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(73) Patenthaver: **DeLaval Holding AB, Box 39, 147 21 Tumba, Sverige**

(72) Opfinder: **DE VILLIERS, Pierre, Blickavägen 35, S-146 50 Tullinge, Sverige**

(54) Benævnelse: **FODRINGSSYSTEM OG FREMGANGSMÅDE**

(56) Fremdragne publikationer:
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NL-C2- 1 030 090
US-A- 4 712 511

DESCRIPTION

TECHNICAL FIELD OF THE INVENTION

[0001] The present invention generally relates to a system and a method for feeding at least one animal with mixed feed, especially mixed feed comprising solid ingredients, according to a selected recipe.

BACKGROUND OF THE INVENTION

[0002] Feeding arrangements for animals on a farm typically have different sections or areas intended for different groups of animals respectively. The different groups of animals may have different needs with regards to their feed composition so as to optimise the milk production, body condition scoring (BCS) or other desired qualities of the animals. Important for many feeding schemes is that there is a constant supply of feed for the animals so that there is a constant feed available to optimize dry matter intake.

[0003] WO 2005/067704 discloses an arrangement for feeding animals on a farm comprising an on-farm analyzer device provided for measuring, e.g. at least on a daily basis, the amount of a constituent of solid feed to be fed to said animals, and a feeding device provided for feeding said animals, wherein the feeding depends on the result of said measurement, and the amount of the constituent of solid feed is measured immediately prior to the feeding of said animals. By the arrangement, a proper solid feed mix with a balanced composition can be given to the animals.

[0004] FR 2689727 discloses equipment including a number of positions for distributing a feed mixture. These are supplied via a mixer with powdered milk, water, pure milk from a tank and various additives from a battery of dosing pumps. The pumps are controlled by a computer system to dispense required quantities. Each animal arriving at a position is identified, and supplied with an amount of food - possibly 500 grams - and this is recorded for the particular animal. If there is any left when the animal leaves, this is also noted, so that an accurate record of consumption is produced. The invention provides accurate control of the feed amount taking into consideration varying conditions e.g. season, and improves the well-being of the individual animal by allowing it to eat or drink whenever it feels hungry or thirsty.

[0005] US 4712511 discloses a feed delivery system for individualized rations for specific livestock including a programmable controller responsive to the status of the livestock. Individual elements of a feed ration are combined to meet the requirements of a specific animal and delivered only to that animal. Plural delivery containers may each be loaded with different rations for different animals. The inventive concept may also be used for delivery of food to hospital patients having different dietary requirements, for delivery of different components to various worksites in a manufacturing process, or for delivery of chemicals to a chemical process.

[0006] DE 20115929 U 1 discloses a vehicle for mixing and discharging biomass, with at least one remotely fillable mixing chamber which contains a vertical mixing screw and each of which is assigned at least one, in particular lateral, discharging device, a chassis with a propelling drive, a drive system for optionally driving the vertical mixing screw, the discharging device and the chassis, at least one electronic, programmable biomass weighing device, and an automatic computerized control device. In one embodiment there is optionally a further weighing device provided at the respective feeding place, said weighing device outputting a requirement signal if fodder is no longer present or if the fodder has dropped below a minimum weight. This requirement signal is picked up by the control device and, via a weighing computer assigned to the respective weighing device, used for approaching and charging the feeding place.

[0007] NL 1030090 C and intermediate document WO 2008/097080 A1 disclose a feeding system and method according to the preamble of independent claims 1 and 12 respectively.

SUMMARY OF THE Invention

[0008] It is an object of the present invention to provide a system and a method, respectively, for feeding at least one animal with mixed feed, especially mixed feed comprising solid ingredients, according to a selected recipe so that the animal always has desired access to feed and that the feed may be optimally composed with regard to composition of the ingredients of the feed.

[0009] It is also an object of the present invention to provide such a system and such a method, by which the amount of feed supplied to the animal can be controlled.

[0010] It is a further object of the invention to provide such a system and such a method which are reliable and fully or partly automated.

[0011] The above objects, among others, are according to the present invention attained by systems and methods as specified in the appended claims.

[0012] According to claim 1 there is provided a system for feeding an animal with mixed feed, especially mixed feed comprising solid ingredients, according to a selected recipe comprising a mixing device, a control device, a feed area, and a feed measurement arrangement such as a feed weighing arrangement.

