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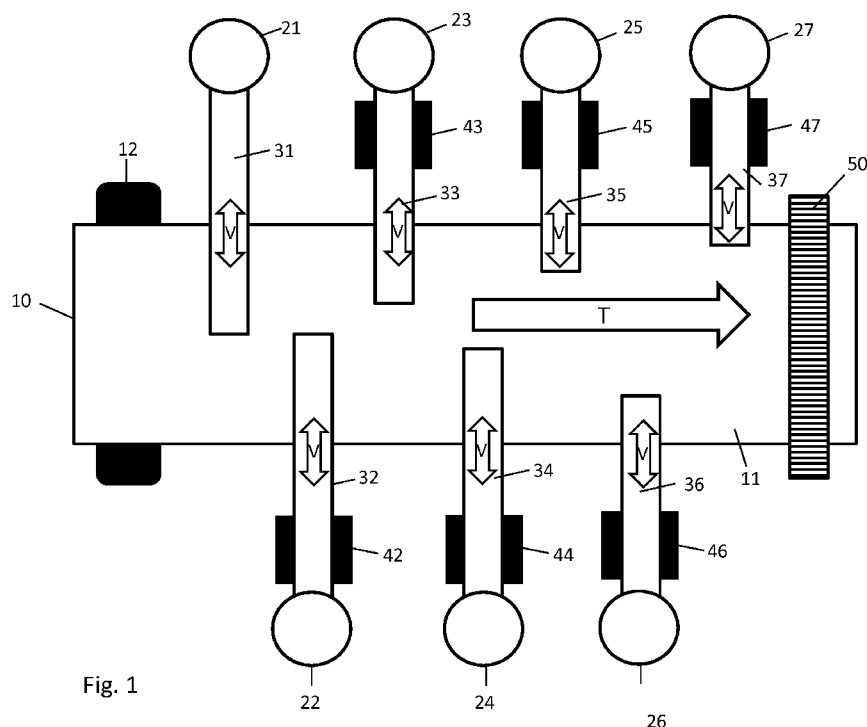


Fig. 1

(57) Abstract: Method and device for uniformly feeding a continuous conveyor The above mentioned invention describes a method for feeding a continuous conveyor with granular material, wherein at least two loading devices are moved to each other such that by each loading device a continuous lane of the material is formed on a bearing area of the continuous conveyor. These lanes are parallel to each other and overlap such that a single material bed is formed on the bearing area which in a cross section being orthogonal to the bearing area has the form of a trapezoid. The parallel sides of the trapezoid are parallel to the bearing area.



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Method and device for uniformly feeding a continuous conveyor

The invention relates to a method and the corresponding device for feeding a continuous conveyor with granular material, wherein at least two loading devices
5 are moved to each other such that each loading device forms a continuous lane of the material on a bearing area of the continuous conveyor and wherein these lanes are parallel to each other and overlap such that a single material bed on the bearing area is formed, wherein the material bed in a cross section being orthogonal to the bearing area has the form of a trapezoid and wherein the
10 parallel sides of the trapezoid are parallel to the bearing area.

Continuous conveyors or also elevators are transport systems generating a continuous transport stream. They are in particularly suitable for the transport of mass streams of large amounts of material or continuously required materials on
15 predefined routes. In addition, they are particularly suitable for transporting bulk material. They are characterized by a continuous and/or steady movement and so they differ from the discontinuous conveyors which move the material to be transported in single cycles.

Continuous conveyors are available as floor-bound or floor-free systems. Floor-bound continuous conveyors are capable of transporting the material to be transported in a horizontal, inclined and vertical manner. They are connected with the disadvantage that they occupy much space and that the route of transportation is predefined. In most fields of application floor-free systems are
20 rail-bound.
25

Continuous conveyors are automated devices and are constructed for uninterrupted operation, and therefore they often are characterized by a simple type of construction as well as low energy consumption. Inter alia, they are
30 used, when materials and goods of the chemical industry, in the mining industry,

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in surface mining, of the metal production and processing industry, in power plants, in the production flow, in the storage area are provided and/or removed and anywhere else, when single production steps are connected.

5 In the sense of the present invention, continuous conveyors are in particularly mechanical conveyors and gravity conveyors. The mechanical conveyors are roller conveyors with driving unit, oscillating conveyors, cycle conveyors, carousel conveyors, belt conveyors, cellular wheel sluices, bucket elevators, chain conveyors, screw conveyors and endless-rope haulage systems as well
10 as chains of wagons. Gravity conveyors are in particularly the spiral chute and any form of tracks such as roller paths, ball transfer tables and unpowered track railways.

All these continuous conveyors are characterized by a continuous material
15 transport being conducted by them which also depends on their feed. An unchanged material transport by the continuous conveyor in the course of time can only be reached, when also the feeding of the continuous conveyor is realized in an absolutely uniform manner. Thus, the feeding of a continuous conveyor has a direct influence to what extent downstream processes can
20 generally be performed in a steady-state manner. So the feeding is also directly associated with the turnover and the yield and/or the product quality. To a greater degree this is true, when a continuous conveyor is fed from different sources at the same time, thus, when it functions not only as a transport means, but also, in addition, as a collector.

25

Till today, normally, the feeding has been adjusted on-site and per hand. For example, green pellets of iron ore being prepared by a plurality of pelletizing disks were applied onto a single continuous conveyor being designed as a belt conveyor, which thus gets the function of a collector and serves as a means for
30 the further transport of the green pellets to the pellet kiln for thermal treatment.

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Partly, it was possible to adjust the pelletizing disks and/or the discharge belts belonging to the pelletizing disks, which then had transported the material onto the continuous conveyor, with respect to their exact discharge position on the bearing area of the belt conveyor per hand or with the help of a driving unit, but
5 the adjustment was only conducted exclusively on-site, manually and/or by visual inspection. This means that the plant operator either had to be on site or had to rely on plant cameras and to find out on the basis of a (television) picture how the material is distributed, and, in addition, had to adjust the discharge belts accordingly, if possible at all.

10

Thus, it is the object of the present invention to provide a method for feeding a continuous conveyor with which a completely steady-state material stream can be achieved.

15

This object is solved by a method being characterized by the features of patent claim 1. Such a method for feeding a continuous conveyor with preferably granular material comprises at least two loading devices. These two loading devices can be moved to each other, wherein this, for example, can be realized by a suitable driving unit, in particularly in a hydraulic manner, pneumatic
20 manner or by an (electric) engine for at least one loading device. But it is also possible to realize the possibility of a mechanical movement to each other, for example, by snapping into place in different positions. Basically, the possibility of a movement to each other can be realized in a continuous or discontinuous manner, wherein a possibility of a continuous movement to each other allows a
25 better adjustment of both loading devices, because so they can occupy each position.

30

With each loading device a continuous lane of the material is applied onto the bearing area of the continuous conveyor, for example on a conveyor belt. According to the present invention, here both loading devices are moved to

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each other such that the lanes are parallel and overlap each other such that a single material bed on the bearing area is achieved. In particular, in this connection overlapping means that by the application of the lanes by the loading device a bulk material plane with beveled sides in the sense of a slope being
5 determined by the bulk properties of the material is obtained and that the sides of the two beveled bulk material planes of the at least two loading devices overlay each other such that a single material bed is achieved on the bearing area, wherein the formed single material bed in a cross section being orthogonal to the bearing area has the form of a trapezoid and the two sides of the
10 trapezoid which are parallel to each other are also parallel to the bearing area of the continuous conveyor, such as for example of a conveyor belt. According to the present invention, thus the single lanes of the at least two loading devices in total form a trapezoid profile from which cannot be followed that it is composed of different single lanes.

15 In practice, this means that the several cones or truncated cones of bulk material form a continuous truncated cone of bulk material, so that the largest bearing area is the one on which the material is accumulated on the continuous conveyor, the shorter side which is parallel thereto forms the upper region of the
20 truncated cone of the bulk material and both side areas being parallel to the edges of the continuous conveyor represent the cone of the bulk material which is determined by the material properties of the material used.

25 Preferably, the material bed is formed parallel to at least one edge of the bearing area with a deviation of at most 10° , preferably 5° , particularly preferably 2° . This means that, for example, no waves or meandering lanes are formed on the transport area, since also such ones would result in a non-uniform feeding. Therefore, accordingly, a movement of one of the at least two loading devices has to be conducted slowly in relation to the transport speed of
30 the continuous conveyor.

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Furthermore, it is preferable, when the granular material contains iron. In particularly in the case of the production of iron and steel mass streams of large amounts of iron ore are handled so that in the example of conveying green pellets from the pelletizing disks to the pellet kiln being designed as a traveling grate plant such a method results in decisive advantages, because only a uniform feeding of the grate wagons of the traveling grate can guarantee that with the prevailing conditions in the plant the material used is burned in a uniform manner and thus at the end of the process a homogenous quality of the product can be achieved.

Furthermore, it was shown to be advantageous, when at least one measuring device examines that side of the material bed which is parallel to the bearing area with a distance D of at least one centimeter thereto. This measuring device or these measuring devices examine(s) this side for minima and/or maxima and thus, in this way, non-uniformities can be determined. When a measuring device selects such a non-uniformity, then the loading devices again can be move to each other such that again a material bed is formed which in a cross section being orthogonal to the bearing area of the continuous conveyor has the form of a trapezoid and wherein the sides of said trapezoid which are parallel to each other are also parallel to the bearing area.

It was shown to be particularly advantageous, when a measuring device is chosen which is capable of measuring the overall trapezoid profile on the bearing area so that with it the cross-sectional area of the profile can be calculated. So with it, by multiplying by the transport speed of the continuous conveyor, the volume stream (volumetric flow rate) of the bulk material to be conveyed can be calculated. When in the course of time by measuring and calculating a change of the volume stream of the bulk material is determined, then, on the one hand, in a regulating manner the upstream process step can be

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modified, e.g. by a change of the mass stream of iron ore to the pelletizing disks which is contrary to the determined change, for bringing back again the volume stream of the bulk material to the desired value, or, on the other hand, the downstream process step, such as for example the pellet kiln, can be prepared
5 for the changed volume stream of the bulk material in the sense of a feed forward control, e.g. by an accordant change of the transport speed of the traveling grate in the pellet kiln. With the feed forward control process fluctuations in the course of time can very much reliably be minimized, because it is not necessary to wait for an error signal. This normally results in a
10 particularly high efficiency, in particularly energy efficiency, of the whole process.

Furthermore, it was shown to be advantageous, when the loading devices are arranged on both sides of the continuous conveyor in its transport direction T
15 one after the other. So in the case of moving the loading device it is not possible to get caught and the whole arrangement of upstream process steps is more favorable.

In this connection it is particularly advantageous, when, starting with the second
20 loading device, each loading device adds its respective lane on that side of the bearing area to the already present lane on which this loading device is present. This means that a first loading device forms a first lane on the bearing area, being preferably arranged in the middle thereof. Adjacent thereto on a first side a second loading device is present which on this first side adds the second lane
25 being parallel to the first lane and overlapping with it. On the second side of the continuous conveyor then a third loading device adds a third lane which again on this second side is added to the first lane in a parallel and overlapping manner. The fourth, sixth and finally 2^{nd} lane is added on the first side to the second to finally the $2n-2^{\text{nd}}$ lane, whereas on the second side the fifth to finally
30 the $2n+1^{\text{st}}$ lane is added to the third to finally the $2n-1^{\text{st}}$ lane. When the overall

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trapezoid profile consists of an even number of lanes, then on the second side the $2n-1^{\text{st}}$ lane is the outermost lane which is added to the $2n-3^{\text{rd}}$ lane in a parallel and overlapping manner.

5 In particularly in the case of at least three loading devices it was shown to be advantageous to arrange the loading devices on both sides of the continuous conveyor in its operating direction one after the other in their positions P such that the loading devices, starting with the at first applied lane, add their lanes in the lane positions 2 to $2n$ on that side of the bearing area to the already present
10 lane on which they are arranged. When a flatness imperfection of the overall trapezoid profile in the form of a minimum or maximum is attributed to one loading device on one side and this corresponds to the complete failure of one loading device, then the loading device(s) being arranged downstream with respect to this loading station on the respective side is moved such that it
15 occupies on the respective side the position(s) P-1, thus respectively that position which has been till now the upstream position.

In the same manner the loading devices are arranged on both sides of the continuous conveyor in its operating direction one after the other in position so
20 that the loading devices, starting with the at first applied lane, add their lanes in lane position 2 to $2n$ or $2n+1$. Here, they add their lanes on that side of the bearing area to the already present lane on which they are arranged. When during the detection of flatness imperfections a maximum is attributed to one loading device on one side, since it is switched on again and so two lanes
25 overlap completely, then the loading devices on this side being arranged downstream one after the other with respect to this loading device a are moved such that they occupy the position P+1, thus respectively that position which has been till now the downstream position.

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In addition, it is also possible that material streams of one loading device increase or decrease. But also in this case it is possible to achieve a uniform profile on the continuous conveyor in the sense of the invention. A precondition therefor is that an increased material stream results in a lane of material having
5 a higher width and a decreased material stream results in a lane of material having a lower width on the continuous conveyor. However the heights of these material lanes stay unchanged so that differences of height, as described, can only be caused by an overlapping of the material lanes which is too strong or too low. Therefore, a minimum or a maximum in the profile of the overall bed can
10 also arise, when the overlay of two adjacent lanes is too low or too strong. Then it is only allowed to move the following loading station and all further following loading stations on this side a little bit for changing the overlay into the direction of an ideal overlay, i.e. a flat bed surface.

15 For guaranteeing that the material stream only with respect to the width of the applied lane shows differences, it was shown to be advantageous to design the loading devices itself as continuous conveyors which for their part are fed again. By an adjustment of the speed of operation of these supplying continuous conveyors this can be achieved. Preferably, the speed of operation of each
20 supplying continuous conveyor is proportional to the mass stream of material being transported on it.

With the above described possibility of moving the loading devices the way which the loading devices have to travel within the control/regulating operation is
25 minimized. This simplifies the construction of the plant and results in a space-saving arrangement. In addition, in a relatively simple manner, so single loading devices can be removed from the system or can be added thereto again without the necessity of a complicated logic according to which it is determined where which loading device applies or adds which lane.

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Furthermore, it was shown to be preferable, when at each time the material bed is formed parallel to at least one edge of the bearing area with a deviation of at most 10° , preferably 5° , particularly preferably 2° . This means that a movement of the loading device in relation to the motion of the continuous conveyor, for example of a conveyor belt, is relatively slow. Preferably, here, the movement of the loading device is conducted with a speed which is lower than 18 %, preferably lower than 9 %, particularly preferably lower than 3.5 % of the speed of the conveyor belt. So it is possible to prevent larger faults in downstream process steps due to accumulations or shortages of material. Here, the ratio of the movement speed to the speed of the conveyor belt can be calculated with the help of the tangent of the desired angle. With large angles (correspondingly high movement speed of the loading device in relation to the speed of the conveyor belt), when material is transferred onto the continuous conveyor, in each case a fault is caused. According to that, for example, when a movement of 10° is realized, the movement speed is 18 % of the speed of the conveyor belt, and when an adjustment of 2° is realized, the movement speed is 3.5 % of the speed of the conveyor belt.

But also a very quick movement may be reasonable, when it is desired to guarantee again as quickly as possible a compact material web with uniform material flow.

Therefore, it is particularly advantageous, when in the case of the complete absence of one material lane or in the case of the complete overlapping of two material lanes the corresponding loading devices are moved with 17.5 % of the speed of the continuous conveyor, for quickly solving the problem. But when only a small defect in the overlay of two adjacent lanes is detected, then the corresponding loading devices will only be moved with 1.75 % of the belt speed in the sense of a fine tuning, for preventing an overshooting of the regulating device.

When the material is applied from the first continuous conveyor onto a second continuous conveyor, it is important that the discharge device adds parallel lanes on the second continuous conveyor which ideally adjoin to each other such that a continuous material bed is achieved. Thus, according to the present invention, the single lanes which are applied or added on the second continuous conveyor by the discharge device of the first continuous conveyor form an overall material bed which is designed such that it is not possible to see that it consists of different single lanes.

