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(54) **MACHINE FOR EMPTYING SACKS CONTAINING POWDER OR GRANULAR MATERIAL**

(57) The machine for emptying sacks (1) comprises, by known means: one picker and handling unit (10), able to take at least one sack (S) from a feed station (2); one cutter unit (30), operating in a sack-emptying station (3) situated downstream of the feed station (2), for slitting the sack (S) in transit; means for collecting the product (31), situated in the sack-emptying station (3), that receive the powder or granular material coming out of the cut sack (S); means (40) for receiving and removing the empty sacks (S), situated in a sack-ejection station (4).

According to the invention, the picker and handling unit (10) comprises: one carriage (11), moving horizontally forward (F) and backward (R) between the stations

(4, 3, 2); prongs (16), mounted on the carriage (11), able to pierce at least one full sack (S) present in the sack-feed station (2) during the forward travel (F) of the carriage (11), so that the sack is attached to and carried along with the carriage on its return travel (R) toward the sack-emptying station (3).

The cutter unit (30) comprises circular blades (34), set at an angle relative to the rotation axis, which slice the sack forming a cut of sinusoidal shape.

Downstream of the blades (34) are ring-shaped beaters (39), likewise angled relative to the rotation axis, that strike the sack along a sinusoidal pattern.

This ensures that the sack (S) is fully emptied.

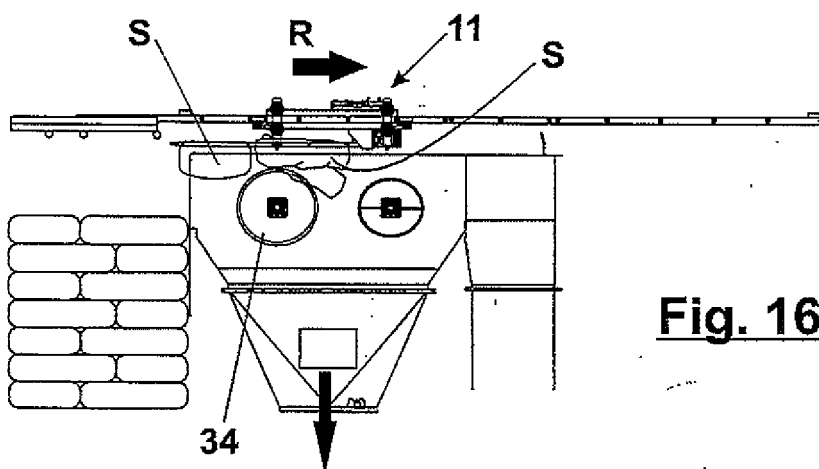


Fig. 16

Description

[0001] The invention falls within the technical sector of automatic machines for emptying sacks.

[0002] It pertains more specifically, though not exclusively, to sacks filled with raw materials in granule or powder form, and comparable in shape, dimensions and weight to ordinary cement sacks.

[0003] The sacks in question can be made of paper, polythene paper, polythene, polypropylene raffia or the like, but in any case of flexible, thin materials that can be cut with relative ease.

[0004] The sacks preferably have a flattened rectangular shape, which is optimal for stacking them on pallets.

[0005] Such sacks often contain materials that must be continuously fed into production machines, for the most disparate purposes. This makes it necessary to install, upstream of those machines, automated equipment for opening the sacks and conveying the contents into a feed line to the production machine.

[0006] In some known solutions, the palletized sacks are retrieved singly by an operator or by an anthropomorphic robot. In the former case, they are cut or broken open manually by the operator. In the latter case they are sliced by fixed blades mounted on the emptying hopper.

[0007] An alternative solution is for the sacks to be taken from the stack one layer at a time, using a system of multiple hooks that are mechanically or pneumatically actuated. The hooked sacks are then conveyed through sets of circular blades arranged vertically along planes parallel to the transit direction of the sacks. The blades rotate continuously, in such a way as to slice the lower portion of the sacks. The partially emptied sacks are then deposited on a beater table to ensure they are fully emptied.

[0008] The known emptying solutions described above present some drawbacks. In particular, the systems for hooking the sacks are complex to construct, somewhat bulky, and not always reliable.

[0009] Moreover, the hooking systems can be particularly costly and complex to maintain.

[0010] A further drawback is that the conventional solutions for automated cutting of the sacks do not always guarantee complete emptying of the sacks, owing to the straight shape of the cuts. As a result, especially when the material to unload is tightly packed, for example owing to residual moisture, part of the material may fail to drop out of the sacks and into the collection hopper.

[0011] This is a frequent occurrence especially for fine-powder materials, which can more easily become compacted and tightly packed.

[0012] The principal purpose of this invention is to construct a machine for emptying sacks containing powder or granular material that, starting from conventionally stacked and palletized sacks, which are therefore easily handled with fork lifts, in a quick and simple automated fashion picks up one layer at a time, then slices it and

empties it completely, before going on to process another layer.

[0013] Another purpose of the invention is to provide a sack-emptying machine of innovative design that provides superior functionality compared to the known solutions described previously.

[0014] A further purpose of the invention is to provide a highly effective sack cutter design that guarantees fast and complete emptying of materials in powder or granule form.

[0015] A further purpose of the invention is to provide a sack-emptying machine that is more reliable less costly than the known solutions described previously.

[0016] A further purpose of the invention is to provide a machine that is compact and relatively lightweight, in accordance with the preferred technical solution of handling and processing an entire sack layer at a time, rather than individual sacks, thereby notably increasing the throughput capacity of the system, and leaving less product residues inside the cut sacks.

