission axis and the rotation regulator.

The rotation regulator may comprise a centrifugal brake,
25 wherein the centrifugal brake has a shaft that is mechanically coupled to the transmission axis and that is rotatably mounted in a housing and one or more brake members arranged in between the shaft and the housing. Using the second gear transmission allows the shaft to rotate at higher speeds than the transmission axis.
30 This has the advantage that the rotational speed can be controlled better using a smaller force exerted onto the shaft of the centrifugal brake.

The braking unit can be configured, for the purpose of said stopping rotation of the transmission axis in the first rotational
35 direction, to engage the transmission axis directly. In this case, the braking unit directly contacts the transmission axis when

stopping rotation. Alternatively, the transmission axis can be engaged indirectly by directly engaging the first or second gear transmission, by directly engaging the shaft of the centrifugal brake, or by directly engaging the brake members of the

5 centrifugal brake.

The first member can be configured to be operable in a default state and in a de-activated state. When the first member is in the default state, it is configured to stop rotation of the transmission axis in the first rotational direction while allowing
10 rotation of the transmission axis in the second rotational direction. When the first member is in the de-activated state, the first member is configured to allow rotation of the transmission axis in the first rotational direction. Accordingly, when a user does not use the first member, descent of the person or load will
15 be prevented. It should be noted that the first member may be provided with a lock to keep the first member operating in the de-activated state even after a user releases the first member.

The drum can be rotatably mounted around the transmission axis. In this case, the locking unit can be further configured for
20 allowing the drum to rotate relative to the transmission axis in the second rotational direction. The device may further comprise a third member that is rotationally coupled to the drum using a third gear transmission, wherein the third member is preferably releasably coupled to the drum. For example, the third member may
25 comprise a wheel for winding the cable onto the drum without rotating the transmission axis. This can be achieved because operating the third member will cause the drum to rotate relative to the transmission axis in the second rotational direction. This rotation is not blocked by the locking unit.

30 Alternatively, the locking unit can be configured for rotationally locking the transmission axis and the drum preventing the drum to rotate relative to the transmission axis in the second rotational direction.

The locking unit may comprise a first recess formed in an
35 inner wall of the drum, and a second recess formed in an outer wall of the transmission axis. The locking unit may further

comprise a resiliently mounted arm that is spring biased to extend from the first recess into the second recess or vice versa when the first and second recesses are aligned. To this end, the arm is mounted in the first recess or second recess, respectively.

5 The arm can be configured to remain extended when the drum rotates in the first rotational direction, e.g. during unwinding, and to be pushed against a spring biasing force into the first recess or second recess, respectively, when the drum rotates in the second rotational direction.

10 When the arm extends from the first recess into the second recess, or vice versa, the transmission axis and the drum are rotationally locked preventing the drum to rotate relative to the transmission axis in the first rotational direction. Conversely, when the drum rotates in the second rotational direction, the arm
15 is pushed against the spring biasing force in the first recess or second recess, respectively, preventing the abovementioned rotational lock from being achieved.

 The present invention further provides an offshore wind turbine that comprises a working platform, and the device
20 described above arranged on the working platform. The wind turbine may further comprise a pivotable support unit for guiding the cable of the device. The pivotable support unit may for example comprises a crane, such as a davit crane, or a pivotable arm.

 After the above more general realistic indication of
25 embodiments of the present invention, more detailed realizations into practice will be further described herein below under reference to illustrations in the appended drawing, wherein the same or similar reference numbers may be used for the same, similar or comparable elements, components and aspects, and
30 wherein the below described embodiments merely serve to enhance the readers understanding of the general and detailed principles of the invention, without limitation to the specifically illustrated embodiments or components, elements and/or aspects thereof, and wherein:

35 Figure 1 represents a view in perspective of a device according to the present invention;

Figure 2 represents an exploded view of the device shown in figure 1;

Figure 3 represents a detailed view of the device shown in figure 1 in the free rotation mode, and

5 Figure 4 represents a detailed view of the device shown in figure 1 in the inhibited rotation mode;

Figure 5 represents a schematic drawing of an individual which is lowered from a tall structure using a device according to the present invention attached to the tall structure during a
10 fire;

Figure 6 represents a cross sectional side view of a device in another embodiment;

Figure 7 represents a side view of the device according to figure 6 in use;

15 Figure 8 represents in a perspective view an embodiment of a device in yet another embodiment;

Figures 9 and 10 represent in respective perspective and exploded views an embodiment of a device in yet another embodiment;

20 Figure 11 represents a detail of the embodiment of figure 10;

Figures 12 and 13 represent cross sectional side views of the embodiment in figures 9-11 in one operational state;

25 Figure 14 represents a cross sectional side view of the embodiment in figures 9-11 in another operational state;

Figure 15 illustrates a known offshore wind turbine;

Figure 16 illustrates a safety device that can be mounted on the working platform of the wind turbine of figure 15; and

30 Figure 17 schematically illustrates the safety device of figure 16 mounted on the working platform of the wind turbine of figure 15.

Figure 1 shows a safety device 1, comprising a drum 2 and a cable 3 of suitable length wound about said drum 2. The drum 2 is mounted on an axle 4 rotatable in a frame 5 using ball-bearings 6.
35 The axle 4 transmits rotation of the drum 2 to rotation regulator 7 also mounted on frame 5.

A hook fastener 16 connected to cable 3 allows coupling to the safety device 1 of an individual 41 in figure 5 to be saved from a building 40, and to be lowered to a ground level 42.

Figure 2 shows the above described safety device, specifically detailing the rotation regulator 7. The rotation regulator 7 comprises a first substantially cylindrical member 8, encasing a second substantially cylindrical member 9. In the preferred embodiment shown, the second member 9 comprises brake shoes 10 connected to each other by a spring mechanism 11.

Upon rotation of axle 4, the second member 9 starts to rotate in the first member 8. This rotation will create a centrifugal force causing the second member 9 to expand when the brake shoes 10 elevate from the outer surface of the second member 9 under influence of centrifugal force at a determined rotational speed of the axle 4. As a result of the centrifugal force, the brake shoes 10 are forced against an inner surface of the first member 8.

Action of the brake shoes against the inner surface of the first member 8 is restricted by the springs 11. The centrifugal force, which is directly related to the rotational speed of the axle 4, must exceed the spring force of the springs 11 for the brake shoes 10 to act on the inner surface of the first member 8. In this manner control is provided over expansion of the second member 9, and action of the brake shoes 10 irrespective of the weight of an individual attached to a hook fastener 16 or the like, as depicted in figure 5.

This control allows setting of a rotational speed of the axle 4 and therewith of the drum 2, at which the two brake shoes 10 will frictionally engage the inner surface of the first member 8 to limit rotational speed of drum 2.

A more detailed view of the brake shoes 10 and the spring mechanism 11 is provided in figures 3 and 4.

Figures 3 and 4 show brake shoes 10 on second member 9, comprising a bracket 12 to provide assembly of spring mechanisms 11 and brake shoes 10 to surround the second member 9, and transmission of rotation of the axle 4 in the direction of arrow A

on bracket 12 into a centrifugal force on the brake shoes 10. The outer surface of brackets 12 is at least partially covered by a frictional layer 14 for frictionally engaging the inner surface of the first member 8. When the axle 4, and hence the drum 2, is not rotating, and the device 1 is in rest or when axle 4 is rotating at a speed lower than a predetermined speed controlled by the spring mechanism 11 in relation to a generated centrifugal force in the direction of arrows B in figure 4, than a gap 15 between the first member 8 and the frictional layer 14 provides free rotation of the second member 9. However, at a predetermined rotation speed of the axle 4, as shown in figure 4, brake shoes 10 will elevate from the outer surface of the second member 9, when centrifugal force in the direction of arrows B in figure 4 exceeds a restraining force exerted on the brake shoes 10 by the springs 11. Then, the layer 14 will frictionally engage the inner surface of first member 8, thereby inhibiting a further increase of the rotation of the axle 4 and, as a consequence, also rotational speed of drum 2.

Frame 5 is attached to the tall structure 40 using bolt/nut connections 13.

The entire safety device 1 may be surrounded by an enclosure or housing comprising an opening to allow the cable 3 to pass through.

Figure 4 shows the use of a safety device 1 during an emergency. The safety device 1 is firmly attached to the tall structure 40. The individual 41 to be rescued attaches himself or is attached by helpers to the cable 3 and is lowered, at a predetermined speed independent of the weight of the individual 41, and without active participation of the individual or any helpers. The safety device 1 automatically limits a lowering speed of the individual 41 along the exterior of the tall structure 40 to a safe level 42, which is ground level in the embodiment shown in figure 4.

Figure 6 shows a cross sectional side view of a further embodiment of a device 20 exhibiting particular principles or aspects of the present invention. Device 20 comprises a housing 21

with a lid 24 connected to housing 21 at a hinge 25. The housing 21 accommodates a drum 26 with cable 3 wound thereon. The cable 3 is connected to a hook fastener 16 or the like, via a shock absorber 27. Thus, when an individual attaches the hook fastener 26 to for instance a harness, which can be accommodated in a bag 23, after having put on the harness, and jumps from a tall building, it will take some time before the rotation regulator in a different embodiment relative to the previously described figures will start to act and limit rotational speed of the drum 26. Individuals, trying to escape from the tall building, may experience a shock or jolt, which may be damped by employing the shock absorber 27.

Additionally, the sleeve 22 is arranged around cable 3 near the hook fastener 16. This sleeve 22 is itself connected to the housing 21 of the device 20 via a chain 29 or another cable, or may be attached to a part or portion of the tall structure. When an individual, trying to escape from the tall structure, puts on the harness from the bag 23, attaches the harness to the hook fastener 16 and the jumps over a railing 28 of a balcony, or the like, cable 3 may experience considerable wear and tear from moving over an edge of the railing 28, especially in case of repeated use for lowering of individuals to safety. The sleeve 22 is then held at the specific distance from the device 20 or a part or portion of the tall structure by the chain 29 or additional cable. Preferably, the distance between an attachment point of chain 29 or cable and an edge of the railing 28 of a balcony is measured at installation of the device 20, where the same distance is set of the sleeve 22, such that the sleeve 22 rests on the railing 28 of the balcony or the like, as shown in figure 7.

In figure 7, the device 20 is attached to a vertical wall of the tall structure 40. There, the lid 24 is omitted from the drawing. It is evident, that the chain 29 or cable is tensioned to keep the sleeve 22 in position over an edge of the railing 28 of the balcony of the tall structure 40. The cable, on the other hand, is free to unwind from the drum 26, and pass through the

sleeve 22 in a protected state against wear and tear from the edge of the railing 28.

