(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
12 June 2025 (12.06.2025)

WIPO | PCT

(10) International Publication Number
WO 2025/122020 A1

(51) International Patent Classification:
A01K 1/10 (2006.01) *A01K 5/02* (2006.01)
A01K 5/00 (2006.01) *A01F 25/20* (2006.01)

(21) International Application Number:
PCT/PL2024/050098

(22) International Filing Date:
06 December 2024 (06.12.2024)

(25) Filing Language: Polish

(26) Publication Language: English

(30) Priority Data:
P.447024 08 December 2023 (08.12.2023) PL

(71) Applicant: **GAMA GROUP SZEPIETOWSCY SPÓŁKA JAWNA** [PL/PL]; ul. Przemysłowa 5, 18-200 Wysokie Mazowieckie (PL).

(72) Inventor: **SZEPIETOWSKI, Marcin**; Staszica 12, 18-200 Wysokie Mazowieckie (PL).

(74) Agent: **ŻYGADŁO, Krystian**; ul. Rudolfa Weigla 12, 53-114 Wrocław (PL).

(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CV, CZ, DE, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IQ, IR, IS, IT, JM, JO, JP, KE, KG, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, MG, MK, MN, MU, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, WS, ZA, ZM, ZW.

(54) **Title:** AUTONOMOUS FEED PREPARATION VEHICLE AND FEED PREPARATION SYSTEM WITH THE USE OF THE AUTONOMOUS FEED PREPARATION VEHICLE

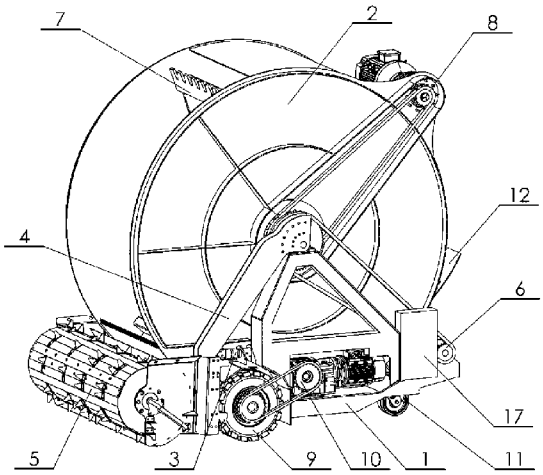

Fig. 1

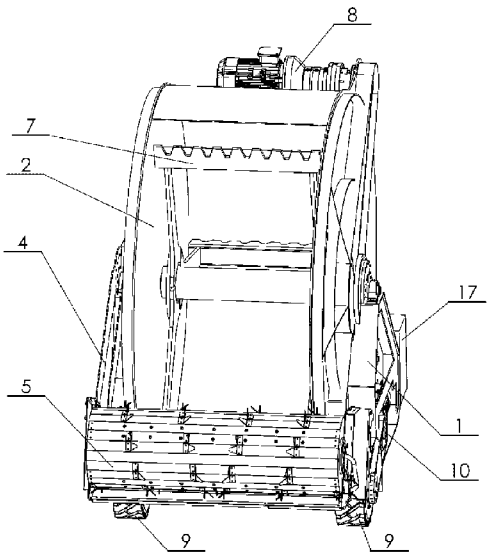

Fig. 1a

(57) **Abstract:** An autonomous feed preparation vehicle comprises a mobile support frame (1) on which at least one feed mixing container (2) is mounted, comprising a pair of parallel side walls and a rear wall extending between them, the walls defining the interior of the container. Perpendicularly between the side walls of the container extends at least one shaft (7d) connected with at least one first drive (8) with radially arranged mixing elements (7) for breaking up and mixing the feed. The vehicle has a front section and a rear section, and is provided with at least one movable arm (4) rotatably attached to the support frame parallel to the container side walls with its first end connected to a second drive (6) and with its second end extending towards the front section. A milling cutter (5) for extracting feed is attached to at least one second end of the arm, parallel to the drive shaft, and on the milling cutter side the feed mixing container is provided with a loading-unloading opening connected to the interior of the container, the loading-unloading opening

[Continued on next page]

WO 2025/122020 A1

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, CV, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SC, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, ME, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Published:

— *with international search report (Art. 21(3))*
— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))*
— *in black and white; the international application as filed contained color or greyscale and is available for download from PATENTSCOPE*

extending between the side walls, an upper edge (2d) of the loading-unloading opening and a lower edge (2e) of the loading-unloading opening, the lower edge defining a loading threshold. The container is connected to the support frame through weight sensors (3) configured to determine the weight of the container, wherein in the rear section the vehicle comprises a cutting knives arrangement (12a) for cutting the feed inside the container. The invention also comprises a feed preparation system.

Autonomous feed preparation vehicle and feed preparation system with the use of the autonomous feed preparation vehicle

The subject of the invention is an autonomous feed preparation vehicle. The invention also comprises a feed preparation system with the use of the autonomous feed preparation vehicle.

On the market, there are several solutions for self-loading self-propelled feed wagons which extract feed with the use of a self-loading milling cutter. The company KUHN ARA offers a self-propelled device AURA 2022, also known from European patent EP3586604B1, which is provided with a rotary milling cutter installed on an arm which mills the feed and loads it into a tank with the use of a belt installed on the arm. However, this solution has several drawbacks. Specifically, the feed milled by the milling cutter must be loaded onto a conveyor belt, which causes electrical energy losses. Furthermore, loading the feed onto a belt narrower than the milling cutter itself causes additional losses as it is necessary to compress the feed. Another consequence of such a structure is that, during loading the feed onto the belt, the milling cutter often becomes clogged, which in turn results in the need for a more powerful milling cutter drive motor. Additionally, transporting the feed with the belt to the tank is a further energy expenditure. Yet another disadvantage of loading the feed with the belt is the inability to precisely weigh the feed. Weight sensors are installed on the tank. During loading, when the required weight of an ingredient is reached, the material on the belt which wasn't weighed must also be taken into account. It is also important to note that such an installation of the milling cutter makes the device long and difficult to maneuver. A device by Ipacol comprises a milling cutter for extracting feed, however, it is operated by an employee, and the loading shelf is positioned quite high, which necessitates a milling cutter with greater power. A similar solution is used in a device by Agross do Brasil. Moreover, when the loading shelf is positioned high, it is necessary to use additional augers, belts, or an unloading window, as in devices by Satellite (Satellite Viper 2000 SF), FK Machinery (FBHSS) or KEENAN.

