Title: CONVEYOR DEVICE HAVING A ROTATABLE TRANSFER SECTION

Fig. 1

Abstract:
The invention relates to a conveyor device (2) for transporting objects, such as goods or workpieces, in particular motor vehicle bodies (12). The conveyor device (2) has a conveyor segment (16) on which the objects (12) can be displaced by means of a fixedly arranged drive system (40, 42), changing the direction of movement (46, 50, 54, 8). According to the invention, the conveyor segment (16) comprises at least one transfer section (24, 30, 36), to which the objects (12) are supplied with a first direction of movement (48, 52, 56), in which the objects (12) are rotated about a rotational axis (48, 52, 56), and from which the objects (12) are removed with a second direction of movement (50, 54, 58) that is different from the first direction of movement (46, 50, 54).
(54) Title: CONVEYOR DEVICE HAVING A ROTATABLE TRANSFER SECTION

(54) Bezeichnung: FORDERVORRICHTUNG MIT DREHBAREM UMSETZABSCHNITT

(57) Abstract: The invention relates to a conveyor device (2) for transporting objects, such as goods or workpieces, in particular motor vehicle bodies (12). The conveyor device (2) has a conveyor segment (16) on which the objects (12) can be displaced by means of a fixedly arranged drive system (40, 42), changing the direction of movement (46, 50, 54, 8). According to the invention, the conveyor segment (16) comprises at least one transfer section (24, 30, 36), to which the objects (12) are supplied with a first direction of movement (48, 52, 56), in which the objects (12) are rotated about a rotational axis (48, 52, 56), and from which the objects (12) are removed with a second direction of movement (50, 54, 58) that is different from the first direction of movement (46, 50, 54).

(57) Zusammenfassung:

[Fortsetzung auf der nächsten Seite]
Die Erfindung betrifft eine Fördervorrichtung (2) für das Transportieren von Gegenständen, z.B. Waren oder Werkstücke, insbesondere Kraftfahrzeugkarossen (12). Die Fördervorrichtung (2) hat eine Förderstrecke (16), auf der die Gegenstände (12) unter Änderung der Bewegungsrichtung (46, 50, 54, 8) mit einem ortsfest angedachten Antriebssystem (40, 42) verlagerbar sind. Erfindungsgemäß weist die Förderstrecke (16) wenigstens einen Umsetzabschnitt (24, 30, 36) auf, dem die Gegenstände (12) mit einer ersten Bewegungsrichtung (48, 52, 56) zugeführt werden, in dem die Gegenstände (12) um eine Drehachse (48, 52, 56) gedreht und aus dem die Gegenstände (12) mit einer von der ersten Bewegungsrichtung (46, 50, 54) verschiedenen zweiten Bewegungsrichtung (50, 54, 58) abtransportiert werden.
Conveyor device having a rotatable transfer section

Description

5 The invention relates to a conveyor device for transporting objects arranged in succession, for example goods or workpieces, in particular motor vehicle bodies, having a conveyor segment on which the objects can be moved by means of a fixed drive system, changing the direction of movement. The invention additionally relates to a facility for treating the surface of workpieces, in particular for drying workpieces, for example motor vehicle bodies, by means of a conveyor device of this type.

15 A conveyor device of the type mentioned in the introduction is known from DE 199 50 202 A1 or EP 0 641 984 B1. Such conveyor devices are used in industrial production facilities, in particular in coating or cleaning facilities. They can be used to move workpiece carriers with production objects, for example baskets or also frames or frameworks, in particular also transport slides known as "skids", on which the production objects are received, through a facility. The workpiece carriers are moved here on a multiplicity of rolls, some of which are driven and some of which are not driven.

The object of the invention is provide a conveyor device with which objects that are arranged in succession on a conveyor segment can be transported with high throughput through a facility arranged in a confined space.

35 This object is achieved by a conveyor device of the type mentioned in the introduction, in which the conveyor segment contains at least one transfer section, to which the objects are supplied with a first direction of movement, in which the objects are rotated
about a fixed axis of rotation, and from which the objects are removed with a second direction of movement that is different from the first direction of movement.

The conveyor device preferably has a conveyor segment with a transfer section, upstream of which an acceleration section is arranged and downstream of which a braking section is arranged.

In the acceleration section, the objects are accelerated by means of a supply unit from a first transport speed \( v_{T1} \) to a second transport speed \( v_{T2} \) that is higher than the first transport speed \( v_{T1} \). The accelerated objects are then supplied with the first direction of movement to the transfer section from the acceleration section. They are rotated in the transfer section about the axis of rotation and are then handed over to the braking section with a second direction of movement that is different from the first direction of movement. The objects handed over to the braking section are then braked by means of a handover unit from a third transport speed \( v_{T3} \) to a fourth transfer speed \( v_{T4} \) that is lower than the third transport speed \( v_{T3} \). In a preferred variant, \( v_{T1} \) and \( v_{T4} \) match one another, as do the differences between \( v_{T1} \) and \( v_{T2} \) on the one hand and also \( v_{T3} \) and \( v_{T4} \) on the other hand.

The acceleration of the objects before a transfer and the braking of the objects after the transfer makes it possible for the direction of movement of the objects to be changed in a sufficient period of time and in a confined space. Here, the period of time available for the transfer of the objects is determined in particular by the extent of the acceleration(s) and the length of the acceleration section and, where applicable, of the braking section.
The conveyor device preferably contains transport sections, in which the workpiece carriers or the production objects are moved at substantially constant speed. The process times for the treatment of workpiece surfaces in coating facilities can thus be maintained definitively with low effort.

