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Description

The invention relates to a step conveyor for conveying parts from a storage container to a target position which is situated above the storage container, wherein the step conveyor comprises at least one fixed plate and one respective conveying surface, which is associated with the fixed plate and is positioned at an angle to a side surface of the fixed plate and, by way of an actuator of the step conveyor, is movable in relation to the fixed plate in order for the parts on the conveying surface to be lifted along this side surface in the conveying direction, wherein the conveying surface or at least one of the conveying surfaces is formed by an end piece which is attached in a releasable manner to a conveying plate which is displaceable by way of the actuator, wherein the end piece extends the conveying plate in the conveying direction. Such a step conveyor is known from the document CN 106 006 075 A. In addition, the invention relates to a step conveying system and a method for changing the step width of a step conveyor.

Step conveyors are used in particular to separate parts which are first supplied as bulk material and are intended to be subsequently separated and further processed in an orientated manner. For example, step conveyors are used in order to separate and optionally orientate screws, nuts or the like and to supply them to subsequent steps of a production process. An example of such a step conveyor is, for example, disclosed in the publication DE 10 2013 112 942 A1.

Document CN 106 006 075 A discloses a step conveyor for conveying parts from a storage container to a target position located above the storage container. The parts are in this instance lifted by means of a moving plate along a wall. In this instance, the raised part is supported by means of a roller which is provided in a fitting configured separately from the moving plate.

In order to achieve good separation and orientation of parts, the step geometry of a step conveyor has to be adapted to the geometry of the conveyed parts. Whilst this is readily possible, for example, in production plants which are used in the long term for the same production tasks, this can limit the usability of step conveyors when production sequences are varied in relatively short periods of time, for example, in the case of small-batch production. Also in the field of packing technology or in the handling of components, medications or the like in the medical sector, it may be desirable to process parts with a different shape or size at different times. In these cases, step conveyors cannot be readily used to separate or orientate or different step conveyors have to be kept or a complex retrofitting has to be carried out.

The object of the invention is consequently to provide a step conveyor which can be retrofitted with little complexity in order to convey different parts.

The object is achieved according to the invention by a step conveyor of the type mentioned in the introduction, wherein the respective conveying plate has at least one guide pin which extends in the or a transverse direction of the step conveyor, which transverse direction is at an angle, in particular at an angle between 70° and 110° with respect to the conveying direction and which is at least partially received in a respective cutout or aperture of the end piece and/or wherein the respective end piece has at least one guide pin extending in the transverse direction of the step conveyor and received at least partially in a respective cutout or aperture of the conveying plate.

The releasable securing of the end piece to the conveying plate enables the step conveyor to be retrofitted with little complexity by the end piece being removed from at least one conveying plate and being replaced with an exchange end piece. The exchange end piece may, for example, have a different surface profile of the conveying surface in order to adapt the shape of

the conveying surface for optimum separation and/or orientation of parts which are intended to be conveyed. In particular, as a result of the replacement of the end piece, the step width of the conveying surface may also be adapted so that, for example, when changing to smaller or narrower parts to be conveyed, the step width can be reduced in order to continue to achieve a reliable separation. A narrower step width of the conveying surface may, for example, be compensated for by the fact that the fixed plates are replaced with wider fixed plates or by a supporting component which is fitted to them at the top side also being changed, as will be explained in greater detail below.

Consequently, relatively extensive modifications of the step conveyor for adapting to the parts which are intended to be conveyed are possible, in particular without any intervention in the actuator system or movement mechanism of the step conveyor being required. While for conventional step conveyors a retrofitting for adaptation to other parts which are intended to be conveyed is consequently not possible or possible only with significant complexity, with the step conveyor according to the invention it is possible with very little complexity.

The fixed plate or a supporting component which is fitted thereto and the conveying surface form in each case individual steps of the step conveyor. In particular, the step conveyor may have a plurality of fixed plates, for example, two fixed plates, in order to provide a plurality of steps of fixed height, wherein in each case an associated conveying surface which is moved by the actuator is used in order to lift the parts to the height of this respective fixed step.

The displacement of the conveying plate may be carried out substantially parallel with the side surface of the fixed plate. In this instance, tolerance-related deviations may occur so that the displacement can be carried out, for example, at an angle of less than 10° or less than 5° with respect to the side surface. The displacement or conveying direction may extend in an angled manner with respect to the horizontal, in particular

at an angle of at least 45° or at least 60° in order to lift the parts by means of the displacement of the conveying surface.

The conveying surface and/or an end face of the fixed plate or a temporary holding surface which is formed by a supporting component which is coupled to the fixed plate for the parts may stand substantially perpendicularly, for example, at an angle between 80° and 100°, with respect to the side surface of the fixed plate. As a result of an inclination of the side surface of the fixed plate or alternatively by selecting a suitable angle between the conveying surface or temporary holding surface for the parts, on the one hand, and the side surface of the fixed plate, on the other hand, when an adequate height of the conveying surface is reached a movement, for example, a sliding or rolling, of the parts with respect to the temporary holding surface which is supported by the fixed plate can be carried out. In the case of a multi-stage conveying operation, a further movement of the part in this instance can initially be stopped by the side surface the next conveying plate until the conveying surface which is coupled thereto has been lowered sufficiently for the parts to be able to move further on this conveying surface, etcetera.

