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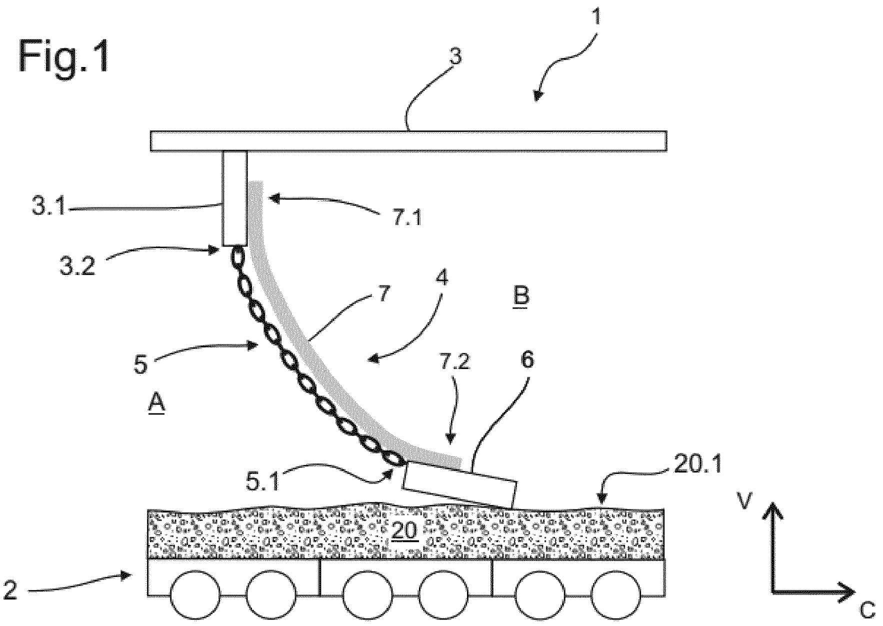
(54) CONVEYING DEVICE FOR BULK MATERIAL

(57) The invention relates to a conveying device (1) for bulk material (20), with a conveyor (2) for transporting bulk material (20) in a conveying direction (C), a hood (3) extending above the conveyor (2), and a sealing device (4) that is attached to the hood (3) and configured to hinder gas exchange along the conveying direction (C).

In order to provide an effective and reliable seal between bulk material on a conveying device and a hood extending over the conveying device, the invention provides that the sealing device (4) comprising at least one flexible sealing sheet (7) having an upper end (7.1) and a lower end (7.2); and at least one sliding block (6) configured to be in sliding contact with the bulk material (20) wherein the upper end (7.1) of the flexible sealing sheet (7) is connected to the hood (3) and the lower end (7.2) of the flexible sealing sheet (7) is connected to the sliding block (6).

Fig.1



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Description

Technical Field

[0001] The invention relates to a conveying device for bulk material and to a sealing device for such a conveying device.

Background Art

[0002] In iron metallurgy, travelling grate machines are commonly used to agglomerate fine particles of a bulk material by a sintering process. The initially particulate material is thermally treated as it is conveyed on the travelling grate. The travelling grate may either move linearly or circularly. In many cases, gaseous media are used in the thermal treatment process. There may be several consecutive treatment zones along the travel path of the grate, each of which utilises a different gas atmosphere. Normally, the entire treatment area is covered from above and sideways (with respect to the travelling direction) by a gas-tight hood. In the travelling direction, the individual treatment zones are sealed against each other and/or the outside atmosphere by transversally extending sealing devices. Even if there are no individual treatment zones within the hood, it is necessary to employ one transversal sealing device at the beginning and at the end of the hood, respectively.

[0003] For several reasons, providing an effective seal is a very challenging task. One main reason is that on the lower side, the seal has to be provided between the sealing device and the bulk material on the travelling grate. The upper surface of the bulk material, however, will generally have an uneven and irregular shape, even if it has been mechanically straightened by a scraping device or the like. Furthermore, the bulk material can be abrasive and/or hot, wherefore direct contact can lead to a relatively fast deterioration of the sealing device.

[0004] There are several different solutions known in the art, all of which have certain drawbacks. One solution is to simply provide one stationary vertical wall with a lower edge sufficiently spaced from the travelling grate to allow for the bulk material to pass through. There is no direct contact between the wall and the bulk material, no moving parts and therefore virtually no deterioration over time. However, there is a considerable gap between lower edge of the wall and the bulk material, wherefore the sealing effect is limited. Another solution is to provide a vertically movable wall (or several movable wall segments horizontally next to each other) which is attached to a stationary wall. Although the gap between the movable wall and the bulk material is smaller, it still is considerable and there is additional leakage between the stationary wall and the movable wall. Another possibility is to provide a plurality of individual sealing elements which are pivotably mounted on a transversally extending shaft. Due to the weight of each individual element, it normally hangs down from the shaft, thus extending a maximum distance vertically downwards. However, by rotating around the shaft, the element can adapt to the variable height of the upper surface of the bulk material. Although the sealing effect is improved, the solution is mechanically less reliable, because contamination may lead to blocking of neighbouring elements. Yet another solution is based on a labyrinth seal effect and utilises a horizontally extending plate which is suspended below the hood so that there is a small gap between the plate and the bulk material. The longer the horizontal plate extends, the better the sealing effect. However, if the surface of the bulk material is very uneven, the sealing effect is seriously reduced. Furthermore, it is known to use one or several sealing elements, each of which comprises a plurality of plates connected by hinges. Under ideal circumstances, the plates can adapt to the locally changing height of the bulk material. However, the sealing effect is usually not optimal and the hinges tend to block or jam, which renders the sealing device ineffective.

Technical Problem

[0005] It is thus an object of the present invention to provide an effective and reliable seal between a conveying device, in particular when loaded with bulk material, and a hood extending over the conveying device. This object is solved by a conveying device for bulk material according to claim 1 and by a sealing device according to claim 15.

General Description of the Invention

[0006] The invention provides a conveying device for bulk material, with a conveyor for transporting bulk material in a conveying direction, a hood extending above the conveyor, and a sealing device that is attached to the hood and configured to hinder gas exchange along the conveying direction.

[0007] The conveying device may in particular be a travelling grate machine and the bulk material may be raw material to be sintered as it is transported by the conveyor. More generally, the conveying device may be configured for thermal treatment of the bulk material. The bulk material may contain particles that can range between 1 and 200 mm. The conveyor may be a travelling grate. The conveying direction is normally a horizontal direction or differs from the horizontal direction by at most 45°. It may be a linear direction if the conveyor is configured for linear motion or it may be a tangential direction if the conveyor is configured for circular motion.

[0008] The hood is disposed and extends above the conveyor, normally over only part of the length of the conveyor along the conveying direction. The hood, which may also be referred to as a housing, can be considered to be more or less gas-tight, i.e. it its function is to prevent or limit uncontrolled gas exchange between the space above the conveyor and the outside atmosphere. However, the hood can have access openings which are connected to a pipe or the like in order to supply or remove gas in a controlled way. The hood normally has an upper wall (or ceiling) and sidewalls which extend on either side of the conveyor. In order to allow passage of the conveyor and the bulk material, the hood needs to have an opening on either end, which opening needs to be protected against gas exchange. Also, there may be different zones along the conveying direction containing gases of different temperature, pressure and/or composition. Gas exchange between these zones also needs to be limited. For these reasons, the conveying device comprises a sealing device that is attached to the hood and configured to hinder gas exchange along the conveying direction. In other words, the sealing device is configured to hinder gas exchange between two areas (or volumes) along the conveying direction, wherein at least one of these areas is located inside the hood. Ideally, the sealing device is configured to completely prevent gas exchange, but minor leakages are usually acceptable.