[0017] These and other purposes are fully attained by a machine for emptying sacks containing powder or granular material, of a type that comprises: one picker and handling unit, able to take at least one sack from a feed station of full sacks; one cutter unit, operating in a sack-emptying station situated downstream of the feed station, for slitting the sack carried by the picker and handling unit; means for collecting the product, situated in the sack-emptying station underneath the cutter unit, that receive the powder or granular material falling by gravity out of the previously-cut sack, to convey the material towards a transfer line; means for receiving and removing the empty sacks, situated in a sack-ejection station, where the machine is equipped with a picker and handling unit that comprises:

- one carriage, moving horizontally along a guideway located above the emptying and ejection stations, actuated so that it travels forward and back between the sack-ejection station and the sack-feed station, passing through the sack-emptying station.
- prongs, mounted almost horizontally on the carriage, able to pierce at least one full sack present in the sack-feed station when the carriage completes its forward travel, so that the sack is attached and carried along with the carriage on its return travel toward the sack-emptying station.

[0018] The characteristics of the invention are clearly illustrated by the following description of a preferred embodiment of this machine for emptying sacks containing powder or granular material, according to the stated claims, and with the aid of the enclosed drawings where:

- Fig. 1 provides a side view of the sack-emptying machine.
- Fig. 2 provides a plan view from the top of the machine in Fig. 1.

- Fig. 3 provides a side view of the machine in Fig. 1.
- Figs. 4, 5, 6 provide orthographic views of a picker and handling unit in the machine.
- Fig. 7 provides an axonometric view of the same picker and handling unit.
- Figs. 8 and 9 provide two orthographic views of a cutter unit in the machine.
- Figs. 10 and 11 provide two orthographic views of a beater unit in the machine.
- Figs. 12 to 19 illustrate the sequence of operational steps of the machine.

[0019] In the above figures, the label 1 indicates the sack-emptying machine in its entirety.

[0020] The sacks S contain powder or granular material and have a flattened rectangular shape, optimal for stacking them on pallets P of standard type (Figs. 1, 2, 3), suitable for handling by means of lift trucks.

[0021] The figures illustrate, by way of example, a stack of sacks S where each layer of the stack is composed of five sacks S (see in particular Fig. 2). Obviously, the number of sacks S in a layer can range from a minimum of one to a certain number, depending on their size.

[0022] The sacks S are made of materials such as paper, polythene paper, polythene, polypropylene raffia or the like, but in any case of flexible, thin materials that can be sliced with relative ease.

[0023] The machine 1 comprises: one picker and handling unit 10, able to take at least one sack S from a feed station 2 of full sacks S; one cutter unit 30, operating in a sack-emptying station 3 situated downstream of the feed station 2, for slitting the sack S carried by the picker and handling unit 10; means for collecting the product 31, situated in the sack-emptying station 3, underneath the cutter unit 30, that receive the powder or granular material falling by gravity from the previously-cut sack S, to convey the material towards a transfer line (not illustrated); means 40 for receiving and removing the empty sacks S, situated in a sack-ejection station 4, installed downstream of the sack-emptying station 3.

[0024] The full-sack feed station 2 of the machine 1 is provided with elevator means 20 (Figs. 2, 3) able to support and vertically transport a pallet P of stacked sacks S, in such a way that the topmost layer of sacks S is positioned at a pre-established height.

[0025] The elevator means 20 are essentially of known type, and are not illustrated or described in detail.

[0026] In the picker and handling unit 10 of the machine 1, according to a preferred embodiment of the invention, there is a carriage 11 that travels horizontally along a guideway 12 running above the emptying 3 and ejection 4 stations, actuated by powered means (not illustrated).

[0027] The carriage 11 comprises two roller sliders 13, placed parallel to each other at a pre-established distance, advantageously greater than the corresponding dimension of a layer of sacks S on the pallet P, and attached to each other by a frame 14 (Figs 4 to 7).

[0028] The roller sliders 13 move along corresponding

linear rails 15 that make up the guideway 12, fixed to the frame of the machine 1, and whose length enables the carriage 11 to complete forward F and return R travel between the sack-ejection station 4 and the sack-feed station 2, passing through the sack-emptying station 3 (Figs 12 to 19).

[0029] In the middle portion of the frame 14 are mounted prongs 16 extending outward in a near-horizontal direction (Figs. 4 to 7) from the front of the carriage 11, able to pierce at least one filled sack S at the top of the stack in the sack-feed station 2, when the carriage 11 completes its forward travel F (Figs. 12 to 15).

[0030] According to the invention, the cutter unit 30 situated in the sack-emptying station 3 comprises at least one first shaft 32, rotated by a first actuator 33, arranged so that the horizontal axis of the shaft is perpendicular to and underneath the direction of movement of carriage 11, and a number of circular blades 34, keyed at preset distances along the first shaft 31 and set at an angle relative to the axis of this shaft (Figs. 8, 9).

[0031] As a result of this angle, during the rotation each of the circular blades 34 follows a trajectory such that the point of contact between its circumference and a tangential plane oscillates on a line parallel to the axis of the first shaft 32, with amplitude proportional to the aforesaid angle.

[0032] The first shaft 32 with the circular blades 34 is supported by the walls 35 of the machine 1 (Figs. 1, 2) which also contain and direct the material coming out of the sacks S toward a hopper 31 below it, of conventional type, which constitutes the product collection means.

[0033] The hopper 31 is intended for unloading the product onto a conveyor underneath, which is not shown.

[0034] In the sack emptying station 3, next to the cutter unit 30, downstream of it according to the return travel R of the carriage 11, there is a beater unit 36 comprising at least one second shaft 37, rotated by a second actuator 38, arranged with its horizontal axis perpendicular to the direction of movement of the carriage 11 and underneath it, and a number of beater elements 39 keyed at preset distances along the second shaft 37 and projecting radially from it.

[0035] The second shaft 37 is, for example, arranged parallel to the first shaft 32 and supported by the same walls 35 (see Fig. 2 again).

[0036] In a preferred embodiment, shown in the figures, each of the beaters 39 is in the shape of a circular ring and set at an angle relative to the axis of the second shaft 37 (Figs. 10, 11).