In accordance with the invention, such a transport section is arranged upstream of the acceleration section or downstream of the braking section.

It is possible to act on the objects in the acceleration section with an acceleration force that changes as the objects are displaced in the acceleration section. In other words, the acceleration of the objects may gradually increase and then decrease again, for example with progressive displacement in the acceleration section. Accordingly, the objects in the braking section can be braked with a changing acceleration.

Within the scope of the invention, workpiece carriers or production objects may in particular be conveyed by two lines arranged substantially parallel whilst the production objects are subject to a rearrangement process. In accordance with the invention, such a reconfiguration process concerns a coating of a production object (for example with a paint), an irradiation process, a heating and/or cooling process and/or a process of plastic or machining deformation.

To transmit movement forces to workpiece carriers or production objects, (linear) drive units are provided and comprise driven tension elements such as chains or cables, which are mechanically coupled to workpiece carriers or production objects and thus also move in translation along a specific path segment with the workpiece carriers or production objects.
Alternatively, fixedly mounted rolls are provided and impart a driving torque to the workpiece carriers or production objects via a rolling movement.

The conveyor device in accordance with the invention additionally also comprises a plurality of further conveyor sections (what are known as discharge units), over which the workpiece carriers or production objects are accelerated or braked. In particular, these conveyor sections are used as decoupling members between at least one first conveyor section and one third conveyor section.

These further conveyor sections can be divided into a group of accelerating discharge units and into a group of braking discharge units, wherein the accelerating discharge units each have at least one accelerating linear drive arrangement, and wherein the braking discharge units each contain at least one braking arrangement. This braking arrangement can also be formed as a linear drive arrangement or can be integrated into a linear drive arrangement.

In accordance with the invention, the conveyor device has a conveyor section in the form of a transfer section. The transfer section is in particular characterized in that a workpiece arranged in the transfer section or a corresponding workpiece mount can be rotated or pivoted about a vertical axis through a practically arbitrary angle $\alpha$ ($0^\circ < \alpha < 360^\circ$). This makes it possible to displace a workpiece carrier or production object over a circular path about a vertical axis.

In the transfer section, there is preferably a conveyor device formed as a linear movement arrangement. Here, the accelerating discharge units each convey one or more workpiece carriers or production objects at a
speed that is increased compared to the transport speed of a first conveyor section in order to achieve, for this one or plurality of workpiece carriers or production objects, a spatial and temporal "head start" over subsequent workpiece carriers or production objects.

The aforementioned head start is selected in accordance with the invention such that a workpiece in the transfer section can be rotated or pivoted as desired during this time. The workpiece carriers or production objects accelerated in this way are initially received largely completely by the transfer section from the third linear movement arrangement and are braked at the transfer section to a speed that is less than the transport speed of the first conveyor section. In a preferred variant, the workpiece carriers or the production object is/are stopped temporarily in a resting position relative to the transfer section. Once the rotational/pivoting movement of the transfer section is largely concluded, workpiece carriers or production object is/are again accelerated with the aid of the third linear movement arrangement to a speed that is preferably greater than the transport speed of the first conveyor section, and are then handed over to a braking discharge unit.

In accordance with the invention, the first, second and third linear movement arrangements are each designed as roll conveyors or rack-and-pinion conveyors that can be controlled independently of one another, or as cable conveyors, belt conveyors or chain conveyors. The first linear movement arrangement is particularly preferably designed as a chain conveyor, whereas the second linear movement arrangement and the third linear movement arrangement are designed as roll conveyors, preferably as roll conveyors each having a plurality of rolls.
moved via a common drive and mounted rotatably about a horizontal axis.

In particular, a conveyor device according to the invention can be used to move workpiece carriers or transport units (skids) that are used in a widespread manner in industrial production facilities on conventional conveyor devices. A conveyor device according to the invention can also be formed however such that practically any goods, workpieces or objects can be transported thereby without having to be arranged at or on a transport unit.

Since the transfer section receives the objects from a supply unit (accelerating discharge unit), in which the objects have been accelerated relative to the speed of the first conveyor section, a period of time is provided, in which the transfer section moves and can be prepared for a subsequent object. Continuous transportation of the objects in the first conveyor device at constant speed is thus possible.

It is advantageous if the transfer section has a rotary device that is rotatable about the fixed axis of rotation and has a linear movement arrangement for pulling objects onto the rotary table in the first direction of movement and releasing objects in the second direction of movement. This measure makes it possible for objects that are arranged in a very confined space to be transported with horizontal turning. In particular, this measure makes it possible to change the direction of movement of objects that are moved through a facility, without the use of chain tension arrangements. This is advantageous in particular in facilities having a chemical, aggressive process atmosphere and/or in facilities in which workpieces are moved through a hot-gas atmosphere. With the conveyor device according to the invention,
workpieces, in particular vehicle bodies, can be moved here specifically without incorporation of dirt particles and/or condensate into the hot-gas or process atmosphere, which cannot be avoided or can only be avoided with difficulty in the case of conveyor devices having a conveyor chain.

The conveyor device may have a linear movement arrangement for moving objects on the rotary device, said linear movement arrangement being formed with a path of displacement arranged in a manner spatially offset in relation to the fixed axis of rotation. Alternatively, it is also possible however to design the linear movement arrangement for the movement of objects on the rotary device so as to have two paths of displacement arranged in a manner spatially offset in relation to one another and in relation to the fixed axis of rotation.