Figure 8 shows another embodiment of a device 30. The device 30 comprises a housing 21 accommodating a plurality of drums 31, 32, 33 and 34. The drums are arranged on a common transmission axis 35, or example shown in more detail in figure 10. The transmission axis 35 is suspended in bearings 36 between mounting plates 37. The mounting plates also accommodate a crankshaft 39 connected to a crank 38 for rewinding cable from a drum 31-34.

Each of the drums 31-34 is capable of controlled lowering or unwinding of an associated cable 3. Each of the drums 31-34 has its own cable. Thereby it is possible to allow several individuals to descend without first having to rewind cable on the relevant one of drums 31-34. The embodiment of figures 8, 9 and 10 even allows for simultaneous descent by multiple individuals, each or more than one of said individuals being coupled to a relevant one of the cables, where multiple cables may be employed simultaneously for a lowering one or more than one individual on each cable simultaneously or subsequently.

Also, this embodiment of figure 8, 9 and 10 comprises a rotation regulator 7. The rotation regulator 7 is connected to transmission axis 35 via a transmission 43, which is made visible through the removal of the rotation regulator 7 in figure 10, representing an exploded view of the device of figures 8 and 9, which is the same as the device in figure 9, except for the addition of the crankshaft 39 with the crank 38. The transmission 43 transforms a rotational speed of the transmission axis 35 into a higher rotational speed through the use of corresponding to the wheels 44, 45. Each one of the drums 31-34 in figure 8, 9 may be coupled with the transmission axis 35 at any particular time to allow individuals to descend from the tall structure. Only when individuals actually are suspended from a cable on a relevant one of the drums 31-34 is the drum coupled with the transmission axis 35. For this, a mechanism is employed, which will be described in more detail herein below. Likewise, each cable on the relevant one of the drums 31-35 can be retrieved after having been lowered, by

using the crank shaft 39 in conjunction with the crank 38. At the side, each drum 31-34 comprises a toothed wheel, which can be selectively engaged by a corresponding to the wheel 57 on the crankshaft 39. Selectivity of such engagement can be achieved by
5 movement of the toothed wheels 57 on the crankshaft 39 in the direction of double arrow C. To achieve such selectivity, the skilled person is able to devise any suitable configuration within the realm of his normal capability and capacity. When any one of the toothed wheels 57 is brought into engagement with the
10 corresponding one of the toothed wheels 46, a cable can be rewound on its drum 31-34 by using the crank 38.

The rotational regulator 7 can be of the same type as the one described in relation to figures 1 through 4, or may be any alternative type of configuration, which is preferably based on
15 the rotational limitation of the speed of unwinding cables from the drums.

In the representation of figure 10, the transmission axis 35 is shown in isolation to have an elongate recess 58, in which coupling elements 47 are accommodated, the function and structure
20 of which will be elaborated on in more detail herein below. Also, figure 10 shows one of the drums 31 in a disassembled state, comprising a flange 48, the cylindrical body 49 around which a cable 3 can be wound, and anchor ring 50 to fix the cable 3, and that the aforementioned tooth wheel 46. The cylindrical body 49 is
25 enclosed between the flange 48 and the toothed wheel 46 with the anchor ring 50 on the essentially cylindrical body 49. The cylindrical body 49 comprises a number of projections 51, into which screws 52 can be driven to assemble the shown one of the drums 31. In an assembled state, drum 31 is arranged on the
30 transmission axis 54.

The coupling elements 47 tend to rotate or swivel in the direction of arrows D in figure 11, but are constrained to stay within the recess 58 with the cylindrical body 49 on the transmission axis 35. The cylindrical body 49 further also
35 comprises recesses 52, which or shapes and designs to fittingly

accommodated coupling elements 47, when rotated in the direction of arrows D.

The toothed wheel 44 of transmission 43 comprises or is connected with an insert 54, of which the circumferential shape corresponds closely with the internal surface of the transmission axis 35. In an assembled state, as shown in figures 12, 13 and 14, the drum 31 is arranged on the transmission axis 35, which is in turn arranged on the insert 54 of the tooth wheel 44. When the drum 31 rotates to unwind cable therefrom, transmission 43 increases the rotational speed of the transmission axis 35 using the large toothed wheel 44 and the relatively small toothed wheel 45. Toothed wheel 45 is fixed to a drive axis 55 which extends into the rotation regulator 7. As shown in figures 12, 13 and 14, the initial state is exhibited in figure 12, where the cable 3 has begun to unwind from the drum 31 in the direction of arrow E. This means, that an individual has coupled himself to an end of cable 3, and has started his or her descent from a higher level of the tall structure in a downward direction. From this initial state, the drum 31 is free to rotate around the transmission axis 35 over an angular distance indicated by arrow F. In this movement, there is no coupling between drum 31 and transmission axis 35 since coupling elements 47, that form extendable arms in the sense of the claims of the present disclosure, are maintained within the recesses 58. After drum 31 has freely rotated over an angular distance corresponding with arrow F outside of transmission axis 35, recesses 52 of the cylindrical body 49 will be positioned immediately above the coupling elements 47 within recesses 58 of the transmission axis 35. This state is shown in figure 13. The coupling elements 47, which tend to rotate in the direction of arrow D in figure 11, have room for this movement in an outward direction relative to the transmission axis 35, when the recesses 52 of the cylindrical body 49 of the drum 31 are arranged immediately above the recesses 58 in the transmission axis. The coupling elements 47 then come to abut within the recesses 52 of the cylindrical body 49, as a consequence of which a coupling is generated between the drum 31 and the transmission axis 35, when

the drum 31 is rotated further in the counterclockwise direction corresponding with arrow F in figure 12. Since the transmission axis 35 is further coupled with insert 54, as shown in figure 10, 12, 13 and 14, a rotational velocity is transmitted to the rotation regulator 7 via the transmission 43. As soon as the rotational speed in the direction of arrow G in figure 13 exceeds a limit, which is predetermined in the interior of the rotation regulator, for instance in the embodiment as described in relation to figures 1-4, a rate of descent may be limited or restricted for a person hanging from the cable 3.

It should be noted, that when transmission axis 35 rotates in the direction of arrow G, as shown in figure 14, the other drums 32-34 may stand still, unless another individual is hanging from a cable 3 wound at least partially still on one of these other drums 32-34. To achieve this standstill of the other drums 32-34, a stop 56 is pressed against a toothed wheel 46. This is a very simple and elegant configuration, where hardly any force or pressure is required to maintain the standstill of the other drums 32-34. Namely, the coupling elements 47 in the recesses 58 of the transmission axis 35 will be dragged across the recesses 52 in the inner surface of the cylindrical body 49 of the other still standing drums 32-34, without achieving engagement or coupling there between.

Consequently, drum 31-34 only drives the transmission axis, when sufficient weight is suspended from a cable 3 which is wound around a relevant one of said drums 31-34. Still standing drums remain to be motionless, since no engagement is achieved between the coupling elements 47 and recesses 52.

Relative to the embodiments of figures 8-14, just two, three or more than four drums can be provided. Each of the drums may have an individual rotation regulator instead of the common rotation regulator of the above described embodiments. Figures 8 and 9 only mutually differ with respect to the presence of the crankshaft in combination with the crank, but are for the rest considered essentially identical. Other brake systems or speed reduction systems can be envisaged, in addition to or as

alternatives for the rotation regulators 7 in the embodiments. The sleeve 22 in figures 6 and 7 can have any suitable shape or form, such as tubular, and can be made from any suitable material, but is preferably provided in an embodiment of a smooth, low friction material. The transmission 43 can connect anyone of the drums 31-34 with the rotation regulator 7, where coupling elements 47 and recesses 52 act and function as switches and/or selectors to couple a used one of the drums 31-34 with the transmission axis 35. In this sense, these coupling elements in combination with the recesses can be considered to constitute switches and/or selectors. However, in another embodiment it may be possible to require an operator to actively set a switch or selector to engage a selected one or more than one of the drums 31-34 with the transmission axis 35. Further, it may be possible to prevent, in an embodiment with a lot of drums 31-34, to limit the force exerted on the rotation regulator, by preventing too many of the drums 31-34 from being connected simultaneously to the rotation regulator 7. For instance, selectors and/or switches can be interconnected to prevent more than two of the drums 31-34 from being connected to the rotation regulator 7. In relation to figure 8 it has been disclosed that a manual crank or crankshaft can be provided to draw a cable back on its drum. However, it is also very well possible to provide an automated manner, employing for instance a motor or the like, of retrieving a cable and rewinding it onto its drum. However, any embodiment should preferably be independently powered from the structure, to which such a device is attached, in view of the potential danger of power falling out during for instance a fire.

Figure 15 illustrates a known offshore wind turbine 100. It comprises a nacelle 101 and hub 102 from which a plurality of blades 103 extend. Nacelle 101 is mounted on a tower 104, which is connected through a transition piece 105 to a monopile 106 by which turbine 100 is secured in the seafloor. As illustrated, transition piece 105 extends partially above sea level 107, and monopile extends partially below and partially above the mudline 108.

The part of wind turbine 100 arranged in the seafloor is referred to as the foundation 109, and the part of wind turbine 100 arranged in between mudline 108 and sea level 107 as substructure 110. The combination of tower 104, transition piece 5 105, and monopile 106 is referred to as support structure 111.

Arrow WP indicates the positioning of a working platform 120, which is illustrated in more detail in figure 17. Working platform 120 comprises a railing 121 mounted on a floor 122. It further comprises a Davit crane 123.

10 As shown in figure 17, Davit crane 123 supports a cable 203 of safety device 200. Cable 203 is coupled to a stretcher 124. Next, the functionality of safety device 200 will be explained referring to figure 16. When explaining the functionality of safety device 200, reference signs will be used having the format 15 2XY, wherein X and Y are integer numbers. The components referred to using these reference signs are identical or similar to components XY shown in figures 1-14. For example, cable 203 in figure 16 corresponds to cable 3 in figure 1.

Safety device 200 is a modification of safety device 1 or 20 safety device 30. It too comprises a transmission axis and a drum 231 that is mounted around the transmission axis. Drum 231 can be rotatably mounted around the transmission axis or it can rotatably fixed relative to the transmission axis. Similar to safety device 30, the transmission axis is connected via a gear transmission 243 25 to a rotation regulator 207, of which the functionality is similar to that of rotation regulator 7.

Safety device 200 is provided with a cable guiding bracket 270 for guiding cable 203. It is further provided with a member 280 for manually rotating the transmission axis or drum 231.

30 Member 280 is connected to the transmission axis via gear transmission 281.

Safety device 200 is provided with a braking unit for stopping rotation of the transmission axis. The braking unit can be operated using a member 290 that is connected to the braking 35 unit via a cable 291.

