

Separator, transverse web and compartment bottom for energy guiding chains

The invention relates generally to the field of energy guiding chains for the protected, dynamic guiding of lines such as cables, hoses and the like. Energy guiding chains are typically constructed from pivotally connected chain links which have two side plates spaced apart in a transverse direction. In at least some of the chain links, these are stably connected to each other by two transverse webs and define an inner receiving space or guide channel for the lines.

The invention relates specifically to a so-called separator for the internal division of an energy guiding chain. Such separators and so-called compartment bottoms serve to form a shelf-like internal division in the receiving space of the chain links. In this way, the inserted lines are guided in an orderly manner from chain link to chain link in a longitudinal direction of the energy guiding chain, and this order is maintained during displacement. This reduces wear caused by mutual friction between the guided lines. The separators are used for vertical separation and can be used without compartment bottoms. The compartment bottoms (also called compartment shelves) are optionally used for horizontal division. Separators are held on transverse webs.

The invention also relates to a transverse web for connecting side plates, which is specially further developed for mounting and holding separators. Separators in turn hold the compartment shelves or compartment bottoms. Furthermore, the invention also relates to such a compartment shelf or compartment bottom for internal partitioning.

Separators for holding compartment bottoms are usually plate-like in design and have at least one, but usually several, through-openings (passage openings) for one compartment bottom each. Separators can be functionally divided into the following sections: Top portion, bottom portion, first side bar, and second side bar, wherein the side bars delimit the through-openings in the direction of the separator width and wherein the top portion and the bottom portion are each designed to be connected to the transverse webs. This connection is intended to ensure at least stable holding against lateral tilting during operation, but can also mean a fastening of the separator to the transverse web which can only be released with particular force.

To equip chain links with compartment bottoms, these must be inserted into the through-openings of the separators. In the case of simply constructed separators, the compartment bottoms must be inserted in their longitudinal direction through the through-openings of the separators for this purpose. Subsequent modification of the internal partitioning and/or line replacement from the lower partition compartments is thus usually only possible with considerable effort.

Separators are already known which can be easily and quickly fitted with compartment bottoms or reconfigured. The closest prior art is considered here to be a separator according to the disclosure document DE 198 10 960 A1. Here, each separator has a first side bar which can be detached and/or swung open. Thus, a lateral access to the through-openings is released, for inserting or removing a compartment bottom perpendicular to its longitudinal extension. The top portion of the separator according to DE 198 10 960 A1 has a recess between its broad sides, which partially accommodates the upper end of the hinged side bar to counteract unwanted unfolding during operation. However, this design weakens the connection to the top portion of the separator. However, unintentional unfolding of the separator must also be prevented during operation if the assembled separator or the compartment bottoms attached thereto are subjected to unusual forces in the longitudinal direction of the chain during operation, e.g. due to friction with a line not laid on the neutral fiber, especially at the top end section of the separator. This can occur, for example, with heavy lines or in vertical applications and can lead to the compartment bottom or the line exerting a sufficient force on the separator in the unfolding direction to open its side bar. However, the loosening of individual parts during operation of an energy guiding chain should always be avoided.

Separators, which can be detached in several parts and in some cases swung open, have already been proposed, for example, in DE 195 47 215 A1, in DE 198 52 133 A1 or in DE 10 2017 117 089 A1.

According to a first aspect of the present invention, it is therefore an object to propose a separator which allows a particularly simple and quick assembly of the compartment bottoms and yet ensures a stable hold of the compartment bottoms.

This is already achieved in a generic separator according to the preamble from claim 1 in that both the top portion and the bottom portion each have a holding clamp for cooperating with the narrow sides of the transverse web, so that the

separator is held securely on the transverse web at least in the longitudinal direction of the energy guiding chain or in the direction of the separator width. In this case, the top portion is captively connected in particular to the first side bar, in particular manufactured integrally therewith, and can be detached and/or swung open together with the latter. The cooperation with the narrow sides of the transverse web can be achieved, for example, by a retaining engagement of the opposite narrow sides of a transverse web and/or by fastening, for example by latching.

Due to the holding clamps on both sides, the separator is reliably held between the transverse webs, and at the same time the holding clamp on the top portion prevents unwanted unfolding during operation. Both holding clamps secure or lock the separator between the transverse webs in both directions perpendicular to the longitudinal extension of the transverse webs. Thanks to the holding clamp on the top portion, the detachable and/or pivotable side bar can only be opened when the transverse web is removed from the top portion, i.e. at least this transverse web is preferably designed as an opening transverse web.

The top portion with the first side bar can be pivoted relative to the bottom portion and the second side bar to facilitate compartment bottom assembly. An optional attachment of the holding clamp can secure the separator along the longitudinal direction of the transverse web as well as firmly attach it across the longitudinal direction of the transverse web. A merely retaining holding clamp can, for example, be held by the narrow sides in such a way that the separator is held captive only in the transverse direction of the transverse web or in the longitudinal direction of the chain. Optionally, the separator can be held on the transverse webs so that it can be displaced in the longitudinal direction of the transverse web or in the transverse direction of the chain link to make it easier to change the internal separation. However, the bottom portion of a separator is usually fastened to a transverse web, e.g. positively or non-positively engaged, so that it does not come loose when a transverse web is opened.

