

Energy Supply System

The present invention relates to an energy supply system according to the preamble of claim 1.

A generic energy supply system is known, for instance, from EP 2 610 208 A1. In a variant shown in Figures 12 to 15, the carrier is guided in a guide device, wound onto or unwound from a winding device. The guide device has transport discs with several concentric tracks arranged in steps. The carrier has sections with different widths, which can be wound onto or unwound from the stepped tracks according to the width, in which the winding takes place from the innermost track to the outermost track. A track change between the tracks takes place through the ramps connecting the tracks and the changing width of the carrier.

However, such an energy supply system has some disadvantages. For example, the carrier is designed in a very complex way. Winding devices with different intake capacities require specifically designed carriers in each case. Furthermore, the height of the winding at the outlet of the winding device varies in each case by the winding layer.

It is the object of the invention to provide an improved energy supply system without the disadvantages discussed above.

This object is accomplished by an energy supply system having the features of claim 1. Advantageous embodiments of the invention are defined in the dependent claims.

The energy supply system comprises a line storage for winding and unwinding of at least one energy line around a winding center of the line storage.

The line storage can serve as a space-saving and orderly storage of a part of the energy line that is not taken out of the line storage.

Essentially, as a winding center, a centrally located point in the line storage can be understood, starting from which (or towards which) the at least one energy line can be wound in the line

storage, running in one or more windings. Such a course can, for instance, be similar to a flat spiral or a helical line.

For the energy supply system, it can generally be provided that the at least one energy line enters into the line storage in the winding center, for instance through a suitable joint. It can thus be provided that the energy line enters into the line storage in the winding center, from there runs in sectionally guided windings to the opening, and exits from the line storage through the opening.

The energy supply system can be provided for a tool that can be fixed or is fixed to a hoist.

The energy supply system can generally allow relative movement of the tool (or in general a free end of the energy line) towards the line storage. The tool can remain connected to the energy line during the movement. The length of the section of the energy line taken from the line storage can be adapted to the relative movement between the tool and the line storage by winding up and unwinding the at least one energy line into the line storage or out of it.

The at least one energy line can comprise at least one hydraulic supply line and/or at least one electrical supply line.

For the energy supply system, at least one carrier is provided for the at least one energy conducting line. The energy line can be arranged in the carrier (in other words, the carrier can embrace the energy line), so that winding and unwinding the energy line in the line storage is carried out by winding and unwinding the carrier. The carrier may conceivably be formed by a sheath of the line or lines.

The line storage comprises an opening for the inlet and outlet of the carrier and the energy line. A section of the carrier can thus be brought into the line storage through the opening or partially be removed from the line storage through the opening.

The carrier (and thus the energy line) of the energy supply system according to the invention can be guided by guide means via guide sections and guide arches to the winding center of the line

storage for guiding the carrier section by section in the line storage.

The carrier can generally have a section with guide means and a section without guide means.

Here, a first guide section and a first guide arch adjoining it, and a second guide section and a second guide arch adjoining it, whereas the second guide section is adjoining the first guide arch, and further a third guide section adjoining the second guide arch, lying further inwards compared to the first guide section relative to the winding center, are provided.

The first guide section and the second guide section can essentially have the same distance (measured for instance as normal distance) to the winding center.

The first guide arch and the second guide arch can essentially have the same distance (for instance measured as the standard distance of the center of curvature) to the winding center.

The first guide section and the second guide section can, relative to the winding center, be arranged facing each other.

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If necessary, further guide arches and guide sections can be provided. So, a third guide arch can for instance be provided, which adjoins the third guide section, and is located further inwards relative to the winding center compared to the first guide arch, and which is adjoined by a fourth guide section located further inwards relative to the winding center compared to the second guide section. It should not be ruled out that even further guide arches and guide sections are provided.

The guide sections and guide arches can form a guide track, and the guide track can have an essentially spirally winding course from the opening towards the winding center, narrowing (thus, essentially with a decreasing radius of curvature) in the direction of the winding center.

By such an arrangement of guide sections and guide arches, it can be achieved that these have an essentially spiral course from the opening towards the winding center, and the at least one carrier can be wound and unwound section by section and essentially spirally in the line storage towards the winding center.

In other words, such an arrangement of guide arches and guide sections can have an essentially narrowing (more tightly wound), spiral course starting from the opening of the line storage towards the winding center of the line storage.

In this way, a sectional, essentially spiral, multi-layered and concordant (with the same winding sense) winding and unwinding of the carrier (and thus of the energy line) in the line storage can be achieved.

Because of the guide arches and guide sections and the corresponding guide means, the line storage itself can be formed with essentially no movable parts.

By means of the guide arches and guide sections and the corresponding guide means, the occurring forces can be spread in a better way. This can minimize wear.