In the state of the art, feed preparation devices are known. Chinese patent description CN212545076U presents a feeding device for livestock breeding, consisting of a machine shell,

a first hydraulic device fixedly welded to the left side in the machine shell, a first moving wheel fixedly arranged at the bottom of the first hydraulic device, and a first fixing rod fixedly arranged at the axis of the first moving wheel; a second hydraulic device is fixedly arranged on the right side in the machine shell in a welded mode, a second moving wheel is arranged at the fixing bottom of the second hydraulic device, a first fixing rod is fixedly arranged at the axis of the second moving wheel, and the first fixing rod fixes the axes of the first moving wheel and the second moving wheel. The sensor can control and adjust the distance between the feed trough and the sensor, so that the feed in the feed trough can be controlled, waste is avoided, and the feed amount of livestock breeding animals is adjusted; the first hydraulic device and the second hydraulic device adjust and contract the first moving wheel and the second moving wheel to move the whole device to adjust the position of the device and place the device to other positions when not used. International patent application WO22081066A1 discloses an autonomous vehicle and a method of controlling thereof, comprising, in the vehicle, detecting a primary guide arrangement in the floor, which primary guide arrangement forms a track for the vehicle to follow. European patent EP0833558B1 presents a mixer feeder wagon with a mixer for mixing animal feed containing hay, straw, silage, etc. It consists of a mixing compartment and a dispensing compartment. A mixing rotor rotates in the mixing compartment in order to mix animal feed, while a dispensing auger in the dispensing compartment dispenses the mixed animal feed through a dispensing outlet. A plurality of first blades extend radially from the mixing paddles of the mixing rotor and cooperate with a plurality of second blades mounted on the base of the mixing compartment to cut the fibrous material of the animal feed into relatively short segments while the mixing rotor is rotating. European patent application EP4145988A1 describes an autonomous vehicle for use in feeding animals, in particular cows, comprising a container arranged on a frame for holding animal feed with a dispensing opening for dispensing the held animal feed from the container, and a rotatable auger arranged in the container for mixing and/or chopping the held animal feed. A mixing apparatus in the form of a tractor powered agricultural trailer is known from US patent US5061081. It has a main body in which a main mixing rotor rotates for agitating and stirring the material which it sweeps round the lower part of a cylindrical wall structure of the body and a lateral extension along an upper side of the main body having a feed out rotor therein for urging the material to and through a discharge door in said extension. The

inboard side of the extension is open to the main part of the body and said wall structure includes a part bounding the bottom of the extension which can be moved angularly between a first position close to the envelope of revolution of the mixing rotor to deflect material from entering the extension during mixing and a second position at which it is remote from said envelope so that material is swept into the extension during discharge. Another US patent US5630665 discloses a feed mixer apparatus including a tongue attached to a frame mounted upon a wheeled axle, a forward and rearward mixing chambers separated by a trough, a pair of reels driven by sprockets and gears and drive shafts which are actuated by a power take-off, preferably a prime, a plurality of elongate mixing members extending between the side walls of the mixing chambers and deflectably attached to the ends of a plurality of radially-extending arms, an auger being rotatably disposed in the trough and having fins attached thereon for flipping clumps or chunks of feed material back into the chambers, an opening through a side wall in alignment with the trough and through which fine particles of feed material are dispensed to the outside, and a conveyor chute pivotally attached to the side wall in alignment with the opening to facilitate the dispensing of fine particles of feed material to the outside. Another US patent US4506990A presents a feed mixer including a mixer tank with a bottom wall having two curved wall portions defining the bottom of a large main chamber and smaller auxiliary chamber with an elongated ridge therebetween. The chamber contains a rotor having several elongated rotor bars adjacent to the outer periphery, which rotor is supported in the main chamber for rotation in a direction for movement of the rotor bars across the bottom of the main chamber toward the auxiliary chamber. The auxiliary chamber includes a pair of stacked augers adapted for moving material from one end of the tank to the other in opposite directions. Material is thus continuously cycled from the main chamber into a lower portion of the auxiliary chamber where it is moved toward one end of the mixer, forced upwardly into an upper portion of the auxiliary chamber and then directed toward the opposite end of the tank while spilling back into the main chamber for efficient end-to-end mixing of even long stringy hay material. Polish patent application P.438478 describes a device for collecting feed from a feed storage area comprising a rotary separating member for separating feed from a feed storage area with a first drive for driving the rotary separating member, a power unit for powering the first drive and an operating parameter sensor of the first drive, and a lifting member for moving the rotary separating member in a relatively

vertical plane with a second drive and a transfer member for transferring the separated feed from the rotary separating member to a container placed on a moving platform with drive wheels and a third drive. Yet another European patent EP/PL2844063 presents a feed mixing and dispensing apparatus comprising at least one container mountable on a transport means, the container having a longitudinal axis, a transverse axis and a vertical axis, a pair of opposite end walls, a pair of opposite side walls and a base wall; the end walls, the side walls and the base wall define an interior and a top opening, wherein the longitudinal axis of the container extends substantially parallel to the direction of travel of the container during use and the transverse axis is perpendicular to the direction of travel of the container; the container having a mixing shaft mounted such that it allows for a rotational movement inside the container, the mixing shaft is connected to a drive means; wherein the mixing shaft extends between the side walls substantially perpendicular to the longitudinal axis of the container and comprises mixing members extending radially from the mixing shaft towards the end walls and the base wall of the container, the mixing members being configured to break up and mix the feed; and which is provided with a feed discharge arrangement in communication with the interior of the container for discharging the mixed feed from the container.

The technical problem would be to provide an autonomous feed device which is able to extract feed directly from silos, or another storage area, allows obtaining feed of a similar length, allows selective cutting of the feed during feed preparation, wherein each time the same amount of raw feed is extracted, and simultaneously the weight measurement error of the feed which is being prepared is minimized, and which is characterized by lower electrical energy demand and easy servicing. Furthermore, in the prior art solutions, the lack of dynamics in mixing, i.e. the lack of rotational speed, prevents the feed from circulating as it would at higher auger speeds. A very low speed prevents the feed from circulating near the walls. In addition, the slow rotation causes the feed near the auger to be cut better than that near the walls of the container. Long mixing destroys the structure of the feed at the auger, and the feed at the walls is not cut, which leads to a lack of homogeneity of the feed. Another problem is connected with this issue. Namely, determining when the feed in the container has been sufficiently fragmented. Another problem is filling the feed wagon during use. For

example, the most preferable filling of a vertical feed wagon is 80% of its volume. This leads to a problem in preparing the feed for small herds.