[0013] The control device is connected to the mixing device and controls the mixing device to mix a batch of feed according to the selected recipe. The feed area is adapted for receiving the batch of mixed feed and for offering the batch to the animal. The feed measurement arrangement is located in connection with the feed area and measures repeatedly the amount of mixed feed that is left for consumption by the animal.

[0014] The control device, which is connected to the feed measurement arrangement, compares values of the repeatedly measured amount of mixed feed that is left for consumption with a threshold value and controls the mixing device to mix a further batch of feed according to the selected recipe when the values of the repeatedly measured amount of mixed feed that is left for consumption fall below the threshold value.

[0015] The control device is arranged to set said threshold value so that the further batch of mixed feed will be supplied to the feed area before the animal has consumed the entire amount of mixed feed according to the selected recipe that is left for consumption.

[0016] By such a system it can be ensured that the animal always has desired access to mixed feed according to the selected recipe. Hereby, the dry matter intake can be optimized.

[0017] In one embodiment of the invention the mixing device or a separate feed supplying device is an automated device provided for automatically supplying each of the batches of mixed feed according to the selected recipe to the feed area.

[0018] Hereby, an entirely automated feeding arrangement that supplies the animal with feed is provided.

[0019] In another embodiment of the invention a notifying apparatus such as for instance a device for visual or sound notification is provided for automatically notifying the farmer in connection with the mixing of the further batch of feed according to the selected recipe in order to alert the farmer that the further batch of mixed feed shall be supplied to the feed area.

[0020] This alert could be made early so as to allow the farmer to plan his/her working operations.

[0021] In yet another embodiment of the invention the feeding system of the invention is implemented at a farm wherein a plurality of separated groups of animals are supplied group wise with feed, each according to a respective selected recipe. The feeding system measures and supplies mixed feed to each of the groups of animals separately according to any of the above approaches. According to claim 12 there is provided a method for feeding an animal with mixed feed according to a selected recipe. According to the feeding method a batch of feed, especially feed comprising solid ingredients, is mixed according to the selected recipe and the batch of mixed feed is offered to the animal at a feed area.

[0022] The amount of mixed feed according to the selected recipe that is left at the feed area for consumption is repeatedly measured; values of the repeatedly measured amount of mixed feed that is left for consumption are compared with a threshold value; and a further batch of feed is mixed according to the selected recipe as soon as the values of the repeatedly measured amount of mixed feed that is left for consumption fall below the threshold value.

[0023] Further characteristics of the invention, and advantages thereof, will be evident from the following detailed description of embodiments of the invention given hereinafter and the accompanying Figs. 1-6, which are given by way of illustration only, and thus are not limitative of the present invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0024]

Fig. 1 is a schematic view of a system for feeding at least one animal according to a first embodiment of the claimed invention.

Figs. 2a and 2b are schematic views of two embodiments of a mixer as being comprised in the system of Fig. 1.

Fig. 3 shows schematically a first embodiment of a method for automated delivery of a batch of mixed feed.

Fig. 4 shows schematically a second embodiment of a method for automated delivery of a batch of mixed feed.

Fig. 5 shows schematically an embodiment of a method for delivery of a batch of mixed feed that requires manual intervention by a farmer.

Fig. 6 shows schematically a flowchart of a method for feeding at least one animal according to an embodiment of the invention.

DETAILED DESCRIPTION OF EMBODIMENTS

[0025] A system for feeding, which is shown in Fig. 1, comprises a mixer or mixing device 1, a control device 2, a feed area 3, and a feed measuring arrangement 4.

[0026] The control device 2 is operatively connected to the mixing device 1 and is provided for controlling the mixing device 1 to mix or make a batch of feed comprising solid ingredients according to a selected recipe. The feed area 3 is provided for receiving the batch of mixed feed according to the selected recipe and for offering the batch of mixed feed to at least one animal. The measuring arrangement 4 is located in connection with the feed area 3 and is provided for repeatedly or continuously measuring the amount of existing remaining mixed feed according to the selected recipe at the feed area 3. The control device 2 is operatively connected to the measuring arrangement 4 and is provided to repeatedly or constantly compare the measured existing remaining amount of feed at the feed area 3 with a threshold value and when it falls below the threshold, to control the mixing device 1 to mix or make a new batch of feed according to the selected recipe.