The guide arches and guide sections and corresponding guide means can allow a gliding movement of the carrier relative to the guide arches and guide sections.

A connection of a guide section to a guide arch (or vice versa) does not have to be direct, uninterrupted or immediate. In an exemplary embodiment of the guide sections and guide arches in the form of webs or recesses, there can be a certain gap or discontinuity, for example, between a guide arch and a subsequent guide section. However, such a gap or discontinuity is to be measured in such a way that a guidance of the carrier with its guide means is ensured.

It is provided that the third guide section, relative to the winding center compared to the first guide section, is arranged lying further inwards. For instance, the first guide section and the third guide section, relative to the winding center, can be arranged facing each other, and the third

guide section is located closer to the winding center.

The guide sections and also the guide arches, in particular the first and third guide section, can be arranged and spaced in such a way that a carrier wound thereon does not touch itself between adjacent guide sections or guide arches. This can lead to a reduction in the frictional forces that occur.

The guide arches and guide sections and the corresponding guide means can subject the carrier to forced guidance in sections in the line storage.

The guide arches and guide sections and the corresponding guide means can be used to guide the carrier in sections in the line storage in a shearing-resistant manner. When a tensile or thrust force is applied to the carrier in the direction of the carrier, it can be moved along the guide arches and guide sections. The guide arches and guide sections and the corresponding guide means can engage in such a way that only a movement of the carrier along the guide arches and guide sections is possible. This can prevent buckling and thus being wound an unwound in a disorderly manner.

It can be provided for the carrier to be in the form of at least one sheath of the energy line or in the form of at least one chain with chain links connected to each other in a jointed manner. Such chains are known in the prior art as energy chains or also as energy guiding chains. The at least one energy line can be arranged in an inner part of the chain.

The carrier can be essentially freely bendable or windable in at least one direction.

In one embodiment of the carrier as a sheath of the power line, the carrier can have a certain transverse stiffness, but can be bent to a certain minimum bend radius and thus can be wound.

In one embodiment of the carrier as a chain, the carrier can be freely bendable or windable in at least one direction (for example, at least in the sense of winding) essentially up to a certain minimum bend radius. Bending or winding in certain directions can be suppressed by self-locking

of the chain.

In one embodiment of the invention, it can be provided that the guide means of the carrier are formed as axial projections protruding from at least a part of the carrier, in particular from the sheath or a part of the chain links.

Axial protrusion can generally be understood as a protrusion transverse to the longitudinal extent of the carrier. The axial protrusions can be provided with rollers or friction-reducing coatings to reduce friction. The protrusions can be cylindrical or web-shaped.

The line storage can have at least one planar carrier plate, and the guide arches and guide sections can be formed in the carrier plate in the form of a guide track corresponding to the guide means of the carrier. The guide track can be in the form of a step, a groove or a recess in the carrier plate. The guide track can be continuous or in sections, i.e. as a series of individual sections.

In one embodiment of the invention, it is conceivable that the guide track is formed as a single continuous groove or recess in the at least one carrier plate of the line storage.

In a further embodiment of the invention, it can be provided that the guide means of the carrier are formed as a guide track in the form of a plurality of individual guide tracks in at least a part of the sheath or at least a part of the chain links. The individual guide tracks can for instance be formed as grooves or recesses in the carrier.

The guide arches and guide sections can have the form of an arrangement or sequence of protrusions protruding from the carrier plate.

Protruding from the carrier plate can generally be understood as a protrusion from the plane of the carrier plate. The protrusions can be provided with rollers or friction-reducing coatings to reduce friction. The protrusions can have a cylindrical or web-like shape.

For the energy supply system, in a further embodiment of the invention, it can be provided that

- the carrier has an outer, first end and an inner, second end, and
- the carrier has a section with guide means and a section without guide means, and the section without guide means extends from the second end to the section with guide means, and
- the carrier is connected to the winding center at the second end of the carrier, and the section without guide means is unguided in the line storage.

In other words, it can be provided that the carrier in the line storage has a guided section and an unguided section. The guided section can essentially extend from the opening of the line storage over the guide sections and guide arches to the end of the section of the carrier with guide means or to the beginning of the section of the carrier without guide means, respectively. The unguided section can extend from there to the winding center.

The carrier can also have guide means outside the line storage.

The first end of the carrier can be arranged on the section of the carrier taken from the line storage.

An unguided section can generally be understood as a section of the carrier that is not guided by guide arches or guide sections and corresponding guide means. Such an unguided section can be similar to a drag chain.

For this embodiment, it can be provided that the unguided section of the carrier can be wound essentially in a spiral manner about the winding center, and that the winding radius of the unguided section of the carrier increases or decreases as the guided part of the section with guide means of the carrier is wound up and down. An increase or decrease in the winding radius of the unguided section can be the case when transitioning to a loose or tight winding.