Figure 16 illustrates a rotational direction R of the transmission axis for unwinding cable 203 from drum 231. Hereinafter, a rotational direction opposite to rotational direction R will be referred to as R-opp.

5 Safety device 200 comprises a locking unit configured for rotationally locking the transmission axis and drum 231 preventing drum 231 to rotate relative to the transmission axis in rotational direction R.

10 It is noted that the coupling of drum 231 to the transmission axis can be identical to that of drum 31 to transmission axis 35.

Referring to figures 11 and 12, the transmission axis of safety device may be provided with a first recess similar to recess 58 in which an arm similar to arm 47 is resiliently
15 mounted. Drum 231 may be provided with a second recess that is similar to recess 52. The arm is spring biased to extend from the first recess into the second recess when the first and second recesses are aligned. The arm is configured to remain extended when drum 231 rotates in rotational direction R, and to be pushed
20 against a spring biasing force into the first recess when drum 231 rotates in rotational direction R-opp. In this manner, a rotational locking between drum 231 and the transmission axis can be obtained when unwinding cable 203. In other embodiments, the locking unit can be configured for rotationally locking the
25 transmission axis and drum 231 preventing drum 231 to rotate relative to the transmission axis in rotational direction R-opp. The braking unit is configured to stop rotation of the transmission axis in rotational direction R and for allowing rotation of the transmission axis in rotational direction R-opp.
30 Accordingly, when the braking unit is activated, transmission axis can no longer rotate according to rotational direction R. Due to the operation of the locking unit, this will also stop drum 231 from rotating in this same direction. Hence, when a user operates the braking unit, the unwinding process will stop. However, even
35 when activated, the braking unit will not stop the transmission axis from rotating in the opposite direction. This becomes

advantageous when a user operates wheel 280 for manually winding cable 203 onto drum 231. To this end, the mechanical coupling between wheel 280 and the transmission axis or drum 231 is such that wheel 280 can be rotated for causing the transmission axis and/or drum to rotate in rotational direction R-opp. However, rotating wheel 280 in the opposite direction R will not cause the transmission axis to rotate. Put differently, a rotation of the transmission axis in rotational direction R is not coupled to a rotational movement of wheel 280. Accordingly, when cable 203 is unwound from drum 231, wheel 280 will not move. It is furthermore noted that gear transmission 281 will ensure that a user is capable of moving relatively heavy loads without requiring excessive strength.

As noted above, wheel 280 can be operated to wind cable 203 back onto drum 231. This action may be performed when the braking unit is still activated because this latter unit only blocks rotation of the transmission axis in rotational direction R.

Member 290 may operate the braking unit via cable 291 via a mechanical, pneumatic, or hydraulic action. Furthermore, member 290 can be configured such that the braking unit is activated when member 290 is not engaged or otherwise operated. In such embodiments, the braking unit is activated by default. More in particular, a load or person can only be transported down by engaging member 290. Member 290 may however be equipped with mechanical means for keeping member 290 in a state in which it de-activates the braking unit.

The locking unit can be configured for allowing drum 231 to rotate relative to the transmission axis in rotational direction R-opp. Furthermore, device 200 may comprise a third member, similar to crank 38, for rotating drum 231 for the purpose of winding cable 203 onto drum 231. Third member is typically coupled to drum 231 using a gear transmission. In this case, operating the third member allows winding of the cable without causing the transmission axis to rotate as the rotation of the drum relative to the transmission axis in rotational direction R-opp is not blocked by the locking unit. In a further embodiment, the third

member can be decoupled from a remainder of the device after having wound cable 203 onto drum 231.

Next, a process of evacuating a person using safety device 200 will be explained referring to figure 17. In this embodiment, the locking unit only locks the drum 231 from rotating in rotational direction R relative to the transmission axis and member 280 is mechanically coupled to the transmission axis. The invention is however not limited thereto.

As a first step, a user will arrange the person to be evacuated in stretcher 124 and stretcher 124 is coupled to cable 203 which is guided by an end section of Davit crane 123.

Next, the user will operate member 280 for lifting stretcher 124 into the air to a position above railing 121. During this process, transmission axis will rotate in rotational direction R-opp. At a given moment, the first and second recesses will be aligned allowing the arm to extend into the second recess. At this moment, drum 231 and transmission axis will be rotationally locked. Consequently, when transmission axis rotates further, it will cause drum 231 to rotate along with it, thereby winding cable 203 onto drum 231 and raising stretcher 124 into the air.

Once raised above railing 121, the user will rotate Davit crane 123 to bring stretcher 124 into a position in which it can be transported down along transition piece 105.

To enable the downward movement, the user will operate member 290 to allow the transmission axis to rotate in rotational direction R. At this moment, stretcher 124 and the person in stretcher 124 exert a force onto drum 231 causing it to rotate in rotational direction R. Due to the action of the locking unit, the rotation of drum 231 is transferred to the transmission axis.

Using rotation regulator 207, the unwinding of cable 203 is regulated or limited similar as with safety devices 1 and 30.

In case of an emergency it may be required to stop the descent of stretcher 124. In this case, the user may stop using member 290, which will activate the braking unit. Once activated, the transmission axis will stop rotating in rotational direction R and, through the action of the locking unit, drum 231 will also

stop rotating in this direction. At this point, the user may operate wheel 280 for raising stretcher 124 as discussed before.

In the above, the invention was described using detailed embodiments thereof. However, the present invention is not limited
5 to these embodiments. Various modifications to the embodiments are possible without departing from the scope of the present invention, which is defined by the appended claims.

CLAIMS

1. A device (200) for evacuating individuals from a structure during an emergency, comprising:

- 5 - a transmission axis;
- a drum (231) with a cable (203) of suitable length, wound thereon, wherein the drum is mounted around the transmission axis;
- a locking unit configured for rotationally locking the transmission axis and the drum preventing the drum to rotate
- 10 relative to the transmission axis in a first rotational direction (R) that corresponds to an unwinding of the cable from the drum;
- a rotation regulator (207) that is mechanically coupled to the transmission axis and that is configured to limit a rotation speed thereof during said unwinding of the cable from the drum;
- 15 - a braking unit for stopping rotation of the transmission axis in the first rotational direction and for allowing rotation of the transmission axis in a second rotational direction (R-opp) opposite to the first rotational direction;
- a first member (290) for operating the braking unit; and
- 20 - a second member (280) for rotating the transmission axis or drum in the second rotational direction.

2. The device according to claim 1, wherein the second member is mechanically coupled to the transmission axis or drum

25 using a mechanical coupling that causes the transmission axis or drum to rotate in the second rotational direction by engaging the second member, respectively.

3. The device according to claim 2, wherein the mechanical

30 coupling is configured to release or prevent a mechanical coupling between the second member and the transmission axis or drum for rotational movement of the transmission axis or drum in the first rotational direction, respectively.

35 4. The device according to claim 2 or 3, wherein the second member comprises a wheel and a first gear transmission (281) by

which the wheel is mechanically coupled to the transmission axis or drum.

5 5. The device according to claim 2 or 3, wherein the second member comprises an electric motor of which a drive shaft is mechanically coupled to the transmission axis or drum either directly or through a first gear transmission.

10 6. The device according to any of the previous claims, further comprising a second gear transmission (243), which is provided between the drum and/or transmission axis and the rotation regulator.

15 7. The device according to any of the previous claims, wherein the rotation regulator comprises a centrifugal brake, said centrifugal brake having a shaft that is mechanically coupled to the transmission axis and that is rotatably mounted in a housing and one or more brake members arranged in between the shaft and the housing.

20

8. The device according to any of the previous claims, wherein the braking unit is configured, for the purpose of said stopping rotation of the transmission axis in the first rotational direction, to:

25

engage the transmission axis directly;

engage the transmission axis indirectly by directly engaging the first gear transmission;

engage the transmission axis indirectly by directly engaging the second gear transmission;

30

engage the transmission axis indirectly by directly engaging the shaft of the centrifugal brake; or

engage the transmission axis indirectly by directly engaging the brake members of the centrifugal brake.

9. The device according to any of the previous claims, wherein the first member is configured to be operable in a default state and in a de-activated state, wherein:

when the first member is in the default state, the first member is configured to stop rotation of the transmission axis in the first rotational direction while allowing rotation of the transmission axis in the second rotational direction; and

when the first member is in the de-activated state, the first member is configured to allow rotation of the transmission axis in the first rotational direction.

10. The device according to any of the previous claims, wherein the drum is rotatably mounted around the transmission.

11. The device according to claim 10, wherein the locking unit is configured for allowing the drum to rotate relative to the transmission axis in the second rotational direction.

12. The device according to claim 11, further comprising a third member that is rotationally coupled to the drum using a third gear transmission, wherein the third member is preferably releasably coupled to the drum.

13. The device according to any of the claims 1-9, wherein the locking unit is configured for rotationally locking the transmission axis and the drum preventing the drum to rotate relative to the transmission axis in the second rotational direction.

14. The device according to any of the previous claims, wherein the locking unit comprises a first recess formed in an inner wall of the drum, and a second recess formed in an outer wall of the transmission axis;

the locking unit further comprising a resiliently mounted arm that is spring biased to extend from the first recess into the