The term "retaining engagement" therefore refers to a connection between the holding clamp of the separator and the transverse web which prevents the separator from moving or coming loose in the width direction of the transverse web or transversely to the latter.

Direct contact between the holding clamp and the transverse web is not required for retaining engagement. The top portion of a separator can, for example, engage in a retaining manner a detachable transverse web (so-called opening transverse web) to facilitate opening of the chain link.

Preferably, the top portion and/or the first side bar can be connected by positive locking to the bottom portion, a central region of the separator and/or the second side bar. This allows quick assembly of the optionally multi-part separator in the assembled state, in which the top portion, bottom portion and both side bars surround a central region of the separator.

In a preferred embodiment, the top portion and/or the first side bar may be latchable to the second side bar when the separator is assembled to counteract unintentional disengagement of the second side bar from the top portion during operation. The latching can preferably be implemented by means of a latching notch at an end of the second side bar on the top portion side and a latching lug on the top portion, which is designed to engage in the latching notch.

The top portion preferably has a planar recess between its broad sides. A top-portion-side end of the central region in turn preferably has a projection extending in a height direction of the separator for engagement in the recess, wherein in the assembled state of the separator the projection is received in the recess, similar to a tongue-and-groove connection, in order to stabilize the separator transversely to the height direction.

In a preferred embodiment, the first side bar is made in one piece and in particular flexurally rigid with the top portion. An integral design of the pivotable part of the separator facilitates handling.

Preferably, the first side bar can be connected or is connected to the bottom portion by a hinge-like joint connection, in particular by a pivot joint. The bearing receptacle of the joint is preferably formed on the bottom portion. The joint part that fits into the bearing receptacle, such as a pivot pin, can then be formed on the first side bar. However, the first side bar can also be non-detachably connected to the bottom portion, e.g. by a film hinge, and thus possibly also be formed integrally with the bottom portion.

The pivot axis of the joint connection preferably extends perpendicularly to the

width direction and height direction of the separator, so that the first side bar can be pivoted open with the top portion laterally in the main plane of the separator.

Alternatively or additionally, the first side bar can be detachably connected to the bottom portion by a plug-in connection. In this case, the first side bar can be inserted into and removed from a plug-in receptacle in the bottom portion along the height direction of the separator together with the top portion. An end of the first side bar on the bottom portion side can be manufactured as a kind of bending joint, made from a flexible material, in particular in one piece with the rest of the first side bar. In this case, the first side bar may, for example, have only limited pivotability relative to the bottom portion when it is inserted in the plug-in receptacle.

The central region of the separator with the through-openings may preferably have projections in the form of tongues extending in the direction of the separator width, which cooperate with corresponding pockets of the first side bar. Accordingly, the latter may have pockets for receiving the tongues, wherein the tongues act in the assembled state of the separator in the manner of a tongue-and-groove connection to stabilize the separator, in particular the first side bar, in the direction transverse to the direction of the separator width. Conversely, it is also possible that the tongues are formed on the first side bar and the corresponding pockets in the central region.

Each through-opening of the separator can have a latching cam on one side for latching into a compartment bottom. This allows the position of the compartment bottom received in the through-opening to be fixed with regard to its longitudinal direction.

According to a further aspect independent of the foregoing, the invention further relates to the further development of a transverse web for a chain link of an energy guiding chain. Transverse webs typically serve to connect two mutually spaced-apart side plates of the chain link.

A generic transverse web is of elongated design and can be connected to one of the side plates at each of its longitudinal ends in order to define a space for lines. The transverse web can be designed as an opening transverse web, the connection of which to one or to both side plates can be easily released, for example without tools. An opening transverse web can be held pivotably on one or both side plates.

The transverse web has two narrow sides extending in the longitudinal direction of the transverse web or between the longitudinal ends of the transverse web, which generically have a holding device for holding separators, in particular at least in such a way that, when the chain link is closed, the bottom portion or top portion of a separator cannot be displaced or separated in the longitudinal direction of the energy guiding chain.

Transverse webs are known whose narrow sides each have a groove extending in the longitudinal direction for latching a separator onto the transverse web. A bottom portion, for example, can be forcefully latched onto this. A type of tothing on the transverse web has also been proposed, e.g. in DE 10 2009 030 798 A1.

An object according to the second aspect of the invention is to simplify the attachment of separators to the transverse webs or the opening of a transverse web designed as an opening link.

According to the invention, the holding device is designed on each narrow side as a row of teeth directly accessible on each narrow side for a positive connection with complementary separators. Individual teeth of the row of teeth project in the width direction, perpendicular to the length of the transverse web. In particular, each tooth can have a dimension in the height direction of the transverse web that is larger than its dimension in the longitudinal direction of the transverse web. The teeth of the tooth row form the outer edge of the respective narrow side, so that the respective narrow side has a toothed outer contour. This makes it possible to attach and detach separators in the manner of a simple plug-in connection particularly easily and quickly perpendicular to the longitudinal direction of the transverse web, optionally also with only a small amount of force, e.g. with only lateral holding.

