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The present invention relates to the field of cattle farming, and more particularly feeding farm animals.

A stable generally comprises a living area separated from a feed aisle by a feeding barrier allowing the farm animals present in the living area to pass their head through to obtain feed from the feeding aisle. The feeding barrier is for example a feeding grill.

Feed (fodder, pellets, etc.) is deposited along the feeding barrier. The composition and quantity of the feed are determined to provide the farm animal with an appropriate diet. While eating, the animals push the feed away from the feeding barrier. It is desirable to push the feed back toward the feeding barrier to allow the animals to eat the appropriate dose.

EP 1,779,722 A1 discloses vehicles for pushing feed back along the ground of a feeding barrier. A vehicle comprises a V-shaped scraper blade pointing forward to push feed back on the sides of the vehicle due to the movement thereof. Another vehicle comprises a rectilinear scraping blade rotatable around a vertical axis to push the feed back on the side of the vehicle by an alternating rotational movement of the scraping blade combined with an incremental movement of the vehicle. Still another vehicle comprises a rectilinear scraper blade extending parallel to the longitudinal direction of the vehicle and translatable along a transverse direction of the vehicle to push the feed back by an alternating translational movement combined with an incremental movement of the vehicle.

EP 2,007,191 A1 discloses an autonomous vehicle with no crew to push feed along the ground, comprising a carriage provided with a rotating circular element surrounding the carriage and mounted rotating around an axis close to the vertical, to push the feed along the ground against a feed barrier.

NL 9,400,771 A1 discloses vehicles for pushing feed along the ground.

DE 101 18 026 C1 discloses a tractor provided with a pusher device having a pusher member adjustable in particular by sliding along a transverse direction of the tractor.

One of the aims of the invention is to propose a pusher device for pushing feed along the ground in front of the vehicle that is effective and easy to implement.

To that end, the invention proposes a vehicle according to claim 1. In specific embodiments, the vehicle comprises one or more of the optional features of claims 2 to 15. The invention also relates to an installation for feeding farm animals according to claim 16.

The invention and its advantages will be better understood upon reading the following description, provided solely as an example and done in reference to the appended drawings, in which:

- Figures 1 and 2 are schematic perspective views of the front part of an autonomous vehicle with no crew, provided with a pusher device to push feed along the ground;

- Figures 3 and 4 are schematic front views of the vehicle moving along a feed barrier;

- Figures 5 and 6 are schematic top views of the vehicle moving along the feed barrier; and

- Figures 7 and 8 are side and perspective views of the vehicle further equipped with a feed distributing assembly.

The vehicle shown in Figures 1 to 6 is an automatic vehicle. It is autonomous and has no crew. It is designed to move automatically following a predetermined program, situating itself within its environment, optionally using a guide or beacons.

The vehicle 2 is configured to move in a feed aisle of a stable, along a feed barrier 3 separating the feed aisle from a living area for the farm animals, pushing the feed back along the ground against the feed barrier 3. The barrier allows the farm animal to pass its head through to eat feed placed on the ground along the feed barrier.

The vehicle 2 is provided to move along a longitudinal direction L corresponding to the rectilinear movement direction of the vehicle moving forward or backward.

In the rest of the description, the terms "longitudinal", "transverse", "vertical", "front", "rear", "left", "right", "top" and "bottom" extend in reference to the longitudinal direction L and the forward movement direction (see the top of Figures 5 and 6).

The vehicle 2 comprises a carriage 4 provided with wheels 6 rolling on the ground (Figure 3). The carriage 4 comprises at least one motorized drive wheel to command the movement of the vehicle 2 forward or backward and at least one steering wheel to control the direction of the vehicle 2.

As shown in Figures 5 and 6, the vehicle 2 comprises an automatic guiding device 8 to command the movement of the vehicle automatically.

