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(54) DEVICE FOR SEPARATING SHEET-LIKE MATERIAL FROM BULK MATERIAL

(57) Device for separating sheet-like material from bulk material, comprising a bulk material feeding inlet (10), an outlet (11) for the separated sheet-like material and an outlet (12) for the resulting non sheet-like material, which comprises a plurality of catching rods (2) coupled, so as to radially project, with means for the movement around a closed path, said inlet (10) being placed such that the fed bulk material passes through the catching rods (2).

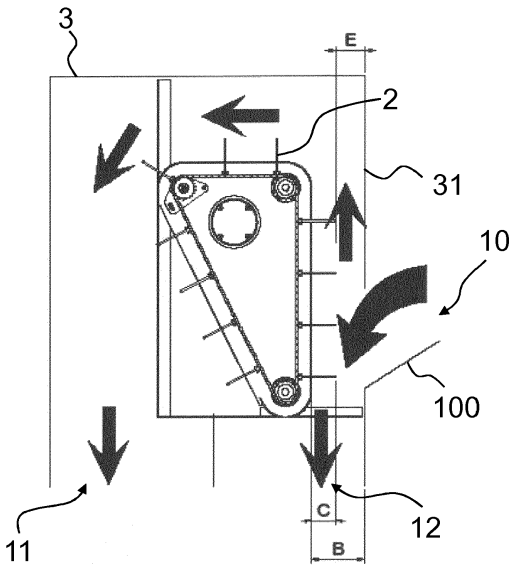

Fig. 1

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Description

[0001] The present invention relates to a device for separating sheet-like material from bulk material, comprising a bulk material feeding inlet, an outlet for the separated sheet-like material and an outlet for the resulting non sheet-like material according to the preamble of claim 1.

[0002] The invention finds application in the field of recovery of material from municipal solid waste or the like. The device acts for separating, from a stream of bulk material, solid elements with different shapes and trajectories. Particularly it captures sheet-like material (2D) from rolling or semi-rolling material (3D) coming from a continuous and/or discontinuous stream, such as a conveyor belt or a feeding chute.

[0003] In prior art there are systems separating materials from municipal solid waste with purposes similar to the separating device, subject matter of the present patent application. Such systems require considerable energy absorptions, require frequent and accurate maintenance and require large spaces for being installed consequently occupying considerable areas, including maintenance areas. These characteristics are more highlighted when revamping existing plants.

[0004] The document DE19823019 describes a separating device for the continuous separation of solid material having different dimensions. A pair of closed bands subtended between two deflection rollers bears a plurality of transversal plates. These latter are spaced from each other by a predetermined amount, are supported only at their ends by the two bands and are oriented perpendicularly to the plane subtended by the two bands.

[0005] Materials are separated only by a catching effect and a falling effect by gravity. However when the material is very light the separation is not enough effective and such material can remain captured in the device.

[0006] The separating device, according to the present patent application, aims at overcoming said drawbacks of the currently known devices, and, the separating ability being equal, it aims at using mechanisms particularly simple and with a low ordinary maintenance. Moreover since it takes reduced spaces, it is easy to be placed in existing plants and therefore it allows to be frequently repositioned depending on separation purposes.

[0007] The present invention aims at said objects by a device such as described in the preamble of claim 1 and that in combination has the characteristics of the characterizing part of said claim 1.

[0008] Therefore the device is a "catching" separator that acts for separating material with different shapes, composition and nature (e.g. municipal waste). The principle of bounce and catching separation is the difference of easiness of getting entrapped of the material to be sorted. In a preferred embodiment two streams of material are separated having different characteristics as regards mix of shape, specific surface and density (e.g. sheets, bags, pieces of cloth or fabric from bottles, boxes, caps).

[0009] Simple interventions allow dimensional variants to be carried out for defining the size (minimum dimension of the material to be separated). For example, in a sorting plant with different sorting cycles depending on the received raw material, it can be necessary to place the separator in different points adapting it depending on the material sorting cycle.

[0010] In one embodiment the movement means comprise belts or chains movable by dragging about two or more transmission pulleys, at least one transmission pulley being coupled with a driving shaft.

[0011] According to an advantageous improvement there are provided for each belt or chain three transmission pulleys, the path being triangular.

[0012] In one embodiment the movement means move the rods in a direction opposite to the one of the incoming stream of bulk material. This increases the ability of the device in catching the material to be separated between its rods and it allows an effective removal.

[0013] According to a further embodiment each belt or chain is placed in a housing area defined by two support elements coupled with each other and such that the belt or chain and the transmission pulleys are confined into the housing area, while the rods extend beyond the perimetral edges of the support elements. The support elements coupled with each other and placed side by side therefore create a channel for the running of the rods along the closed path.

[0014] In one improvement the perimetral edges of the support elements are provided at least partially with such covers that, at the covers the distance between two adjacent support elements substantially corresponds to the diameter of the rods. This allows only the rods to come out from the housing area, therefore contemporaneously protecting the chains or belts and the pulleys. Thus both the bulk material and the sheet-like material already separated cannot enter in contact with the chains or belts and pulleys, preventing accidental jamming situations, damages or malfunctions.

[0015] According to one embodiment there are provided means for detaching the sheet-like material caught in the rods in the direction of the corresponding outlet by means of forced air.