Here, it can be possible that the energy line enters into the line storage in the winding center through a non-rotary joint. The winding of the unguided section with a second end held non-rotary in the winding center, resulting from winding and unwinding of the guided part of the

section with guide means of the carrier, for which in other embodiments, a technically complex rotary joint is provided, can be permitted by an essentially spiral winding around the winding center and an increasing or decreasing winding radius. The space in the line storage occupied or vacated by the winding or unwinding of the unguided section can be made available or filled by the guided part of the carrier moving out of or into the line storage.

Alternatively, for this embodiment, it can be provided that a rotary joint is provided for the energy line in the winding center. The torsion of the unguided section resulting from winding and unwinding of the guided section of the carrier can be permitted or prevented by connecting the second end of the carrier to the rotary joint.

As a further alternative, but also in combination with the essentially spiral winding described above, it can be provided that the unguided section of the carrier can be wound and unwound in opposing layers about the winding center when the guided section of the carrier is wound and unwound. The movement of the unguided section of the carrier can resemble a two-layer folded drag chain, which can be wound in a sliding arrangement around the winding center.

When winding the unguided section of the carrier around the winding center, it can generally be provided that the unguided section is supported on and slides along the section of the carrier guided at the guide sections and guide arches. In particular, this can be the case with an increasing winding radius (transition to a loose winding) of the unguided section of the carrier as the guided section is wound up. In particular, this can be the case with an increasing winding radius (transition to a loose winding) of the unguided section of the carrier as the guided section is wound up.

For the energy supply system, it can generally be provided that the distance of the guide arches to each other is essentially invariable.

Winding and unwinding of the carrier (and thus of the energy line) into or out of the line storage can be carried out along a fixed guide track, which can be predetermined, or a predetermined guide track formed by the guide sections and guide arches.

For the energy supply system, it can be generally provided that the guide arches have an essentially 180 degree winding angle and/or the guide arches have equal and/or different radii of curvature, and the guide arches with different radii of curvature have a decreasing radius of curvature from the opening of the line storage towards the winding center, and/or the respective radius of curvature of a guide arch is constant.

The guide arches can each be semicircular in shape.

Groups of guide arches with different radii of curvature, which have a decreasing radius of curvature from the opening of the line storage to the winding center, can be arranged concentrically. The grouping can, for instance, be made on opposite sides relative to the winding center.

For the energy supply system, it can generally be provided that the respective guide sections have an essentially straight course and/or essentially the same longitudinal extent.

For the energy supply system, it can generally be provided that the line storage has an essentially elongated shape with a greater longitudinal extent than transverse extent, and the guide sections extend essentially along the longitudinal extent of the line storage.

An elongated shape of the line storage can optimize the length of the energy line that can be wound and unwound in or out of the line storage.

The line storage can, for instance, have an essentially rectangular shape, in which the guide arches are arranged on the short sides of the rectangle and the guide sections are arranged along the long sides of the rectangle.

For the energy supply system, it can generally be provided that the winding and unwinding of the at least one carrier takes place essentially in one plane. This can enable crossing-free winding of the carrier.

For the energy supply system, it can be generally provided that the inlet and outlet of the at least one carrier through the opening takes place at a fixed position of the line storage. This can be achieved by the first guide section being located adjacent to the opening.

In energy supply systems known in the prior art, the position of the inlet and outlet to or from the line storage changes with the length of the carrier wound or unwound in the line storage. In contrast, for the energy supply system according to the invention, it can be provided that this takes place at a fixed position of the line storage, which makes it easier to predict the course of the carrier taken from the line storage.

For the energy supply system, it can generally be provided that the at least one carrier has an essentially constant transverse extent. This can be used to easily adapt the carrier to the windable length in the line storage.

For the energy supply system, a drive acting on the at least one carrier can be provided for winding and unwinding the at least one carrier. The drive can be present in the form of one (or more) driven rollers or a driven gear wheel. The drive can have an energy storage, for example in the form of a spring, or a motor.

For the energy supply system, it can generally be provided that the position of the winding center in the line storage can be adjusted. For instance, the winding center can be arranged in the line storage so that it can be moved linearly. For this, a drive can preferably be present. Preferably, the position of the winding center in the line storage can be designed to be linearly movable in the direction of and/or transverse to the guide sections.

By being able to adjust the position of the winding center in the line storage, the length of the unguided section of the carrier can be reduced.

Protection is also requested for hoist, in particular a crane, with an energy supply system as previously described.

The hoist can comprise a tool, and the energy supply system can allow a relative movement of the tool to the line storage. The tool can remain connected to the energy line during the movement, and the length of the section of the energy line taken from the line storage can be adapted to the relative movement between the tool and the line storage.

With such a hoist, the energy supply system can be attached to an outrigger, for instance an arm of an arm system, of the hoist.