Each tooth preferably has a dimension in the height direction of the transverse web or in the thickness direction of the transverse web that is larger than a dimension of the tooth in the width direction of the transverse web. This increases the stability of the teeth and the holder in the longitudinal direction.

The dimension of each tooth in the height direction of the transverse web can preferably be at least 3 mm, particularly preferably at least 6 mm. This allows stable holding of a separator on the transverse web, since an overlap area of the holding device of the separator with the teeth is sufficiently large.

The teeth and their gaps can be distributed alternately and evenly along at least a major part of the longitudinal extension of the narrow sides. This allows flexible partitioning of the receiving space of the chain link, since the separator can be used in different positions in the transverse direction of the chain link. The teeth and tooth spaces may each have a rounded profile or contour in plan view along the height direction of the transverse web. This can reduce wear of the teeth and or the guided lines.

Furthermore, according to the second aspect, the invention relates to a separator for a chain link of an energy guiding chain that matches the proposed transverse web. A typical separator is formed with a flat plate-like body, including a top portion and a bottom portion, respectively, for holding and/or attaching to the transverse webs.

According to the second aspect, the top portion and/or the bottom portion each comprises a holding clamp for engaging a corresponding row of teeth of a transverse web or a row of teeth on the respective narrow side of the transverse web, according to one of the embodiments described above regarding the second aspect.

In this case, the respective holding clamp has two opposing retaining extensions, each of which has at least one tooth projection at the end for positive engagement in the row of teeth of the transverse web, so that simple, smooth attachment of the separator to the transverse web is made possible essentially parallel to the height direction of the separator. The tooth projections of the two opposing retaining extensions can face each other and each project from the respective retaining extension in the direction of the opposing tooth projection.

The tooth projection can have an extension in the direction of the opposite tooth projection corresponding to the depth of the tooth gap. An extension of the tooth projection in the height direction of the separator is preferably at least 3 mm. This permits robust attachment of the separator.

The separator further comprises a central portion between the top and bottom portions. In a preferred embodiment, both are designed to be relatively narrow, i.e. in particular the holding clamp protrudes laterally only slightly, since latching is not provided according to the second aspect. In this regard, the holding clamp may be dimensioned such that it protrudes perpendicularly to the main plane of the

separator on each side by no more than 150%, preferably no more than 100%, of the material thickness in the central portion of the separator. A narrow design of the separator in the area of the holding clamp leaves more space for the installation and maintenance of the guided lines.

In one embodiment, each of the retaining extensions has two tooth projections for positive engagement in two successive tooth spaces of the transverse web. Preferably, the end region of the retaining extensions is U-shaped in cross-section.

The invention further relates, according to a third independent aspect, also to a compartment bottom for a chain link of an energy guiding chain, wherein the chain link comprises two side plates spaced apart from each other and interconnected by two transverse webs and at least one separator arranged between the transverse webs and having at least one through-opening. The through-opening may have a latching cam on one side for latching the compartment bottom. The compartment bottom is plate-like and elongated in shape and matches the outline of the through-opening in cross-section. The compartment bottom has, on a long narrow side, a toothing for cooperating with the latching cam of the through-opening in order to secure the compartment bottom against displacement in the longitudinal direction of the compartment bottom.

The compartment bottom according to the invention is characterized in that on the opposite other long narrow side it has a recess, in particular a groove, which is continuously toothless in the longitudinal direction and in which the latching cam can be accommodated in a longitudinally displaceable manner, so that the compartment bottom can be inserted by a 180° rotation either in a longitudinally displaceable manner or with a latching effect with respect to the longitudinal direction of the compartment bottom. In particular, the groove is designed to be planar on the inside, i.e. all inner walls of the groove have a planar surface without teeth or other projections.

According to a fourth independent aspect, the invention also relates to a further development of known transverse webs to the effect that they hold the guided lines more gently in the receiving space. Generic transverse webs are intended for chain links of energy guiding chains, which have two side plates spaced apart from each other. In this case, the transverse web has an elongated main body made of plastic and a fastening area at each of its longitudinal ends for fastening to one of the side

plates in order to define the receiving space for lines. According to the fourth independent aspect of the invention, it is proposed that on the inner side of the main body, which is intended to face the receiving space, a line-protecting layer of a second plastic is provided, which is selected to be different from the plastic of the main body at least with respect to the composition, but in particular with respect to the base material, e.g. the selected base polymer. This second plastic may, for example, be a different thermoplastic and be based on a different polymer than the first plastic of the transverse web. While the main body may be made of typical polyamide, which may be reinforced or have additives, the additional line-protecting layer may be made of a polyethylene or a polypropylene or the like. In particular, the second plastic can have a different hardness and/or stiffness than the first plastic, so that an abrasion-reducing effect is achieved to protect the guided lines. Optionally, it may be more soft-elastic or, preferably, harder than the first plastic. In addition, the line-protecting layer can form an edge protector which covers and defuses interfering edges of the main body.