[0037] As a result of this angle, during the rotation the ring-shaped beaters 39 describe trajectories similar to those of the circular blades 34.

[0038] Advantageously, the sack-ejection station 4 has an extractor rake 44 that intersects the prongs 16 at the end of the return travel R of the carriage 11, so as to pull the empty sack S away from the prongs and allow it to drop down into the means 40 for receiving and removing the empty sacks S.

[0039] The means 40 can consist, for example, of a vertical tube connected at its base to suction and/or grinding equipment-- not illustrated in detail here because not directly relevant to this invention.

[0040] The operation of the machine 1 is described below.

[0041] A pallet P containing a stack of filled sacks S is placed on the elevator means 20 of the feed station 2, for example using a lift truck or a transpallet, not illustrated (Fig. 12).

[0042] When the elevator means 20 move upward (U arrow in Fig. 13), the pallet P containing the stack of sacks S is lifted until the topmost layer of sacks reaches a pre-established height, such that the prongs 16 are at the requisite height relative to the topmost layer of sacks S. This height shall preferably, but not exclusively, coincide with the midpoint of the thickness of the sacks.

[0043] In a synchronised fashion, the carriage 11 completes its forward travel F so that the prongs 16, as they advance, progressively pierce the sacks S of the top layer (Fig. 14).

[0044] At this point, the elevator means 20 are actuated for a short downward travel (figure D in Fig. 15) so that the stack of sacks S in the pallet is separated from the topmost layer of sacks S pierced by the prongs 16, allowing the pierced sacks to be carried along by the carriage 11 during its return travel R, without the friction of the sacks S underneath impeding their movement or causing the sacks to detach from the prongs 16.

[0045] The sacks S carried by carriage 11, during the return travel R, are progressively carried through the rotating circular blades 34, whose angled position slices the lowermost portion of the passing sacks S along a sinusoidal pattern which facilitates the outflow of the powder or granular material into the hopper 31 below (Fig. 16).

[0046] Immediately after, the same sacks S are carried through the ring-shaped beaters 39, which are likewise rotationally actuated to beat the sliced, lowermost portion of the passing sacks S, to ensure complete emptying of the powder or granular material into the hopper 31 (Fig. 17).

[0047] This beating action on the bottom of the sacks S in transit likewise advantageously follows a sinusoidal pattern.

[0048] The carriage 11 continues its return travel R with the sacks S, now completely emptied, attached to the prongs 16; the sacks S are carried to intercept the extractor rake 44, which stops them and pulls them away from the prongs 16 (Fig. 18), allowing them to drop into the tube conveyor 40 that carries them down to a position near the ground (Fig. 19).

[0049] The above description clarifies the innovative characteristics of this machine for emptying sacks: from a construction standpoint, it offers a simple and rational design, and in terms of functioning, the sequence and manner of the operational steps guarantee the utmost reliability.

[0050] An important feature of the proposed machine is its ability to operate starting from conventionally stacked and palletized sacks, which can therefore be easily handled with lift trucks; moreover, the machine is able, without any manual intervention, to pick up a layer of sacks at a time, and cut and empty it completely, in an automated, controlled and effective fashion.

[0051] A significant contribution to innovative characteristics of the machine, which ensures quick and complete emptying of both powder and granular materials, is the particular angled arrangement of the circular blades, and the similarly angled arrangement of the ring-shaped beaters.

[0052] A further advantage arises from the construction design, based on compact and relatively lightweight components, that limits the actuator power requirements and so contains production costs.

[0053] In any case, the above examples are illustrative and non-limiting. Further detail variants that may be necessary for technical and/or functional reasons shall be considered to also fall under the protection of the below claims.

Claims

- Machine for emptying sacks containing powder or granular material, that comprises: one picker and handling unit (10), able to take at least one sack (S) from a feed station (2) of full sacks (S); one cutter unit (30), operating in a sack-emptying station (3) situated downstream of the feed station (2), for slitting the sack (S) carried by the picker and handling unit (10); means for collecting the product (31), situated in the sack-emptying station (3) underneath the cutter unit (30), that receive the powder or granular material falling by gravity from the previously-cut sack (S), to convey the material towards a transfer line; means (40) for receiving and removing the empty sacks (S), situated in a sack-ejection station (4) with the picker and handling unit (10), comprising one carriage (11), moving horizontally along a guideway (12) located above the emptying (3) and ejection (4) stations, actuated so that it travels forward (F) and back (R) between the sack-ejection station (4) and the sack-feed station (2), passing through the sack-emptying station (3), **characterized by** the fact that prongs (16), mounted almost horizontally on the carriage (11), able to pierce at least one full sack (S) present in the sack-feed station (2) when the carriage (11) reaches the end of its forward travel (F), so that the sack is attached to the carriage and carried along with it on the return travel (R) toward the sack-emptying station (3).
- Machine according to claim 1, **characterized by** the fact that the sack-feed station (2) is equipped with elevator means (20) able to support and vertically

move a pallet (P) of stacked sacks (S), in such a way that the topmost sack (S) of the pile is placed at a pre-established height some time before the carriage (11) completes its forward travel (F), so that the prongs (16) are at the requisite height relative to the thickness of the sack (S).