Preferably, the step conveyor can be used under clean room conditions and/or is suitable for contact with foodstuffs or medications. In these sectors, it is advantageous to electrically drive the step conveyor. Possible ways of doing this will be explained below. In addition, suitable materials have to be selected. The fixed plate and the conveying plate and additional components, for example, a housing, may, for example, be produced from high-grade steel. The end piece or a supporting component which is used to form the temporary holding surface on the fixed plate may either also be made from high-grade steel or from a plastics material. In this instance, plastics materials which are suitable for contact with foodstuffs or medications are preferably used, for example, polyethylene or polypropylene.

The end piece may be attached to the conveying plate by at least one fastening means, in particular a screw, wherein the fastening means extends through a lateral terminating face of the end piece in a transverse direction of the step conveyor which is located at an angle, in particular at an angle between 70° and 110° with respect to the conveying direction, and acts on the conveying plate, wherein in particular the fastening of the end piece is carried out exclusively by the fastening means which extend through exactly one lateral terminating face.

In particular, the respective fastening means can be released by means of an activation portion which is exposed in the transverse direction, for example, a screw head. With respect to the fastening means which engage from the conveying surface, a smoother conveying surface which is consequently better to clean can be provided, whereby the suitability for use in the food sector or medical sector is thereby improved.

As a result of an exclusive fastening of the end piece by fastening means which extend through precisely one lateral terminating face, the changing of end pieces can be further facilitated. For example, it may be sufficient to open one or more screws on a lateral terminating face in order to subsequently be able to lift or remove the end piece. In particular, it may thereby be possible for the entire retrofitting of the step conveyor for conveying other parts to be able to be carried out from one side of the step conveyor so that, for example, a housing of the step conveyor only has to be opened at one side or an adequate accessibility for a corresponding retrofitting can be achieved more easily.

The transverse direction is located in particular substantially perpendicularly to the conveying direction, for example, at an angle between 70° and 110° with respect to the conveying direction. In particular, the transverse direction is also located at an angle, in particular perpendicularly or at an angle between 70° and 110°, on the normal of the side surface of the fixed plate. The fastening means may consequently be

accessible from the lateral edges of the step conveyor. Compared with access, for example, via an end face in the stacking direction of the plates, easier access may thereby be achieved and it is possible to prevent the fastening means or receiving spaces for them from leading to friction between the components of the step conveyor or to avoid the need to use relatively large gaps for avoiding friction.

The terminating face may be located at an angle, in particular at an angle between 70° and 110°, in particular substantially perpendicularly, to the conveying surface and/or the side surface of the fixed plate. In particular, two or more fastening means per end piece can be used, which can lead to an improvement of the securing of the orientation of the end piece.

The respective conveying plate has at least one guide pin which extends in the or a transverse direction of the step conveyor which is located at an angle, in particular at an angle between 70° and 110° with respect to the conveying direction and which is at least partially received in a respective cutout or aperture of the end piece or alternatively or additionally the respective end piece has at least one guide pin which extends in the transverse direction of the step conveyor and which is at least partially received in a respective cutout or aperture of the conveying plate. The use of at least one guide pin may support the securing of the position and/or orientation of the end piece. This may, on the one hand, serve to facilitate the assembly, for example, by the position of the aperture of the terminating face being determined by the guide pin with respect to a receiving member for the fastening means on the conveying plate. In addition, by means of one or in particular a plurality of guide pins, the position and orientation with the exception of a degree of freedom in the longitudinal direction of the at least one guide pin may already be determined so that it is sufficient for the fastening means to block a movement in this direction in order to secure the end piece to the conveying plate. The assembly can thereby be further facilitated.

The guide pin preferably extends at an angle between 80° and 100° with respect to the terminating face and/or in a direction which is located at an angle of a maximum of 10° with respect to the side surface of the fixed plate. In particular, the respective guide pin of the conveying plate extends in the transverse direction in the direction of the terminating face of the end piece or the guide pin of the end piece extends in the transverse direction away from the terminating face. The end piece can then be guided in the transverse direction via the guide pin, pushed up to a stop and be clamped by this and the fastening means. In particular, in total two or more guide pins can be used in order, for example, to secure the end piece so as to prevent rotation on the conveying plate. Alternatively, this could also be achieved with a guide pin with a non-round form.

A temporary holding surface which is formed by the fixed plate and/or by a supporting component which is attached thereto and to which the parts are guided by the conveying surface which is associated with the respective fixed plate may have an extent, perpendicular to the side surface of this fixed plate, which is at least 20% or at least 50% greater than that of the associated conveying surface. In conventional step conveyors, the same widths are used for the different steps. As already mentioned in the introduction, in the case of conveying parts which are significantly narrower than the step width, a significantly worse separation or orientation may result. In the step conveyor according to the invention, as a result of the assembly of suitable end pieces, it is possible to selectively use narrower conveying surfaces and to compensate for this by a wider temporary holding surface being used. A similarly good separation and orientation can thereby be achieved, as with the use of a narrower step width for all the steps. At the same time, however, the complexity for retrofitting the step conveyor is considerably less than for a reduction of the step width of all the steps since for this purpose, for example, modifications of the drive mechanism would also be necessary. The supply and removal of parts as a result of the proposed procedure may also

remain unchanged in the step conveyor according to the invention even when narrower parts are intended to be conveyed.