The drive for the linear movement arrangement is preferably arranged above or below the rotary device. This measure ensures the space-saving arrangement of the drive at a large distance from the conveyor segment of the conveyor device. In addition, with this measure, the drive can be operated outside a hot and, in some circumstances, also aggressive process atmosphere, through which the workpieces are moved by means of the conveyor device.

In accordance with the invention, the conveyor device has a conveyor segment with at least one meandering section and/or a section guided in a W-shaped, L-shaped, S-shaped or also U-shaped manner.

The conveyor device is suitable in particular for use in a facility for the treatment of the surfaces of workpieces, for example in a drier tunnel for drying workpieces, for example for drying motor vehicle
bodies. Here, a concept of the invention is to use the conveyor device to transport objects, with a change in direction, in a hot-gas atmosphere region. There, the temperature is increased by 20°C to 100 °C or more compared to the surrounding environment.

Since the linear movement arrangement of the rotary device is arranged in the hot-gas atmosphere region of the drier tunnel, and the drive is arranged outside the hot-gas atmosphere region of the drier tunnel, the drive does not have to be designed for operation in a hot-gas atmosphere.

Here, the drive of the linear movement arrangement is coupled by means of a transmission that contains a transmission element protruding from outside the hot-gas atmosphere region into the hot-gas atmosphere region. The transmission element may for example be a shaft, for example a vertical shaft or an endless chain. This transmission element has at least one section extending from outside the hot-gas atmosphere region into the hot-gas atmosphere region and made of a material that has a thermal conductivity lower than 10 W/(m°K), in particular lower than 1 W/(m°K), for example made of ceramic or made of plastic.

A ceramic suitable for use in a facility according to the invention having the stipulated low thermal conductivity may for example contain silicate raw materials, such as clay minerals and kaolins, and/or may be formed from oxidic raw materials, such as aluminum oxide and beryllium oxide, or from non-oxidic raw materials, such as silicon carbide, boron nitride or boron carbide.

Plastics of which the thermal conductivity and strength values are favorable and which are therefore suitable for use in a facility according to the invention are
selected in particular from the group of polyethylene terephthalates (PET), polyurethanes (PUR), polyamides (PA), polyimides (PI), polytetrafluoroethylenes (PTFE), epoxy resins (EP) or polymethyl methacrylates (PMMA).

Due to a thermal insulation of the transmission, it is possible for a reduced quantity of condensate to be deposited in the drier tunnels.

The invention will be explained in greater detail hereinafter on the basis of the exemplary embodiments illustrated schematically in the drawing, in which:

figure 1 shows a coating facility comprising a hot-gas atmosphere region for drying and comprising a conveyor device for transporting motor vehicle bodies;

figure 2 shows different speed curves for the movement of motor vehicle bodies by means of the conveyor device;

figure 3 shows a plan view of a detail of the conveyor device;

figure 4 shows a side view of the detail of the conveyor device;

figure 5a shows a plan view of a facility for drying motor vehicle bodies in a hot-gas atmosphere region with a conveyor device;

figure 5b shows a length of a longitudinal section of the facility for drying motor vehicle bodies;

figure 6 shows a drying section in a coating facility; and
figure 7 shows a further drying section in a coating facility.

A coating facility 1 in figure 1 is formed in accordance with the invention as a facility for treating the surface of workpieces in the form of motor vehicle bodies 12. The coating facility 1 has treatment sections 4, 6, 8 and 10. In the coating facility 1, there is a conveyor device 2 for the motor vehicle bodies 12. In the conveyor device 2, the motor vehicle bodies 12 are each arranged on a skid 14 (transport slide for workpieces). In the treatment sections 4, 6, the motor vehicle bodies 12 are coated with paint, which is applied with use of painting robots to the motor vehicle bodies 12. In the treatment sections 8, 10, the motor vehicle bodies 12 are transported through a hot-gas atmosphere for drying. In modified exemplary embodiments, parts of ships, aircraft and/or rail vehicles are transported and treated. In further modified exemplary embodiments, parts of exhaust gas cleaning arrangements or wind energy conversion facilities are transported and treated. Here, a facility according to the invention is also suitable in particular for the handling of bulky products measuring more than 3 m.

The conveyor device 2 has a conveyor segment 16. By means of the conveyor device 2, the motor vehicle bodies 12 can be moved on a skid 14 along the conveyor segment 16 through the coating facility 1. The conveyor segment 16 of the conveyor device 2 is laid in the coating facility 1 with a W shape.

The conveyor segment 16 has a plurality of conveyor sections 20, 22, 24, 26, 27, 28, 30, 31, 32, 34, 36, 37, 38 arranged in succession. The conveyor segment 16 contains a first conveyor section 20, which is a
transport section. Here, the skids 14 are moved with the motor vehicle bodies 12 with a substantially constant average speed corresponding to a substantially uniform first transport speed \( v_{T1} \).