The guiding device 8 for example comprises an electromagnetic sensor cooperating with a filament yarn buried in the ground or with magnetic terminals buried in the ground at a distance from one another. Alternatively, the guiding device comprises an optical sensor cooperating with a line drawn on the ground, marks drawn on the ground or marks at a height distributed throughout the stable. Alternatively, the device comprises a laser detector and reflective terminals distributed throughout the stable. Alternatively, the guiding device comprises a viewing device comprising at least one camera, preferably two cameras for

stereoscopic vision, and an image analysis device able to recognize the environment of the vehicle after learning.

The guiding device 8 commands the driving of the or each drive wheel and the orientation of the or each steering wheel to control the movements of the vehicle 2.

As illustrated in Figures 1 to 6, the vehicle 2 comprises a pusher device 12 for pushing feed along the ground in front of the vehicle 2.

The pusher device 12 comprises a pusher member 14—or scraper—configured to be moved along the ground to push feed along the ground laterally on the side of the vehicle 2 along a transverse direction T, due to the movement of the pusher device 12 along the longitudinal direction L, the transverse direction T being perpendicular to the longitudinal direction L.

The pusher member 14 here is formed to push the feed sideways on both sides of the pusher member 14. The pusher member 14 forms a scraping blade. It has a V-shape pointing toward the longitudinal direction, toward the outside of the vehicle 2, here toward the front.

The pusher member 14 has two lateral segments 16 (Figures 6 and 4), each oriented so as to push the feed back sideways on a respective side of the vehicle 2. Each lateral segment is inclined relative to the longitudinal direction L and the transverse direction T while being oriented toward the front and toward a respective lateral side of the vehicle. The two lateral segments 16 are connected by a convex curved intermediate segment 18 extending transversely.

The pusher member 14 is provided on its lower edge with a wearing strip 20 (Figures 1 to 4) by which the pusher member 14 rubs on the ground. The wearing strip 20 is replaced when it is worn out.

The pusher member 14 is translatable along the transverse direction T, between a retracted position (Figures 1 and 3), in which the pusher member 14, seen along the longitudinal direction L, fits in the width of the carriage 4, without protruding laterally relative to the carriage 4, and a deployed position (Figures 2 and 4), in which the pusher member 14 is transversely offset relative to the retracted position, the pusher member 14 protruding transversely from the carriage 4, on a lateral side thereof.

The pusher member 14 is preferably movable transversely in both directions, toward a right deployed position, protruding on the right side of the carriage 4, and a left deployed position, protruding on the left side of the carriage 4.

The pusher device 12 has an inactive configuration (Figures 1 and 3), in which the pusher member 14 is raised away from the ground, and an active configuration (Figures 2 and 4), in which the pusher member 14 is lowered to push feed along the ground.

Preferably, in the inactive configuration, the pusher member 14 is in the retracted position, as shown in Figures 1 and 3, so as not to protrude laterally from the carriage 4.

The pusher device 12 comprises a support 22 supporting the pusher member 14. The pusher member 14 is mounted on the support 22 while being translatable along the transverse direction T relative to the support 22. This allows the pusher member 14 to move between the retracted position and the deployed position.

The pusher member 12 comprises a deployment actuator to command the movement of the pusher member 14 along the transverse direction T between the retracted position and the deployed position. The deployment actuator is positioned between the pusher member 14 and the support 22.

The support 22 is mounted on the carriage 4 while being translatable along the vertical direction Z relative to the carriage 4 to lower the pusher member 14 in the active configuration of the pusher device 12 or to raise the pusher member 14 in the inactive configuration of the pusher device 12.

The pusher device 12 comprises a lifting actuator (not shown) to command the vertical movement of the support 22 between the inactive configuration and the active configuration. The lifting actuator is positioned between the support 22 and the carriage 4. The lifting actuator is for example a pneumatic, hydraulic or electric actuator.

The pusher device 12 comprises a frontal detection device 28 for detecting obstacles in front of the vehicle 2, in particular in front of the pusher device 12. The detection device 28 is configured to automatically command the stoppage of the vehicle 2 upon detecting an obstacle on the trajectory of the vehicle 2.