[0016] In one improvement the detachment means are composed of the support elements themselves, each support element being composed of a box-like element, being provided with a manifold connecting to an air supplying duct and it being provided with one or more holes for discharging forced air.

[0017] According to a further embodiment, downstream of said inlet with respect to the movement direction of the rods, there is provided a wall placed at a predetermined distance from the rods, which wall is movable such to adjust the distance from the rods. This allows a duct for removing the sheet-like material to be generated, whose port is variable and adjustable depending on needs. Thus it is possible to exert a slight pressure of the

removed material towards the rods, such to increase the adhesion of the sorted material on the rods. It is also possible to adjust the port of the removal duct for example for allowing cumbersome items to pass avoiding jamming or damages.

[0018] In one embodiment there are provided two or more of said belts or chains, there being provided means for independently adjusting the position of the rods of one or another chain or belt. Thus it is possible to modify the closeness of the rods and so to change the type of separation, taking the rods out of alignment.

[0019] In a further embodiment the distance between the bulk material feeding inlet and the rods is adjustable. This allows the ideal distance and adjustment to be defined between the loading mouth of the inlet and the rods, for an optimal separation.

[0020] These and other characteristics and advantages of the present invention will be more clear from the following description of some embodiments shown in the annexed drawings wherein:

Fig.1 is a first variant embodiment defined as "gravity";
Fig.2 is a second variant embodiment defined as "scraping";
Fig. 3 is a detail of the system moving the rods;
Fig. 4 is the device in the assembled condition;
Figs. 5 and 6 are different views of a first configuration example of the device;
Figs.7 and 8 are different views of a second configuration example of the device;
Figs. 9 and 10 are different views of a first configuration example of the device;
Figs. 11 and 12 are different views of a first configuration example of the device.

[0021] Figure 1 shows a functional diagram of a first variant embodiment defined as "gravity" one of the device separating sheet-like material from bulk material of the present invention.

[0022] The device comprises a bulk material feeding inlet 10, an outlet 11 for the separated sheet-like material and an outlet 12 for the resulting non sheet-like material.

[0023] The device comprises a plurality of catching rods 2, coupled, so as to radially project, with means for the movement around a closed path. The inlet 10 is placed such that the fed bulk material passes through the catching rods 2.

[0024] The GRAVITY feed of figure 1 occurs by a suitable hopper or loading mouth 10, that is the inlet 10 and that is placed at the front of the separator.

[0025] The SCRAPING feed, shown in figure 2, is carried out by placing the separator above a material transport element (chute, conveying belt, vibratory table, etc.) suitably interfering with the material to be sorted.

[0026] In both configurations, the separation process occurs by a mechanical system moving the rods 2, that takes, transports and releases the sorted material.

[0027] The movement path of the rods 2 develops along a right-angled triangle, where the longer cathetus is vertically arranged and the smaller cathetus is arranged horizontally above. The inlet 1 is placed at the base of the longer cathetus.

[0028] This allows an advantageous arrangement such as shown in figure 2, where the sorted material outlet 11 comprises a conveyor belt whose initial end is at the hypotenuse of the triangle. Thus the two outlets are parallel one above the other one, but the triangle arrangement guarantees the sorted material to fall only on the upper conveyor belt and therefore to be discharged from the proper outlet.

[0029] The sorted material is taken by a series of rods 2 (rigid or flexible) moved by a mechanical drive in countercurrent with respect to the stream of the incoming material: such rods 2 form a series of "combs" that drag the pieces that are caught and make the other ones to pass.

[0030] The device comprises a supporting frame 3 and a series of protection cases 30 that together with the frame 3 compose a casing containing the system moving the rods 2.

[0031] Downstream of the inlet 1 with respect to the movement direction of the rods, namely above it, there is provided a wall 31 movable so as to adjust the distance from the rods 2, denoted in the figures by letter E.

[0032] Therefore a duct removing the sorted material is identified, one wall of which being movable and it exerts a slight pressure towards the comb drive such to increase the adhesion of the sorted material against the combs. The movable wall for example is a plate made of rubber and it allows cumbersome pieces to pass through preventing the separator from being damaged or jammed.

[0033] The sorted material is transported by the rods 2 towards the upper part of the separator where the wall 31 and the casing of the machine contain and guide the material upwards.

[0034] The sorted material is released in the rear part of the separator, that is the final end of the smaller cathetus of the triangle path. The material gets detached when the rods 2 are faced downwardly, helped by jets of forced air.

[0035] The amount, type and size of the sorted material are regulated by the following parameters: position and inclination of the feeding inlet 10, speed of the rods 2, distance between the rods 2, step between the rods 2, shape of the rods 2, distance of the wall 31, speed and flow rate of the forced air stream. All the parameters are adjustable.

[0036] The catching separator is composed of a series of rods, that can be seen in more details in figure 2, with a length ranging from 5 to 25 cm and with a diameter of 1 to 30 mm. The dimensions of the rods 2 are determined by several factors such as the operating speed and composition of the material to be sorted. The rods 2 can be composed of carbon steel, stainless steel or synthetic material, such as for example glass fibers or carbon fiber. The choice of the material for the rods 2 depends on the

level of wear, specific weight and adhesion of the material to be sorted on the catching separator.