The first subject of the invention is an autonomous feed preparation vehicle, comprising a mobile support frame on which at least one feed mixing container is mounted, comprising a pair of parallel side walls and a rear wall extending between them, the walls defining the interior of the feed mixing container, and inside the feed mixing container, between the side walls and perpendicular to the side walls, extends at least one shaft connected with at least one first drive with radially arranged mixing elements for breaking up and mixing the feed, wherein the vehicle has a front section and a rear section and is characterized in that at least one movable arm is rotatably attached to the support frame parallel to the side walls of the feed mixing container, with its first end connected to a second drive and with its second end extending from the first end towards the front section of the vehicle, a milling cutter for extracting feed is attached to at least one second end of the arm, parallel to the drive shaft, and on the milling cutter side the feed mixing container is provided with a loading-unloading opening connected to the interior of the container, the loading-unloading opening extending between the side walls and the upper edge of the loading-unloading window and the lower edge of the loading-unloading opening, wherein the lower edge defines the loading threshold, the loading threshold preferably being parallel to the milling cutter, and the container is connected to the support frame through weight sensors configured to determine the weight of the feed mixing container, wherein in the rear section the vehicle comprises a cutting knives arrangement for cutting the feed inside the feed mixing container. Preferably, the autonomous vehicle comprises two moveable arms.

In a preferable embodiment of the invention, the support frame comprises drive wheels connected with a third drive for moving the vehicle.

In the next preferable embodiment of the invention, the cutting knives are attached to a cutting knives holder, wherein the cutting knives holder is detachably attached to the rear wall of the feed mixing container or is attached to the rear wall of the feed mixing container through a cutting knives drive system.

In a further preferable embodiment of the invention, the mixing elements for breaking up and mixing the feed are mixing tine claws with at least one arm of a mixing tine claw attached radially to the drive shaft.

In another preferable embodiment of the invention, the mixing tine claw is attached to the drive shaft through at least one first end of the arm, to the second end of which there is attached, parallel to the drive shaft, a mixing tine claw beam and a feed moving beam for moving the feed in the feed mixing container.

In yet another preferable embodiment of the invention, the mixing tine claw is attached to the drive shaft through two mixing tine claw arms, or through one mixing tine claw arm.

In yet another preferable embodiment of the invention, the mixing tine claw beam connecting the arms and the feed moving beam extend between a pair of the arms.

Preferably, the beam connecting the arms and the feed moving beam extend from one tine claw arm to a length corresponding to the length of the drive shaft.

In another preferable embodiment of the invention, the mixing tine claw beam and feed moving beam extend from the tine claw arm to a part of the drive shaft length either in the direction towards one of the side walls or in the direction from one of the side walls of the feed mixing container.

In yet another preferable embodiment of the invention, at least two tine claw arms are attached to the drive shaft, from which mixing tine claw beams and feed moving beams extend from the tine claw arm for a part of the drive shaft length, wherein the total length of the mixing tine claw beams and feed moving beams correspond to the drive shaft length.

Preferably, a means for balancing forces acting on the milling cutter is attached from the first end of the arm, parallel to the sidewalls. Preferably, the means for balancing forces acting on the milling cutter is a counterweight. In a preferable embodiment, the counterweights extend towards the rear section of the vehicle.

In the next preferable embodiment of the invention, the lower and upper edges are end edges of the rear wall.

In yet another preferable embodiment of the invention, the rear wall comprises openings configured for inserting cutting knives into the container.

In the next preferable embodiment of the invention the vehicle comprises an independent power source, preferably a rechargeable battery.

Preferably, the vehicle is provided in its front section with feed moving means.

In a preferable embodiment of the invention, the vehicle is provided in its front part with a conveyor system for transferring feed from the feed mixing container, wherein the conveyor system is attached with at least one movable arm to the support frame, preferably with two arms, and covers for covering the milling cutter are coupled to the conveyor system.

In a preferable embodiment of the invention, a means for balancing forces acting on the milling cutter is attached to both movable arms.

The second object of the invention is a feed preparation system with the use of the autonomous feed preparation vehicle, characterized in that it comprises an autonomous feed preparation vehicle as defined in the first object of the invention, connected to a reloading device for sending feed to downstream feed distribution systems.

In a preferable embodiment of the invention, a reloading device for sending feed to downstream feed distribution systems enables buffering of excess feed.

In the next preferable embodiment of the invention, the autonomous feed preparation vehicle moves only within the feed kitchen building.

In another preferable embodiment of the invention, the autonomous feed preparation vehicle is capable of leaving the feed kitchen building.

In another preferable embodiment of the invention, the autonomous feed preparation vehicle is provided with means for unloading feed from the feed mixing container onto a feeding table.

In yet another preferable embodiment of the invention, the feed is detected by weight sensors, through which the feed mixing container is connected to the support frame.

In yet another preferable embodiment of the invention, the feed is detected by changes in the weight of the feed container. The device according to the invention solves the above-described problems. During the whole operation time, the mixing tine claws constantly move the feed to the rear section of the feed mixing container, where the main volume of feed is stored. Thanks to this solution, an empty space is created at the front section of the feed mixing container on the side of the loading milling cutter, which makes it possible to lower the loading threshold to a height approximate to the size of the diameter of the milling cutter. Due to the lowered loading threshold, the feed extracted by the milling cutter is loaded directly into the feed mixing container. The loading threshold, in relation to the subject of the invention, should be understood to be the minimum height to which the extracted material must be transported, e.g., lifted, in order to place it inside the feed mixing container. The milling cutter, in relation to the invention, should be understood to be a drum for extracting the feed, provided with milling cutters on its circumference and driven by an electric motor, such as, for example, the one described in Polish patent Pat.239092. Since the milling cutter loads the feed directly into the feed mixing container, such loading does not require the use of additional conveyors to transport the feed extracted by the milling cutter into the feed mixing container, which reduces energy consumption and the cost of the device. Also, an error in measuring the weight of the feed is minimal as the feed is loaded directly into the container. An additional advantage of locating the loading threshold at a small height is that no additional unloading window is required. By using a low loading threshold, the milling cutter does not need to require high power to load the feed ingredients. In addition, the device according to the invention may be easily serviced. The low loading threshold facilitates entering the container for service purposes, e.g., no ladders are required. The structure of the device according to the invention allows maintaining homogeneous structure of the feed, as all the feed is mixed independently of the rotational speed due to the structure of the feed mixing

container. Even long mixing does not cause the feed structure to deteriorate, as the feed is aerated during free falling. Moreover, the device according to the invention does not require a minimum feed amount which can be mixed. An important feature is also that the retractable feed cutting knives facilitate their easy and safe replacement.