[0009] According to the invention, the sealing device comprises at least one flexible sealing sheet, with an upper end and a lower end, and at least one sliding block being configured to be in sliding contact with the conveyor or the bulk material arranged on the conveyor. The flexible sealing sheet creates a barrier between the upstream and downstream areas of the flexible sealing sheet so as to prevent gasses from escaping the area under the hood. The sliding block ensures that the sealing device is in contact with the bulk material on the conveyor even when there is a difference in thickness in the layer of bulk material arranged on the conveyor.

[0010] Indeed, the at least one sliding element attached to a lower end of the flexible sealing sheet is configured to be in sliding contact with the bulk material. In some embodiments, where the sliding element has a compact shape, it can be referred to as a "sliding block". The term "lower end" of course implies that the flexible sealing sheet extends downwards from the hood, although it normally does not extend vertically, but at an angle with respect to the vertical direction. In particular, due to its flexible property, the flexible sealing sheet does not have to be straight during operation, but may be bent or curved. Of course, in order to keep the sliding element in contact with the bulk material, the length of the flexible sealing sheet has to be sufficient. The weight of the sliding element and/or the weight of the flexible sealing sheet keeps the sliding element in contact with the bulk material. However, since the flexible sealing sheet is flexible, no excessive pressure is exerted on the sliding element or the bulk material, i.e. it can always follow the surface profile of the bulk material. The flexible sealing sheet transfers a pulling force between the hood and the sliding element. Its function is to "drag" the sliding element along the surface of the bulk material, although strictly speaking, the bulk material is moved under the sliding element, which remains more or less stationary. In order to ensure the sealing function, the at least one sliding element can extend transversally over at least the larger part (e.g. at least 95% or at least 98%) of the width of an inner cross-section of the hood. The sliding element can be made of a heat-resistant material and/or an abrasion-resistant material, such as e.g. Teflon, metal, or others.

[0011] While the at least one sliding element provides a reasonably tight contact with the bulk material, the space above the sliding element is sealed by the at least one flexible sealing sheet connected to the hood and the at least one sliding element. In other words, the sealing sheet extends from the sliding element to the hood, preventing or at least minimising gas exchange in this region. The sheet is made of a material that is either impermeable to gases or at least diminishes gas flow, such as e.g. silicate ceramic material, fiberglass material, or others. The width of the sealing sheet may correspond to at least 95% or at least 98% of the width of the inner cross-section of the hood. Thus, gas is largely prevented from passing between the sealing sheet and the hood. It is preferred that the sealing sheet is tightly connected to the hood and to the at least one sliding element, so that any gas leakage in between is prevented. The sheet may comprise a woven or nonwoven fibrous material, which may be surface-treated to make it more gas-tight, more resistant to heat etc.

[0012] According to a preferred embodiment of the invention, the sealing device comprises at least one flexible elongate suspension element, which is at least indirectly connected to the hood in a connection area, wherein the at least one sliding block is attached to a lower end of the at least one suspension element. Preferably, the sealing device comprises a plurality of flexible elongate suspension elements, which are at least indirectly connected to the hood in a connection area and are spaced apart transversally to the conveying direction. Usually, the suspension elements are connected in the same position across the conveying direction. In order to work as suspension elements, they are configured to transfer a pulling force. Since the suspension elements are spaced apart transversally to the conveying direction, they do not work as sealing elements. The space between two suspension elements can correspond to a multiple of the thickness of one suspension element. If the sealing device is in a high-temperature area, the suspension elements can be made of a material that is resistant to such temperatures. For example, if the conveying device is a travelling grate machine used to thermally treat sinter material, temperatures of several hundred degrees can be expected, wherefore the suspension elements can e.g. be made of steel.

[0013] This aspect of the invention provides for a functional separation between the suspension elements and the sealing sheet. While the suspension elements can be optimised for suspending the sliding element, i.e. they provide the necessary strength but do not need to contribute to the sealing effect, the sealing sheet is optimised for the sealing function, but normally does not transfer significant forces acting between the sliding element and the hood. In particular, while the suspension elements are usually put under tension during operation of the conveying device, the sealing sheet may remain more or less relaxed. Of course, the effective length of the sealing sheet and the suspension elements can be chosen accordingly, i.e. the sealing sheet can be designed long enough so that no significant tension is exerted. Since the sealing device does not need any hinges, bearings or the like, no blocking of such elements can occur and the mobility of the at least one sliding element can be maintained over a long time.

[0014] The effectiveness of the sealing device can be considerably improved if it comprises a plurality of separate sliding elements disposed transversally adjacent each other. The sliding elements are separate and therefore can move separately. Therefore, if one sliding element is lifted by a large particle of bulk material or a local bump in the surface, this will only affect one element, while the adjacent element(s) can maintain a lower position to stay in tight contact with the bulk material. The number of elements may be e.g. between 1 and 10, but more may also be possible. While a higher number of elements makes the sealing device more sensitive to local irregularities of the bulk material, it also increases the complexity and usually the cost. Also, every sliding element needs to be attached to at least one suspension element, wherefore the number (and thus the weight) of the suspension elements increases with the number of sliding elements.

[0015] It is conceivable that the suspension elements are ropes or even elongate, narrow sheets. The material can be chosen according to requirements like heat resistance. Preferably, the at least one suspension element is a chain. A chain, being composed of individual links, is highly flexible, even though the individual links can be relatively thick and robust. Therefore, the sliding element(s) can be suspended in a highly flexible, yet stable way. The chain may in particular be made of metal, e.g. steel.

[0016] In order to stabilise the suspension, it is preferred that at least two suspension elements are connected by at least one transversal coupling element. Such a coupling element extends transversely and transfers at least pulling forces between the suspension elements. This connection or coupling limits the relative motion of the suspension elements. In particular, every two neighbouring suspension elements can be connected by a coupling element. Also, two suspension elements may be connected by a plurality of coupling elements, which are disposed along the length of the suspension elements.

[0017] Any coupling element can be rigid or flexible. Also, it may be connected rigidly or movably to the respective suspension elements. A coupling element may e.g. be a bar or a rope. Preferably, at least one coupling element is a chain. In particular, all coupling elements can be chains. They can have properties that are identical to those of chains that are used for the suspension elements.

[0018] According to a preferred embodiment, at least one sealing sheet is disposed behind the suspension elements along the conveying direction. Since during operation, the suspension elements are usually inclined away from the conveying direction, this also means that the sealing sheet is positioned above the suspension elements. Thus, the sealing sheet is placed a little further away from the bulk material, which may serve to protected against high temperatures. Also, the suspension elements are prevented from resting on the sealing sheet, which could reduce its lifetime.

[0019] For several reasons, it is preferred that an effective length of the suspension elements between the connection area and the lower end is adjustable. This is called the "effective" length since it determines the maximum range of motion of the sliding element(s). The total length of the suspension elements can be longer than the effective length. As will be understood, if the effective length is increased, the lifting force applied to the sliding element by the suspension elements decreases or a part of the weight of the suspension elements may even rest on the sliding element. In other words, the sliding element presses down on the bulk material with the majority of its own weight and also a part of the weight of the suspension elements. This serves to keep the element in tight contact with the bulk material but also increases abrasion effects and reduces the lifetime of the element. On the other hand, if the effective length is decreased, the lifting effect of the suspension elements increases and the pressure by the sliding element on the bulk material is reduced. In some cases, this may affect the sealing effect detrimentally, but it also reduces abrasion effects. Which effective length is to be preferred may of course depend on several factors, like the properties of the bulk material, the speed of the conveyor etc. Also, the adjustability of the effective length allows the sealing device to be easily adapted to be used with different heights of bulk material. Indeed, if a thinner layer of bulk material is deposited on the conveyor, the length of the suspension elements is adapted such that essentially the same gliding force exists between bulk material and sliding element, i.e. the sealing is maintained for different heights of bulk material on the conveyor.