The or a temporary holding surface, to which the parts are guided by the respective conveying surface, may be formed by the or a supporting component which is releasably secured to the fixed plate associated with the respective conveying surface and which extends it in the conveying direction. In particular, the supporting component may be secured to the fixed plate in the same manner as the end piece to the conveying plate. Consequently, the features explained above for connecting the end piece to the conveying plate can be transferred to the connection of the supporting component to the fixed plate. The related features of the end piece can be transferred to the supporting component and the related features of the conveying plate to the fixed plate.

As a result of the configuration of the temporary holding surface by means of a supporting component which is releasably secured to the fixed plate, it is possible not only to adapt the conveying surface by changing the end piece but also the temporary holding surface by changing the supporting component. For example, it may be possible by means of appropriate selection of the surface shape or texture of the supporting component to support the orientation or separation of parts or depending on the parts which are intended to be conveyed to use conveying surfaces and temporary holding surfaces made of different materials.

Changeable supporting components may in particular be advantageous when, in order to adapt to specific parts, an end piece with a reduced width perpendicular to the side surface of the fixed plate is intended to be used. This would with a conveying geometry which is otherwise identical lead to wide gaps between the conveying surface and temporary holding surface if they are located at the same height. This can be avoided if the width of the temporary holding surface is also adapted by replacing the supporting component in order to compensate for

the reduction of the width of a conveying surface by means of corresponding widening of the temporary holding surface.

In order to ensure that even heights of the conveying surface below the temporary holding surface and in particular below the supporting component do not result in excessively large gaps, it is possible to replace the fixed plate or to move it in the direction of the associated conveying surface, for example, by means of a displacement within grooves and securing at another position or by means of a transfer between fixedly predetermined positions. Alternatively or additionally, to this end, additional spacers may be installed on the side surface.

The supporting component may be fitted to the fixed plate by means of at least one fastening means, in particular a screw, wherein the fastening means extends through a lateral terminating face of the supporting component in the or a transverse direction of the step conveyor which is located at an angle, in particular at an angle between 70° and 110° relative to the conveying direction and engages on the conveying plate, wherein in particular the securing of the supporting component is carried out exclusively by the fastening means which extend through the precisely one lateral terminating face. The same advantages can thereby be achieved as by the above-explained corresponding securing of the end piece to the conveying plate.

The fixed plate may have at least one guide pin which extends in the or a transverse direction of the step conveyor which is located at an angle, in particular at an angle between 70° and 110° relative to the conveying direction and which is at least partially received in a respective cutout or aperture of the supporting component, and/or the respective supporting component may have at least one guide pin which extends in the transverse direction of the step conveyor and which is at least partially received in a respective cutout or aperture of the fixed plate. The same advantages can thereby be achieved as have been explained above in relation to the guiding of the end piece by the guide pins.

Preferably, the actuator is an electric motor. Additionally or alternatively, it is preferable for the actuator to be used to drive a rotation of a rotatable component which is coupled to the conveying surface in such a manner that a rotation of the rotatable component results in a linear displacement of the conveying surface.

Typically, moving steps of step conveyors are pneumatically driven. In clean room applications or during the conveying of foodstuffs, medications or other parts for the medical sector, it may be problematic in this instance that, as a result of contamination of the compressed air foreign bodies can be introduced. A pneumatic drive with compressed air which is sufficiently free from contamination is, however, very complex. It is therefore, particularly in the sectors or applications mentioned, advantageous to electrically drive the step conveyor or to use an electric motor as an actuator.

It is in principle possible to directly use a linear motor for driving the step conveyor. However, this is technically relatively complex so that it is typically advantageous to use an electric motor with a rotating output shaft. The rotatable component may be the output shaft itself or, for example, a disc or the like which is coupled thereto. The electric motor is preferably a low-voltage motor, for example, a 24 V motor. A network-independent operation of the step conveyor, for example, a supply via batteries, can thereby be produced.

The rotatable component may have a projection which is arranged eccentrically in relation to the rotation axis thereof and which engages in a cutout or aperture of the conveying plate or at least one of the conveying plates or a respective coupling component which is rigidly coupled to the respective conveying plate. The projection may in the event of a rotation of the rotatable shaft be moved substantially parallel with the conveying plate or the side surface of the associated fixed plate. If the dimensions of the cutout or aperture are selected

in such a manner that the extent in the conveying direction is only insignificantly, for example, by a maximum of 10% or a maximum of 20% greater than the extent of the projection but at least significantly less than double the spacing of the projection from the rotation axis, the movement of the conveying plate in the conveying direction substantially follows the movement of the projection in this direction. In the direction perpendicular to the conveying direction, the dimension of the cutout or the aperture can be selected in such a manner that it is at least twice as large as the spacing of the projection from the rotation axis of the rotatable component. Movements of the projection perpendicularly to the conveying direction are consequently decoupled from the conveying plate, so that the circular movement of the projection is converted into a linear movement of the conveying plate with periodically changing direction.