Till now for that no controlling or regulating mechanisms were available, so that the second continuous conveyor was fed in a non-uniform manner. With the help of the example of the transport of green pellets of iron ore to the pellet kiln again it should be explained, what that means: green pellets are prepared on so-called pelletizing disks and from these pelletizing disks either via continuous conveyors or directly they are applied onto a first continuous conveyor for accumulating the material. This first continuous conveyor feeds a discharge device which is moved over the width of the material bed on a second continuous conveyor. This second continuous conveyor then provides the material directly or via a sieving step e.g. by means of a roller screen in the grate wagons on which it is moved in a traveling grate chain through the thermal treatment. But when the grate wagons are not fed uniformly, then this either results in material losses due to a load which is too high or the plant does not reach its theoretical maximum throughput, since the load of single grate wagons is too low. When single grate wagons carry a normal load, whereas others carry a load which is lower, then the gas distribution during the thermal treatment becomes non-uniform, because the gas preferable chooses the way which is connected with the lower flow resistance, that means that the gas preferably flows through the bed on the grate wagon with the low load. On the one hand, this compromises the homogeneity of the product quality, since the pellets in the grate wagons

due to the different loads of the grate wagons are subjected to different process conditions, and on the other hand, the grate wagons either loose material due to overload or the capacity of the plant is only partially used due to a load which is too low. When then the pellet kiln is operated such that also the green pellets on the grate wagons with the normal load still achieve the required product quality, then the energy demand of the kiln per mass unit of the burned pellets increases, because the pellets on the grate wagons with a low load are overburned.

The system of applying material from one continuous conveyor onto another continuous conveyor can also be found in other fields of application, in particular then, when the first continuous conveyor is used for collecting material originating from different sources and when the second continuous conveyor is arranged in a transverse direction with respect to the first continuous conveyor. When a slewing belt is used as a discharge device, then it is also possible that both continuous conveyors have the same transport direction.

Due to the described problems of a non-uniform feeding of downstream process steps by the second continuous conveyor it is therefore an object of the invention to provide a method and the corresponding device with which material is transferred from a first continuous conveyor onto a second continuous conveyor such that on the second continuous conveyor a steady-state material flow is achieved. In particular, furthermore, with the invention hills and valleys in the transport direction T_2 of the second continuous conveyor should be prevented.

In such a method a first continuous conveyor which preferably, but not necessarily has been charged according to one of claims 1 to 9 transports material with a material bed M_1 having a mean width B_1 . Width in the sense of

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the invention means the measure of the material bed being orthogonal to the transport direction T_1 of the first continuous conveyor. This continuous conveyor transports the material into the direction of a discharge device. This discharge device can be moved in two running directions, wherein the first running direction is opposite to the second running direction. In the first running direction the discharge device has a first running speed v_{A1} , in the second running direction the discharge device has a running speed v_{A2} . Here, the first running direction of the discharge device of the first continuous conveyor corresponds to the transport direction T_1 of the first continuous conveyor. According to prior art, here, the following is true: $v_{A1} = v_1$. In practice, so it is achieved that the discharge device does not discharge material onto the second continuous conveyor, when it is moved in the first running direction.

With respect to the discharge device a second continuous conveyor is arranged such that the discharge device with its both running directions is moved to and fro over the desired width B_2 of the material bed M_2 on the second continuous conveyor. Also here the width in the sense of the invention corresponds to the measure of the bed being orthogonal to the transport direction T_2 of the second continuous conveyor. During the movement the discharge device continuously applies material onto the second continuous conveyor in at least one, normally the second running direction. Here, in particular, it has to be emphasized that this target can be achieved best, when the material flow of the first continuous conveyor to the discharge device is already a steady-state one and when the bed on the first continuous conveyor in an orthogonal direction with respect to the transport direction T_1 ideally has a trapezoid profile. This is preferably achieved by a method and the corresponding device which are described in DE 10 2016 119 044 and which belong in their comprehensive description there to the content of the disclosure of this application.

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The main idea of the invention is that the second continuous conveyor is moved with a speed v_2 which is within a range which follows from the running distance of the discharge device in the sense of the width of the material bed on the first continuous conveyor B_2 , from the width of the material bed on the first continuous conveyor B_1 and from both running speeds of the discharge device v_{A1} and v_{A2} . According to the invention the following is true:

$$\frac{B_1 \cdot 0.85}{\int_0^{B_2} \frac{1}{v_{A1}(x)} dx + \int_0^{B_2} \frac{1}{v_{A2}(x)} dx} \leq v_2 \leq \frac{B_1 \cdot 1.15}{\int_0^{B_2} \frac{1}{v_{A1}(x)} dx + \int_0^{B_2} \frac{1}{v_{A2}(x)} dx}$$

This formula represents the most general case, namely that the speeds v_{A1} and v_{A2} are different from each other and that both are variable over the width B_2 . In practice, this in fact is the case, because it not possible to accelerate the discharge device at the turnaround points to the desired speeds v_{A1} or v_{A2} in an arbitrarily short time. Within the range being mentioned in the formula it is possible to achieve that the discharge device during the application in one running direction applies a material lane onto the second continuous conveyor to which then the next material lane is added nearly seamlessly, and so a continuous material bed M_2 on the second continuous conveyor is achieved. So a continuous, ideally steady-state material flow on the second continuous conveyor can be achieved, so that also subsequent process steps are charged uniformly which results in an increase with respect to the throughput and/or a homogenization of the product quality.

Preferable is the following range

$$\frac{B_1 \cdot 0.95}{\int_0^{B_2} \frac{1}{v_{A1}(x)} dx + \int_0^{B_2} \frac{1}{v_{A2}(x)} dx} \leq v_2 \leq \frac{B_1 \cdot 1.05}{\int_0^{B_2} \frac{1}{v_{A1}(x)} dx + \int_0^{B_2} \frac{1}{v_{A2}(x)} dx}$$

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and particularly preferable is

$$\frac{B_1 \cdot 0.98}{\int_0^{B_2} \frac{1}{v_{A1}(x)} dx + \int_0^{B_2} \frac{1}{v_{A2}(x)} dx} \leq v_2 \leq \frac{B_1 \cdot 1.02}{\int_0^{B_2} \frac{1}{v_{A1}(x)} dx + \int_0^{B_2} \frac{1}{v_{A2}(x)} dx}.$$

5

The profile is completely seamless, when the following is true

$$v_2 = \frac{B_1}{\int_0^{B_2} \frac{1}{v_{A1}(x)} dx + \int_0^{B_2} \frac{1}{v_{A2}(x)} dx}$$

10 and when the widths B_1 and B_2 are defined as the widths of the trapezoid profiles at the half height (thus mean width).

In a special case of the invention the first and the second running speeds v_{A1} and v_{A2} of the discharge device – with the exception of the algebraic sign – are identical and they are nearly constant during the running time so that a uniform movement of the discharge device in both directions results. This allows a particularly simple form of the driving unit for the discharge device.

20 According to prior art both running speeds v_{A1} and v_{A2} of the discharge device are equated with the transport speed v_1 of the first continuous conveyor so that the discharge device in the first running direction does not discharge material onto the second continuous conveyor and that in the second running direction of the discharge device exactly one material lane is applied onto the second continuous conveyor. In this case and when the processes of deceleration and acceleration in the region of the turnaround points are ignored the following

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simplified formula for calculating the transport speed v_2 of the second continuous conveyor according to the present invention is true

$$\frac{v_1}{2} \cdot \frac{B_1}{B_2} \cdot 0.85 \leq v_2 \leq \frac{v_1}{2} \cdot \frac{B_1}{B_2} \cdot 1.15.$$

5

Also possible is a further embodiment of the invention in which the discharge device applies two material lanes onto the second continuous conveyor one upon the other, wherein, like above, only in the second running direction of the discharge device material is applied onto the second continuous conveyor. This means that the lanes overlap by 50 % each, wherein this means that the first lane is applied onto the second continuous conveyor and onto the half of the width of these first lane the half of the width of the second lane is applied, whereas the other half of the width of the second lane forms a new lane onto which then in turn the half of the third lane is applied, whereas the other half of the third lane forms a new lane. So, higher material loads of the second continuous conveyor can be achieved. Then for the range of the transport speed v_2 of the second continuous conveyor the following is true

20

$$\frac{v_1}{4} \cdot \frac{B_1}{B_2} \cdot 0.85 \leq v_2 \leq \frac{v_1}{4} \cdot \frac{B_1}{B_2} \cdot 1.15$$

When the transport speed v_2 of the second continuous conveyor is adjusted according to one of the above formulas, then this is a pure control.

25

Furthermore, it was shown to be advantageous, when the material bed on the first continuous conveyor in a cross section being orthogonal to a bearing area of the continuous conveyor has the form of a trapezoid, because so a uniform feeding of the second continuous conveyor can be guaranteed. In addition or in an alternative, the mean width B_1 is the mean width of this trapezoid which is

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determined in an orthogonal direction with respect to the transport direction T_1 of the first continuous conveyor.

Furthermore, it was shown to be advantageous, when the granular material
5 contains iron. In particular in the case of the production of iron and steel large
amounts of material are handled, and the example of the transport of green
pellets from the pelletizing disks which are used for their production to the
burning in a traveling grate plant shows that such a method is connected with
decisive advantages, because only a uniform feeding of the grate wagons of the
10 traveling grate can guarantee that at the present conditions in the plant the used
material is burned uniformly and that so at the end of the process a
homogenous product quality can be achieved.

Furthermore, it was shown to be advantageous, when a first measuring device
15 examines the material bed on the first continuous conveyor for minima or
maxima in longitudinal and transverse directions with respect to the transport
direction T_1 of the first continuous conveyor. So it is possible to detect, when
already the first continuous conveyor is charged in a non-uniform manner, and
measures can be taken for guaranteeing a steady-state material flow here
20 again.

A further preferable embodiment of the invention includes that a second
measuring device examines the material being applied onto the second
continuous conveyor for minima and/or maxima. So it can be determined, if here
25 a non-uniform feeding takes place. When also the material bed on the first
continuous conveyor is examined for minima or maxima, then it is possible to
correlate the results of the second measuring device with the results of the first
measuring device, and thus influences of a non-uniform feeding of the first
continuous conveyor can be eliminated.

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But when in the course of time only the second measuring device detects minima which occur, in addition, at least three times one after the other periodically with the periodic time of the movement to and fro of the discharge direction, then this means that the speed of the second continuous conveyor
5 has to be adjusted in the sense of a regulation. When periodic minima in an otherwise nearly horizontal profile are detected, then the driving speed of the driving unit of the second continuous conveyor (thus its transport speed v_2) has to be reduced. This preferably is realized by a gradual decrease of the transport speed of the second continuous conveyor. The reason for that is that the cause
10 of the minima is a gap between two lanes being applied by the discharge device or an insufficient overlay between these two lanes.

However, when periodic maxima in the periodic time of the movement to and fro of the discharge direction in an otherwise nearly horizontal profile are formed,
15 then the driving speed of the driving unit of the second continuous conveyor and/or its transport speed have to be increased, because the reason for these maxima is a double bed in the edge region of two lanes being applied by the discharge device onto the second continuous conveyor. Preferably, this is achieved by very slowly increasing the speed of the second continuous
20 conveyor, till the maximum cannot be detected any longer.

In this case, the reduction or the increase of the transport speed v_2 of the second continuous conveyor preferably amounts only to 1 % in 15 s. The reason for this very slow change of the speed is the dead time which elapses, till a
25 change of the distance between two lanes applied by the discharge device reaches the measuring device. By the same token, from this follows that the measuring device should be arranged as near as possible with respect to the first continuous conveyor so that the dead time is short.

In the specific example this means, that for $B_1 = 2$ m, $B_2 = 4$ m, $v_1 = 0.8$ m/s and the distance y^* between the edge of the material bed M_1 on the first continuous conveyor being more remote to the measuring device = 3 m the range of the transport speed v_2 of the second continuous conveyor is calculated according to the following formula:

$$\frac{v_1}{2} \cdot \frac{B_1}{B_2} \cdot 0.85 \leq v_2 \leq \frac{v_1}{2} \cdot \frac{B_1}{B_2} \cdot 1.15$$

From the product of 0.85 and 0.2 m/s as specific minimum value and the product of 1.15 and 0.2 m/s as specific maximum value of this range follows the mean value of 0.2 m/s. Thus, for moving the distance of 3 m, the material bed M_2 on the second continuous conveyor on average needs $3 \text{ m} / (0.2 \text{ m/s}) = 15 \text{ s}$. When during these 15 s the transport speed of the second continuous conveyor would be changed by more than 1 %, then there would be the risk that the regulating device overshoots which should be prevented.

Generally, the transport speed v_2 should preferably be increased in steps of 0.1 m/s, particularly preferably 0.05 m/s, particularly preferably 0.01 m/s. In the case of larger steps there is the risk that the regulating circuit overshoots.

For most process steps a uniform feeding is the ideal feeding, because so a steady-state material flow and thus also steady-state conditions in downstream process steps can be adjusted. Here, there are also methods and devices in which the formation of profiles in the feeding of the downstream process steps is reasonable, wherein the mass stream of the feed in the course of time still stays constant. An example for that is the burning of so-called green pellets of iron ore, a binder, water and optionally a solid fuel in pellet kilns being designed as traveling grate plants. Till today the green pellets have been applied onto so-called grate wagons, wherein the application typically has been conducted such

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that a horizontal line between the upper edges of the side walls of the grate wagons was formed and that also the bed in the running direction of the grate wagons has formed a horizontal plane. This is connected with the advantage that the hoods for the gas guidance above the pellet bed used in the traveling grate plant can be constructed relatively simple with horizontal bottom edges and that there only a small gap is formed between the surface of the pellet bed on the movable grate wagons and the stationary bottom edge of the hood. So it is possible to achieve small leakage streams between the interior of the hood and the environment of the plant. The grate wagons themselves are moved in a circular course within a closed chain and thus they are also a continuous conveyor.

But normally, in such plants it is only examined to what extent the mean height of the bed in the feeding zone of the traveling grate corresponds with the respective process conditions, however not, how the form of the bed itself is designed. Typically, then the mean height of the bed is regulated by varying the transport speed v_4 of the traveling grate such that it corresponds to the height of the side walls S of the grate wagons. Here, optional waves and asymmetric forms of the surface of the pellet bed on the traveling grate are not automatically corrected, although they may have indeed a troublesome influence onto the process of pellet burning.

But even when an ideal horizontal surface of the pellet bed is achieved, this profile is connected with two disadvantages. On the one hand, the filling degree of a horizontal profile is lower than the filling degree of a profile with a convex form with respect to the bearing area of the grate wagon, because in the case of the convex profile with the volume of the vaulted part above the horizontal profile an additional filling volume is created.

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On the other hand, the gas flow within a grate wagon is not homogenous, in particularly in the burning zone. The reason for that is that the temperature profile of the hot flue gasses over the width of the hood (thus in x direction) is not homogenous. The hot flue gas is present in the burning zone in the hood and by a low pressure in the wind box below the grate wagon it is sucked through the pellet bed. In most pellet kilns built the flue gas in the center of the hood has a higher temperature than the flue gas at the rims of the hood. This results in different flow conditions within the pellet bed of a grate wagon, wherein in the center of the grate wagon more heat is transferred from the flue gas to the pellets so that the pellets in the center reach the desired quality in a shorter time than the pellets being located at the rims of the grate wagon. When then the pellet kiln is operated such that also the pellets being located at the rim achieve the desired quality, then the pellets in the center are overburned which is not desired and results in an unnecessarily high energy demand of the pellet kiln. It becomes clear that the uniform feeding of the pellet kiln with a horizontal bed profile which to the bearing area R of the grate wagon (being formed by the crossbars and the grate bars being arranged thereon) or another continuous conveyor, e.g. also a belt dryer with a thermal treatment on a perforated conveyor belt, can nevertheless result in inhomogeneous product quality and that therewith even an undesirably high energy demand is connected. When a convex profile is formed, wherein the maximum height of it is located in the center of the grate wagon (center in the sense of the invention is primarily the center of mass of the rectangle or trapezoid being formed by the bearing area R and the side limits S), then here due to the larger bed height also the areic volume stream of the flow of the hot flue gas through it in the burning zone becomes lower. Therefore, it is also possible to guarantee homogenous process conditions within the grate wagon over the width of the grate wagon by a targeted variation of the bed height.

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In the case of other special features of the plant it may be reasonable to adjust asymmetric profiles (thus profiles having a maximum which is not located in the center between the side walls). So, for example, problems being caused by special flow features can be balanced which are the result of an asymmetric geometry of the wind boxes below the grate wagons.

Therefore, it is also an object of the invention to provide a method and a respective device with which it is possible to create in a targeted manner profiles of the height of the material bed over the width of a material bed on a continuous conveyor. Here, the width of the material bed of a continuous conveyor is the dimension of the bed in the orthogonal direction with respect to the transport direction of the continuous conveyor.

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This object is solved by a method being characterized by the features of patent claim 1.

In such a method by a first continuous conveyor material in a material bed having a mean width B_1 is transported into or onto a discharge device. Preferably, the material bed on the first continuous conveyor in a cross section through the material being orthogonal to the transport direction T_1 has the form of a trapezoid, wherein both parallel sides of the trapezoid are also parallel to the bearing area of the first continuous conveyor. Therefore, in particular, the mean width B_1 is the mean width of the trapezoid so formed.

