

Gripper for moving piece goods, and method for moving piece goods by means of the gripper

5 The present invention relates to a gripper for moving piece goods and to methods for moving piece goods using the gripper. In particular, the invention relates to a gripper for a storage device having horizontal storage surfaces for storing and retrieving piece goods, and to methods for moving piece
10 goods onto and from a gripper.

 In order to move piece goods from a storage surface, picking machines, as an example of a storage device for pharmaceutical packages, regularly use grippers which move the piece goods, i.e. the pharmaceutical packages, from the
15 storage surface onto the gripper by clamping the pharmaceutical packages by means of pivotable clamping jaws and then pulling them onto the gripper. The clamping force to be applied by the clamping jaws must exceed the static friction of the pharmaceutical package/storage surface,
20 otherwise the pharmaceutical packages will remain on the storage surfaces. Overcoming the static friction by means of clamps is not problematic in the case of lightweight pharmaceutical packages. In the case of heavy pharmaceutical packages or other heavy piece goods, movement by means of
25 clamps is not possible or possible only with complex mechanisms due to the weight. Clamping as such may also be undesirable since a certain clamping force must necessarily be exerted on the piece good, which is disadvantageous or even impossible in the case of sensitive piece goods.

30 The object of the present invention is to provide a gripper which allows even heavy and/or sensitive piece goods to be moved. It is also the object of the present invention to provide methods for moving heavy and sensitive piece goods.

The invention is achieved on the one hand by a gripper according to claim 1. The gripper according to the invention for moving piece goods comprises a deposit table extending in a first horizontal direction (X direction) and a second
5 horizontal direction (Y direction) which is orthogonal to the first horizontal direction, with at least one storage and retrieval end face extending in the Y direction, and a gripping means guide arrangement which is arranged above the deposit table and has a gripping means which extends in the X
10 direction and is movable in the X direction and has an end portion remote from the gripping means guide arrangement and an end portion close to the gripping means guide arrangement. The mobility of the gripping means can be provided in different ways, for example by moving the gripping means guide
15 arrangement as such in the X direction, for example by means of a linear drive extending in the X direction, or by moving the gripping means or portions thereof, for example by a telescopic design of the gripping means. Grippers having the above-mentioned components and their functionality are known
20 from the prior art.

The gripping means of the gripper according to the invention comprises a first deflection device, a first guide portion extending in the X direction and a second guide portion, as well as a first unilaterally flexible chain which
25 interacts with the deflection device and the guide portions and has a plurality of chain links with a chain link length KGL, the unilaterally flexible chain comprising a bending limitation device which limits pivoting of the chain links relative to one another in a first articulation direction and
30 allows it in a second articulation direction, and the first unilaterally flexible chain having a first end remote from the gripping means guide arrangement and a second end close to the gripping means guide arrangement.

According to the invention, the unilaterally flexible chain can be moved by means of a drive and can be deflected by means of the deflection device in the second articulation direction at an angle of between $70-110^{\circ}$ to the X direction, and the
5 unilaterally flexible chain is arranged in such a way that, when the gripping means is moved in the X direction, pushing forces can be transmitted to a piece good to be moved onto the deposit table, and the unilaterally flexible chain has an alignment device which, in the non-articulated state, holds
10 the chain links in a mutually non-pivoted, stretched alignment and secures them against pivoting in the second articulation direction.

A single-sided flexible chain, also known as a push chain or back-stiff chain, is a special product in linear drive
15 technology. A push chain consists of specially formed, high-precision mechanical chain links. The chain links are designed in such a way that pivoting of the chain links is possible only to a limited extent in a first articulation direction (the non-flexible "side" of the chain), but is permitted in
20 the second articulation direction (the flexible "side" or direction). These chains are usually constructed in such a way that the chain links can only be pivoted so far in relation to the non-flexible side that a stretched, straight chain can be formed. Exactly how the limitation of the pivoting is achieved
25 depends on the exact structure of the chain; in this case the device used for this purpose is referred to as a bending limitation device. A more detailed description of the general structure and the general mode of operation of these chains will not be given since these are known to a person skilled in
30 the art. Only those details that are essential to the present invention and that may differ from known chains are described.

In the gripper according to the invention, the first unilaterally flexible chain can be deflected by means of a

chain drive and by means of the first deflection device at an angle of between $70-110^\circ$ to the X direction. In order to prevent the unilaterally flexible chain from assuming an "arbitrary" orientation after "leaving" the deflection device, for example rolling up in the second articulation direction, according to the invention the chain comprises the above-mentioned alignment device, and this ensures that the chain remains linearly aligned after "leaving" the deflection device.

10 The gripper according to the invention makes it possible to push piece goods onto the deposit table (from the "point of view" of the chain, although from the overall view of the gripper this is more of a pulling action). However, since a pushing chain portion is flexible when a compressive force is exerted on the side remote from the storage and retrieval end face (i.e. the back) (the chain portion can therefore be pivoted further in the second articulation direction), no piece goods can be pushed onto a storage surface using a corresponding gripper.