The detection device 28 here comprises a feeler 30 extending cantilevered in front of the pusher member 14. The feeler 30 extends transversely, substantially over the entire width of the vehicle 2. The feeler 30 is supported by at least one arm, here two arms 32. Each arm 32 extends along the longitudinal direction L. Each arm 32 is telescoping to allow the feeler 30 to withdraw when it strikes an obstacle.

The detection device 28 detects any contact of the feeler 30 with an obstacle and immediately commands the stoppage of the vehicle 2.

In front view of the pusher device 12, and in the lowered and retracted position of the pusher member 14 (Figure 3), the pusher member 14 does not protrude laterally relative to the feeler 30.

In front view of the pusher device 12, and in the lowered and retracted position of the pusher member 14 (Figure 4), the pusher member 14 protrudes laterally relative to the feeler 30.

The detection device 28 here is a detection device by contact. Alternatively, the detection device is a remote, contactless detection device. Such a detection device is for example an optical device with a camera and image analysis, a laser scanner device, an ultrasound scanner device or any other type of contactless obstacle detection device.

The detection device 28 has a low configuration (Figures 1 and 3), in which the detection device 28 detects obstacles from a first height H1, and a high configuration (Figures 2 and 4), in which the detection device 28 detects obstacles from a second height H2 greater than the first height H1.

The low configuration allows detection with a higher security level, while making it possible to detect the obstacle from the first height H1, and the high configuration allows detection with a lower security level, allowing obstacle detection only from the second height H2.

The second height H2 is chosen to be greater than the height of feed on the ground pushed back away from the feed barrier by farm animals, and thus to avoid needlessly stopping the vehicle 2 when it pushes the feed back along the ground.

The detection device 28 is placed in the low configuration when the pusher device 12 is in the active configuration, to ensure a high security level, and the detection device 28 is placed in the high configuration when the pusher device 12 is in the active configuration.

In the case at hand, the feeler 30 is vertically movable between a low position (Figure 3) corresponding to the low configuration, and a high position (Figure 4), corresponding to the high configuration. The first height H1 corresponds to the height of the lower edge of the feeler 30 in the low position, and the second height H2 corresponds to the height of the lower edge of the feeler 30 in the high position.

The detection device 28 is for example mounted on the support 22. The detection device 28 is mounted to be vertically movable on the support 22 with a sufficient amplitude making it possible to raise the feeler 30 into the high position while offsetting the downward movement of the support 22 in order to lower the pusher member 14 near or into contact with the ground.

The detection device 28 comprises an adjusting actuator (not shown) to lower the feeler 30 or raise the feeler 30. The adjusting actuator is positioned between the support 22 and the arms 32. The adjusting actuator is for example a pneumatic, hydraulic or electric actuator.

The pusher device 12 incorporating the detection device 28 forms a pusher module able to be mounted on an existing vehicle.

During operation, when the vehicle 2 moves, by default, the detection device 28 is positioned in the low configuration and the pusher member 14 is raised.

To push feed back along the ground toward a feed barrier, the detection device 28 is positioned in the high configuration and the pusher member is lowered.

The guiding device 8 commands the vehicle 2 in order to move the vehicle 2 along the feed barrier 3, preferably at a constant predetermined passage distance from the feed barrier.

Due to the movement of the vehicle, the pusher member 14 pushes feed found on the trajectory of the vehicle 2 toward the feed barrier 3.

As illustrated in Figure 5, the vehicle 2 for example performs a first passage at the predetermined passage distance D relative to the feed barrier, the pusher member 14 being lowered and in the retracted position.

As illustrated in Figure 6, the vehicle 2 next performs a second passage, still at the same passage distance D, but the pusher member 14 is lowered in the deployed position. The pusher member 14 is laterally offset relative to the carriage 4, toward the feed barrier 3.

The carriage 4 thus remains at the passage distance D from the feed barrier 3, while making it possible to bring the feed closer to the feed barrier 3 at an appropriate distance for consumption thereof by the farm animal.