Embodiments for carrying out the invention have been illustrated in the figures, where:

- Fig. 1 shows a view of the autonomous feed preparation vehicle presenting its left side;
- Fig. 1a shows a view of the autonomous feed preparation vehicle with the milling cutter for extracting feed attached to a single arm;
- Fig. 2 shows a view of the device with the counterweights of the milling cutter for extracting feed;
- Fig. 3 shows a view of the device centered on the interior of the mixing container;
- Fig. 4 shows the general structure of the mixing container;
- Fig. 4a shows the optional design of the mixing container consisting of two interconnected containers comprising two sets of mixing tine claws;
- Fig. 5 shows the structure of the mixing tine claws in a C-formation;
- Fig. 5a shows the structure of the mixing tine claws in a T-formation;
- Fig. 5b shows the structure of the mixing tine claws in an L-formation attached in the middle of the shaft;
- Fig. 5c shows the structure of the mixing tine claws in an L-formation attached on both ends of the shaft;
- Fig. 5d shows the structure of the mixing tine claws in an L-formation attached on one end of the shaft;
- Fig. 6a shows the first stage of the feed preparation process, which is driving up to the feed storage;
- Fig. 6b shows the second stage of the feed preparation process;
- Fig. 6c shows the third stage of the feed preparation process;
- Fig. 7 shows the process of mixing and cutting feed in the mixing container;
- Fig. 8 shows the retraction control of the cutting knives assembly;
- Fig. 9 shows the unloading of the feed prepared in the container with the milling cutter in the upper position;

- Fig. 10 shows the unloading of the feed prepared in the container with the milling cutter in the lower position;
- Fig. 11 shows a feed preparation system with the use of the autonomous feed preparation vehicle, with the autonomous feed preparation vehicle moving within the building;
- Fig. 12 shows a general top view of the feed preparation system with the use of the autonomous feed preparation vehicle, with the autonomous feed preparation vehicle moving within the building;
- Fig. 13 shows an optional solution for the feed preparation and distribution system on a farm;
- Fig. 14 shows a device provided with a conveyor for distributing feed in livestock buildings;
- Fig. 15 shows a device provided with at least two rotary brushes;
- Fig. 16 shows a device provided with a conveyor moving the feed in front of the device laterally;

Example 1. The autonomous feed preparation vehicle

The structure of the autonomous feed preparation vehicle has been illustrated in Figs. 1-3.

Fig. 1 shows a plan of the device according to the invention presenting its left side, respectively denoting the support frame 1 to which the feed mixing container 2 is attached. Container 2 is attached to the support frame 1 through weight sensors 3 which measure the weight of container 2 together with its contents. In the front of the device there is a milling cutter 5 for extracting feed. The milling cutter 5 is attached to the second end of at least one movable arm 4 (Fig. 1a), and its first end is attached to the support frame 1. Preferably, the milling cutter 5 may also be attached to two movable arms 4. The remainder of this description will be concentrated on a structure comprising two movable arms 4. However, it will be obvious to a person skilled in the art that the presented features may also be applicable to a structure comprising a single movable arm 4. The arms 4 in each embodiment variant are attached to the support frame 1 in a movable way, allowing rotational movement, e.g. through bearings, bearing sleeves, etc. The pivot point of the arms 4 relative to their attachment point to the frame 1 is located on the axis of the container 2. However, it is possible to locate the attachment point of the arms in a different place, allowing increasing the arms 4 length, and

therefore the scope of feed extraction. The arms 4 are attached to the support frame 1 in a movable manner allowing them to rotate, e.g. through bearings, bearing sleeves, etc. On the extension of the first end of the arms 4, there may be attached means for balancing forces acting on the milling cutter 5, e.g. gravity, during its movement, which allows the arms 4 to move it more easily in the up-down direction and additionally reduces consumption of electricity which is required to set the arms 4 in motion by the drive 6. The means 14 may take the form of counterweights. Such an embodiment of the device is illustrated in Figure 2. The lifting motion of the arms 4 with the milling cutter 5 is realized by the drive 6. The drive of the milling cutter 5 may preferably be located inside the drum of the milling cutter 5. The structure of the milling cutter 5 is known from the state of the art, e.g. from patent specification PL239092B1. The milling cutter 5 drive may also be located outside. Inside the feed mixing container 2 there are mixing elements 7 for breaking up and mixing feed, which have the form of mixing tine claws 7 moved by a drive 8. In this example, Figures 1-3 show a device comprising three mixing tine claws 7. However, the device may also comprise more mixing tine claws, which should be arranged on the shaft 7d in a manner ensuring a uniform distribution of their weight. Exemplary structures of the mixing tine claws 7 are shown in Figures 5a-5e. The mixing tine claws 7 operate by performing a rotary motion around the axis of the feed mixing container 2 and are actuated by the drive system 8. The rotational movement of the tine claws 7 may be carried out in two opposite directions. The rotation direction of the tine claws depends on whether the feed is being loaded to or unloaded from the mixing container 2. The mixing tine claws 7 are constructed of a drive shaft 7d to which either arms or a single arm 7c are radially attached, which are then connected with a beam or beams 7a with a comb-like rigid element 7b arranged thereon. The element 7b, which has a form of a series of elongations extending radially from the mixing tine claw beam 7a, has a rigid structure, which allows moving the feed inside the container 2 and moving the feed between the knife blades 12a. The arms 7c may be connected to the shaft 7d at its ends (Figs. 5a, 5d, 5e) or in the middle of the shaft 7d length. When the arm/arms 7c are connected to the shaft 7d at its ends, the beam 7a with the comb 7b may either extend parallel to the entire shaft 7d length (Figs. 5a, 5e) or only to a part thereof (fig. 5d). A similar situation may take place when the arm 7c is attached to the shaft 7d in the middle of its length (Figs. 5b, 5c). In the case of an embodiment where the beam 7a extends to less than the entire shaft 7d length

