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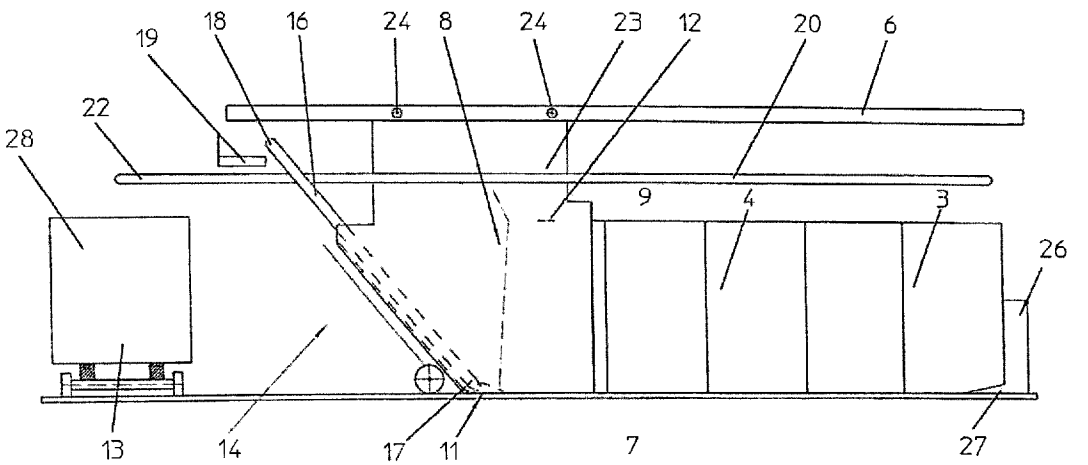

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Apparatus and process for processing blocks or bales of feed. The apparatus comprises a movable mixing bin and a store room with a fixed floor for one or more rows of the blocks or bales of feed. The apparatus further comprises separating means for separating feed the full length of a cutting face which extends downwards from the top of the block or the bale. Conveying means move the separating means in the direction of the cutting face. Discharge means move separated feed to the mixing bin.

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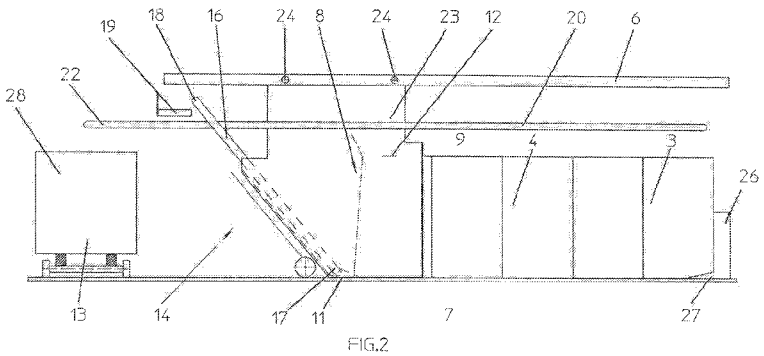

FIG.2

(57) Abstract: Apparatus and process for processing blocks or bales of feed. The apparatus comprises a movable mixing bin and a store room with a fixed floor for one or more rows of the blocks or bales of feed. The apparatus further comprises separating means for separating feed the full length of a cutting face which extends downwards from the top of the block or the bale. Conveying means move the separating means in the direction of the cutting face. Discharge means move separated feed to the mixing bin.

PROCESSING OF BLOCKS OR BALES OF FEED

The invention relates to an apparatus and a process for processing blocks or bales of feed for livestock.

Silage can be made up of grass, mixtures of grass and clover, cereals such as wheat, barley or mixtures thereof or mixtures of cereals with peas or beans. Cut silage compacted in a silage pit is usually referred to as "blocks", while feed compacted in a baling press is usually referred to as "bales". On compacting a layered structure is formed.

EP 1 625 787 discloses an apparatus for separating various types of feed from blocks or bales which are mixed in a mixing carriage provided with weighing means. By weighing the amount of feed which is deposited in the mixing carriage, a desired composition can be obtained which can then be dispensed to the livestock. The blocks or bales are supplied on supply conveyers to a cutting unit, where the feed is cut from the blocks or bales. It is then conveyed to the mixing carriage by means of conveyor belts.

Lely markets an automatic feeding system under the trade name Vector®, which has been described int. al. in the publication "*Lely voedt automatisch*" ("*Lely's automatic feeding*"), G. Zevenbergen, published in *Veehouderij Techniek*, June 2012. This system involves blocks of feed being deposited in a feed kitchen. A grabber grabs feed from a block to put it in a mixing carriage. In the mixing carriage the feed, originating from different blocks, is mixed and conveyed to the livestock to be fed. Because the grabber has to be able to grab around the blocks, the blocks in the feed kitchen have to be spaced apart. As a result of this, they turn over easily and a comparatively large space is required.

Separating feed from a bale or block should be done in such a way that the structure of the remaining part

of the block or bale remains intact and does not break off in order to prevent oxygen from intruding in the bale and setting decomposition processes in motion. Using a grabber can cause the blocks to break and fall apart, as a result of which the remaining feed will decompose more quickly. Also, such a grabber makes precise dosing impossible. Furthermore, feed will fall from the grabber when it is moved to the mixing carriage. Nor is the grabber able to properly pick the last remnants of the block off the floor. Feed remnants left behind may start to ferment and accelerate the spoiling of the other feed in the feed kitchen. Because of this the feed kitchen will need to be cleaned and filled on a regular basis.

The present invention has for its object to provide a system which will enable efficient automatic feeding and will require less frequent filling or cleaning of the feed kitchen.

The object of the invention is attained with an apparatus for processing blocks or bales of silage, comprising:

- a movable mixing bin;
- a store room with a fixed floor for one or more rows of the blocks or bales of silage;
- separating means for separating feed the full length of a cutting face, with the cutting face extending downwards from the top of the block or the bale;
- conveying means for moving the separating means in the direction of the cutting face;
- discharge means for moving separated feed to the mixing bin.

By using blocks or bales of silage, which will keep longer than silage which has not been compacted, larger stores, which need to be filled less frequently, can be put in the feed kitchen. The feed is separated from the block the full length of a cutting face which extends downwards from

the top of the block or the bale. The cutting face thus is essentially vertical, for instance the full length of a side face or the full length of a front face or back face of the bale. The cutting face is disposed essentially transverse to the top and can for instance be vertical or at a slight angle of say less than 30 degrees, or less than 20 degrees to the vertical. The cutting face in that case can be essentially transverse to the layered structure of the block. Surprisingly, it has been found that this enables precise separating and dosing and that the block is slow to fall apart. Because the separating means can be moved towards the cutting face, supply conveyers are no longer required. The bales or blocks can be placed on a fixed stationary floor, such as the fixed floor or ground of the store room, an intermediate floor or a pallet or similar stationary carrier.

The mixing bin and/or the discharge means can be provided with weighing means, so that the feed can be dosed precisely according to a predetermined recipe, in particular when the feed to be mixed is made up of various ingredients, to be separated from bales or blocks of different types of feed. The apparatus can be provided with a control unit for driving the separating means, depending on the measured amount of separated feed in the mixing bin and/or feed on the discharge conveyors. The control unit can also be programmed to drive the mixing carriage and/or the separating means along the various potential trajectories between the rows of blocks and the stable where the feed is dispensed to the livestock.

The store room or feed kitchen can be provided with one or more back walls or boards. The blocks and/or bales can be disposed between the back walls and the separating means. The back walls support the bales or blocks during the cutting, which is especially relevant when the back block or bale is cut.

The discharge means can for instance comprise a vertical conveyor moving in an inclined upward direction with a bottom end in the range of the bottom section of the cutting face, that is to say, in such a position that separated feed will end up on the bottom end of the vertical conveyor. The top end of the vertical conveyor can connect to an inlet or an open upper side of the mixing bin. In another embodiment the top end of the vertical conveyor can connect to a second conveyor belt. The second conveyor belt can be configured as a transverse belt with a conveying direction which is essentially transverse to the conveying direction of the vertical conveyor. A third conveyor belt can be disposed contiguous to the transverse belt, in which case the movable mixing carriage can be positioned beneath an end of the third conveyor belt.

In a further potential embodiment the discharge means for moving separated feed to be mixing bin can for instance comprise a suction unit and/or a blowing unit.

In order to be able to mix different kinds of feed, the separating means and the discharge means can be movable among several rows of blocks or bales. Each row in that case will for instance comprise a single type of feed. The separating means in that case can be part of a unit which can be moved separately from the mixing bin. The movable unit with separating means can be provided with its own driving gear, or the unit can be driven by the mixing carriage. In another potential embodiment the separating means can be carried by the mixing carriage.

In a potential embodiment the separating means and the discharge means can be movable by means of a roller guide along a support beam. The separating means can be moved along the support beam in the direction of the rows, while the support beam together with the separating means can be moved in transverse direction from one row to the other. The support beam can for instance be laterally movable by means

of a guide on a support frame. In another potential embodiment the support beam can be mounted on a laterally movable supporting frame or cross-bar.

The apparatus can be provided with a shoveling plate extending beneath the separating means at such a level that the shoveling plate can be slid beneath a bale. The shoveling plate can be used to wipe the floor and during the cutting the shoveling plate slid beneath the bale or the block can exert counterpressure. In a specific embodiment the apparatus can be provided on either side of the shoveling plate with parallel side walls which are spaced further apart than the width of the blocks of silage to be cut. The shoveling plate can for instance connect to the bottom end of a vertical conveyor or to an inlet of a mixing bin of the mixing carriage.