Advantageously, the energy supply system can be arranged on an inner outrigger, for instance the beginning of a telescopic arm system, and a tool supplied by the energy supply system can be arranged on an outer outrigger that is movable with respect thereto, for instance at the end of a telescopic outrigger of a telescopic arm system.

When the telescopic arm system is extended and retracted, the length of the section of the carrier taken from the line storage, and thus of the energy line, can be adapted to the relative movement between the tool and the line storage.

Other applications of the energy storage device according to the invention, such as for CNC machining centers, industrial robots, or general moving machine parts, are also imaginable.

Embodiments according to the invention are discussed with reference to the figures. They show:

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| Fig. 1 | an energy system arranged on an outrigger in a first embodiment, |
| Fig. 2 | an energy storage according to a second embodiment in isolation, |
| Fig. 3 | an energy storage according to the first embodiment in isolation, |
| Fig. 4 | a further view of an energy storage according to the first embodiment in isolation, |
| Figs. 5a to 5j | cross-sectional views of a winding or unwinding process of the carrier from |
| or | into the line storage of an energy storage according to the first |
| | embodiment, |
| Fig. 6 | a cross-section through an energy storage according to the first |

	embodiment,
Figs. 7a, 7b, 7c	schematic illustrations of different embodiments of the carrier and the guide
Fig. 8	an embodiment of the energy storage with a rotary joint,
Fig. 9	an embodiment of the energy storage with a multi-layer, counter-rotating winding of the unguided part of the carrier,
Figs. 10a and 10b	embodiments of the energy storage with movable winding centers,
Figs. 11a and 11b	an embodiment of an energy storage with a drive, and
Figs. 12a to 12d	views to a hoist with an energy guide.

Figure 1 shows an energy supply system 1, which is arranged with a housing 20, which accommodates the line storage 3, on an inner outrigger 36 of a hoist not shown here in more detail (see Figures 12a to 12d). The carrier 6, which can be wound or unwound in or out of the line storage 3, is attached on a first end 30 to an outer outrigger 40, which is movable relative to the line storage 3.

Figure 2 shows in isolation an embodiment of an energy supply system 1 with a line storage 3 arranged in a housing 20, from the opening 7 of which a part of the carrier 6 is taken. In this embodiment, the carrier 6 is formed by a chain 22 with chain links 23, on which guide means 8 are arranged in the form of two axially protruding protrusions 24 per chain link 23. In this embodiment, the line storage 3 has an elongated, approximately rectangular shape. This embodiment of the carrier 6 is also shown in the embodiment of the energy storage 1 of figures 11a and 11b.

In Figure 3, a further embodiment of an energy supply system 1 is shown in isolation, in which the energy supply system 1 again has a line storage 3 arranged in a housing 20, from the opening 7 of which a part of the carrier 6 is taken. In this embodiment, the carrier 6 is formed by a chain 22 with chain links 23, on which guide means 8 are arranged in the form of an axially protruding protrusion 24 for each chain link 23. The carrier plate 26 of the line storage 3 has been made visible in this embodiment by partially blanking out the lid of the housing 20.

Figure 4 shows a view of Figure 3 in which the lid of the housing 20 has been completely banked out. It is identifiable that the carrier 6 is guided for at least one energy-carrying line (not visible here, see Figures 5a-5j and Figure 6) for the inlet and outlet of the carrier 6 through the opening 7 of the line storage 3, for guiding the carrier 6 and the energy line in sections in the line storage 3 with the help of guide means 8 via a first guide section 9 through a first guide arch 10, and via a second guide section 11 adjoining the first guide arch 10 through a second guide arch 12, and via a third guide section 13 adjoining the second guide arch 12, which is lying further inwards relative to the winding center 5 (see also Figure 5a) compared to the first guide section 9 - and, analogous to this, via further guide arches 15, 17 and guide sections 14, 16, 18 - is guided to the winding center 5 of the line storage unit 3. The further course of the carrier 6 between the end of the innermost guide section 18 and the winding center 5 is shown with dashed lines in Figure 4 and can be seen in detail in Figure 5a.

The third guide section 13 is arranged lying further inwards compared to the first guide section 9 relative to the winding center 5. The first guide section 9 and the third guide section 13 are arranged opposite each other relative to the winding center 5, and the third guide section 13 is located closer to the winding center 5.

Moreover, a third guide arch 14 is shown, which adjoins a further inwards lying third guide section 13 compared to the first guide arch 10 relative to the winding center 5, to which a fourth guide section 15 adjoins, lying further inwards, compared to the second guide section 11 relative to the winding center 5. The same applies to the further guide arches 16, 18 and the further guide sections 17, 19. It should not be ruled out that, different to what is shown, further guide arches and guide sections are provided in addition to those shown.

