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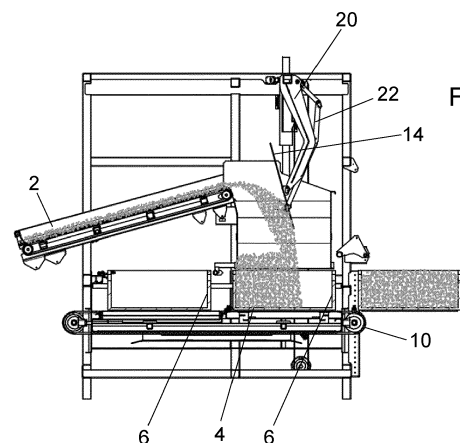
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(54) **METHOD AND A MACHINE FOR PACKING LEAFY VEGETABLES**

(57) Method for packing leafy vegetables, comprising the steps of:
 - transferring said vegetables (4) with transport means (2) in a position above at least one box (6) to be filled, placed in a filling station filling,
 - filling said box (6), through its upper opening, with said vegetables (4),
 - compacting said vegetables (4) contained in said box and replacing said filled box with another empty box for repeating the cycle,
 characterized by the fact that:
 - said vegetables (4) are thrown with horizontal component by said transport means (2) towards a deflector (14), which faces the exit of said transport means in a position above said box (6) and is configured to deflect said vegetables downwards within said box,
 - said deflector (14) is simultaneously rotated to make it distribute said vegetables (4) uniformly throughout the box (6) by one second from one wall to the opposite wall,
 - said transport means (2) stop when the predetermined quantity of vegetables (4) has been introduced into said box (4),
 - the rotation of said deflector (14) is allowed to continue until it is placed substantially parallel to the bottom of said box (6),
 - said deflector (14) is lowered towards said box (6) to compact the vegetables (4) uniformly distributed within it,

- said deflector is brought back to the initial position.



Description

[0001] The present invention relates to a method and a machine for packing leafy vegetables.

[0002] Agricultural machines are known to be positioned on the ground or on board an agricultural wagon and configured to carry out the packing of leafy vegetables, meaning by packing both the filling of crates with previously harvested vegetables and their compacting in the crates, in order to reduce its volume.

[0003] The compaction of the vegetables placed in the boxes is carried out with suitable equipment after filling them and provides that a suitable pressure organ, generally consisting of a plate just smaller than the size of the individual boxes, is made to descend on each box, already positioned in the compaction station, so as to compact the vegetables stored in the box for a predetermined duration and with the predetermined pressure. The compacting station can be the same filling station or a different station, in which the boxes coming from a filling station are sent.

[0004] These packing and compacting operations are more frequently carried out on the vegetable harvesting field, even if sometimes they can be carried out in a warehouse, where vegetables previously harvested in the field have been transported.

[0005] In the particular case of packing in the field, this operation is carried out before transporting the filled boxes to the storage and/or marketing place, which can be located hundreds of kilometers away from the collection site. Indeed, in this regard it is already known to subject the packed and compacted vegetables to cooling to a temperature of about 3-5°C in order to keep them in a suitable environment and avoid their deterioration, which is all the more frequent and rapid the more critical are the external environmental conditions.

[0006] Generally this cooling can be done before transport begins or even during transport.

[0007] A drawback of these known packing equipment consists in the fact that the filling of each box takes place by dropping the vegetables from a dispensing or filling member, which is fixed with respect to the box, and this entails a non-uniform filling of the box following the creation of a sort of cone sloping down from the center of the box towards its side walls. It follows that the subsequent compacting of the vegetables within the box leads to the formation of a layer with a substantially uniform thickness but with a non-uniform density and more precisely with a higher density in the center and less high towards the vertical walls of the box; this results in inadequate storage conditions for dedicated products such as leafy vegetables.

[0008] To this drawback is added another even more serious drawback, which consists in the different cooling conditions to which the compacted vegetables are subjected. In particular, vacuum cooling is effective if the vegetables are distributed and compacted evenly, but does not ensure reliable storage of the vegetables in the

presence of differently compacted areas.

[0009] Another drawback is linked to the fact that standardized boxes with a different conformation from those of the previous standards have been proposed for some time. In particular, while the boxes of the previous standards had rounded vertical edges, the current ones have a perfectly parallelepiped conformation with sharp vertical edges. If on the one hand this has the function of increasing the capacity of the box, on the other hand it has proved to be a trick of limited effectiveness, since the vegetables are always placed in the box in a central position and only partially manage to reach the vertical edges of the latter.

[0010] US 2007/062159 describes a method and an apparatus for packing leafy vegetables and provides for the use of a support structure of one or two pressers articulated with one side to the structure itself and associated with corresponding actuators that control the movement of the presser between an upturned position, which leaves the upper opening of the box free for it to be filled by gravity with leafy vegetables in such quantity as to exceed the upper edge of the box itself, and a substantially horizontal crushing position vegetables until they are arranged flush with that edge. However, this solution does not eliminate the drawback of a non-uniform compaction of the vegetables within the box and their consequent cooling in the packed condition; and moreover it does not ensure a complete compaction of the vegetables inside the box, since the extremely soft nature of these would require the presser not to stop at the upper edge of this but to go down inside it.