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The discharge device is moved in a first running direction L_{A1} with a first running speed v_{A1} and in a second running direction L_{A2} with a running speed v_{A2} , wherein the orientations of both running directions are preferably opposite to each other and wherein the first running direction L_{A1} corresponds with the transport direction T_1 of the first continuous conveyor. Opposite to each other in the sense of the invention, in particular, means that the discharge device is moved over the width B_2 of the material bed of a second continuous conveyor, wherein here the movement may not necessarily describe a straight distance.

The width B_2 of the material bed on the second continuous conveyor has to be understood in the sense of the invention in an orthogonal direction with respect to its transport direction T_2 and thus means in practice normally the width of the bearing area of the second continuous conveyor minus a safety distance on both sides.

The discharge device continuously applies in at least one running direction, preferably in running direction L_{A2} material onto the second continuous conveyor. It is a subject matter and a basic idea of the invention that during the process of applying material onto the second continuous conveyor by the discharge device the running speed v_2 of the discharge device is varied and thus is not constant. This means that the running speed v_2 of the discharge device comprises at least three minima and/or one maximum over the width B_2 . This follows from the fact that also during normal operation at the begin and at the end of its running distance, thus at the positions $x=0$ and $x=B_2$, a minimum is reached each, since the discharge device is decelerated, when it approaches the turnaround points, and at the positions $x=0$ and $x=B_2$ for the running speed the following is true: $v_2=0$. In addition thereto, then according to the

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present invention at least one further minimum and/or at least one further maximum is included.

So, basically, the running speed v_{A2} of the discharge device becomes a function of the location:

$$v_{A2} = f(x) = v_{A2}(x)$$

and the running time of the discharge device in the running direction L_{A2} is defined as follows:

$$\tau_{A2} = \int_0^{B_2} \frac{1}{v_{A2}(x)} dx = \frac{B_2}{v_{A2}^*}$$

Then, for the mean running speed v_{A2}^* of the discharge device during its running distance in running direction L_{A2} the following is true:

$$v_{A2}^* = \frac{B_2}{\tau_{A2}}$$

This means that, when the local running speed $v_{A2}(x)$ of the discharge device is lower than the mean running speed v_{A2}^* of the discharge device during its running distance in running direction L_{A2} with a steady-state material flow on the first continuous conveyor locally more material is applied onto the second continuous conveyor. But when, on the contrary, the local running speed $v_{A2}(x)$ of the discharge device is higher than the mean running speed v_{A2}^* of the discharge device, then with a steady-state material flow on the first continuous conveyor locally less material is applied onto the second continuous conveyor. The reason for that is that the amount of the locally applied material directly and reproducibly depends on the local running speed $v_{A2}(x)$ of the discharge device

in running direction L_{A2} , as long as the material flow on the first continuous conveyor is a steady-state one, i.e. is constant in the course of time. So, with the invention in a targeted manner maxima and minima and profiles over the width B_2 of the material bed (x direction) on the second continuous conveyor can be created, while the height of the material bed on the second continuous conveyor in y direction ideally is constant at each coordinate x^* ($0 \leq x^* \leq B_2$), even though it is not identical with the height of the material bed on the second continuous conveyor at another coordinate x^{**} ($0 \leq x^{**} \leq B_2, x^{**} \neq x^*$).

In a preferable embodiment of the invention the changing running speed $v_{A2}(x)$ is characterized by a minimum in the middle of the width B_2 of the material bed of the second continuous conveyor. So a maximum in the middle of the material bed on the second continuous conveyor can be achieved, so that, e.g. in the case of feeding grate wagons the advantageous effect of a convex formed profile is possible. But in total this advantage can be used in each application in which capacities of downstream process steps play a role. The height of the maximum each is determined by the angle of repose β of the respective granular material, since the angle of repose cannot be exceeded. So the maximum height which is possible in the middle of the width B_2 of the material bed on the second continuous conveyor would be defined as follows:

$$h_{\max} = \frac{B_2}{2} \cdot \tan \beta$$

and the profile of the material bed on the second continuous conveyor being created such would be an isosceles triangle, wherein the length of the base thereof would be B_2 and its height would be $h_{\max}$.

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Furthermore, it was shown to be advantageous, when starting from an axis running in the operating direction of the second continuous conveyor through the middle of the width B_2 of the second continuous conveyor, the running speed $v_{A2}(x)$ changes symmetrically. So symmetric profiles are achieved which normally correspond with the requirements of the plants and support the provision of homogenous conditions in subsequent process steps.

Preferably, the discharge device discharges material in only one running direction L_{A2} . In the other running direction L_{A1} each then the mean running speed v_{A1}^* is exactly the transport speed v_1 of the first continuous conveyor. This corresponds to the mode of operation being common at the moment.

Furthermore, it is particularly advantageous, when the profile of the material bed $h(x)$ on the second continuous conveyor can be calculated as follows:

$$h(x) = a \cdot x^2 + b \cdot x \text{ with } a < 0 \text{ and } 0 < b < 1$$

So a parabolic cross section of the material bed being orthogonal to the transport direction T_2 on the second continuous conveyor and thus the already discussed convex profile can be achieved. In a particularly preferable embodiment of the invention for b the tangent of the angle of repose is chosen. So the created convex profile is characterized on its edges by the angle of repose and is flatter in the middle, because the first derivative of the above-mentioned equation with respect to x results in the slope $\frac{dh}{dx}$, i.e. the tangent of the respective angle. So the first derivative is as follows

$$h'(x) = 2 \cdot a \cdot x + b$$

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and at the position $x = 0$ thus the following is true: $h'(0) = b$.

But generally, it is also possible to adjust other profile forms, in particularly arc-like, triangular, trapezoid and concave profiles.

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Here, preferably, the material bed, as described above, on the first continuous conveyor has the form of a trapezoid. In this connection trapezoid means that a cross section through the material being orthogonal to the bearing area of the continuous conveyor is formed, wherein both parallel sides of the trapezoid are also parallel to the continuous conveyor and/or to its bearing area. Therefore, in particularly, the mean width B_1 is the mean width of the trapezoid so formed. This design guarantees that the material lane being applied by the discharge device onto the second continuous conveyor will also have a trapezoid cross section. So the top edge of this trapezoid lane profile is parallel to the bearing area of the second continuous conveyor. This is the best prerequisite for a constant height of the material bed on the second continuous conveyor in y direction at each coordinate $x = x^*$, $0 \leq x^* \leq B_2$. This is preferably achieved by a method and the corresponding device which are described in DE 10 2016 119 044 and which belong in their comprehensive description there to the content of the disclosure of this application.

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Furthermore, it was shown to be advantageous, when a first measuring device examines the material bed on the first continuous conveyor for minima or maxima in transverse direction (y direction) and/or a second device examines the material being applied onto the second continuous conveyor for periodic minima or maxima in the course of time, thus in the case of a stationary measuring device also examines the material bed on the second continuous conveyor which is running through beneath it for periodic minima and maxima in y direction.

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An examination of the first continuous conveyor by means of a measuring device should be conducted, because it has to be guaranteed that the material flow on the first continuous conveyor is a steady-state one and that ideally the material bed on the first continuous conveyor always is characterized by the same trapezoid profile having a mean width B_1 being constant in the course of time and with respect to the position. When this is not the case, then even an optimally adjusted regulating device cannot create the desired profile $h(x)$ on the second continuous conveyor by changing the running speed $v_{A2}(x)$ of the discharge device which depends on the position.

Periodic changes of the bed height h on the second continuous conveyor in the course of time, in particular in the periodic time of the movement to and fro of the discharge device, are detected by the second measuring device. They indicate that the transport speed v_2 of the second continuous conveyor is not exactly adjusted to the mean running speed v_{A2}^* of the discharge device. Rather, in the case of the detection of periodic minima arising in the periodic time of the movement to and fro of the discharge device it would be such that the second continuous conveyor runs too fast so that the discharge device is not capable of applying uniformly and/or sufficiently overlapping lanes on it. But when in the course of time periodically maxima arising in the periodic time of the movement to and fro of the discharge device are detected, then this means that the second continuous conveyor in relation to the mean running speed v_{A2}^* of the discharge device runs too slow, because here the overlapping of the lanes of the bed material of the discharge device is too strong. Thus, these non-uniformities in the course of time of the material bed on the second continuous conveyor which are detected by the second measuring device can be corrected by a suitable regulating mechanism. This is preferably achieved by a method and the corresponding device which are described in DE 10 2016 119 086 and

which belong in their comprehensive description to the content of the disclosure of this application.

Furthermore, it was shown to particularly advantageous, when a third measuring device measures the actual profile of the material stream with the width T_4 being applied onto the fourth continuous conveyor with the transport direction T_4 and the transport speed v_4 and when a regulating device correlates the actual status so measured with a desired status representing the ideal profile of the material bed on the fourth continuous conveyor. So the desired status of the profile on the fourth continuous conveyor can exactly be achieved by regulating. Here, the desired profile on the fourth continuous conveyor – similarly as in the case of the desired profile on the second continuous conveyor – may be a linear, convex, triangle-shaped, arc-shaped, parabolic, trapezoid or also concave one, respectively symmetric with respect to the centerline of the fourth continuous conveyor or also asymmetric thereto. When the fourth continuous conveyor comprises limitations on the sides S , upturns, elevated edges of a conveyor belt or side walls, then the height of the desired profile at the edges of the width B_4 can also be > 0 . This is absolutely reasonable for the gas flow through the material bed on the fourth continuous conveyor in the sense of a thermal treatment, because otherwise the flow resistance in the edge region would be very low. This would result in the fact that the gas to be passed through preferably flows through at the edges of the material bed, however where it does not meet much solid. A low thermal efficiency of the thermal treatment would be the result.

So the desired profile on the fourth continuous conveyor is different from the desired profile on the second continuous conveyor, where the height of the material bed at the edges of the width B_2 is always $= 0$.

This third measuring device should in particular be used, when between the second and the fourth continuous conveyors still a third continuous conveyor with the transport direction T_3 , the transport speed v_3 and the width of the material bed B_3 is inserted. In practice, for example, as a third continuous conveyor often a so-called roller screen with driven rollers is used, wherein the transport direction T_3 is identical to the transport directions T_2 and T_4 , the widths of the material beds B_2 , B_3 and B_4 typically only differ by at most 20 %, preferably by less than 10 %, however the transport speeds v_2 , v_3 and v_4 all are different from each other. The roller screen, besides its transport function has also the function of a screen for material grains which are too small and/or too large. In addition, with it there is a tendency to a homogenization of the cross section profile $h_2(x)$ on the second continuous conveyor, thus in particular to a reduction of a convex superelevation in the middle of the profile. Thus, in a regulating sense this roller screen induces a fault. Insofar it is a particularly preferable embodiment of the invention, when the profile $h_2(x)$ on the second continuous conveyor is changed so long, until on the fourth continuous conveyor the desired profile $h_{4,desired}(x)$ results. For that the measuring device above the second continuous conveyor is helpful, but not necessarily required.

For example, the mentioned measuring devices may provide continuously or discrete measuring results, wherein continuously and discrete mean both, with respect to the time of the measurement and thus to the local measuring points in movement direction of the first, second or a third or fourth continuous conveyor and also with respect to the widths of the material beds B_1 , B_2 , B_3 or B_4 .

Normally, per measuring device several sensors are used which in a discrete or continuous manner detect the whole widths of the respective continuous conveyors. These measurements, in addition, may be conducted in a continuous manner or within single intervals, wherein during the running of the discharge device in each of both running directions at least two, preferably at least four

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measurements are conducted. Frequent measurements result in the advantage that also small deviations from the respective desired profile can be identified and that with the help of the second measuring device it is easier to distinguish between periodically recurring non-uniformities, which are the result of an
 5 imperfect tuning between the mean running speed v_{A2}^* of the discharge pulley and the speed v_2 of the second continuous conveyor, and other deviations.

With the measuring devices it is possible to detect discrete or continuous differences between the actual state and the desired state of the heights
 10 $h_{desired}(x)$ and $h_{actual}(x)$ over the widths B_2 , B_3 or B_4 of the applied beds on the second or a downstream continuous conveyor. Starting with that, according to the present invention, the running speed of the discharge device in the material-applying running direction(s) as a function of the coordinate x is adjusted. For that the previous vectorial speed $\overrightarrow{v_{old}(x)}$ during the application of the material in
 15 one or in both running directions L_{A1} and L_{A2} is changed such that the desired new vectorial speed $\overrightarrow{v_{new,normed}(x)}$ during a constant time τ of the application of material is as follows

$$\overrightarrow{v_{new,normed}(x)} = \left(\overrightarrow{v_{old}(x)} \cdot \left[\frac{\overrightarrow{h_{actual}(x)} - \overrightarrow{h_{desired}(x)}}{h_{desired}\left(\frac{B_4}{2}\right)} \cdot \alpha + 1 \right] \right) \cdot \left[\frac{\int_0^{B_2} \frac{1}{v_{new}(x)} dx}{\tau} \right].$$

20

α is a dimensionless damping factor which is ≤ 1 , preferably ≤ 0.5 , particularly preferably ≤ 0.2 . With a suitable choice of the damping factor α an overshooting of the regulating device can be avoided.

25 $\overrightarrow{v_{A2,new}(x)}$ is the new running speed of the discharge device, preferably of a discharge pulley, being discretized as a vector and being defined as follows:

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$$\overrightarrow{v_{new}}(x) = \overrightarrow{v_{old}}(x) \cdot \left[\frac{\overrightarrow{h_{actual}}(x) - \overrightarrow{h_{desired}}(x)}{h_{desired}\left(\frac{B_4}{2}\right)} \cdot \alpha + 1 \right]$$

Details and considerations for the regulating mechanism are now explained
 5 once again more specifically for a system in which a third measuring device
 transmits the actual height profile $h_{4,actual}(x)$ on a fourth continuous conveyor, the
 desired profile $h_{4,desired}(x)$ is stored in a connected regulating device and in which
 the discharge device applies material only in the second running direction L_{A2}
 for the duration τ_{A2} . However, the considerations may directly be transferred to
 10 any other system.

When the regulating device being connected to the third measuring device
 detects a difference between the actual and the desired state of the cross
 section profile of the bed on the fourth continuous conveyor within one single
 15 discharge cycle, thus within the single complete movement of the discharge
 device in both running directions L_{A1} and L_{A2} , then the new running speed
 being defined as a vector and being discretized $\overrightarrow{v_{A2,new}}(x)$ of the discharge pulley
 can be calculated according to the following equation

$$\overrightarrow{v_{A2,new}}(x) = \overrightarrow{v_{A2,old}}(x) \cdot \left[\frac{\overrightarrow{h_{4,actual}}(x) - \overrightarrow{h_{4,desired}}(x)}{h_{4,desired}\left(\frac{B_4}{2}\right)} \cdot \alpha + 1 \right]$$

wherein $h_{4,desired}(x)$ and $h_{4,actual}(x)$ are the heights of the desired and the actual
 profiles of the bed on the fourth continuous conveyor being discretized in
 vectorial form. Here, it is only required that the discretization of $\overrightarrow{v_{A2,new}}(x)$ is

conducted with the same number of steps as the discretization of the bed profiles $h_{4,desired}(x)$ and $h_{4,actual}(x)$ on the fourth continuous conveyor, even in the case, when the widths of the material beds B_2 and B_4 are different.

- 5 Thus, for example, the running speed $\overrightarrow{v_{A2}(x)}$ of the discharge device and the profiles of the beds on the fourth continuous conveyor may be discretized in 41 equidistant steps each so that they can be expressed as vectors comprising 41 lines each. Then the 21st, thus the line in the middle of the equation being written in vectorial form is as follows:

10

$$v_{A2,new}\left(\frac{B_2}{2}\right) = v_{A2,old}\left(\frac{B_2}{2}\right) \cdot \left[\frac{h_{4,actual}\left(\frac{B_4}{2}\right) - h_{4,desired}\left(\frac{B_4}{2}\right)}{h_{4,desired}\left(\frac{B_4}{2}\right)} \cdot \alpha + 1 \right]$$

15

When in this example the actual height of the profile on the fourth continuous conveyor at the centerline of this conveyor is 45 cm and thus is 5 cm higher than the desired height of the profile at this position (in this example 40 cm), then the value of the fraction in this equation is + 0.125. When for α the value 0.1 is chosen, then the value in the squared brackets of the equation is 1.0125. Thus, the new running speed of the discharge device at the centerline of the second continuous conveyor is increased by 1.25 % with respect to the old running speed at the same position. In an analogous manner all other 40 lines of the equation being written as a vector are calculated.