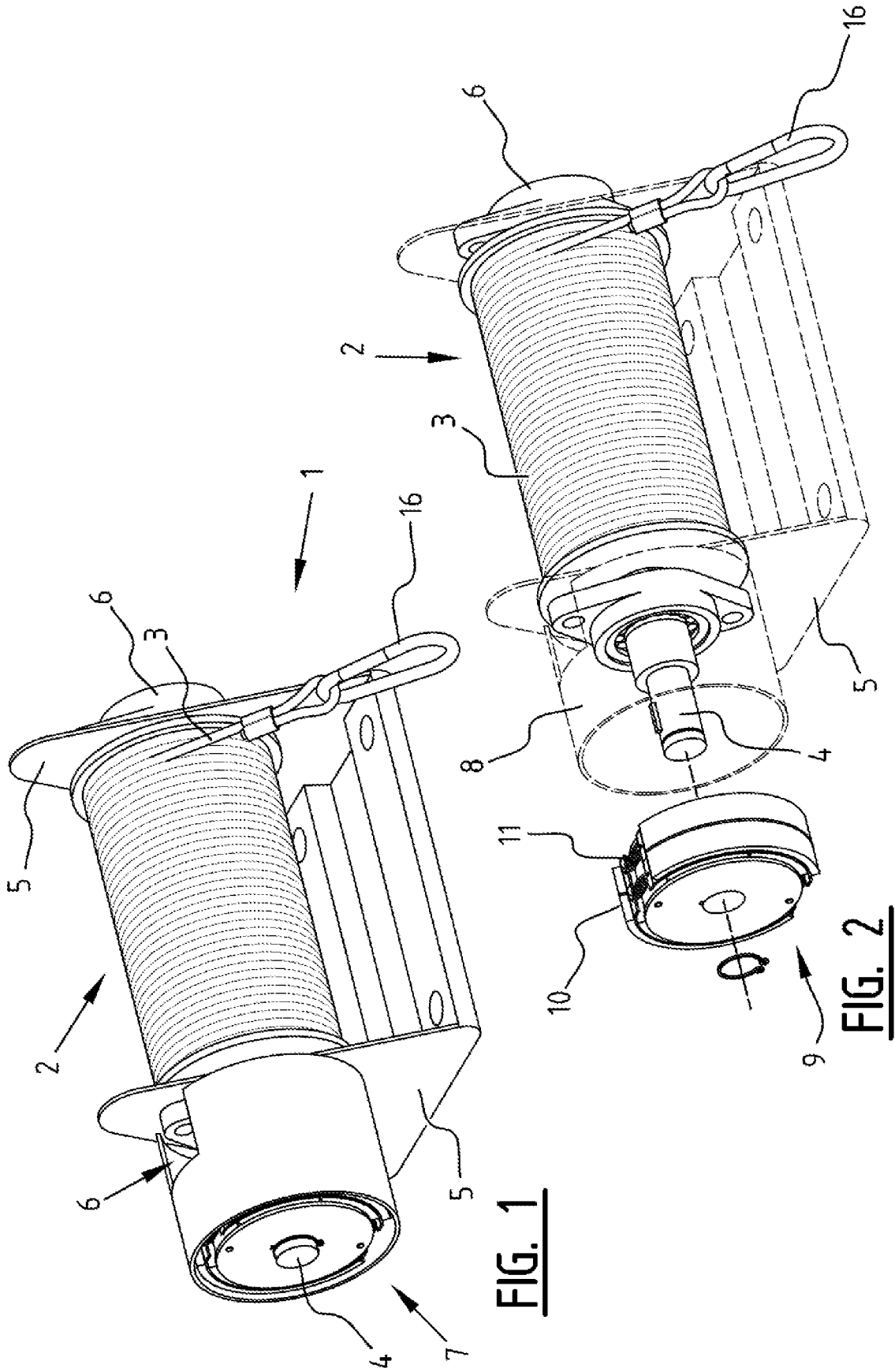
second recess or vice versa when the first and second recesses are aligned;

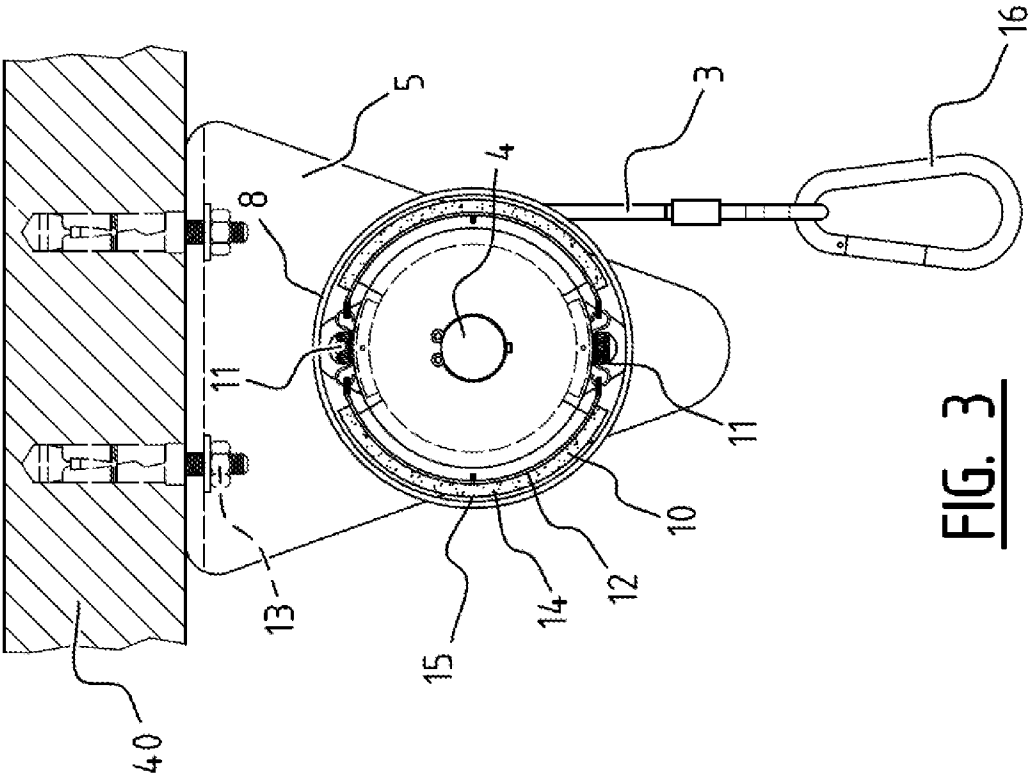
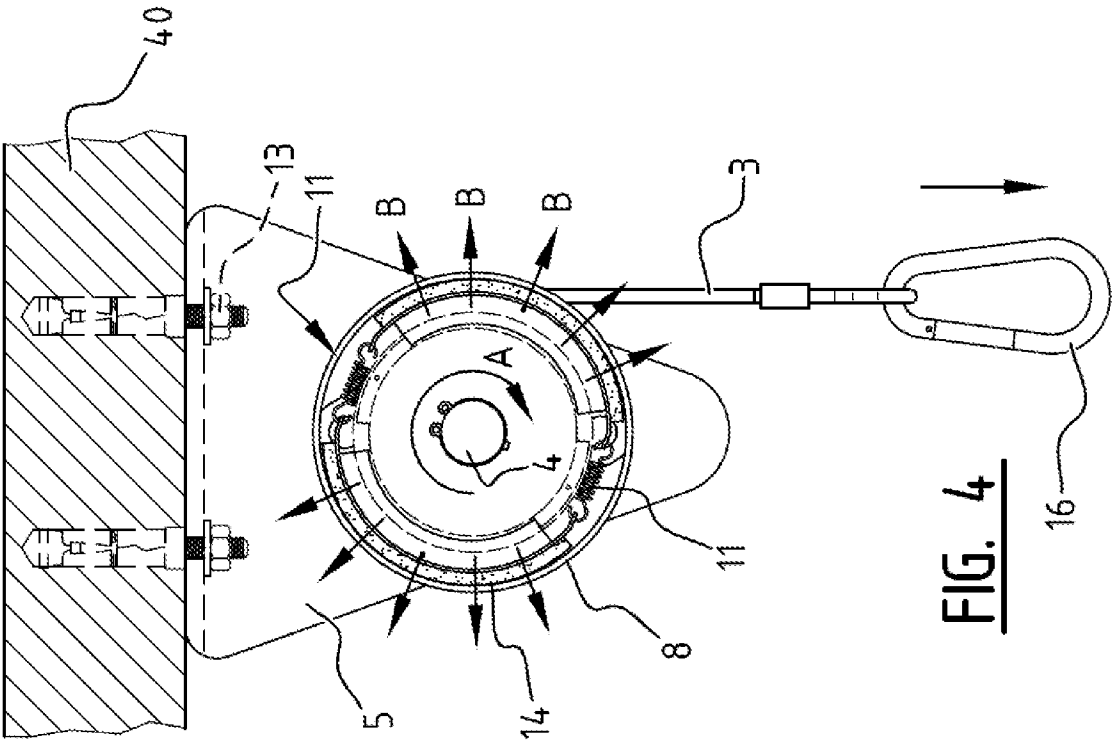
wherein, in so far as depending on claim 10, the arm is configured to remain extended when the drum rotates in the first rotational direction, and to be pushed against a spring biasing force into the first recess or second recess when the drum rotates in the second rotational direction.

15. An offshore wind turbine (100), comprising:
a working platform (120); and
the device (200) according to any of the previous claims arranged on the working platform.

16. The wind turbine according to claim 15, further comprising a pivotable support unit for guiding the cable (203) of the device.

17. The wind turbine according to claim 16, wherein the pivotable support unit comprises a crane, such as a davit crane (123), or a pivotable arm.