20 According to the invention, an alignment device is provided for the gripper and holds the unilaterally flexible chain in a stretched, non-pivoted alignment in the non-articulated state, i.e. when it is moved or extended over the deposit table. In one embodiment, the alignment device of the unilaterally flexible chain is designed as a spring element that extends through the chain and presses the chain links in the first articulation direction against the bending limitation device. A corresponding design of the alignment device is technically simple and requires only minor modifications to "conventional" unilaterally flexible chains.

30 In an alternative embodiment, the alignment device is formed by a plurality of latching arms with latching lugs and latching receptacles, wherein a latching arm of one chain link

can interact with a latching receptacle of an adjacent chain link and interacting latching arms and latching receptacles align the corresponding chain links in a stretched manner. In order to ensure the alignment of the chain links, the chain links must be locked before moving the chain portion over the deposit table. For this purpose, in this embodiment the second guide portion is designed in such a way that it causes adjacent chain links to lock. Depending on the exact configuration of the latching means (latching arms, latching lugs, latching receptacles), this can be achieved for example by the second guide portion being longer than a chain link length.

With the gripper according to the invention, it is not possible to push heavy piece goods from the deposit table to a storage location for the reasons mentioned above (the unilaterally flexible chain is flexible in the pushing direction from the deposit surface over the storage and retrieval end face, the chain links can pivot in the second articulation direction). A piece good can be pushed from the deposit table to a storage location using an additional device of the gripper.

In a preferred embodiment of the gripper in which piece goods can also be pushed from the deposit table with the aid of the first flexible chain, the gripper has a second gripping means, the second gripping means having a receiving device which can be detachably connected to the first end of the first unilaterally flexible chain in such a way that a pushing force (from the "point of view" of the chain) is transmitted to the piece good when the gripping means are moved in the X direction toward the storage and retrieval end face.

By providing a detachable connection to the receiving device, a rigid and pressure-resistant connection is provided in both directions (in relation to the storage and retrieval

end face), which can also be used to transmit greater forces, i.e. even heavy piece goods can be moved from a storage surface onto the gripper and from the gripper onto a storage surface.

5 Another significant advantage of the invention is that the structure of the gripping means is relatively simple and the chain as such can be stored in a "space-saving" manner in the X direction of the gripping means. The gripping means itself can also be slim, which is essential for a narrow and thus
10 space-saving storage of piece goods on a storage surface with defined dimensions. Furthermore, the components are very robust; frequent maintenance and rapid wear are not to be expected.

In order to be able to use the full length of the gripping
15 means, in a preferred embodiment the first deflection device and the receiving device are arranged at the end portions of the gripping means that are remote from the gripping means guide arrangement.

By moving the gripping means in the X direction toward the
20 deposit table of the gripper, one or more piece goods are moved onto the deposit table. In the case of maximum "movement" of the gripping means (in the X direction), the positioning of the deflection device and the receiving device on the gripping means defines the deposition location of the
25 piece good(s) on the deposit table. When the deflection device and the receiving device are thus arranged in the end portions remote from the gripping means guide arrangement, a piece good is positioned close to the storage and retrieval end face. However, this may be a non-optimal or even unusable position
30 for the further handling of the piece good. Furthermore, this arrangement does not readily (i.e. not without the provision of further components) allow piece goods to be moved from the

deposit table onto a storage surface with the unilaterally flexible chain.

In order to make it possible, among other things, to arrange a piece good in different positions on the deposit
5 table, according to a preferred embodiment the first deflection device and/or the receiving device can each be moved by means of a drive in the X direction on or at the relevant gripping means. Such mobility also allows piece goods to be moved from the gripper onto e.g. a storage surface with
10 the aid of the first flexible chain, which will become clear in the description of the methods below.

The receiving device can be designed or realized in various ways as long as its function is ensured, namely to enter into a detachable connection with the first end of the first
15 unilaterally flexible chain so that a pushing force is transmitted to a piece good when the gripping means are moved in the X direction toward the storage and retrieval end face. In a structurally simple embodiment, the receiving device comprises an opening for receiving the first end of the first
20 chain, the opening preferably having a depth which is greater than a chain link length.

In an alternative embodiment, the receiving device is provided by a first end of a second unilaterally flexible chain which interacts with a second deflection device and can
25 be moved by means of a second chain drive and can be deflected by means of the second deflection device at an angle of between 70° - 110° to the X direction, as a result of which the first end of the second chain can be moved into the space between the gripping means and the first ends of the chains
30 can be detachably interconnected such that a pushing force is transmitted to the storage and retrieval end face when the gripping means are moved in the X direction.

In this embodiment, the two gripping means have the same components, which are (arranged to be) mirror-symmetrical to one another. In this case, the receiving device is provided by all of the aforementioned components.