20

Over several movement cycles of the discharge device by means of the dimensionless damping factor α the profile of the running speed $\overrightarrow{v_{A2}(x)}$ can vectorially be regulated such that an actual profile $\overrightarrow{h_{4,actual}(x)}$ which corresponds

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with the desired profile $\overrightarrow{h_{A,desired}(x)}$ can be achieved on the fourth continuous conveyor.

Consequently, this regulation of the profile $h_{A,desired}(x)$ can only be influenced by a

5 variation of the speed profile $\overrightarrow{v_{A2}(x)}$ of the discharge pulley above the second continuous conveyor. This is decisive, because a solution which is connected with a mechanical correction of the profile by skimming cannot be used in a lot of methods, e.g. also in the case of pelletizing plants for iron ore, because mechanical skimmers here may result in damages on the granular material. E.g.
 10 in the case of green pellets of iron ore each mechanical stress easily results in their plastic deformation. So it would easily be possible that the green pellets under the influence of a skimmer flatten out at the points of contact with the skimmer or with the adjacent pellets, which results in a reduction of the porosity of the pellet bed and thus in a reduction of the permeability. In the end, so the
 15 energy demand for burning the pellets would be increased which is not desired.

It is preferable, when the discharge device discharges material only during the running direction L_{A2} . Thus, also only the running speed $\overrightarrow{v_{A2}(x)}$ in this running direction L_{A2} dependent on the coordinate x of the discharge device is varied. In
 20 principle, the mean running speed v_{A2}^* can be chosen freely, but it is restricted by technological limits of the conveyor technique. In particularly, the use of very high-powered driving units for the acceleration of a mass with a weight which is so high that it cannot be ignored has to be avoided due to constructive and financial reasons. In the other running direction L_{A1} , in which the discharge
 25 device in the preferred form of the invention applies no material onto the second continuous conveyor, it is advantageous, when the discharge device is moved with the speed v_1 of the first continuous conveyor so that there is no relative movement between the discharge device and the bearing area of the first

continuous conveyor. So in this case material directly remains at the discharge edge of the discharge device and already when the discharge device is decelerated, thus still before the start of the application of material in the running direction L_{A2} again material is dosed onto the second continuous conveyor.

5 Insofar it was shown to be advantageous, when the acceleration and deceleration processes of the discharge device at the turnaround points of the running direction are as short as possible, preferably < 3 s and particularly preferably < 1 s.

10 In a concrete example this means that the first continuous conveyor is moved with a speed of 0.5 m/s. Thus, the running speed v_{A1} of the discharge device in the running direction L_{A1} (forward moving), in which the discharge device does not apply material, is also 0.5 m/s. Provided that the width B_2 of the second continuous conveyor is 4 m, thus, the duration τ_{A1} of this movement – when
 15 acceleration and deceleration processes are ignored – is 8 s. For the mean speed v_{A2}^* in the sense of an average speed of the discharge device in running direction L_{A2} (backward moving) 0.25 m/s may be chosen so that the duration τ_{A2} of the backward movement in the case of a width $B_2 = 4$ m of the second continuous conveyor is 16 s. Thus, in this example, a complete discharge cycle
 20 of the discharge device in total takes $8 \text{ s} + 16 \text{ s} = 24 \text{ s}$.

Now, the speed profile $\overrightarrow{v_{A2}(x)}$ of the discharge device is chosen in a targeted manner such that the desired bed profile results. In a special limit case, when the speed of the discharge device is 0, on the second continuous conveyor only
 25 a slim, but high lane of material, e.g. of green pellets, would be found, the profile of which would generally be determined by the angle of repose of the material. From that it becomes clear that in the case of a slower movement of the discharge device a higher bed height results than in the case of a faster movement. Thus, a convex bed profile will be provided, when the discharge

device during the application of material is moved slower in the middle of the second continuous conveyor than in the edge regions thereof.

A first approximation of the speed profile of the discharge device for generating
 5 convex desired profiles $\overrightarrow{h_{2,desired}(x)}$ on the second continuous conveyor can be calculated in closed form which seems suitable for a parabolic bed profile or by discretization of an arbitrary bed profile. This first approximation allows a control of the running speed $\overrightarrow{v_{A2}(x)}$ of the discharge device which may change dependently on the special site during the running direction L_{A2} during which
 10 material is applied, wherein here still no measuring of the actual state of the bed profile is required. A discretization can e.g. be realized with supporting points of the pre-calculated speed profile in continuous distances such as about every 5 or 10 cm so that the pre-calculated speed profile is then available as a vector $\overrightarrow{v_{A2,pre-calculated}(x)}$ which in the case of a given width B_2 of 4 m with distances of
 15 5 cm comprises 81 values or in the case of distances of 10 cm comprises 41 values. The first and the last values of the vector always are the values of the desired bed heights at the edges of the second continuous conveyor. Assuming that the second continuous conveyor is a conveyor belt having a horizontal bearing area, the desired bed height at the edges is always 0. When the
 20 conveyor belt comprises upturns in the edge region, then the desired bed height in the edge region may also be > 0 .

But because of the fact that through the interlinking of continuous conveyors additional disturbance variables may become important, such as for example a
 25 homogenization of convex profiles by the interposition of a roller screen (for screening out grains which are too large and/or too small) as the third continuous conveyor, a fully automated regulation of the bed profile $\overrightarrow{h_{4,desired}(x)}$ is desired which compensates each deviation between the actual profile $\overrightarrow{h_{4,actual}(x)}$

and the desired profile $\overrightarrow{h_{4,desired}(x)}$ on the fourth continuous conveyor nearly completely and which also completely compensates optional disturbance variables. Therefore, in the regulating device at first in the described manner the desired bed profile $\overrightarrow{h_{4,desired}(x)}$, the duration τ_{A2} of the movement of the discharge
 5 device during the running speed L_{A2} during which material is applied and the pre-calculated running speed profile $\overrightarrow{v_{A2,pre-calculated}(x)}$ are stored.

Preferably, these values will not be changed after the start of the operation of the plant and respective optimization measures, but rather they will be kept
 10 constant during continuous operation. At every restart of the plant, e.g. after a maintenance shutdown, then always these stored data are used again. When then the discharge device has applied material during some movement cycles onto the second continuous conveyor, a short time before the start of the running direction L_{A2} during which material is applied each the speed profile
 15 $\overrightarrow{v_{A2,new}(x)}$ of the discharge device is calculated according to the above-mentioned formula. For that the actual profile $\overrightarrow{h_{4,actual}(x)}$ on the fourth continuous conveyor is measured in the described manner and stored.

It is possible to describe the actual profile with the help of a sectionally defined
 20 mathematical function, for example with the help of a spline interpolation, but generally however it was shown that a discretized form is more suitable for common controlling and regulating mechanisms and is also sufficiently exact. For that, e.g. the actual profile $\overrightarrow{h_{4,actual}(x)}$ on the fourth continuous conveyor is measured in discrete distances of for example 5 or 10 cm over the width B_4 of
 25 the fourth continuous conveyor. The desired profile $\overrightarrow{h_{4,desired}(x)}$ on the fourth continuous conveyor is discretized in the same manner. Now, the measured actual profiles $\overrightarrow{h_{4,actual}(x)}$, for which e.g. measurements every 0.1 s have been

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conducted and stored, are averaged over a whole discharge cycle. In this example, thus, during a total movement cycle of the discharge device with a periodic time of 24 s 240 profiles are averaged. This averaged actual profile being written as a vector is then used in the above-mentioned equation as

$$\overrightarrow{h_{4,actual}(x)}.$$

It was shown to be advantageous to subtract from this actual profile being written in vectorial form the desired profile being also written in vectorial form

$$\overrightarrow{h_{4,desired}(x)} \text{ and to divide the difference by the desired height } \overrightarrow{h_{4,desired}\left(\frac{B_4}{2}\right)} \text{ in the}$$

middle of the fourth continuous conveyor. Thus a dimensionless deviation is obtained which is a negative one, when the local actual height is smaller than the local desired height. But it is a positive one, when the local actual height is larger than the local desired height. Thus, typically, the values of the dimensionless deviation being also written as a vector are nearer to 0 than to -1 or +1.

By the multiplication of this dimensionless deviation by the damping factor α , for which preferably a value of < 0.2 is chosen, the values become smaller again.

When then the result is added to the unit vector 1, values which are near 1 result. They are larger than 1, when the local actual height is larger than the local desired height, and they are smaller than 1, when the local actual height is smaller than the local desired height. When then the result of this addition being

written in vectorial form is multiplied by the old speed profile $\overrightarrow{v_{A2,old}(x)}$ of the discharge device, then the new running speed $v_{A2,new}(x)$ of the discharge device

will be higher than the old running speed $v_{A2,old}(x)$, when the local actual height was larger than the local desired height.

This makes sense insofar that in the case of a higher running speed locally less material is applied from the discharge device onto the second continuous conveyor. Thus, it can be expected that this intervention of the regulating device results in a reduction of the local actual height and that thus it is brought more
 5 into line with the local desired height. Conversely, the new running speed $v_{A2,new}(x)$ of the discharge device will be lower than the old running speed $v_{A2,old}(x)$, when the local actual height was lower than the local desired height.

As a consequence, at this place more material is applied from the discharge device onto the second continuous conveyor, so that the local actual height will
 10 increase and thus is brought more into line with the local desired height. When there is no longer a difference between the local desired height and the local actual height, then there is also no longer a necessity for changing the local speed of the discharge pulley. Then the squared brackets of the above-mentioned formula amounts to exactly 1.0 so that the new local running speed
 15 $v_{A2,new}(x)$ stays identical with the old local running speed $v_{A2,old}(x)$.

Finally, it has to be guaranteed that the duration τ_{A2} of the running direction L_{A2} during which material is applied is not changed by the targeted change of the speed profile, since otherwise this would result in the described discrepancies
 20 between the speed of the second continuous conveyor and the discharge device, which would result in periodically formed minima or maxima in y direction of the second continuous conveyor or which would require the adjustment of the transport speed v_2 of the second continuous conveyor in each cycle of the discharge device which is not desired. Therefore, the newly
 25 calculated speed profile $\overrightarrow{v_{A2,new}(x)}$ has to be normed:

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$$\overrightarrow{v_{A2,new,normed}(x)} = \overrightarrow{v_{A2,new}(x)} \cdot \left[\frac{\int_0^{B_2} \frac{1}{v_{A2,new}(x)} dx}{\tau_{A2}} \right]$$

The integral of the reciprocal value of the path-dependent speed over the width B_2 of the second continuous conveyor provides a duration of the backward movement of the discharge device in running direction L_{A2} . When this duration is becoming longer than the intended duration which has to be kept constant τ_{A2} , then the speed $\overrightarrow{v_{A2}(x)}$ is increased according to the above-mentioned equation, which results in the adjustment of the desired duration τ_{A2} again. Then in the new discharge cycle the complete material application is again conducted without any regulating interventions within this cycle, rather, then the actual profiles are stored again and are used for regulating the subsequent discharge cycle in the described manner. So the deviations between the actual profile and the desired profile in the course of the discharge cycles are becoming smaller and smaller so that after an initial adjustment only minimal corrections of the speed profile $\overrightarrow{v_{A2}(x)}$ are still required. In total, this results in a regulating mechanism with which each arbitrary bed profile can be regulated for bringing it more into line with a desired state as long as this desired state is within the given limit being defined by the angle of repose.

Furthermore, it was shown to be advantageous, when the second continuous conveyor applies the material onto a third continuous conveyor with the transport speed v_3 . So, on the second continuous conveyor without any further influences the profile can be formed and can also be regulated accordingly. This also corresponds with the common plant design, when iron-containing pellets are burned, wherein at first the material from the pelletizing disks is collected on a first continuous conveyor, then the material from the first continuous conveyor

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is transferred by means of a discharge device onto the second continuous conveyor, wherein it is possible to form profiles here, and subsequently the material is transferred via a roller screen which can be regarded as a third continuous conveyor into the grate wagons of a traveling grate plant, wherein the traveling grate itself has to be regarded as the fourth continuous conveyor. Then in the same manner the third continuous conveyor can transfer material onto a fourth continuous conveyor. Similarly, also the material from the second continuous conveyor can directly be transferred onto the fourth continuous conveyor. Preferably, also the third continuous conveyor and/or the fourth continuous conveyor comprise a measuring device each.

Preferably, in this case by means of a measuring device a mean bed height $h_{3,actual}^*$ of the material bed M_3 on the third continuous conveyor is determined and this determined actual value is compared with a predetermined desired value $h_{3,desired}^*$. When the actual value $h_{3,actual}^*$ is lower than the predetermined desired value $h_{3,desired}^*$, then this means that the transport speed v_3 of the third continuous conveyor is too high and that this speed v_3 has to be reduced accordingly. Conversely, when the actual bed height $h_{3,actual}^*$ exceeds the desired value $h_{3,desired}^*$, then the speed v_3 of the third continuous conveyor is too low so that the residence time of the material on this third continuous conveyor and thus the mean bed height are becoming longer and larger, respectively, than desired. In both cases the transport speed v_3 of the third continuous conveyor is increased or decreased in a discrete or continuous manner so long, until the mean bed height $h_{3,actual}^*$ again corresponds with the desired value $h_{3,desired}^{**}$.

It is particularly preferable, when a measuring device above the fourth continuous conveyor can determine the actual profile of the material bed on this conveyor and when an evaluation unit connected therewith can calculate the cross sectional area of this material bed. In the sense of the invention, this cross sectional area is determined in an orthogonal direction with respect to the transport direction T_4 of the fourth continuous conveyor. This calculated actual value of the cross sectional area $Q_{4,actual}$ being based on the measurement is compared with a desired value $Q_{4,desired}$. When there are differences between the actual value $Q_{4,actual}$ and the desired value $Q_{4,desired}$, then in the sense of a regulating intervention it can be reacted in two different kinds:

- a) The material stream, when the first continuous conveyor is fed, can be influenced in such a way that the actual value of the cross sectional area $Q_{4,actual}$ is brought more into line with the desired value $Q_{4,desired}$. When, for example, the calculated actual cross sectional area $Q_{4,actual}$ is smaller than the respective desired value $Q_{4,desired}$, then, when the first continuous conveyor is fed, more material is applied.
- b) The transport speed v_4 of the fourth continuous conveyor is adjusted such that the calculated actual value of the cross sectional area $Q_{4,actual}$ is brought more into line with the desired value $Q_{4,desired}$. Thus, in the example mentioned in a) the transport speed v_4 of the fourth continuous conveyor would be reduced so long, until the desired value $Q_{4,desired}$ is reached.

A deviation between the actual cross sectional area $Q_{4,actual}$ and the desired cross sectional area $Q_{4,desired}$ can, for example, arise, when the size distribution of the grains of the bed material changes so that the grains become smaller and smaller and when the third continuous conveyor is a roller screen which screens

out these smaller grains and therefore does not apply them onto the fourth continuous conveyor. Furthermore, it is essential for the regulating (device) being described here that the measuring device above the fourth continuous conveyor does also determine the actual height profile of the material bed on the
 5 fourth continuous conveyor.

But it may also be that the actual profile is different from the desired profile, but that the actual cross sectional area $Q_{4,actual}$ exactly corresponds to the desired cross sectional area $Q_{4,desired}$. In this case, it is not necessary to make an
 10 amendment as described in a) or b) above, but the regulating intervention may only consist of a manipulation of the speed $\overrightarrow{v_{A2}(x)}$ of the discharge device which may change dependently on the special site.

Conversely, also the case may become true that the actual profile corresponds
 15 indeed in its form with the desired profile, but that the actual cross sectional area $Q_{4,actual}$ differs from the desired cross sectional area $Q_{4,desired}$. In such cases, normally, the measured profile in total is located too high or too low. In this case the regulating intervention with respect to the speed profile $v_{A2}(x)$ of the discharge device is not helpful. Here, rather, at first the actual cross sectional
 20 area $Q_{4,desired}$ has to be brought more into line with the desired cross sectional area $Q_{4,desired}$.

It was shown to be expedient to maintain the lastly calculated speed profile $v_{A2,new,normed}(x)$ of the discharge device so long, until the actual volume stream of
 25 the material bed has leveled out at a range of 98 to 102 % of the desired volume stream of the material bed. Only then the regulating of the profile is started again. The same logic was shown to be advantageous in the case of starting the chain of continuous conveyors: in the sense of a control at first the pre-

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calculated speed profile $\overrightarrow{v_{A2,pre-calculated}(x)}$ is used, while the cross sectional area of the profile of the material bed on the fourth continuous conveyor is regulated to the desired value $Q_{4,desired}$ in the manner being described either in a) or in b). Only when the actual value of the cross sectional area is in the range of 98 to 102 % of the desired cross sectional area $Q_{4,desired}$, then automatically it is switched over to the above-described regulation of the profile by manipulating the speed profile $v_{A2}(x)$ of the discharge device. The logic described in this paragraph can accordingly also be used in the case of the first and second continuous conveyors, when above this respective continuous conveyor a corresponding measuring device is present.