In second conveyor sections 22, 28, 34 of the conveyor segment 16, skids 14 with motor vehicle bodies 12 are accelerated from a first transport speed \( v_{T1} \) to a second speed \( v_{T2} \), wherein preferably \( v_{T2} > v_{T1} \) is selected. The second conveyor sections 22, 28, 34 are therefore acceleration sections. In addition, the conveyor segment 16 comprises third conveyor sections 24, 30 and 36. The third conveyor sections 24, 30 and 36 are transfer sections. In a conveyor section 24, 30, 36 formed as a transfer section, skids 14 with motor vehicle bodies 12 are rotated about an axis of rotation 48, 52, 56. In fourth conveyor sections 26, 31, 37, skids 14 with motor vehicle bodies 12 are braked from a third transport speed \( v_{T3} \) to a fourth speed \( v_{T4} \), wherein preferably \( v_{T4} < v_{T3} \) is selected, and wherein the fourth speed \( v_{T4} \) is preferably selected so as to be greater than or equal to the first transport speed \( v_{T1} \). These fourth conveyor sections are braking sections. A fifth conveyor section 27 adjoins the fourth conveyor section 26 and is again a transport section, in which the skids 14 with the motor vehicle bodies 12 are moved with a substantially constant average speed corresponding to a uniform fourth transport speed \( v_{T4} \).

The conveyor segment 16 is formed with further conveyor sections 32, 38, which are likewise transport sections, in which skids 14 with motor vehicle bodies 12 are moved with a substantially constant average speed.

In each of the conveyor sections 20, 22, 24, 26, 27, 28, 30, 31, 32, 34, 36, 37, 38, there is a skid conveyor arrangement 21, 23, 25, 29 with a drive system 40, 42, 43, 44. The skid drive system 40 in the first
conveyor sections 20, 27, 32, 38 is formed as a two-line conveyor arrangement. In the second conveyor sections 22, 28, 34, the skid conveyor arrangement 23 preferably has a skid drive system 42, 43 with fixed bearing and driving rolls, over which a skid 14 can roll. The skid conveyor arrangements 23 are each formed as discharge roll conveyors. There, a skid 14 is in particular accelerated and optionally braked with the aid of fixedly mounted, driven rolls on the skid conveyor arrangements 23. In a modified exemplary embodiment, at least one skid conveyor arrangement 23 is designed as a shorter chain conveyor.

In the conveyor sections 24, 30, 36 formed as a transfer section, a skid conveyor arrangement 25 is arranged and contains a rotary device having a skid drive system 44. The skid drive system 44 of a skid conveyor arrangement 25 in particular comprises two linear movement arrangements that are positioned parallel to one another to a distance and that are assembled on what is known as a rotary table. The distance between the linear movement arrangements corresponds to twice the curve radius of the conveyor segment in the region of the transfer section 24.

In the conveyor section 20, skids 14 with motor vehicle bodies 12 arranged thereon are transported at the first speed $v_{T1}$. The skids 14 pass from the conveyor section 20 into the conveyor section 22. By means of the discharge roll conveyor 23 in the second conveyor section 22, a skid 14 supplied at the first speed $v_{T1}$ into the conveyor section 22 is accelerated to the second speed $v_{T2}$. The discharge roll conveyor 23 in the conveyor section 22 acts as a supply unit for the conveyor section 24. A skid 14 passes at the second speed $v_{T2}$ from the second conveyor section 22 into the conveyor section 24. In the conveyor section 24, the skid 14 is braked by means of the skid drive system 44.
of the skid conveyor arrangement 25 from the speed \( v_{\tau 2} \) into a rest position. There, it is rotated on a rotary table about an axis of rotation 48. After a rotation of the rotary table through 180°, the skid 14 is accelerated by means of the skid drive system 44 to the speed \( v_{\tau 3} \) and is displaced in the conveyor section 24 to the fourth conveyor section 26 with a second direction of movement 50 that is different from the first direction of movement 46. In the fourth conveyor section 26, a skid 14 with a motor vehicle body 12 arranged thereon is then braked by means of the skid drive system 43 of the skid conveyor arrangement 29 from the third speed \( v_{\tau 3} \) to the fourth speed \( v_{\tau 4} \). The skid conveyor arrangement for this purpose has fixedly mounted rolls provided with at least one braking arrangement. Here, the skid conveyor arrangement 29 acts as a handover unit, which hands over and brakes the skids 14 with motor vehicle bodies 12 from the conveyor section 24. The conveyor section 267 hands over the skid 14 at the speed \( v_{\tau 4} \) to the next conveyor section 27. From this conveyor section 27, the above-described procedure is repeated in a preferred exemplary embodiment as often as desired, and the preceding procedure mechanisms (method steps) are repeated.

In the exemplary embodiment according to figure 1, a skid 14 with a motor vehicle body passes from the conveyor section 27 to the conveyor section 28 by means of a discharge roll conveyor 23. There, the discharge roll conveyor 23 accelerates the skid 14 as in the conveyor section 22 and moves it into the conveyor section 30. As in the conveyor section 24, the skid 14 is transferred in the region of the conveyor section by means of a rotary table. To this end, the skid 14 is again rotated, together with the rotary table, about a second vertical axis of rotation 52 through 180° or is displaced along a circular path. The direction of
rotation of the rotary table in the conveyor section 30 is opposite here to the direction of rotation of the third conveyor section 24. In the conveyor section 30, the direction of movement 50 of the skid 14 is changed to the third direction of movement 54. Here, the third direction of movement 54 is parallel to the first direction of movement 46 and has the same direction.