3. Machine according to claim 1, **characterized by** the fact that the carriage (11) consists of two roller sliders (13), placed parallel to each other at a pre-established distance, greater than the corresponding dimension of the sack or sacks (S), and attached to each other by a frame (14), in the middle of which are mounted the prongs (16) with the roller sliders (13) moving along corresponding linear rails (15) that make up the guideway (12) and are fixed to the frame of the machine (1). 5 10 15
4. Machine according to claim 1, **characterized by** the fact that the cutter unit (30) comprises at least one first shaft (32) rotated by a first actuator (33), arranged so that the horizontal axis of the shaft is perpendicular to the direction of movement of the carriage (11) and underneath the sack (S) carried by the carriage during the return travel (R), and with a number of circular blades (34), keyed at preset distances along the first shaft (32) and set at an angle relative to the axis of this shaft, so that each of the blades (34) is able to intercept and slice the lower surface of the passing sack (S), forming a cut of sinusoidal shape that facilitates the outflow of the powder or granular material into the product-collection means (31) below. 20 25 30
5. Machine according to claim 1, **characterized by** the fact that the sack-emptying station (3) includes a shaker unit (36), comprising at least one second shaft (37) rotated by a second actuator (38), arranged with its horizontal axis perpendicular to the direction of movement of the carriage (11) and underneath the sack (S) carried by the carriage during the return travel (R), and a number of beater elements (39), keyed at pre-established distances along the second shaft (37) and protruding radially from it so as to intercept and beat the slit lower surface of the sack (S) in transit, and thereby cause all of the powder or granular material to fall out and into the product-collection means below (31). 35 40 45
6. Machine according to claim 5, **characterized by** the fact that each of the beater elements (39) is in the shape of a ring and positioned at an angle relative to the axis of the second shaft (37), in such a way that the beating action underneath the sack (S) follows a sinusoidal pattern. 50 55
7. Machine according to claim 6, **characterized by** the fact that the first shaft (32) with the circular blades

(34) and the second shaft (37) with the ring-shaped beaters (39) are mounted on the side walls (35) of the frame of the machine (1), which also contain and direct the material coming out of the sacks (S) toward the product-collection means underneath (31).

8. Machine according to claim 1, **characterized by** the fact that the sack-ejection station (4) has an extractor rake (44), that interacts with the prongs (16) at the end of the return travel (R) of the carriage (11), so as to pull the empty sack (S) away from the prongs and allow it to drop down into the means (40) for receiving and removing the empty sacks (S).