Furthermore, it was shown to be advantageous, when the granular material contains iron. In particular in the case of the production of iron and steel large amounts of material are handled, and the example of the transport of green pellets from the pelletizing disks which are used for their production to the burning in a traveling grate plant shows that such a method is connected with decisive advantages, because only a changed feeding of the grate wagons of the traveling grate can guarantee that, on the one hand, the receiving capacity of the grate wagons is increased and, on the other hand, at the present conditions in the plant the used material is burned uniformly and that so at the end of the process a homogenous product quality can be achieved.

Furthermore, the invention comprises a device being characterized by the features of patent claim 10. This device is preferably characterized by the features of at least one of claims 1 to 9 and the corresponding description.

Such a device comprises one continuous conveyor as well as at least two loading devices which are designed such that with each loading device a continuous lane of the granular material to be applied is formed on a bearing

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area of the continuous conveyor. In the sense of the invention these lanes should be parallel to each other and should overlap each other such that a single material bed on the bearing area is formed, wherein the material bed in a cross section being orthogonal to the bearing area has the form of a trapezoid and wherein the parallel sides of the trapezoid are also parallel to the bearing area. According to the present invention, the device is designed such that at least one loading device can be moved transverse with respect to the longitudinal direction of the continuous conveyor.

A preferable embodiment of the invention is characterized by the fact that at least one loading device is a second continuous conveyor. This makes it possible to transport material from previous process steps by means of a continuous conveyor, such as for example a roller screen or a further conveyor belt, to the first continuous conveyor so that this one serves as a collector for different material streams having the same or different compositions.

It is preferable, when in addition to the first loading device on each side of the bearing area of the continuous conveyor in the transport direction thereof at least one further movable loading device is provided. So on both sides of the at first applied lane further lanes can be added which are added seamlessly with respect to the at first applied lane and thus represent an embodiment of the overall material bed in the sense of the invention. In the case of the failure of one single loading device the next loading device being arranged on the same side and being moveable can occupy its position.

Here it is also preferable, that the design of a first loading device is a static one and that it applies the first lane approximately in the middle of the continuous conveyor. When this first loading device fails, then the lane in the middle can be applied by each other moveable loading device, preferably by the second or the

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third loading devices. Therefore, due to higher costs, in the case of the first loading device a moveable design is not necessary.

5 However, in a particularly preferable embodiment all downstream loading devices are characterized by a moveable design so that the above-described movement of the loading device can be conducted in each set-up.

10 It is particularly advantageous, when the described device comprises at least one measuring device which is capable of detecting flatness imperfections in the bed in the form of minima or maxima in the transverse direction of the continuous conveyor. Such minima or maxima in the case of the described arrangement of the loading devices particularly often are created by the circumstance that the overlapping of adjacent lanes is still not optimal. For example, a groove being parallel with respect to the edge of the continuous
15 conveyor in the surface of the bed can be created by the fact that the groove is located at the overlapping position of two lanes, wherein the distance between the centers of these two lanes for the respective volume streams was chosen to large.

20 Such measuring devices may, for example, be ultrasonic probes which are arranged on a beam side by side such that they cover the whole width of the continuous conveyor. The width in the sense of the invention should be understood in an orthogonal direction with respect to the transport direction of the continuous conveyor. Also laser systems or simple deflection methods such
25 as for example one or more metal strips which are deflected stronger or not so strong by minima or maxima, which is then detected, for example, with the help of a rotary potentiometer being assigned to one metal strip each, can be used. Besides a measurement via ultrasonic probes also radar probes could be used. The detection may also be conducted via an optical system, for example a
30 camera, and then analyzed by means of a computerized picture analysis.

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A device in which exclusively or in combination with the till now described devices being characterized by the features of at least one of claims 10 to 15 also material is transferred from a first to a second continuous conveyor comprises a first and a second continuous conveyor as well as a discharge device. The first continuous conveyor is designed for the transport of a material bed M_1 having a mean width B_1 and a transport speed v_1 into or onto the discharge device. The discharge device is moved in a first running direction with a first running speed v_{A1} and in a second running direction being opposite to the first one with a second running speed v_{A2} over a width B_2 of the material bed M_2 of the second continuous conveyor. This second continuous conveyor has the transport speed v_2 . In this case the discharge device at least in one running direction continuously applies material onto the second continuous conveyor. It is subject matter of the invention that the device comprises a controlling device, partially coupled with a regulating device which adjusts the transport speed v_2 of the second continuous conveyor to a value according to the following equation:

$$\frac{B_1 \cdot 0.85}{\int_0^{B_2} \frac{1}{v_{A1}(x)} dx + \int_0^{B_2} \frac{1}{v_{A2}(x)} dx} \leq v_2 \leq \frac{B_1 \cdot 1.15}{\int_0^{B_2} \frac{1}{v_{A1}(x)} dx + \int_0^{B_2} \frac{1}{v_{A2}(x)} dx}.$$

Preferable is the following range

$$\frac{B_1 \cdot 0.95}{\int_0^{B_2} \frac{1}{v_{A1}(x)} dx + \int_0^{B_2} \frac{1}{v_{A2}(x)} dx} \leq v_2 \leq \frac{B_1 \cdot 1.05}{\int_0^{B_2} \frac{1}{v_{A1}(x)} dx + \int_0^{B_2} \frac{1}{v_{A2}(x)} dx}$$

and particularly preferable is the following range

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$$\frac{B_1 \cdot 0.98}{\int_0^{B_2} \frac{1}{v_{A1}(x)} dx + \int_0^{B_2} \frac{1}{v_{A2}(x)} dx} \leq v_2 \leq \frac{B_1 \cdot 1.02}{\int_0^{B_2} \frac{1}{v_{A1}(x)} dx + \int_0^{B_2} \frac{1}{v_{A2}(x)} dx}.$$

Every time, when one of the parameters v_{A1} , v_{A2} , B_1 or B_2 changes, immediately and automatically the transport speed v_2 of the second continuous conveyor is adjusted according to the same formula.

So a continuous feeding of the second continuous conveyor can be guaranteed so that the further material flow is relatively a steady-state one and corresponding downstream process steps are no longer subject of fluctuations with respect to the load with the granular material.

Preferably, the first and/or the second continuous conveyor is a conveyor belt or a roller screen. The design of a conveyor belt is preferable, because a conveyor belt is a particularly simple continuous conveyor. A roller screen is connected with the advantage that so material having a size which is too large and/or too small (size in the sense of the diameter) can be unloaded from the process. Also combinations of two continuous conveyors are possible, wherein for example a combination is conceivable in which at least one of the continuous conveyors partially consists of a conveyor belt and partially of a roller screen.

Furthermore, it is preferable, when the discharge device is a discharge pulley. This is a particularly simple solution for a discharge device which can be moved, for example, by a double-acting hydraulic cylinder in connection with a hydraulic pump and respective hydraulic valves or a rack and pinion gear with motor driving unit in connection with end switches which change the direction of rotation of the driving unit or an electric linear motor with a respective control in two directions.

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But it is also in the sense of the invention, when as a discharge device a slewing belt which applies the material from the first continuous conveyor onto the second continuous conveyor is used. Therefore, here, again it has to be emphasized that running direction in the sense of the invention does not necessarily mean a straight running direction, but only the movement from one side of the second continuous conveyor to the opposite side and back again and explicitly also, for example, a parabolic material application by the application with a slewing belt is comprised by the invention.

Another preferable embodiment of the invention comprises a measuring device which examines the material being applied onto the second continuous conveyor for minima and/or maxima. Preferably, this measuring device is mounted on the second continuous conveyor. Based on the measuring results of this at least one measuring device, then the transport speed of the second continuous conveyor can be influenced by the regulating device such that a steady-state material stream on the second continuous conveyor is provided. In comparison to the above explained control the regulation is a fine tuning of the transport speed v_2 of the second continuous conveyor which also compensates perturbations such as time variable angles of repose of the material beds. So v_2 is the actuating variable, while the controlled process variable is the mass stream, wherein the temporal fluctuations of which are regulated such that they are virtually zero.

Furthermore, it was shown to be advantageous, when a first measuring device examines the material bed on the first continuous conveyor for minima and maxima in transverse direction.

Such a device comprises a first and a second continuous conveyor as well as a discharge device. The first continuous conveyor is designed for transporting a material bed having a mean width B_1 into or onto the discharge device. The

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discharge device is constructed such that it is moveable in a first running direction L_{A1} with a running speed of v_{A1} and in a second running direction L_{A2} being opposite to the first one with a running speed v_{A2} over the width B_2 of the material bed on the second continuous conveyor. The discharge device applies
5 in at least one running direction, preferably in the running direction L_{A2} , lanes of material onto the second continuous conveyor.

According to the present invention, the device comprises at least one controlling or regulating device (the last one preferable with a corresponding control unit)
10 which controls and/or regulates the changing running speed, preferably $v_{A2}(x)$, of the discharge device in at least one running direction, preferably in the running direction L_{A2} , during the application. This means either that the discharge device applies material only in one running direction and that during this material application the local running speed is changed or that the discharge
15 device applies material in both running directions, wherein in at least one running direction the running speed is locally changed. So profiles in x direction, preferably convex profiles, instead of a material bed having a trapezoid cross section can be formed on the second continuous conveyor and thus, for example, receiving capacities of downstream process steps can be increased.

Furthermore, it was shown to be advantageous, when the first and/or the second continuous conveyor is a conveyor belt or a roller screen. A conveyor belt is a particularly simple and reliable form of a continuous conveyor and thus is preferable. A roller screen provides the possibility, at the same time, to remove
25 particles which are too small or too large from the material bed and thus to further homogenize the material bed. But roller screens have the disadvantage that they partially again homogenize adjusted profiles. Also combinations of two continuous conveyors are possible, wherein for example a combination is conceivable in which at least one of the continuous conveyors consists partially
30 of a conveyor belt and partially of a roller screen.

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However, preferable is the embodiment of the invention in the form that both, the first and also the second continuous conveyor are conveyor belts and that after the second continuous conveyor a roller screen as a third continuous
5 conveyor and a traveling grate plant as a fourth continuous conveyor follow.

Furthermore, it is preferable, when the discharge device is a discharge pulley which, for example, can be moved by a double-acting hydraulic cylinder in connection with a hydraulic pump and respective hydraulic valves or a rack and
10 pinion gear with motor driving unit in connection with end switches which change the direction of rotation of the driving unit or an electric linear motor with respective control in two directions.

But it is also in the sense of the invention, when as a discharge device a slewing
15 belt which applies the material from the first continuous conveyor onto the second continuous conveyor is used. Therefore, here, again it has to be emphasized that running direction in the sense of the invention does not necessarily mean a straight running direction, but only the movement from one side of the second continuous conveyor to the opposite side and back again and
20 explicitly also, for example, a circular arc-like material application by a slewing belt is comprised by the invention.

Finally, it was also shown to be advantageous, when at least one measuring device is provided which detects the profile of the material being applied onto
25 the fourth continuous conveyor. Preferably, this measuring device is connected with the above-described regulating mechanism. However, an arrangement is preferable which comprises two measuring devices, namely the first one above the first continuous conveyor and the second one after the application of the material onto the fourth continuous conveyor.

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Particularly preferable is an arrangement which comprises three measuring devices, namely one measuring device each above the first, second and fourth continuous conveyors. So a successful regulating of deviations between the actual profile and the desired profile on the fourth continuous conveyor can be achieved in the shortest time.

At least one such measuring device may, for example, be ultrasonic probes which are arranged on a beam side by side such that they cover the whole width of the continuous conveyor. The width in the sense of the invention should be understood in an orthogonal direction with respect to the transport direction of the continuous conveyor. Also laser systems or simple deflection methods such as for example one or more metal strips which are deflected stronger or not so strong by minima or maxima, which is then detected, for example, with the help of a rotary potentiometer being assigned to one metal strip each, can be used. Besides a measurement via ultrasonic probes also radar probes can be used. The detection may also be conducted via an optical system, for example a camera, and then analyzed by means of a software analysis.

In the following the invention is explained further with reference to the figures. Here, all described and/or illustrated features for themselves or in arbitrary combination form the subject matter of the invention independently on their summary in the patent claims or their back references.

Shown are in:

- fig. 1 a device according to the present invention,
- fig. 2a-d different overall profiles depending on the operational state,
- fig. 3a-d different overall profiles depending on the operational state,

- fig. 4 an interconnection according to the present invention of a first continuous conveyor and a second continuous conveyor in x-y direction,
- fig. 5 the interconnection of a first and a second continuous conveyor in x-z direction,
- fig. 6 an interconnection according to the present invention of a first, second, third and a fourth continuous conveyor in x-y direction, and
- fig. 7 the interconnection of a first and a second continuous conveyor in x-z direction.

The continuous conveyor 10 may be an ordinary conveyor belt, as shown, which is operated in a revolving manner via at least one driving unit 12 such that the material to be transported is transported in the transport direction T. Here, the material is applied onto a bearing area 11. A roller screen as well as all above-mentioned types of a continuous conveyor are also conceivable.

The production devices 21 to 27 are devices for conducting an upstream process step. Here, for example, they may be pelletizing disks for the production of green pellets of iron ore. Starting from these devices 21 to 27, the further continuous conveyors 31 to 37 lead to the continuous conveyor 10. They are designed such that at their ends they apply the material onto the continuous conveyor 10. In the simplest form this may be achieved by the fact that these continuous conveyors 31 to 37 are designed as conveyor belts which at the position of their respective discharge pulley discharge the material which is transported on them onto the continuous conveyor 10. Basically, it is also possible to omit the continuous conveyors 31 to 37 and to apply the material directly from the devices 21 to 27 onto the continuous conveyor 10. In principle, it is also possible to install between the devices 21 to 27 and the continuous conveyors 31 to 37 further devices which after-treat the product of the devices 21 to 27. So, for example, green pellets of iron ore from one of the pelletizing

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disks 21 to 27 could at first be screened by means of a roller screen (which is not shown), before they fall onto one of the continuous conveyors 31 to 37.

5 Here, in each embodiment of the invention, the mass streams of the single lanes have not to be identical, i.e. the cross sectional areas of the single lanes may all be different. Thus, it is not a prerequisite of the invention that all mass streams from all loading devices are the same, rather, this is a special case.

10 The continuous conveyors 32 to 37 have a design such that they can be adjusted in the movement direction V, and for that they comprise the adjustment devices 42 to 47. Preferably, they can be adjusted by a driving unit so that they can directly be moved by means of a primary control unit. But it is also conceivable here to provide a mechanical adjustment device which is operated in a manual manner, e.g. a crank mechanism.

15 When, for example, the production device 23 fails, then its lane which is adjacent to the lane of device 21 is no longer added. When the information is obtained that the production device 23 has failed or when a minimum in the formed overall bed is detected which can be attributed to the production device
20 23, then it is possible to move the production devices 25 and 27 and/or the corresponding continuous conveyors 35 and 37 via the adjustment devices 45 and 47 such that the continuous conveyor 35 occupies the previous position of the continuous conveyor 33 and that the continuous conveyor 37 occupies the previous position of the continuous conveyor 35. So the vacancy being the
25 result of the failure of the production device 23 is filled again, wherein the overall profile becomes slimmer.

30 Preferably always in the case, when the failure of one of the devices 21 to 27 is directly indicated by an electrical signal, the positions of the subsequent devices on the same side of the continuous conveyor are immediately changed with

17.5 % of the transport speed of the continuous conveyor 10 to the new positions. So the fault caused by the failure of one of the devices 21 to 27 is nearly completely remedied again within a few seconds. Thereafter, a fine tuning of the moved loading devices is conducted during which minima and maxima in the surface of the bed are detected by means of the measuring device 50 and are compensated by slow movement of the loading devices which before have been moved relatively quickly. It is particularly preferable, when the movement speed during such a fine tuning is 1.75 % of the belt speed. Always in a case, when maxima (hills) are detected in the overall profile in transverse direction to the transport direction T, the respective loading devices have to be moved from the width coordinate of the maximum into the direction of the edge of the continuous conveyor. Always in a case, when a minimum (valley or groove) is detected in the overall profile in transverse direction to the transport direction T, the respective loading devices have to be moved into the direction of the middle of the continuous conveyor. So the lanes again directly adjoin each other so that again a single uniform material bed having an overall trapezoid profile is created on the continuous conveyor 10.