A skid 14 passes from the conveyor section 30 via a further second conveyor section 31 into a further conveyor section 32. There, the skid is handed over with the direction of movement 54 from the skid conveyor arrangement formed as an accelerating discharge unit 23 into the conveyor section 34. There, the skid 14 is accelerated again and is supplied to the last conveyor section 36. The skid 14 is conveyed here by rotation of a rotary table of the skid conveyor arrangement 25 about an axis of rotation 56, again through 180°, from a movement with the third direction of movement 54 into a movement with an opposed fourth direction of movement 58. The skid 14 passes from the conveyor section 36 into the conveyor section 37, which is preferably formed as a braking discharge unit. From there, it is moved into the last conveyor section 38.

Figure 2 shows different speed curves for the movement of motor vehicle bodies in the coating facility 1. The speed of the motor vehicle bodies is plotted in figure 2 according to a displacement s over the conveyor segment. The motor vehicle bodies 12 are moved in the conveyor section 20 at a constant speed \( v_{T1} \). In the adjoining acceleration section 22, the motor vehicle bodies 12 are then preferably accelerated in accordance with one of the speed curves 71, 73, 75 at a constant or changing acceleration from the speed \( v_{T1} \) to the speed \( v_{T2} \) and are supplied to the transfer section 24. In this first acceleration section (as is also the case in the subsequent acceleration and/or braking sections),
acceleration profiles running parabolically or hyperbolically may in particular be provided in accordance with the invention. In the transfer section, the motor vehicle bodies 12 are braked preferably in accordance with the speed curves 77, 79, 81 in order to then be accelerated again to a speed \( v_{T3} \) in accordance with one of the speed curves 83, 85, 87 once the rotary table has been rotated. The motor vehicle bodies 12 handed over to the braking section 29 are braked there with constant or changing acceleration, preferably in accordance with one of the speed curves 89, 91, 93, in order to then be moved again at a constant speed \( v_{T4} \) in the conveyor section 27.

The use of rotary tables in the region of the transfer sections enables a particularly narrow embodiment of a W-shaped conveyor segment 16 and therefore a space-saving design of the coating facility 1. The negotiation of curves by skids and products is avoided.

Skids 14 with the products arranged thereon can be moved here at a particularly short spacing through the coating facility 1. The minimum distance to be maintained between two skids 14 for the movement of skids 14 in the conveyor device 2 is determined here substantially by the conveying capacity of the third conveyor sections 24, 30 and 36. This is an advantageous difference from conveyor devices with continuously running chain conveyors, in which the direction of movement of skids is changed by negotiation of curves. The minimum spacing to be maintained by two successive skids is dependent here specifically on the radius of the curves and must therefore be greater, the smaller is the curve radius. The acceleration and braking of the skids 14 with the motor vehicle bodies 12 received thereon in the conveyor sections 22, 24, 26, 28, 30, 31 and also 34, 36 and 37 here ensures that the skids 14 can be
transported in the conveyor sections 20, 27, 32 and 38 continuously and with short spacing from one another.

The conveyor sections 32 to 38 described above will be specified in greater detail with reference to figure 3. Basic principles of construction can also be transferred however to the other conveyor sections 20 to 31. Figure 3 shows a section of the coating facility 1 with conveyor sections 32, 34, 36, 37 and 38. The conveyor sections 32, 34, 36, 37 and 38 are arranged in a drier tunnel 60. They are located in a hot-gas atmosphere. The temperature $T$ of this hot-gas atmosphere generally lies in the following temperature range: $60 \, ^\circ\text{C} \leq T \leq 250 \, ^\circ\text{C}$.

The drier tunnel 60 has a thermally insulating outer wall 62. In the drier tunnel 60, the conveyor section 32 is separated from the conveyor section 38 by an inner wall 64 (optionally also thermally insulated) with insulation material. The drive rolls 66, 68 in the conveyor sections 32, 38 are each coupled to a drive system arranged outside the drier tunnel 60. The conveyor direction for the motor vehicle bodies 12 is opposite in each of the two conveyor sections 32 and 38.

Figure 3 shows an electric motor 70 for driving the drive rolls 66 in the conveyor section 32. The electric motor 70 is equipped with a drive shaft 72 protruding through the wall 62 of the drier tunnel 60 and transmitting forces onto and endless chain via a gearwheel. This measure means that the electric motor 70 does not have to be designed for operation in the hot-gas atmosphere.

The conveyor sections 34 and 37 likewise have drives in the form of electric motors 74, 76, which are likewise arranged outside the thermally insulated outer wall 62 of the drier tunnel.
The conveyor section 36 contains a rotary device 78. The rotary device 78 has a rotary table 80, two linear movement arrangements 83, 85 mounted on the rotary table and inclusive of respective drive units for the rotary table and for the linear movement arrangements. The rotary table 80 is arranged rotatably about a fixed vertical axis of rotation 56, wherein the linear movement arrangements are positioned parallel to one another and on the rotary table in each case at a distance from the axis of rotation. The positioning of the linear movement arrangements corresponds to paths of displacement 94, 96 for the skids, said paths being arranged in a spatially offset manner.