[0037] The rods 2 are made integral with a drive belt or chain 20 by a mechanical joint or by bolting. The joint system occurs by a system called as "bayonet" namely a hollow seat integral with the drive, such as for example a sleeve, allows the rod to be housed for a short portion, about 15 ÷ 30 mm. The obtained joint is guaranteed by a peg or split pin that through a common hole, both for the sleeve and the rod 2, prevents the rod 2 from being removed from the sleeve. While the bolting system is carried out by making the rod 2 integral with the drive system by supports or plates present on the drive system (chain or belt). In this specific case the rod 2 has to provide such an end to be able to interface with the supports present on the drive, usually a plate with one or more holes. Finally a series of self-tapping screws or through bolts allow the rod 2 to be made integral with the drive system.

[0038] The rods 2 are made integral with the drive with a regular or variable pitch on the whole length of the drive (chain/belt) till forming a "flexible" comb. There is provided a system for taking the rods out of alignment such to modify the closeness of the combs and so to change the type of separation. In the case of a chain drive, the out-of-alignment is carried out by placing the link of the chain with the rod 2 in a position different than the adjacent chain. In case of a belt drive, it is sufficient to loosen the tension and to slide the belt till obtaining a position of the rod 2 different than the adjacent rod 2 and then to tension the belt.

[0039] It is possible to provide means for automatically setting the arrangement of the rods 2 in the different chains/belts 20 such to form the catching combs. Thus predetermined arrangements are made, each one specifically directed to particular purposes or particular types of material. Therefore a setting unit allows the user to select the desired arrangement, and the automatic setting means adjust the arrangement of the rods 2 such that they take the set arrangement.

[0040] The rods 2 have a different profile depending on the material to be sorted. The shape or the profile of the rod 2 is: STRAIGHT that is with a cylindrical base or other and with a straight profile, SABRE that is with a cylindrical base or other and a curved profile with a constant or variable radius, SERPENTINE that is with a cylindrical base or other and with a profile bent and bent again for two or more times for the whole length of the rod 2. The profile of the rods 2 together with other mechanical factors or factors regarding the material to be sorted, determine the sorting degree and/or efficiency of the catching separator.

[0041] Each belt or chain 20 is placed within a housing area defined by two support elements 21 coupled with each other. The chain or belt 20 and the transmission pulleys 22 are confined in the housing area, while the rods 2 extend beyond the perimetral edges of the support elements 21.

[0042] Particularly figure 3 shows a series of identical modular support elements 21 each one forming the support and the housing for the drive shafts 24, 25, and 26.

[0043] The drive shafts can be two or more depending on the shape of the desired drive and can be parallel with each other, in this case they are three: a driving shaft 24, a tension shaft 25 and an idler shaft 26, that will be described below.

[0044] The connection of two support elements 21 form a hollow panel, the support elements 21 thereof forming the side walls, inside which the belt or chain 20 is slidably housed.

[0045] The chain 20 is driven by the driving shaft 24 and it engages gears provided on the drive shafts, axially spaced from each other and coinciding with each one of the chains 20 that therefore are housed within the gap between two support elements 21.

[0046] Each support element 21 has at least one hole allowing a connection duct 27 to be made for supplying air inside the gap provided between each support element 21.

[0047] With the support elements 21 in the connected condition, the connection duct 27 is made such to allow air to be supplied inside the generated hollow panel.

[0048] For example it is possible to provide the connection duct 27 along its perimetral inner wall to have slots supplying air inside the hollow panel.

[0049] According to the variant shown in figure 3, the holes allowing the duct 27 to be formed, are coincident in the connected condition of the support elements 21.

[0050] Each hole further has delimitation perimetral walls that project by a predetermined extent in the direction of the adjacent support elements 21, such to abut against the perimetral walls delimiting the adjacent hole, retaining the two side surfaces of each hollow panel at such a distance to house inside it all the components of the mechanism described above.

[0051] The side walls have a peripheral edge extending in the direction of the drive shafts 24 and 25 by an amount smaller than the perimetral walls delimiting the holes, such that, in the connected condition, they form a continuous passage slit for the rods 2.

[0052] Moreover the peripheral edge identifies a cover 23 having a plurality of holes 28 placed near the discharge, intended to discharge the air present inside the hollow panel.

[0053] The peripheral edges of the support elements 21 are provided with such a cover 23 that, at the covers the distance between two adjacent support elements substantially corresponds to or is slightly greater than the diameter of the rods 2.

[0054] The rods 2 and the drive systems are operated by a series of drive shafts, which pass through the support elements 21.

[0055] The drive shafts can be two or more depending on the shape of the desired drive and parallel with each other, in this case they are three: a driving one 24, a tension one 25 and an idler one 26.

[0056] The driving shaft is driven by a driving system such as for example a gearmotor directly fitted on the shaft or by a chain/belt drive. On the driving shaft there are several pinions or pulleys at a regular distance, which are made integral by tabs and/or locking dowels, locking assemblies or other fastening systems. The whole driving shaft rests on bearing supports that allow a low friction rotation. The supports are placed at the ends of the shaft, but it is possible to apply other intermediate supports such to reduce its bending under stress if the length of the shaft requires it.