The separating means can for instance be part of the mixing carriage, so that the number of individually movable parts of the system is limited. The maneuverability of such a self-propelling mixing carriage can be increased by providing the mixing carriage with swivel wheels, so that the mixing carriage can be moved in line with the rows as well as in transverse direction thereto. The mixing carriage can be provided with a shoveling plate which can be slid beneath a bale or block to be cut. The separating means in that case can for instance consist of one or more rotors with a vertical rotor shaft and cutting organs. The cutting organs can for instance comprise cutting crowns with radial cutting edges disposed one above the other.

In a specific embodiment the separating means can comprise a cutting apparatus which can be moved the full length of an essentially vertical or arched cutting face by means of one or more supporting arms.

In a specific embodiment the apparatus comprises a routing apparatus along which the mixing bin and/or the separating means can be moved. Such a routing apparatus can

for instance consist of a rail guide, such as an upper rail guide or a base rail guide, and/or a navigation system combined with a detector on the parts to be moved for identifying beacons along potential routes.

The described apparatus is especially suitable for utilisation of a process for processing blocks or bales of silage, in which process the blocks or bales are arranged on a fixed floor and where feed is separated from a block or bale the full length of a cutting face extending downwards from the top of the bale or block. The separated feed is then discharged into a mixing bin of a movable mixing carriage and weighed, after which the mixing carriage moves to a feeding place and delivers the separated feed.

A feed mixture can be prepared according to a predetermined recipe or formula. This can be attained as follows: after feed has been separated from a first block, feed is separated from at least a second block of a different type of feed and then mixed in the mixing carriage with the feed from the first block. Using weighing means in the mixing bin and/or the conveyor belts makes it possible for the various ingredients to be precisely dosed according to the desired recipe in that case.

In an embodiment of the process, a row can be filled with new blocks or bales after a part, for instance at least 15 - 20%, of the feed of a last block or bale from the row has been separated. This can be done after separating a part of the last block or bale by moving it together with the back wall in the direction of the separating means which have been returned to a starting position. The back wall is then removed, whereupon the row is filled with new blocks or bales, with the opened up back block now forming the front block. The back wall is then put back against the new last block or bale.

For a proper alignment of the rows, for instance when filling with new blocks, markings, such as marking

lines, can be applied to the store room or feed kitchen floor. The marking lines for the various rows in that case can lie on a line, so that as a result the fronts of new or freshly filled rows will aligned in a line side by side. The marking lines can for instance consist of a front line, alongside which the front face of the front bale is arranged, and two side lines alongside which the side faces of the front bale are arranged.

If so desired, the bales to be processed may be tipped in such a way that the various layers are disposed parallel to the cutting face. This is particularly advantageous in the embodiment where the separating means are part of the mixing carriage and consist of one or more rotors with a vertical rotor shaft and cutting crowns with radial cutting edges disposed one above the other.

The invention is further elucidated below with reference to the drawings, in which some embodiments are shown by way of illustration.

Figure 1: is a schematic representation in perspective view of an apparatus according to the invention;

Figure 2: is a representation of the apparatus of Figure 1 in side view;

Figure 3: is a representation of the apparatus of Figure 1 in top view;

Figure 4: is a schematic representation of a second potential embodiment of an apparatus according to the invention;

Figure 5: is a representation of the apparatus of Figure 4 in front view;

Figure 6: is a representation of a cutting unit of an apparatus according to the invention;

Figure 7: is a representation of an alternative embodiment of a cutting unit;

Figure 8: is a representation of the cutting unit of Figure 7 in side view;

Figure 9: is a representation of a saw blade for the cutting unit of Figure 7;

Figure 10A: is a representation of the saw blade of Figure 9 in cross-section;

Figure 10B: is a schematic representation in top view of the position of the saw blade vis-à-vis the cutting face;

Figure 10C: is a schematic representation in side view of the position of the saw blade vis-à-vis the cutting face;

Figure 11: is a representation of a third potential embodiment of an apparatus according to the invention;

Figure 12: is a representation of a fourth potential embodiment of an apparatus according to the invention;

Figure 13: is a representation of the apparatus of Figure 12 in side view;

Figure 14: is a representation of a sixth potential embodiment of an apparatus according to the invention;

Figure 15A-D: is a representation of the apparatus of Figure 14 in operation.

Figure 1 is a representation of an automatic feeding apparatus 1 with a feed kitchen 2 in which a number of parallel rows 3 of blocks 4 of silage are arranged on a fixed floor 10. In the feed kitchen 2 a supporting structure 5 is disposed, to which a laterally movable support beam 6 is connected which is essentially parallel to the rows 3. In the shown embodiment the support frame 5 is an XY-frame, from which the support beam 6 is laterally movably suspended. The apparatus 1 further comprises a cutting unit 7, such as for

instance a cutter or knife with or without a discharge mechanism, which can be moved the full length of an essentially vertical cutting face 8 (see Figure 2) along a guide on the inside of a slide 9. The slide 9 comprises a bottom plate 11 positioned beneath the cutting unit and two parallel side walls 12. The space between the side walls 12 - and thus the width of the bottom plate 11 - exceeds the width of the blocks 4, for instance the width of a block 4 multiplied by twice the tread width of the wheels of a tractor. Because of the extra-wide bottom plate 11 the floor beside the rows 3 is wiped clean and feed which on being separated falls beside the blocks is cleared away.

The apparatus further comprises a mixing carriage 13 and conveying means 14 for moving separated feed from the slide 9 to the mixing carriage 13. The conveying means 14 comprise a vertical conveyor 16 moving in an inclined upward direction, with a bottom end 17 connecting the the bottom plate 11 of the slide 9, and a top end 18 connecting to one end of a cross belt 19. The other end of the cross belt 19 connects to a third conveyor belt 20. The third conveyor belt 20 has an end 22 above the place where the mixing carriage 13 can be positioned. The slide 9 with the vertical conveyor 16 moving in an inclined upward direction and the cross belt 19 are connected to a suspension 23, which is coupled to the support beam 6 by means of a roller guide 24 6. At the end of the row of blocks 3 opposite the cutting face 8 there is a vertical end board 26, which is provided with a horizontal foot 27 moving in an inclined downward direction beneath the back bale of the row 3. The foot 27 can for instance be made up of forks, pins or a base plate.

The mixing carriage 13 is provided with a weighing bin 28 with weighing means (not shown). In addition, the mixing carriage 13 comprises a control unit (not shown) for moving the mixing carriage 13, for instance along a guide or by means of a navigation system.

At a pre-programmed moment the apparatus 1 is activated for a new feeding round. The mixing carriage 13 is moved to a loading position beneath the end 22 of the third discharge belt 20. Next, the cutting unit 7 is activated from the control unit of the mixing carriage 13 and moved the full length of the cutting face 8 of the front block of the row 3. The separated feed is loaded by way of the vertical conveyor 16 and the cross belt 19 onto the third conveyor belt 20, which then deposits it into the mixing bin 28 of the mixing carriage 13. When the cutting unit 7 has passed the cutting face in full, the cutting unit 7 is returned to its starting position and the slide 9 with the cutting unit 7, the vertical conveyor 16 and the cross belt 19 is moved in the direction of the cutting face 8, after which the cutting unit 7 can again be moved the full length of the cutting face 8 until sufficient feed is present in the mixing bin 28.

Optionally, the conveyor belts 16, 19, 20 may also be provided with weighing means. If sufficient feed is present in the mixing bin and/or on the conveyor belts, the cutting unit 7 is stopped. Once all the feed on the conveyor belts has been deposited in the mixing bin 28, the mixing carriage 13 can be driven to a next type of feed or to the stable.

The support beam 6 can now be moved laterally with the aid of driving means, such as a geared motor, to a next row of blocks 3 of a different type of feed, after which a required amount of the different type of feed can be separated in the same way and deposited in the mixing bin 28. Using the weighing means in the mixing bin 28 and/or the conveyor belts 16, 19, 20, a precise record can be kept of how much feed of each type has been deposited in the mixing bin and/or the conveyor belts. In this way a mixture can be prepared precisely according to a recipe entered into the control unit in advance.

When about 15% has been cut off the last bale or block in the row 3, the row 3 is filled with new bales or blocks. The slide 9 with the cutting unit 7 is first placed in a position furthest removed from the end board 26. Next, the end board 26 along with the remainder of the last bale is disposed in the direction of the slide 9, for instance up into the slide 9 or up to a marking line. When using a marking line, the fronts of the various rows can be mutually aligned. The back wall can for instance be moved using a silage cutter. Next, the foot 27 of the end board 26 is removed from beneath the last bale or block and the end board 26 is removed and temporarily set aside. The row 3 is now filled with blocks or bales up to the desired length. Finally, the end board 26 is replaced at the end of the filled row 3 with the foot 27 beneath the last bale or block.

Figure 4 is a representation of an alternative embodiment in side view of an apparatus 30 with the support beam 31 extending fixedly between a front portal 32 and a back portal 33. The support beam 31 can be moved laterally together with the front and back portals 32, 33 as a single entity. The front portal 32 can be moved along a rail guide 34 on the side of the mixing carriage 36. On the other side the back portal 33 rests on wheels 37, which can for instance be provided with a brake (not shown) in order to block the wheels 37 when the portal 33 has been put in a desired position. The front portal 32 is shown in front view in Figure 5. Using two side wheels 41, 42, a driving chain 38 is passed round a chain wheel 39 disposed between the side wheels 41, 42. The chain wheel 39 is driven, for instance by means of a geared motor (not shown). Such a guide enables very precise positioning of the portal 32, 33, thus reducing the risk that the cutting unit will get caught in the silage to be separated.