[0011] The object of the invention is to eliminate all the drawbacks which jointly or separately are recognizable in the state of the art.

[0012] In particular, the object of the invention is to propose a method and a machine which ensure uniform filling of the boxes in machines for packing leafy vegetables.

[0013] Another object of the invention is to propose a method and a machine which, in addition to ensuring correct and uniform filling of the boxes, ensure correct compaction of the leafy vegetables with which the boxes have been filled.

[0014] Another object of the invention is to propose a method and a machine which carry out the filling of the boxes with leafy vegetables in a simple and rapid manner and the subsequent compaction.

[0015] Another object of the invention is to propose a method and a machine which arrange the compacted vegetables inside the boxes so as to ensure their regular and effective vacuum cooling.

[0016] Another object of the invention is to propose a method and a machine which combine the advantages of a simplicity of construction with the advantages of a reliable operation.

[0017] According to the invention, all these objects and others which will result from the following description are achieved jointly or separately with a method for packing leafy vegetables as defined in claim 1 and with a machine

as defined in claim 5.

[0018] The present invention is hereinafter further clarified in some of its preferred embodiments reported for purely illustrative and non-limiting purposes with reference to the attached tables of drawings, in which:

- figure 1 shows a general perspective view of a multiple machine for packing in the field of leaf vegetables,
- figure 2 shows it in front view,
- figure 3 shows it in side view in the initial phase of filling a box with vegetables,
- figure 4 shows it in side view in an intermediate phase of filling the box,
- figure 5 shows it in a side view in the final stage of filling the box,
- figure 6 shows a side view with the box filled waiting for the compaction of the vegetables,
- figure 7 shows it in the final phase of compaction of the vegetables, and
- figure 8 shows it in a side view in the phase that precedes the repetition of the operating cycle on a new box.

[0019] As can be seen from the figures, the apparatus according to the invention is intended for packing various types of leafy vegetables, and in particular for collecting salad, radicchio, parsley, spinach, chicory, chard, etc. It can be placed in a warehouse, to which the leafy vegetables collected in the cultivation fields are sent or it can be mounted on a wagon advanced in the cultivation field together with a traditional machine for harvesting vegetables, so that the collection of the latter can take place in the field immediately after their collection.

[0020] In both uses, the machine is advantageously provided with a conveyor belt 2 for the leafy vegetables 4 to be packed. This conveyor belt 2 has the function of bringing the leafy vegetables 4 to a position above the individual boxes 6 to be filled, and then making them fall into the latter.

[0021] In the example shown, the conveyor belt 2 has a width suitable for operating simultaneously on three side-by-side boxes 6, which are fed by means of a transverse conveyor belt 8 or a roller conveyor in a waiting station, adjacent to the filling station, to then be transferred to the filling station itself with a second longitudinal conveyor belt 10 or with a roller conveyor, which also removes the filled and compacted boxes from the filling station to make way for new empty boxes.

[0022] The feeding of the empty boxes to the filling station and the removal of the filled and compacted boxes from the compacting station is preferably carried out automatically on the basis of an operating program which is not described as it is traditional in itself.

[0023] In fig. 1 schematically indicated an empty box 6 which protrudes laterally from the machine as it is about to enter the waiting station and three filled and compacted boxes, which have left the filling station and must be re-

moved to be taken to the storage or shipping area.

[0024] The arrangement of the various parts of the machine and the operating parameters of the same are such that at the predicted working speed of the belt 2, which transports the vegetables 4, these are thrown with a certain horizontal component of speed into the boxes 6 waiting in the filling station.

[0025] In order to ensure the correct filling of the side-by-side boxes 6 with the vegetables 4 and to prevent even a small part of these from falling out of the same, it is provided that containment baffles 12 are arranged above these which delimit laterally and frontally the space above each box 6 and ensure that the vegetables 4 fall precisely within these.

[0026] The machine according to the invention also comprises, in a position above each box 6, and more particularly in a position delimited laterally by two adjacent partitions 12, a motorized deflector element 14 better described below. In the exemplified case of a collection machine configured to simultaneously fill three boxes 6 side by side, the machine according to the invention provides three deflectors 14 side by side.

[0027] Each deflector 14 is mounted together with the others on a single support structure 16, driven in its vertical movements along the frame 18 of the machine by traditional actuators, preferably constituted by motors and belts or by pneumatic jacks.

[0028] Furthermore, each deflector 14, which in practice can consist of a substantially rigid rectangular plate of plastic or metal material or also of an inflatable cushion filled with air and applied to a substantially rigid rectangular plate of plastic or metal material, has a shape similar to the plan form of the boxes 6 and slightly smaller dimensions than the latter and is articulated in a central position to support arms 20, in turn fixed to the structure 16, and, in a position shifted towards a smaller side, to movement arms 22, which cause the rotation of the deflectors 14 around the axes of articulation to the support arms 20.