[0057] On the tension shaft 25 there are several pinions or pulleys, placed at the same distance as the driving shaft, which are made integral by tabs and/or locking dowels, locking assemblies or other fastening systems. At the ends there are provided the bearing supports that, by a sliding system 32, visible in figure 4, allow the shaft to have a radial and linear movement such to obtain the tension of the chains or belts 20.

[0058] The idler shaft 26 is composed of a series of supports that allow the return of the drive but allow also the tension of each drive chain or belt 20 to be slightly adjusted. The support is composed of a plate made of steel fastened to the frame of the separator by a rotation hole placed eccentrically with respect to the axis of the pinion. A pin protruding from the plate allows the pinion, bearing and locking ring or screw to be positioned. The adjustment occurs by means of a slot obtained in the supporting plate, the plate by rotating around the rotation hole allows the pinion to be radially moved while by means of the slot and a screw it is possible to lock its position.

[0059] The support element 21 or intermediate module has three functions. The main function is to protect drives from directly contacting the material to be sorted such to prevent the material from compromising the proper operation. The second function is to guide the rods through the spaces obtained between the support elements. The rods 2, with respect to the support elements 21, protrude depending on the material to be sorted. The third function is that of a blower. By means of a double wall, the intermediate module is a box-like one and it acts as an air chamber that, since supplied by a fan through a connection duct 27 of the support elements 21, allows air to be distributed through a series of holes 28 placed near the discharge. The obtained air jets allow the separated material to be detached, for example plastic bags, from the catching separator.

[0060] The mechanical parts described above determine a dynamic drive able to contemporaneously operate one or more drive belts/chains 20 complete with rods 2, to accurately regulate their positioning and to supply forced air where necessary for detaching the sorted material.

[0061] Figure 4 shows the assembled device. The whole drive system is supported by a frame 3 made of steel that determines the shape and the dimension of the catching separator. This allows a separator to be obtained with different shape and dimensions depending on the required industrial application.

[0062] Moreover the bulk material feeding inlet 1 is shown, through which the system moving the catching rods 2 is partially visible.

[0063] The supporting frame 3 is composed of four main parts, the casing 30, the loading mouth 10, the movable wall 31, the ventilation duct 27 and the protection cases 33.

[0064] The frame 3 has the main function of supporting the drive of the rods 2. Moreover it acts as a support for a propulsor 34, for the protection cases 33, for the feeding chute 100 and for the ventilation duct 27.

[0065] The feeding chute 100, placed in front of the separator, conveys the material to be sorted directly on the moving rods 2. By means of its shape and slots that allow it to be adjusted in its position that is moving up/down, moving near/away with respect to the drive, it is possible to optimize sorting depending on the material to be sorted.

[0066] The movable wall 31 is a plate of rubber or PVC. It is secured on the upper part of the supporting frame 3, while in the lower part it forms a "U"-shaped flap determining the opening of the loading mouth 10. Moreover the flap determines a sort of spring, that opposes the thrust of the channeled material improving its adhesion on the rods and at the same time is gets deformed avoiding jamming if a cumbersome piece gets captured.

[0067] From the figures it is possible to note how the device has reduced encumbrance and a flexibility in the shape to promote the installation in existing plants. The dimensions, particularly in elevation, of the combs can vary such to transport and discharge the sorted material, directly in points placed at a high distance with respect to the loading point of the separator.

[0068] Such great versatility of the device is testified by figures 5 to 12, where different configurations of the device are shown. In such figures the several outlets and the several conveyor belts are denoted by the reference numerals as in figure 2 when the outlets and belts are about the discharge and loading of the corresponding type of material.

[0069] In the figures 5 and 6 the device has a gravity feed, and the outlets of the separated sheet-like material 11 and of the resulting non sheet-like material 12 respectively come out on conveyor belts placed perpendicularly with each other, of which the conveyor belt of the resulting material proceeds in the same direction as the feeding conveyor belt 10, while the conveyor belt of the sorted material has a direction lateral with respect to the other two conveyor belts.

[0070] In figures 7 and 8 the device has a gravity feed, and the outlets of the separated sheet-like material 1 and of the resulting non sheet-like material 12 respectively come out on conveyor belts placed perpendicularly with each other, of which the conveyor belt of the resulting material proceeds in the direction as the feeding conveyor belt 10 but in an opposite way, it being underneath it,

while the conveyor belt of the sorted material has a direction lateral with respect to the other two conveyor belts.

[0071] In figures 9 and 10 the device has a gravity feed, and the outlet of the resulting non sheet-like material 12 comes out on a conveyor belt placed perpendicularly to the feeding conveyor belt 10. The outlet of the sorted sheet-like material 11 is on the contrary connected to a discharge hopper.

[0072] In figures 11 and 12 the device has a scraping feed. There is provided a single conveyor belt both for the feeding bulk material 10 and for the resulting non sheet-like material 12. From such conveyor belt the device takes the material to be sorted, and brings it on a further conveyor belt 11, placed on the side along an axis perpendicular to the first conveyor belt.