The vertical conveyor 43 is movable in the direction of the cutting face 44, as well as in lateral

direction together with the support beam 31. The vertical conveyor 43 can be supported in that process by swivel wheels 46 capable of rolling in both directions.

The cutting unit 50 is shown in greater detail in Figure 6. The cutting unit 50 comprises a circular saw 51 which with the aid of a motor 52 can be moved forward and backward horizontally by way of a first guide 53 and can be moved by way of a second guide 54 between a top position (indicated by a dotted line in the figure) and a bottom position. The vertical guide 54 is parallel to the cutting face 44, which is rearwardly inclined at an angle. This helps to reduce or prevent the uncontrolled breaking off of feed.

The saw 51 comprises a circular saw blade 56 which is capable of rotation around an axis. The saw blade 56 is at an angle of about 5 degrees to the cutting face 44. A spiral 57 extends coaxially from the saw blade 56 in the direction of the vertical guide 54. The spiral 57 has a diameter which corresponds to the inner diameter of the saw teeth. The sawn-off feed is propelled by the spiral 57 in the direction of the vertical conveyor 43 moving in an inclined upward direction. The shaft of the spiral 57 is formed by a bushing 58 with a large diameter in order to prevent grass silage from getting stuck around the shaft. The bushing 58 rotates with the drive shaft. The long drive shaft creates space for the feed, which expands after it has been separated from the block.

The vertical conveyor 43 comprises a horizontal front section 59 and a shoveling plate 61 which extends from the horizontal section 59 of the vertical conveyor 43 and can be slid beneath the block 4 of silage.

During sawing the saw 51 is moved horizontally from one side of the cutting face to the opposite side. After each horizontal turn the saw 51 is moved downwards over a certain distance. In this way the saw 51 is moved from top to bottom in zigzag fashion.

Another potential cutting unit 70 is shown in Figures 7 and 8. This cutting unit 70 comprises a circular saw blade 71, which is disposed at an angle α of about 1 - 6 degrees to the cutting face 72. At the back a tapered feeding-out roller 73 is disposed with a longitudinal axis Y which is essentially parallel to the centre plane X of the saw blade 71 and which is at an angle β of 1 - 6 degrees to the vertical (see Figure 8). As can be seen in Figure 7, the feeding-out roller 43 is disposed at a distance B from the centre of the saw blade 71. The feeding-out roller 73 is disposed in the place of a section of the saw blade 71, which is present in the direction of rotation R behind the point S where the saw blade and the cutting face make contact (see Figure 7). In this embodiment the point S is the bottom tip of the saw blade 71. The distance B corresponds to about 0.2 - 0.8 times, for instance 0.3 -0.6 times the radius of the saw blade 71. Both in top view (Figure 10B) and in side view (Figure 10C) the saw blade 71 lies at a sharp angle φ, ω to a vertical plane through the intersection S. These angles can for instance be 1 - 20 degrees, for instance 6 - 15 degrees, by which the saw blade 71 runs clear of the cutting face 72 as much as possible.

The feeding-out roller 43 comprises a central shaft with blades or boards 74 which cast the sawn-off feed in the direction of the vertical conveyor. The blades 74 can for instance be radial straight boards or move spiral-wise to some extent.

The saw 71 is shown in greater detail in Figures 9 and 10. In the shown embodiment the saw 71 comprises a standard circular saw blade 76. The usual teeth 77 (represented by a dotted line) with saw teeth 78 are covered by a flat ring 79 with chamfered inner and outer sides 81, 82. The flat ring 79 is connected to the saw blade 71 with bolts 83. The tips of the saw teeth 78 are provided with cutting edges 84, which protrude from beneath the flat ring

79 in a desired length. Because of the teeth's short length the risk of the saw getting stuck is greatly reduced or even eliminated.

Another potential embodiment of an apparatus 90 according to the invention is shown in Figure 11. In this case the top end 91 of the vertical conveyor 92 moving in an inclined upward direction connects to a funnel 93 with an upper side which is as wide as the vertical conveyor 92. The funnel 93 leads to a fan housing 94 with a fan (not shown) which blows the supplied feed into a telescopically movable discharge pipe 96. The telescopically movable discharge pipe 96 at one end is hinged with respect to the fan housing 94, and at the other end it is hinged with respect to a cyclone 97 which delivers the feed from the discharge pipe 96 to a mixing carriage 98 disposed beneath it. The bottom end of the vertical conveyor 92 connects to a shoveling plate 99, which can be slid beneath the first bale or block from the row.

Figures 12 and 13 show a further potential embodiment of an apparatus 100 with a top rail guide 101 along which a mixing carriage 102 and a cutting carriage 103 can be moved. The rail guide 101 comprises a rail 104 at each row of blocks or bales 106. The rails 104 meet at a switch 107. When the cutting carriage 103 has to be moved from one row to the next, the cutting carriage 103 is moved together with the mixing carriage 102 to a position past the switch 107. The switch 107 is then set such that the cutting carriage 103 is guided to a next row when it is moved back. The mixing carriage 102 and the cutting carriage 103 in that case can be driven for instance by means of a sliding contact or with the aid of a battery. The carriages can be provided with an individual driving mechanism or with a joint driving mechanism.

The cutting carriage 103 comprises a vertical conveyor 108 moving in an inclined upward direction(see Figure 13) with a bottom end connecting to a shoveling plate

109. The shoveling plate 109 wipes the floor clean en is slid beneath a bale or block 111 to be separated, in order to provide counterpressure during the cutting. The vertical conveyor 108 further comprises a top end connecting to a guide plate 112, along which feed can be deposited in a mixing bin 113 of the mixing carriage 102.

On either side of the belt 108 moving in an upward direction the cutting carriage 103 comprises a side wall 114. The two side walls 114 continue on both sides of the shoveling plate 109 up to a distance behind the back edge of the shoveling plate 109. The space between the side walls 114 is such that a bale or block 111 can be put between them with ample clearance. To this end the end edges 116 of the side walls 114 have been folded slightly outwards. On the underside the cutting carriage 103 is further provided with a pair of support wheels 117 near the folded end sides 116 and a second pair of support wheels 118 near the bottom end of the vertical conveyor 114. At the top the side walls are provided with a recess 119. On either side of the outer surfaces of the side walls 114 a lifting arm 121 is hinged to a hinged joint 122 near the top end of the vertical conveyor 123. The lifting arms 121 are interconnected at their free ends by means of a cross rod 124 (see Figure 12). At the level of the recess 119 in the side walls 114 the lifting arms 121 can be moved up and down with the cross rod 124, for instance with the aid of hydraulic cylinders (not shown). On the sides of the two lifting arms 124 which face each other there is mounted on the cross rod a second pair of lifting arms 126 which extend essentially between the side walls 114. Between the free ends of these lifting arms 126 a cutting unit 130 is mounted with a frame 131, a knife 132 which is suspended inside the frame 131 with a downward-directed cutting edge. The knife 132 can be moved forward and backward with the aid of driving means (not shown). Behind the knife 132 a scraping-off roller 133 is suspended in the frame 131

to remove separated feed from the knife 132 and cast it in the direction of the vertical conveyor 108. As a result of the lifting arms 121 moving up and down vis-à-vis the hinged point 122 the knife 132 is moved the full length of the cutting face 134. The cutting face is curved but essentially vertical.

The bales or blocks 111 sit loose on a fixed floor 136, pushed together in a straight row. The last bale or block of the row is pushed against a fixed end board 137. The blocks or bales can be rectangular. Alternatively, round bales can be used.

The mixing carriage 102 has a mixing bin 140 with a closed upright wall 141 and an open upper side 142. In the mixing bin there are mixing screws 143. Driving means 144 are suspended from the underside of the mixing carriage 102 for driving the mixing screws 143. The mixing carriage 102 further comprises weighing means (not shown) for weighing feed in the mixing bin and a control unit.

In the shown embodiment the mixing carriage 102 and the cutting carriage 103 are units that can be moved individually. In another potential embodiment the two parts can be configured as a single carriage.

In the embodiment of Figures 14 and 15A-D the apparatus 170 comprises separating means 171 which are part of a self-propelling mixing carriage 172. There is no separate cutting carriage. The mixing carriage 172 comprises a mixing bin 173 with a closed upright side wall 174 and an open upper side 175. In the mixing bin 173 there is a rotatably driven mixing screw 176. At the side the mixing bin is provided with a closable outlet using a cover that can be slid away 177.

On the underside the mixing carriage 172 is provided with swivel wheels 178. This increases the maneuverability of the mixing carriage 172, which as a result

can be moved as easily in longitudinal direction of a row as in transverse direction from one row to the next.

The underside of the mixing bin continues at the front and forms a shoveling plate 179, on which the separating means 171 are disposed. The separating means 171 are made up of two column-shaped rotors 181, each consisting of a number of star-shaped knives 182 with radial cutting edges 183 disposed one above the other. The two rotors 181 both rotate inwards with opposite rotational directions A, A', causing the separated feed to be conveyed inside in the direction of an inlet 184 of the mixing bin 173. The cutting action of such rotors 181 can be further enhanced by tipping the blocks or bales, with the layers ending up transverse to the longitudinal direction of the row. In this way the rotors 181 can separate the feed layer by layer and the risk of uncontrolled breaking off of the feed is reduced.