[0029] The actuators, which cause the vertical movements of the support structure 16 along the frame 18 of the machine, and the actuators, which move the arms 22 and therefore cause the rotations of the deflectors 14 are traditional in themselves, and are not further described here.

[0030] In the filling station of the boxes 6 there are sensors, preferably consisting of load cells which detect the weight of the individual boxes 6 during the filling phase and are connected to a control unit (not shown), which supervises the operation of the machine and that coordinates the interventions of the various components of the latter. In a particular embodiment load cells can be advantageously provided which detect the weight of a single box 6, on the assumption that all the boxes are filled substantially in a manner not very different from each other. In this case, the signal generated by those load cells is used to operate the movement arms 22 of the various deflectors 14 in synchronism.

[0031] In a different embodiment, load cells are provided for each box 6 and the possibility of operating in rotation of the various deflectors 14 independently, in accordance with the degree of filling of the individual boxes 6.

[0032] The operation of the machine according to the invention is now described starting from the beginning of the phase of filling the boxes 6 placed in the filling and compacting station in front and at a lower level than the unloading end of the conveyor belt 2.

[0033] At that moment the conveyor belt 2 is in operation and its speed is defined so that when the vegetables 4 leave its downstream end they are equipped with a speed having a horizontal component sufficient to reach the deflectors 14, which at this instant are inclined so that the vegetables impact on them and are diverted from them into the underlying crates 6 to reach their internal area delimited by the transverse wall closest to the conveyor belt 2 (fig. 3).

[0034] As new vegetables 4 are thrown from the conveyor belt 2 against the deflectors 14, these are automatically made to rotate slowly with continuity so as to progressively deviate the vegetables themselves towards areas of the boxes 6 placed more and more downstream, until they reach the wall opposite transversal wall, that is the transversal wall furthest away from the conveyor belt 2, thus ensuring regular and uniform filling of the same (fig. 4).

[0035] In this phase the rotation speed of each deflector 14 is regulated by the control unit according to the signals coming from the load cells positioned in the filling station below the various boxes 6, so as to ensure the correct and uniform filling of each box.

[0036] When the deflectors 14 have reached their most deviated position with respect to the initial position (fig. 5), the load cells detect the weight of the respective boxes and transmit corresponding signals to the control unit of the machine, which stops the conveyor belt 2 for prevent the throwing of further vegetables, and indeed reverses their movement for a short moment, to move the vegetables away from its front end and prevent their further unwanted fall from it, and at the same time continue the rotation of the deflectors 14 until these are arranged horizontally (fig. 6). The operating program of the machine can provide that the filling of each box 6 requires a single pass of the deflector 14, or, if in particular the leafy vegetables have small dimensions, several passes of the deflector 14 in either direction.

[0037] In any case, when each box has been completely filled, the actuators which cause the rotation of the deflectors 14 are stopped and the actuators which cause the descent of the support structure 16 along the frame 18 of the machine are controlled, so that each deflector 14 can descend on the underlying box 6 to carry out the compaction of the vegetables 4, which he had previously distributed in it (fig. 7).

[0038] The compaction of the vegetables 4 within the respective boxes 6 is carried out in a manner linked to

the nature of the vegetables themselves, but in general it provides that each deflector 14 can enter the respective box 6 and that is to say that it can descend beyond the upper edge of the latter up to a predetermined level. To this end, the dimensions of each deflector are smaller than the dimensions of the boxes 6 sufficiently not only to ensure the descent of the deflector 14 into the relative box 6, but to prevent damage to the vegetables 4 which are located between the edge of the deflector and the walls of the box.

[0039] Once this compaction has been carried out with predetermined methods both in intensity and in duration, the control unit commands the upward movement of the deflectors 14 (fig. 8) and their rotation so as to make them resume their initial position (fig. 3) before restarting the conveyor belt 2 for repeating the cycle in the manner already described.

[0040] Basically, the apparatus according to the invention provides for the use of the members, which in the equipment according to US 2007/062159, are limited to partially compacting the vegetables 4, both to perform the same compaction in a more complete and effective way, and also to perform a new function, which consists in dynamically diverting the vegetables 4, which leave the conveyor belt 2, and in distributing them uniformly inside the boxes 6, before carrying out on them, thus distributed, the compaction function.

[0041] This ensures a more complete and regular filling of the boxes, a uniform density of the vegetables within the boxes both before and after their compaction, and essentially their predisposition for a more regular and effective cooling, for the benefit of their conservation in optimal conditions and for longer times.

[0042] In an embodiment of the invention it is provided that the various intervention phases of the deflectors are distinct from each other and take place in sequence, but in a different embodiment it is also possible that they occur in partial overlap, in the sense that for example the rotation and raising/lowering of the deflectors can be carried out simultaneously with an evident reduction in the execution time of the entire cycle.