Claims

1. Device for separating sheet-like material from bulk material, comprising a bulk material feeding inlet (10), an outlet (11) for the separated sheet-like material and an outlet (12) for the resulting non sheet-like material,
   characterized in that
   it comprises a plurality of catching rods (2) coupled, such as to radially project, with means for the movement around a closed path, said inlet (10) being placed such that the fed bulk material passes through the catching rods (2) **in that** it has means for detaching the sheet-like material caught in the rods (2) towards the corresponding outlet (11) by means of forced air.

2. Device according to claim 1, wherein the movement means comprise belts or chains (20) movable by dragging around two or more transmission pulleys (22), at least one transmission pulley (22) being coupled to a driving shaft (24).

3. Device according to claim 2, wherein there are provided three transmission pulleys (22) for each belt or chain (20), the path being a triangular path.

4. Device according to claim 1, wherein the movement means move the rods (2) in a direction opposite to the one of the incoming stream of the bulk material.

5. Device according to claim 3, wherein each belt or chain (20) is placed in a housing area defined by two support elements (21) coupled with each other and such that the belt or chain (20) and the transmission pulleys (22) are confined into the housing area, while the rods (2) extend beyond the perimetral edges of the support elements (21).

6. Device according to claim 5, wherein the perimetral edges of the support elements (21) are provided at least partially with covers (23) such that, at the covers (23) the distance between two adjacent support elements (21) substantially corresponds to the diameter of the rods (2).

7. Device according to one or more of the preceding claims 1 to 6, wherein the detachment means are composed of the support elements (21) themselves, each support element (21) being composed of a box-like element, being provided with a manifold connecting to an air feeding duct (27) and it being provided with one or more outlet holes (28) for the forced air.

8. Device according to one or more of the preceding claims, wherein downstream of said inlet (10) with respect to the movement direction of the rods (2), there is provided a wall (31) arranged at a predetermined distance from the rods (2), which wall (31) is movable such to adjust the distance from the rods (2).

9. Device according to one or more of the preceding claims, wherein there are provided two or more of said belts or chains (20), there being provided means for independently adjusting the position of the rods (2) of one or another chain or belt (20).

10. Device according to one or more of the preceding claims, wherein the distance between the bulk material feeding inlet (10) and the rods (2) is adjustable.