5 Such an embodiment is particularly useful when the possible distances between the gripping means can be great—in this way, it is still possible to use relatively short chains, as these only have to bridge half of the space in each case. The exact manner of the detachable connection between the ends of the
10 chains depends on the individual case – in the simplest case a simple rigid male/female connection can be used.

As described above, it can be the case that the deflection devices or a deflection device and the receiving device can be moved in the X direction along the gripping means. However,
15 the freedom of movement of a deflection device is limited by the chain length as such, at least when the chain is not received in the gripping means guide arrangement when the deflection device is moved toward the end portion of the gripping means that is close to the gripping means guide
20 device. In order to allow a wide range of motion during the movement of the deflection device(s), according to a preferred embodiment a gripping means having a deflection device at the end portion remote from the gripping means guide arrangement has a further deflection device at the end portion close to
25 the gripping means guide arrangement, with a unilaterally flexible chain being deflectable from the X direction, preferably at an angle $< 90^\circ$, by means of the further deflection device, as a result of which the second end of a chain can be moved over the deposit table.

30 The object is also achieved by a method for moving piece goods onto a gripper according to the invention, wherein the gripper is moved toward a storage surface associated with a piece good to be retrieved, at least one gripping means is

moved in the X direction toward the storage surface so that the piece good is arranged next to a gripping means, and the first unilaterally flexible chain is moved by means of the associated chain drive in such a way that the first end is
5 extended by the first deflection device remote from the gripping means guide arrangement at an angle of between 70-110° to the X direction, wherein adjacent chain links downstream of the deflection device remote from the gripping means guide arrangement are brought into a mutually non-
10 pivoted, stretched alignment so that a stretched portion of the unilaterally flexible chain is moved behind the piece good in such a way that the piece good is arranged between the stretched portion of the chain and the deposit surface. Finally, the at least one gripping means is moved in the X
15 direction toward the deposit table, with the stretched portion of the first unilaterally flexible chain pushing the piece good onto the deposit table.

As already explained above, with a gripper having only one gripping means, it is possible only to push piece goods onto
20 the gripper—due to the properties of the unilaterally flexible chain it cannot be used to push the piece good from the gripper onto a storage surface.

In a preferred embodiment of the method which, however, can be carried out only using a gripper having two gripping means,
25 the gripper is moved toward a storage surface associated with a piece good to be retrieved, the gripping means are moved in the X direction toward the storage surface so that the piece good is arranged between them, and the first unilaterally flexible chain is moved by means of the associated chain drive
30 in such a way that the first end is extended by the first deflection device remote from the gripping means guide arrangement at an angle of between 70-110° to the X direction, wherein adjacent chain links downstream of the deflection

device remote from the gripping means guide arrangement are brought into a mutually non-pivoted, stretched alignment so that a stretched portion of the unilaterally flexible chain is moved behind the piece good in such a way that the piece good
5 is arranged between the stretched portion of the chain and the deposit table. The first end of the first chain is then detachably connected to the receiving device of the second gripping means in such a way that pushing forces can be transmitted to the piece good when the gripping means are
10 moved in the X direction toward the storage and retrieval end face. Finally, the gripping means are moved in the X direction toward the deposit table so that the piece good is pushed onto the deposit table of the gripper.

In a preferred embodiment, the first end of the chain is
15 detachably connected to the receiving device by moving the second unilaterally flexible chain by means of the associated chain drive in such a way that the first end of the second chain is moved into the space between the gripping means by the second deflection device remote from the gripping means
20 guide arrangement, and the first ends of the chains are detachably interconnected in such a way that a pushing force is transmitted to a piece good when the gripping means are moved in the X direction toward the storage and retrieval end face.

25 Depending on the exact configuration of the gripper, a piece good can also be pushed from the gripper onto a storage surface using the flexible chains. For this purpose, the deflection devices remote from the gripping means guide arrangement or a corresponding deflection device and the
30 receiving device are moved toward the end portions of the gripping means that are close to the gripping means guide arrangement. The first unilaterally flexible chain is then moved by means of the associated chain drive in such a way

that the first free end is moved by the first deflection device remote from the gripping means guide arrangement into the space between the gripping means, namely behind—with respect to the storage and retrieval end face—the piece good
5 to be moved, and the first free end of the first chain is detachably connected to the receiving device of the second gripping means in such a way that a pushing force can be transmitted to the piece good when the gripping means are moved in the X direction toward the storage and retrieval end
10 face, and then the gripping means are moved in the X direction over the storage and retrieval end face so that the piece good is moved from the supporting table of the gripper.