(Figs. 5c, 5d), it is possible to attach the arms 7c to the shaft 7d in such a manner that the beams 7a ends are directed towards the side walls (2b, 2c) of the container 2 (Fig. 5c) or in a direction from said walls (Fig. 5d). If the beams 7a extend only to a part of the shaft 7d length from each of the arms 7c, the total length of the beams 7a corresponds to the total length of the shaft 7d. In the examples illustrated in Figure 5c or 5d, the beams length corresponds to half of the shaft 7d length, that is, to their length ratio of 1:1. However, this ratio may be different. It is essential that the total length of the beams 7a in the case of variants as in Figs. 5c or 5d corresponds to the total length of the shaft 7d. This ensures mixing and breaking up raw feed over the entire width of the feed mixing container 2. Split tine claws (Figs. 5c, 5d) push only a part of the feed mass which reduces their load, a single claw 7 pushes a smaller amount of feed through the cutting knives which reduces the amount of the required energy. The split tine claws 7 shifted in relation to each other (Figs. 5c, 5d) provide a better circulation of feed inside the feed mixing container 2. The tine claw 7 in a T-formation (Fig. 5b) results in the absence of rigid arms moving close to the side walls of the feed mixing container 2. When such arms 7c are close to the container 2 walls, they may be blocked by clumped feed fragments or by stones and other foreign bodies wedged in the gap between the tine claw arm and the wall of the container 2. It is also possible to attach the tine claws in such a manner that they are not parallel to the shaft axis, i.e., they may also be inclined with respect to the axis so that the feed is also moved from one side of the container to the other. The drive shaft 7d is pivotally attached to the structure of the feed mixing container 2 through means enabling its rotation and known in the field, e.g. bearing sleeves, bearings, etc. Additionally, a second flexible element 7e is attached to the comb 7b, the element remaining in contact with the container walls and adapts to the walls due to its flexibility. The element 7e remains in direct contact with the container 2 walls, as the rigid element 7b cannot directly touch the walls of the container, which would lead to too much load, and the presence of e.g. a stone in the feed might block the device. The element 7e may be elastically deformed upon encountering too much resistance, thus ensuring that the container 2 walls and the knives 12a may be cleaned. All elements operating close to the container 2 walls have cut-outs through which the cutting knives 12a slide.

The device moves on wheels, two of which are drive wheels 9, which are driven by the system 10. The drive wheels 9 also allow the vehicle to perform maneuvers, such as changing the driving direction. The maneuvering may be solved in different manners. It may be accomplished by varying the speed or direction of rotation of the left and right drive wheels (e.g., the left wheel turns at a higher speed than the right wheel – the vehicle turns right). In another possible variant, additional drives turning the wheels 9 may be used, as well as a single drive wheel which, by using an additional mechanism, rotates in a perpendicular axis on the wheel rotation axis.

The remaining wheels are support wheels 11, which have no drives of their own. All mentioned drives, sensors or measuring systems are electrically connected in the control unit 17 responsible for the autonomous operation of the device. In its basic structure, the device according to the invention is connected with a cable to the mains supply. Optionally, the device has a power supply unit for all the systems of the device (mechanical, electrical, electronic), e.g., in the form of a rechargeable battery, which allows the device to move independently.

In its rear section (Fig. 2), the autonomous feed preparation vehicle comprises a cutting knives arrangement 12a attached on a cutting knives holder 12. The holder 12 may have the form of a plate, a frame, a beam or another form, the shape of which corresponds to the shape of the rear wall of the feed mixing container 2. This allows the knives 12a to be inserted through the cut-outs 2h into the interior of the feed mixing container 2. The cutting knives holder 12 may be attached in a movable manner relative to the feed mixing container 2, and its movement is realized through a drive system 13, connected to the cutting knives holder 12. The drive system 13 may be an actuator, a gear train with a motor, or any other, which allows bidirectional movement of the cutting knives holder 12. The drive system 13 is attached to the structure of the feed mixing container 2. Fig. 3 shows a moveable cutting knives 12a set in a situation when the knives are inserted inside the feed mixing container 2. The spacing of the cutting knives 12a corresponds to the length of the cut feed fragments. Another possibility is to attach the plate 12 to the rear wall 2c of the container 2, for example, with a bolted or other detachable joint that would allow easy removal of the cutting knives arrangement in order to replace or service them.

The feed mixing container 2 (Fig. 4) has a structure similar to a cylinder. It has two side walls (2a, 2b), a left wall 2b and a right wall 2a in the shape of a circle. The main element of the feed mixing container 2 is its rear wall 2c, which extends between the side walls 2a and 2b. The side walls 2a, 2b and the rear wall 2c define the interior of the feed mixing container. The rear wall 2c has the form of a cylinder with one section cut out and extends from the edge 2e, which constitutes the loading threshold, to the edge 2d. The height of the loading threshold, i.e., the distance of the edge 2e from the surface on which the vehicle is moving, is approximately the size of the diameter of the milling cutter 5. A cut-out in the container 2 between the edges 2e and 2d forms a loading-unloading window. Cut-outs 2h are made in the rear wall 2c in the rear section of the mixing container through which the cutting knives 12a are inserted into the interior of the container 2. The walls of the feed mixing container 2 are stiffened with suitable structural elements 2g and have holders 2f for attaching the weight sensors 3 therein. The cylindrical structure of the container 2 and the indicated structure of the mixing tine claws 7 mean that the container 2 is free from dead zones where feed might linger, and even a small amount of feed will always be picked up by a passing tine claw 7 and will participate in the mixing. For example, in feed wagons with a vertical auger, a certain amount of feed is required for the mixing process to start; in the structure according to the invention such a phenomenon does not occur.

The device according to the invention may comprise a feed mixing container 2 comprising two elements 7 for mixing and breaking up the feed, as shown in Fig. 4a. In this embodiment, the elements 7 for mixing and breaking up the feed are located one after the other. Each of the elements 7 may be driven independently of the other, if independent drives of the elements 7 are used in the structure. It is then possible for both elements to move concurrently or reciprocally. However, it is preferable when they move concurrently. Meanwhile, a single drive of both elements allows them to move concurrently. The container comprising two elements 7 may have the form of two feed mixing containers 2 located one after the other and connected with an opening allowing the feed to move between them. The use of a double mixing feed container allows increasing its capacity while maintaining a constant width and height of the device, making it easy to adapt the device to a larger farm.

It is also possible to construct the device with a conveyor system integrated into its structure, which is used to distribute feed in livestock buildings, as shown in Fig. 14. The conveyor system 25 which may, for example, be a belt conveyor, a chain conveyor, a screw conveyor, or another type known in the art, is attached on at least one movable arm 26. This arm 26 is attached to the support frame 1, which does not affect the mass of the feed mixing container 2. It is capable of moving because, for the time of feed extraction, the conveyor belt is raised, whereas for the time of distribution, it is lowered and covers the milling cutter 5, and the feed falling from the container lands on the conveyor belt directing it to any side of the container 2. Fig. 14 shows an exemplary embodiment with a conveyor belt. During feed extraction, the conveyor system 25 is raised, allowing the milling cutter 5 to operate. However, during feed distribution, the milling cutter 5 is lowered to the lower position, and the conveyor 25 is lowered and positioned above the milling cutter 5. The conveyor system 25 is coupled with covers 27, which, when lowered, cover hazardous parts of the device, such as the milling cutter 5. In the lowered position, the conveyor belt is located above the milling cutter 5, allowing the feed to be unloaded from the conveyor 2 with the use of the conveyor belt.