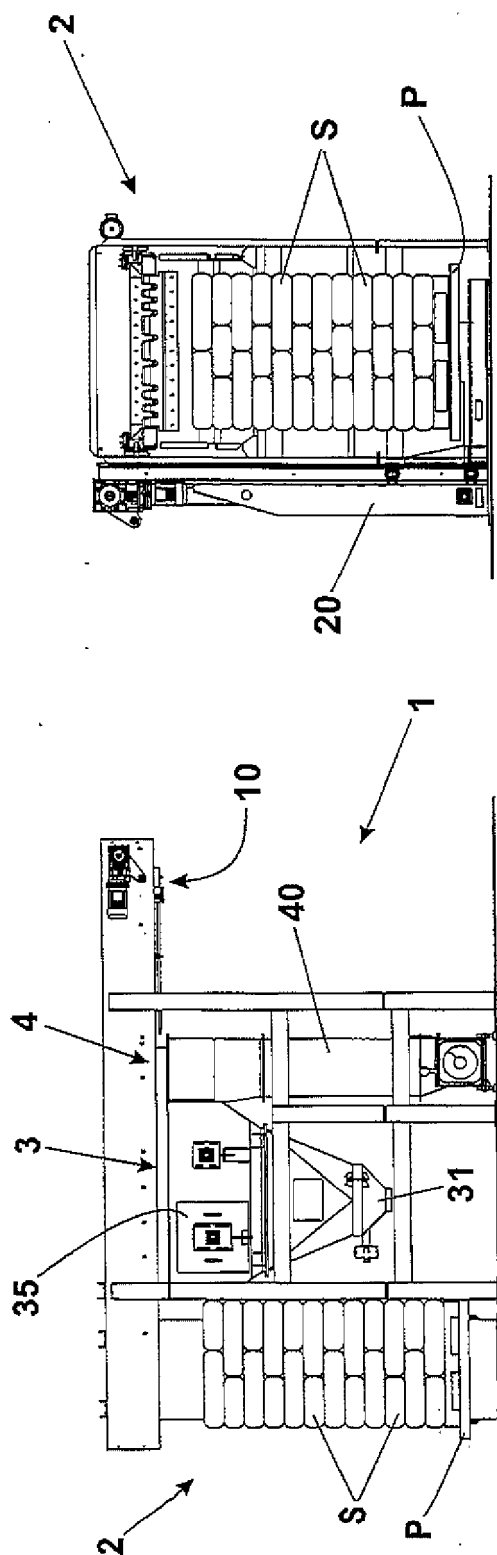


Fig. 1

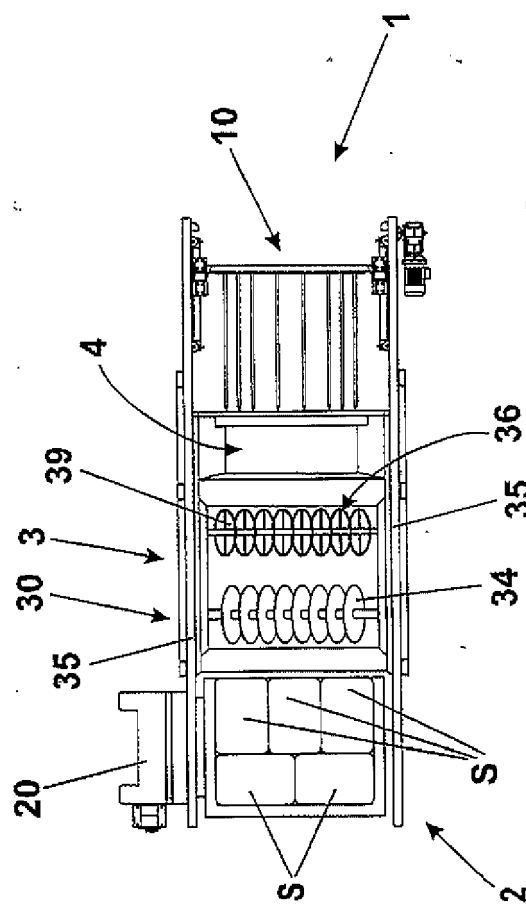


Fig. 2

Fig. 3

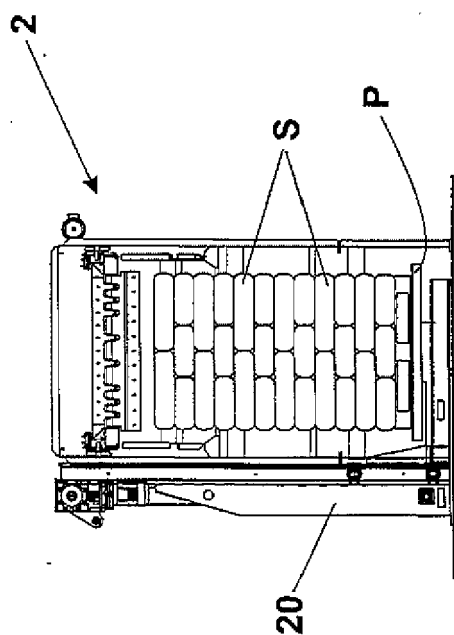


Fig. 4

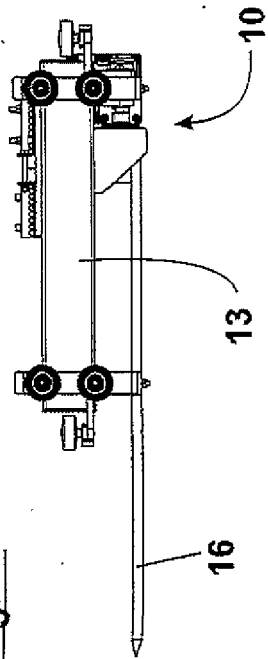


Fig. 5

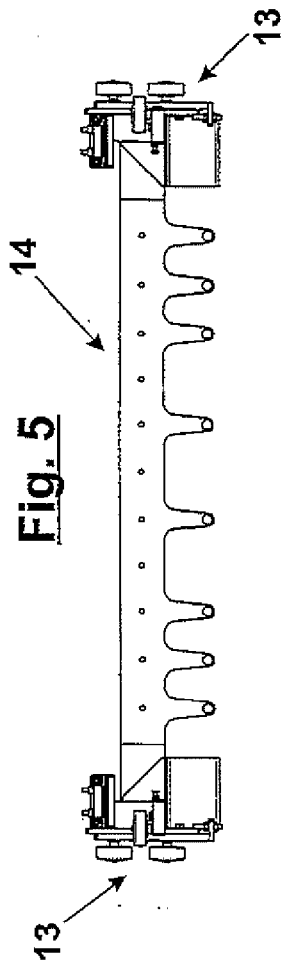


Fig. 7

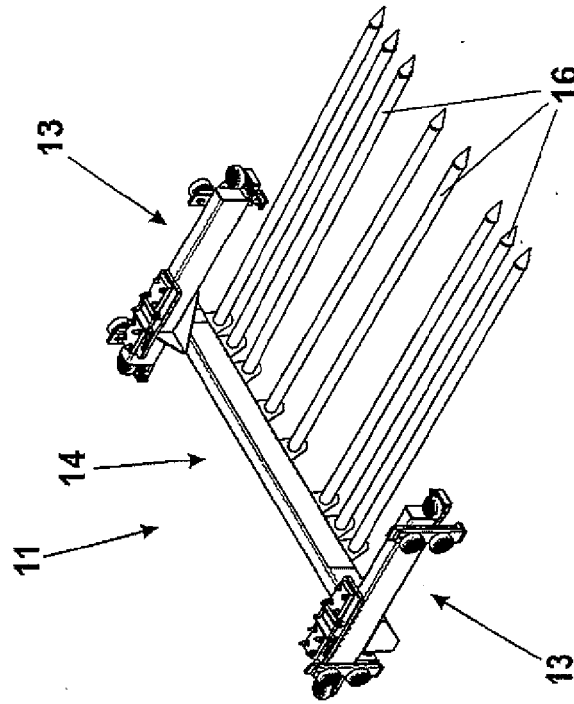
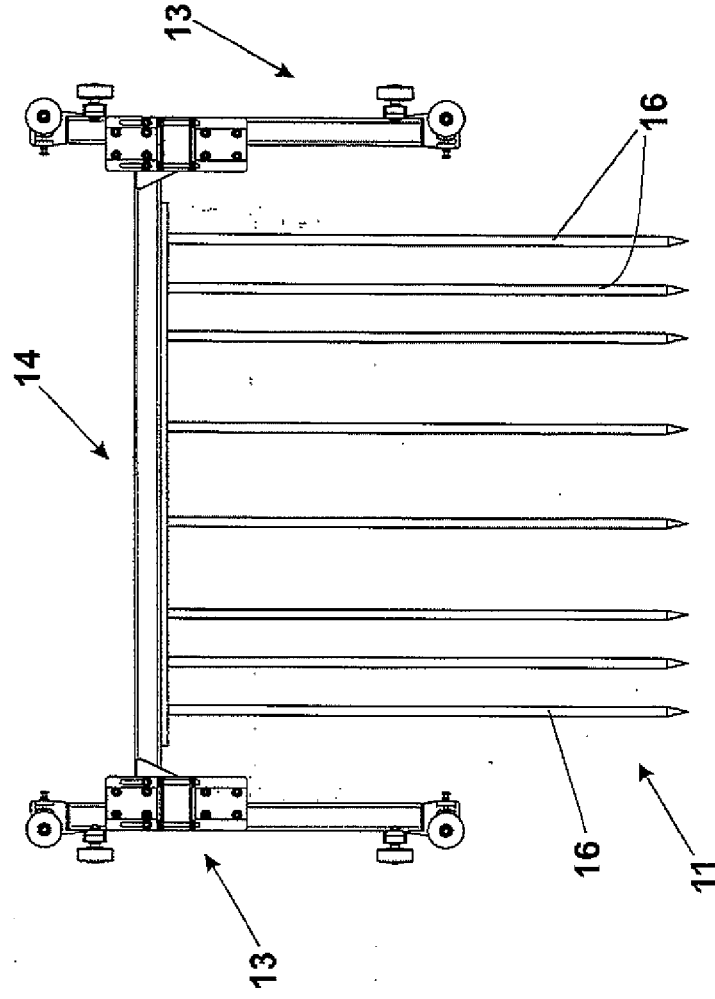