In the following, preferred embodiments of the gripper and method according to the invention shall be described with
15 reference to the drawings, in which:

Fig. 1 schematically shows a first embodiment of the gripper,

Fig. 2a-2d are detailed views of a first embodiment of the unilaterally flexible chain of the gripper according to the
20 invention,

Fig. 3a-3e are detailed views of a second embodiment of the unilaterally flexible chain of the gripper according to the invention,

Fig. 4a and 4b are detailed views of a chain link of the
25 embodiment according to Fig. 3a-3e,

Fig. 5 is a detailed view of portions of the gripping means of a second embodiment of the gripper,

Fig. 6 is a detailed view of portions of the gripping means of a third embodiment of the gripper,

30 Fig. 7a and 7b are schematic plan views of a fourth and fifth embodiment of the gripper,

Fig. 8a-8c show different stages of an embodiment of a method for moving a piece good onto a gripper according to the invention, and

Fig. 9a-9c show different stages of an embodiment of a method for moving a piece good from a gripper according to the invention.

Fig. 1 schematically shows a first embodiment of the gripper 1 according to the invention. This gripper comprises a gripping means 100 which is fastened to a gripping means guide arrangement 20 which in turn is arranged above a deposit table 10 of the gripper. The deposit table extends in a first horizontal direction (X direction) and a second horizontal direction (Y direction) which is orthogonal to the first horizontal direction, and comprises a storage and retrieval end face 11 extending in the Y direction. The gripping means itself can be moved in the X direction, and this mobility can be provided by the gripping means guide arrangement. Alternatively, it is also conceivable for the gripping means to be telescopic, i.e. only a portion of the gripping means can be moved in the X direction. In this context, reference is made to the description of Fig. 7a and 7b, which describes an embodiment in which the mobility of the gripping means is described in more detail.

The gripping means 100 comprises a deflection device 104 and a chain drive 155. Furthermore, the gripping means in this embodiment comprises a first guide portion 103 extending in the X direction and a second guide portion 110 for a first end 301 of a unilaterally flexible chain 300. The unilaterally flexible chain is moved by a movement of the chain drive and deflected from the X direction to the Y direction using the deflection device, and in the embodiment shown the deflection is at an angle of 90° , i.e. from the X to the Y direction. In alternative embodiments, the angle can be between 70° - 110° , and

proper movement of piece goods is possible even at such angles. As will be described in more detail below, the piece goods are pushed onto the deposit table using the unilaterally flexible chain (from the point of view of the chain). Since
5 the unilaterally flexible chain comprises a bending limitation device which limits pivoting of the chain links relative to one another in a first articulation direction (GR1) and allows it in a second articulation direction (GR2), corresponding pushing forces can be transmitted – a more detailed
10 description of the unilaterally flexible chain and the bending limiting device is made with reference to subsequent figures.

As has already been explained above, the unilaterally flexible chain comprises an alignment device which, in the non-articulated state, holds the chain links in a mutually
15 non-pivoted, stretched alignment and secures them against pivoting in the second articulation direction. Two examples of an alignment device are described in more detail below. In an alternative, it is essential that adjacent chain links of the unilaterally flexible chain are locked after the deflection.
20 For this purpose, in the embodiment shown, the length (FAL) of the second guide portion 110 is greater than a chain link length (KGL) (in this guide portion, which is formed by two parallel guide means, two adjacent chain links are aligned with one another and locked) and after deflection the chain
25 links are therefore no longer freely movable, but are moved in a defined direction—the chain is almost “rigid” after locking, but this rigidity can be removed again by applying a certain force. In alternative embodiments, this “rigidity” can be achieved in other ways, as discussed below.

30 With the gripper according to the invention, even heavy piece goods can be pushed from a storage surface onto the gripper, but the piece good cannot be moved from the gripper without further devices or components, since even with a

deflection device (not shown) that can be moved in the X direction and movement "behind" a piece good (also not shown), this piece good cannot be pushed "from bottom to top" since the chain is not rigid but flexible in this direction.

5 Fig. 2a-2d are detailed views of a first embodiment of the unilaterally flexible chain of the gripper according to the invention. In the embodiment shown, the individual chain links 310 each comprise two articulation openings 312 into which articulation extensions 311 of an adjacent chain link engage.

10 As already mentioned, the unilaterally flexible chain used in the gripper according to the invention comprises a bending limitation device that limits pivoting of the chain links relative to one another in a first articulation direction GR1 and allows it in a second articulation direction GR2. In the
15 embodiment shown in Fig. 2a-2d, this bending limitation device is formed by two components of adjacent chain links. Those chain links in which pivoting in the first articulation direction GR1 must be limited comprise a projection 320 which interacts with a stop 321 of an adjacent chain link. As can be
20 seen in Fig. 2c, the stop 321 of the chain link 310' limits further pivoting of the chain link 310" in the articulation direction GR1 since the projection 320 of the chain link 310" abuts the stop of the chain link 310'. What cannot be seen in Fig. 2c is that opposite the stop 321 there is no
25 corresponding stop that limits pivoting of the projection 320.