[0020] The adjustability of the effective length can be achieved in different ways. According to one embodiment, the hood has a connector for each suspension element and each suspension element has a plurality of attachment points for connection to the connector. For example, if the suspension element is a chain, the connector on the hood can be a hook on which the chain hangs, and every link of the chain provides an attachment point.

[0021] According to another embodiment, the suspension elements are windably attached to a winding device, which is operable from outside the hood. The winding device can comprise a shaft that is rotatably disposed inside the hood. By rotating the shaft in one direction, the suspension elements can be wound up, which reduces that the effective length, while rotating the shaft in the opposite direction increases the effective length. In this embodiment, it is also conceivable that the suspension elements are wound up to such an extent that the sliding elements are lifted from the bulk material. For instance, if the sealing device is placed at an opening (inlet or outlet) of the hood, one can easily move it out of the way so that a visual inspection of the inside of the hood is possible.

[0022] Depending on the operating conditions, the lifetime of a sliding element can be seriously reduced by abrasion. On the one hand, it is possible to replace this sliding element with a new one. Alternatively, the loss of the sliding element can be taken into account and a substitute element can be provided from the very beginning. In such an embodiment, at least one sliding element is attached to the suspension elements above the lower end. This sliding element can be considered as a "substitute" or "spare" element. As long as the sliding element attached to the lower end is functional, the spare element is normally suspended above and spaced apart from the surface of the bulk material. However, when the first sliding element has been worn, the effective length of the suspension elements can be increased so that the spare element gets into contact with the bulk material and assumes the sealing function. It is also conceivable that three or more sliding elements are placed along the length of a suspension element, which are used one after another during the lifetime of the sealing device.

[0023] The pressure acting between the at least one sliding element and the surface of the bulk material can be influenced by the effective length of the suspension elements as described above. According to an alternative, at least one pulling device is attached to each sliding element, which pulling device is at least indirectly connected to the hood behind the connection area with respect to the conveying direction. In other words, with respect to the conveying direction, the pulling device exerts a pulling force from behind the connection area. Of course, this pulling force normally has a horizontal and a vertical component, wherein the vertical component helps to carry a part of the weight of the sliding element and reduces the pressure between the element and the bulk material. The pulling device may also have an adjustable effective length and may comprise a chain or a rope and a winding device.

[0024] Especially when a thermal treatment of the bulk material is performed, the sealing device can be exposed to high temperatures. These may have a detrimental effect, especially on the sealing sheet. In order to protect the sealing sheet from thermal damage, heat protection plates can be connected to the suspension elements and/or the transversal coupling elements, if present. In particular, these heat protection plates may be disposed on a side opposite to the sealing sheet. They may also provide some thermal protection for the suspension elements or the coupling elements. Needless to say, the heat protection plates should be made of a material that is heat resistant and normally has poor heat conductivity. Such material may comprise ceramic material, composite material or others. In order to provide a mostly complete protection, they can be disposed so that they overlap. The number of heat protection plates and/or the type of connection to the suspension elements can be chosen so that the flexibility of the suspension elements is not diminished too much.

[0025] Another way to protect the sealing device from elevated temperatures is to provide for an active cooling. According to one embodiment, at least one sealing sheet is disposed circumferentially around the suspension elements and an inner volume of the at least one sealing sheet is connectable to a cooling gas supply. That is, the at least one sealing sheet forms a sort of "hose" or "cushion" around the suspension elements and it defines an inner volume in which the suspension elements are disposed. This inner volume is connectable to a cooling gas supply (normally a supply of cool air) so that cooling gas can be blown into the volume. This, of course serves to cool the suspension elements and the at least one sealing sheet.

[0026] In some applications, the suspension elements and the at least one sealing sheet are connected to the hood spaced apart with respect to the conveying direction. This may be useful in situations where spatial confinements make it difficult to connect them in the same location. In particular, the distance between the connection area and the location where the sealing sheet is connected may correspond to at least 20% or at least 50% of the effective length of the suspension elements.

[0027] The present invention also provides a sealing device for a conveying device for bulk material, with a conveyor for transporting bulk material in a conveying direction, and a hood extending above the conveyor. The sealing device is configured to be attached to the hood and to hinder gas exchange along the conveying direction, and the sealing device comprises a plurality of flexible elongate suspension elements, which are configured to be at least indirectly connected to the hood in a connection area and to be spaced apart transversally to the conveying direction, at least one sliding element attached to a lower end of each suspension element and configured to be in sliding contact with the bulk material and at least one flexible sealing sheet configured to be connected to the hood and the at least one sliding element. All these terms have been explained above with respect to the inventive conveying device and therefore will not be explained again.

[0028] It should be noted that while the above describes a conveyor/hood arrangement wherein the conveyor is movable and the hood is stationary, the skilled person will easily understand that the same principles apply for an arrangement wherein the hood is moveable while the conveyor is stationary. An arrangement with moveable hood is also within the scope of the present invention.

[0029] Preferred embodiments of the sealing device are those of the inventive conveying device.

Brief Description of the Drawings

[0030] Preferred embodiments of the invention will now be described, by way of example, with reference to the accompanying drawings, in which:

Fig. 1 is a side view of a conveying device according a first embodiment to the present invention;

Fig. 2 is a front view of the conveying device of Fig. 1;

Fig. 3 is a side view of a conveying device according a second embodiment to the present invention;

Fig. 4 is a side view of a conveying device according a third embodiment to the present invention;

Fig. 5 is a side view of a conveying device according a fourth embodiment to the present invention;

Fig. 6 is a side view of a conveying device according a fifth embodiment to the present invention;

Fig. 7 is a side view of a conveying device according a sixth embodiment to the present invention;

Fig. 8 is a side view of a conveying device according a seventh embodiment to the present invention; and

Fig. 9 is a side view of a conveying device according an eighth embodiment to the present invention.

Description of Preferred Embodiments

[0031] Fig.1 shows a side view of a conveying device, more particularly a travelling grate machine 1, which comprises a travelling grate 2 for transporting sinter 20 along a conveying direction C. In this embodiment, the conveying direction C is horizontal and thus perpendicular to a vertical direction V. In this embodiment, the travelling grate 2 is configured for linear movement, but alternatively, a conveyor for circular movement could also be used, in which case the conveying direction C would be a tangential direction.

[0032] A hood 3 extends above the travelling grate 2 in order to prevent or at least minimise any uncontrolled gas exchange between the space above the sinter 20 and the outside atmosphere. As can be seen in the front view of Fig. 2, the hood 3 provides a seal in the vertical direction V and in a transversal direction T. However, along the conveying direction C, an effective seal cannot be achieved by the stationary hood 3. In order to minimise or prevent any exchange of gases and dust between a first area A and a second area B, the travelling grate machine 1 comprises a sealing device 4, which is attached to a vertical wall 3.1 of the hood 3. It should be noted that both areas A, B may be located inside the hood 3 or one area may be located outside the hood 3 and the other inside the hood 3. In the latter case, the sealing device 4 is positioned at an inlet or outlet of the hood 3.

[0033] The illustrated sealing device 4 comprises six suspension chains 5, which are connected to the vertical wall 3.1 in a connection area 3.2 and extend downwards along the vertical direction V to a lower end 5.1, to which three sliding blocks 6 are connected. The sliding blocks 6 are separate from each other and are disposed adjacent each other along the transversal direction T. Each sliding block is independently suspended by two suspension chains 5. As can be seen in Fig. 2, the suspension chains 5 are pairwise connected by coupling chains 8. The function of the coupling chains 8 is to stabilise the suspension chains 5 and to limit their relative movement. In order to withstand the elevated temperatures above the sinter 20, the chains 5, 8 and the sliding blocks 6 are made of steel.