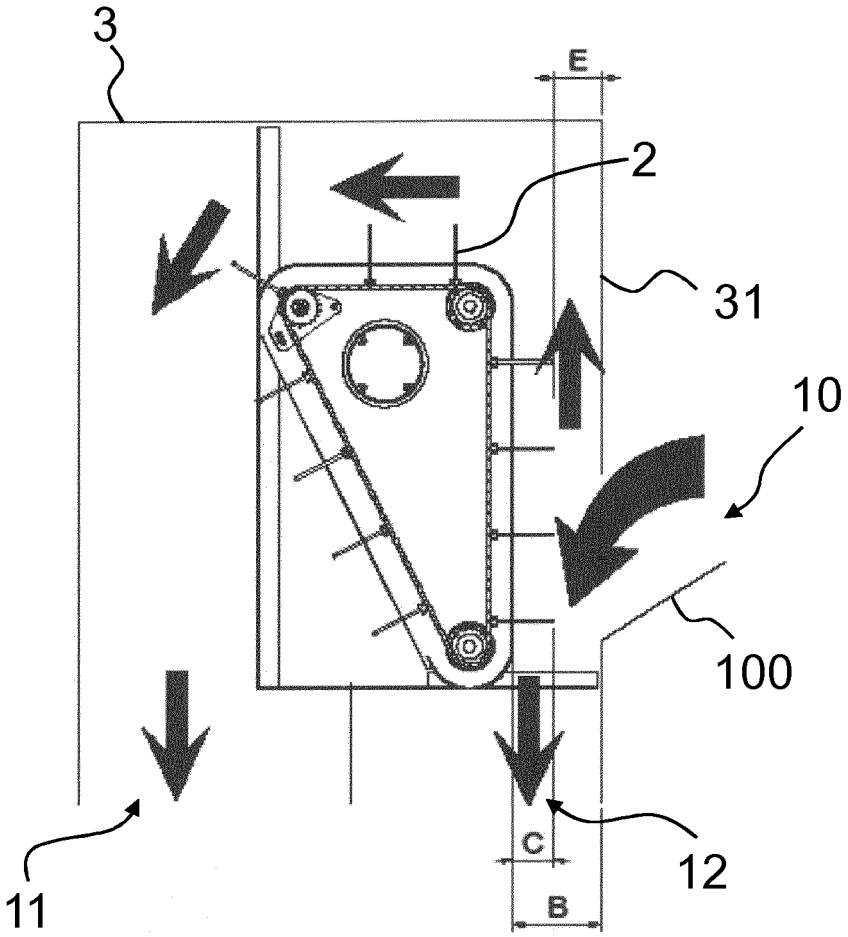

Fig. 1

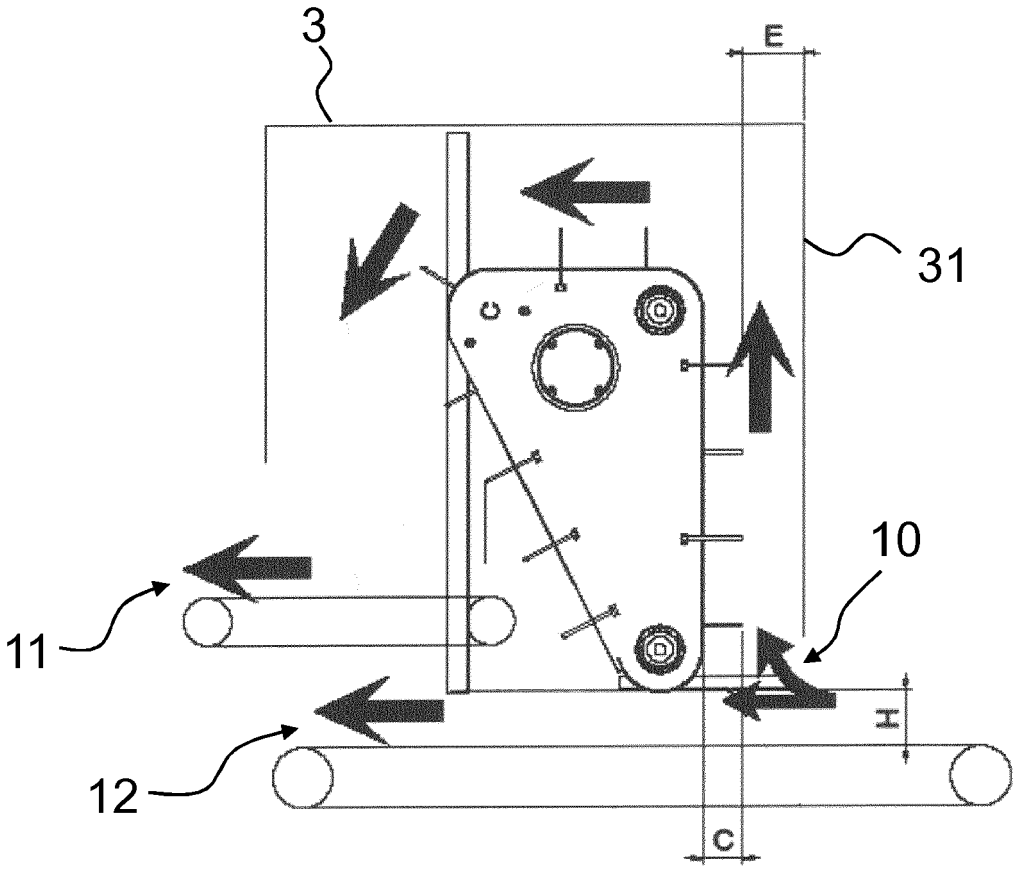

Fig. 2

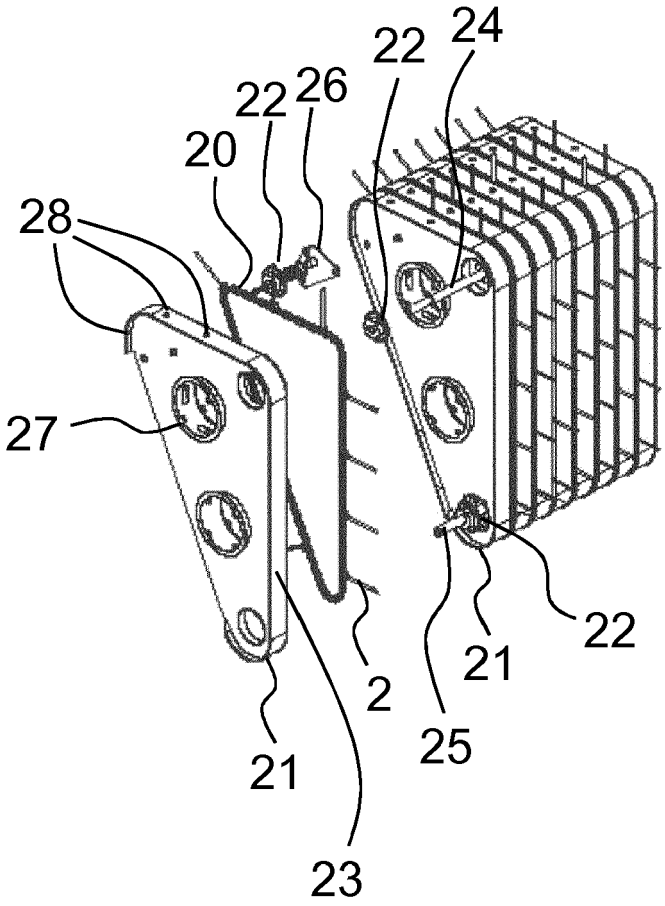

Fig. 3

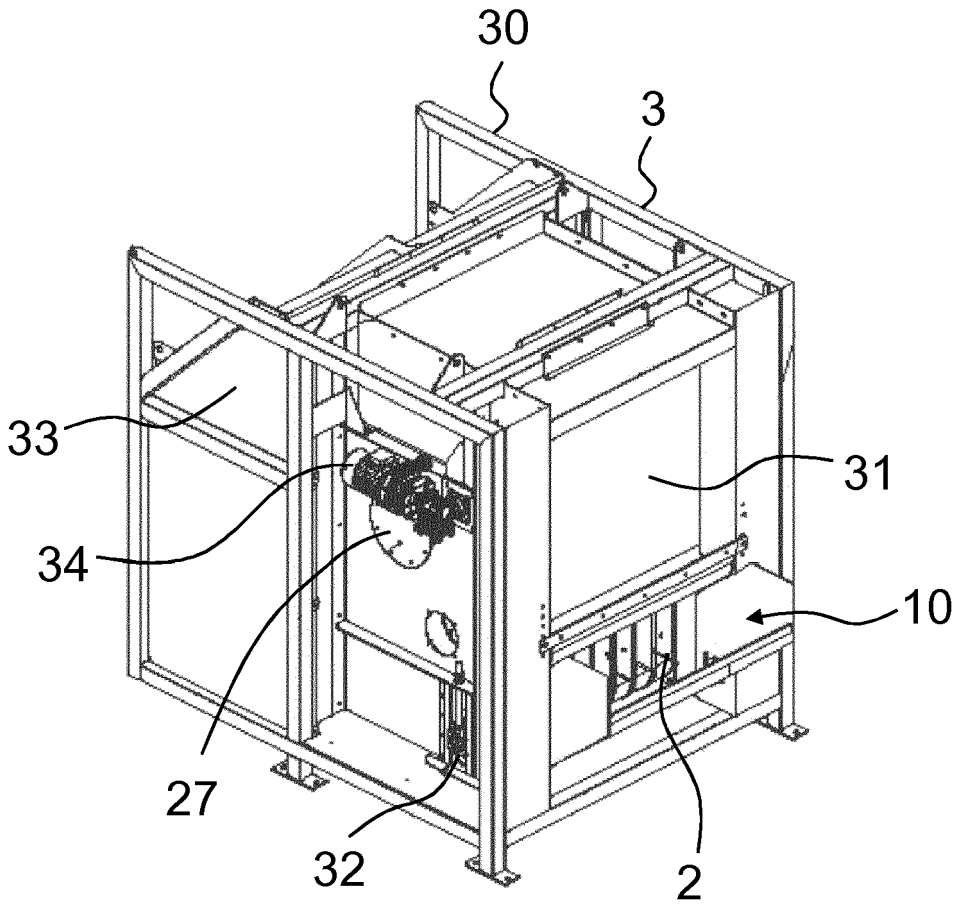

Fig. 4

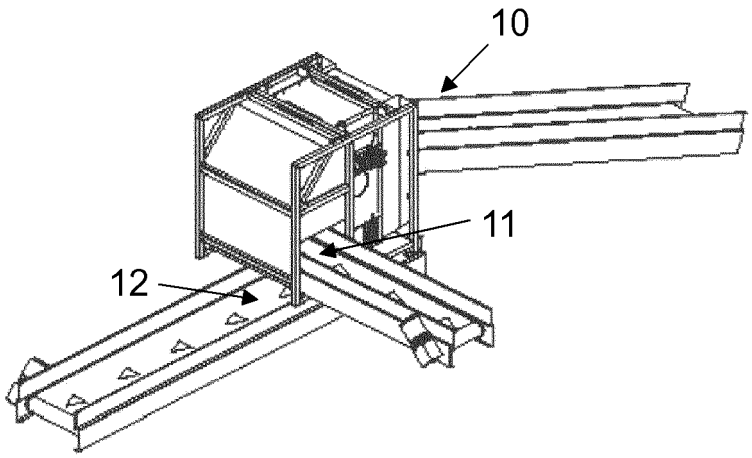

Fig. 5

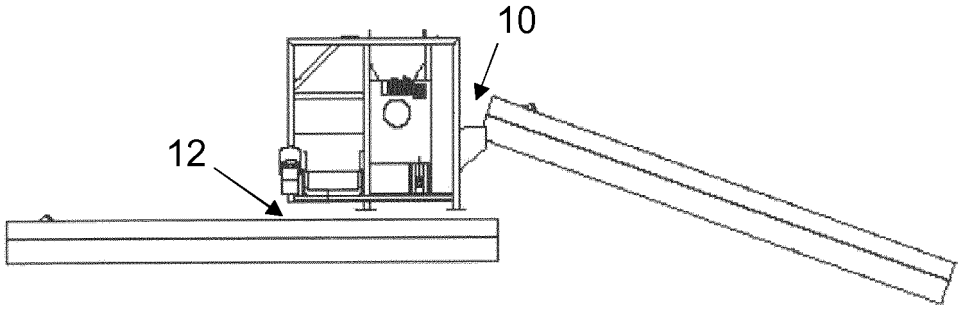

Fig. 6