The unilaterally flexible chain of the gripper according to the invention also comprises an alignment device which, in the non-articulated state, holds the chain links in a mutually non-pivoted, stretched alignment and secures them against
30 pivoting in the second articulation direction. In the embodiment shown, this alignment device is designed as a spring element 330 that extends through the chain 300 and presses the chain links 310 against the bending limitation

device 320, 321 in the first articulation direction GR1. This is illustrated in each case in the "upper" stretched portions of the figures. The alignment device thus ensures that the chain is aligned linearly in the non-articulated state and has
5 a certain rigidity which is defined by the spring force of the spring element 330 in this embodiment.

Fig. 3a-3e are detailed views of a second embodiment of the unilaterally flexible chain of the gripper according to the invention, in which the alignment device is formed by a
10 plurality of latching arms 340 with latching lugs 341 and latching receptacles 342, wherein a latching arm of one chain link can interact with a latching receptacle 342 of an adjacent chain link and interacting latching arms and latching receptacles align the corresponding chain links in a stretched
15 manner. In order to initiate the locking, adjacent chain links must be linearly aligned with one another so that, in this embodiment, it is also necessary for the second guide portion 103 of the gripping means to be designed in such a way that it causes adjacent chain links to lock. This is shown and
20 described for example in the embodiment according to Fig. 1.

Fig. 4a and 4b show a detailed view of a chain link of the embodiment of Fig. 3a-3e; Fig. 4a shows the latching arm 340 together with the latching lug 341 and Fig. 4b shows the latching receptacle 342. The figures also show the projection
25 of the bending limitation device, which in the second embodiment is designed in accordance with the first embodiment, as can be seen in Fig. 3c.

Fig. 5 is a detailed view of portions of gripping means 30, 40 of a second embodiment of the gripper according to the
30 invention. In this second embodiment, the two gripping means are not of mirror-symmetrical "identical" construction, but rather only the "left" gripping means 30 comprises a chain 300 as well as the further components described with reference to

the first embodiment. In contrast with the first embodiment, in this embodiment the deflection device 34 and the second guide portion 38 can be moved in the longitudinal direction of the gripping means 30 (i.e. in the X direction). In the
5 embodiment shown, the deflection device 34 and the second guide portion 38 are arranged on a carriage 39 for this purpose. This carriage further comprises a drive 35 which interacts with a linear guide 36 (shown in dashed lines) for moving the carriage. In the embodiment shown, the chain drive
10 55 is also arranged on the carriage 39. Due to the mobility of the carriage 39, the first guide portion 33 of this embodiment is constructed and arranged slightly differently.

In the second embodiment, the second gripping means 40 comprises a receiving device that is not realized by a mirror-
15 symmetrical assembly of the gripping means 30, but rather as a carriage 70 that can be moved in the X direction and has an opening 71 that can receive a chain link of the first end of the first chain 300. Preferably, the depth of the opening is greater than a length of a chain link, as is also shown. The
20 carriage 70 further comprises a drive 75 which interacts with a linear guide 46 for moving the carriage 70 in the X direction.

Fig. 6 is a detailed view of portions of the gripping means of a third embodiment of the gripper. In this embodiment, the
25 two gripping means 30 40 have a mirror-symmetrical structure, i.e. they have the same components in a corresponding alignment. Fig. 6 shows in particular the alignment or arrangement of the two unilaterally flexible chains 300, 60. The two unilaterally flexible chains 300, 60 are again shown
30 only schematically in Fig. 6; the exact structure of the chains to be used corresponds to the embodiments shown in Fig. 2a-3e, for example. The first guide portions 33, 43 of the gripping means 30, 40 are intended to ensure that the portions

of the chains extending in the X direction do not move freely "inward"; they could thus also be arranged "inward" on the side of the corrugated side surfaces of the chain links.

Fig. 7a and 7b are schematic plan views of a fourth and fifth embodiment of the gripper, with the gripper according to the invention being described in detail again with reference to these figures.

The gripper 1 comprises a deposit table 10 extending in an X direction and a Y direction which is orthogonal to the X direction, with a storage and retrieval end face 11. The gripper 1 further comprises a gripping means guide arrangement 20 having a drive 22 which interacts with a linear guide 21 (indicated by dashed lines) in order to move the gripping means guide arrangement 20 in the X direction. In the embodiment shown, the gripping means guide arrangement 20 comprises two gripping means 30, 40 which can be moved in the Y direction along a linear guide 23 by means of a drive 24a, 24b so that the distance between the gripping means can be adapted to piece goods and the distances between them can be adjusted.

The two gripping means 30, 40 are mirror-symmetrical in both embodiments and each comprise an end portion 31, 41 close to the gripping means guide arrangement 20 and an end portion 32, 42 remote from the gripping means guide arrangement 20. A deflection device 34, 44 is arranged on each of the end portions 32, 42 remote from the gripping means guide arrangement 20, by means of which device a unilaterally flexible chain 300, 60 (also referred to simply as a chain below) of a gripping means can be deflected into the space between the gripping means, specifically at an angle of between 70-110° based on the X direction. The chains each have a first end 301, 61 remote from the gripping means guide

arrangement 20 and a second end 302, 62 close to the gripping means guide arrangement 20.