Fig. 6



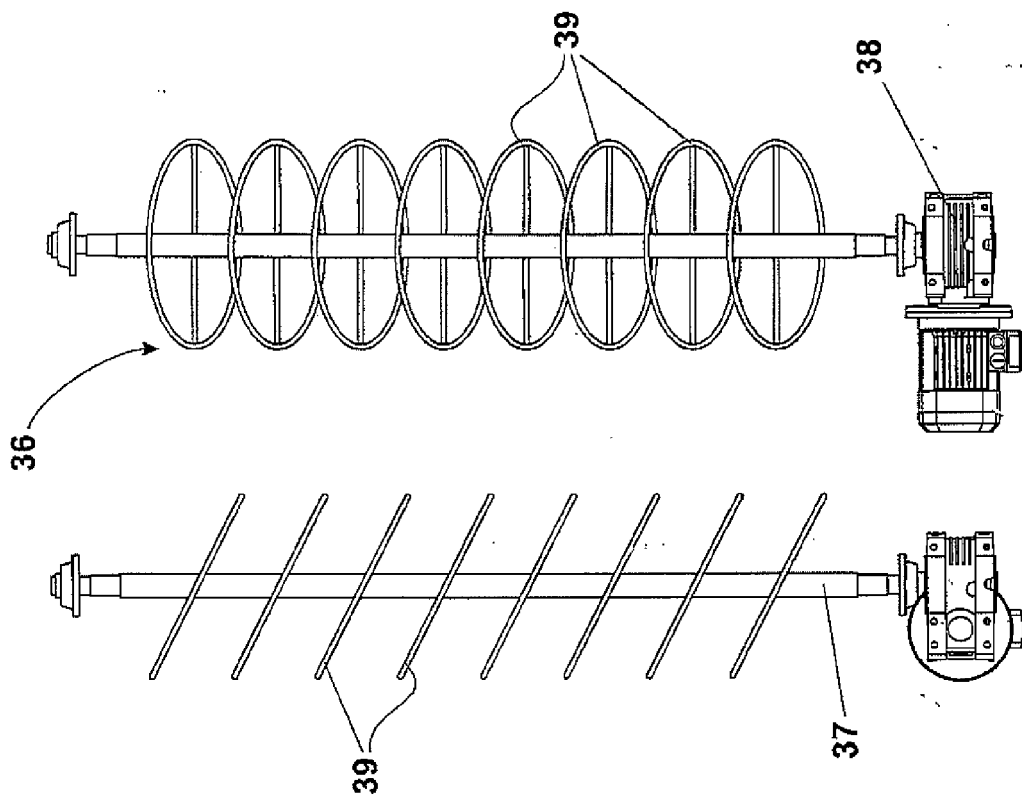


Fig. 11

Fig. 10

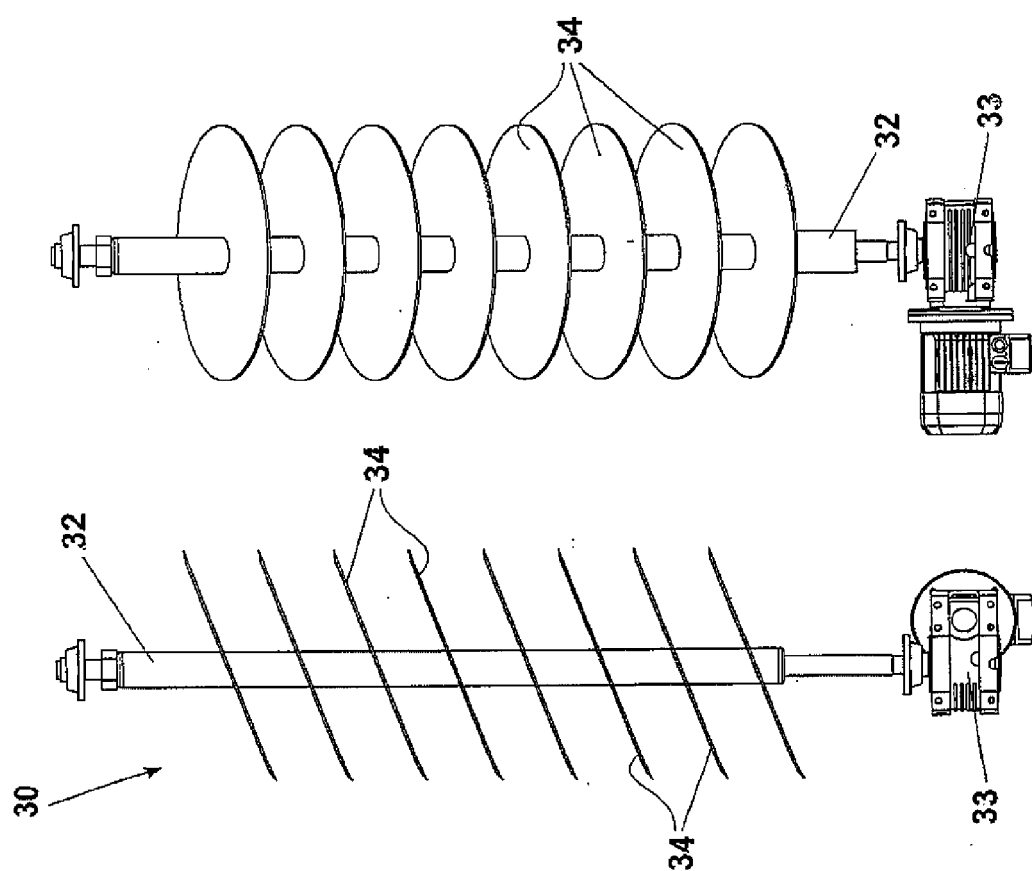
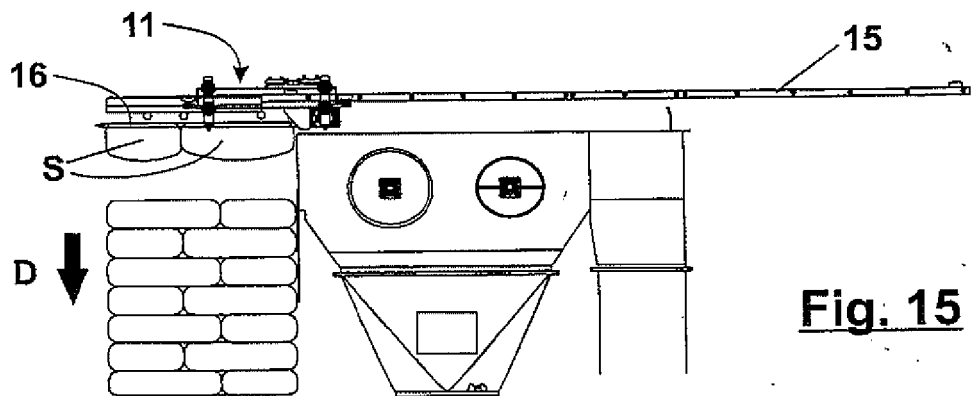