Such a transverse web can be produced, for example, using suitable two-component (2K) injection molding technology, or, for example, by subsequently extrusion-coating the second plastic onto a separately produced main body.

For the most complete possible protection of the lines, one exemplary embodiment provides for the line-protecting layer to extend continuously in the longitudinal direction between the longitudinal ends or fastening areas and in the width direction from one narrow side to the other narrow side, thus covering the inside of the main body essentially completely. The material thickness of the additional line-protecting layer can be significantly less than that of the main body, which forms the actual structural component.

The invention also relates to a chain link for an energy guiding chain, comprising two side plates which are connected to one another by transverse webs and can be pivotably connected to side plates of further chain links in a longitudinal direction, wherein the chain link comprises at least one separator according to one of the embodiments described above and/or at least one transverse web according to one of the embodiments described above and/or a compartment bottom of one of the embodiments described above.

The invention also relates to an energy guiding chain for dynamically guiding lines,

such as cables and/or hoses, comprising at least one such chain link.

Further details, features and advantages of the invention can be found in the following, more detailed description of preferred exemplary embodiments based on the accompanying figures. These show purely by way of example:

FIG. 1: shows a cross-section of a chain link of a purely exemplary energy guiding chain equipped with lines and an internal separation;

FIGS. 2A-2B: show an exemplary embodiment of a separator according to the invention in a side view (FIG. 2A) of the assembled state, and in a longitudinal section parallel to the main plane of the separator (FIG. 2B);

FIGS. 3A-3B: show a partial view of a chain link according to an exemplary embodiment of the invention in perspective (FIG. 3A) and in cross-section through the main plane of the compartment bottom (FIG. 3B);

FIG. 4: shows another exemplary embodiment of a separator and transverse web according to the invention in partial view from below;

FIG. 5: shows a further exemplary embodiment of a separator according to the invention in a side view; and

FIG. 6: shows another exemplary embodiment of a transverse web or opening transverse web according to the invention in front view of a narrow side.

FIG. 1 illustrates, in cross-section perpendicular to the longitudinal direction of an energy guiding chain 1 through a chain link 10, an exemplary internal structure of the energy guiding chain 1 for actively guiding lines, such as cables 17 and hoses 16. The energy guiding chain 1 is composed of a plurality of chain links 10 pivotably connected to one another in the direction perpendicular to the plane of FIG. 1. The chain links 10 in this case also consist of individual parts and have at least two side plates 11. The chain links 10 also consist here of individual parts and have at least two side plates 11. In the case of each or, for example, every second chain link 10, the side plates 11 are firmly connected by two parallel, identical transverse webs 12

to form a stable framework and are kept at a distance in the transverse direction of the energy guiding chain 1 and parallel. For this purpose, the transverse webs 12 are detachably fastened to the side plates 11 by means of end-side fastening areas, for example by means of clamping receptacles on horns (not shown) of the side plates 11. The side plates 11 and transverse webs 12 delimit a receiving space 14 for the lines 16, 17. The structure of an energy guiding chain 1 is known and can be arbitrary, e.g. with cranked side plates or alternating inner and outer bars as side plates 11. In particular, two-piece chain links are also possible, in which the two side plates 11 and one transverse web 12 are manufactured from one piece, i.e. in one piece, and only the other transverse web 12 is detachable (not shown).

For internal partitioning, it is known, as shown by way of example in FIG. 1, to provide horizontal compartment bottoms 18 for dividing the height H of the receiving space 14 and vertical separators 20 for dividing the width B of the receiving space 14. The separators 20 have two end regions in the direction of the height H, a top portion 22 and a bottom portion 24, and can be fastened at least at one of the end regions, for example at the bottom portion 24, to the narrow sides 23 of the transverse webs 12 at a selectable position in the direction of the width B of the receiving space 14 or in the direction of the length of the transverse web 12, for example by a latching connection. In any case, the transverse webs 12 are secured in the longitudinal direction of the energy guiding chain 1 or in the direction of the width of the transverse web. The compartment bottoms 18 are each provided in horizontally continuous through-openings 32 (as can be seen in FIGS. 2A-2B), which are provided on the separators 20 in accordance with a predetermined grid and are to be mounted in selectable steps of height H. FIG. 1 here shows insertable shelves as compartment bottoms 18 which are almost completely continuous over the width B. Shorter shelves which divide only part of the width B are also possible. The separators 20 are of plate-like or flat design and extend with their main plane or longitudinal direction parallel to the side plates 11. The compartment bottoms 18 are also of plate-like design and extend parallel to the transverse webs 12. For each chain link 10 with transverse webs 12, a similar internal division of the receiving space 14 should be made for the benefit of the lines 16, 17. Separators 20 and compartment bottoms 18 should thus be provided at regular intervals and in identical arrangement on every n^{th} chain link 10, in order to divide the receiving space 14 into constant compartments 19 for the orderly and better protected guidance of the cables 16, 17. FIGS. 2A,B show an exemplary embodiment of a separator 20 according to the first aspect of the invention in side view in the

assembled state of the separator 20 (FIG. 2A), and in longitudinal section of the assembled state (FIG. 2B). The separator 20 has a top portion 22 and a bottom portion 24 each for connecting to a transverse web. The separator 20 further comprises a first and a second side bar 26, 28, and a central region 30 bounded by the top portion 22, the bottom portion 24, the first side bar 26, and the second side bar 28. The separator 20 has a plurality of through-openings 32 in its central region 30, in this case, for example, three through-openings 32 for accommodating compartment bottoms 18. In FIG. 2B, for example, an accommodated compartment bottom 18 is shown.