The rotary table 80 is formed in accordance with the invention as a hot-region rotary table: The rotary table 80 is received on a supporting construction made of steel, for example steel of the St 37 type or the like. The rotary table 80 may in particular have a plate made of a stainless steel sheet, which can be fitted onto a structure made of structural steel. The rotary table may however also be produced fundamentally from aluminum or other metals, and is preferably provided on the underside with at least one layer of thermally insulating non-metal material. For the movement of the skids 14 with motor vehicle bodies 12 received thereon, the rotary device 78 contains two linear movement arrangements 83, 85 with a roll conveyor 82 and a roll conveyor 84. The roll conveyors 82, 84 are designed as hot-region conveyors. They have transport rolls 86, 88, which are formed at least in sections of temperature-resistant plastic and/or of a metal. The linear movement arrangements 83, 85 each comprise a roll conveyor, a transmission and in each case an electric drive 90, 92. The transmission couples the electric drives 90, 92 to the transport rolls 86, 88 of the roll conveyors 82, 84 respectively.
By means of the electric drives 90, 92, a motor vehicle body 12 can be moved by means of a skid 14 on the rotary device 78 over a circular arc 79 having the radius \( r = \frac{A}{2} \), wherein the sign \( A \) denotes the distance of the conveyor segment 16 in the conveyor section 32 from the conveyor segment 16 in the conveyor section 38 (see figure 3). The radius \( r \) may for example be slightly less than 2.90 m and here may still enable a width \( B \) of in each case more than 4.0 m of the conveyor sections 32, 38, separated by the wall 64, in the drier tunnel 60. For the drying of passenger vehicle bodies, this width \( B \) of the conveyor sections 32, 34 is sufficient. For a radius \( r \approx 3.4 \) m, it is possible to form the conveyor sections 32, 34 with a width \( B \) that is more than 5.0 m. With this dimensioning, it is possible to dry commercial vehicle bodies in the drier tunnel 60.

Figure 4 shows a side view of the section of the coating facility 1 with the conveyor sections 32, 34. The drier tunnel 60 (similarly to the rotary table) has a base 98, which is thermally insulated. The electric drives 90, 92 for the transport rolls of the roll conveyors 82, 84 are arranged outside the drier tunnel 60. The drives 90, 92 are received on a rotary holding arrangement 100. The holding arrangement 100 is positioned beneath the base 98 of the drier tunnel 60. The transmission for the coupling of the electric drives 90, 92 to the transport rolls 86, 88 of the roll conveyors 82, 84 contains an endless chain 102 as a transmission element. The chain 102 is arranged in a thermally insulating housing 104, which has an opening 106 that communicates with the interior 108 of the drier tunnel 60.

In order to drive the transport rolls 86, 88, the electric drives 90, 92, alternatively hereto, can also
be coupled to the transport rolls 86, 88 by means of a transmission that, instead of the endless chain 102, contains an endless belt or toothed belt, an endless steel cable, a cardan shaft or a vertical shaft.

For the movement of the rotary table 80, the rotary device 78 has an electric drive 110. The electric drive 110 is rotationally coupled by an endless chain 112 to the holding arrangement 100. By means of the electric drive 110, the rotary table 80 is moved to and fro in an oscillating manner in accordance with the double-headed arrow 114 shown in figure 2 between a 0° and 180° pivot position in order to transfer the skids 14 with a motor vehicle body 12 supplied with the direction of movement 54 from the conveyor section 34 so as to then transport these further with the direction of movement 58.

Due to this measure, the electric drives 90, 92 for the transport rolls 86, 88 can be operated without a complex execution of rotation for the supply with electrical power.

Figures 5a and 5b show a further facility 400 for drying bulky products (for example motor vehicle bodies) in a hot-gas atmosphere region with a conveyor device. With the conveyor device, products (not illustrated) received on a skid can be moved through the facility 400 on a conveyor segment 416 in the direction of the arrows 402. The facility 400 has a drying section 401 with a drier tunnel 418, which extends from a first hot-gas region 414 to a second hot-gas region 420. The conveyor segment 416 comprises a conveyor section 417 with a skid conveyor arrangement 425. The conveyor section 417 is a transfer section. The skid conveyor arrangement 425 is located in the drier tunnel 418. In the conveyor section 417, skids with motor vehicle bodies are rotated on a rotary table
450 about an axis of rotation 448. The rotary table 450 is located in a hot region of the drier tunnel 418. There, the temperature is increased by 20°C to 200 °C compared to the surrounding environment.

The further facility 400 contains two hoisting devices 404, 406. The hoisting devices 404, 406 each serve as a lifting and lowering mechanism. The first hoisting device 404 lifts a product moved in the conveyor device, received on a skid and coming from an inlet section 408 approximately 3 m to 4 m to a discharge arrangement 412 arranged above the inlet section 408 and adjoined by the hot-gas region 414. With the hoisting device 406, a motor vehicle body received on a skid coming from the hot-gas region 420 is moved from a discharge arrangement 422 adjoining the hot-gas region 420 to an outlet region 424. Further aspects of the aforementioned components of the further facility 400 correspond to the embodiment of the corresponding components of the previously described facilities (figure 1 to figure 4), and therefore reference is made to the previous descriptions with regard to further details.

The rotary table 450 in the conveyor section 417 has a drive 452 arranged below the base of the drier tunnel 418. The drive 452 is therefore arranged outside the hot-gas regions 414, 420 and in a space below a thermally insulated rotary table in the region of the transfer section. The drive is thus particularly well shielded against sensitive heat (which tends to rise).

Figure 6 shows the drying section 502 of a coating facility 501 with an air lock 557 acting as an input lock, and an air lock 555, which is an output lock. The air locks 555, 557 contain nozzles for producing a fluid flow curtain. These locks have a structure that is described in Offenlegungsschrift DE 10 2009 021 004.
Al, in particular a structure that is explained with reference to figure 4 and in paragraphs [0067], [0068] and [0069] of this Offenlegungsschrift. The air locks can also have the structure described in German patent application no. 10 2010 043 087.0 filed with the German Patent and Trademark Office on 28.10.2010. The description, the figures and also the patent claims of the aforementioned patent application are therefore incorporated hereby fully by way of reference.