On either side of the rotor 181 the mixing carriage comprises a side wall 186, which connects to the wall 174 of the mixing bin 173. The space between the side walls 186 exceeds the width of the bales or blocks to be processed. The end sides 187 of the side walls 186 are folded outward under a slight angle.

The mixing carriage 172 is self-propelling and to this end comprises a control unit (not shown). The mixing carriage 172 can for instance be provided with a navigation system combined with a detector for identifying beacons along the potential routes between the desired loading and unloading stations. The mixing carriage can also be provided with a base guide 188, as shown in Figures 15A-D.

CLAIMS:

1. Apparatus for processing blocks or bales of feed, comprising:

- a movable mixing bin;
- a feed kitchen with a stationary carrier carrying on it one or more rows of the blocks or bales;
- separating means for separating feed the full length of a cutting face, with the cutting face extending downwards from the top of the block or the bale;
- conveying means for moving the separating means in a direction towards the cutting face; and
- discharge means for moving separated feed to the mixing bin,

wherein the separating means are part of a mixing carriage on which the mixing bin is disposed.

2. Apparatus according to claim 1, wherein the separating means and the mixing bin are part of different movable units.

3. Apparatus according to claim 1 or 2, wherein the apparatus comprises a routing apparatus along which the mixing bin and/or the separating means can be moved.

4. Apparatus according to claim 1, 2 or 3, wherein the store room is provided with one or more movable back walls wherein the blocks or bales can be arranged in a row between the back wall and the separating means.

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5. Apparatus according to any one of claims 1 to 4, wherein the discharge means comprise a vertical conveyor moving in an inclined upward direction with a bottom end in the range of the bottom side of the cutting face and a top end connecting to the mixing bin or to a second conveyor belt.

6. Apparatus according to claim 5, wherein the second conveyor belt is a cross belt is with a conveying direction which is essentially transverse to the conveying direction of the vertical conveyor.

7. Apparatus according to claim 5 or 6, wherein the discharge means connecting to the second conveyor belt comprise a third conveyor belt with an end beneath which the mixing bin can be positioned.

8. Apparatus according to any one of claims 1 to 7, wherein the separating means and the discharge means are movable among several rows of blocks.

9. Apparatus according to claim 8, wherein the separating means and the discharge means are movable by way of a guide, such as a roller guide, along a support beam.

10. Apparatus according to claim 9, wherein the support beam is laterally movable by way of a guide on a support frame, such as a XY-frame.

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11. Apparatus according to claim 9 or 10, wherein the support beam is attached to a laterally movable portal.

12. Apparatus according to claim 10 or 11, wherein the support beam is attached to a support frame which is laterally movable by way of a guide.

13. Apparatus according to claim 1, 2 or 3, wherein the mixing bin includes therein mixing means therein and driving means suspended from an underside of the mixing carriage for driving the mixing means.

14. Apparatus according to any one of claims 1 to 13, wherein the apparatus comprises a shoveling plate extending beneath the separating means at such a level that the shoveling plate can be slid beneath a bale.

15. Apparatus according to claim 14, wherein the shoveling plate connects to an inlet of the mixing bin.

16. Apparatus according to claim 15, wherein the separating means consist of one or more rotors with a vertical rotor shaft and cutting organs, wherein the rotors are disposed before the inlet.

17. Apparatus according to claim 16, wherein the cutting organs comprise cutting crowns with radial cutting edges disposed one above the other.

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18. Apparatus according to any one of claims 1 to 17, wherein the apparatus on either side of the separating means is provided with side walls which are spaced apart further than the width of the blocks or bales to be cut, with the side walls extending to beyond the cutting face to be described by the separating means.

19. Apparatus according to claim 1, 2 or 3, wherein the separating means comprise a cutting unit which can be moved the full length of the cutting face by means of one or more movable supporting arms.

20. Apparatus according to any one of claims 1 to 19, wherein the separating means and/or the mixing bin are movable by way of a rail guide, such as an upper rail guide or a base rail guide.

21. Apparatus according to any one of claims 1 to 20, wherein the discharge means for moving separated feed to the mixing bin comprise a suction unit and/or a blowing unit.

22. Apparatus according to any one of claims 1 to 21, wherein the floor of the store room is provided with markings, such as marking lines, for positioning the rows of blocks and/or bales.

23. Apparatus according to any one of claims 1 to 22, wherein the mixing bin includes therein mixing screws.

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24. Apparatus according to any one of claims 1 to 23, wherein the mixing carriage is provided with swivel wheels.

25. Process for processing blocks or bales of silage, wherein the blocks or bales are arranged loose on a stationary carrier in a feed kitchen and wherein feed is separated from a block or bale the full length of a cutting face which extends downwards from a top of the block or the bale using a separating means, after which the separated feed is deposited in a mixing bin and weighed, after which the mixing bin is moved to a feeding place to deliver the separated feed ,wherein the process further comprises moving the separating means in a direction towards the cutting face using a conveying means, wherein the separating means are part of a mixing carriage on which the mixing bin is disposed.

26. Process according to claim 25, wherein after feed has been separated from a first block, feed is then separated from at least a second block of a different type of feed, which is mixed in the mixing bin with the feed from the first block.

27. Process according to claim 25 or 26, wherein the blocks or bales are arranged in a row with the last block or bale being arranged against a movable back wall and wherein after the separation of part of the last block or bale it is moved together with the back wall in the direction of the separating means returned to a starting position, after which the back wall is removed, after which the row is

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filled with new blocks or bales, after which the back wall is replaced against the new last block or bale.

28. Process according to claim 27, wherein the row of blocks or bales is filled with new blocks or bales after at least 20% of the feed of the last block or bale has been separated.

29. Process according to any one of claims 25 – 28, wherein the blocks or bales are built up of several layers disposed parallel to the cutting face or transverse thereto.

30. Process according to claim 27, wherein the row of blocks or bales is filled with new blocks or bales after at least 15% of the feed of the last block or bale has been separated.