[0034] Due to its own weight and partially due to the weight of the chains 5, 8, each sliding block 6 presses down onto a surface 20.1 of the sinter 20. Due to this pressure, there is a relatively close contact between the sliding blocks 6 and the surface 20.1. Also, since the blocks 6 are individually movable, an uneven shape of the surface 20.1 along the transversal direction T can be compensated. While the sliding blocks 6 maintain a largely tight contact with the surface 20.1, a seal between the sliding blocks 6 and the hood 3 is maintained by a sealing sheet 7, which is with its upper end 7.1 connected to the vertical wall 3.1 and with its lower end 7.2 to each of the sliding blocks 6. The sealing sheet 7 may be made of a woven fibrous material and is therefore flexible so that it does not impair the movement of the sliding blocks 6. The length of the sealing sheet 7 in relation to the length of the suspension chains 5 can be chosen such that the forces between the hood 3 and the sliding blocks 6 are exclusively or mainly transferred by the suspension chains 5, while the flexible sealing sheet 7 is not under tension. This helps to increase the lifetime of the sealing sheet 7. As can be seen in Figs 1 and 2, the sealing sheet 7 is placed behind (along the conveying direction C) and above (along the vertical direction V) the chains 5, 8. Therefore, the weight of chains 5, 8 does not rest on the sealing sheet 7. Fig. 2 also shows a side wall 2.5 of the travelling grate 2 and a side wall 3.5 of the hood 3. Both side walls 2.5, 3.5 are configured and arranged such that a seal is formed therebetween, thereby preventing gas exchange along the transversal direction T.

[0035] The embodiment shown comprises suspension chains 5 to take the weight of the sliding blocks 6 and the flexible sealing sheet 7 is arranged to merely carry out the sealing function. It is however also possible and within the scope of the present invention to provide a flexible sealing sheet 7 with sufficient strength to also take the weight of the sliding blocks 6. In that case, the suspension chains 5 may not be required.

[0036] Fig. 3 shows a second embodiment of a travelling grate machine 1, which is largely identical to the embodiment of Figs 1 and 2 and therefore will not be described in detail again. However, in this embodiment, each suspension chain 5 is connected to a hook 9 fixed to the vertical wall 3.1 in the connection area 3.2. In this case, an upper end 5.2 of the suspension chains 5 is hanging down from the hook 9, while an intermediate link of the chain (e.g. the 3rd link) is placed over the hook. It will be appreciated that in this embodiment, every link corresponds to an attachment point 5.3 for the hook 9. By placing different links over the hook 9, an effective length of the suspension chains 5 between the connection area 3.2 and the lower end 5.1 can be adjusted. A longer effective length leads to an increased pressure between the sliding blocks 6 and the surface 20.1, which is beneficial in terms of a sealing effect but also leads to increased abrasion of the sliding blocks 6 and reduces their lifetime. Therefore, the effective length can be adjusted individually to find an optimum balance between sealing effect and lifetime of the sliding blocks 6.

[0037] Another option to adjust the effective length is shown in the embodiment of Fig. 4, where the suspension chains 5 are connected to a winding device 10, which is operable from outside the hood 3. By winding the suspension chains 5 around the rotatable shaft of the winding device 10, the effective length can be reduced, while it can be increased by unwinding. This makes it impossible to entirely remove the sliding blocks 6 from the surface 20.1. For instance, if either of the first or second area A, B is outside the hood 3, i.e. the sealing device 4 is placed at an opening (inlet or outlet) of the hood 3, one can easily move it out of the way so that a visual inspection of the inside of the hood 3 is possible.

[0038] Fig. 5 shows an embodiment where the abrasion effect on the sliding blocks 6 is taken into account by providing two spare sliding blocks 6 for each active sliding block 6, which spare blocks 6 are connected to the suspension chains 5 above the lower end 5.1. If one sliding block 6 has been worn by abrasion, the next sliding block 6 can take over its role by adjusting the effective length of the suspension chain 5.

[0039] While the force of the sliding block acting on the surface 20.1 in figs. 3 and 4 can only be influenced by adjusting the effective length of the suspension chains 5, Fig. 6 shows another embodiment, in which a pulling device 11 acts on the sliding blocks 6. This pulling device 11 comprises steel ropes 12 connected to the sliding blocks 6 and a winding device 13, which is connected to the hood 3 behind the connection area 3.2. Therefore, the pulling device 11 exerts a force on the sliding blocks 6 that has a vertical and a horizontal component. The horizontal component is compensated by the suspension chains 5, while the vertical component acts as a lifting force, which reduces the pressure by the sliding blocks 6 on the surface 20.1.

[0040] Figs 7 and 8 illustrate two embodiments that account for the risk of the sealing device 4 and especially the sealing sheet 7 getting damaged by high temperatures. In fig. 7, a plurality of heat protection plates 14 are connected to the front side of the suspension chains 5 (i.e. opposite the sealing sheet 7).

[0041] In Fig. 8, the sealing sheet 7 is disposed circumferentially around the suspension chains 5 and the coupling chains 8 and forms a hose or cushion around them. An inner volume 7.5 of the sealing sheet 7 is connected to an air supply 15 through which cool air can be introduced.

[0042] Fig. 9 is an embodiment where the coupling chains 5 and the sealing sheet 7 are connected to two separate vertical walls 3.1, 3.3 of the hood 3, which are spaced apart along the conveying direction C. In other words, the sealing sheet 7 is connected to the hood 3 behind the connection area 3.2.

Legend of Reference Numbers:

1	travelling grate machine	7.5	inner volume
2	travelling grate	8	coupling chain
2.5	side wall of travelling grate	9	hook
3	hood	10	winding device
3.1	vertical wall	13	winding device
3.3	vertical wall	11	pulling device
3.2	connection area	12	steel rope
3.5	side wall of hood	14	heat protection plate
4	sealing device	15	air supply
5	suspension chain	20	sinter
5.1	lower end of suspension chain	20.1	surface of sinter
5.2	upper end of suspension chain	A	first area
5.3	attachment point	B	second area

(continued)

6	sliding block	C	conveying direction
7	sealing sheet	T	transversal direction
7.1	upper end of sealing sheet	V	vertical direction
7.2	lower end of sealing sheet		

Claims

1. Conveying device (1) for bulk material (20), with

- a conveyor (2) for transporting bulk material (20) in a conveying direction (C),
- a hood (3) extending above the conveyor (2), and
- a sealing device (4) that is attached to the hood (3) and configured to hinder gas exchange along the conveying direction (C),

wherein the sealing device (4) comprises

- at least one flexible sealing sheet (7) having an upper end (7.1) and a lower end (7.2); and
- at least one sliding block (6) being configured to be in sliding contact with the conveyor (2) or the bulk material (20) arranged on the conveyor (2)

the upper end (7.1) of the flexible sealing sheet (7) being connected to the hood (3) and the lower end (7.2) of the flexible sealing sheet (7) being connected to the sliding block (6).

2. Conveying device according to claim 1, **characterised in that** the sealing device (4) further comprises

- at least one flexible elongate suspension element (5), which is at least indirectly connected to the hood (3) in a connection area (3.2);

wherein the at least one sliding block (6) is attached to a lower end (5.1) of the at least one suspension element (5).

3. Conveying device according to claim 2, **characterised in that** the sealing device (4) comprises a plurality of flexible elongate suspension elements (5) which are spaced apart transversally to the conveying direction (C).