The procedure described is, on the one hand, very simple, particularly since no complex control of the step conveyor is required, but instead a simple operation is, for example, possible simply by an electric motor which drives the rotatable component being continuously supplied with electrical power so that it rotates, for example, at a constant speed. On the whole, a simple, advantageous and robust implementation of the step conveyor results. At the same time, it is possible for the speed of the conveying surface towards the reversal locations to continuously decrease and consequently sudden direction change is avoided. This leads, on the one hand, to a reduction of the loading of the mechanism of the step conveyor and consequently to less wear and, on the other hand, to a gentler conveying of the parts.

Alternatively, driving via a rotatable component, for example, a rotary electric motor, could be carried out by the rotation movement being converted into a linear movement via a toothed rack, a rubber roller which runs on the conveying plate or the like. In this instance, however, a more complex control would be required since the rotation direction of the rotatable

component at the reversal locations of the conveying plate would have to be reversed. The complexity for the control of the drive would additionally further increase if the above-described braking of the conveying surfaces was also intended to be carried out in the region of the reversal locations.

The step conveyor may comprise at least two of the conveying plates, wherein the conveying plates are coupled to the actuator in such a manner that during operation of the actuator they are moved together in the same direction. For example, the eccentrically arranged projection of the rotatable component may be formed by a rod which extends through the apertures of both conveying plates, or the like.

The step conveyor may have an apparatus for discharging dust or other small particles of contamination. For example, between the storage container and an adjacent conveying surface or the conveying plate which is coupled thereto, a gap through which corresponding contamination can fall into a collection container, onto a slide for discharging the contamination or the like may remain.

In addition to the step conveyor according to the invention, the invention comprises a step conveying system which comprises a step conveyor according to the invention and at least one exchange end piece, wherein the exchange end piece is used to replace a respective associated end piece of the step conveyor during retrofitting. The step conveying system according to the invention consequently enables a replacement of at least one of the end pieces as required in order to adapt the step conveyor to a respective conveying task.

The conveying surface formed by the exchange end piece in the mounted state may have an extent perpendicular to the side surface of the associated fixed plate which differs from the extent of the conveying surface of the associated end piece in this direction. Alternatively or additionally, the conveying surface of the exchange end piece may have a different surface

texture and/or shape from the associated end piece. Advantages of the adaptable step width, surface texture and/or shape have already been explained above with reference to the step conveyor according to the invention.

Should additional components be required for retrofitting the step conveyor, for example, a replacement supporting component which can replace a supporting component of the step conveyor in the context of the retrofitting, these additional replacement components may also be part of the step conveying system according to the invention.

In addition, the invention relates to a method for changing the step width of a step conveyor according to the invention, wherein at least one end piece of the step conveyor is replaced by an exchange end piece, wherein the conveying surface which is formed by the exchange end piece in the mounted state has an extent perpendicular to the side surface of the associated fixed plate which differs from the extent of the conveying surface of the previously mounted end piece in this direction. Depending on how significantly the extent of the conveying surface is changed by this retrofitting, it may be advantageous in an additional method step to adapt at least one of the temporary holding surfaces, for example, as explained above, by at least one supporting component being replaced by a replacement supporting component and/or the position of at least one of the fixed plates being changed and/or at least one of the fixed plates being replaced with a replacement plate.

Other advantages and details of the invention will be appreciated from the exemplary embodiments and the associated drawings. In the schematic drawings:
Figure 1 shows an exemplary embodiment of the step conveying system according to the invention which comprises an exemplary embodiment of the step conveyor according to the invention,
Figure 2 shows a disassembled end piece or a disassembled supporting component which can be used in the step conveyor

which is shown in Figure 1 in order to form the conveying surface or a temporary holding surface,

Figure 3 shows the assembly of the end piece shown in Figure 2 or the supporting component shown in Figure 2 on a conveying plate or fixed plate which can be carried out, in particular in the context of an exemplary embodiment of the method according to the invention, and

Figure 4 shows a detailed view of the step conveyor shown in Figure 1 which shows the coupling of the actuator to one of the conveying plates.

Figure 1 shows a step conveyor 1 for conveying parts 2 from a storage container 3 to a target position 4 located above the storage container 3. The parts are typically introduced as heaped bulk material into the storage container 3, wherein for reasons of clarity only a single part 2 is illustrated in Figure 1. The step conveyor 1 comprises in the example two fixed plates 6, 7 which may be fitted, for example, directly to the housing 25. As a result of conveying plates 15, 16 which are arranged in the stacking direction 18 in each case adjacent to the fixed plates 6, 7, end pieces 13, 14 which are releasably connected thereto and which form a conveying surface 8, 9 which is associated with the respective fixed plate 6, 7 are carried.

As a result of an actuator 12, the conveying plates 15, 16 and consequently also the end pieces 13, 14 and the conveying surfaces 8, 9 can be displaced in a conveying direction 17. In particular during operation of the step conveyor they are periodically displaced from the position shown in Figure 1 into a respective upper position 19, 20 illustrated with broken lines. In this instance, the fixed plates 15, 16 and consequently also the conveying surfaces 8, 9 may in particular be moved together and synchronously.