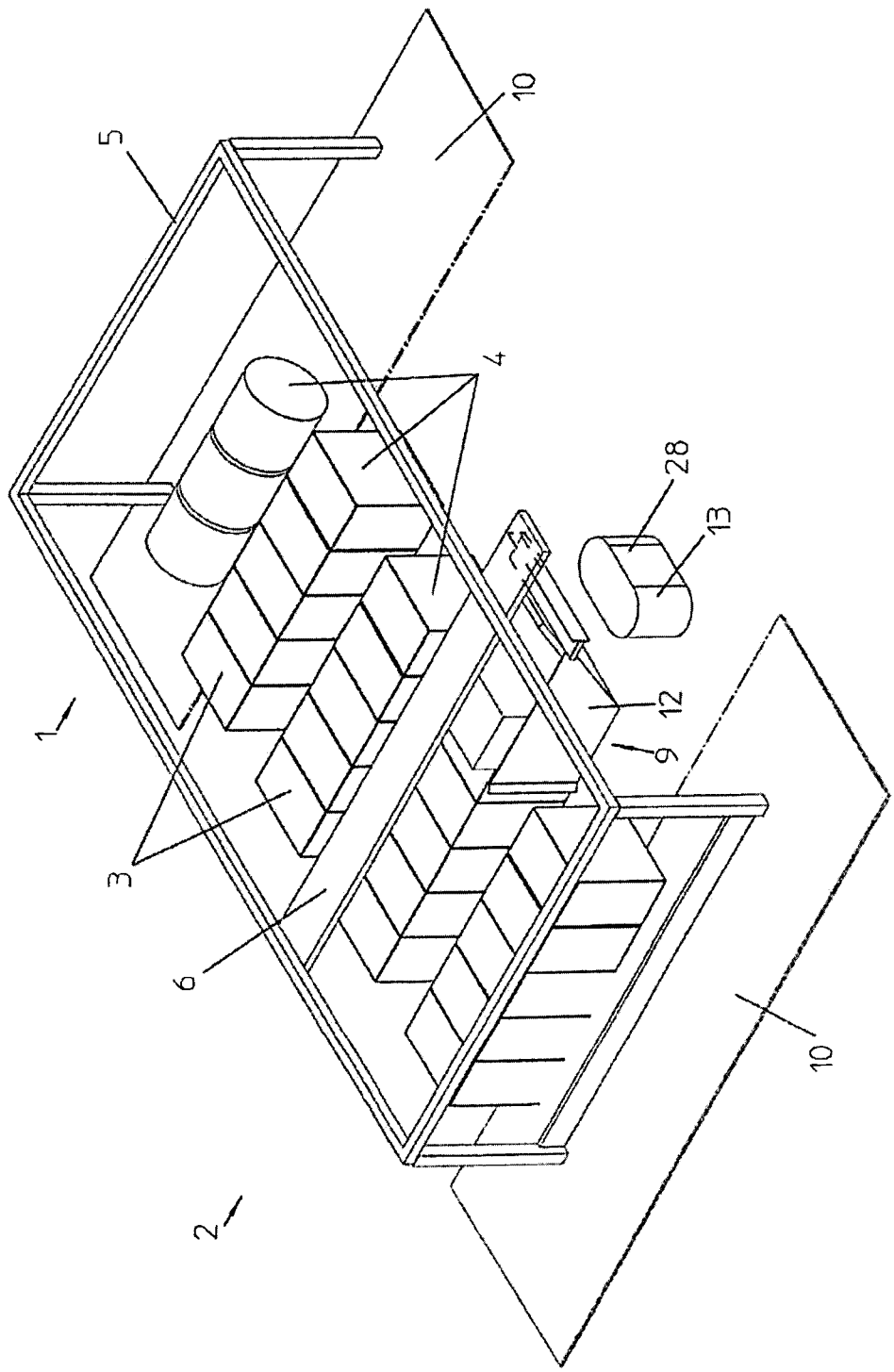

FIG.1

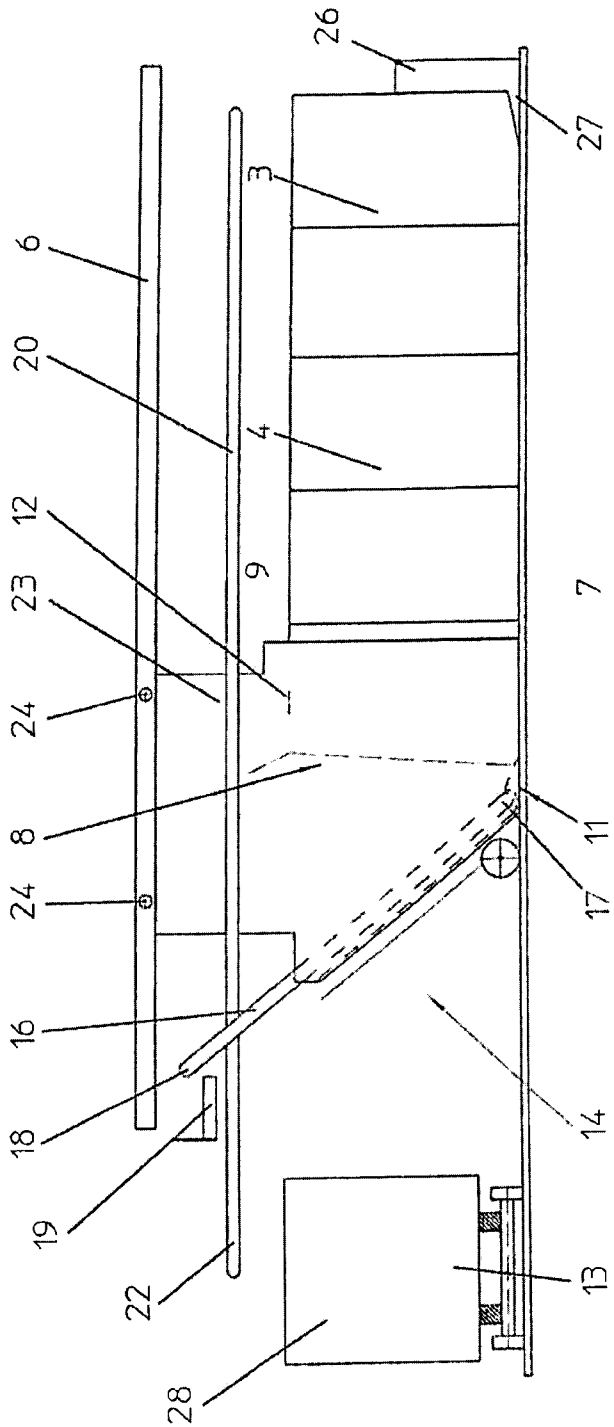

FIG.2

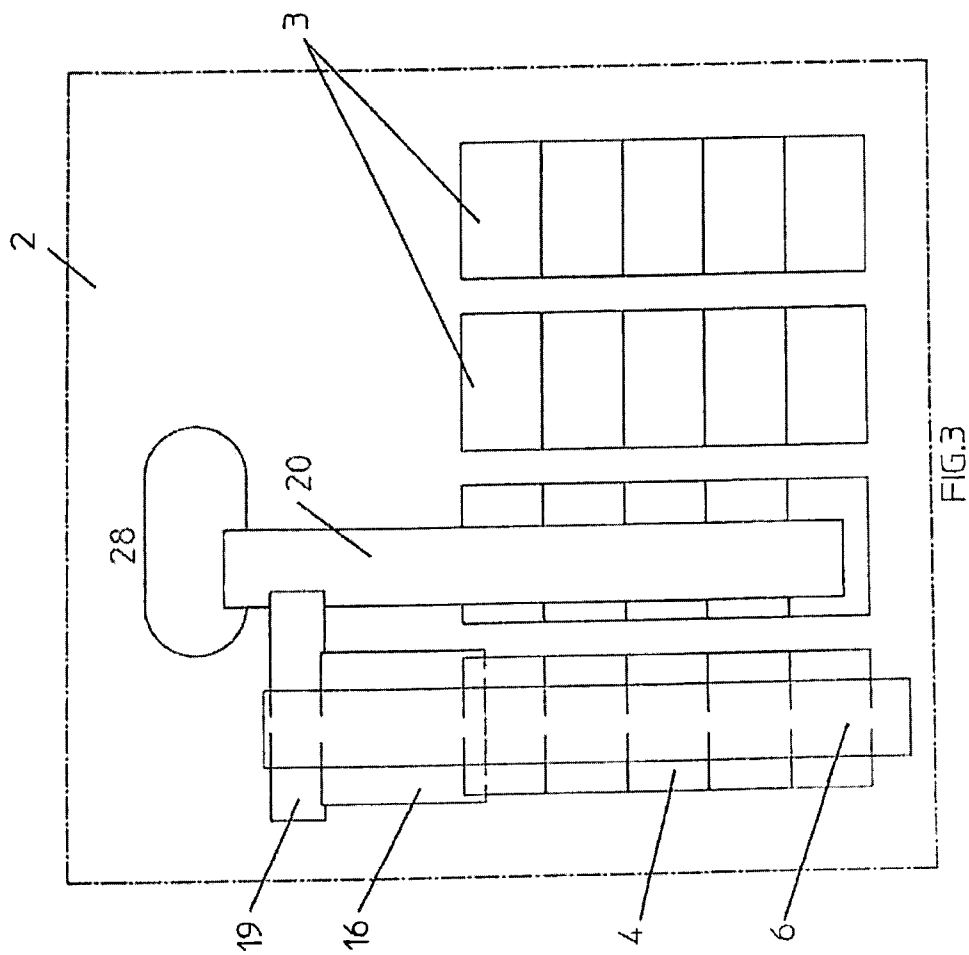

FIG.3

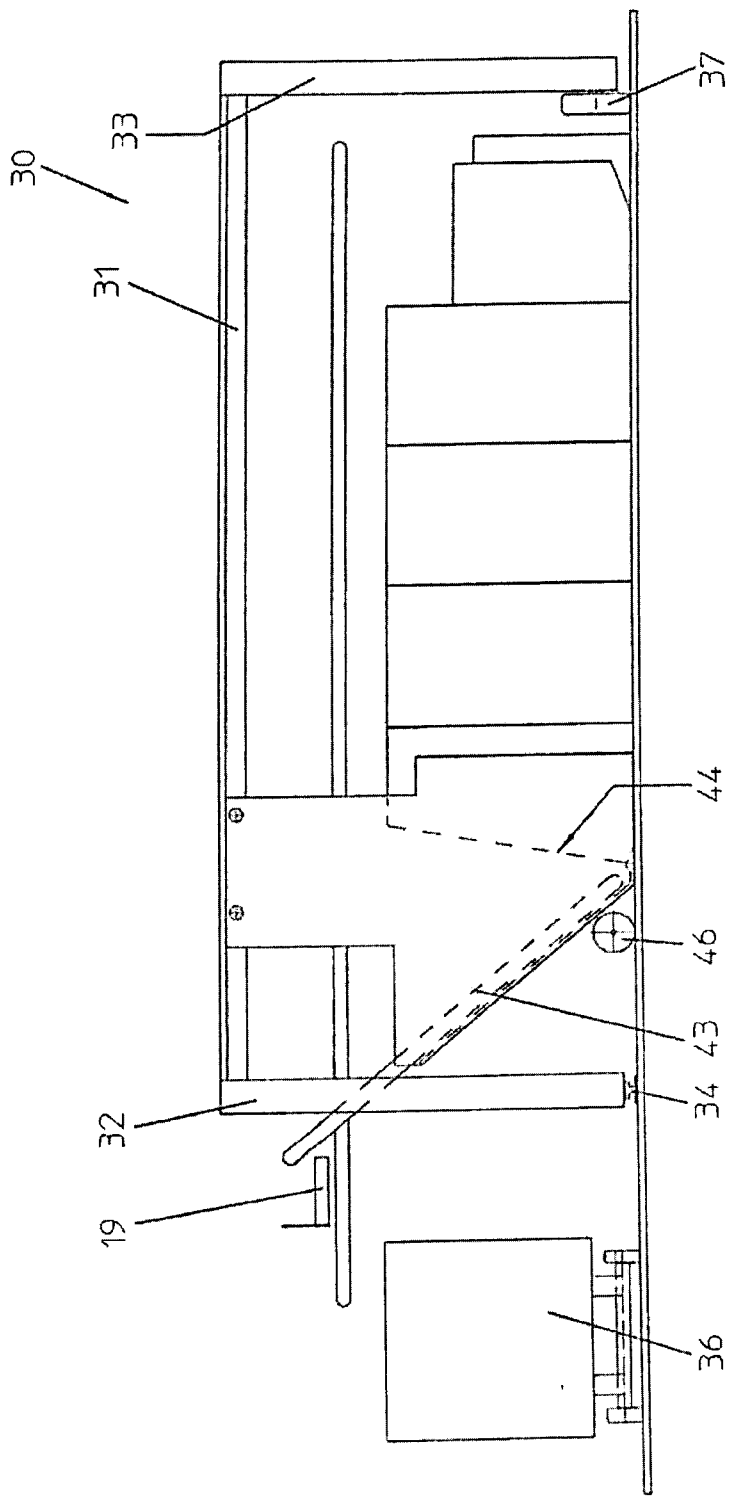

FIG.4

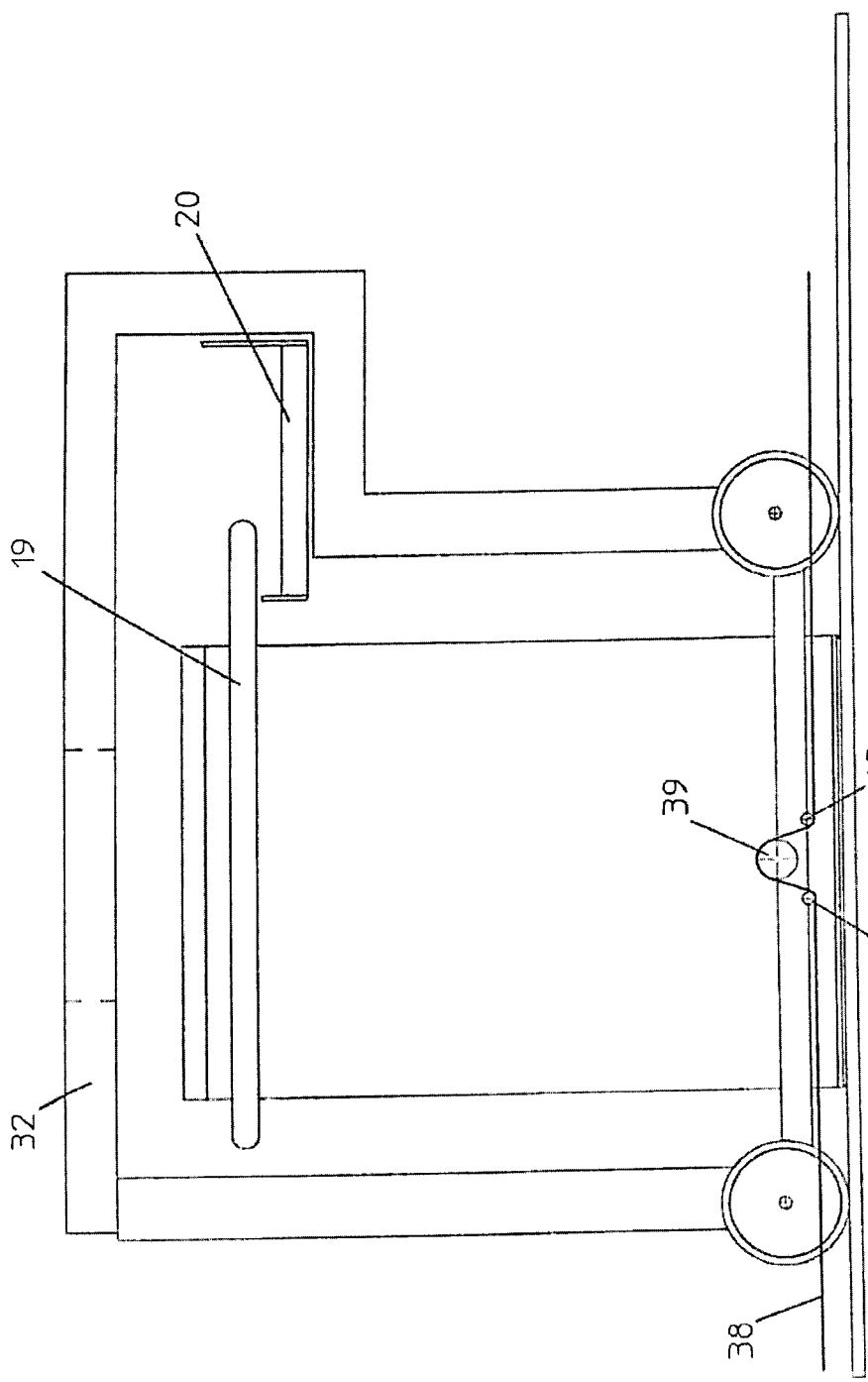

FIG.5