4. Conveying device according to any of claims 1 to 3, **characterised in that** the sealing device (4) comprises a plurality of separate sliding blocks (6) disposed transversally adjacent each other.

5. Conveying device according to any of claims 2 to 4, **characterised in that** the at least one suspension element (5) is a chain.

6. Conveying device according to any of claims 3 to 5, **characterised in that** at least two suspension elements (5) are connected by at least one transversal coupling element (8), wherein the at least one coupling element (8) is preferably a chain.

7. Conveying device according to any of claims 2 to 6, **characterised in that** the at least one sealing sheet (7) is disposed behind the at least one suspension element (5) along the conveying direction (C).

8. Conveying device according to any of claims 2 to 7, **characterised in that** an effective length of the at least one suspension element (5) between the connection area (3.2) and the lower end (5.1) is adjustable.

9. Conveying device according to claim 8, wherein

- the hood (3) has a connector (9) for each suspension element (5) and each suspension element (5) has a plurality of attachment points (5.3) for connection to the connector (9); or
- the suspension elements (5) are windably attached to a winding device (10), which is operable from outside the hood (3).

10. Conveying device according to any of claims 8 or 9, **characterised in that** at least one sliding block (6) is attached to the suspension elements (5) above the lower end (5.1).

11. Conveying device according to any of the preceding claims, **characterised in that** at least one pulling device (11) is attached to each sliding block (6), which pulling device (11) is at least indirectly connected to the hood (3) behind the connection area (3.2) with respect to the conveying direction (C).

12. Conveying device according to any of claims 2 to 11, **characterised in that** heat protection plates (14) are connected to the suspension elements (5) and/or to the coupling elements (8).

13. Conveying device according to any of claims 2 to 12, **characterised in that** at least one sealing sheet (7) is disposed circumferentially around the suspension elements (5) and an inner volume (7.5) of the at least one sealing sheet (7) is connectable to a cooling gas supply (15).

14. Conveying device according to any of claims 2 to 13, **characterised in that** the suspension elements (5) and the at least one sealing sheet (7) are connected to the hood (3) spaced apart with respect to the conveying direction (C).

15. Sealing device (4) for a conveying device (1) for bulk material (20), with

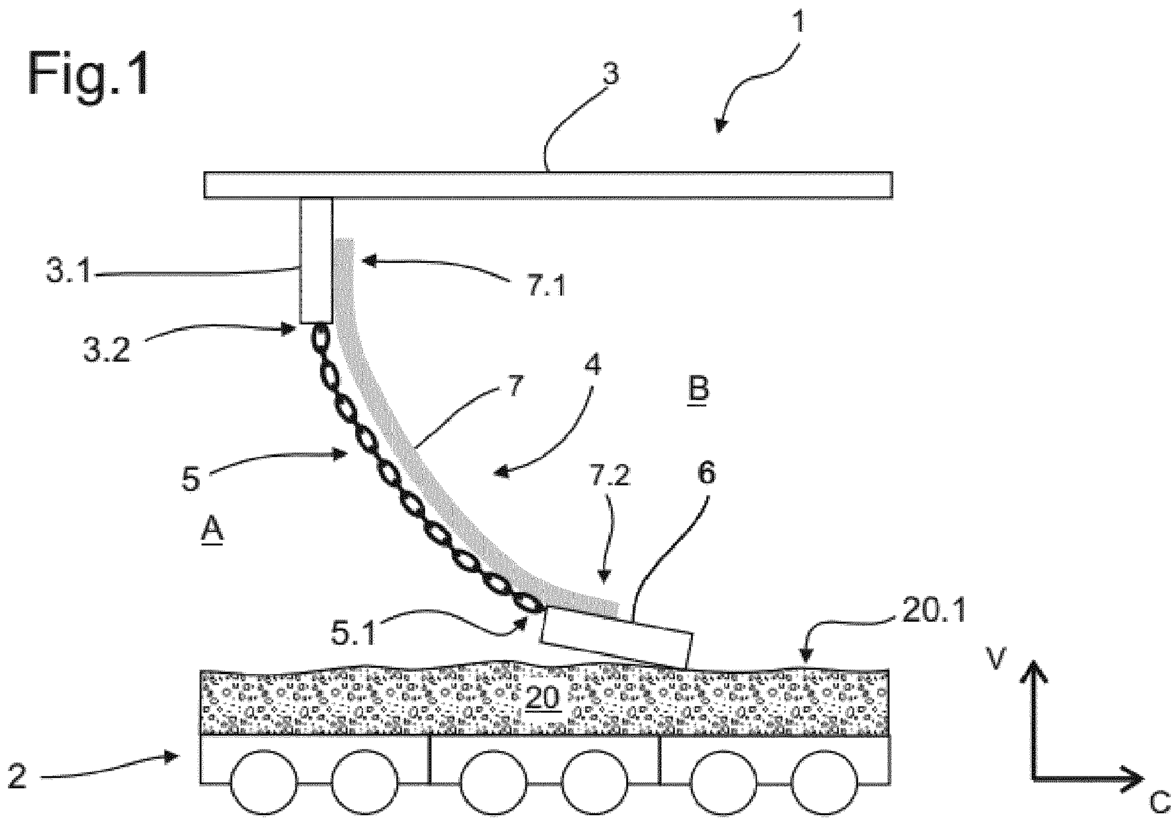
- a conveyor (2) for transporting bulk material (20) in a conveying direction (C), and
- a hood (3) extending above the conveyor (2),

wherein the sealing device (4) is configured to be attached to the hood (3) and to hinder gas exchange along the conveying direction (C), and the sealing device (4) comprises

- at least one sliding block (6) configured to be in sliding contact with the conveyor (2) or the bulk material (20) arranged on the conveyor (2); and
- at least one flexible sealing sheet (7) having an upper end (7.1) and a lower end (7.2); the upper end (7.1) of the flexible sealing sheet (7) being configured to be connected to the hood (3) and the lower end (7.2) of the flexible sealing sheet (7) being configured to be connected to the at least one sliding block (6)

wherein the sealing device (4) preferably further comprises at least one flexible elongate suspension element, which is least indirectly connected to the hood (3) in a connection area (3.2), wherein the at least one sliding block (6) is attached to a lower end (5.1) of the at least one suspension element (5).

Fig.1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V
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Fig.2

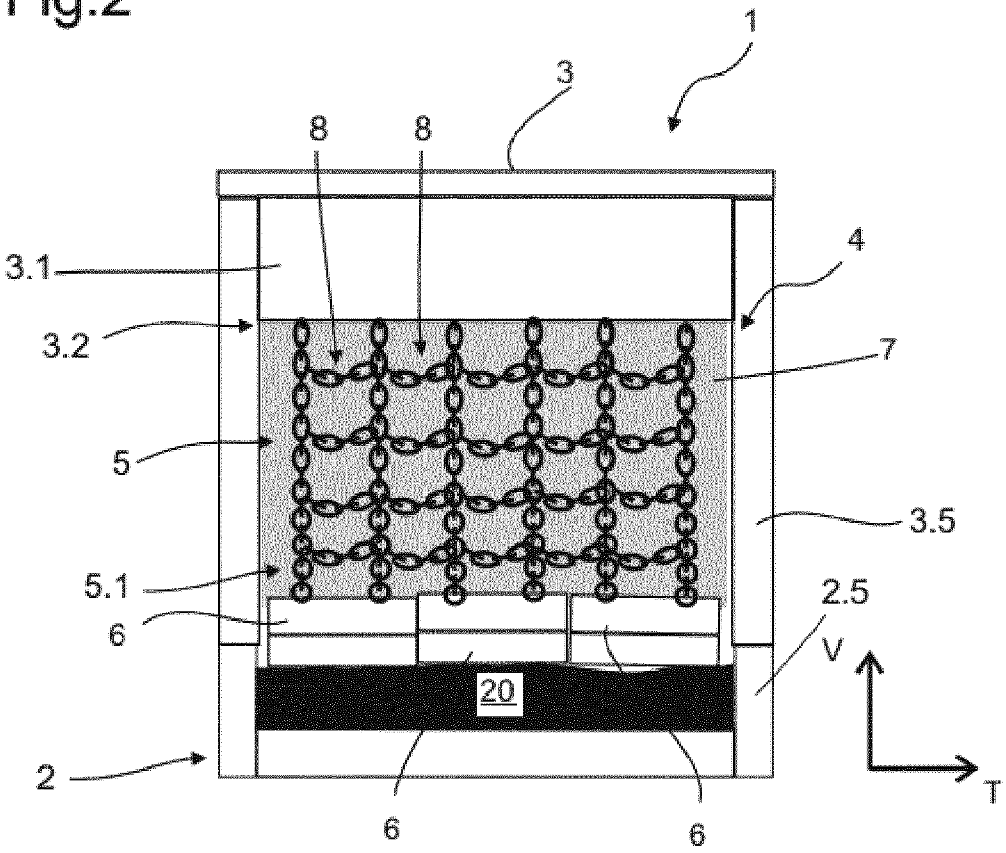
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Fig.3