Claims

1. Method for packing leafy vegetables, comprising the steps of:

- transferring said vegetables (4) with transport means (2) in a position above at least one box (6) to be filled, placed in a filling station filling,
- filling said box (6), through its upper opening, with said vegetables (4),
- compacting said vegetables (4) contained in said box and replacing said filled box with another empty box for repeating the cycle,

characterized by the fact that:

- said vegetables (4) are thrown with horizontal component by said transport means (2) towards a deflector (14), which faces the exit of said transport means in a position above said box (6) and is configured to deflect said vegetables downwards within said box,
 - said deflector (14) is simultaneously rotated to make it distribute said vegetables (4) uniformly throughout the box (6) by one second from one wall to the opposite wall,
 - said transport means (2) stop when the predetermined quantity of vegetables (4) has been introduced into said box (4),
 - the rotation of said deflector (14) is allowed to continue until it is placed substantially parallel to the bottom of said box (6),
 - said deflector (14) is lowered towards said box (6) to compact the vegetables (4) uniformly distributed within it,
 - said deflector is brought back to the initial position.
2. Method according to claim 1 **characterized in that** it carries out the filling of said box (6) with a single pass of said deflector (14).
 3. Method according to one or more of the preceding claims **characterized in that** after stopping said transport means (2) a brief inversion of their movement is caused.
 4. Method according to claim 2, **characterized in that** a single conveyor belt (2) is used as the means of transport, having a width substantially multiple of the width of the individual boxes (6) to be filled at the same time, and a plurality of deflectors (14) are used, each operating on a box.
 5. Method according to one or more of the preceding claims **characterized in that** the weight of at least one box (6) is detected during its filling and the weight data thus detected are used to control the rotation movement of the overlying deflector (14) .
 6. Method according to claim 5 **characterized in that** the weight of at least one box (6) is measured with load cells positioned in said filling station below said box.
 7. Method according to one or more of the preceding claims, **characterized in that** the rotation of said deflector (14) and its vertical movement are simultaneously controlled in the intermediate operating phases between successive filling and compacting phases.
 8. Method according to one or more of the preceding claims, **characterized in that** during the compacting

of the pre-existing vegetables poured into each box (6) the entry of said deflector (14) into said box is caused.

9. Machine for packing leafy vegetables (4) **characterized in that** it comprises:

- means of transport (2) of said vegetables (4) at a height greater than the positioning height of at least one box (6) placed in a filling station,
- at least one deflector (14) facing the outlet of said transport means (2) to divert the flow of vegetables (4) coming from said transport means (2) towards said box (6), said deflector (14) having a shape similar to the bottom of said box and slightly smaller than said bottom,
- at least one actuator for the rotation of said deflector (14) around an axis which is substantially horizontal and transversal with respect to the direction of movement of said vegetables (14),
- at least one actuator for the downward translational movement of said deflector (14), which at least in the lower portion of its stroke is arranged parallel to the bottom of said box (6), towards the box itself, to compact the vegetables present in it, and for the upward translation movement, at the end of the compaction, to leave the box free and allow it to be replaced with another empty box,
- a control unit that supervises the operation of the machine and coordinates the activation of said transport means and the rotation and/or translation movements of said deflector (14) in the sense that:

- when the transport means (2) of the vegetables (4) are activated, said deflector so as to continuously deviate downwards the flow of vegetables that run over it to distribute them uniformly over the entire box (6) from one wall to the opposite wall,
- when the box has reached the predetermined degree of filling, it is deactivate said transport means (2) but the rotation movement of said deflector (14) is continued until it reaches the substantially horizontal configuration, and subsequently or simultaneously its descent towards said box (6) is also commanded to cause the compaction of said vegetables (4) with predetermined modalities of entity, duration and intensity,
- when the compaction of the vegetables is completed, the deflector (14) is raised and it rotates to make it resume its initial position and furthermore the activation of the means of transport (2) of the vegetables (4) is again commanded.

10. Machine according to claim 9 **characterized in that** said transport means comprise a single conveyor belt (2), which has a width substantially multiple of the width of said box (6) and is configured to simultaneously feed several boxes arranged side by side in said box filling station and each topped by a deflector (14). 5
11. Machine according to claim 9 **characterized in that** it comprises in the filling station a plurality of partitions (12) for delimiting the individual spaces above said boxes (6) and for containing the vegetables (4) intended to fill them. 10
12. Machine according to one or more of claims 9 to 11 **characterized in that** each deflector (14) has an air cushion applied to the surface intended to compact said vegetables (4). 15
13. Machine according to one or more of claims 9 to 12 **characterized in that** it comprises at least one sensor configured to detect the weight of said box and to supply a corresponding signal to said control unit for controlling the movements of said deflector. 20
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14. Machine according to one or more of claims 9 to 13 **characterized in that** it comprises a plurality of sensors associated with the individual boxes (6) and configured to detect the weight of these and to supply corresponding signals to the control unit for the command movement of the respective deflectors (14). 30
15. Machine according to one or more of claims 9 to 14 **characterized in that** said sensors consist of load cells positioned at the filling station of said boxes (6) below them. 35