A chain drive 55, 65 which interacts with a chain 300, 60 and by means of which the chains can be moved in the X direction along a gripping means is arranged at each of the deflection devices 34, 44. Using the deflection devices, this movement in the X direction is deflected into a movement in the Y direction so that the chain drives deflect the first ends 301, 61 into the space between the gripping means. The chain drives (like all the components), which are only indicated schematically, can simply comprise a chain gear interacting with the chains, and a rotary drive. In alternative embodiments, the chain drives can be arranged at a different location or, if necessary, can be designed completely differently – for example, a chain link can be connected to a driver that moves in the X direction, which in turn is moved on a linear guide.

The chains themselves are guided along a first guide portion 33, 43 in order to prevent the chains from moving “freely” and possibly getting caught or swinging arbitrarily with the second end into the space between the gripping means. How exactly the first guide portion 33, 34 is designed depends on the design of the gripping means themselves.

In addition to the first guide portion 33, 43, each of the two gripping means also has a second guide portion 38, 48, the orientation of which determines how the chains are guided into the space between the gripping means. In addition, depending on the exact design of the unilaterally flexible chains, the second guide portions can also have the task of locking the chain links of the chains after deflection, which has already been described in more detail with reference to previous figures.

Fig. 7b shows the gripper with "extended" gripping means; the gripping means are moved in the X direction toward a storage surface 3 next to a piece good 2. It is also indicated that the two chains 300, 60 are moved into the space between the gripping means. In the case of the mutually facing first ends 301, 61 of the chains 300, 60, coupling pieces 54, 64 by means of which the two ends are detachably connected are provided in the fifth embodiment. In the simplest case, a detachable, rigid male/female connection can be established.

10 As can be seen, the two chains grip the piece good 2 from behind (in relation to the direction of the piece good/storage and retrieval end face). Since the chains are only unilaterally flexible (see description of Fig. 2a-3e), the free portions moved between the gripping means (also due to

15 the connection) cannot be moved "upward" when the gripping means are moved back toward the deposit table. During this movement, the chains can then exert a pushing force on the piece good (from the "point of view" of the chains).

Further deflection devices 37, 47 are indicated at the end portions 31, 41 of the gripping means that are close to the gripping means guide arrangement, which devices act in the same way as the gripping means at the remote end portions, except that they deflect the second ends 302, 62 of the chains into the space between the gripping means. Why this is useful

25 and necessary is explained in one of the following figures.

Fig. 8a-8c show different stages of an embodiment of a method for moving a piece good onto a gripper according to the invention, wherein the illustrated embodiment of the gripper has two mirror-symmetrically constructed gripping means 30, 40 each having a unilaterally flexible chain. Furthermore, the deflection devices, which are not explicitly shown but are constructed in accordance with those above, can be moved in the X direction, as is described with reference to Fig. 5 with

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the carriage 39. The gripping means guide arrangement 20 is shown only schematically, and other components of the gripper are completely omitted. Fig. 8a-8c (and also the following Fig. 9a-9c) are only intended to schematically illustrate the method for moving piece goods onto and from a gripper.

In Fig. 8a, the gripping means are moved in the X direction toward the storage surface 3 next to the piece good 2. The chains are then "extended" and connected, i.e. the chains are moved via the deflection devices into the space between the gripping means, are detachably connected and grip the piece good 2 from behind (viewed from the storage surface/deposit table 10 of the gripper). After gripping the piece good 2 from behind (by deflecting the first ends of the chains between the gripping means and detachably connecting coupling means that are not shown here), the gripping means are moved in the X direction toward the deposit table 10, as a result of which the chains exert a pushing force on the piece good and push it onto the deposit table as shown in Fig. 8b.

Fig. 8b shows the position which is the end position in an embodiment in which the deflection devices cannot be moved in the X direction. In the present case, however, the deflection devices are movable, as shown in Fig. 8c; the deflection devices are moved further in the X direction toward the gripping means guide arrangement 20, as a result of which the piece good 2 is moved in the X direction toward the gripping guide means arrangement 20.

Fig. 9a-9c show different stages of an embodiment of a method for moving a piece good from a gripper according to the invention onto e.g. a storage surface, with this movement being performed using the gripping means and the chains. In the embodiment of the gripper shown in Fig. 8a-8c and 9a-9c, the gripping means have further deflection devices 37, 47 at the end portions of the gripping means that are close to the

gripping means guide arrangement 20, which devices are designed in such a way that they guide the second ends of the chains into the space between the gripping means, as illustrated in Fig. 9a.