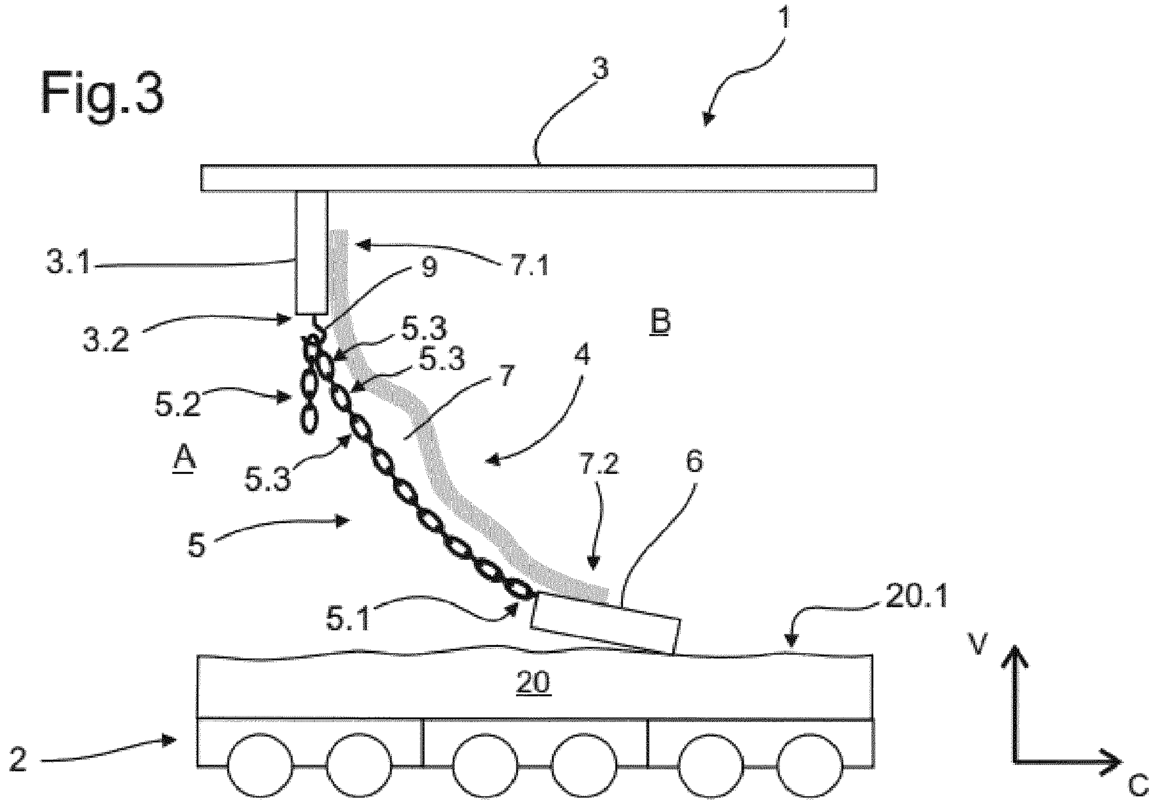
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Fig.4

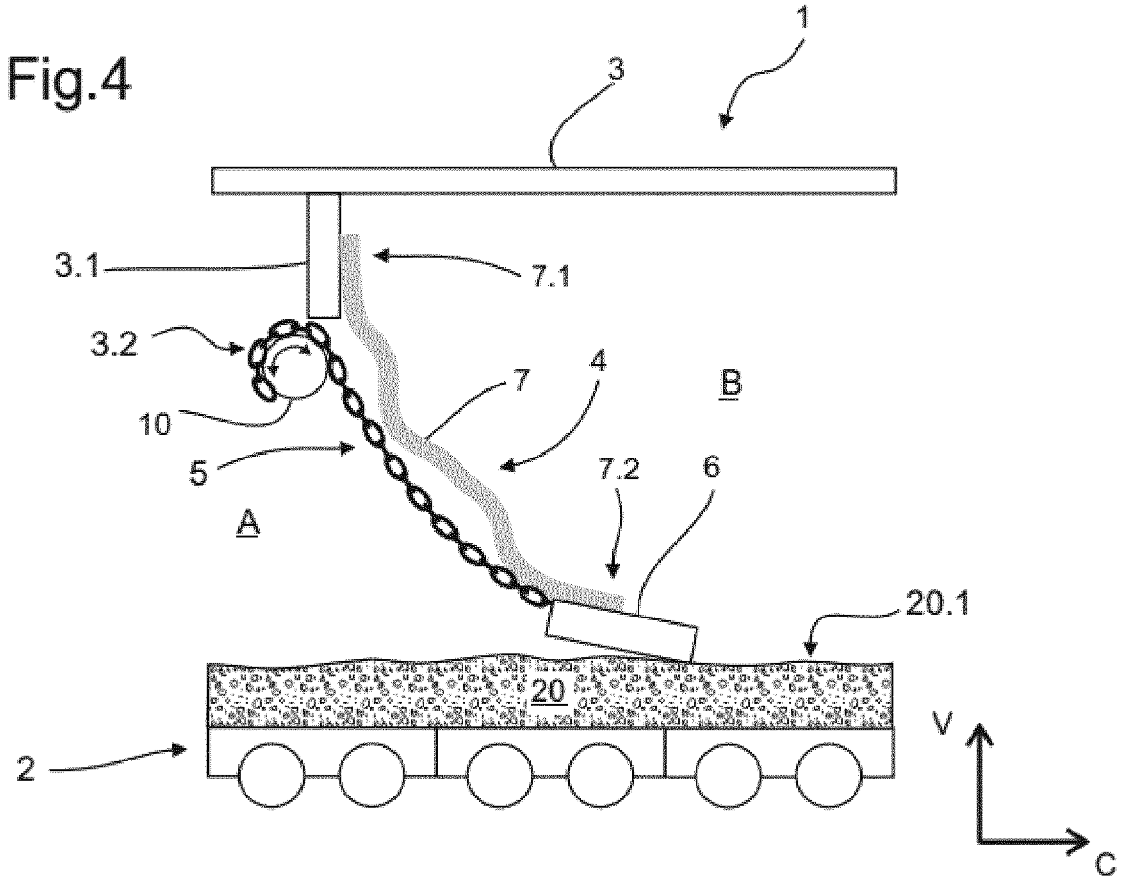
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Fig.5