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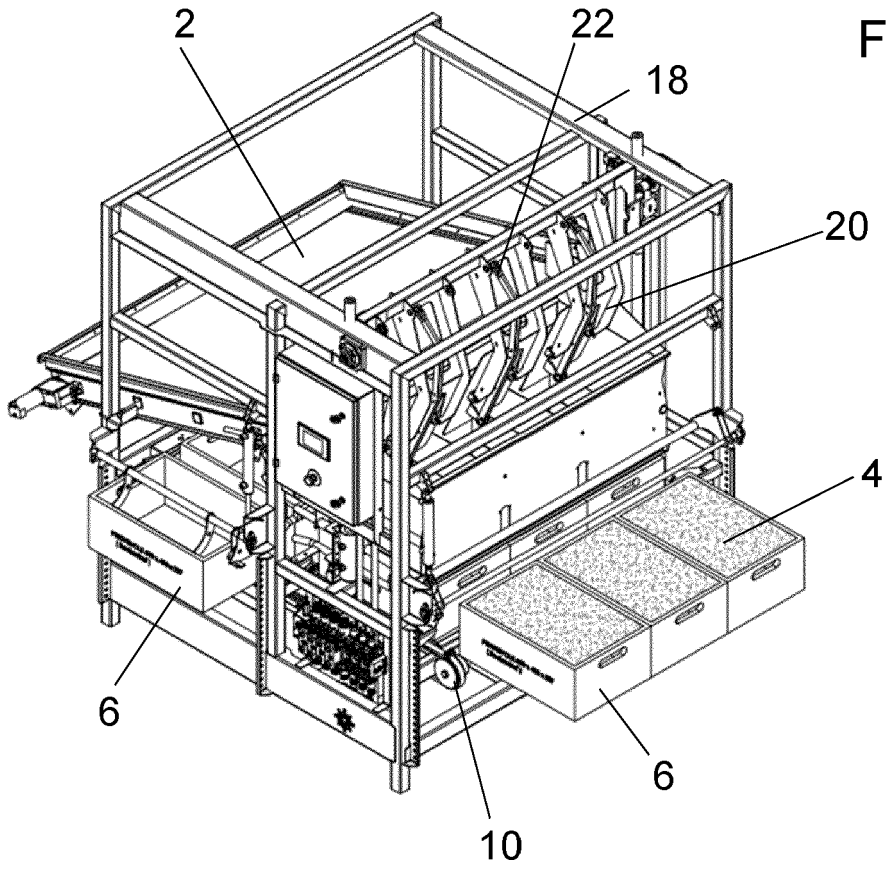