Based on the operating situation schematically illustrated in Figure 1, the part 2 may initially as a result of the oblique base of the storage container 3 slide or roll in the stacking direction 18 towards the conveying surface 8. If, at the time

at which the part 2 reaches the end of the storage container, the conveying surface 8 is in the position shown in Figure 1, the part 2 is stopped by the side surface 10 of the fixed plate 6 and consequently comes to rest on the conveying surface 8. In other positions of the conveying plate 15, the part 2 is first stopped by the conveying plate 15 or end piece 13 and moves onto the conveying surface 8 only when the position shown in Figure 1 is reached.

After the part 2 has reached the conveying surface 8, a movement of the conveying plate 15 in the direction of the second position 19 leads to a raising of the part 2 on the conveying surface 8, wherein the part 2 is guided along the side surface 10 of the fixed plate 6. In this instance, an incorrect orientation of the part 2 or a layering of a plurality of parts 2 on the conveying surface 8 may lead to excess or incorrectly orientated parts falling back into the storage container 3. During the conveying, a separation or orientation of the parts 2 can thus be achieved.

As soon as the second position 19 is reached, the conveyed part 2 may slide or roll onto the temporary holding surface 21. In this instance, the second conveying plate 16 is, however, first in the second position 20 thereof since it is moved synchronously with the first conveying plate 15. That is to say, the part 2 initially remains on the temporary holding surface 21 until the conveying plate 16 has again reached the position shown in Figure 1. At this time, the part 2 can slide or roll onto the conveying surface 9 and subsequently be conveyed onwards thereby, as already explained for the previous conveying by the conveying surface 8.

After reaching the second position 20 as a result of the conveying surface 9, the part can reach the target position 4 via the temporary holding surface 22 which in the example is a slide by means of which the part 2 is guided to another device 5, for example, a conveying or processing device.

The already-mentioned function of separation or orientation of the parts 2 is largely dependent on the size and shape of the part 2 and the width of the conveying surfaces 8, 9 in the stacking direction 18. In addition, this function can be further improved in some circumstances by means of suitable shaping of the conveying surface 8, 9. If different parts 2 are intended to be conveyed by the step conveyor 1 at different times, it may therefore be desirable to use conveying surfaces 8, 9 which have different widths or which are configured differently. In order to enable this, the conveying surfaces 8, 9, as already mentioned above, are formed by means of end pieces 13, 14 which are releasably connected to the conveying plates 15, 16. A step conveying system schematically illustrated in Figure 1 can, in addition to the step conveyor 1 consequently for at least one of the conveying plates 15, 16, comprise an exchange end piece 26 which in place of the respective end piece 13, 14 can be fitted to the respective conveying plate 15, 16. This may have a different structure of the conveying surface, for example, an additional or differently shaped recess or the like. If this is the only difference in this instance, the retrofitting of the step conveyor 1 is already complete after the replacement of the end pieces 13, 14.

In order to be able to better separate relatively large or small parts 2, however, it may also be advantageous for at least one of the end pieces 13, 14 to be replaced with an exchange end piece 26 with a different width 27 in the stacking direction 18. The width of a gap between the end pieces 13, 14 and the adjacent fixed plates 6, 7 or the supporting components 23, 24 which are fitted thereto is thereby also initially varied. It may therefore be advantageous to also replace all of the fixed plates 6, 7. The retrofitting of the step conveyor 1 is nonetheless not too complex since no intervention in the movement mechanism is required.

In a particularly preferred manner, however, a change of the width 27 of the end pieces 13, 14 can be compensated for by the fact that the supporting components 23, 24 which form the

temporary holding surfaces 21, 22 are also replaced by a respective replacement supporting component 28. Under some circumstances, it may additionally be necessary to adapt the positions of the fixed plates 6, 7 in the stacking direction 18, for example, by them being displaced into grooves of a retention member and secured in a new position.

In conventional step conveyors, a same width is used for the conveying surfaces 8, 9 and the temporary holding surfaces 21, 22. If for adapting to the parts which are intended to be conveyed or separated, the width 27 of the end pieces 13, 14 is adapted, but with the basic geometry of the step conveyor 1, in particular the spacing of the conveying plates 15, 16, being intended to remain consistent, this typically results in a different width of the conveying surface and temporary holding surface. In order to keep drop heights of the parts small during separation, it is advantageous in this instance to keep the conveying surface narrower than the temporary holding surface. With a configuration of the step conveyor for the maximum part size to be conveyed, the temporary holding surfaces 21, 22 and the conveying surfaces 8, 9 may have substantially the same extent perpendicularly to the side surface 10, 11 of the fixed plates or in the stacking direction 18. For conveying smaller parts, a configuration can then be used in which the extent of the temporary holding surface 21, 22 in this direction is at least 20% or at least 50% greater than the extent of the associated conveying surface 8, 9 in this direction.

One advantageous possibility of mounting the end pieces 13, 14 on the conveying plates 15, 16 is explained below with reference to Figures 2 and 3. The same procedure can preferably also be used to secure the supporting components 23, 24 to the fixed plates 15, 16 so that below the securing of the end pieces 13, 14 and the supporting components 23, 24 is discussed together. However, it would also be possible to mount the supporting components 23, 24 in another manner or instead of using supporting components 23, 24 forming the temporary holding surfaces 21, 22 directly using the fixed plates 6, 7 themselves.