5 In order to push a piece good from the storage table 10, it must be gripped again from behind (based on the view from the gripping means guide device/storage and retrieval end face). For this purpose, the deflection devices that can be moved in the X direction (for example starting from the position in
10 Fig. 8c) must be brought further toward the gripping means guide arrangement 20 and behind (according to Fig. 9a "below") the piece good. In order not to move the piece good in the process, it is necessary to loosen the first ends of the chains and retract the chains if this has not already
15 happened. The "retraction" results in the portions of the chains that are arranged in parallel with the gripping means in the X direction being lengthened. The further deflection devices then guide the second ends of the chains into the space between the gripping means – depending on the length of
20 the chains and the position of the first and the second deflection device, this occurs as soon as the retraction happens or "only" when the first and the second deflection device are moved further below or behind the piece good to be moved.

25 When the deflection devices are moved to the appropriate positions, the chains are moved using the associated chain drives in such a way that the first ends are moved into the space between the gripping means, namely "below" the piece good 2, by the first and the second deflection devices remote
30 from the gripping means guide arrangement 20. The first ends of the chains are then detachably interconnected in such a way that pushing forces can be transmitted from the chains to the piece good when the gripping means are moved in the X

direction toward the storage and retrieval end face. During this pushing movement, a connection of the ends of the chains is essential, since the chains are stressed in their flexible direction during the pushing movement toward the storage and
5 retrieval end face.

After the detachable connection has been created, the gripping means are moved in the X direction toward and over the storage and retrieval end face and the piece good is finally moved onto a storage surface or another location
10 within a storage device – for example on a conveyor belt or a retrieval chute.

Claims

1. Gripper for moving piece goods, comprising:
a deposit table (10) extending in a first horizontal
5 direction (X direction) and a second horizontal direction (Y
direction) which is orthogonal to the first horizontal
direction, with at least one storage and retrieval end face
(11) extending in the Y direction,
a gripping means guide arrangement (20) which is arranged
10 above the deposit table (10) and has a gripping means (100;
30) which extends in the X direction and is movable in the X
direction and has an end portion remote (101) from and an end
portion close (102) to the gripping means guide arrangement
(20),
15 the gripping means (100; 30) comprising a
first deflection device (104; 34), a first guide
portion (103; 33) extending in the X direction and a second
guide portion (110; 38) and
a first unilaterally flexible chain (300) which
20 interacts with the deflection device (104; 34) and has a
plurality of chain links (310) with a chain link length
KGL,
the unilaterally flexible chain (300) comprising a bending
limitation device (320, 321) which limits pivoting of the
25 chain links relative to one another in a first articulation
direction (GR1) and allows it in a second articulation
direction (GR2), and the first unilaterally flexible chain
(300) having a first end (301) remote from the gripping means
guide arrangement (20) and a second end (302) close to the
30 gripping means guide arrangement (20),
characterized in that the unilaterally flexible chain (300)
can be moved by means of a drive (155; 55) and can be
deflected by means of the deflection device in the second

articulation direction at an angle of between 70-110° to the X direction,

in that the unilaterally flexible chain (300) is arranged in such a way that, when the gripping means (100; 30) is moved
5 in the X direction, pushing forces can be transmitted to a piece good to be moved onto the deposit table (10),

and in that the unilaterally flexible chain (300) comprises an alignment device which, in the non-articulated state, holds the chain links in a mutually non-pivoted, stretched alignment
10 and secures them against pivoting in the second articulation direction.

2. Gripper for moving piece goods according to claim 1, characterized in that the alignment device of the unilaterally
15 flexible chain (300) is designed as a spring element (330) that extends through the chain and presses the chain links (310) in the first articulation direction (GR1) against the bending limitation device (320, 321).

20 3. Gripper for moving piece goods according to claim 1, characterized

in that the alignment device is formed by a plurality of latching arms (340) with latching lugs (341) and latching receptacles (342), wherein a latching arm of a chain link
25 (310) can interact with a latching receptacle (342) of an adjacent chain link and interacting latching arms and latching receptacles align the corresponding chain links in a stretched manner, and

in that the second guide portion (103) is designed in such
30 a way that it causes adjacent chain links to lock.

4. Gripper for moving piece goods according to any of claims 1-3, characterized in that the gripper has a second

gripping means (40), the second gripping means (40) having a receiving device which can be detachably connected to the first end (301) of the first unilaterally flexible chain (300) in such a way that a pushing force is transmitted to a piece
5 good when the gripping means are moved in the X direction toward the storage and retrieval end face (11).

5. Gripper for moving piece goods according to any of claims 1-4,

10 characterized in that the first deflection device (34) and/or the receiving device are arranged at the end portions of the gripping means (100; 30, 40) that are remote from the gripping means guide arrangement (20).

15 6. Gripper for moving piece goods according to claim any of claims 1-5,

characterized in that the first deflection device (34) and/or the receiving device can each be moved in the X direction by means of a drive (35, 75).

20

7. Gripper for moving piece goods according to any of claims 4-6,

characterized in that the receiving device of the second gripping means (40) comprises an opening (71) for receiving
25 the first end (301) of the first chain (300), the opening preferably having a depth greater than a chain link length.