The coating facility 501 comprises a conveyor device with a conveyor segment 516. By means of the conveyor device, skids 514 with motor vehicle bodies 512, which are introduced with the direction of movement 546 into an entry region 516, are moved on the conveyor segment 516 through the coating facility 501. The conveyor device contains a conveyor section 504. Skids 514 with motor vehicle bodies are conveyed through the air lock 557 into the drying section 554 via the conveyor section 504. The drying section 554 contains a transfer section 536 with a conveyor arrangement that contains a rotary table 580. The conveyor arrangement with rotary table 580 replaces the turning loop conventionally formed in drier tunnels with a chain conveyor device for skids with motor vehicle bodies 512. In a production hall, such a turning loop has a much greater spatial requirement compared to a rotary table. Otherwise, the embodiment of all key components of the previous exemplary embodiments, to which reference can therefore be made fully, is the same.

Figure 7 shows a coating facility 601 with a conveyor device 602 for transporting motor vehicle bodies 612 on a skid 614 along a conveyor segment 616 guided in a U-shaped manner. The conveyor segment 616 has conveyor sections 620, 622, 624, 626, 628, 630, 632, 634 and 636 arranged in succession.
The conveyor segment 616 contains conveyor sections 620, 628, 636, in which skids 614 with motor vehicle bodies 612 are moved at a substantially constant speed.

In the conveyor sections 622, 630, skids 614 with motor vehicle bodies 612 are accelerated from a transport speed $v_{T1}$ to a speed $v_{T2} > v_{T1}$. In further conveyor sections 626, 634, skids 614 with motor vehicle bodies 612 are braked from a transport speed $v_{T3}$ to a speed $v_{T4} < v_{T3}$. The conveyor segment 616 additionally contains conveyor sections 624, 632. The conveyor sections 624, 632 are transfer sections. In the transfer sections 624, 632, skids 614 with motor vehicle bodies 612 are rotated about the axes of rotation 648, 656.

In each of the conveyor sections 620, 622, 624, 626, 628, 630, 632, 634 and 636, there is a skid conveyor arrangement 621, 623, 625, 629 with a drive system 640, 642, 643, 644.

The structure of the skid conveyor arrangements 621, 623 and 629 corresponds to the structure of the skid conveyor arrangements 621, 623 and 629 in the conveyor device 2 from figure 1. Reference can therefore be made fully to the first exemplary embodiment according to figure 1 with regard to further details.

In the conveyor sections 624, 632 acting as a redirection section, the skid conveyor arrangement 625 in each case contains a rotary device 658. By means of the rotary device 658, a skid 614 with a motor vehicle body 612 can be rotated about the axes of rotation 648 and 656 through 90° in accordance with the double-headed arrows 670, 672 between a position for receiving skids, which is indicated in figure 6 by a solid line, and a position for receiving skids 614, which is indicated in figure 6 by a dashed line, respectively.

In the conveyor device 602, skids 614 with motor
vehicle bodies 612 are supplied to the transfer section 624 with the direction of movement 646. By means of the rotary device 658, the motor vehicle bodies 612 are rotated in the transfer section 624 about the axis of rotation 648 and, after the rotation, are removed with the direction of movement 650. The skids 614 with motor vehicle bodies 612 are accordingly supplied with the direction of movement 650 to the transfer section 632 in the conveyor device 602. By means of the rotary device 658, the motor vehicle bodies 612 are rotated in the transfer section 624 about the axis of rotation 656 and, after the rotation, are removed with the direction of movement 652. In the conveyor device 602, the skid conveyor arrangement 623 acts as a supply unit for the transfer section 624, in which skids 614 with motor vehicle bodies 612 are accelerated. The skid conveyor arrangement 629 is a handover unit, to which the skids 614 with motor vehicle bodies 612 are supplied from a transfer section 625.

To summarize, the following preferred features of a device according to the invention are to be noted in particular: the invention relates to a conveyor device 2 for transporting objects, for example goods or workpieces, in particular motor vehicle bodies 12. The conveyor device 2 has a conveyor segment 16 on which the objects 12 can be displaced by means of a fixedly arranged drive system 40, 42, changing the direction of movement 46, 50, 54, 58. The conveyor segment 16 has at least one transfer section 24, 30, 36, to which the objects 12 are supplied with a first direction of movement 48, 52, 56, in which the objects 12 are rotated or pivoted about an axis of rotation 48, 52, 56, and from which the objects 12 are removed with a second direction of movement 50, 54, 58 that is different from the first direction of movement 46, 50, 54.
Patent Claims

1. A conveyor device (2, 652) for transporting objects arranged in succession, for example goods or workpieces, in particular motor vehicle bodies (12, 612), having a conveyor segment (16, 616) on which the objects (12, 612) can be moved by means of a fixed drive system (40, 42),

characterized in that

the conveyor segment (16, 616) has at least one transfer section (24, 30, 36, 624, 632), to which the objects (12, 612) are supplied with a first direction of movement (48, 52, 56, 646, 650), in which the objects (12, 616) are rotated about an axis of rotation (48, 52, 56, 648, 656), and from which the objects (12, 612) are removed with a second direction of movement (50, 54, 58, 650, 652) that is different from the first direction of movement (46, 50, 54, 646, 650).