Preferably, for the detection of flatness imperfections in the formed overall material bed on the continuous conveyor 10 a measuring device 50 is used. Particularly preferable is also a detection after each second or third loading device. The advantage of a higher number of measuring devices is that the dead time in the sense of the duration which passes by from the arising of a minimum or maximum till the detection by the measuring device is reduced. In the case of a distance of 20 m between the first and the last loading devices and a transport speed of the continuous conveyor 10 of 0.5 m/s the dead time may e.g. be 40 s. It is also conceivable that after each loading device 31 to 37 a measurement is conducted.

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The figures 2a to 2d show different overall profiles of the material bed on the continuous conveyor 10 in a transverse direction with respect to its transport direction T in the case of a design according to figure 1.

5 Figure 2a shows an ideal material bed being formed as a trapezoid on the bearing area 11 of the continuous conveyor 10. Both parallel sides of the trapezoid are parallel to the bearing area of the continuous conveyor. Each supplying continuous conveyor 31 to 37 applies or adds its own lane S1 to S7 which here in parallel direction seamlessly adjoin each other such that this
10 overall trapezoid profile is formed. In figure 2, in this case, the single lanes S1 to S7 are assigned to the supplying continuous conveyors 31 to 37 on the basis of the last digit of the number.

Figure 2b shows the result of the failure of the production device 23 with the
15 corresponding continuous conveyor 33 which has already been the theme in figure 1, wherein at the respective position a minimum is obtained which corresponds to the absence of the whole lane S3.

Figure 2c shows then, how the overall material bed is again amended through
20 the movement of the continuous conveyors 35 and 37 by the adjustment devices 45 and 47 to a material bed according to the present invention having the form of a trapezoid which now comprises one lane less. In this case the continuous conveyor 35 has occupied the position which was previously the position of the continuous conveyor 33 and the continuous conveyor 37 has occupied the
25 position which was previously the position of the continuous conveyor 35.

Figure 2d shows then, how the overall profile is changed again, when the production device 23 is again switched on so that at this position via the continuous conveyor 33 again material is applied. Here, now, a maximum is
30 formed, because continuous conveyor 33 and continuous conveyor 35 apply

material at the same position of the bearing area 11 of the continuous conveyor 10. The analysis of the cross sectional area of the maximum by the measuring device 50 results in the conclusion that here two complete lanes are applied at the same position. After the detection, for example by the measuring device 50,
5 now the continuous conveyors 35 and 37 are moved by the adjustment devices 45 and 47 into the direction of the edge of the continuous conveyor 10 such that they again occupy their original position, wherein again a material bed according to figure 2a is formed.

10 In fig. 3a again the same ideal overall profile as in fig. 2a is shown.

In fig. 3b in the overall profile a small maximum can be seen, namely at the position, where the lanes S3 and S5 overlap each other. In this case the discharge positions of the continuous conveyors 33 and 35 for the respectively
15 supplied volume streams are too near to each other. When the measuring device 50 detects such a maximum, then, thus, the connected regulating device will change the positions of the continuous conveyors 35 and 37 by a movement into the direction of the edge of the continuous conveyor 10, namely so long, until the ideal profile of the overall bed as in fig. 3 a is adjusted again.

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In fig. 3c however in the overall profile a small minimum can be seen, namely at the position, where the lanes S2 and S4 overlap each other. Here, thus, the distance between the discharge positions of the continuous conveyors 32 and 34 for the supplied volume streams is too large. When the measuring device 50
25 detects such a minimum, then, thus, the connected regulating device will move the positions of the continuous conveyors 34 and 36 into the direction of the middle of the continuous conveyor 10, namely so long, until the ideal profile of the overall bed as in fig. 3a is adjusted again.

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In a particularly preferable embodiment of the invention the measuring device 50 is designed such that the cross sectional area of the overall bed can be calculated easily and automatically, and even also in the case, when the actual profile differs from the ideal profile. In particularly preferable is the coupling with an analyzing unit which especially in the case, when the actual profile differs from the ideal profile, identifies at which position the deviation is present and how large it is. For example, the analyzing unit in the case of faults as in fig. 2b and 2d would detect that here a whole lane is absent or that two lanes have been applied at the same position. In the case of such faults the analyzing unit would transmit the signal to the movement driving units 45 and 47 to move with 17.5 % of the transport speed of the continuous conveyor 10 into the direction which is necessary each. When, however, the analyzing unit detects small faults as in fig. 3b or 3c, then it will transmit a signal to the respective movement driving units to move with 1.75 % of the transport speed of the continuous conveyor 10. So it is guaranteed that a large fault in the overall profile is remedied quickly, and, in contrast, a small one is remedied slowly in the sense of a fine tuning so that overreactions of the regulating device are avoided.

In an embodiment according to the present invention according to figure 4 the material (M_1 with the width B_1) is applied via a first continuous conveyor 210 onto a second continuous conveyor 220. In the shown variant the first continuous conveyor 210 has the design of a conveyor belt with at least one driving unit. The continuous conveyor 220 consists of a conveyor belt 221 and a roller screen 222 which has the advantage that so particles which are too small and/or too large can be removed before further process steps are conducted. In this case, preferably, the conveyor belt 221 and the roller screen 222 have separate driving units. But similarly also any design of the continuous conveyor according to the continuous conveyors mentioned in the introduction of this description is conceivable.

The continuous conveyor 210 transports material into or onto the discharge device 230. In the simplest case, this can be achieved by a design of the discharge device as a discharge pulley, around which the belt of the conveyor belt is passed with an entwining angle of ca. 180°.

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The discharge device 230 is moved in two running directions, namely over the width of the material bed M_2 on the continuous conveyor 220 (B_2), wherein the width has to be understood as orthogonal with respect to the movement direction. Ideally, thus, the discharge device 230 moves from one side of the continuous conveyor 220 back to the other side. Here, in at least one running direction it discharges material. Normally, this is the case, when the discharge pulley is moved in the second running direction, thus opposite to the transport direction T_1 of the first continuous conveyor. This material (M_2 with a width B_2) is then further transported on the bearing area of the second continuous conveyor 223 from the second continuous conveyor 220.

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Preferably, a measuring device 250 is provided which detects the course of the material flow on the continuous conveyor 220 and/or its bearing area. Such devices may, for example, be ultrasonic or radar probes which are arranged on a beam side by side such that they cover the whole region over the width of the second continuous conveyor. Also laser systems or simple deflection methods such as for example one or more metal strips which are deflected stronger or not so strong by minima or maxima, which is then detected again, can be used. Besides a measurement via ultrasonic probes also radar probes could be used. The detection may also be conducted via an optical system, for example a camera, and then analyzed by means of a computerized picture analysis.

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When in the course of time the measuring device 250 detects periodically recurring minima or maxima of the layer height of the material bed M_2 , then the transport speed v_2 of the second continuous conveyor 220 which is provided by

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a control device 240 can also be fine-tuned by a design as a regulating device 240 so that the minima or maxima disappear.

Fig. 5 shows the same device in x-z direction. Here, the material M_1 is, preferably in a steady-state material stream, transported on the bearing area 211 of the first continuous conveyor 210 to the discharge pulley 230.

After the discharge of the material M_1 from the discharge edge of the discharge pulley 230 the bearing area 211 of the first continuous conveyor 210 is guided in known manner via a first tail pulley 212, a tension pulley 214 with the corresponding tensioning weight 215 and a second tail pulley 213.

The discharge device 230 can be moved over the width B_2 of the second continuous conveyor, for example as shown, by means of a hydraulic cylinder 231. In an alternative also an electric movement device or an arrangement with two hydraulic cylinders is possible.

In the embodiment according to the present invention according to figure 6 the material is applied via a first continuous conveyor 310 onto a second continuous conveyor 230 which in turn applies material onto the third continuous conveyor 330 which in turn transfers the material onto the fourth continuous conveyor 340. In the shown variant in x-y direction the first continuous conveyor 310 is designed as a conveyor belt with at least one driving unit. The second continuous conveyor 320 is also designed as a conveyor belt. The third continuous conveyor 330 is designed as a roller screen which is connected with the advantage that so particles which are too small and/or too large can be removed before conducting further process steps. However, the fourth continuous conveyor 340 is designed as a traveling grate plant. Similarly, however, any design of the continuous conveyor according to the continuous

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conveyors which are mentioned in the introduction of the description is conceivable.

The continuous conveyor 310 transports material into or onto the discharge
5 device 316. In the simplest case this can be achieved by a design of the
discharge device as a discharge pulley which redirects the conveyor belt of the
first continuous conveyor 310, wherein the discharge device 316 can be moved
over the width B_2 and so is moved over the discharge region 60 of the bearing
area 321 of the second continuous conveyor 320 so that the material falls down
10 from the discharge device 316 and is distributed over the whole width B_2 of the
second continuous conveyor 320. In total, the design of the discharge device
316 is such that it accumulates the whole material being transported by the first
continuous conveyor 310 and transfers it onto the second continuous conveyor
320, but in discontinuous form.

15 The discharge device 316 is moved in two running directions, namely over the
width B_2 of the material bed M_2 of the continuous conveyor 320, wherein the
width has to be understood in an orthogonal direction with respect to the
transport direction T_2 of the second continuous conveyor. Ideally, thus, the
20 discharge device 16 moves from one side of the continuous conveyor 320 back
to the other side. Here, in at least one direction it discharges material. This
material is then further transported by the continuous conveyor 320.

Preferably, above the end of the first continuous conveyor a measuring device
25 351 is provided which detects the form and the course of the material flow on
the first continuous conveyor 310 and/or its bearing area. Such a device may,
for example, be ultrasonic probes which are arranged on a beam side by side
such that they cover the whole region over the width of the first continuous
conveyor. Also laser systems with movable mirrors or simple deflection methods
30 such as for example one or more metal strips which are deflected stronger or

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not so strong by minima or maxima, which is then detected again, e.g. by means of an electric rotary potentiometer, are conceivable.

Furthermore, it is possible to arrange a second measuring device 352 above the
5 second continuous conveyor 320. When the measuring device 352 detects periodically recurring minima or maxima, then the transport speed v_2 of the second continuous conveyor 320 being adjusted by a controlling or regulating device 370 can also be regulated by it, when it is characterized by a design as a regulating device 370 with corresponding control unit, so that the minima or
10 maxima disappear. Furthermore, possible is also the arrangement of a third measuring device 353 above the third continuous conveyor.

It is particularly preferable, when a fourth measuring device 354 is arranged above the fourth continuous conveyor, especially preferably at a position directly
15 after the application of the material. The profile of the material bed below this fourth measuring device is the most important controlled process variable. This profile should not only be kept constant in the course of time by the regulating device 370, but it should be brought, as far as possible, into line with a desired profile.

20 With the example of the fourth continuous conveyor 340 a design of the continuous conveyor is shown which, for example, is formed of plates or grate wagons and thus comprises the segments R. Such a design is possible in the case of any of the four continuous conveyors 310, 320, 330 and 340. In addition,
25 the continuous conveyor 340 comprises side segments S for limiting its bearing area which are exemplarily depicted for one segment R. Also this is a conceivable design for any one of the four continuous conveyors 310, 320, 330 and 340.

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Fig. 7 shows the same device in x-z direction. Here, the material M_1 is transported, preferably in a steady-state material stream on the bearing area 311 of the first continuous conveyor 310 to the discharge pulley 316.

- 5 After the discharge of the material M_1 from the edge of the discharge device 316 the bearing area 311 is guided in known manner via a first tail pulley 312, a tension pulley 314 with the corresponding tensioning weight 315 and a second tail pulley 313.
- 10 The discharge device 316 can be moved over the width B_2 of the material bed M_2 of the second continuous conveyor, for example as shown, by means of a hydraulic cylinder 317. In an alternative also an electromotive movement device or an arrangement with two hydraulic cylinders is possible. Here, the second continuous conveyor 320 has the design of a conveyor belt comprising carrying
15 run 323 and return run 324.

List of reference signs:

	10	continuous conveyor
	11	bearing area
5	12	driving unit
	21 - 27	production device
	31 - 37	continuous conveyors
	42 - 47	adjustment device
	50	measuring device
10	S1 - S7	lanes of the single continuous conveyors
	D	distance
	T	transport direction
	V	movement direction
15	210	first continuous conveyor
	211	bearing area of the first continuous conveyor
	212, 213	tail pulley
	214	tension pulley
	215	tensioning weight
20	220	second continuous conveyor
	221	conveyor belt
	222	roller screen
	223	bearing area of the second continuous conveyor
	230	discharge device
25	231	hydraulic cylinder
	240	controlling and/or regulating device
	250	measuring device
	10	first continuous conveyor
30	311, 321	bearing area

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	312, 313	tail pulley
	314	tension pulley
	315	tensioning weight
	316	discharge device
5	317	hydraulic cylinder
	320	second continuous conveyor
	323	carrying run
	324	return run
	330	third continuous conveyor
10	340	fourth continuous conveyor
	351-354	measuring device
	360	discharge region
	370	controlling and regulating device
15	M_1	material bed on the first continuous conveyor
	M_2	material bed on the second continuous conveyor
	B_1	width of the material stream on the first continuous conveyor
	B_2	width of the material stream on the second continuous conveyor
	B_3	width of the material stream on the third continuous conveyor
20	B_4	width of the material stream on the fourth continuous conveyor
	T_1	transport direction of the first continuous conveyor
	T_2	transport direction of the second continuous conveyor
	T_3	transport direction of the third continuous conveyor
	T_4	transport direction of the fourth continuous conveyor
25	v_1	transport speed of the first continuous conveyor
	v_2	transport speed of the second continuous conveyor
	v_3	transport speed of the third continuous conveyor
	v_4	transport speed of the fourth continuous conveyor
	L_{A1}	first running direction of the discharge device
30	L_{A2}	second running direction of the discharge device

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	v_{A1}	running speed of the discharge device in the first running direction
	v_{A2}	running speed of the discharge device in the second running direction
	R	segments of the fourth continuous conveyor
5	S	side limits of the fourth continuous conveyor
	y^*	distance

Patent claims:

1. A method for feeding a continuous conveyor with granular material, wherein at least two loading devices are moved to each other such that by each
5 loading device a continuous lane of the material is formed on a bearing area of the continuous conveyor and wherein these lanes are parallel to each other and overlap such that a single material bed is formed on the bearing area which in a cross section being orthogonal to the bearing area has the form of a trapezoid, and wherein parallel sides of the trapezoid are parallel to the bearing area.
- 10 2. The method according to claim 1, **characterized in that** the material bed is formed parallel to at least one edge of the bearing area with a deviation of at most 10°.
- 15 3. The method according to claim 1 or 2, **characterized in that** the granular material contains iron.
4. The method according to one of the preceding claims, **characterized in that** one or more measuring devices examine the material bed for local minima
20 and/or maxima.
5. The method according to one of the preceding claims, **characterized in that** the loading devices are arranged on both sides of the continuous conveyor in its running direction one after the other and that starting with the second
25 loading device the loading devices add their respective lane to the already present lane on that side of the bearing area on which they are arranged.
6. The method according to one of claims 4 or 5, **characterized in that** by at least three loading devices a continuous lane of the material is formed and

that, when a minimum or maximum is detected by the measuring device, at least one loading device is moved.

7. The method according to one of the preceding claims, **characterized in that** the loading devices are arranged on both sides of the continuous conveyor in its transport direction one after the other, that the loading devices, starting with the at first applied lane, add their lanes in lane position 2 to n to the already present lane on that side of the bearing area on which they are arranged, that, when a minimum is detected, this is attributed to a loading device a and that the loading devices being downstream to this loading device a on this side are moved such that they from now on occupy the positions n-1.

8. The method according to one of claims 1 to 6, **characterized in that** the loading devices are arranged on both sides of the continuous conveyor in its running direction one after the other, that the loading devices, starting with the at first applied lane, add their lanes in lane position 2 to n to the already present lane on that side of the bearing area on which they are arranged, that, when a maximum is detected, this is attributed to a loading device a on one side and that the loading devices being downstream to this loading device a on this side are moved such that they from now on occupy the positions n+1.

9. The method according to one of claims 6 to 8, **characterized in that** at each time the material bed is formed parallel to at least one edge of the bearing area with a deviation of at most 10° .