In another embodiment, the device of the above-described structure may comprise an arrangement of rotary brushes 28 (Fig. 15) or a conveyor belt 29 (Fig. 16), attached in the front of the device and below the edge 2e. During feed distribution in livestock buildings, the brushes 28 are used to push feed lying in front of the device. In the second case a conveyor 29 moving the feed in front of the device laterally was used. The conveyor 29 may be a belt conveyor, a chain conveyor, a screw conveyor, or a different conveyor.

Example 2. Feed processing with the use of the autonomous feed preparation vehicle

The feed processing method with the use of the autonomous feed preparation vehicle comprises several subsequent steps. Namely:

1. Detection and extraction of individual feed components from their storages by the device described in the first example,
2. loading of feed components, which during the extraction are loaded directly into the feed mixing container 2,
3. mixing in the feed mixing container 2 with the use of mixing tine claws 7, which mix the components together during operation in order to obtain the right structure of

feed. The container 2 may also comprise cutting knives 12a, which, during mixing, cut through excessively long fractions of concentrated feed in order to obtain appropriate lengths of the individual components,

4. reloading the feed after it has been mixed and cut in the container 2 into feed distribution systems in livestock buildings,
5. After the container 2 has been emptied, the feed preparation device repeats the cycle.

2.1 Feed detection and extraction

The first step of the operating cycle of the device described by the structure in the first example is driving up to and detecting feed in a storage. The device pushed by the rotational movement of the drive wheels 9 moves forward towards the feed storage 15, Fig. 6a. Wheels 9 may be driven by belt or chain gears, mechanical gears mounted directly on the drive wheels 9 or by other combinations of known drives. The driving up step is carried out with the milling cutter 5 for extracting the feed operating.

The second stage of the feed preparation process is detecting the presence of the feed storage 15. Upon driving up to the feed storage 15, the milling cutter 5 begins to extract the feed 16, which passes directly into the feed mixing container 2, increasing the weight of the container and the increase is detected by the weight sensors 3. This information is detected by the control system located in the control unit 17 and received as detection of the feed storage 15 which allows beginning feed 16 extraction.

Feed in the storage 15 may have various forms (cut cubes from feed silos, bales or cubes from balers, loosely scattered components in hoppers, or full-sized feed silos). When the device approaches the feed, the milling cutter 5 is activated. The milling cutter 5 then operates by rotating around its own axis and rotates towards the mixing container 2.

Once the feed storage 15 is detected, the actual extraction cycle begins. The milling cutter 5 is raised by means of pivoting arms 4, through which it is attached to the support frame 1, as shown in Figs. 6b-6c. During the driving up to the feed storage 15 step, the milling cutter 5 may operate at slow rotation speed, thus saving energy. Once the feed is detected, the rotation speed of the milling cutter 5 is increased to enable effective feed extraction from the feed storage 15.

It is also possible to reverse the direction of extraction when, with the miller cutter 5 raised, the feed is detected with the feed mixing container 2 and then milled from top to bottom. In this case, during driving up to detect the feed storage 15, the milling cutter 5 is raised to the upper position so that it does not protrude beyond the outline of the device. In such a situation, the device driving up to the feed storage 15 will lean against the feed with the feed mixing container 2 or another structural element which is attached to the device through weight sensors 3. In such a situation, the control unit 17 will read weight change indications resulting from pressing the device against the feed in the storage 15. The milling cutter 5 is then activated, which is lowered and extracts the feed from the storage 15 by milling it from top to bottom.

The movement of the suspension arms 4 of the milling cutter is realized by a lifting drive 6. The drive itself may have various forms: a set of sprockets and chains, a belt drive, a sprocket drive, the use of actuators or winches. To facilitate the upward movement of the milling cutter 5 and reduce power requirements of the lifting drive, it is preferable to use means for balancing forces acting on the milling cutter 5, for example, in the form of counterweights 14, in order to balance the weight of the milling cutter 5, attached at the ends of its arms 4. Exemplary counterweights 14 may have any form that does not impede the movement of the suspension arms 4 of the milling cutter 5.

When the milling cutter 5 moves upward, the feed is being cut off the whole time, extracted from the storage 15 and passed directly to the feed mixing container 2 without the use of any intermediate conveyors. During loading, the mixing tine claws 7 operate, constantly mixing and moving the feed in the feed mixing container 2.

When the control system 17 registers the detection of the feed storage 15, the drive system 6 of the milling cutter arms 4 begins to lift the milling cutter 5 in order to cut off successive feed 16 fragments from the feed storage 15. The feed thus extracted is passed directly to the mixing container 2. The extraction is done by cyclically raising and lowering the milling cutter 5 until the control system 17 receives the appropriate weight value for a given feed ingredient as read by the weight sensors 3.

2.2 Mixing and cutting feed in the container

Mixing of the feed (Fig. 7) in the feed mixing container 2 is carried out by means of mixing tine claws 7, which are attached on the shaft 7d and rotate around the short axis of the feed mixing container 2. The tine claws 7 move the feed 16 along the perimeter of the container 2. Feed which is moved by tine claws 7 into the upper section of the container 2 automatically falls downward by gravity. Feed pushed along the walls of the container 2 passes through cutting knives 12a where long feed fibers are cut. Meanwhile, freshly drawn feed is immediately received by mixing tine claws 7 and moved deeper into the container 2. This is how the mixing of the feed is carried out. The drive shaft 7d to which the mixing tine claws 7 are attached is powered by at least one drive 8. The drive 8 may be any type of commercially or non-commercially available drive which a person skilled in the art would be able to use in the structure of the device according to the invention without affecting the other technical features of the device. The type of drive may be selected at the construction stage from among those commercially available. This drive may be carried out with chain drives, belt drives, etc., or it may also be carried out with a mechanical drive mounted directly on the shaft 7d or inside the shaft 7d.