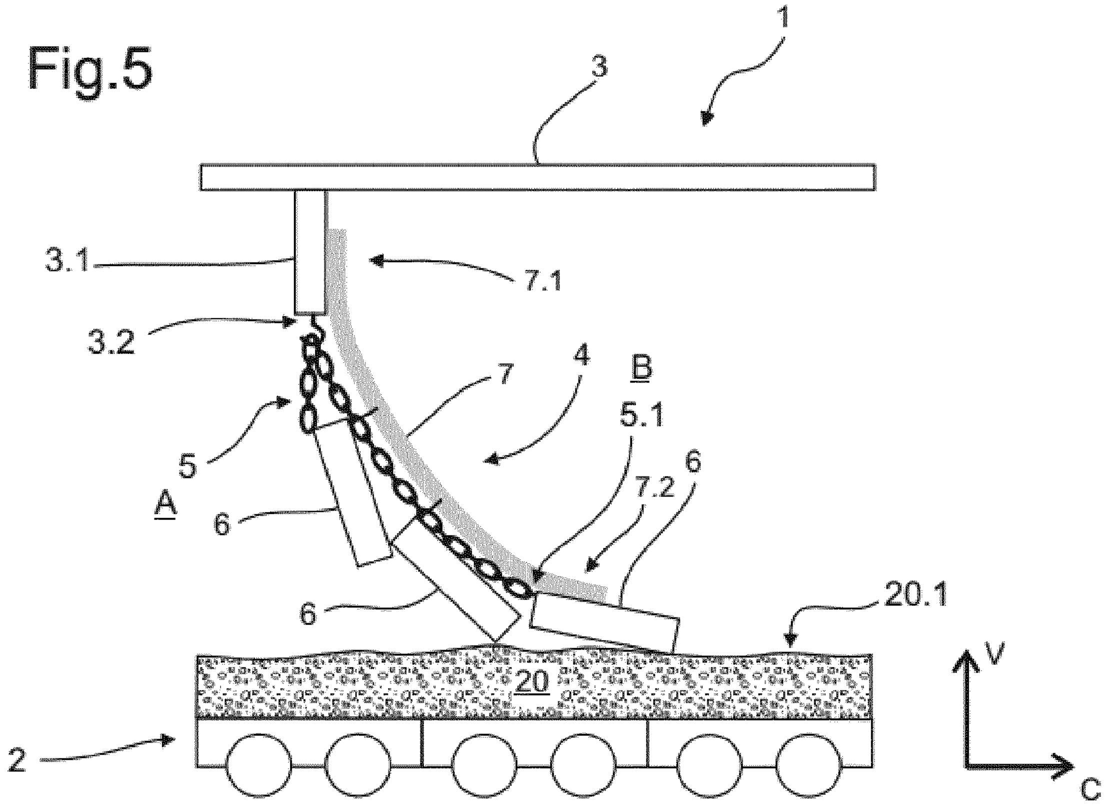
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Fig.6

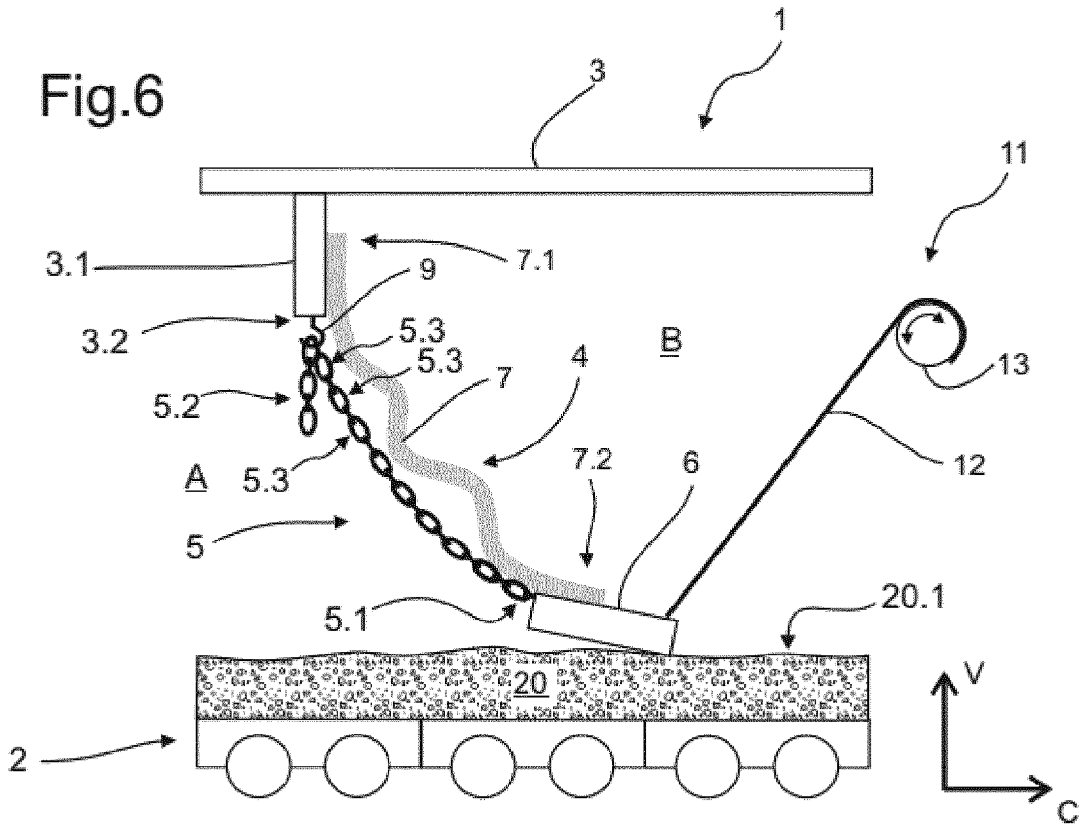
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Fig.7

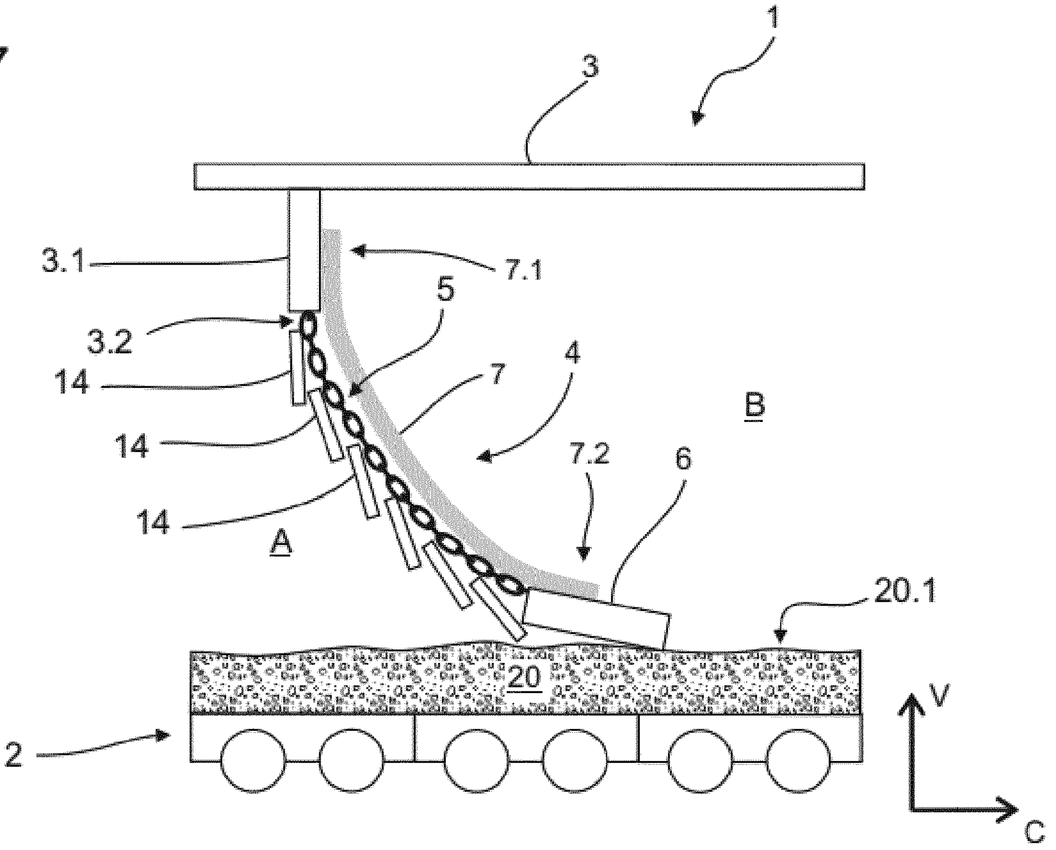
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Fig.8