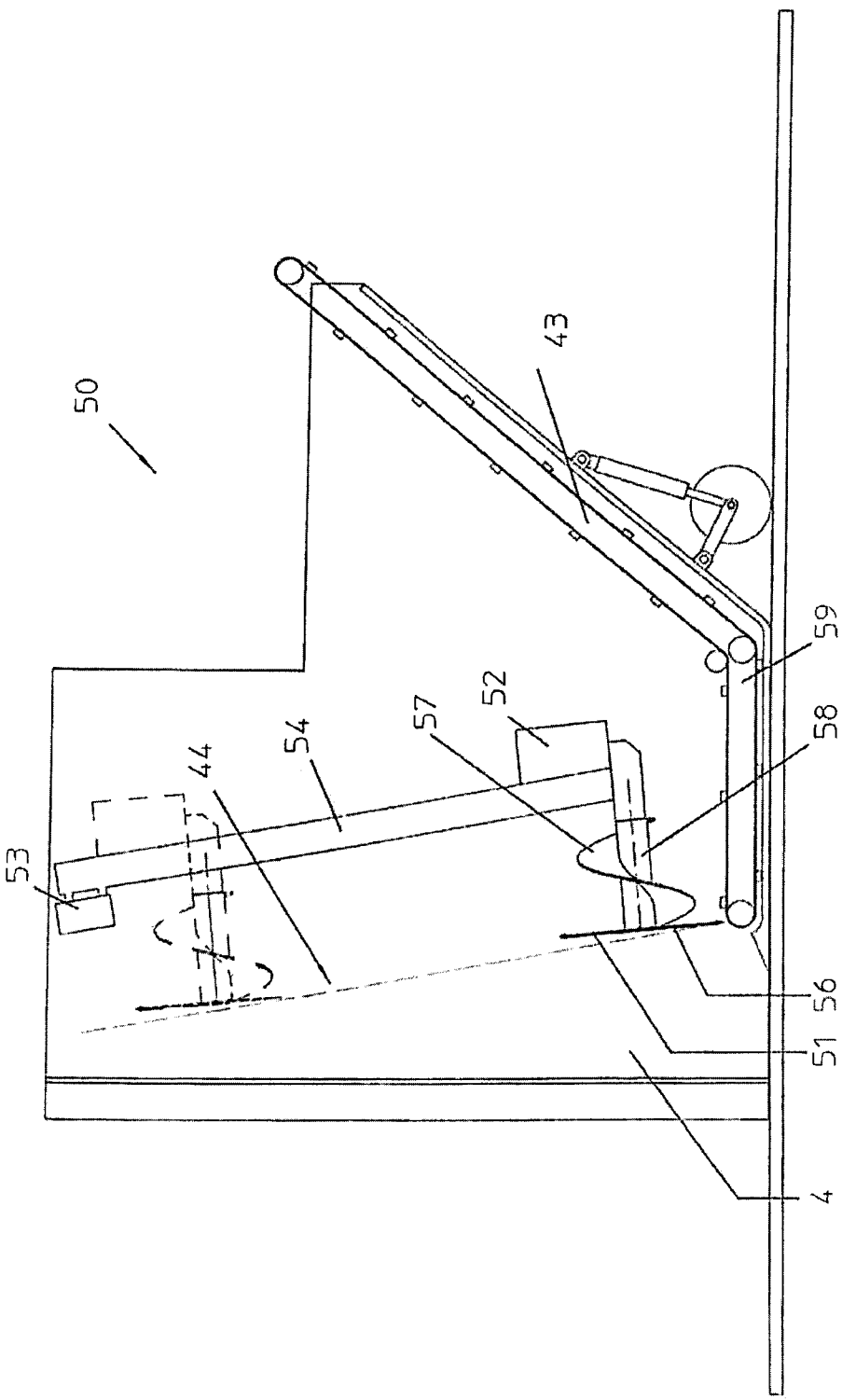

FIG.6

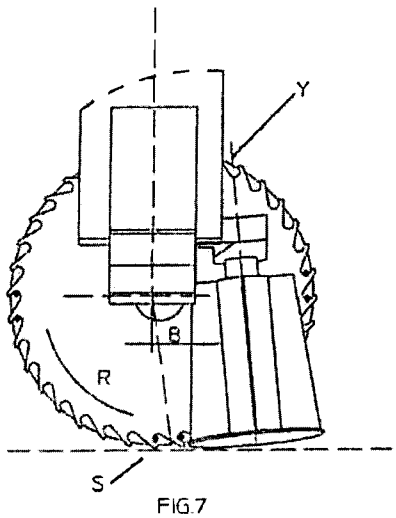

FIG.7

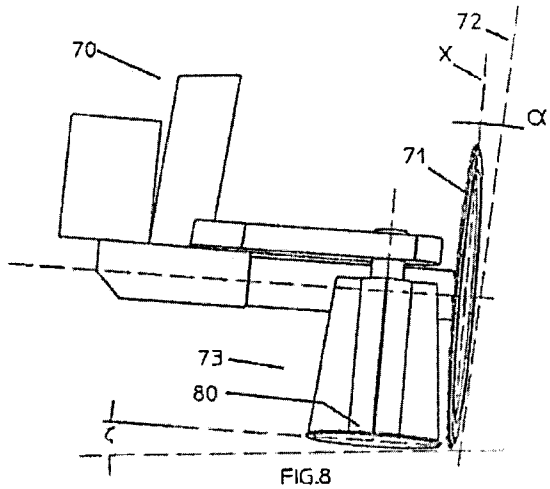

FIG.8

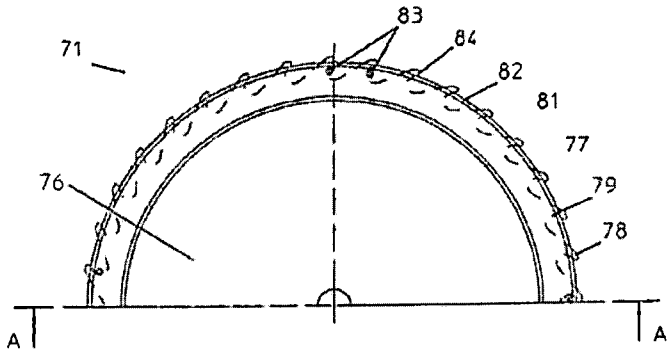

FIG.9

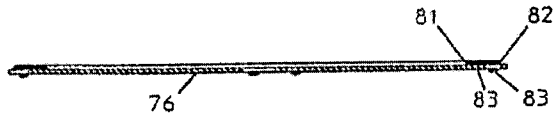

FIG.10A

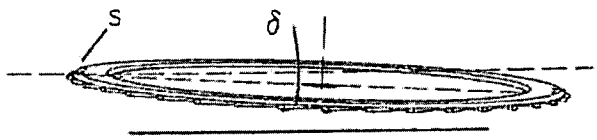