An arrangement 12 with cutting knives 12a is moveably attached to the container 2 through the mechanism 13. By using the mechanism 13 which moves the cutting knives arrangement 12, the knives may be retracted from the container at the right moment and the cutting of the feed may be stopped. The cutting knives 12a enter the interior of the feed mixing container 2 through cut-outs 2h in the container 2. During mixing, the tine claws 7 move the feed through protruding knives 12a. By doing so, the longer fibers are cut, and the proper structure of the feed is obtained. During mixing and cutting of the feed (Fig. 7), the control unit 17 records the parameters of the drive system 8 driving the mixing tine claws 7. These parameters may be, for example, the speed of the motor or the electric current at the motor connections. When the unit registers a change in parameters indicating an overload of the drive system 8, the cutting knives arrangement 12 will be automatically retracted from container 2 by means of the drive system 13. A momentary retraction of the cutting knives 12a from the container 2 facilitates the flow of feed and at the same time reduces the load on the mixing tine claws 7 drive system 8. When the operating parameters return to the specified safe values, the knives 12a may be again

inserted inside the container 2. In addition, the knives 12a may be retracted from the container 2 in order to prevent feed components from being cut and fragmented too strongly.

The ability to insert and retract the cutting knives is very preferable to the operation of the device. The cutting knives 12a put a lot of resistance on the feed moved by the mixing tine claws 7 which results in an increased load on the drive 8. When too much feed reaches the cutting knives, the control unit 17 to which the drive 8 of the mixing tine claws 7 is connected detects an overload. At this point, the cutting knives may be automatically retracted from the container 2, cutting a smaller amount of feed and reducing the resistance on the mixing tine claws 7. It allows optimizing the mixing process and its power requirements. In addition, it provides the possibility of completely retracting the cutting knives from the feed mixing container 2 at a certain stage of mixing. This allows interrupting the fiber cutting process while continuing the mixing, so the best feed structure may be obtained. A suitable feed structure is characterized by the fact that the feed has been properly mixed and cut. The inability to separate these operations might result in feed that has been mixed well but cut too much and, conversely, feed that has been cut well but not mixed enough.

In devices known from the state of the art, such as Canadian patent application CA2869705A1, cutting knives are located on a mixing auger, and the element resisting the feed in order to cut it is a counter-knife, which is automatically inserted and retracted from the mixing container. Such a solution means that despite retracting the counter-knife from the container, the cutting of the feed will still be carried out by the knives located on the mixing auger.

The structure of the used mixing tine claws 7, driven by the drive system 8, combined with the shape of the container 2 and the weight sensors 3 connected to the control unit 17, allows the introduction of quality control of the obtained feed structure. Depending on the degree of fragmentation and bulk density during the fall, the feed acts differently on the weight sensors 3 and the drive system 8. The weight changes amplitude and the duration

of measuring pulses change with the progressive fragmenting and mixing of the feed, and constitutes a basis for determining its fragmentation.

2.3 Unloading the prepared feed.

The unloading of the feed 16 prepared in the container 2 is carried out through the same opening as its loading, therefore the device does not require any additional unloading windows or closeable sliding bolts. When the feed 16 being prepared in the container 2 is ready, the device drives up to the unloading location. The milling cutter 5 is raised to its upper position (Fig. 9) thanks to which the loading-unloading window is exposed. During loading and mixing, the rotation direction of mixing tine claws 7 is counterclockwise. However, during unloading, this direction is reversed so that the tine claws push the feed 16 towards the loading-unloading window in the container 2. Due to the circular shape of the container 2, the feed falls out of the container 2 on its own. The cutting knives 12a are retracted from the container 2 for the time of unloading so that there is nothing to resist the movement of the feed 16.

Optionally, it is still possible to use the milling cutter 5 as a device assisting the unloading of the feed 16 from the container 2 (Fig. 10). In such an arrangement, the milling cutter 5 is located in the unloading window area. By being able to adjust the position of the milling cutter and control its speed, the milling cutter 5 may be used as an element allowing control over the unloading. Excess feed 16 will push against the milling cutter 5, which will in turn unload the feed 16 in portions through the gap formed between the milling cutter 5 and the container. Due to such control, discharging large volumes of feed at once from the mixing container may be avoided.

Example 3. Feed preparation system with the use of the autonomous feed preparation vehicle

Figs. 11 and 12 show a drawing of a building 18 called a feed kitchen, within which the feed preparation device 19 according to the invention operates. In the feed kitchen, there are feed storages 15 from where components for preparing the finished feed are being extracted. The prepared feed is unloaded from the device according to the invention onto a reloading device 20 conveying the feed to downstream feed distribution systems in livestock buildings not shown in the figures. The reloading device 20 is understood to be a type of conveyor. For

instance, in Figure 12 it is depicted as a conveyor belt. The method of transferring the material may be implemented with the use of any available type of conveyor: belt conveyor, chain conveyor, screw conveyor, bucket conveyor or any other suitable conveyor known and used in the field. Building 18 is completely closed during the operation of the feed preparation device, and its gates 21 are opened only when the feed is refilled in the storages 15. Thanks to this, the system is safe for people, and each opening of the gate automatically disables the operation of the system. The feed preparation device, which is an autonomous feed preparation vehicle in accordance with the invention, operates in a continuous manner, extracting feed components from the storages 15, and the finished feed mixture is unloaded into the feed reloading device 20 to the feed distribution system for livestock buildings. The reloading device 20 may be, for example, a belt conveyor with a buffer function for excess feed. In order to maintain continuous operation of the feed preparation device, it is permanently connected to the electricity supply 22. This allows maximizing the efficiency of the device. Since the feed kitchen building 18 serves only as a protection for the device 19 and the feed 16 therein, and prevents people and animals from entering the danger zone, and no components of the system burden the structure of the building, lightweight structures of tent halls, etc., may be used, which reduces investment costs.

In the exemplary embodiment of the system, shown in Fig. 12, the feed preparation device 19 operates continuously inside the building 18. This building is closed at all times during the operation of the device 19, and its gates 21 are opened only when the feed is being refilled in the feed storages 15. Since the device 19 does not leave the building 18, it may operate while being directly connected to the electricity supply 22.

Feed distribution systems for livestock buildings may vary in form and technology. These may be systems of successive conveyor belts, chains, etc. These may also be autonomous distribution carts, as well as dollies and other manually operated systems. The system offers a lot of possibilities for adjusting to existing farms, limiting the necessary construction work which would be needed to modify the buildings.

In one possible embodiment of the feed preparation system (Fig. 14), the mixing device according to the invention drives out of the feed kitchen and distributes the feed directly onto

a feeding table. In another embodiment, the mixing device according to the invention is provided with a transverse belt 25, which is lowered for the time of dispensing the feed, allowing the feed to be scooped from the container 2 by the tine claws 7 directly onto the belt 25. In such an arrangement, the autonomous vehicle is provided with its own power source 24, e.g. rechargeable batteries or batteries. Meanwhile, the feed kitchen 18 is provided with an additional control unit 23 communicating with the autonomous vehicle 19. In this system, the autonomous vehicle 19 is able to open the feed kitchen 18 gates 21 and leave the building area. This allows adding a function of distributing feed to livestock buildings directly by the autonomous vehicle 19.