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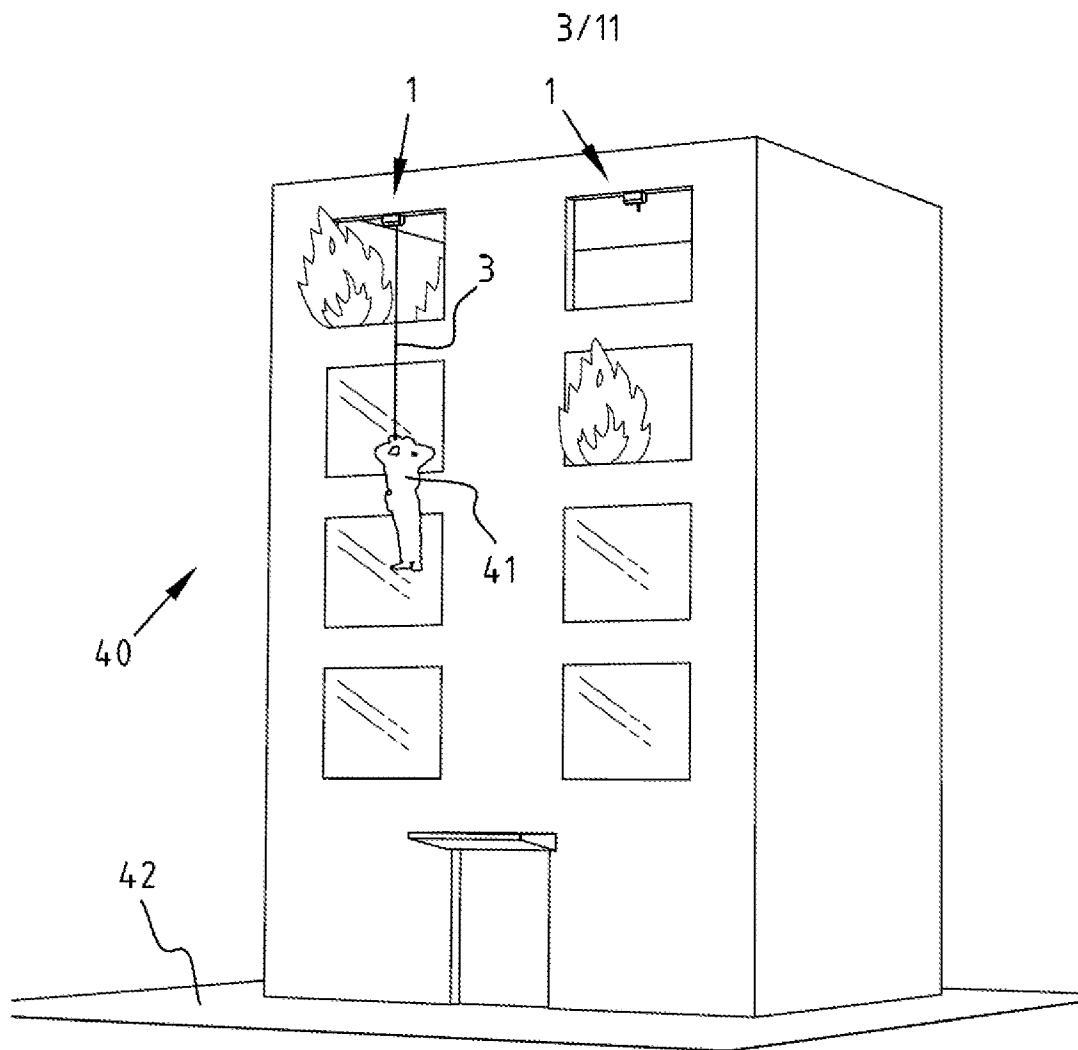
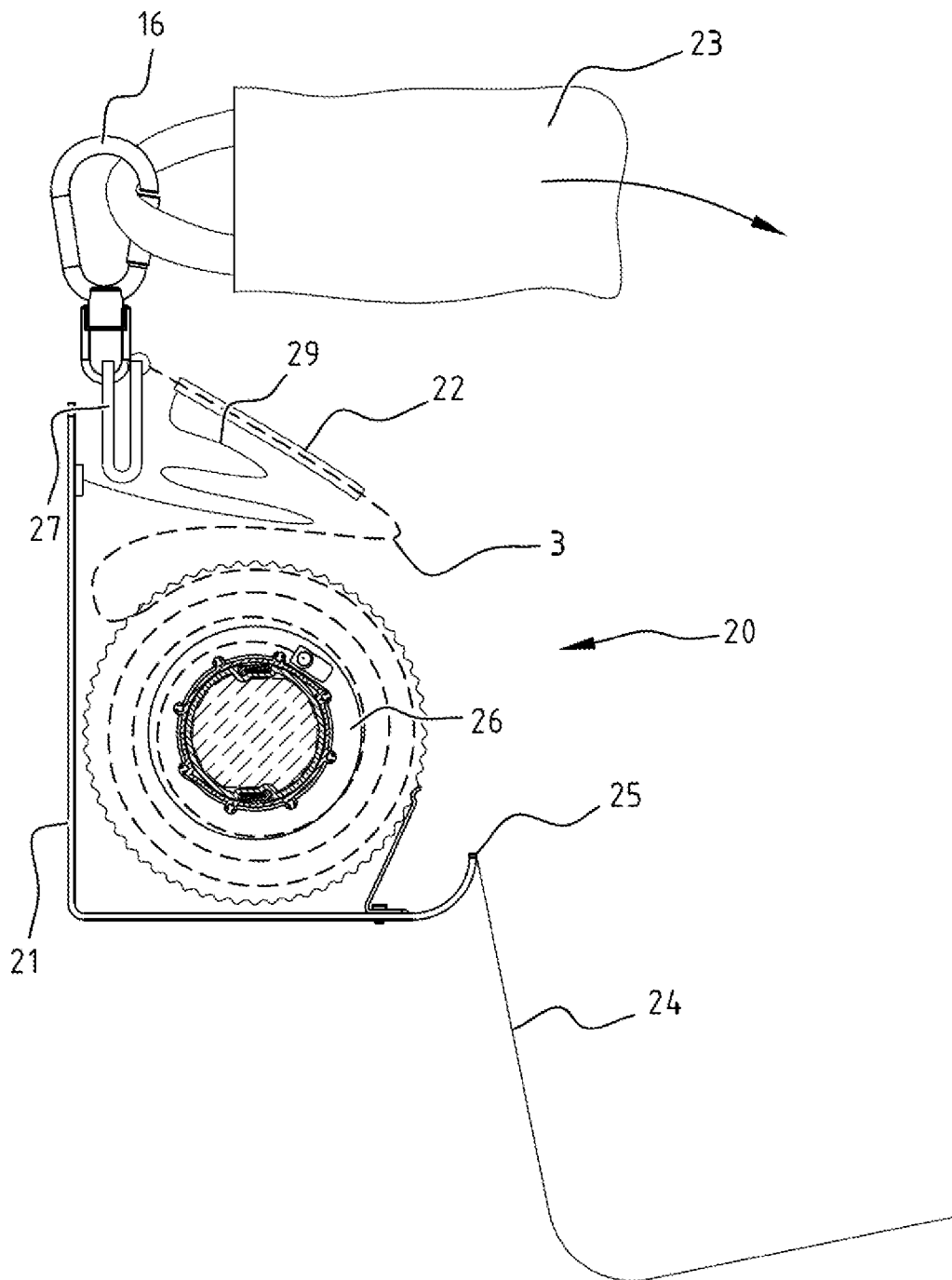
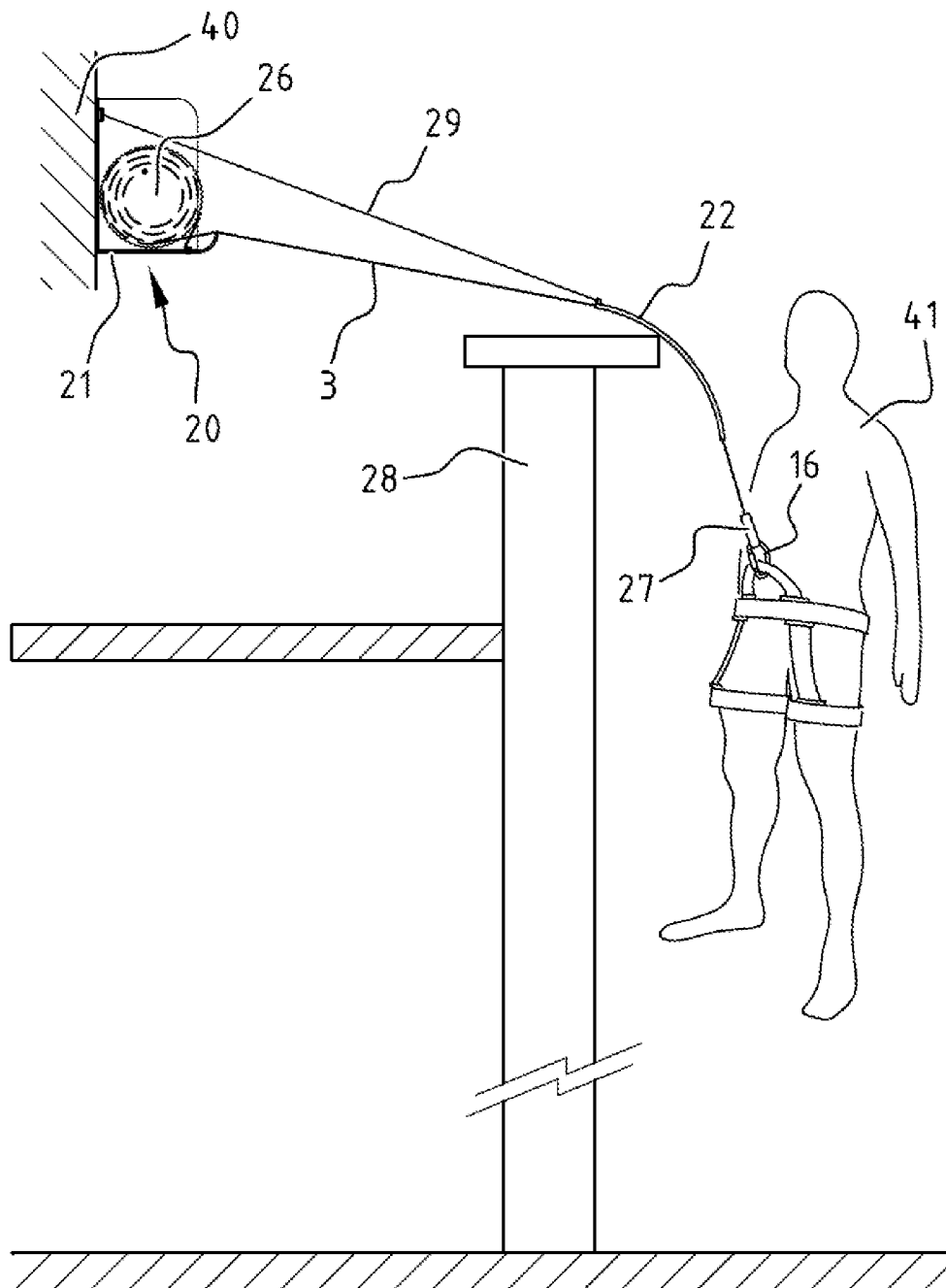