[0027] The feed area 3 may comprise, as being illustrated, a plurality of feed areas or tables FA1, FA2, FA3 ... FAk. Each of a plurality of animals may have access to a respective one of the feed tables FA1, FA2, FA3 ... FAk and each of animals could be fed with feed mixed according to a respective selected recipe that is adjusted for that animal. Therefore, the different feed tables FA1, FA2, FA3 ... FAk are intended for feed of different recipes.

[0028] The measuring arrangement 4 measures continuously the amount of existing remaining mixed feed at each feed table FA1, FA2, FA3 ... FAk separately and sends the measurement data to the control device 2. In the case of having a plurality of feed tables FA1, FA2, FA3 ... FAk, each feed table has its own measuring unit as illustrated in Fig. 1 by M1, M2, M3 ...Mk.

[0029] The control device 2, which is operatively connected to both the mixing device 1 and the measuring arrangement 4, comprises storage means for storing different recipes intended for the different feed tables FA1, FA2, FA3 ... FAk, and processing means for comparing the information received from the measuring arrangement 4 with at least one threshold value. As the control device 2 detects that the amount of existing remaining mixed feed at one of the feed tables FA1, FA2, FA3 ... FAk has fallen below a certain threshold value, it automatically controls the mixing device 1 to make a new batch of feed according to the recipe for that feed table.

[0030] The threshold values are typically chosen, according to the invention, in such a way that ample time is given for the mixing device 1 to mix a new batch of feed and for delivery to the feed tables before the animals at that feed table run out of feed, i.e. it is preferable that the making of a new batch of feed is started well before the amount of existing remaining mixed feed at the feed area is zero.

[0031] The feed measuring arrangement 4 may be realized in several ways. It is preferable that the measuring arrangement is a weighing arrangement such as a weighing arrangement comprising weigh-bars, but also other solutions are possible such as level detectors, e.g. optical level detectors, volume estimating devices, and the like.

[0032] The recipe stipulates the different ingredients the mixing device 1 is to use when mixing a batch of feed. The different ingredients are illustrated in Fig. 1 by I1, I2, I3 ... In.

[0033] The mixing device 1 can be realized in several ways.

[0034] Fig. 2a shows an embodiment where the mixing device 1 may collect different ingredients, such as various solid ingredients, according to a selected recipe from various stations, magazines, silos, or storage areas 5 that are separated from each other.

[0035] Fig. 2b shows another embodiment wherein the mixing device 1 comprises different compartments 6 intended for different solid ingredients that are used to mix a batch of feed according to a selected recipe. In this embodiment the mixing device 1 preferably has means to detect if the level of the ingredient in any of the different compartments falls below a certain threshold value so that it can be filled up.

[0036] It is also preferable to have the feeding system fully automated so that no manual intervention is needed, i.e. a new batch of mixed feed is automatically delivered to a feed area or feed table. This can be implemented in numerous ways as exemplified by Figs. 3-5 respectively.

[0037] Fig. 3 shows an embodiment in which the mixing device 1 is movable so as to move to the specific feed table FA1, FA2, FA3 ... FAk and make a new batch of mixed feed, especially mixed feed comprising solid ingredients, for that feed table in place.

[0038] Fig. 4 shows an embodiment in which an automated feeder 7 is arranged to collect the batch of mixed feed from the mixing device 1 and to deliver to a feed table FA1, FA2, FA3 ... FAk.

[0039] Fig. 5 shows another embodiment in which a batch of mixed feed is delivered manually. Here, the control device notifies a farmer that a new batch of mixed feed is ready for delivery to one feed table FA1, FA2, FA3 ... FAk where the amount of existing remaining mixed feed at that feed table has fallen below a certain threshold value. The notification of the farmer can be realized in several ways, an audible alarm, a message on a display and/or by sending an SMS to the farmer's cellular phone as a few examples.

[0040] Each of the feed tables FA1, FA2, FA3 ... FAk can be accessible to a plurality of animals. On a farm it is often the case that different animals have different needs regarding their respective feed composition. The present invention provides an arrangement for also very large-scale farms with many animals, where the animals are grouped into groups G1, G2, G3 ... Gk (see Fig. 1) with regards to their individual feed composition needs. For instance, the animals may be grouped into different groups based on their lactation statuses and/or their levels of milk production. The feed tables FA1, FA2, FA3 ... FAk should therefore be supplied with feed of different recipes regarding feed composition intended for the different groups G1, G2, G3 ... Gk respectively. Each feed table FA1, FA2, FA3 ... FAk is accessible for a specific group G1, G2, G3 ... Gk of animals of 1 up to e.g. 100 animals.