In the embodiment shown, the guide sections 9, 11, 13, 15, 17, 19 and guide arches 10, 12, 14, 16, 18 form a guide track 27, and the guide track 27 comprises an essentially spirally-wound course from the opening 7 towards the winding center 5, narrowing in the direction of the winding center 5.

It can be further seen in the embodiment shown that

- the guide arches 10, 12, 14, 16, 18 essentially have a winding angle of 180 degrees, and that
- the guide arches 10, 14, 18 or the guide arches 12, 16, respectively, have different radii of curvature, and the guide arches 10, 14, 18 and the guide arches 12, 16, with different radii of curvature, respectively, have a decreasing radius of curvature from the opening 7 of the line storage 3 towards the winding center 5, and that
- the respective radius of curvature of a guide arch 10, 12, 14, 16, 18 is constant.

In the embodiment shown, the guide arches 10, 12, 14, 16, 18 are each formed in an essentially semicircular shape.

Groups of guide arches 10, 14, 18 and 12, 16 with different radii of curvature, which have a decreasing radius of curvature from the opening 7 of the line storage 3 towards the winding center 5, are arranged concentrically in the embodiment shown. The grouping of the guide arches 10, 14, 18 and 12, 16 is arranged on opposite sides relative to the winding center 5.

In the embodiment shown, the guide sections 9, 11, 13, 15, 17, 19 have an essentially straight course and essentially the same longitudinal extent.

In the embodiment shown, the line storage 3 comprises an essentially elongated shape with a greater longitudinal extent than transverse extent, and the guide sections 9, 11, 13, 15, 17, 19 essentially extend along the longitudinal extent of the line storage 3.

The sequence of figures 5a to 5j shows an unwinding of the carrier 6 from the line storage 3 according to the embodiment of figure 4. In reverse order, the figures show a winding of the carrier 6 into the line storage 3.

Figure 5a shows a line storage 3 which is essentially completely wound up. The guided part of the section 33 of the carrier 6 with guide means 8 extends essentially over the entire length of the guide track 27 formed by the guide sections 9, 11, 13, 15, 17, 19 and guide arches 10, 12, 14, 16, 18.

Figure 5j shows a line storage 3 that is essentially completely unwound. The guided part of the section 33 extends essentially over the minimum length of the guide section 9 adjoining the opening 7. The unguided section 32 has been essentially completely wound around the winding center 5 due to the non-rotary joint 37.

Except for the length of the part of the carrier 6 removed from the line storage 3, only the carrier plate 26 shown in Figure 4 is blanked out in Figures 5a to 5j compared to Figure 4. It can be seen that the line storage 3 has at the rear (in the view of Figures 5a to 5j located behind the carrier 6 in perspective) a further carrier plate 26, which in turn has guide sections 9, 11, 13, 15, 17, 19 and guide arches 10, 12, 14, 16, 18. The carrier 6 is guided in sections along the guide sections 9, 11, 13, 15, 17, 19 and guide arches 10, 12, 14, 16, 18 to the winding center 5 of the line storage 3. The carrier 6 is guided on both sides by the presence of the two carrier plates 6 (see also Figures 7a to 7c). However, this does not have to be so, since a single-sided guidance is also conceivable.

In the embodiment shown, the guide track 27 is formed as a single continuous groove in the carrier plate 26 of the line storage unit 3.

The guide sections 9, 11, 13, 15, 17, 19 and guide arches 10, 12, 14, 16, 18 are arranged and spaced in such a way that the carrier 6 wound thereon does not touch itself between adjacent guide sections 9, 11, 13, 15, 17, 19 and guide arches 10, 12, 14, 16, 18.

The carrier 6 has a section 32 with guide means 8 and a section 33 without guide means. The section 33 without guide means extends from the second end 31 of the carrier 6 to the beginning of the section 32 with guide means 8, at which the first guide means 41 of the guided part of the section 32 with guide means 8 is arranged.

The carrier 6 is connected to the winding center 5 at the second end 31 of the carrier 6. The section 33 without guide means runs unguided in the line storage 3, i.e. it is not guided by the guide sections 9, 11, 13, 15, 17, 19 and guide arches 10, 12, 14, 16, 18.

In other words, the carrier 6 in the line storage 3 has a guided section 33 with guide means 8 and an unguided section 32 without guide means. The guided part of the section 33 extends essentially from the opening 7 of the line storage 3 via the guide sections 9, 11, 13, 15, 17, 19 and guide arches 10, 12, 14, 16, 18 to the end of the section 33 of the carrier 6 with guide means 8 and to the beginning of the section 32 of the carrier 6 without guide means 8, respectively. The unguided section 32 extends from there to the winding center 5.