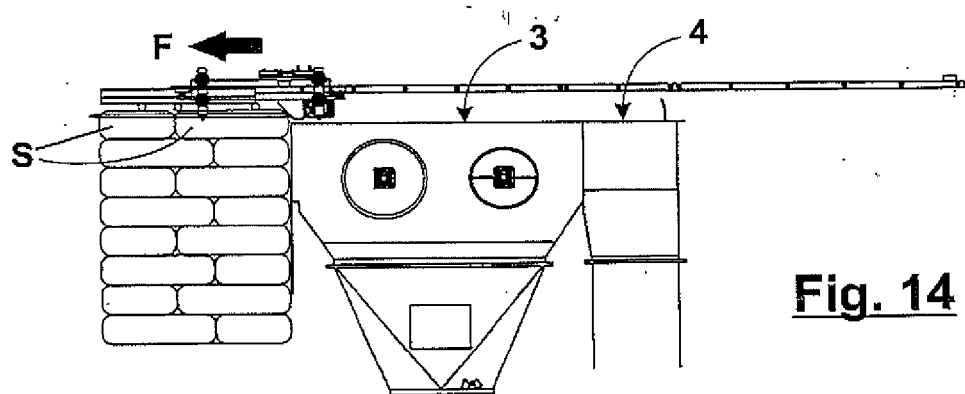
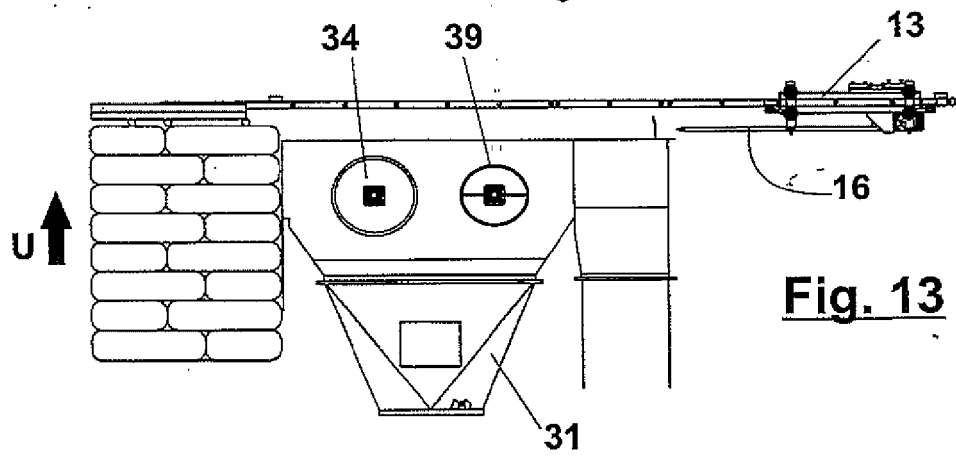
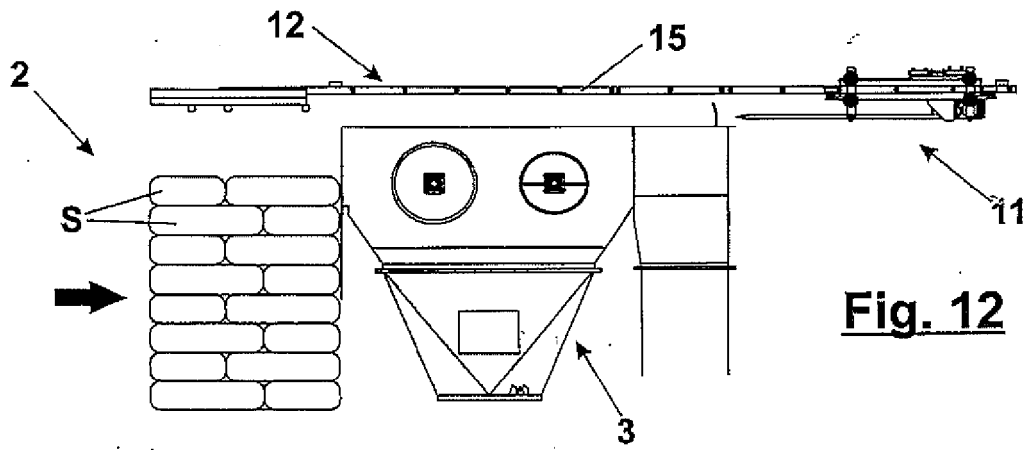