[0041] The present invention is suitable for use in combination with total mixed ration (TMR) feeding programs and partially mixed ration (PMR) feeding programs. TMR is defined as those with all the roughage, ensilage, concentrate and grain ingredients blended together, formulated to specific nutrient concentration and fed free choice. In PMR programs, at least one component of the feed is given to the animals (cows) on an individual basis. The different recipes for the different areas may be based on TMR and/or PMR.

[0042] In particular, the invention provides for the use of feeding schemes to optimize dry matter intake, e.g. by ensuring that the animal(s) always has/have desired access to mixed feed according to the selected recipe.

[0043] The present invention is also directed to a method for feeding at least one animal with mixed feed, especially mixed feed comprising solid ingredients, according to a selected recipe. According to the method as depicted in the flowchart of Fig. 6, a batch of mixed feed is mixed by the mixing device according to a selected recipe (step 62). Then, the batch of mixed feed is offered to the at least one animal at the feed area (step 63). The amount of existing remaining feed at the feed area is measured (step 64). Next, the measured amount of existing remaining feed at the feed area is compared with a threshold value (step 65). If the amount of existing remaining feed at the feed area has fallen below the threshold, the method returns to step 62 wherein a new batch of mixed feed is mixed by the mixing device according to the selected recipe. If the amount of existing remaining feed at the feed area is still above the threshold value, the method returns to step 64 to again measure the amount of existing remaining feed at the feed area, possibly after a short time delay.

[0044] Steps 64 and 65 thus form a loop of repeatedly measuring and comparing until the threshold is passed. Steps 62 and 63 forms a procedure of feed mixing and delivering, which is performed each time the measured amount of existing remaining feed at the feed area is below the threshold value.

[0045] The present invention is suitable for many different animals. The present invention is very suitable for e.g. cows wherein the composition of and the constant accessibility to the feed affect the amount and the quality of the milk. But the present invention is just as suitable for animals with lesser requirements regarding feed composition. It may be of interest to ensure that the animals have constant access to mixed feed and it may be equally important to ensure that the animals don't eat too much but instead have limited access to feed such as e.g. when feed is used for enticing animals to visit a milking station.

[0046] It shall be appreciated that the different embodiments and variants of the present invention as being described above can be readily combined in order to reach yet further embodiments of the invention, as defined by the appended claims.

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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- FR2689727 **[0004]**
- US4712511A **[0005]**
- DE20115929U1 **[0006]**
- NL1030090C **[0007]**
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PATENTKRAV

1. System til fodring af mindst ét dyr med en foderblanding ifølge en valgt opskrift, hvilket system omfatter:

- en blandeanordning (1)
- en styreanordning (2), der står operativt forbundet til blandeanordningen (1) og er indrettet til at styre blandeanordningen (2) til at blande en foderportion ifølge den valgte opskrift;
- et fodringsområde (3) indrettet til at modtage portionen af foderblanding ifølge den valgte opskrift og at tilbyde portionen til det mindst ene dyr;
- et fodermålearrangement (4) i forbindelse med fodringsområdet (3), som er indrettet til gentagne gange at måle mængden af foderblanding ifølge den valgte opskrift, som er tilbage til at blive indtaget af det mindst ene dyr, hvor
- styreanordningen (2) er (i) operativt forbundet til fodermålearrangementet (4); (ii) indrettet til at sammenligne værdier af de gentagne gange målte mængder foderblanding ifølge den valgte opskrift, som er tilbage til at blive indtaget af det mindst ene dyr, med en grænseværdi; og (iii) indrettet til at styre blandeanordningen (1) til at blande en yderligere portion foder ifølge den valgte opskrift, når værdierne af den gentagne gange målte mængde foderblanding ifølge den valgte opskrift, som er tilbage til at blive indtaget af det mindst ene dyr, falder under grænseværdien,

kendetegnet ved, at

styreanordningen (2) er indrettet til at sætte grænseværdien således, at den yderligere portion foderblanding vil blive tilført til fodringsområdet, før det mindst ene dyr har indtaget den fulde mængde foderblanding ifølge den valgte opskrift, der er tilbage til indtagelse.