FIG. 1

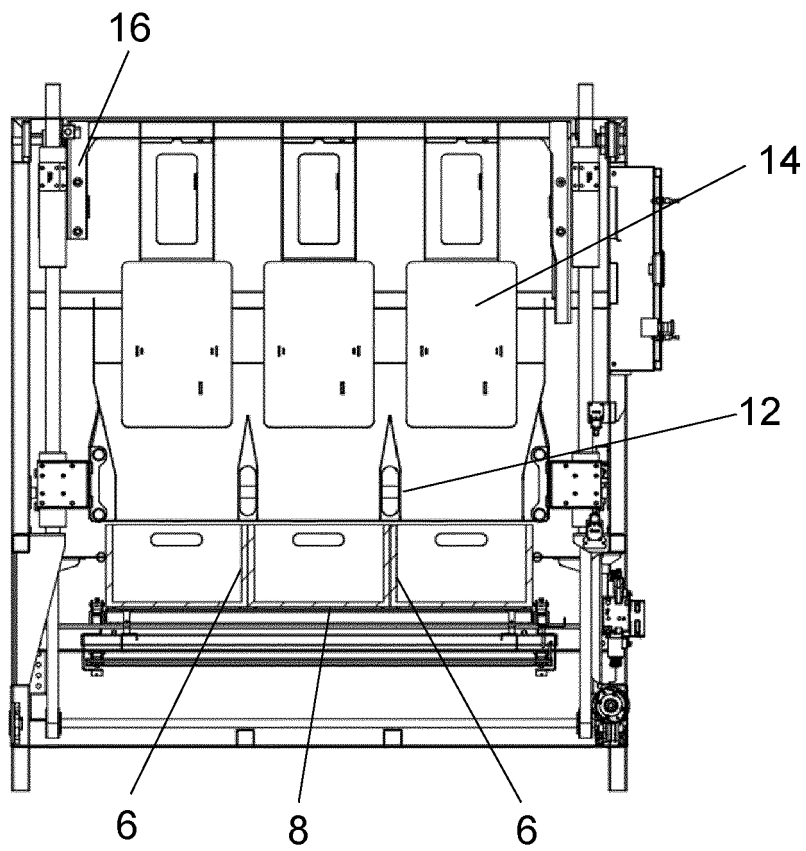


FIG. 2

FIG. 3

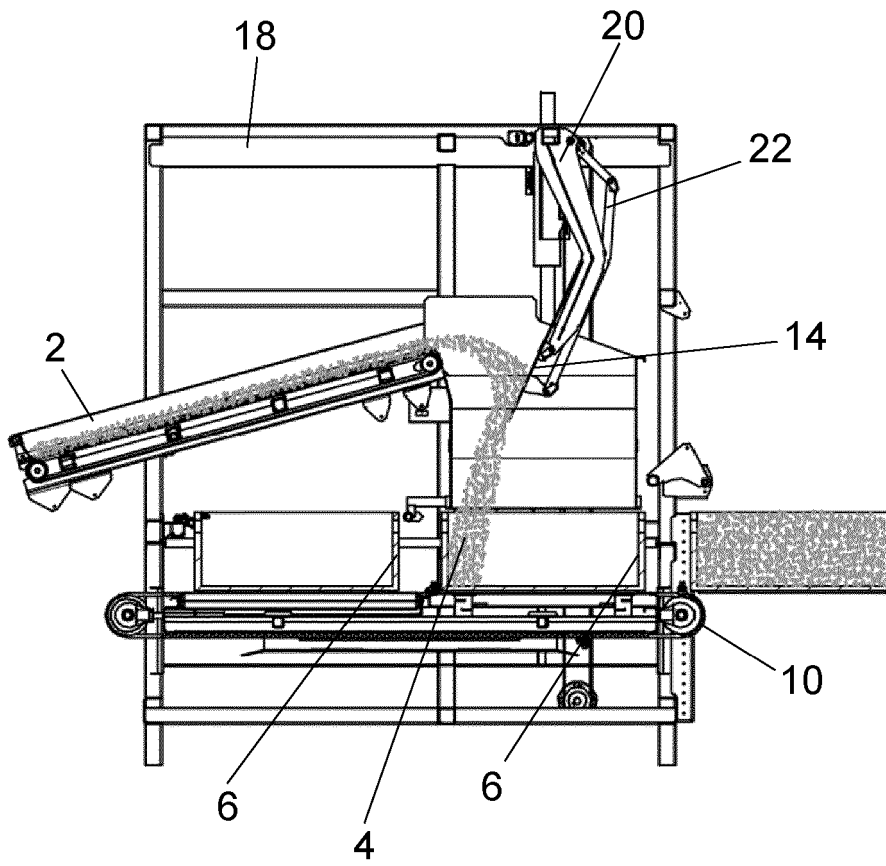


FIG. 4