Preferably, the guiding device 8 is configured such that the vehicle 2 moves at a first speed when the detection device 28 is in the low configuration, and at a second speed when the detection device 28 is in the high configuration, the second speed being lower than the first speed.

This makes it possible to limit the consequences of a potential impact with a low obstacle that is not detected because the detection device 28 is in the high configuration.

As illustrated in Figures 7 and 8, in one embodiment, the vehicle 2 is provided with a front pusher device 12 and a rear pusher device 12, for example if the vehicle is configured to operate in forward and reverse movement, which for example makes it possible to perform roundtrips without turning around.

As illustrated in Figures 7 and 8, in one embodiment, the vehicle 2 is advantageously provided with a distributing assembly 34 to distribute feed along the feed barrier 3. The vehicle 2 thus forms an automatic feed distributing vehicle.

The distributing assembly 34 comprises a container 36, a separator 38 to disentangle feed received in the container 36, a conveyor 40 to push feed received in the container 36 toward the separator 38, and a distributor 42 to distribute the feed on the side of the vehicle 2.

The conveyor 36 is for example a chain or belt conveyor.

The separator 38 comprises at least one rotor 44, here two parallel rotors 44. The rotors 44 are oriented horizontally and rotating around their respective axes. The rotation of the rotors 44 makes it possible to separate the feed pushed by the conveyor 36 toward the separator 38. The feed for example comes from silage and is initially compacted when it is poured into the container 36.

The distributor 42 is a belt distributor emerging laterally on the side of the vehicle 2 in order to deposit the feed along a feed barrier 3 along which the vehicle 2 moves, for example between the vehicle 2 and the feed barrier 3.

Maintaining a same passage distance D upon the first passage and the second passage allows the distributor 42 to deposit the feed appropriately along the feed barrier 3 during two passages.

Maintaining a same passage distance D on the first passage and the second passage makes it possible to maintain a sufficient distance relative to the farm animal to avoid injuring the animals.

The transverse movement of the pusher member 14 makes it possible to adjust its transverse position to push the feed back appropriately while retaining the passage distance D for the vehicle 2.

Upon the first passage and/or the second passage, the vehicle 2 distributes feed. The feed is deposited along the feed barrier by the distributor.

The vehicle 2 preferably moves autonomously to collect feed in automated feed loading stations, then to distribute the feed along the feed barriers. WO 2010/094902 discloses an automated installation for feeding animals comprising such an autonomous vehicle with no crew and stations for preparing feed to be distributed by the vehicle.

As shown in Figures 7 and 8, in one embodiment, the vehicle 2 comprises a lateral detection device 50, for example comprising lateral feelers 52 extending along the lower edge

of a lateral fairing 54 of the vehicle, to detect obstacles touching the vehicle on the side. In the deployed position, the pusher member 14 extends laterally past the lateral feelers 52.

When the vehicle 2 passes along the feed barrier 3, the laterally offset pusher member 14 protects the feelers 52 that are not activated by the pushed feed.

The vehicle 2 is independently provided with two pusher devices 12, a side detection device 50 or a distributing assembly to distribute feed.

The invention is not limited to the illustrated embodiment.

In one alternative, the vehicle is movable along a railroad track provided on the ground. In another embodiment, the vehicle is suspended from a rail along which it moves. In both of these alternatives, the vehicle is preferably autonomous and unmanned. The vehicle moves automatically along the railroad track or the rail to push the feed back along the ground and, if applicable, to collect feed in automated feed loading stations.

Alternatively, the scraping device to push feed back is mounted on a vehicle with a crew, the vehicle having a control station for an operator. The vehicle comprises a manual device for controlling the direction or is guided along a railroad track provided on the ground or suspended from a rail. When the vehicle is not autonomous, the detection device is optional.

Combining a pusher device and an obstacle detection device is interesting independently of the type of pusher member.