2. System ifølge krav 1, hvor fodermålearrangementet (4) er et vejearrangement, der er indrettet til gentagen måling af mængden af foderblanding ifølge den valgte opskrift, der er tilbage til at blive indtaget af det mindst ene dyr, ved hjælp af gentagen vejning af foderblandingen.

3. System ifølge krav 1, hvor fodermålearrangementet (4) er en niveaudetekteringsanordning.

4. System ifølge ethvert af kravene 1 – 3, hvor blandeanordningen (1) er en automatisk anordning og omfatter organer indrettet til automatisk at tilføre hver af portionerne med foderblanding ifølge den valgte opskrift til fodringsområdet (3).

5. System ifølge ethvert af kravene 1 – 3, omfattende en separat fodertilførselsanordning (7), der har organer indrettet til automatisk at opsamle hver portion foderblanding ifølge den valgte opskrift og at tilføre den til fodringsområdet (3).

6. System ifølge ethvert af kravene 1 – 3, omfattende underretningsorganer, der er indrettet til automatisk at underrette en landmand i forbindelse med blandingen af den yderligere portion foder ifølge den valgte opskrift for at gøre landmanden opmærksom på, at den yderligere portion foder er ved at blive tilført fodringsområdet (3).

7. System ifølge ethvert af kravene 1 – 6, som er indrettet til fodring af en flerhed af dyr med foderblanding ifølge den valgte opskrift, hvor fodringsområdet (3) er tilgængeligt for flerheden af dyr.

8. System ifølge ethvert af kravene 1 – 6, som er indrettet til fodring af en flerhed af grupper (G1, G2, G3 … Gk) af dyr med en foderblanding ifølge en for den enkelte gruppe udvalgt af flere forskellige opskrifter, hvor

- der er tilvejebragt en flerhed af fodringsområder (FA1, FA2, FA3 … FAk), som hvert er tilgængeligt for en tilsvarende én af de flere dyregrupper (G1, G2, G3 … Gk);
- styreanordningen (2) for hver af flerheden af dyregrupper (G1, G2, G3 … Gk) er indrettet til at styre blandeanordningen til blanding af en portion foder ifølge den valgte opskrift til dyregruppen (G1, G2, G3 … Gk);
- hvert fodringsområde (FA1, FA2, FA3 … FAk) er indrettet til at modtage en tilsvarende én af portionerne af foderblanding og til at tilbyde portionen

til de dyr i dyregruppen (G1, G2, G3 … Gk), der har adgang til fodringsområdet (FA1, FA2, FA3 … FAk),

- fodermålearrangementet (4) er indrettet til separat og gentagen måling af mængden af foderblanding, der er tilbage til indtagelse ved hvert fodringsområde (FA1, FA2, FA3 … FAk), hvor

- styreanordningen (2) for hvert fodringsområde ((FA1, FA2, FA3 … FAk), er indrettet til (i) sammenligning af værdier af den gentagne gange målte mængde foderblanding, der er tilbage til indtagelse ved fodringsområdet (FA1, FA2, FA3 … FAk), med en tilhørende grænseværdi; og (ii) styring af blandeanordningen (1) til blanding af en yderligere portion foder ifølge den valgte opskrift til gruppen af dyr (G1, G2, G3 … Gk), der har adgang til fodringsområdet (FA1, FA2, FA3 … FAk), når værdierne af den gentagne gange målte mængde af foderblanding, der er tilbage til indtagelse ved fodringsområdet (FA1, FA2, FA3 … FAk), falder under grænseværdien.

9. System ifølge ethvert af kravene 1 – 8, hvor fodringsområdet, der er indrettet til at modtage portionen med foderblanding ifølge den valgte opskrift og til at tilbyde portionen til det mindst ene dyr, er et foderbord.

10. System ifølge ethvert af kravene 1 – 9, hvor foderblandingen omfatter en eller flere faste ingredienser, navnlig grovfoder, ensilage, koncentrat og korningredienser blandet sammen.

11. System ifølge ethvert af kravene 1 – 10, hvilket system er indrettet til fodring af det mindst ene dyr med blandet foder ifølge den valgte opskrift med henblik på optimering af tørstofindtaget.