FIG.10B

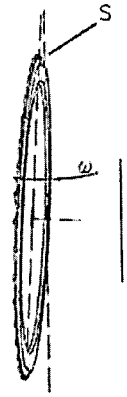

FIG 10C

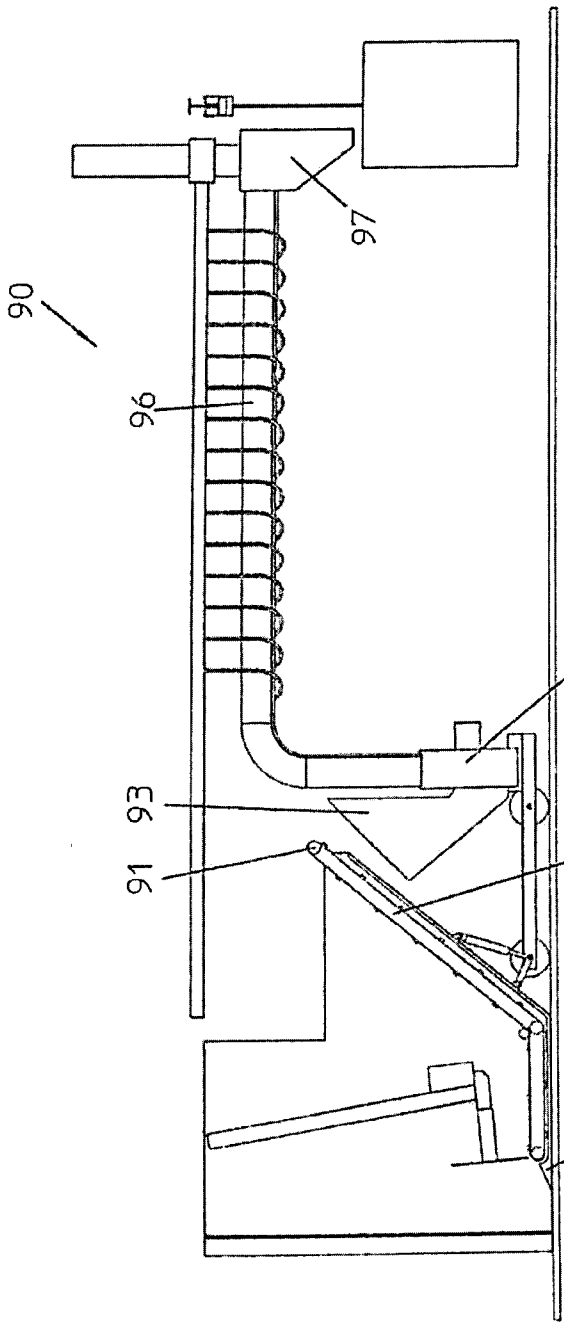

FIG.11

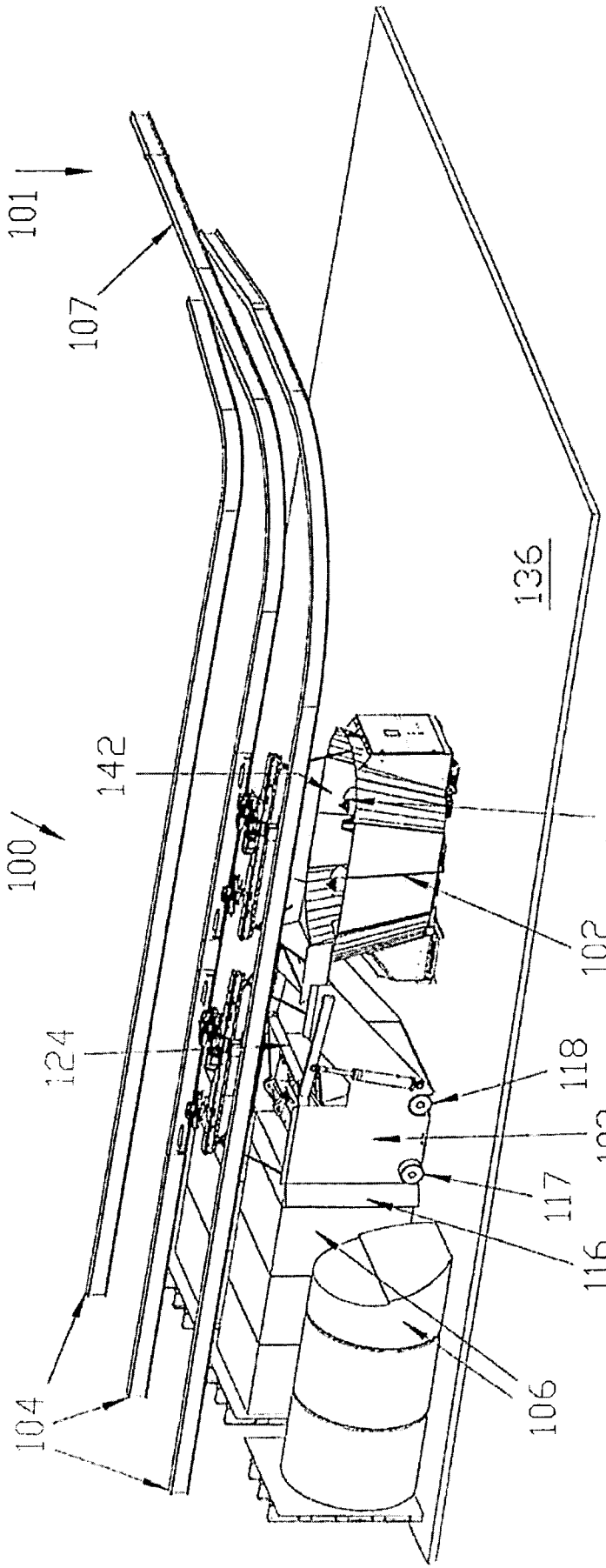

Fig.12

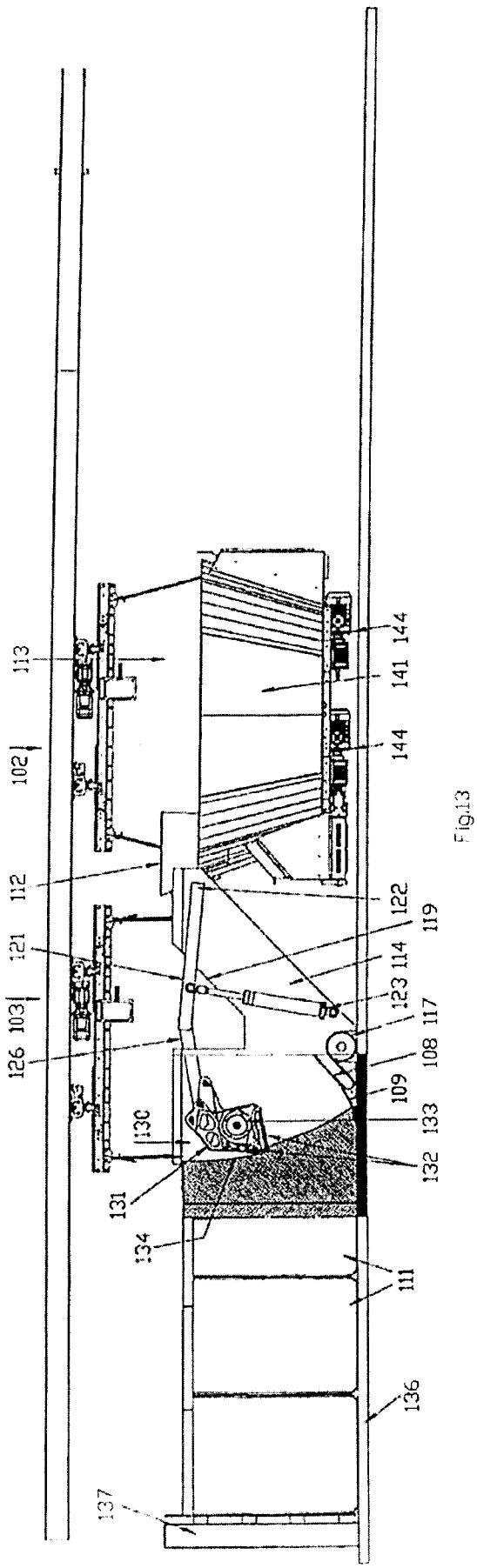
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Fig.13