Thus, generally, the invention relates to a pusher device for pushing feed along the ground, intended to equip a vehicle, the pusher device comprising a support and a pusher member supported by the support, the pusher member being provided to push feed along the ground, and a detection device for detecting an obstacle present in front of the pusher device.

Preferably, the pusher device is configured to lower the pusher member near the ground or to raise the pusher member away from the ground, and the detection device has a low configuration to detect obstacles in front of the pusher device from a first height relative to the ground when the pusher member is raised in a high configuration to detect obstacles in front of the pusher device from a second height greater than the first height when the pusher member is raised.

Patentkrav

1. Køretøj, som omfatter en vogn (4) og en skubbeindretning (12), der er monteret ved en ende af vognen, til at skubbe foder på jorden på siden af køretøjet, hvilken skubbeindretning (12) omfatter en bærer (22) og et skubbeelement (14), som bæres af bæreren, hvilket skubbeelement (14) er tilvejebragt for at skubbe foder på jorden på siden af køretøjet i en tværgående retning (T) af køretøjet som følge af køretøjets bevægelse i en langsgående retning (L) af køretøjet, som er vinkelret på den tværgående retning (T), **kendetegnet ved, at** skubbeelementet (14) er bevægeligt i forhold til bæreren (22) i translation i den tværgående retning (T) mellem en tilbagetrukket position, i hvilken skubbeelementet befinder sig mellem vognens (4) sidekanter, og mindst en udfoldet position, i hvilken skubbeelementet (14) rager frem lateralt i forhold til vognen (4).

2. Køretøj ifølge krav 1, hvor skubbeindretningen (12) omfatter en udfoldningsaktuator til styring af bevægelsen af skubbeelementet (14) i den tværgående retning (T) mellem den tilbagetrukne position og den udfoldede position.

3. Køretøj ifølge krav 1 eller 2, hvor skubbeelementet (14) er bevægeligt i den tværgående retning (T) mellem en tilbagetrukket position og to udfoldede positioner, der befinder sig på begge sider af den tilbagetrukne position.

4. Køretøj ifølge et hvilket som helst af de foregående krav, hvor skubbeelementet (14) er bevægeligt, således at skubbeelementet bringes nærmere eller fjernes (14) fra jorden, når skubbeindretningen er monteret på et køretøj.

5. Køretøj ifølge et hvilket som helst af de foregående krav, hvor skubbeelementet (14) er bevægeligt i en vertikal retning (Z), der er vinkelret på den langsgående retning (L) og den tværgående retning (T).

6. Køretøj ifølge et hvilket som helst af de foregående krav, hvor bæreren (22) er bevægelig i en vertikal retning (Z), der er vinkelret på den langsgående retning (L) og den tværgående retning (T).

7. Køretøj ifølge et hvilket som helst af de foregående krav, som omfatter en detekteringsindretning (28) til detektering af en forhindring, der befinder sig foran skubbeindretningen (12).

8. Køretøj ifølge krav 7, hvor detekteringsindretningen (28) har en lav konfiguration til detektering af forhindringer foran skubbeindretningen (12) fra en første højde (H1) i forhold til jorden og en høj konfiguration til detektering af forhindringer foran skubbeindretningen (12) fra en anden højde (H2), der er højere end den første højde (H1).

9. Køretøj ifølge krav 7 eller 8, hvor detekteringsindretningen anvender detektering med eller uden kontakt.

10. Køretøj ifølge et hvilket som helst af kravene 7 til 9, hvor detekteringsindretningen (28) omfatter en føler (30) til detektering af en forhindring, der rører føleren (30), hvilken føler (30) strækker sig i den tværgående retning (T), med afstand til skubbeelementet (14) i den langsgående retning (L).

11. Køretøj ifølge krav 10, hvor, set i den langsgående retning (L), skubbeelementet (14) i tilbagetrukket position er i flugt med føleren (30), og skubbeelementet i udfoldet position rager frem transversalt i forhold til føleren (30).