12. Fremgangsmåde til fodring af mindst ét dyr med en foderblanding ifølge en valgt opskrift, hvilken fremgangsmåde omfatter:

- blanding af en portion foder ifølge den valgte opskrift med en blandeanordning (1); og

- tilbud af portionen med foderblanding ifølge den valgte opskrift til det mindst ene dyr ved et fodringsområde (3),

- gentagen måling af den mængde foderblanding ifølge den valgte opskrift, som er tilbage ved fodringsområdet (3) til at blive indtaget af det mindst ene dyr;
- sammenligning af værdier af den gentagne gange målte mængde foderblanding, der er tilbage til indtagelse, med en grænseværdi; og
- blanding af en yderligere portion foder ifølge den valgte opskrift med blandeanordningen (1), når værdierne af den gentagne gange målte mængde foderblanding, der er tilbage til indtagelse, falder under grænseværdien, hvilken fremgangsmåde er

kendetegnet ved,

at grænseværdien er sat således, at den yderligere portion foderblanding tilføres fodringsområdet, før det mindst ene dyr har indtaget den fulde mængde foderblanding ifølge den valgte opskrift, der er tilbage til indtagelse.

13. Fremgangsmåde ifølge krav 12, hvor den mængde foderblanding ifølge den valgte opskrift, der er tilbage i fodringsområdet (3) til at blive indtaget af det mindst ene dyr, måles gentagne gange ved vejning.