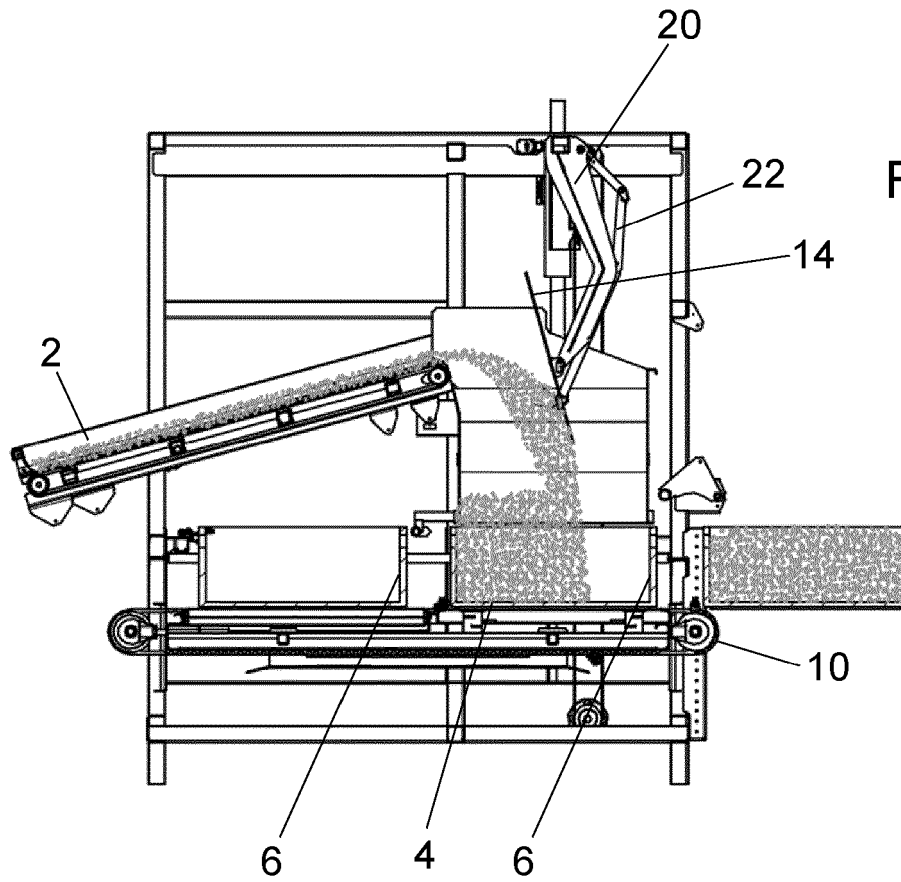


FIG. 5

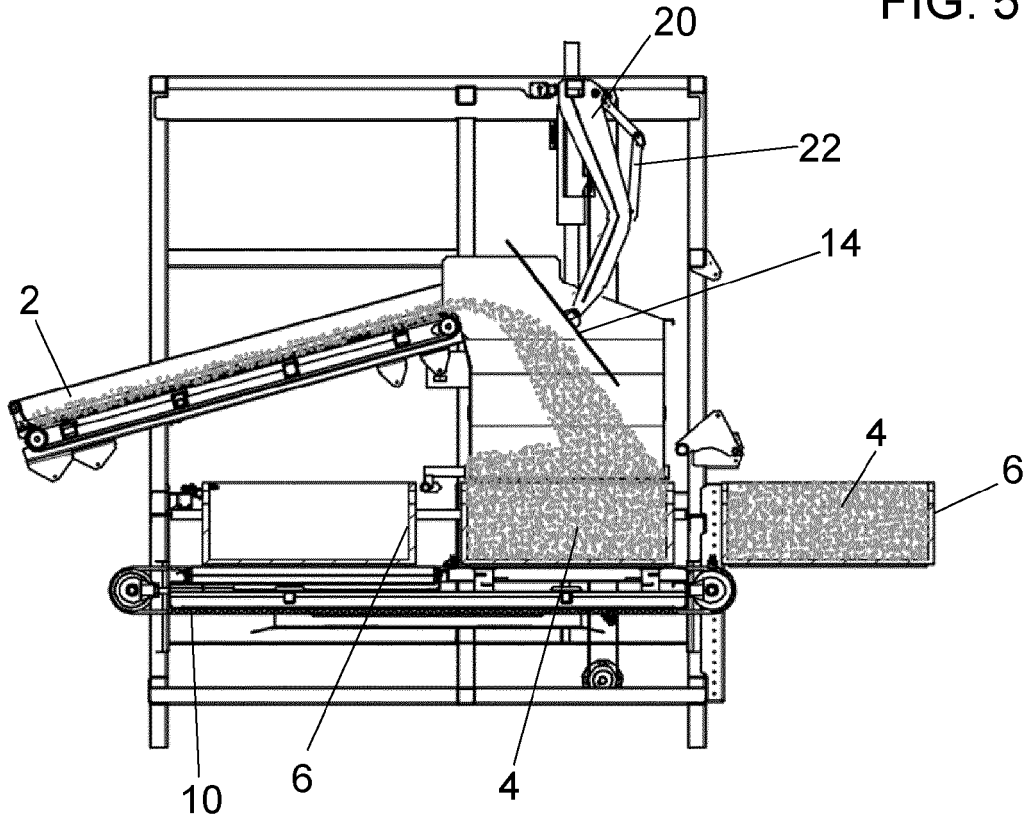
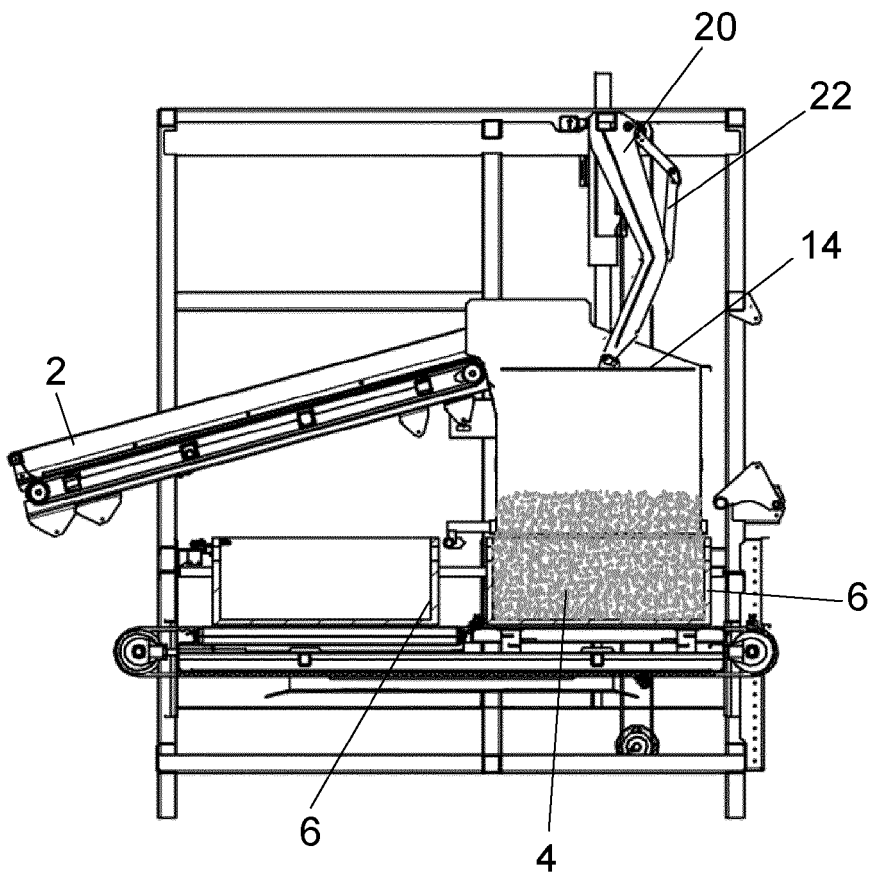