FIG. 5

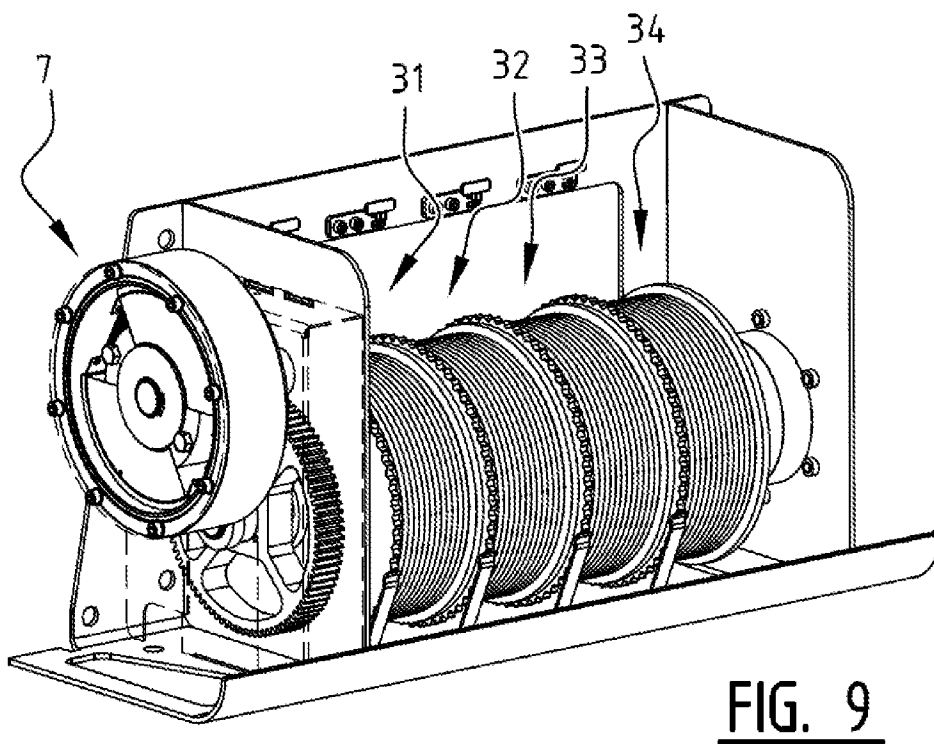
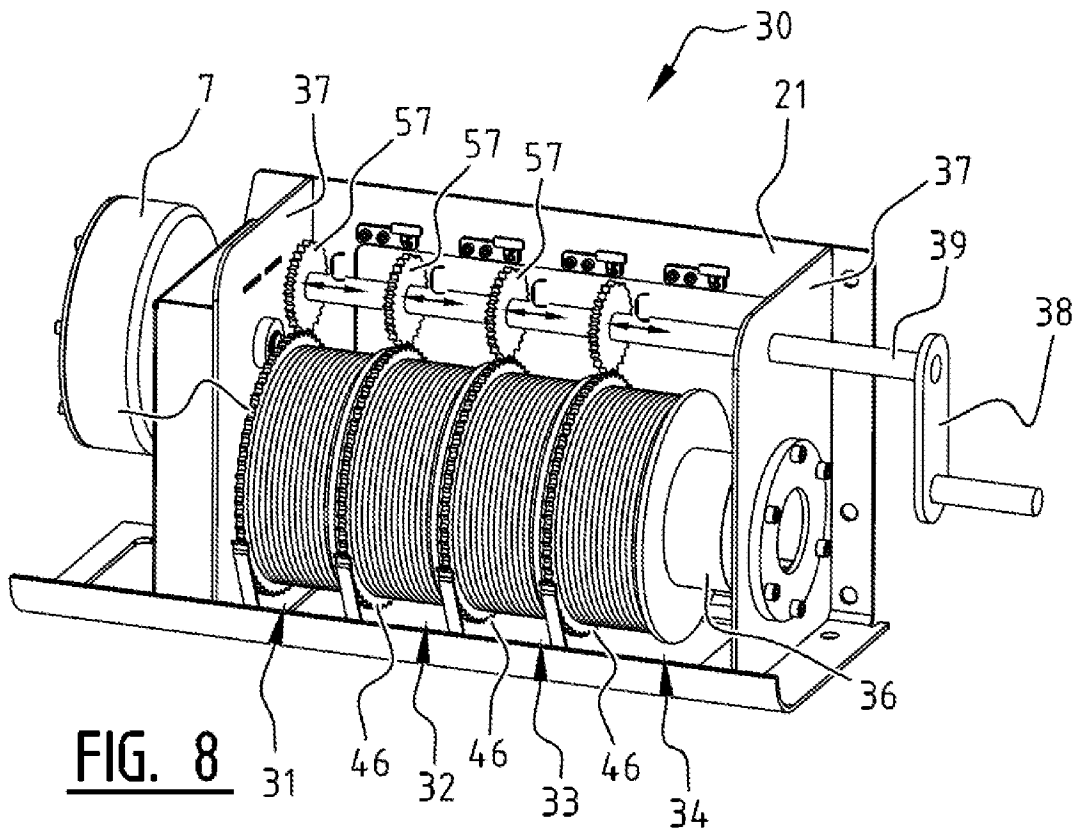
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FIG. 6

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FIG. 7

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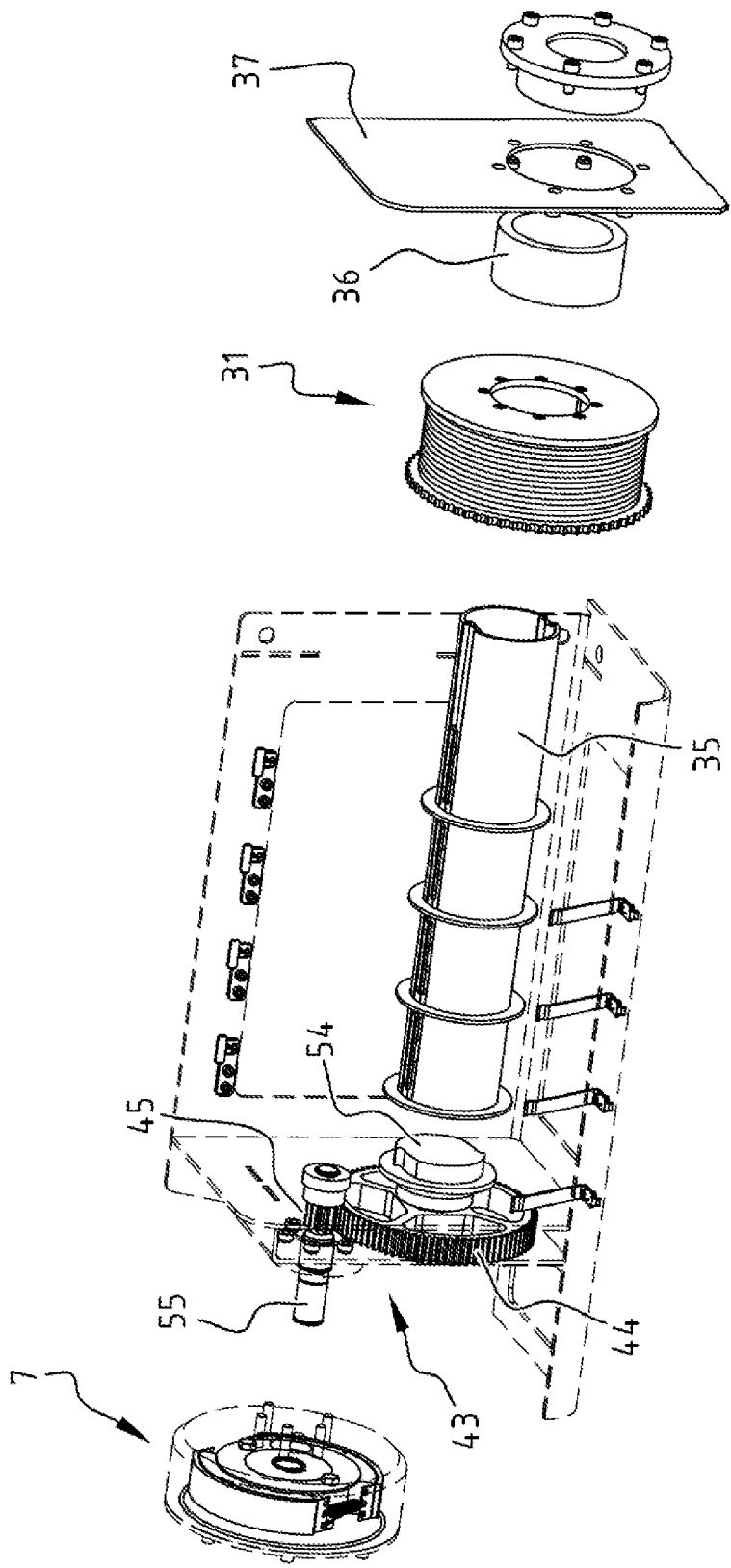