In the embodiment shown in Figures 5a to 5j, the unguided section 32 of the carrier 6 can be windable essentially spirally around the winding center 5, and the winding radius of the unguided section 32 of the carrier 6 can increase or decrease as the guided part of the section 33 is wound and unwound by guide means 8 of the carrier 6. An increase - such as in the transition from Figure 5b to 5a - or decrease - such as in the transition from Figure 5a to 5b - in the winding radius of the unguided section 32 can be the case in a transition to a loose (wind) or tight (unwind) winding.

In the embodiment shown, at least one energy line 4 enters into the line storage 3 at the winding center 5 through a non-rotary joint 37. The carrier 6 connects the non-rotary joint 37 tangentially in the direction of the guide sections 9, 11, 13, 15, 17, 19. The winding of the unguided section 32 resulting from winding and unwinding of the guided part of the section 33 with guide means 8 of the carrier 6 with a second end 31 held non-rotating in the winding center 5, for which alternatively in the embodiment of figure 8 a rotary joint 34 is provided, can be permitted by an essentially spiral winding of the section 32 around the winding center 5 and an increasing or decreasing winding radius. The space in line storage 3 occupied or vacated by winding or unwinding of the unguided section 32 can be made available or filled by the guided part of the carrier 6 leaving or entering into the line storage 3 (in particular, compare Figures 5a and 5j).

When the unguided section 32 of the carrier 6 winds around the winding center 5, the unguided section 32 is supported by and slides along the section 33 of the carrier 6 guided on the guide sections 9, 11, 13, 15, 17, 19 and guide arches 10, 12, 14, 16, 18. In particular, this is the case when the winding radius of the unguided section 32 increases (transition to a loose winding) as the section 33 coils up.

In the course of Figure 5a to Figure 5j, when the carrier 6 is removed from the line storage 3, the first guide means 41 of the guided part of the section 32 moves from the innermost guide section 19 along the guide track 27 formed by the guide sections 9, 11, 13, 15, 17, 19 and guide arches 10, 12, 14, 16, 18 towards the opening 7. An outlet of the carrier 6 from the line storage 3 takes place at a fixed position.

The carrier 6 can be guided in sections in the line storage 3 in a shearing-resistant manner by the guide sections 9, 11, 13, 15, 17, 19 and guide arches 10, 12, 14, 16, 18 and the corresponding guide means 8. When a tensile or thrust force is exerted on the carrier 3 in the direction of the carrier 6, the latter can be moved along the guide sections 9, 11, 13, 15, 17, 19 and guide arches 10, 12, 14, 16, 18 in a guided manner. The guide sections 9, 11, 13, 15, 17, 19 and guide arches 10, 12, 14, 16, 18 and the corresponding guide means 8 intertwine in such a way that only one movement of the carrier 6 along the guide sections 9, 11, 13, 15, 17, 19 and guide arches 10, 12, 14, 16, 18 is possible. This can prevent the carrier 6 from buckling, and thus from being wound and unwound in a disorderly manner.

In Figure 6, a cross-section through the energy storage 1 according to the embodiment of Figure 5a is shown.

Thereby, several energy lines 4 arranged inside the carrier 6 are visible. In the section 33 with guide means 8, the carrier 6 has axial protrusions protruding from the carrier 6 with rollers 25 positioned thereon, which engage in the guide sections 9, 11, 13, 15, 17, 19 and guide arches (not visible here) in the carrier plate 6. The unguided section 32 without guide means is not guided by the guide sections and guide arches.

It is visible that winding and unwinding of the carrier 6 takes place essentially in a plane parallel to the carrier plate 6. It is also visible that the carrier 6 has an essentially constant transverse extent.

Figure 7a schematically shows an embodiment of the carrier 6 in which the carrier 6 has protrusions 24 protruding axially from it, which engage in a groove-shaped guide track 27 of the carrier plate 26 of the line storage 3. Energy lines 4 are arranged inside the carrier 6. This

embodiment essentially corresponds to that of Figures 5 and 6.

Figure 7b schematically shows an embodiment of the carrier 6, in which the carrier 6 is designed in the form of a sheath 21 of the energy line 4. A guide of the carrier 6 is designed analogously to the embodiment of Figure 7b with axially protruding protrusions 24 and a guide track 27.

Figure 7c schematically shows an embodiment of the carrier 6 in which the guide means of the carrier 6 is formed as a guide track 28, here in the form of a groove, in at least part of the carrier 6, and the guide arches and guide sections are formed in the form of an arrangement of protrusions 29 protruding from the carrier plate 6. When the carrier 6 is formed as a chain with chain links, the guide track 28 can be formed in the form of guide tracks arranged in a row in individual chain links. The arrangement of protrusions 29 protruding from the carrier plate 6 can be fashioned after the course of the guide track 27 formed by the guide tracks 9, 11, 13, 15, 17, 19 and guide arches 10, 12, 14, 16, 18 of the embodiment of Figures 5 and 6. An embodiment of the carrier 6 in the form of a sheath 21 of the energy line 4 analogous to the schematic illustration of figure 7b is also conceivable.