In FIGS. 2A-2B, the first side bar 26 is manufactured in one piece with the top portion 22. The second side bar 28 is manufactured, e.g. also as an injection molded part, in one piece with the bottom portion 24 and the central region 30. The first side bar 26 is connected to the bottom portion 24 by a hinge-like articulated connection, which is formed as a pivot joint 40. For this purpose, the bottom portion 24 has a bearing receptacle of the pivot joint 40, and the bottom-portion-side end of the first side bar 26 comprises the matching pivot pin. The separator 20 is assembled from, in this example, two separately manufactured components (top portion 22 with the first side bar 26 on the one hand and bottom portion 24 with the second side bar 28 and the central region 30 on the other hand) by inserting the pivot bolt into the bearing receptacle, for example in the manner of a latching connection. In FIGS. 2A-2B, the first side bar 26 is pivotally mounted to the bottom portion 24 together with the top portion 22. Here, the pivot axis of the pivot joint 40 extends perpendicularly to the main plane of the separator 20 (plane shown in FIG. 2B).

Each through-opening 32 has an elongated oval outline, with main axis in the direction of the separator width, matching the cross-section of the compartment bottoms 18. For simplified mounting of a compartment bottom 18 transversely to its longitudinal direction or in the longitudinal direction of the chain, each through-opening 32 has its own respective insertion opening 33 opening into it, which can be closed by the pivotable first side plate 24 (as shown in FIGS. 2A-2B).

The separator 20 can thus be opened or unfolded by pivoting the first side bar 26 together with the top portion 22 in the main plane. The separator 20 is thereby unfolded along the parting line 36. The parting line 36 extends here at the upper edge of the central region 30 perpendicular to the height direction of the separator

20, starting from the second side bar 28 and then perpendicularly towards the bottom portion 24, and thereby laterally through the end regions of the through-openings 32. In the unfolded state of the separator 20, the through-openings 32 are thus accessible through the associated insertion openings 33, i.e. one can easily mount and dismount the compartment bottoms 18 through the insertion openings 33.

The separator 20 is secured and/or latched in the closed state by positive locking. For this purpose, the top portion 22 has, among other things, a latching lug 222 and the second side bar 28 has, at its top portion end, a latching notch 282 that matches the latching lug 222, wherein the latching lug 222 is configured to engage the latching notch 282. Thus, the top portion 22 and the second side bar 28 can latch into each other. The separator 20 includes a number of other form-fitting means with which it is reinforced when assembled. For example, a top-portion-side end of the central region 30 has a thin projection 302 extending in a height direction of the separator 20, with a smaller material thickness than the body of the central region 30. The top portion 22 forms a recess 224 between its broad sides, and the projection 302 is accommodated in the recess 224 when the separator 20 is assembled and stabilizes the two-part separator 20 transversely of its main plane in the manner of a tongue-and-groove joint.

The central region 30 further includes similarly thin tongues 304 extending in the direction of the separator width. The first side bar 26 has matching pockets 262 for receiving the tongues 304, and when the tongues 304 are accommodated therein in the assembled state of the separator 20, this further stabilizes the separator 20.

Furthermore, each through-opening 32 comprises a latching cam 38 for latching a compartment bottom 18 (according to the third aspect). The latching cam 38 is formed as a projection on the major axis of the through-opening 32 relative to the insertion opening 33.

In the illustrated exemplary embodiment, the top and bottom portions 22, 24 are identically configured for attachment to the transverse webs 12. They each have a holding clamp 34 that engages the narrow sides 23 of the transverse web 12 so that the separator 20 is secured in the longitudinal direction of the transverse web 12.

FIGS. 3A-3B show, particularly according to the second aspect, another exemplary

embodiment of the separator 320 comprising a top portion 322, a bottom portion 324 and a central portion 360 between the top and bottom portions 322, 324. Here, the holding clamps 334 on the top and bottom portions 322, 324 are configured identically to each other. As FIG. 3A shows, the separator 320 is inserted between two identical transverse webs 312, with the holding clamps 334 holding on the narrow sides 323 of the transverse webs.

Each transverse web 312 is elongated and plate-like in design and has a tooth strip or strip-like row of teeth 340 on each of its two longer narrow sides 323, which are designed to form a positive connection with the separators 320 which are designed in a complementary manner.