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10. A method for feeding a continuous conveyor with granular material, wherein at least one first continuous conveyor with a transport direction T_1 and a transport speed v_1 being preferably charged by a method according to claims 1 to 9 transports material as a material bed having a mean width B_1 into or onto a discharge device, wherein the discharge device is moved in a first running

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direction with a first running speed v_{A1} and a second running direction being opposite to the first one with a second running speed v_{A2} over a mean width B_2 of a material bed of a second continuous conveyor and wherein the discharge device applies at least in one running direction continuously material onto the second continuous conveyor, characterized in that the second continuous conveyor has the transport speed v_2 for which the following is true:

$$\frac{B_1 \cdot 0.85}{\int_0^{B_2} \frac{1}{v_{A1}(x)} dx + \int_0^{B_2} \frac{1}{v_{A2}(x)} dx} \leq v_2 \leq \frac{B_1 \cdot 1.15}{\int_0^{B_2} \frac{1}{v_{A1}(x)} dx + \int_0^{B_2} \frac{1}{v_{A2}(x)} dx}$$

- 10 11. The method according to claim 10, **characterized in that** the first running direction of the discharge device and the transport direction T_1 of the first continuous conveyor are identical.
12. The method according to one of claims 10 or 11, **characterized in that**
 15 the first running speed of the discharge device v_{A1} is identical with the transport speed of the first continuous conveyor v_1 .
13. The method according to one of claims 10 to 12, **characterized in that**
 20 the first running speed of the discharge device v_{A1} is identical with the second running speed of the discharge device v_{A2} .
14. The method according to one of claims 10 to 13, **characterized in that**
 the material bed on the first continuous conveyor in a cross section being orthogonal to the continuous conveyor has the form of a trapezoid and that the
 25 width B_1 is the mean width of this trapezoid.
15. The method according to one of claims 10 to 14, **characterized in that**
 the granular material contains iron.

16. The method according to one of claims 10 to 15, **characterized in that** a first measuring device examines the material bed on the first continuous conveyor for minima and/or maxima.

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17. The method according to one of claims 10 to 16, **characterized in that** a second measuring device examines the material being applied onto the second continuous conveyor for periodically recurring minima and/or maxima.

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18. The method according to claim 17, **characterized in that**, when at least three periodically consecutive minima are detected, the speed of the second continuous conveyor is reduced, until the minima no longer arise.

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19. The method according to claim 18 or 19, **characterized in that** the reduction or increase of the transport speed v_2 is at most 2 % per 15 s.

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20. The method for feeding a continuous conveyor with granular material, in particularly according to one of claims 1 to 19, wherein a first continuous conveyor with the transport direction T_1 and the transport speed v_1 transports a material bed having a mean width B_1 into or onto a discharge device, wherein the discharge device is moved in a first running direction L_{A1} with a first running speed v_{A1} and a second running direction L_{A2} being opposite to the first one with a running speed v_{A2} over a width B_2 of the material bed of a second continuous conveyor with the transport direction T_2 and the transport speed v_2 and wherein the discharge device continuously applies material in at least one running direction onto the second continuous conveyor, characterized in that the discharge device during the application of the material has a running speed $v(x)$ with at least three minima and/or at least one maximum which at least partially changes dependently on the location x .

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21. The method according to claim 20, characterized in that the changing running speed $v(x)$ in the middle of the width B_2 of the second continuous conveyor has a minimum.

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22. The method according to claim 20 or 21, characterized in that the changing running speed $v(x)$ is symmetrical with respect to the middle of the width B_2 of the second continuous conveyor.

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23. The method according to one of claims 20 to 22, characterized in that the discharge device applies the material only during one running direction L_{A2} .

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24. The method according to one of claims 20 to 23, characterized in that the material bed with the mean width B_1 on the first continuous conveyor in a cross section being orthogonal to the continuous conveyor has the form of a trapezoid and that the mean width B_1 is the width of the trapezoid being orthogonal to the transport direction T_1 of the first continuous conveyor.

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25. The method according to one of claims 20 to 24, characterized in that a first measuring device examines the material bed on the first continuous conveyor for minima and/or maxima and/or that a second measuring device examines the material being applied onto the second continuous conveyor for periodic minima or maxima.

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26. The method according to one of claims 20 to 22, characterized in that a second measuring device detects the profile of the material being applied onto the second continuous conveyor and that the detected actual profile is correlated with a desired profile.

27. The method according to one of the preceding claims, characterized in that a second measuring device detects the profile of the material being applied onto the second continuous conveyor continuously or at least during one discharge cycle of the discharge device at least four times.

5

28. The method according to claim 27, characterized in that, when there are differences between the actual state and the desired state of the heights of the discretized desired and actual material bed profiles $h_{desired}(x)$ and $h_{actual}(x)$, the vectorial speed $\overrightarrow{v_{new,normed}(x)}$ of the discharge device during the next discharge being the subsequent one to said discharge cycle in relation to the previous vectorial speed $\overrightarrow{v_{old}(x)}$ for the desired profile in the case of a constant duration τ of the material application can be calculated as

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$$\overrightarrow{v_{new}(x)} = \left(\overrightarrow{v_{old}(x)} \cdot \left[\frac{\overrightarrow{h_{actual}(x)} - \overrightarrow{h_{desired}(x)}}{h_{desired}\left(\frac{B_4}{2}\right)} \cdot \alpha + 1 \right] \right),$$

15

wherein the following is true: $\alpha \leq 1$.

29. The method according to one of the preceding claims, characterized in that the second continuous conveyor applies the material onto a third continuous conveyor being moved with a speed v_3 and the third continuous conveyor applies the material onto a fourth continuous conveyor being moved with a speed v_4 or that the second continuous conveyor applies the material onto a fourth continuous conveyor being moved with a speed v_4 .

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30. The method according to claim 29, characterized in that a fourth measuring device determines the cross sectional area $Q_{4,actual}$ of the material

being applied onto the fourth continuous conveyor in transverse direction to the transport direction and that in the case of a cross sectional area $Q_{4,actual}$ which is smaller than a predetermined desired value $Q_{4,desired}$ the speed v_4 is reduced so long, until the desired value is achieved or that in the case of a cross sectional area $Q_{4,actual}$ which is larger than a predetermined desired value $Q_{4,desired}$ the speed v_4 is increased so long, until the desired value $Q_{4,desired}$ is achieved.

31. A device for feeding a continuous conveyor with granular material, comprising a continuous conveyor and at least three loading devices which are designed such that by each loading device a continuous lane of the material on a bearing area of the continuous conveyor is formed and wherein these lanes are parallel to each other and overlap such that a single material bed is formed on the bearing area, wherein the material bed in a cross section being orthogonal to the bearing area has the form of a trapezoid and wherein parallel sides of the trapezoid are parallel to the bearing area, **characterized in that** at least one loading device is movable.

32. The device according to claim 31, **characterized in that** at least one loading device is a second continuous conveyor.

33. The device according to claim 31 or 32, **characterized in that** on each side of the bearing area in movement area of the continuous conveyor at least one moveable loading device is provided.

34. The device according to one of claims 31 to 33, **characterized in that** a first loading device on one side of the bearing area is a static one and all loading devices being downwards thereto are movable.

35. The device according to one of claims 31 to 34, **characterized in that** a measuring device is provided.

36. A device for feeding a conveyor belt with granular material, comprising a first continuous conveyor (210) being preferably characterized by the features according to one of claims 31 to 35 and a second continuous conveyor (210, 220) as well as a discharge device (230), wherein the first continuous conveyor (210) is designed for the transport of a material bed with a mean width B_1 into or onto the discharge device (230), wherein the discharge device (230) is designed such that it can be moved in a first running direction with a running speed v_{A1} and a second running direction which is opposite to the first one with a second running speed v_{A2} over a mean width B_2 of the material bed on the second continuous conveyor (220) and that it at least in one running direction continuously applies material onto the second continuous conveyor (220), characterized by a controlling and/or regulating device (240) which adjusts the speed v_2 of the second continuous conveyor (220) to a value within the following range:

$$\frac{B_1 \cdot 0.85}{\int_0^{B_2} \frac{1}{v_{A1}(x)} dx + \int_0^{B_2} \frac{1}{v_{A2}(x)} dx} \leq v_2 \leq \frac{B_1 \cdot 1.15}{\int_0^{B_2} \frac{1}{v_{A1}(x)} dx + \int_0^{B_2} \frac{1}{v_{A2}(x)} dx}$$

37. The device according to claim 36, characterized in that the first and/or the second continuous conveyors (210, 220) are a conveyor belt and/or a roller screen.

38. The device according to claim 36 or 37, characterized in that the loading device (230) is a discharge pulley.

39. The device according to one of claims 36 to 38, characterized in that at least one measuring device (250) is provided which examines the material being applied onto the second continuous conveyor for periodically recurring minima and/or maxima.

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40. A device for feeding a continuous conveyor with granular material, comprising a first and a second continuous conveyor (310, 320) as well as a discharge device (316), wherein the first continuous conveyor (310) is designed for the transport of a material bed with a mean width B_1 into or onto the discharge device (316), wherein the discharge device (316) can be moved in a first running direction L_{A1} with a first running speed v_{A1} and a second running direction being opposite to the first one L_{A2} with a running speed v_{A2} over a width B_2 of the material bed of the second continuous conveyor (320), and wherein the discharge device (316) can continuously apply material onto the second continuous conveyor (320) in at least one running direction L_{A1} , L_{A2} , characterized by a controlling or regulating device (370) which controls or regulates a running speed $v(x)$ of the discharge device (316) which changes dependently on the location during the application in at least one running direction L_{A1} , L_{A2} such that the discharge device during the application of the material has a running speed $v(x)$ which changes at least partially dependently on the location x comprising at least three minima and/or at least one maximum.

25

41. The device according to claim 40, characterized in that the first and/or the second continuous conveyor (310, 320) is a conveyor belt and/or a roller screen.

42. The device according to claim 41 or 42, characterized in that the loading device (316) is a discharge pulley.

43. The device according to one of claims 41 to 43, characterized in that at least one measuring device (352) is provided which detects the profile of the material being applied onto the second continuous conveyor (320).