Figure 8 shows an embodiment of the energy storage 1 analogous to the embodiment of Figure 5, in which, in contrast to the embodiment of Figure 5, a rotary joint 34 is provided in the winding center 5. The torsion of the unguided section 32, described as for the embodiment of figure 5, resulting from wound and unwound of the guided section 33 of the carrier 6, can here be allowed or prevented by connecting the second end 31 of the carrier 6 to the rotary joint 34.

Since here, when the carrier 6 is removed from the line storage 3, there is no spiral winding of the unguided section 32 around the winding center 5, the longitudinal extent of the unguided section 32 can be formed to be shorter. The transverse extent of the line storage 3 can also be shorter.

Figure 9 shows an embodiment of the energy storage 1 analogous to the embodiment of Figure 5. Here, a non-rotary joint 37 is also provided in the winding center 5, though in contrast to the embodiment of Figure 5, the unwound section 32 of the carrier 6 can be wound and unwound in reverse layers about the winding center 5 when the guided section 33 of the carrier 6 is wound

and unwound. As the carrier 6 progressively unwinds from the line storage 3, or at the beginning of winding the carrier 6 in the line storage 3, an essentially spiral winding of the unguided section 32 about the winding center 5 can take place.

Figure 10a shows an embodiment of an energy storage 1 in which the position of the winding center 5 in the line storage unit 3 can be adjusted. The adjustable range is shown by a dashed line. In Figure 10a, the winding center 5 is arranged in the line storage 3 so as to be linearly movable in the direction of the guide sections 9, 11, 13, 15, 17, 19.

Figure 10b shows an embodiment of an energy storage 1 in which the position of the winding center 5 in the line storage unit 3 can be adjusted. The adjustable range is again illustrated by a dashed line. In Figure 10b, the winding center 5 is arranged in the line storage 3 so as to be linearly movable transversely to the guide sections 9, 11, 13, 15, 17, 19.

By an adjustability of the position of the winding center 5 in the line storage 3, it can be possible to reduce the length of the unguided section 33 of the carrier 6.

Figures 11a and 11b show a drive 38 acting on the carrier 6 for winding and unwinding the at least one carrier 6. The drive 38 has a gear wheel 39 which engages in the guide means 8 in the form of the protrusions 24 of the section 33 of the carrier 6 guided in the line storage 3. In this embodiment, the drive 38 acting on the carrier 6 with the gear wheel 39 is arranged adjacent to the opening 7 at the beginning of the guide track 27. An arrangement at another position of the guide track is also conceivable.

Figures 12a to 12c show a hoist 2 with an energy supply system 1.

The energy supply system 1 is attached with the housing 20 to an inner outrigger 36, for instance an arm of a telescopic arm system, of the hoist 2. A tool supplied by the energy supply system 1, not shown here, can be arranged on the outer outrigger 40 which is movable to it, for instance at the end of a telescopic outrigger of a telescopic arm system. The carrier 6 can thereby be connected with its first end 30 to the tool or the outer outrigger 40.

The energy supply system 1 can allow relative movement of the outrigger 40, and thus of the tool, towards the line storage 3. The tool can remain connected to the carrier 6 and the energy line 4 during the movement, and the length of the section of the carrier 6 and the energy line 4, taken from the line storage 3, can be adapted to the relative movement between the tool and the line storage 3.

List of Reference Signs

1	energy supply system
2	hoist
2	line storage
4	energy line
5	winding center
6	carrier
7	opening
8	guide means
9	first guide section
10	first guide arch
11	second guide section
12	second guide arch
13	third guide section
14	third guide arch
15	fourth guide section
16	fourth guide arch
17	fifth guide section
18	fifth guide arch
19	sixth guide section
20	housing
21	cover
22	chain
23	chain link
24	projection guide means
25	roller
26	carrier plate
27	guide track carrier plate
28	guide track cover
29	projection carrier plate

- 30 first end carrier
- 31 second end carrier
- 32 section with guide means
- 33 section without guide means
- 34 rotary joint
- 35 hoist
- 36 outrigger
- 37 non-rotary joint
- 38 drive
- 39 gear wheel
- 40 outrigger
- 41 first guide means