As best seen in FIG.4, the outer contour of each of the narrow sides 323 forms a row of teeth 340 with teeth 341 projecting outwardly in the widthwise direction of the transverse web 312 and spaced apart by tooth gaps 342. A plurality of identically shaped teeth 341 and tooth gaps 342 are provided alternately and uniformly distributed along a major portion of the longitudinal extension of the narrow sides 323. The teeth 341 and tooth gaps 342 each have a rounded profile on the face side. Each tooth 341 has a dimension in the height direction of the transverse web 312 that is greater than its dimension in the longitudinal direction of the transverse web 312, and is, for example, 7 mm. This dimension of the tooth 341 in the height direction of the transverse web 312 is also larger than the dimension of the tooth in the width direction of the transverse web 312. Thus, a smooth-running and at the same time tilt-resistant plug-in connection is achieved.

The holding clamp 334 has two opposing retaining extensions 350 in the direction of the separator width, which are designed to be complementary to the rows of teeth 340 for retention on the narrow sides 323 of a transverse web 312. The distance between the retaining extensions 350 of a holding clamp 334 corresponds to the width of the transverse web 312. In the illustrated exemplary embodiment, the retaining extensions 350 each have a pair of tooth projections 351. The tooth projections 351 are designed for positive insertion into the tooth strip or row of teeth 340, in this case into two successive tooth gaps 342 in each case. The end region of the retaining extension 350 is here, for example, U-shaped in cross-section.

The dimension of the tooth projections 351 in the direction of the separator width

corresponds to the depth of the tooth gaps 342. The dimension of the tooth projections 351 in the height direction of the separator 320 is, for example, approximately 5 mm in the illustrated exemplary embodiment.

The top portion 322 and the bottom portion 324, in particular their holding clamp 334, can be designed in a very narrow manner thanks to the proposed plug-in connection and protrude, for example, perpendicularly to the main plane of the separator 320, i.e. in the direction of the separator thickness, on each side by only about 25% of the material thickness in the central portion 360 of the separator 320.

FIGS. 3A-3B further show a compartment bottom 318, which is of plate-like design and formed in cross-section to match the through-opening 32. On one of its long narrow sides 317, the compartment bottom 318 has a toothing 327 for cooperating with the latching cam 38 of the through-opening 32. On the opposite long narrow side 319, a recess free of toothing throughout in the longitudinal direction is provided, for example, a groove 329 with the same cross-section throughout. Depending on the orientation of the compartment bottom, the latching cam 38 of the separator 320 may be received in the groove 329 in a longitudinally displaceable manner or may be locked by means of the toothing 327 (as shown in FIG. 3B). Thus, the compartment bottom 318 may optionally be inserted into the through-opening 32 in the reverse orientation so that the latching cam 38 does not provide a locking action due to the groove 329 passing therethrough. In this case, the compartment bottom 318 can be moved perpendicularly to the main plane of the separator 320.

FIG. 5 shows a separator 520 according to another exemplary embodiment, without through-openings for compartment bottoms. The separator 520 has a holding clamp 534 at each of its top and bottom portions 522, 524 for retaining on a transverse web 312 by means of retaining extensions 550. The retaining extensions 550 each have tooth projections 551 at the ends for positive engagement in a row of teeth 340. The separator 520 can be placed vertically on a suitable transverse web, for example according to FIGS. 3A, 3B, and 4, and released therefrom without tools and in a time-saving manner. The design of the tooth projections 551 corresponds to FIG. 4.

FIG. 6 shows, in side view of the narrow sides, a further development of the

transverse web 612 of FIGS. 3A-3B which also has the two tooth strips for a separator 320. In the case of the transverse web 612, the elongated main body 625, like the transverse web 312, is made of a first plastic material, e.g. a reinforced polyamide, to provide robust fastening regions 661A, 661B at each of its longitudinal ends, by means of which the transverse web 612 is connected to the side plates 11. However, at the inner side 662 of the main body 625 shown in FIG. 6 above, which is intended to face the receiving space 14 (cf. FIG. 1), the transverse web 612 comprises a line-protecting layer 665 made of a second plastic material different from the plastic material of the main body 625 and specifically selected to protect the lines. The transverse web 612 may be manufactured, for example, as a 2K injection-molded part. The line-protecting layer 665 covers the entire surface of the main body 625 in the longitudinal direction between the longitudinal ends and in the width direction from one narrow side 623 to the other narrow side, so that only the toothing on the end face projects outwardly (FIGS. 3A-3B).