8. Gripper (1) for moving piece goods according to any of claims 4-7,

30 characterized in that the receiving device is provided by a first end (61) of a second unilaterally flexible chain (60) which interacts with a second deflection device (44) and can be moved by means of a second chain drive (65) and can be

deflected by means of the second deflection device (44) at an angle of between 70-110° to the X direction, as a result of which the first end (61) of the second chain (60) can be moved into the space between the gripping means (30, 40) and the first ends (301, 61) of the chains (300, 60) can be detachably interconnected such that a pushing force is transmitted when the gripping means are moved in the X direction to the storage and retrieval end face (11).

9. Gripper (1) for moving piece goods according to any of claims 1-8,

characterized in that a gripping means (100; 30, 40) having a deflection device (104; 34, 44) at the end portion remote from the gripping means guide arrangement (20) has a further deflection device (37, 47) at the end portion close to the gripping means guide arrangement (20), with a unilaterally flexible chain being deflectable from the X direction, preferably at an angle $< 90^\circ$, by means of the further deflection device, as a result of which the second end of a chain can be moved over the deposit table (10).

10. Method for moving piece goods onto a gripper according to any of claims 1-9, wherein

the gripper is moved toward a storage surface (3) associated with a piece good (2) to be retrieved,

at least one gripping means (100; 30, 40) is moved in the X direction toward the storage surface (3) so that the piece good (2) is arranged next to it,

the first unilaterally flexible chain (300) is moved by means of the associated chain drive (155; 55) in such a way that the first end (301) is extended by the first deflection device (104; 34) remote from the gripping means guide arrangement (20) at an angle of between 70-110° to the X

direction, wherein adjacent chain links (310) downstream of the deflection device (104; 34) remote from the gripping means guide arrangement (20) are brought into a mutually non-pivoted, stretched alignment so that a stretched portion of the unilaterally flexible chain is moved behind the piece good in such a way that the piece good is arranged between the stretched portion of the chain and the deposit table, and the at least one gripping means (100; 30, 40) is moved in the X direction toward the deposit surface, with the stretched portion of the first unilaterally flexible chain pushing the piece good onto the deposit surface.

11. Method for moving piece goods onto a gripper according to any of claims 3-9, wherein the gripper is moved toward a storage surface (3) associated with a piece good (2) to be retrieved, the gripping means (30, 40) are moved in the X direction toward the storage surface (3) so that the piece good (2) is arranged between them, the first unilaterally flexible chain (300) is moved by means of the associated chain drive (55) in such a way that the first end (301) is extended by the first deflection device (34) remote from the gripping means guide arrangement (20) at an angle of between 70-110° to the X direction, wherein adjacent chain links (310) downstream of the deflection device (34) remote from the gripping means guide arrangement (20) are brought into a mutually non-pivoted, stretched alignment so that a stretched portion of the unilaterally flexible chain is moved behind the piece good in such a way that the piece good is arranged between the stretched portion of the chain and the deposit surface, the first end (301) of the first chain (300) is detachably connected to the receiving device of the second gripping means

(40) in such a way that pushing forces can be transmitted to the piece good when the gripping means are moved in the X direction toward the storage and retrieval end face (11), and

the gripping means (30, 40) are moved in the X direction
5 toward the deposit table (10) so that the piece good (2) is pushed onto the deposit table (10) of the gripper.

12. Method for moving piece goods according to claim 11, characterized in that the first end (301) is detachably
10 connected to the receiving device by

moving the second unilaterally flexible chain (60) by means of the associated chain drive (65) in such a way that the first end (61) of the second chain (60) is moved into the space between the gripping means (30, 40) by the second
15 deflection device (44) remote from the gripping means guide arrangement (20), and

the first ends (301, 61) of the chains (300, 60) are detachably interconnected in such a way that a pushing force is transmitted when the gripping means are moved in the X
20 direction toward the storage and retrieval end face (11).

13. Method for moving piece goods from a gripper according to any of claims 6-9 onto a storage surface (3), wherein

the deflection devices (34, 44) remote from the gripping
25 means guide arrangement (20) or a corresponding deflection device and the receiving device are moved toward the end portions (31, 41) of the gripping means (30, 40) that are close to the gripping means guide arrangement (20),

the first unilaterally flexible chain (300) is moved by
30 means of the associated chain drive (55) in such a way that the first free end (301) is moved into the space between the gripping means (30, 40) by the first deflection device (34) remote from the gripping means guide arrangement (20),

the first end (301) of the first chain (300) is detachably connected to the receiving device of the second gripping means (40) in such a way that pushing forces can be transmitted when the gripping means are moved in the X direction toward the
5 storage and retrieval end face (11), and

the gripping means (30, 40) are moved in the X direction over the storage and retrieval end face (11) so that the piece good is moved from the supporting table of the gripper.