Claims

1. An energy supply system (1), in particular for a tool which can be attached or is attached to a hoist (2), having a line storage (3) for winding and unwinding at least one energy line (4) around a winding center (5) of the line storage device (3), wherein at least one carrier (6) is provided for the at least one energy line (4), and the line storage (3) has an opening (7) for the inlet and outlet of the carrier (6) and the energy line (4), characterized in that

the at least one carrier (6) can be guided through the opening (7) for guiding the carrier (6) and the energy line (4) in sections in the line storage (3) by guide means (8) via a first guide section (9) through a first guide arch (10), and via a second guide section (11), which is adjoining the first guide arch (10), through a second guide arch (12), and via a third guide section (13), which is adjoining the second guide arch (12), and lies further inwards, compared with the first guide section (9), relative to the winding center (5) - and possibly further guide arches and guide sections - to the winding center (5) of the line storage (3).
2. The energy supply system according to claim 1, wherein the carrier is designed in the form of at least one sheath (21) of the energy line (4), or in the form of at least one chain (22) with chain links (23) connected to each other in a jointed manner.
3. The energy supply system according to one of the preceding claims, wherein
 - the guide means (8) of the carrier (6) are designed as axial protrusions (24) protruding from at least part of the carrier (6), preferably with rollers (25) arranged thereon, and the line storage (3) has at least one planar carrier plate (26), and the guide arches and guide sections are designed in the form of a guide track (27), preferably in the form of a groove, in the carrier plate (26), or
 - the guide means (8) of the carrier (6) are designed as guide track (28) in the form of guide tracks, preferably in the form of grooves, in at least part of the carrier 6, and the guide arches and guide sections are designed in the form of an arrangement of protrusions (29) protruding from the carrier plate, preferably with rollers arranged thereon.

4. The energy supply system according to one of the preceding claims, wherein
 - the carrier (6) has an outer, first end (30) and an inner, second end (31), and
 - the carrier (6) has a section (32) with guide means (8) and a section (33) without guide means, wherein the section (33) without guide means extends from the second end (31) to the section (32) with guide means, and
 - the carrier (6) is connected to the winding center (5) at the second end (31) of the carrier (6), and the section (33) without guide means is unguided in the line storage (3).
5. The energy supply system according to the preceding claim, wherein the unguided section (33) of the carrier (6) can be wound essentially spirally around the winding center (5), and the winding radius of the unguided section (33) of the carrier (6) increases or decreases as the guided part of the section (33) of the carrier (6) is wound or unwound.
6. The energy supply system according to claim 4, wherein a rotary joint (34) is provided for the energy line (4) in the winding center (5).
7. The energy supply system according to claim 4 or 5, wherein the unguided section (33) of the carrier (6) can be wound and unwound in reverse layers about the winding center (5) as the guided part of the section (31) of the carrier (6) is wound and unwound.
8. The energy supply system according to one of the preceding claims, wherein the distance of the guide arches (10, 12, 14, 16, 18) from each other is essentially invariable.
9. The energy supply system according to one of the preceding claims, wherein
 - the guide arches (10, 12, 14, 16, 18) essentially have a winding angle of 180 degrees, and/or
 - the guide arches (10, 12, 14, 16, 18) have the same and/or different radii of curvature, wherein the guide arches (10, 12, 14, 16, 18) with different radii of curvature have a decreasing radius of curvature from the opening (7) of the line storage (3) towards the winding center (5), and/or

- the respective radius of curvature of a guide arch (10, 12, 14, 16, 18) is constant.
10. The energy supply system according to one of the preceding claims, wherein the respective guide sections (9, 11, 13, 15, 17, 19) have an essentially straight course and/or essentially the same longitudinal extent.
 11. The energy supply system according to one of the preceding claims, wherein the line storage (3) has essentially an elongated shape with a greater longitudinal extent than transverse extent, and the guide sections (9, 11, 13, 15, 17, 19) run essentially along the longitudinal extent of the line storage (3).
 12. The energy supply system according to one of the preceding claims, wherein winding and unwinding of the at least one carrier (6) is essentially in one plane.
 13. The energy supply system according to one of the preceding claims, wherein the inlet and outlet of the at least one carrier (6) takes place through the opening (7) at a fixed position of the line storage (3).
 14. The energy supply system according to one of the preceding claims, wherein the at least one carrier (6) has an essentially constant transverse extent.
 15. The energy supply system according to one of the preceding claims, wherein the guide arches (10, 12, 14, 16, 18) and guide sections (9, 11, 13, 15, 17, 19) have an essentially spiral course from the opening (7) towards the winding center (5), and the at least one carrier (6) can be wound and unwound in sections essentially spirally in the line storage (3) towards the winding center (5).
 16. The energy supply system according to one of the preceding claims, wherein the position of the winding center (5) in the line storage (3) is designed to be adjustable, wherein preferably the winding center (5) in the line storage (3) is arranged to be linearly movable, in particular preferably, linearly movable in the direction of and/or transverse to the guide

sections (9, 11, 13, 15, 17, 19).

17. A hoist (35), in particular a crane, comprising an energy supply system (1) according to one of the preceding claims.

18. The hoist (35) according to the preceding claim, wherein the energy supply system (1) is attached to an outrigger (36) of the hoist (35).