Separator, transverse web and compartment bottom for energy guiding chains

List of reference signs

FIG.1:

- 1 Energy guiding chain
- 2 Chain link
- 11 Side plate
- 12 Transverse web
- 14 Receiving space
- 16 Hoses
- 17 Cables
- 18 Compartment bottom
- 19 Compartments of the receiving space
- 20 Separator
- 22 Top portion of the separator
- 23 Narrow side of the transverse web
- 24 Bottom portion of the separator
- H Height of the receiving space
- B Width of the receiving space

FIGS. 2A, B:

- 20 Separator
- 22 Top portion
- 222 Latching lug
- 224 Recess
- 24 Bottom portion
- 26 First side bar
- 262 Pockets
- 28 Second side bar
- 282 Latching notch
- 30 Central region
- 302 Projection

- 304 Tongues
- 32 Through-opening
- 33 Insertion opening
- 34 Holding clamp
- 36 Parting line
- 38 Latching cams
- 40 Pivot joint

FIGS. 3A, B:

- 312 Transverse web
- 317, 319 Long narrow sides of the compartment bottom
- 318 Compartment bottom
- 320 Separator
- 322 Top portion of the separator
- 323 Narrow side of the transverse web
- 324 Bottom portion of the separator
- 327 Tothing on the compartment bottom
- 329 Groove on compartment bottom
- 334 Holding clamp
- 340 Row of teeth
- 350 Retaining extension
- 351 Tooth projection
- 360 Central portion of the separator

FIG. 4:

- 341 Tooth
- 342 Tooth gap

FIG. 5:

- 520 Separator
- 522 Top portion
- 524 Bottom portion
- 534 Holding clamp
- 550 Retaining extension
- 551 Tooth projection
- 560 Central portion

FIG. 6:

- 612 Transverse web
- 623 Narrow side

625 Main body

665 Protective layer

661A, 661B Fastening region

Separator, transverse web and compartment bottom for energy guiding chains

CLAIMS:

1. **Separator** (20) for a chain link (10) of an energy guiding chain (1), wherein the chain link (10) comprises two side plates (11) which are spaced apart from one another and are connected to one another by two transverse webs (12) and which define a receiving space (14) for lines (16, 17), wherein the separator (20) is designed in the manner of a plate having a plurality of through-openings (32) for a respective compartment bottom (18) and having a top portion (22), a bottom portion (24), a first side bar (26), and a second side bar (28), wherein the side bars (26, 28) delimit the through-openings (32) in the direction of the separator width, and the first side bar (26) is detachable and/or pivotable to provide access to the through-openings (32) for insertion or removal of a compartment bottom (18) into a through-opening (32), wherein the top portion (22) and the bottom portion (24) are each designed for attachment to a transverse web (12), **characterized in that** the top portion (22) and the bottom portion (24) each have a holding clamp (34) for interacting with the narrow sides (23) of a transverse web (12), wherein the top portion (22) is connected to the first side bar (26) and is detachable and/or pivotable together therewith.
2. Separator (20) according to claim 1, **characterized in that** the top portion (22) and/or the first side bar (26) is connectable by positive locking to the bottom portion (24), a central region (30) and/or the second side bar (28).
3. Separator (20) according to claim 1 or 2, **characterized in that** the top portion (22) and/or the first side bar (26) is latchable to the second side bar (28), preferably by a latching notch (282) at a top-portion-side end of the second side bar (28), and a latching lug (222) on the top portion (22) which is designed to engage the latching notch (282).
4. Separator (20) according to one of claims 1 to 3, **characterized in that** the top portion (22) has a planar recess (224) between its broad sides, and a top-

portion-side end of the central region (30) has a projection (302) extending in a height direction of the separator (20) for engaging the recess (224).

5. Separator (20) according to one of claims 1 to 4, **characterized in that** the first side bar (26) is manufactured in one piece and in particular flexurally rigidly with the top portion (22).
6. Separator (20) according to one of claims 1 to 5, **characterized in that** the first side bar (26) is connectable to the bottom portion (24) by means of a hinge-like articulated connection (40), in particular by means of a pivot joint (40), wherein the bearing receptacle is preferably formed on the bottom portion (24).
7. Separator (20) according to claim 6, **characterized in that** the pivot axis of the articulated joint (40) extends perpendicularly to the direction of the separator width and perpendicularly to the height direction of the separator (20).
8. Separator (20) according to one of the preceding claims, **characterized in that** the central region (30) comprises tongues (304) extending in the direction of the separator width, and the first side bar (26) comprises pockets (262) for receiving the tongues (304).
9. Separator (20) according to one of the preceding claims, **characterized in that** each through-opening (32) comprises a latching cam (38) on one side for latching a compartment bottom (18).
10. **Transverse web** (312) for a chain link (10) of an energy guiding chain (1), wherein the chain link (10) comprises two side plates (11) which are spaced apart from each other, wherein the transverse web (312) is connectable at each of its longitudinal ends to a respective one of the side plates (11) to define a receiving space (14) for lines (16, 17), wherein the transverse web (312) has two narrow sides (323) extending in the longitudinal direction of the transverse web (312), the narrow sides (323) having a holding device for retaining of separators (320), **characterized in that** each holding device comprises a respective row of teeth (340) on the respective narrow side (323)

for a positive connection to separators (320) of complementary design, with teeth (341) which project in the width direction of the transverse web (312), and in that each tooth (341) has a dimension in the height direction of the transverse web (312) which is greater than a dimension of the tooth (341) in the longitudinal direction of the transverse web (312).