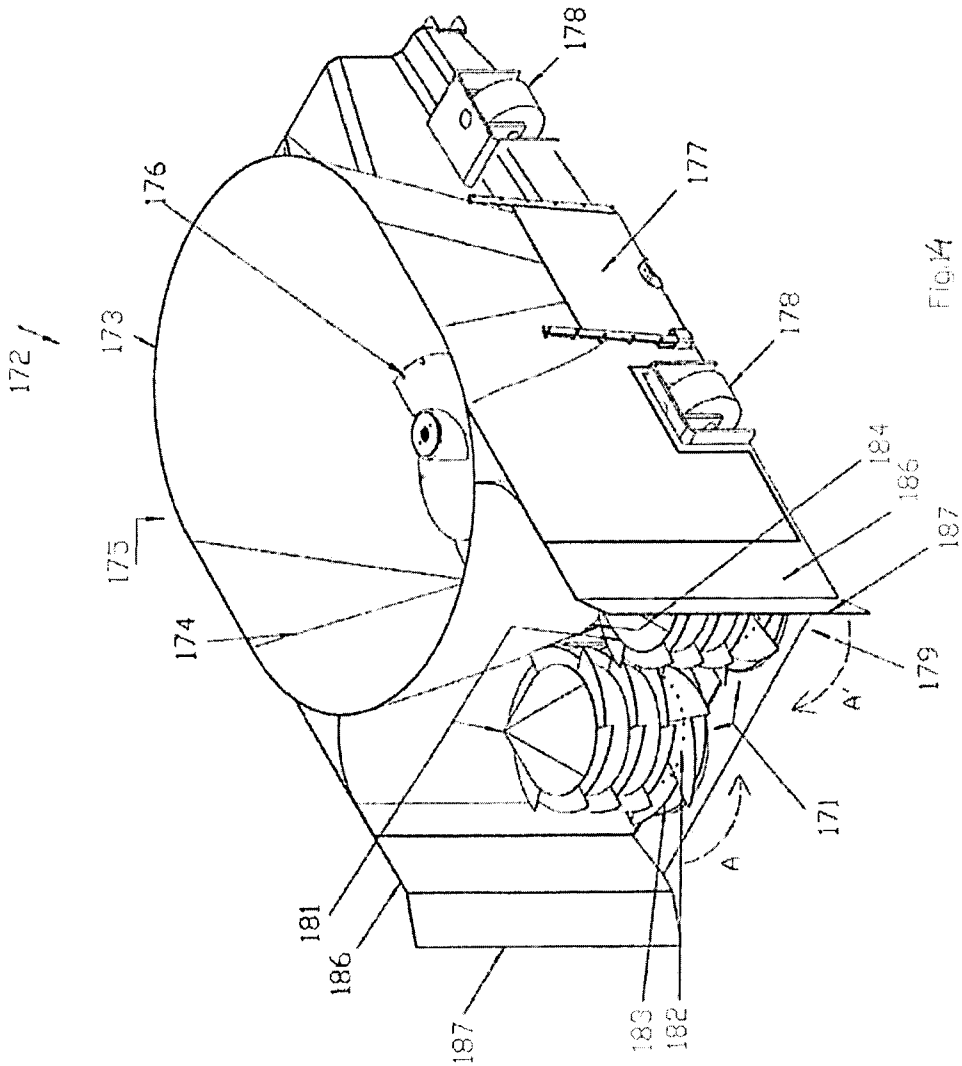
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Fig.14

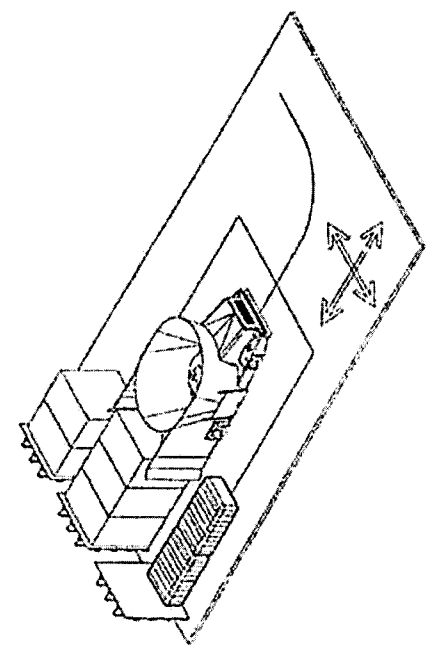


Fig.15b

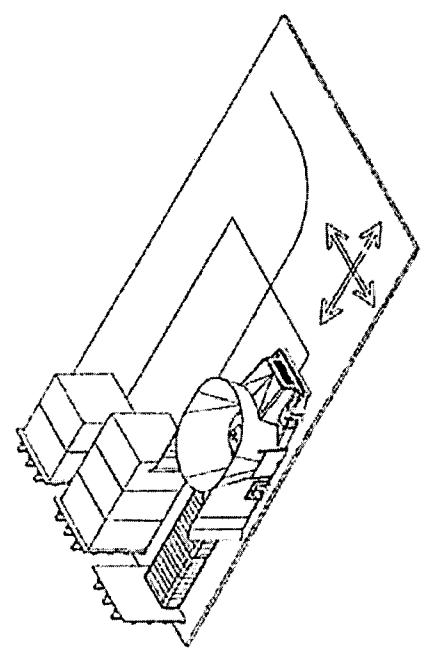


Fig.15d

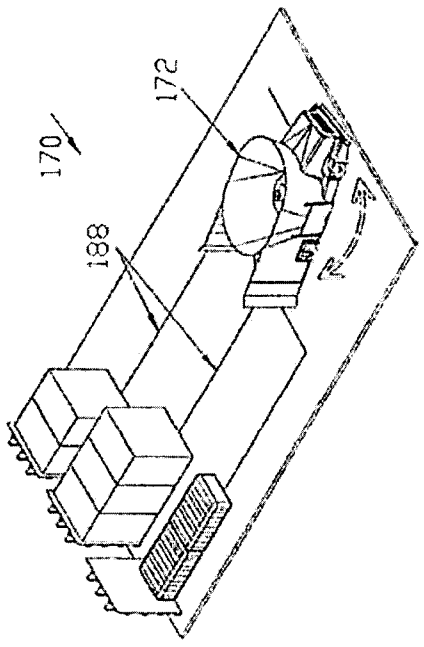


Fig.15a

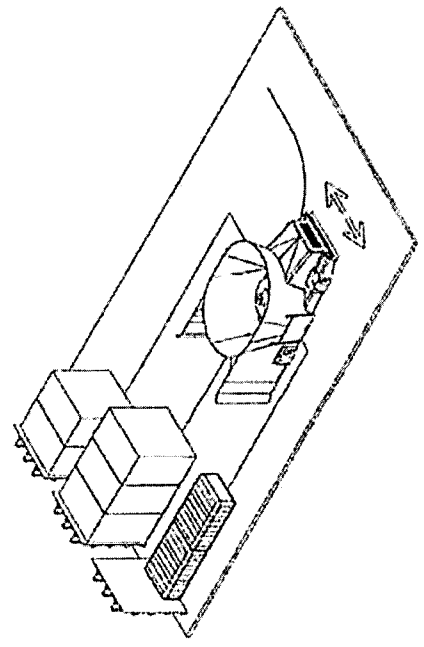
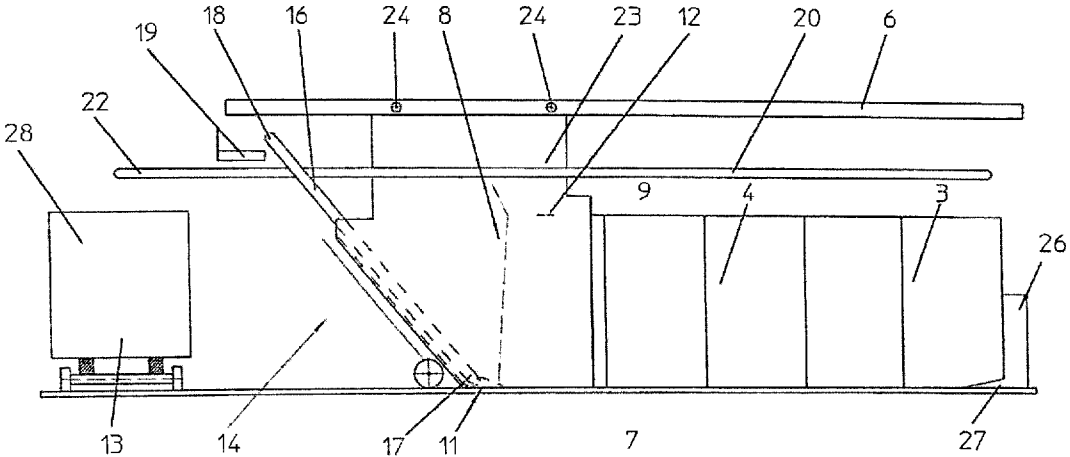


Fig.15c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