FIG. 10

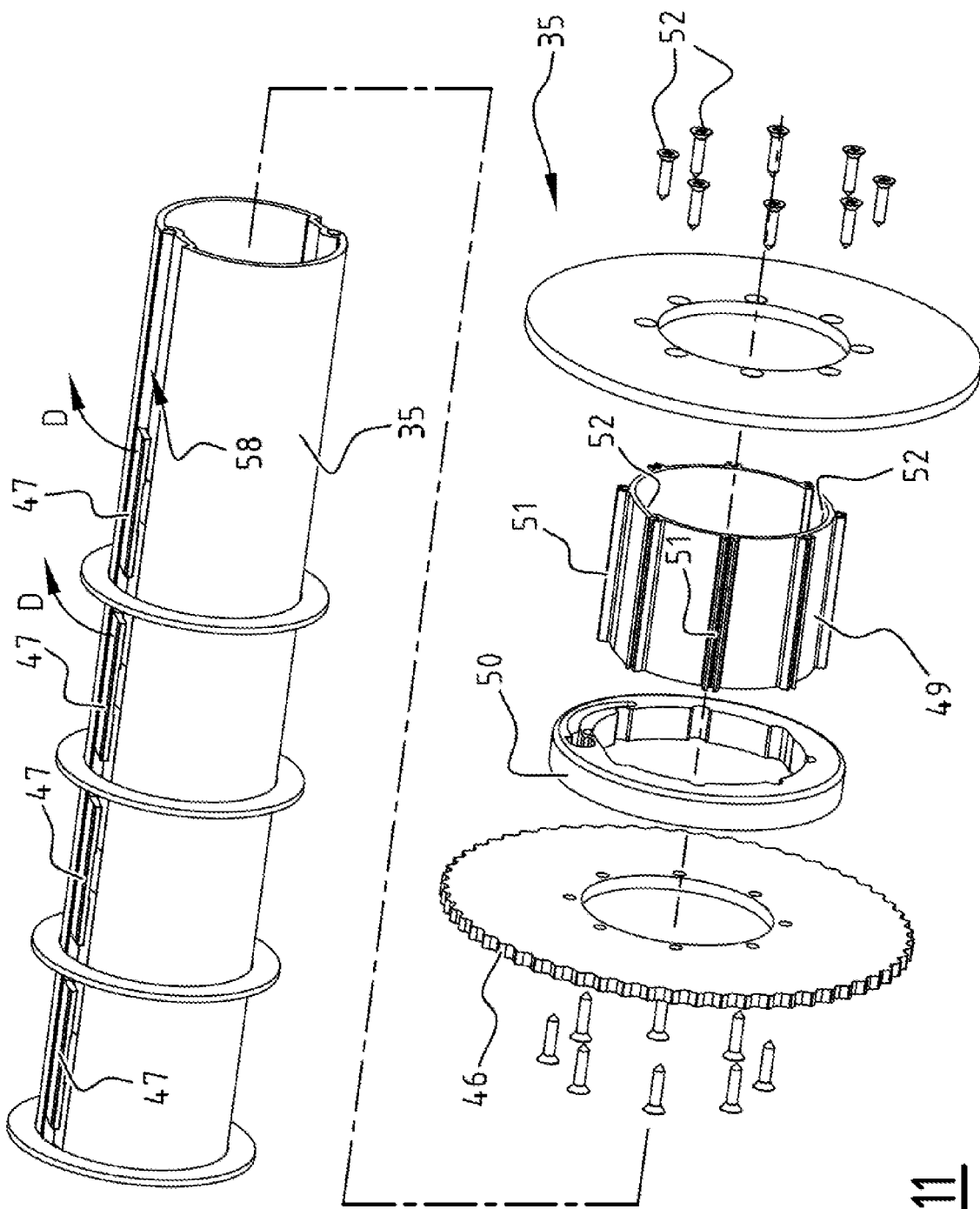


FIG. 11

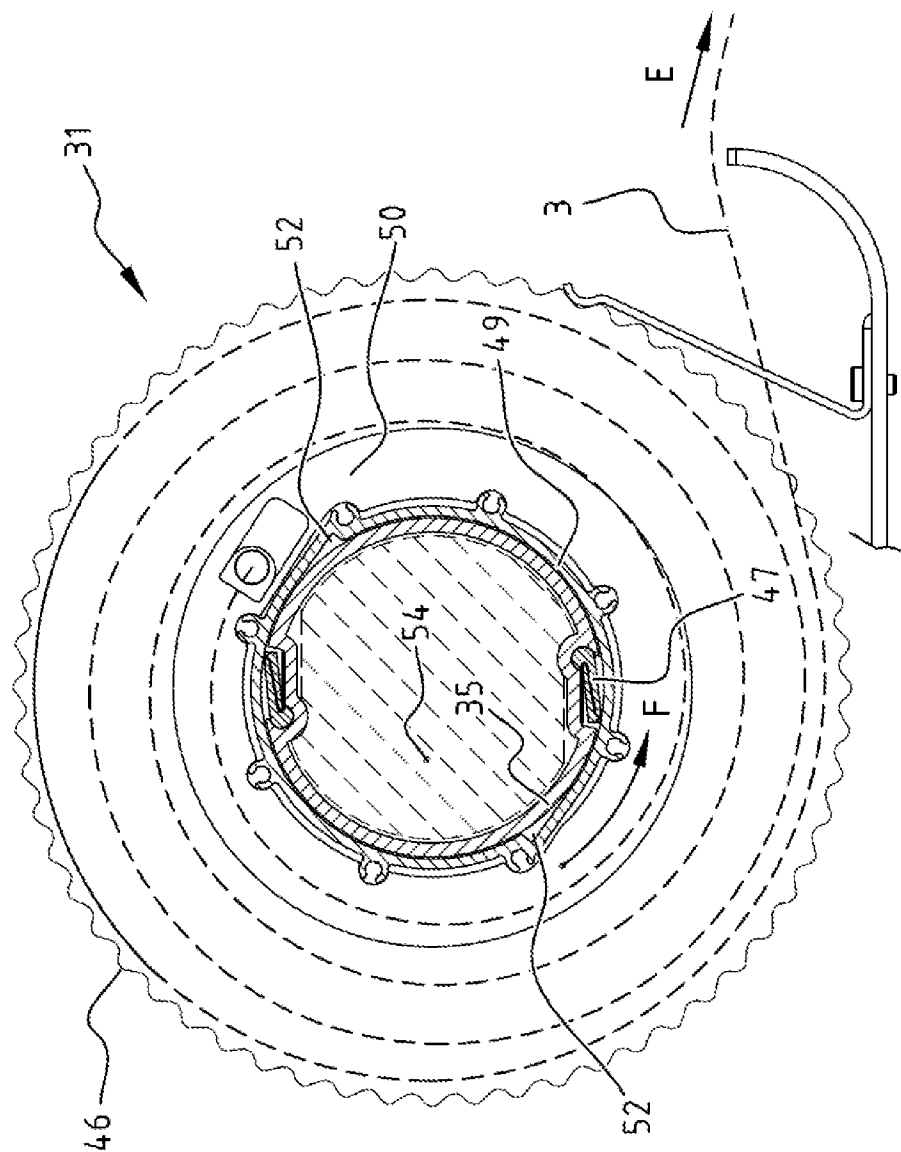


FIG. 12

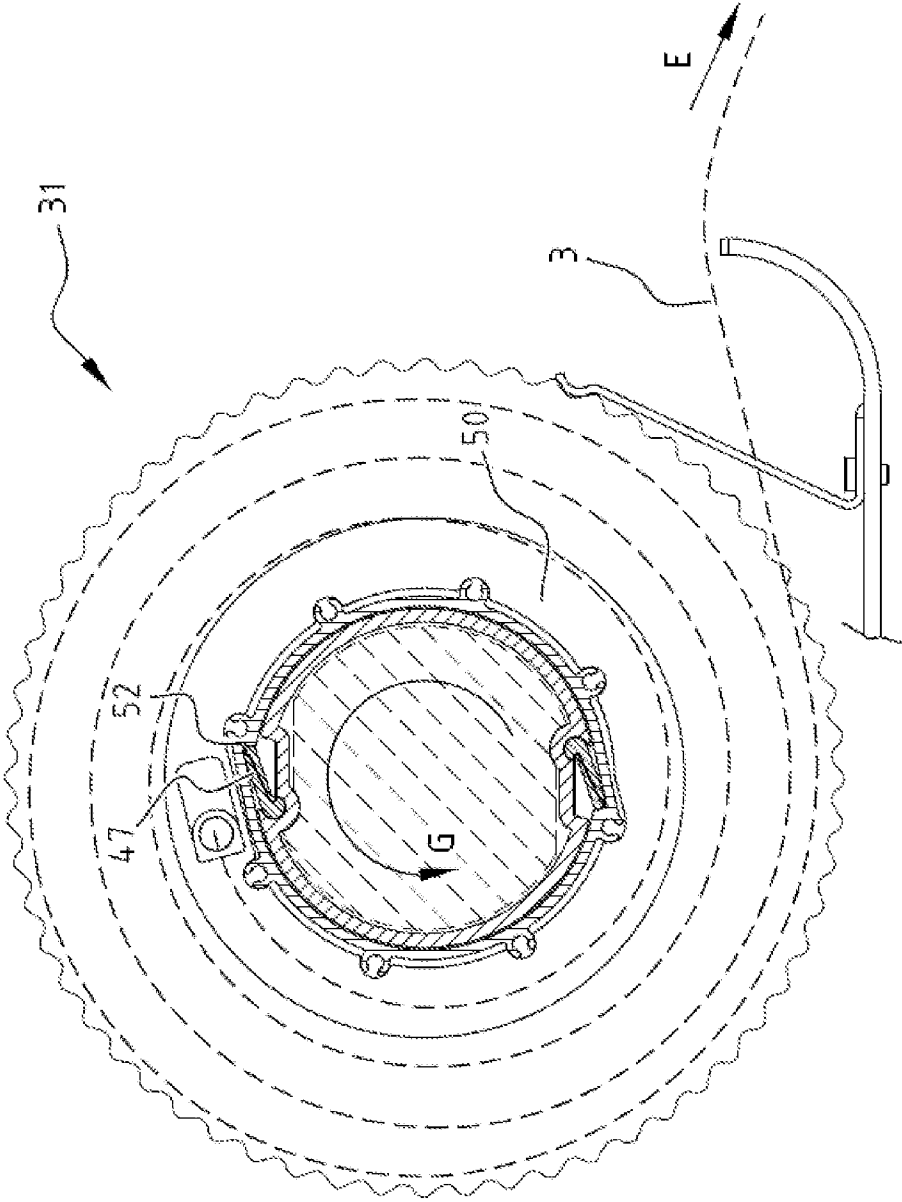


FIG. 13

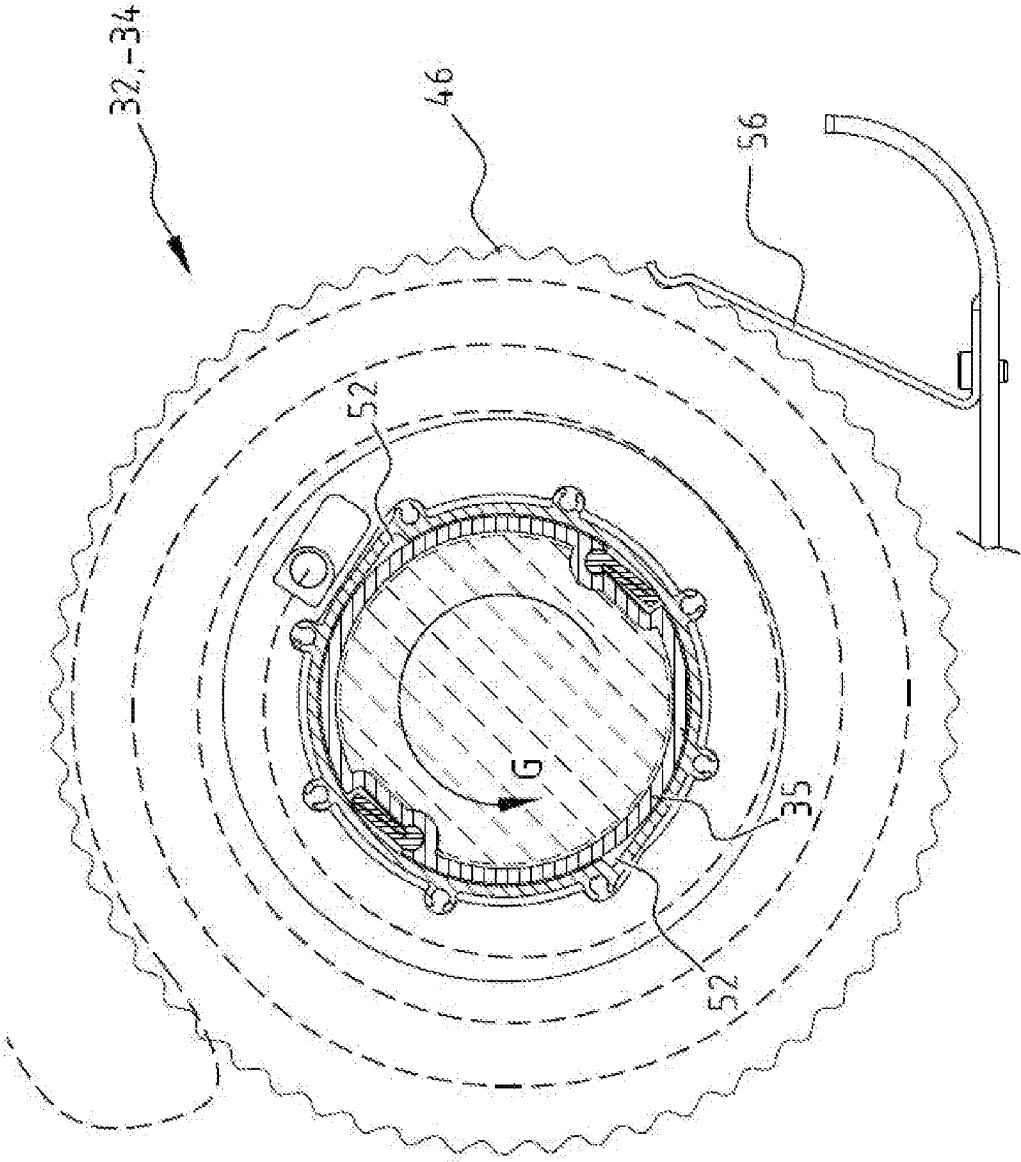


FIG. 14

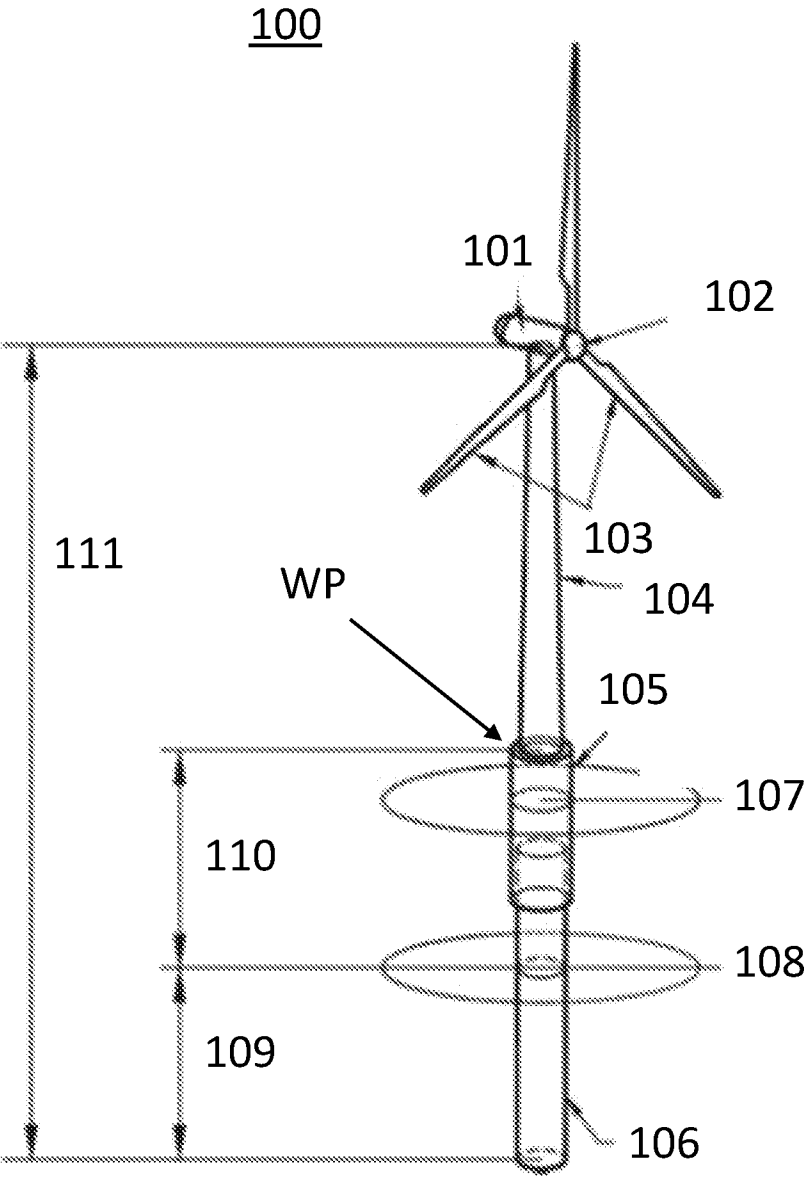
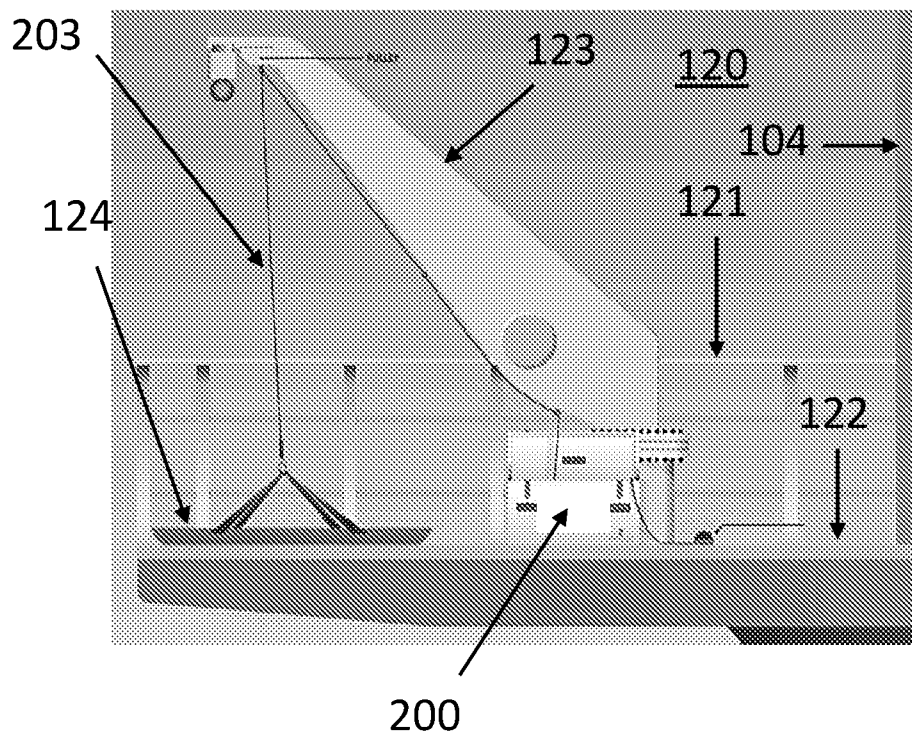
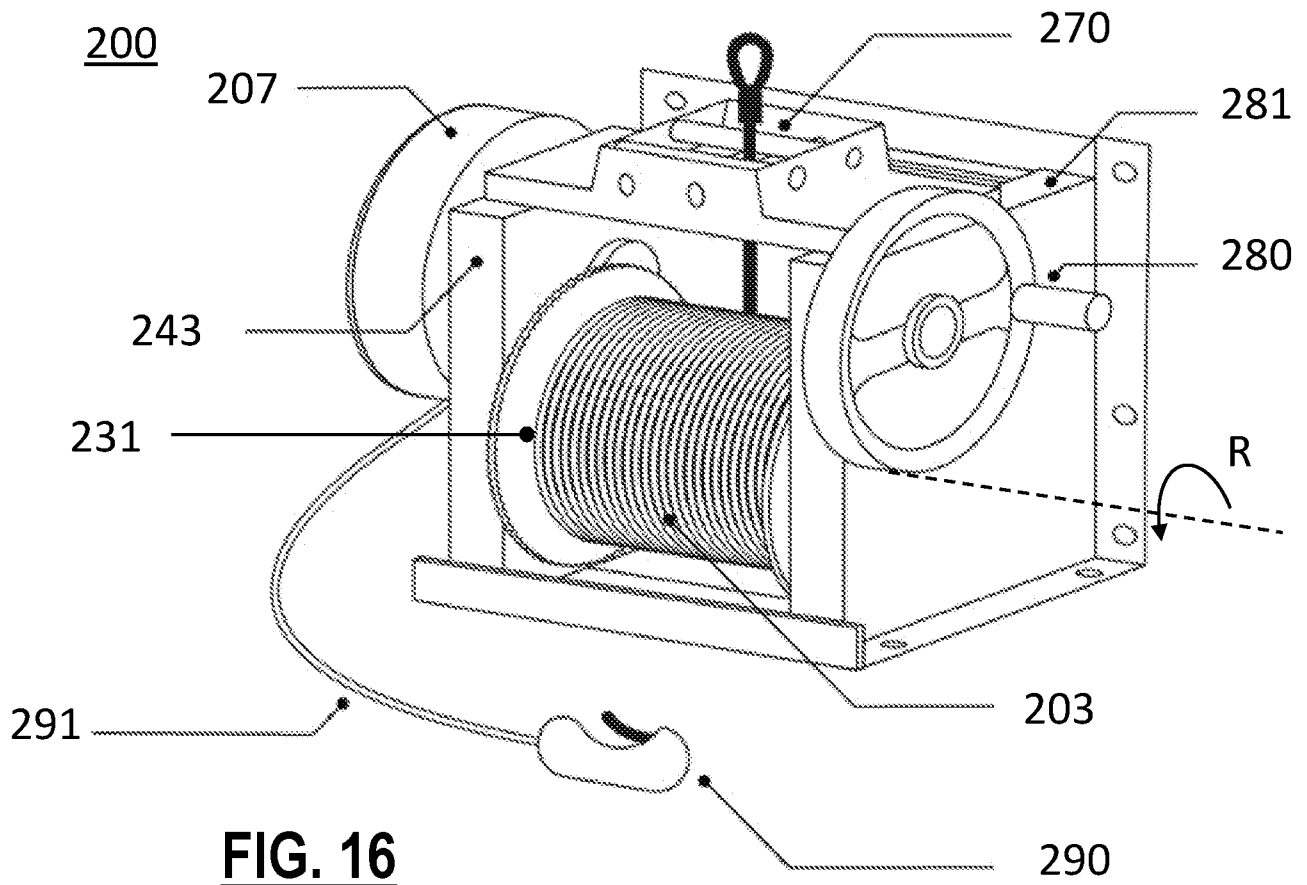


FIG. 15

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INTERNATIONAL SEARCH REPORT

International application No
PCT/NL2024/050259

A. CLASSIFICATION OF SUBJECT MATTER		
INV.	A62B1/10	A62B35/00
	A62B1/00	A62B1/12
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) A62B		
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	JP H10 127798 A (TAKAYANAGI YOSHIHARU) 19 May 1998 (1998-05-19) figures 2, 3 paragraphs [0001], [0026] - [0028], [0030], [0040], [0047], [0055] -----	1 - 17
X	CA 1 113 904 A (HERMANI RUDOLF F) 8 December 1981 (1981-12-08) figures 1, 3, 4 page 5, lines 7-13 - page 6, paragraph bridging -----	1 - 17
X	WO 2021/198758 A1 (PROGRADE S R L [IT]) 7 October 2021 (2021-10-07) figures 1, 5 page 35, lines 7-13 -----	1 - 17
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Date of the actual completion of the international search 20 August 2024	Date of mailing of the international search report 19/09/2024	
Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Authorized officer Almeida, Mariana	

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/NL2024/050259

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
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