Figure 2 shows a perspective view of an exemplary end piece 13, 14 or an exemplary supporting component 23, 24. The conveyor or temporary holding surface 8, 9, 21, 22 is by way of example illustrated in a smooth state but may also be structured in order, for example, to support an orientation of the parts 2. In addition, the width 27 can vary for different end pieces 13, 14 or supporting components 23, 24.

The assembly is illustrated schematically in Figure 3. In this instance, the respective end piece 13, 14 or the respective supporting component 23, 24 is first, as depicted schematically by the arrow 29, pushed in the transverse direction, that is to say, perpendicularly to the drawing plane in Figure 1, onto the respective conveying plate 15, 16 or fixed plate 6, 7 so that the guide pins 30 are introduced into the cutouts 31, whereby with the exception of a displaceability in the transverse direction the position and orientation of the end piece 13, 14 or the supporting component 23, 24 with respect to the respective conveying plate 15, 16 or fixed plate 6, 7 are already determined. In this instance, it would of course alternatively also be possible to provide all or parts of the guide pins 30 on the respective end piece 13, 14 or on the respective supporting component 23, 24 and to provide cutouts for receiving the guide pins 30 in the respective conveying plate 15, 16 or the fixed plate 6, 7.

Subsequently, as illustrated schematically by the arrows 32 in Figure 3, fastening means 33, for example, screws are guided through apertures 35 of the terminating face 34 of the respective end piece 13, 14 or the respective supporting component 23, 24 and engage on the respective conveying plate 6, 7 or fixed plate 15, 16, that is to say, for example, are screwed into the respective thread 36. A robust securing of the end pieces 13, 14 or supporting components 23, 24 on the respective conveying plate 6, 7 or fixed plate 15, 16 is thereby carried out. At the same time, as a result of the described securing, on the one hand, conveyed parts 2 do not contact the fastening means 33,

whereby contamination of parts can be avoided, and, on the other hand, access to the step conveyor 1 is required only from one side in the transverse direction in order to mount, disassemble or replace the end pieces 13, 14 or supporting components 23, 24.

Particularly when the step conveyor 1 is intended to be used in a clean room or to convey food products or medications, a pneumatic drive would be disadvantageous since in this instance discharged air could potentially lead to contamination. There is therefore used in the step conveyor 1 as an actuator 12 an electric motor which drives a rotating component 37, the rotation of which is illustrated schematically by the arrow 38. On the rotating component 37, there is arranged a projection 39 which, as can be clearly seen in particular in Figure 1 and Figure 4, is guided through apertures 40, 41 of the conveying plates 15, 16.

The movement of the projection 39 on a circular path 42 is schematically illustrated in Figure 4. As can be seen here, the dimensions of the apertures 40, 41 are selected in such a manner that in the conveying direction 17 there is hardly any play of the projection 39 with respect to the aperture 40, 41, whilst the projection 39 can be moved freely in the transverse direction 43 over the entire movement path reached. This leads to the movement of the projection 39 in the conveying direction 17 being transmitted substantially completely to the conveying plates 15, 16 whilst with respect to the movement in the transverse direction 43 a movement decoupling is carried out. The circular movement of the projection 39 is consequently converted into a linear movement of the conveying plates 15, 16 in the conveying direction 17.

In this instance, in particular the advantage is achieved that the movement speed of the conveying plates 15, 16 and consequently of the conveying surfaces 8, 9 in the region of the reversal locations is very small, whereby smaller mechanical

loads for the components of the step conveyor and for the conveyed parts 2 result.

Since bulk material is typically conveyed by the step conveyor 1, together with the parts 2, contamination, for example, dust can be guided to the storage container 3. In order to introduce the smallest possible amount of contamination into the step conveyor 1, it is possible for there to remain between the storage container 3 and the conveying surface 8 or the conveying plate 15 a gap 44 through which the contamination falls and can be discharged via a collection or discharge device 45, for example, a slide.

Patentkrav

1. Trintransportør (1) til transport af dele (2) fra en forrådsbeholder (3) til en målposition (4), der ligger oven over forrådsbeholderen (3), hvor trintransportøren (1) omfatter i det mindste en faststående plade (6, 7) og en respektiv til den faststående plade (6, 7) tilordnet transportoverflade (8, 9), der står i en vinkel til en sideflade (10, 11) af den faststående plade (6, 7) og ved hjælp af en aktuator (12) i trintransportøren (1) kan bevæges i forhold til den faststående plade (6, 7) for at løfte delene (2) på transportoverfladen (8, 9) langs denne sideflade (10, 11) i transportretningen (17), hvor transportoverfladen (8, 9) eller i det mindste en af transportoverfladerne (8, 9) er dannet af et endestykke (13, 14), der er anbragt løsbart på en transportplade (15, 16), der kan forskydes ved hjælp af aktuatoren (12), hvor endestykket (13, 14) forlænger transportpladen (15, 16) i transportretningen (17),
kendetegnet ved,
at den respektive transportplade (15, 16) har i det mindste en føringsstift (30), der strækker sig i tværretningen eller en tværretning (43) af trintransportøren (1), hvilken tværretning står i en vinkel, især i en vinkel mellem 70° og 110°, til transportretningen (17), og hvilken føringsstift i det mindste afsnitsvist er optaget i en respektiv udtagning (31) eller gennembrydning af endestykket (13, 14), og/eller at det respektive endestykke (13, 14) har i det mindste en føringsstift, der strækker sig i trintransportørens (1) tværretning (43), og som i det mindste afsnitsvist er optaget i en respektiv udtagning eller gennembrydning af transportpladen (15, 16).