11. Transverse web (312) according to claim 10, **characterized in that** each tooth (341) has a dimension in the height direction of the transverse web (312) that is greater than the dimension of the tooth (341) in the width direction of the transverse web (312).
12. Transverse web (312) according to claim 10 or 11, **characterized in that** the dimension of the tooth (341) in the height direction of the transverse web (312) is at least 3 mm, particularly preferably at least 6 mm.
13. Transverse web (312) according to claim 10, 11 or 12, **characterized in that** the teeth (341) are spaced apart by tooth gaps (342) and the teeth (341) and tooth gaps (342) are alternately and uniformly distributed along at least a major portion of the longitudinal extension of the narrow sides (323) and/or have a rounded profile.
14. **Separator** (320; 520) for a chain link (10) of an energy guiding chain (1) having two transverse webs (312) according to one of claims 10 to 13, wherein the chain link (10) has two side plates (11) which are spaced apart from one another, are connected to one another by the transverse webs (312) and define a receiving space (14) for lines (16, 17), wherein the separator (320; 520) is of plate-like design and comprises a top and a bottom portion (322, 324; 522, 524) for holding and/or fastening to the transverse webs (312), **characterized in that** the top portion (322; 522) and/or the bottom portion (324; 524) each comprise a holding clamp (334; 534) for engaging in a row of teeth (340) of one of the two transverse webs (312), wherein the respective holding clamp (334; 534) comprises two opposite retaining extensions (350; 550) which at the end side each have at least one tooth projection (351; 551) for positive engagement in the row of teeth (340) of the transverse web (312), wherein the tooth projections (351; 551) of the two opposite retaining extensions (350; 550) face one another and in each case

project from the retaining extension (350; 550) in the direction of the opposite tooth projection (351; 551).

15. Separator (320; 520) according to claim 14, wherein the tooth projection (351; 551) comprises an extension in the direction toward the opposite tooth projection (351; 551) that corresponds to the depth of the tooth gap (342) and has an extension in the height direction of the separator (320; 520) that is at least 3 mm.
16. Separator (320; 520) according to claim 14 or 15, wherein the separator (320, 520) comprises a central portion (360; 560) between the top and bottom portions (322, 324; 522, 524), **characterized in that** the holding clamp (334; 534) protrudes perpendicularly to the main plane of the separator (320; 520) to each side by not more than 150%, preferably not more than 100%, of the material thickness in the central portion (360; 560) of the separator (320; 520).
17. Separator (320) according to one of claims 14, 15 or 16, **characterized in that** each of the retaining extensions (350) comprises two tooth projections (351) for positive engagement in two successive tooth gaps (342) of the transverse web (312) in each case, wherein the end region of the retaining extension (350) is preferably U-shaped in cross-section.
18. **Compartment bottom** (318) for a chain link (10) of an energy guiding chain (1), wherein the chain link (10) comprises two side plates (11) which are spaced apart from one another and connected to one another by two transverse webs (12, 312) and at least one separator (20, 320) arranged between the transverse webs (12, 312) and having at least one through-opening (32), wherein the through-opening (32) has a latching cam (38) on one side for latching in the compartment bottom (318), wherein the compartment bottom (318) is of plate-like design and formed in cross-section to match the through-opening (32), wherein the compartment bottom (318) comprises a toothing (327) on a long narrow side (317) for interacting with the latching cam (38) of the through-opening (32), **characterized in that** the compartment bottom (318) comprises, on the opposite other long narrow side (319), a recess, in particular a groove (329), which is continuously toothless in

the longitudinal direction and in which the latching cam (38) can be accommodated in a longitudinally displaceable manner.

19. **Transverse web** (612) for a chain link (10) of an energy guiding chain (1), wherein the chain link (10) comprises two side plates (11) which are spaced apart from one another, wherein the transverse web (612) has an elongated main body (625) made of plastic and comprises at each of its longitudinal ends a fastening region (661A, 661B) by means of which it is connectable in each case to one of the side plates (11) in order to define a receiving space (14) for lines (16, 17), **characterized in that** a line-protecting layer (665) made of a second plastic which is different from the plastic of the main body is provided on the inner side (662) of the main body (625), which, according to intended use, faces the receiving space (14) .
20. The transverse web (612) according to claim 19, wherein said transverse web (612) comprises two narrow sides (623) extending in the longitudinal direction of the transverse web (612), each narrow side (623) having a holding device for retaining of separators (320), and the line-protecting layer (665) extends in the longitudinal direction between the longitudinal ends and in the width direction from the one narrow side (623) to the other narrow side and substantially completely covers the inner side of the main body (625).
21. Chain link (10) for an energy guiding chain (1), comprising two side plates (11) which are connected to one another by transverse webs (12, 312) and are pivotably connectable in a longitudinal direction to side plates of further chain links, **characterized in that** the chain link (10) comprises at least one separator (20, 320) according to one of claims 1 to 9 and/or 14 to 17, and/or at least one transverse web (12, 312) according to one of claims 10 to 13 or 19 to 20, and/or a compartment bottom (18, 318) according to claim 18.
22. Energy guiding chain (1) for dynamically guiding lines, such as cables (17) and/or hoses (16), comprising at least one chain link (10) according to claim 21.