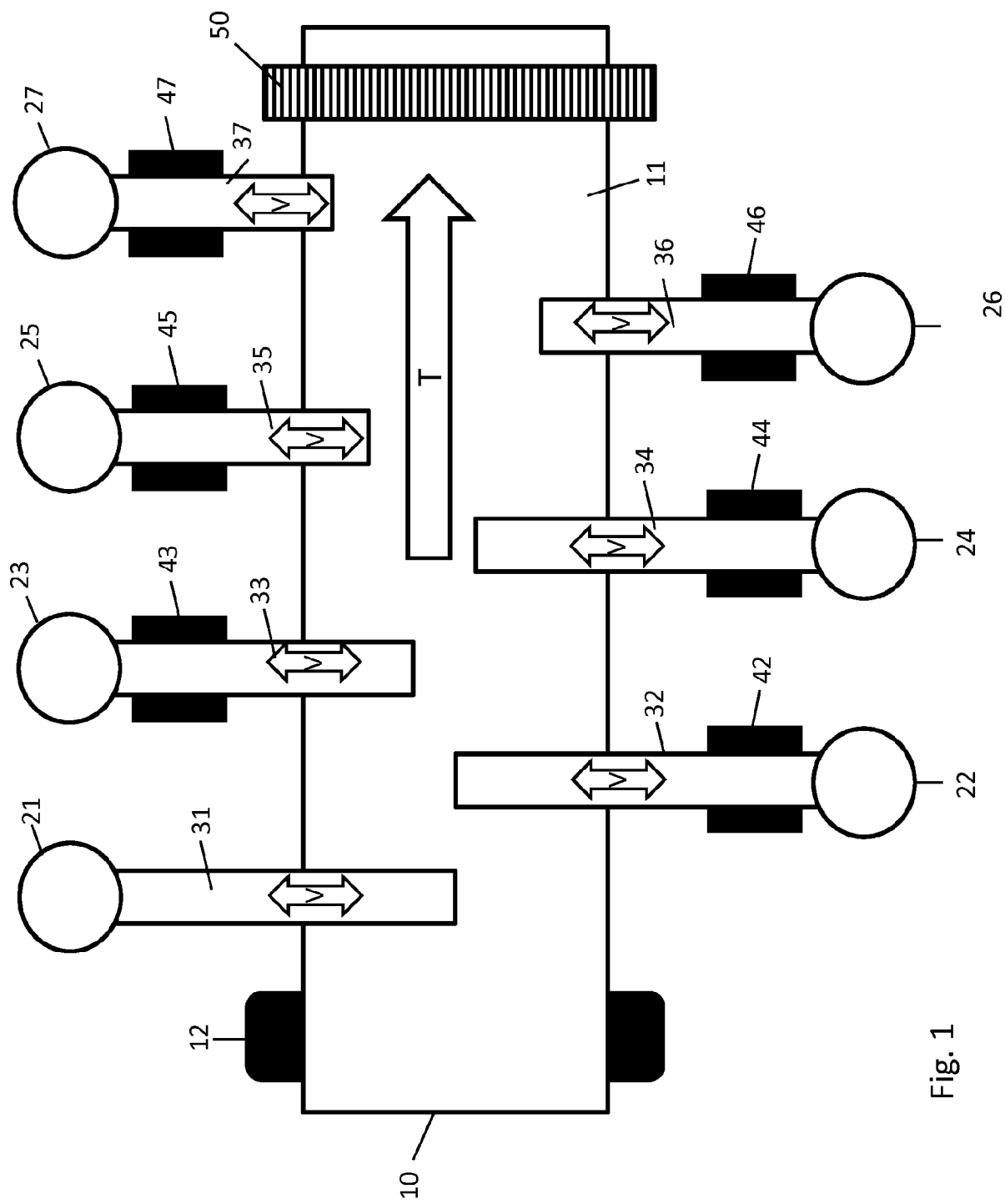


Fig. 1

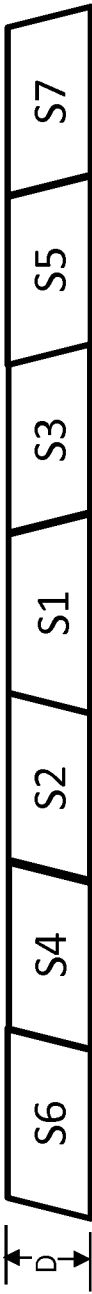


Fig 2a

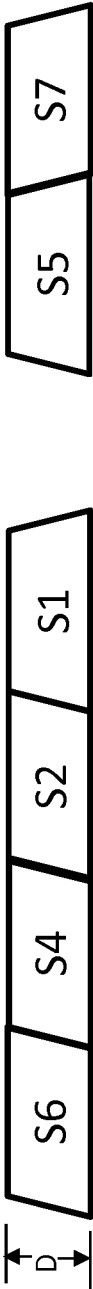


Fig 2b



Fig 2c

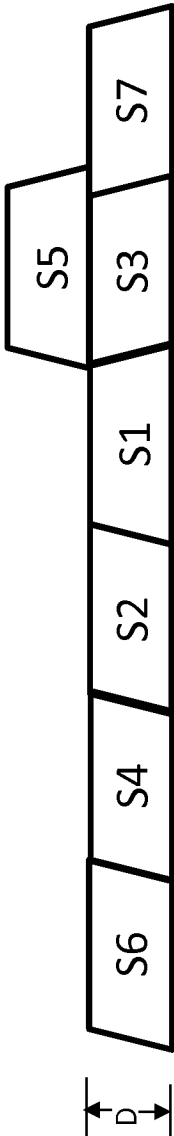


Fig 2d

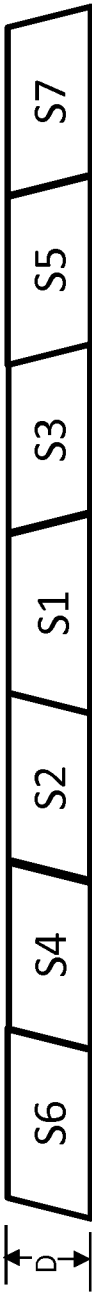


Fig 3a

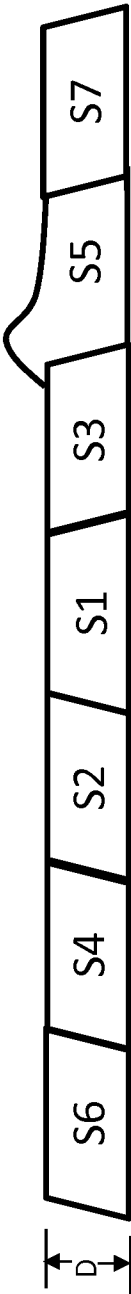


Fig 3b



Fig 3c

ANY REFERENCE TO FIGURE 3D SHALL BE
CONSIDERED NON-EXISTENT

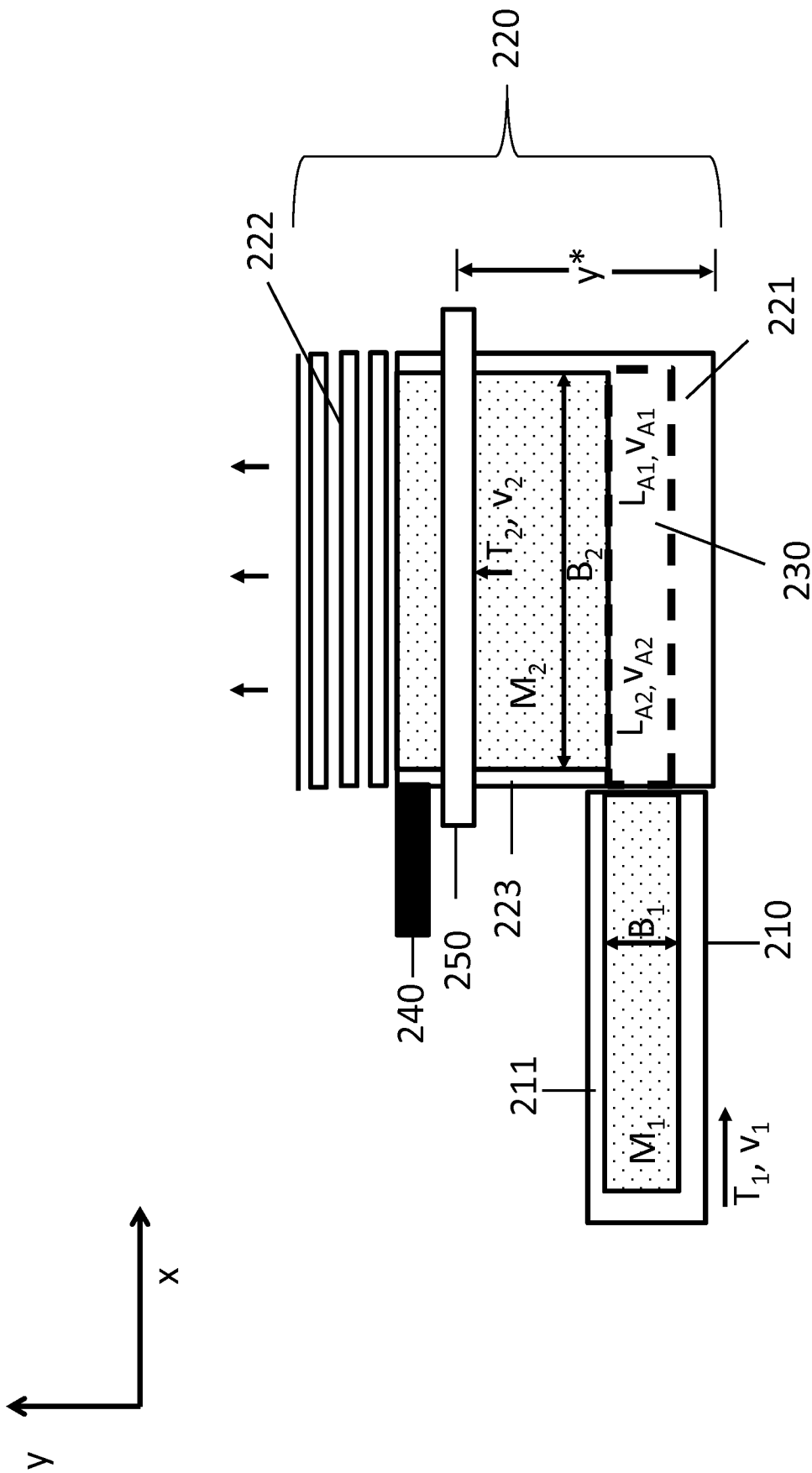


Fig. 4

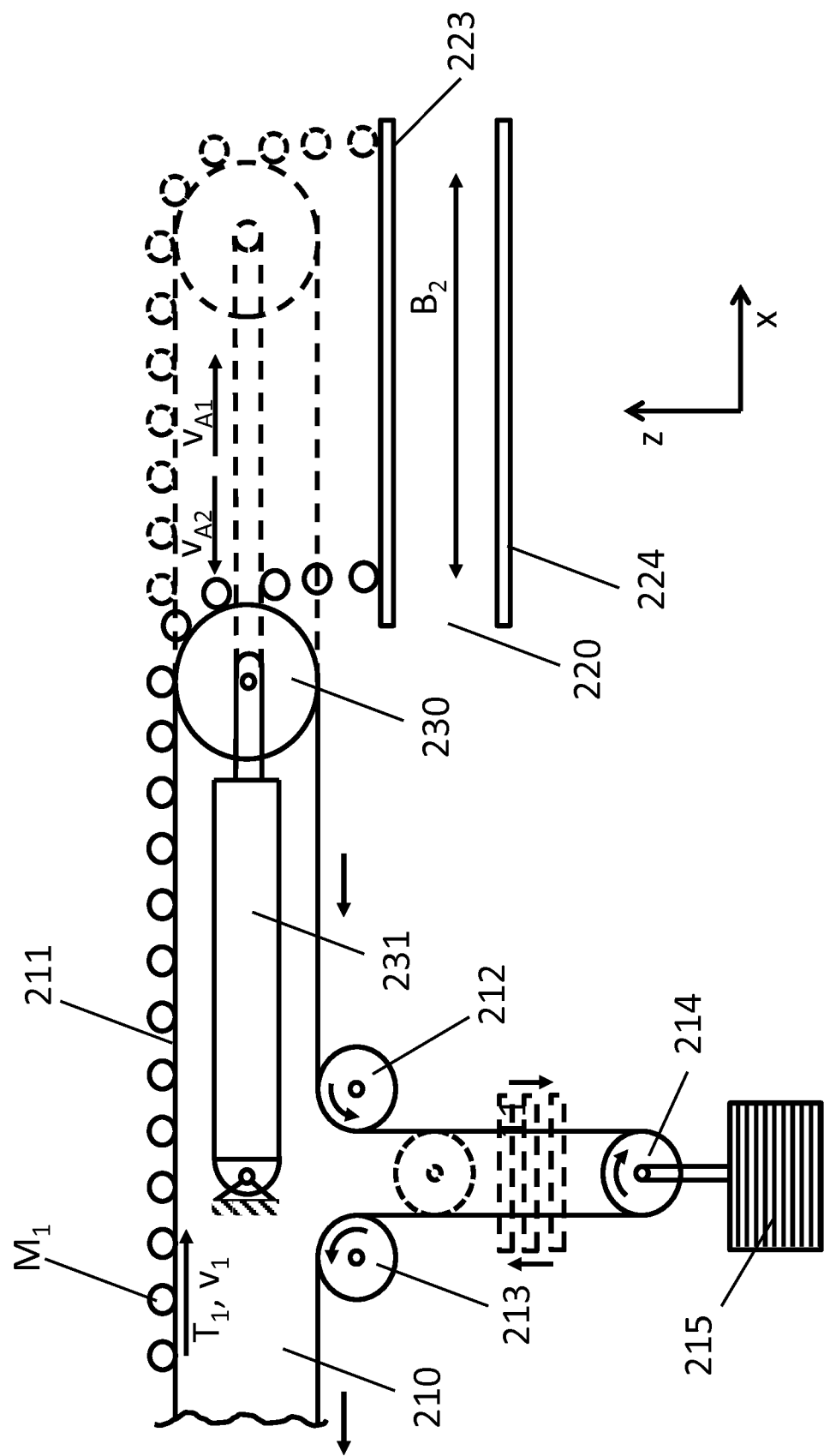
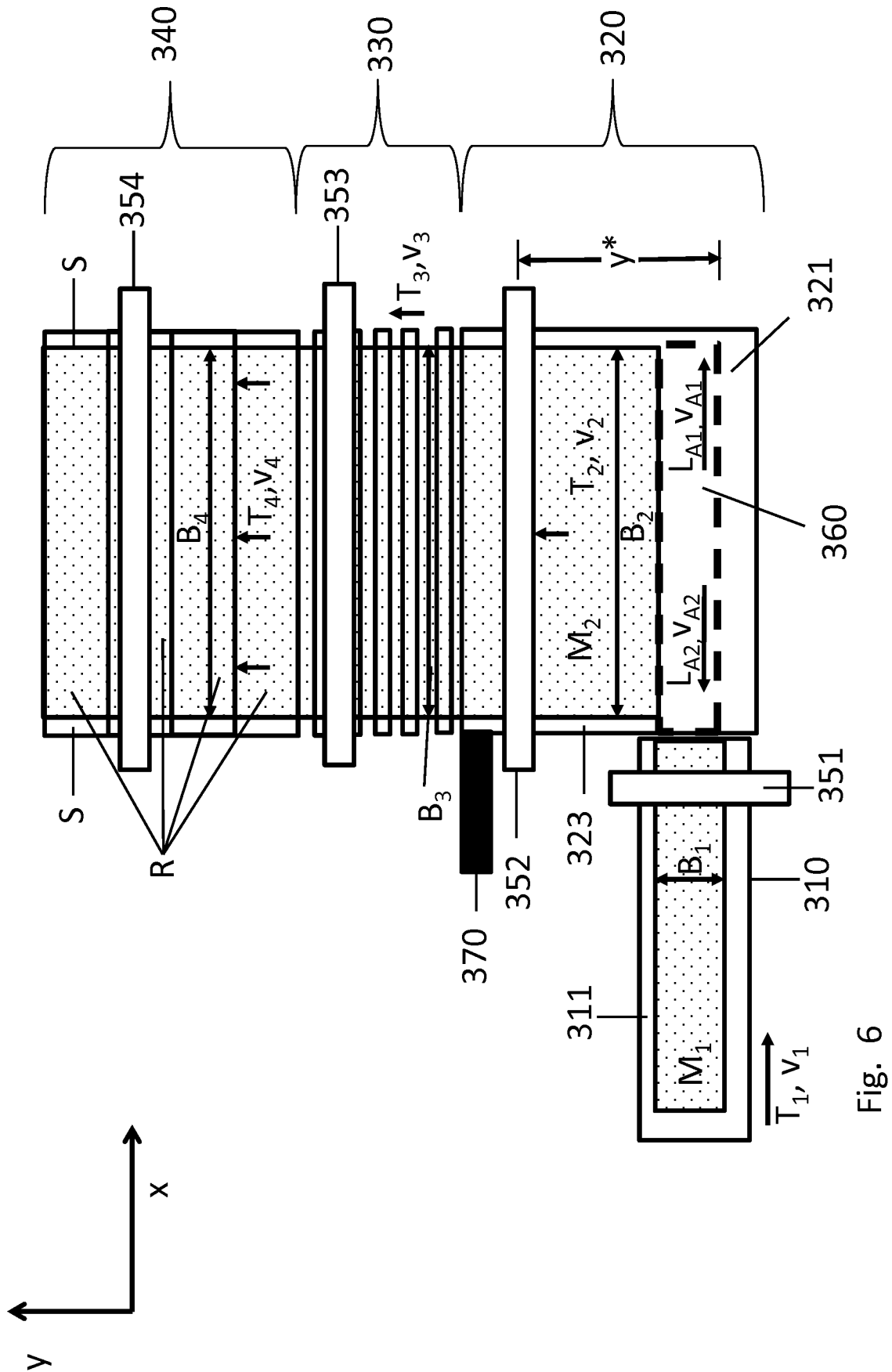


Fig. 5



File 6

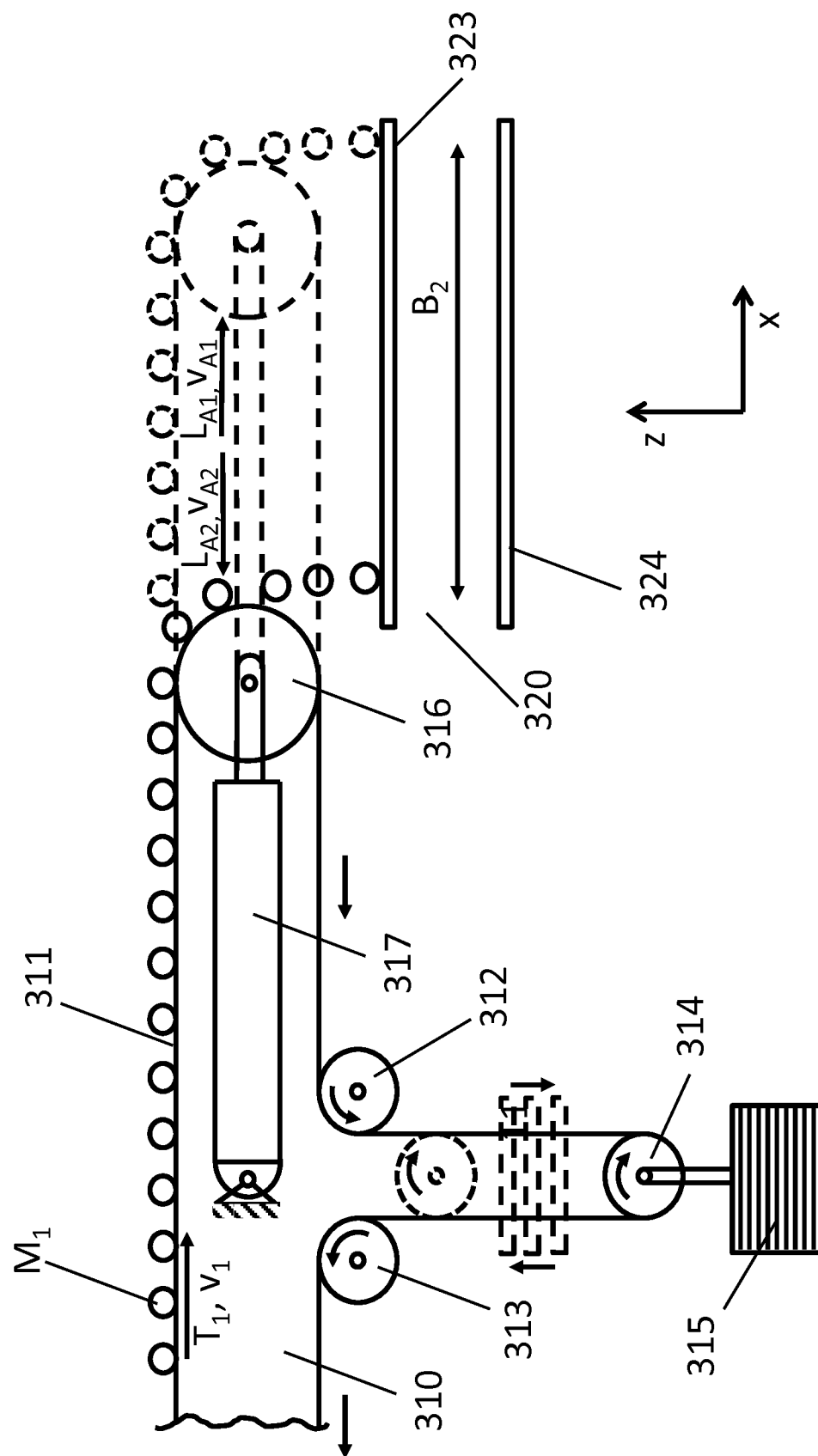


Fig. 7

INTERNATIONAL SEARCH REPORT

International application No

PCT/EP2017/075347

A. CLASSIFICATION OF SUBJECT MATTER

INV. B65G43/08 B65G69/04
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
B65G

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X A A A X	US 2 996 102 A (WERNER SCHULLER) 15 August 1961 (1961-08-15) column 3, line 54 - column 4, line 67; claims; figures ----- US 3 828 399 A (LAMBERT R) 13 August 1974 (1974-08-13) claims; figures ----- JP 2005 220633 A (OHBAYASHI CORP) 18 August 2005 (2005-08-18) paragraph [0016] - paragraph [0050]; figures ----- EP 0 294 616 A2 (WURTEX MASCHINENBAU HOFMANN GM) 14 December 1988 (1988-12-14) column 2, line 11 - column 6, line 49; claims; figures -----	1-3, 31-35 4-6,9 1 1-9,31, 35 20-30, 40-43



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

9 March 2018

Date of mailing of the international search report

16/03/2018

Name and mailing address of the ISA/

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Authorized officer

Hoffert, Rudi

INTERNATIONAL SEARCH REPORT

International application No.
PCT/EP2017/075347

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of additional fees.
3. ☒ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

1-9, 20-35, 40-43
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☒ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-9, 31-35

Method for feeding a continuous conveyor with a plurality of feeding devices and corresponding device for feeding a continuous conveyor

2. claims: 10-19, 36-39

Method for feeding a continuous conveyor with two conveyors, one of which has an adjustable speed, and corresponding device

3. claims: 20-30, 40-43

Method for feeding a continuous conveyor with a discharge device with adjustable speed, and corresponding device

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2017/075347

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
US 2996102	A	15-08-1961	BE 537511 A	09-03-2018
			CH 332743 A	30-09-1958
			FR 1129996 A	29-01-1957
			GB 805551 A	10-12-1958
			NL 111341 C	09-03-2018
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			DE 3719129 A1	15-12-1988
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