2. The conveyor device as claimed in claim 1, characterized in that the conveyor segment (16, 616) contains an acceleration section (22, 622) arranged upstream of the transfer section (24, 30, 36, 624, 632) and a braking section (26, 626) arranged downstream of the transfer section, wherein

the objects (12, 612) in the acceleration section (22, 622) are accelerated by means of a supply unit (23, 623) from a first transport speed ($v_{T1}$) to a higher second transport speed ($v_{T2}$),

the accelerated objects (12, 612) are supplied with a direction of movement (42, 52, 56, 646, 650) to the transfer section (24, 30 36, 624, 632) from the
acceleration section (22, 622), are rotated in the transfer section (24, 30, 36, 624, 632) about the axis of rotation (48, 52, 56, 648, 656), and are handed over to the braking section (26, 626) with the second direction of movement (50, 54, 58, 650, 652) that is different from the first direction of movement (46, 50, 54, 646, 650), and

the objects (12, 612) handed over to the braking section (26, 626) are braked by means of a handover unit (29, 629) from a third transport speed ($v_{73}$) to a lower fourth transport speed ($v_{74}$).

3. The conveyor device as claimed in claim 2, characterized in that the conveyor segment (16) is formed with a transport section (20) arranged upstream of the acceleration section (22), the objects (12) being moved in said transport section at a substantially constant transport speed ($v_{71}$).

4. The conveyor device as claimed in claim 2 or 3, characterized in that the conveyor segment (16) is formed with a transport section (27) arranged downstream of the braking section (26), the objects (12) being moved in said transport section at a substantially constant transport speed ($v_{74}$).

5. The conveyor device as claimed in one of claims 2 to 4, characterized in that the objects (12) are accelerated in the acceleration section (22) with a changing acceleration and/or the objects (12) are braked in the braking section (29) with a changing acceleration.

6. The conveyor device as claimed in one of claims 2 to 5, characterized in that the first transport speed ($v_{71}$) and the fourth transport speed ($v_{74}$) are the same.
7. The conveyor device as claimed in one of claims 1 to 6, characterized in that the objects (12) are braked in the transfer section (24), are rotated about the axis of rotation (48), and are then accelerated again.

8. The conveyor device as claimed in one of claims 1 to 7, characterized in that the conveyor segment (16) has conveyor sections (20, 27) running parallel to one another and in which the objects (12) are displaced with opposite directions of movement and/or the conveyor segment (16) has at least one section guided in a W-shaped manner and/or one section guided in a meandering manner and/or at least one section guided in a rectangular manner and/or in a U shape.

9. The conveyor device as claimed in one of claims 1 to 8, characterized in that the transfer section (24) has a rotary device (78) that is rotatable about the axis of rotation (48) and has a linear movement arrangement (83, 85) for pulling objects (12) in the first direction of movement (46, 50, 54) and releasing objects (12) in the second direction of movement (50, 54, 58).

10. The conveyor device as claimed in claim 9, characterized in that the linear movement arrangement (83, 85) is designed for moving the objects (12) on the rotary device (78) with a path of displacement (94, 96) arranged in a manner spatially offset in relation to the fixed axis of rotation (56).

11. The conveyor device as claimed in claim 9 or 10, characterized in that the linear movement arrangement (83, 85) is designed for moving the
objects (12) on the rotary device (78) with two paths of displacement (94, 96) running parallel to one another and arranged in a manner spatially offset in relation to the fixed axis of rotation (56).

12. The conveyor device as claimed in one of claims 9 to 11, **characterized in that** the linear movement arrangement (83, 85) has a drive (90, 92) that is arranged above the rotary device (78) or is located beneath the rotary device (78).

13. The conveyor device as claimed in one of claims 9 to 12, **characterized in that** the linear movement arrangement (83, 85) is designed for braking objects (12) supplied in the first direction of movement (46, 50, 54) and for accelerating objects (12) in the second direction of movement (50, 54, 58).

14. A facility (1) for treating the surface of workpieces, in particular for drying workpieces, for example motor vehicle bodies (12), in a hot-gas atmosphere region (108), said facility having a conveyor device (2) formed in accordance with one of claims 1 to 13.

15. The facility as claimed in claim 14 with a conveyor device (2) formed in accordance with claim 12, in which the drive (110) of the rotary device (78) is arranged outside the hot-gas atmosphere region (108) of the drier tunnel (60).

16. The facility as claimed in claim 14 or 15 with a conveyor device (2) formed in accordance with claim 12, in which the linear movement arrangement (82, 84) of the rotary device (78) is arranged in the hot-gas atmosphere region (108) of the drier tunnel.
(60) and has a drive (90, 92) which is positioned outside the hot-gas atmosphere region (108) of the drier tunnel (60), wherein the drive (90, 92) of the linear movement arrangement (82, 84) is coupled by means of a transmission that contains a transmission element (102) protruding from outside the hot-gas atmosphere region (108) into the hot-gas atmosphere region (108) and consisting at least in a section extending from outside the hot-gas atmosphere region (108) into the hot-gas atmosphere region (108) of a material that has a thermal conductivity lower than 10 W/(m°K), in particular lower than 1 W/(m°K), for example made of ceramic or made of plastic.

17. The facility as claimed in claim 16, characterized in that the transmission arrangement is surrounded at least in part by a thermally insulating housing (104).