FIG. 6



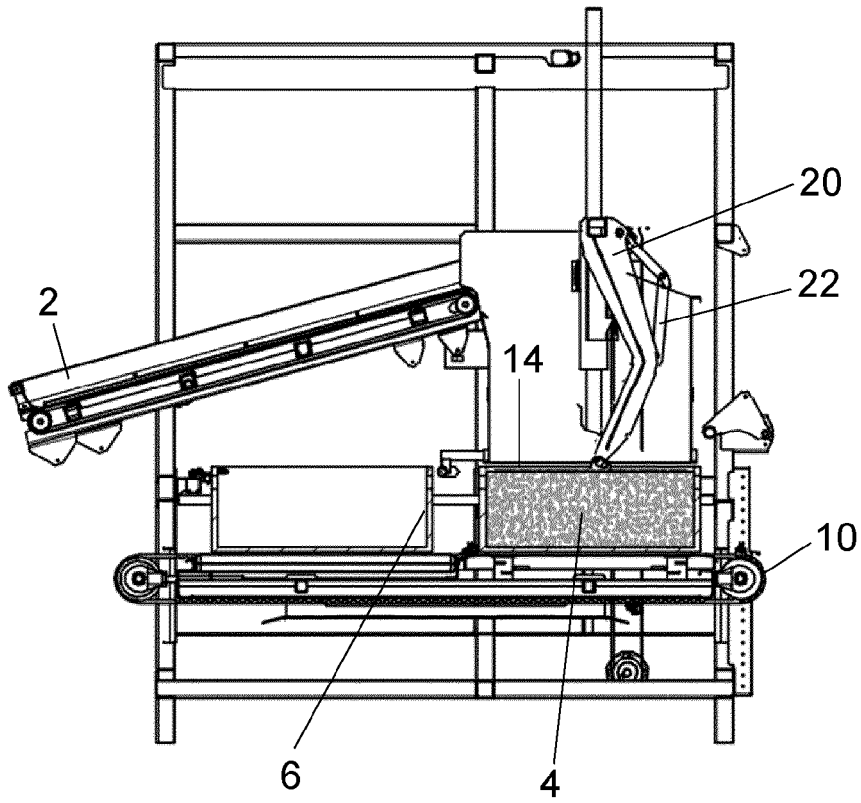


FIG. 7

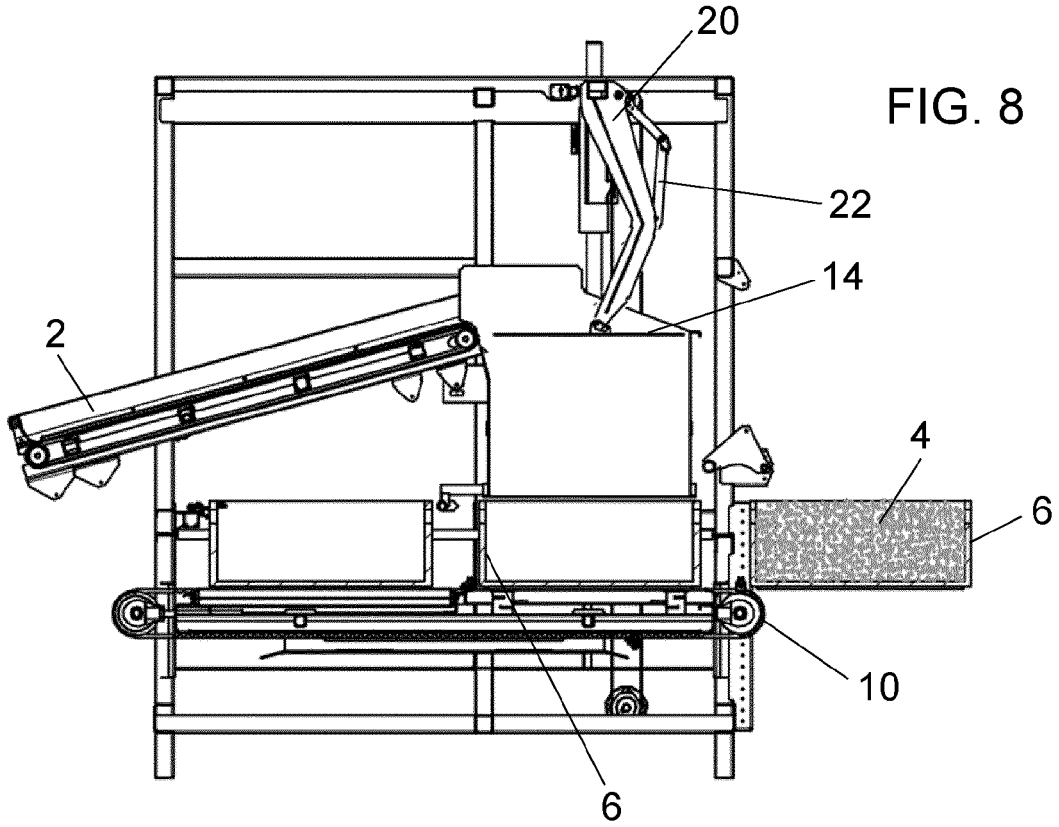


FIG. 8



EUROPEAN SEARCH REPORT

Application Number

EP 22 16 0279

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The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 29 July 2022	Examiner Dick, Birgit
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