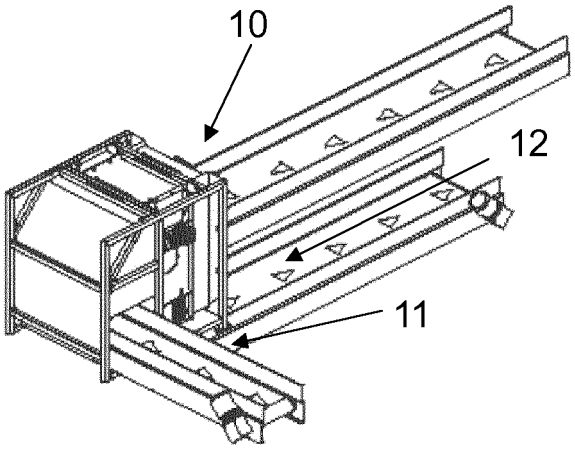

Fig. 7

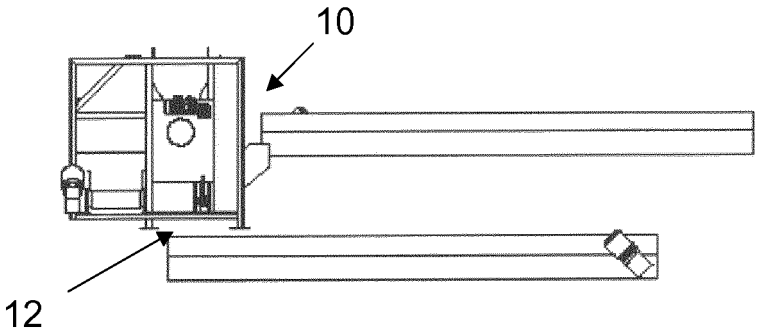

Fig. 8

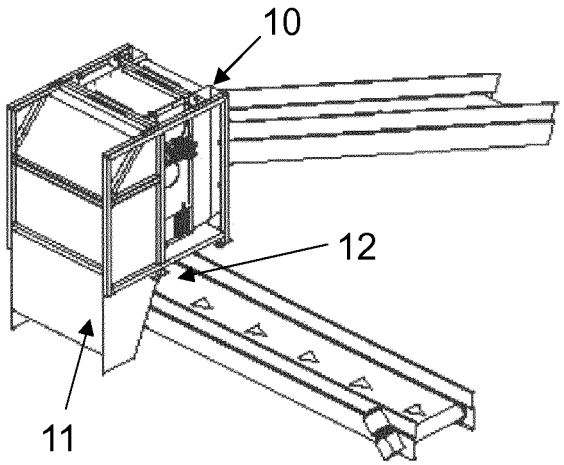

Fig. 9

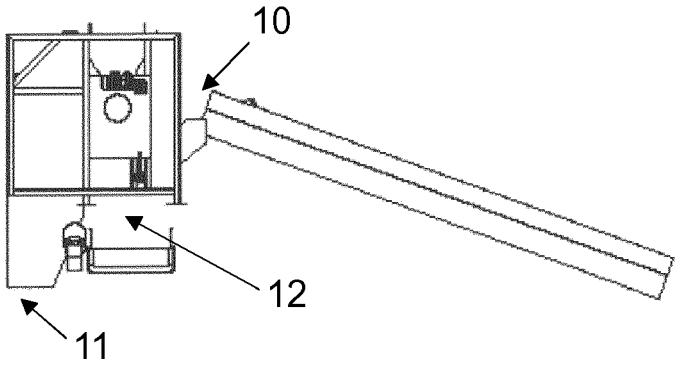

Fig. 10

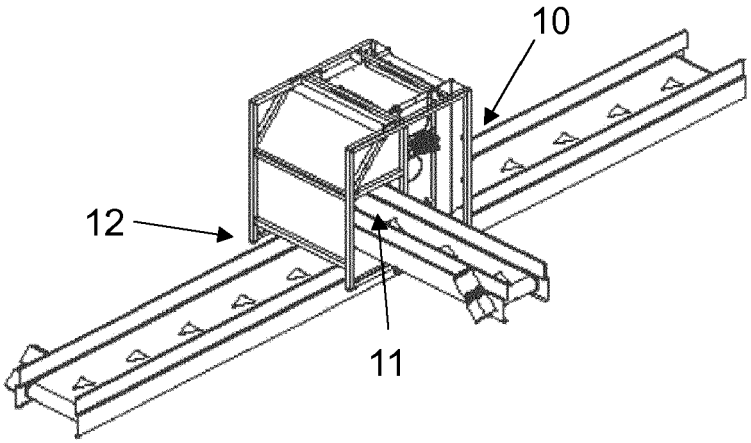

Fig. 11

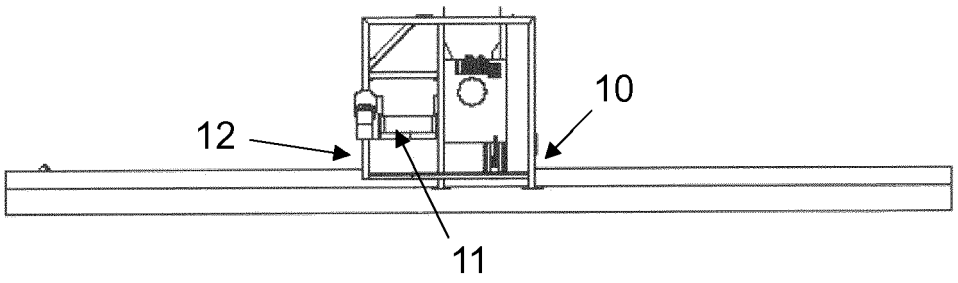

Fig. 12

Europäisches Patentamt
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EUROPEAN SEARCH REPORT

Application Number
EP 15 17 9700

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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Place of search	Date of completion of the search	Examiner
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