2. Trintransportør ifølge krav 1,
kendetegnet ved,
at endestykket (13, 14) ved hjælp af i det mindste et fastgørelsesmiddel (33), især en skrue, er anbragt på transportpladen (15, 16), hvor fastgørelsesmidlet (33) gennemtrænger en sideværts afslutningsflade (34) på endestykket

(13, 14) i en tværretning (43) af trintransportøren (1), hvilken tværretning står i en vinkel, især i en vinkel mellem 70° og 110°, til transportretningen (17) og indvirker på transportpladen (15, 16), hvor især fastgørelsen af endestykket (13, 14) udelukkende sker via fastgørelsesmidlerne (33), som gennemtrænger den præcist ene sideværts afslutningsflade (34).

3. Trintransportør ifølge et af de foregående krav, kendetegnet ved,
at en af den faststående plade (6, 7) og/eller af en på denne anbragt støttekomponent (23, 24) dannet mellemlejeflade (21, 22), til hvilken delene (2) føres ved hjælp af den til den respektive faststående plade (6, 7) tilordnede transportoverflade (8, 9) har en mindst 20% eller mindst 50% større udstrækning vinkelret på sidefladen (10, 11) af denne faststående plade (6, 7) end den tilordnede transportoverflade (8, 9).

4. Trintransportør ifølge et af de foregående krav, kendetegnet ved,
at mellemlejeoverfladen eller en mellemlejeoverflade (21, 22), til hvilken delene (2) føres ved hjælp af den respektive transportoverflade (8, 9), er dannet af støttekomponenten eller en støttekomponent (23, 24), der er løsbart fastgjort på den til den respektive transportoverflade (21, 22) tilordnede faststående plade (6, 7) og forlænger denne i transportretningen (17).

5. Trintransportør ifølge et af de foregående krav, kendetegnet ved,
at aktuatoren (12) er en elektromotor, og/eller at aktuatoren (12) tjener til at fremdrive en rotation af en drejelig komponent (37), der er koblet sådan med transportoverfladen (8, 9), at en rotation af den drejelige komponent (37) fører til en lineær forskydning af transportoverfladen (8, 9).

6. Trintransportør ifølge krav 5, kendetegnet ved,

at den drejelige komponent (37) har et i forhold til sin drejeakse excentrisk anbragt fremspring (39), som indgriber i en udtagning eller gennembrydning (40, 41) i transportpladen (15, 16) eller i det mindste en af transportpladerne (15, 16) eller en respektiv koblingskomponent, der er stift forbundet med den respektive transportplade (15, 16).

7. Trintransportør ifølge et af de foregående krav, kendetegnet ved,
at den omfatter i det mindste to af transportpladerne (15, 16), hvor transportpladerne (15, 16) er sådan koblet med aktuatoren (12), at de ved en drift af aktuatoren (12) bevæges i fællesskab og i den samme retning.

8. Trintransportsystem, omfattende en trintransportør (1) ifølge et af de foregående krav,
hvor
trintransportørsystemet omfatter i det mindste et udskiftningsendestykke (26), hvor udskiftningsendestykket (26) tjener til at erstatte et respektivt tilordnet endestykke (13, 14) i trintransportøren (1) som led i en omstilling.

9. Trintransportsystem ifølge krav 8, kendetegnet ved,
at den ved hjælp af udskiftningsendestykket (26) i den monterede tilstand dannede transportoverflade (8, 9) har en udstrækning vinkelret på den tilordnede faststående plades (6, 7) sideflade (10, 11), hvilken udstrækning adskiller sig fra udstrækningen af det tilordnede endestykkes (13, 14) transportoverflade (8, 9) i denne retning.

10. Fremgangsmåde til ændring af trinbredden af en trintransportør ifølge et af kravene 1 til 7,
hvorved
i det mindste et endestykke (13, 14) i trintransportøren (1) erstattes med et udskiftningsendestykke (26), hvorved den ved hjælp af udskiftningsendestykket (26) i den monterede tilstand dannede transportoverflade (8, 9) har en udstrækning vinkelret

på sidefladen (10, 11) af den tilordnede faststående plade (6, 7), hvilken udstrækning adskiller sig fra udstrækningen af det forangående monterede endestykkes (13, 14) transportoverflade (8, 9) i denne retning.