DRAWINGS

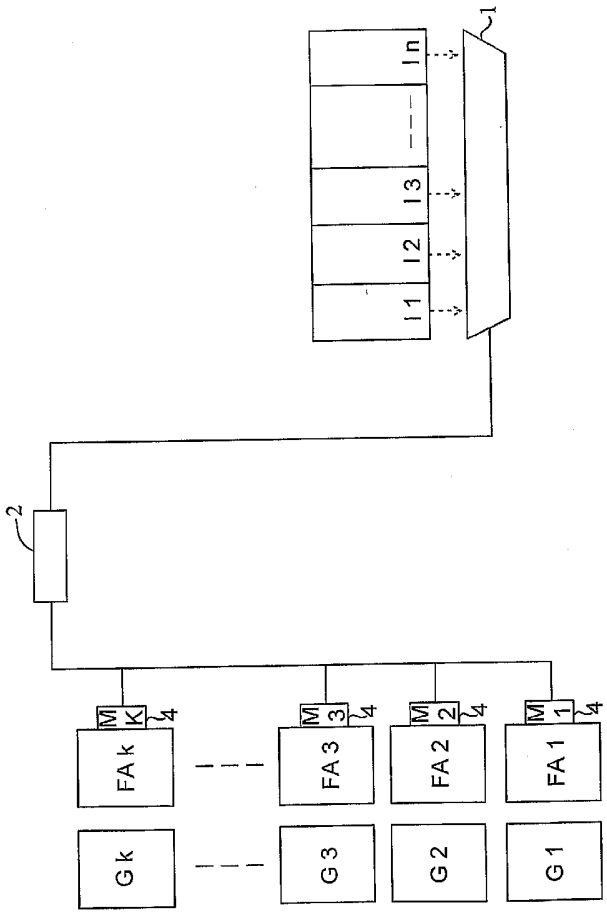

Fig. 1

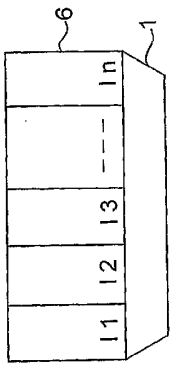

Fig. 2b

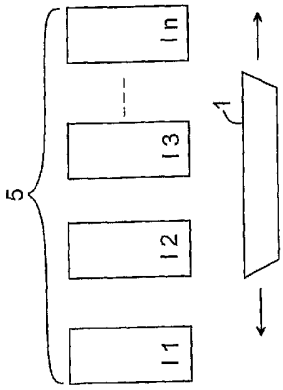

Fig. 2a

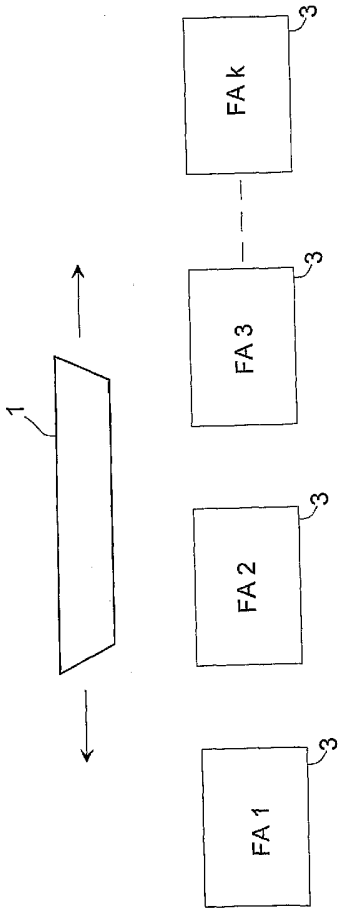

Fig. 3

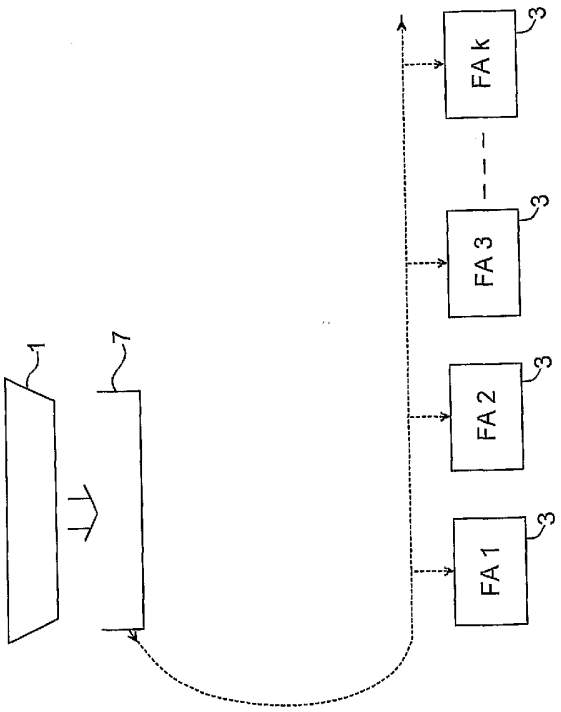

Fig. 4

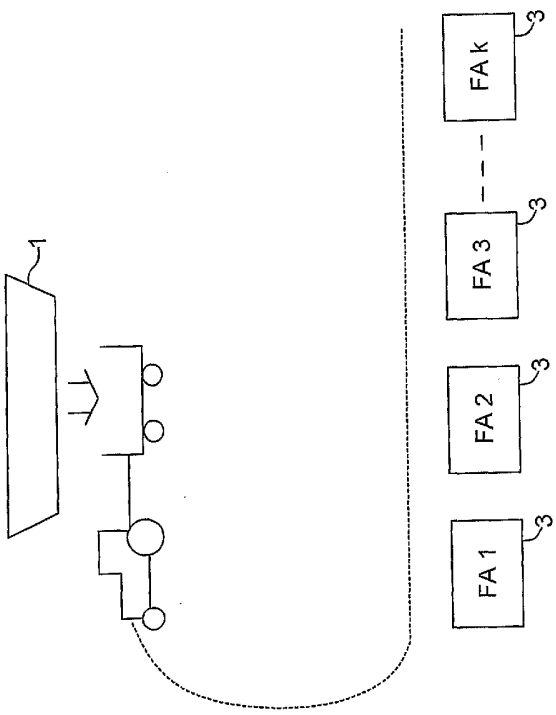

Fig. 5

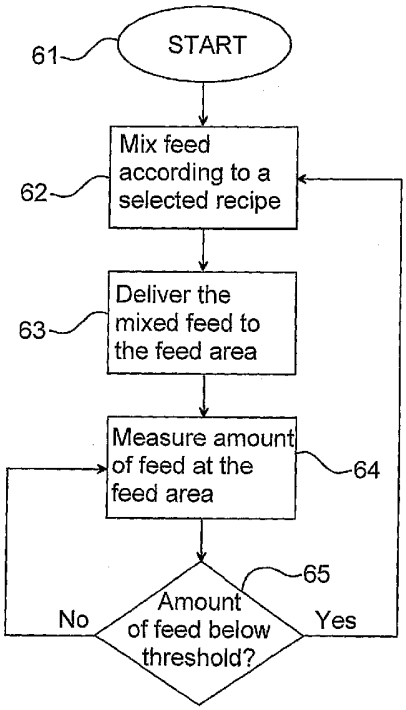
START
61
Mix feed according to a selected recipe
62
Deliver the mixed feed to the feed area
63
Measure amount of feed at the feed area
64
Amount of feed below threshold?
65
No
Yes

Fig. 6