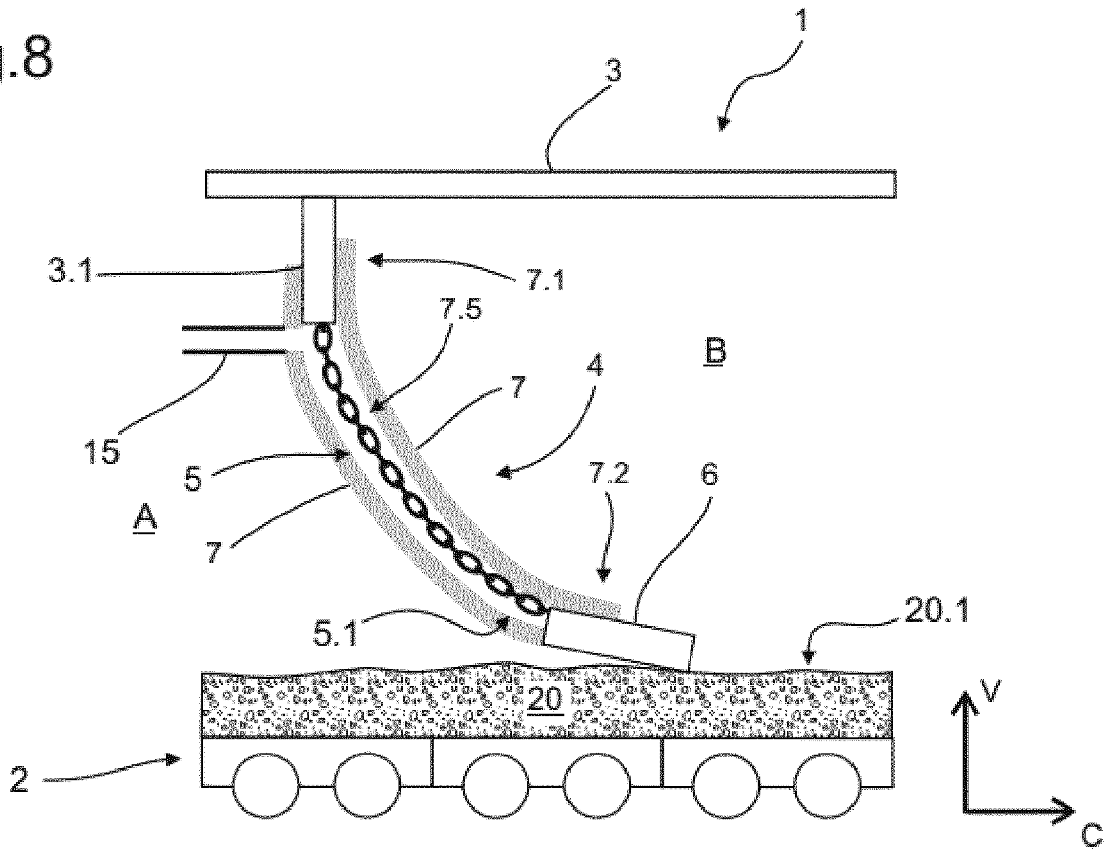
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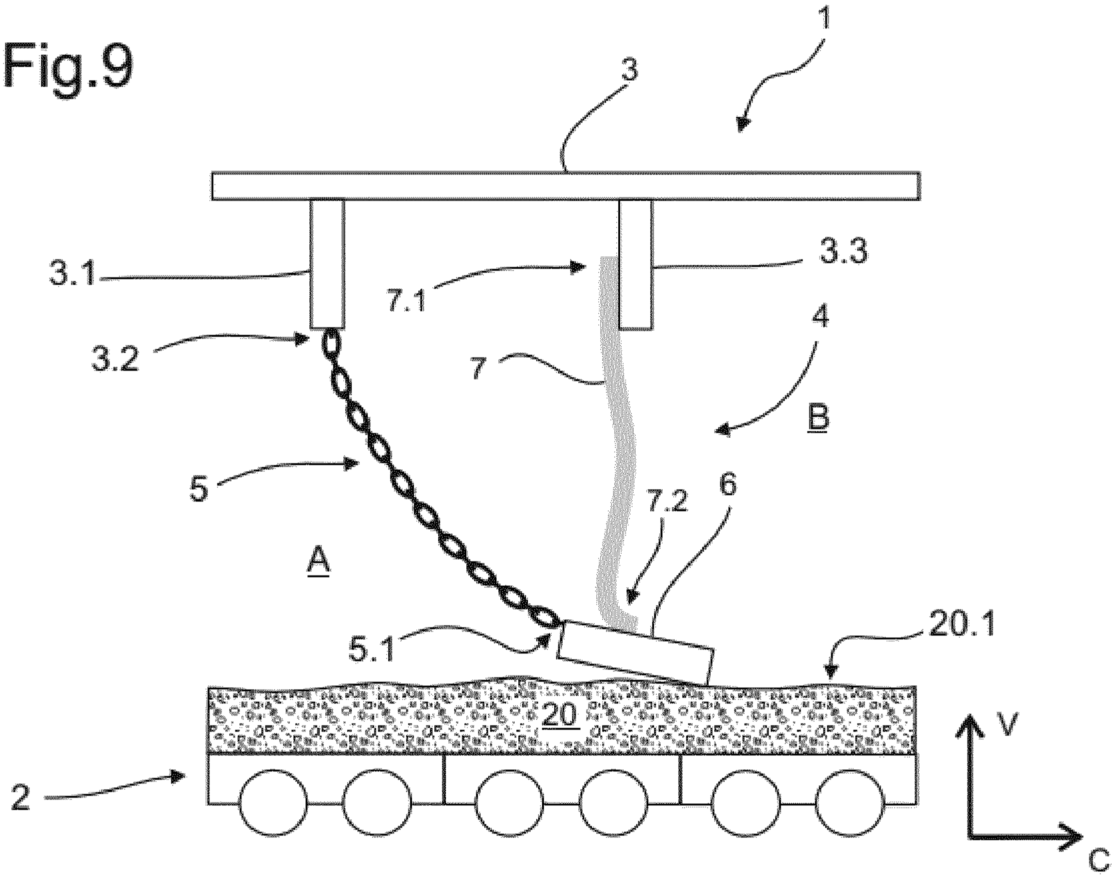
Fig.9



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Application Number
EP 17 15 9905

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F27B
F27D

The present search report has been drawn up for all claims

1

Place of search	Date of completion of the search	Examiner
Munich	15 September 2017	Gavriliu, Alexandru

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