FIG. 1

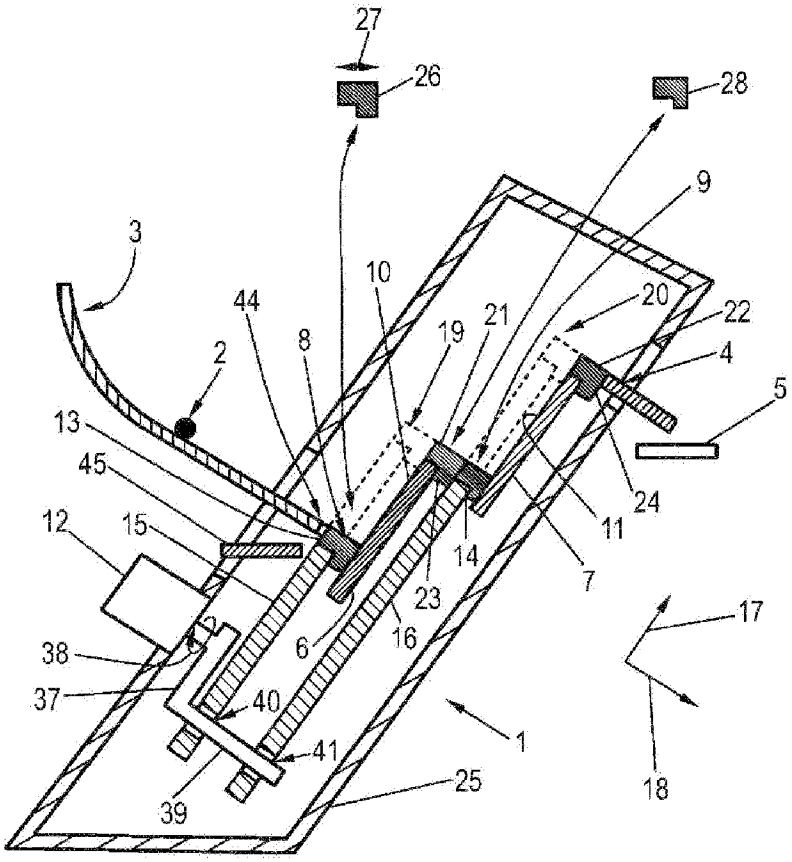
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FIG. 2

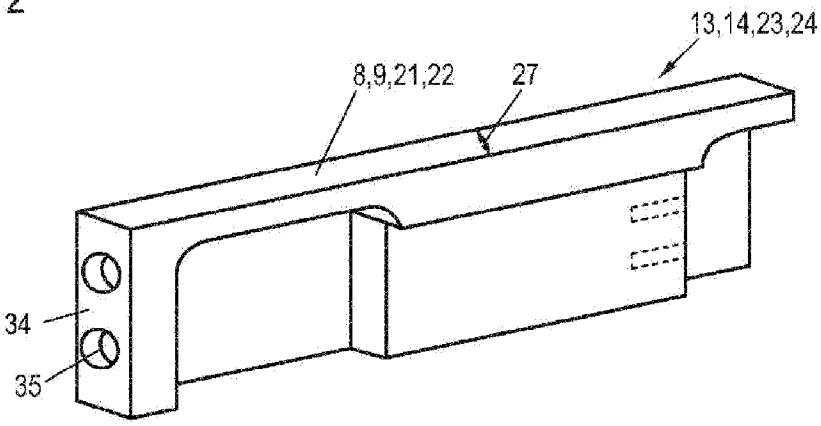

FIG. 3

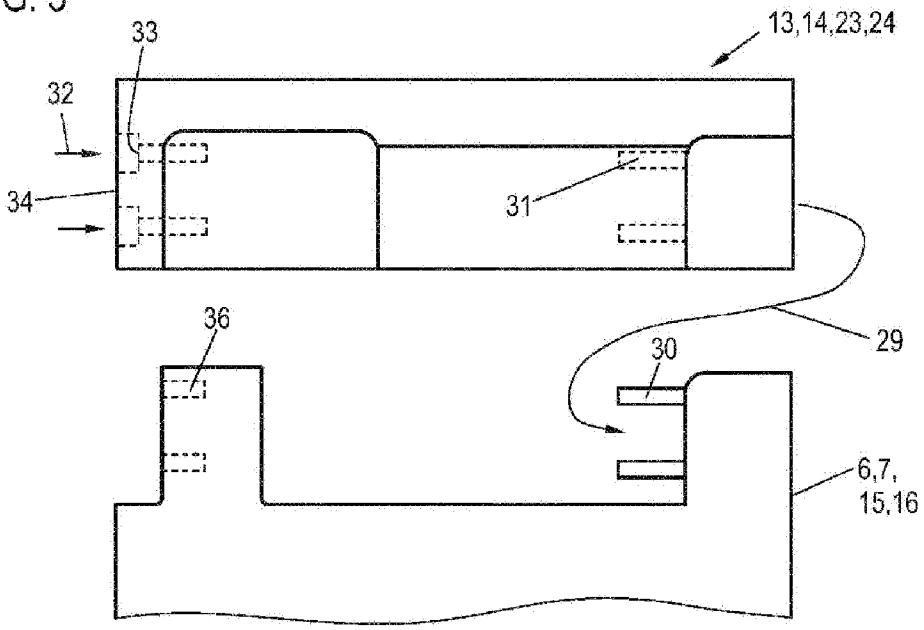

FIG. 4