12. Køretøj ifølge et hvilket som helst af de foregående krav, som er autonomt og ubemandet.

13. Køretøj ifølge et hvilket som helst af de foregående krav, som omfatter en automatisk føringsindretning.

14. Køretøj ifølge et hvilket som helst af de foregående krav, hvor vognen (4) er forsynet med hjul til kørsel på jorden, omfattende mindst et motoriseret drivhjul og mindst et styrehjul.

15. Køretøj ifølge et hvilket som helst af kravene 1 til 12, som er bevægeligt langs et spor, der er tilvejebragt på jorden eller ophængt i en skinne, langs

hvilken det bevæger sig.

16. Anlæg til fodring af landbrugsdyr, omfattende et køretøj ifølge et hvilket som helst af de foregående krav.

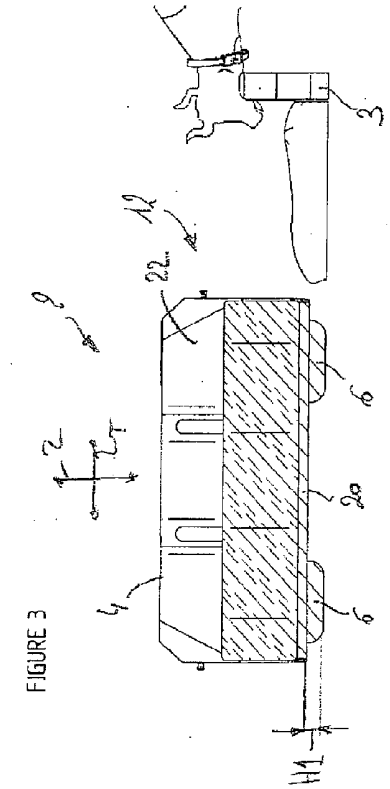

FIGURE 3

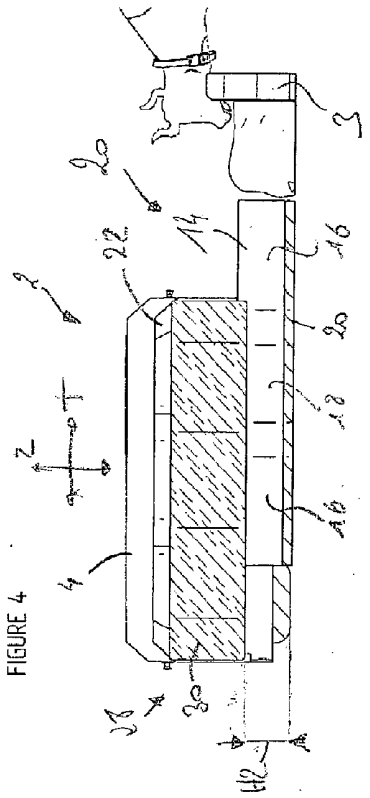

FIGURE 4

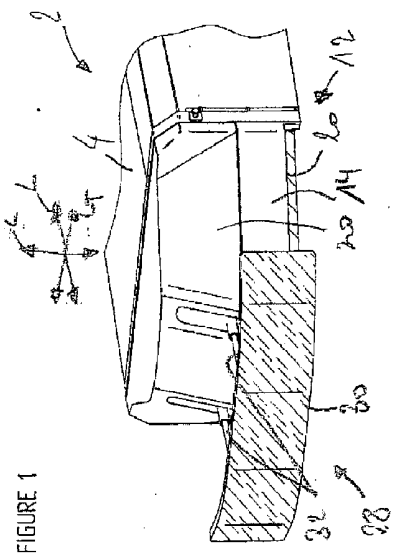

FIGURE 1

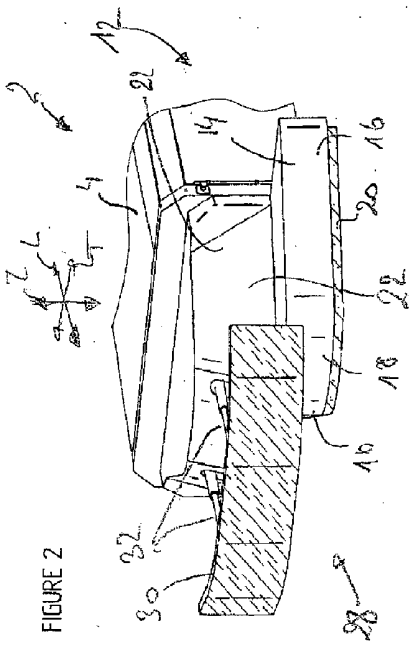

FIGURE 2

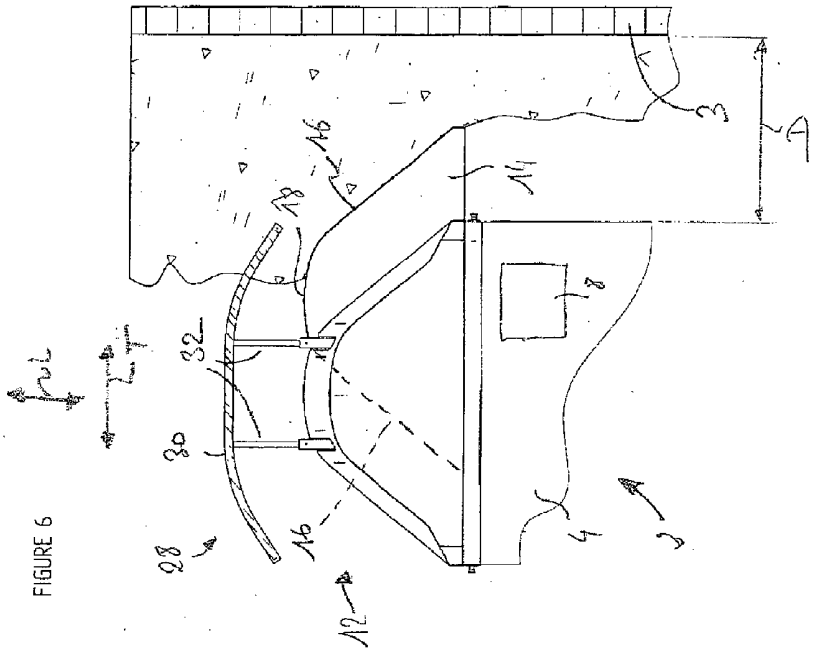

FIGURE 6

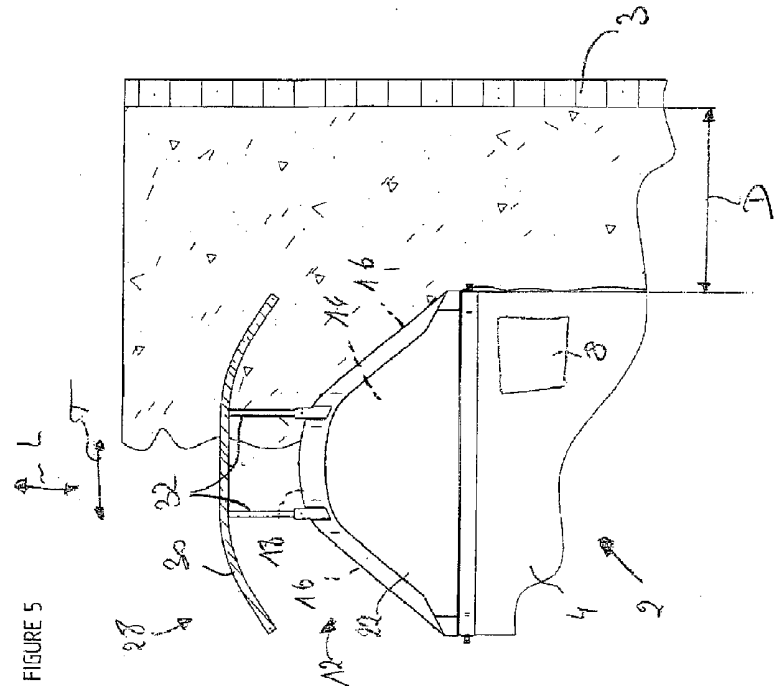

FIGURE 5

Fig 4

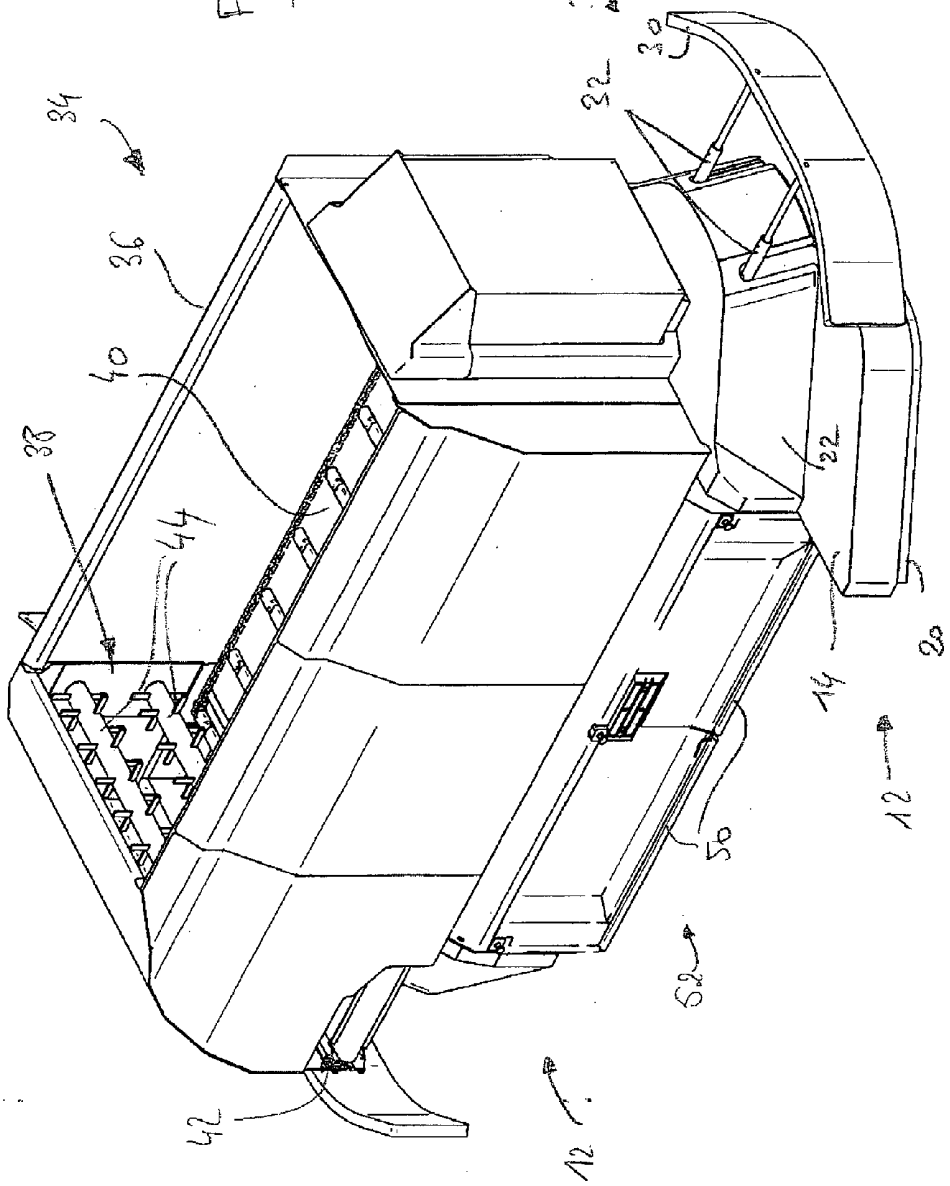

FIG 5