Fig. 9

Fig. 8



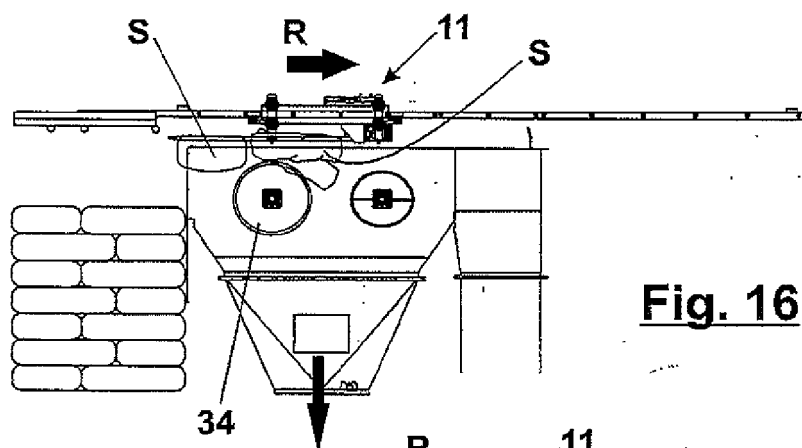


Fig. 16

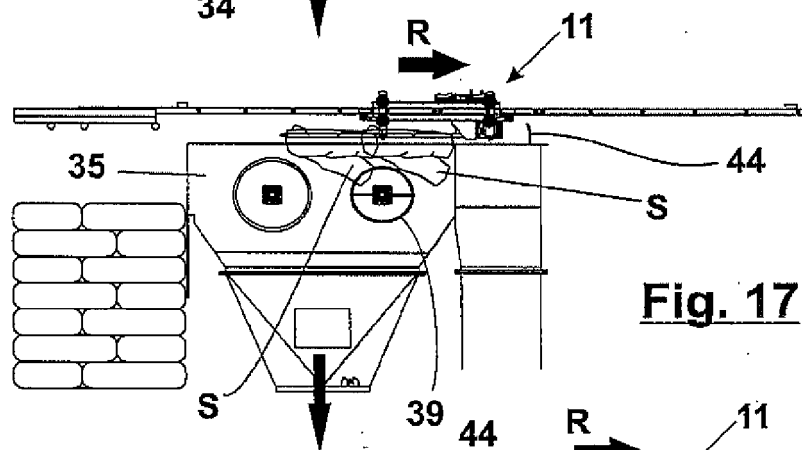


Fig. 17

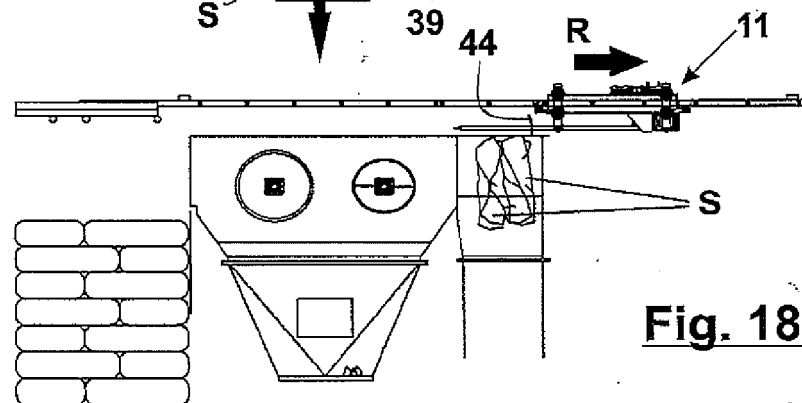


Fig. 18

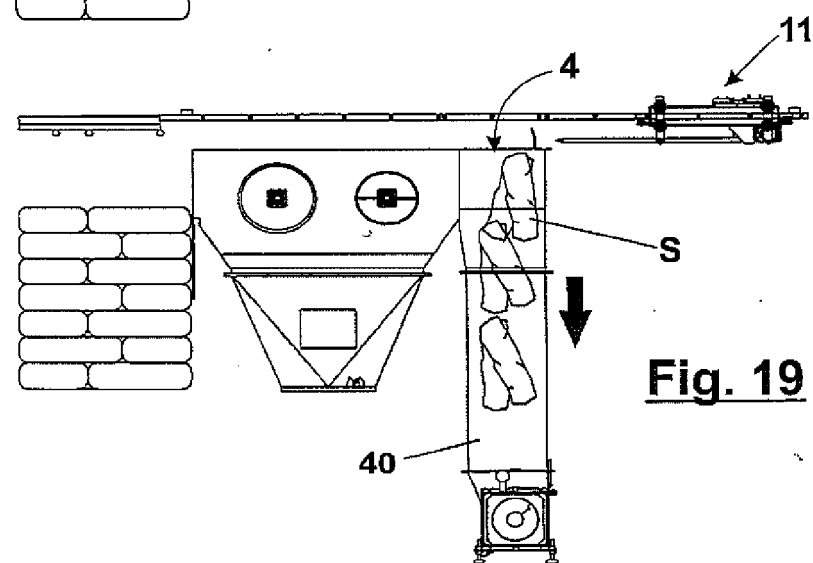


Fig. 19



EUROPEAN SEARCH REPORT

 Application Number
 EP 16 02 0488

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The present search report has been drawn up for all claims			
Place of search		Date of completion of the search	Examiner
Munich		11 April 2017	Vassoille, Philippe
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**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

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5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
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