Reference Signs List:

1. support frame,
2. feed mixing container,
   a. right container wall,
   2b. left container wall,
   2c. rear container wall,
   2d. upper edge of the loading-unloading window,
   2e. lower edge of the loading-unloading window (loading threshold),
   2f. holders of the weight sensors for the container,
   2g. structural elements of the container,
3. weight sensors,
4. movable arm of the milling cutter suspension,
5. extracting milling cutter,
6. drive moving the milling cutter suspension arm,
7. tine claws mixing feed in the container,
   7a. mixing tine claw beam,
   7b. beam for moving feed in the container,
   7c. mixing tine claws arms,
   7d. mixing tine claws drive shaft,
   7e. flexible elements scraping from the container,
8. drive putting mixing tine claws into rotary motion,

9. driving wheels – drive wheels,
10. drive powering the drive wheels,
11. support wheels,
12. cutting knives holder,
12a. cutting knives,
13. cutting knives drive system,
14. counterweight arranged on the milling cutter arm,
15. feed storage,
16. extracted/mixed feed,
17. autonomous device control unit,
18. feed kitchen building,
19. autonomous device – the object of the invention,
20. reloading device,
21. feed kitchen gates,
22. power supply of the autonomous device in the feed kitchen,
23. feed kitchen control unit,
24. own power supply of the autonomous device,
25. conveyor for distributing feed in livestock buildings,
26. conveyor mounting arm,
27. covers coupled with the conveyor,
28. rotary brushes pushing the feed in front of the device,
29. conveyor, e.g., a belt conveyor, pushing the feed in front of the device laterally,

Claims

1. An autonomous feed preparation vehicle, comprising a mobile support frame on which at least one feed mixing container is mounted, comprising a pair of parallel side walls and a rear wall extending between them, the walls defining the interior of the feed mixing container, and inside the feed mixing container, between the side walls and perpendicular to the side walls, extends at least one shaft in connected with at least one first drive with radially arranged mixing elements for breaking up and mixing the feed, wherein the vehicle has a front section and a rear section, characterized in that at least one movable arm (4) is rotatably attached to the support frame (1) parallel to the side walls (2a, 2b) of the feed mixing container (2), with its first end connected to a second drive (6) and with its second end extending from the first end towards the front section of the vehicle, preferably the vehicle comprises two moveable arms (4), a milling cutter (5) for extracting feed is attached to at least one second end of the arm (4), parallel to the drive shaft (7d), and on the milling cutter (5) side the feed mixing container (2) is provided with a loading-unloading opening connected to the interior of the container (2), the loading-unloading opening extending between the side walls (2a, 2b) and the upper edge (2d) of the loading-unloading window and the lower edge of the loading-unloading opening (2e), wherein the lower edge (2e) defines the loading threshold, the loading threshold preferably being parallel to the milling cutter (5), and the container (2) is connected to the support frame (1) through weight sensors (3) configured to determine the weight of the feed mixing container (2), wherein in the rear section the vehicle comprises a cutting knives arrangement (12a) for cutting the feed inside the feed mixing container (2).
2. The vehicle according to claim 1, characterized in that the support frame (1) comprises drive wheels (9) connected to a third drive (10) for moving the vehicle.
3. The vehicle according to claim 1, characterized in that the cutting knives (12a) are attached on a cutting knives holder (12), wherein the cutting knives holder (12)is detachably attached to the rear wall (2c) of the feed mixing container (2) or is attached to the rear wall (2c) of the feed mixing container (2) through a cutting knives drive system (13).

4. The vehicle according to claim 1, characterized in that the mixing elements for breaking up and mixing the feed are mixing tine claws (7) with at least one arm (7c) of a mixing tine claw attached radially to the drive shaft (7d).
5. The vehicle according to claim 4, characterized in that the mixing tine claw (7) is attached to the drive shaft (7d) through at least one first end of the arm (7c), to the second end of which there is attached, parallel to the drive shaft (7d), a mixing tine claw beam (7a) and a feed moving beam (7b) for moving the feed in the feed mixing container (2).
6. The vehicle according to claim 5 or 4, characterized in that the mixing tine claw (7) is attached to the drive shaft (7d) through two mixing tine claw arms (7c), or through one mixing tine claw arm (7c).
7. The vehicle according to any of claims 4 to 6, characterized in that the mixing tine claw beam (7a) connecting the arms (7c) and the feed moving beam (7b) extend between a pair of the arms (7c).
8. The vehicle according to any of claims 4 to 6, characterized in that the beam (7a) connecting the arms and the feed moving beam (7b) extend from one tine claw arm (7c) to a length corresponding to the length of the drive shaft (7d).
9. The vehicle according to any of claims 4 to 6, characterized in that the mixing tine claw beam (7a) and the feed moving beam (7b) extend from the tine claw arm (7c) to a part of the drive shaft (7d) length either in the direction toward one of the side walls (2c, 2d) or in the direction from one of the side walls (2c, 2d) of the feed mixing container (2).
10. The vehicle according to claim 6 or 9, characterized in that at least two tine claw arms (7c) are attached to the drive shaft (7d), from which the mixing tine claw beams (7a) and the feed moving beams (7b) extend from the tine claw arm (7c) to a part of the drive shaft (7d) length, wherein the total length of the mixing tine claw beams (7a) and feed moving beams (7b) correspond to the drive shaft (7d) length.
11. The vehicle according to claim 1, characterized in that a means (14) for balancing forces acting on the milling cutter (5) is attached from the first end of the arm (4), parallel to the sidewalls (2a, 2b).

12. The vehicle according to claim 1 or 5, characterized in that the means (14) for balancing forces acting on the milling cutter (5) is a counterweight.
13. The vehicle according to claim 6, characterized in that the counterweights extend toward the rear section of the vehicle.
14. The vehicle according to claim 1, characterized in that the lower edge (2d) and the upper edge (2e) are end edges of the rear wall (2c).
15. The vehicle according to claim 1, characterized in that the rear wall (2c) comprises openings configured for inserting cutting knives (12a) into the container (2).
16. The vehicle according to claim 1, characterized in that it comprises an independent power source, preferably a rechargeable battery.
17. The vehicle according to any of the previous claims, characterized in that it is provided in its front section with feed moving means (28, 29).
18. The vehicle according to any of claims 1 to 11, characterized in that it is provided in its front section with a conveyor system (25) for transferring feed from the feed mixing container (2), wherein the conveyor system (25) is attached to the support frame (1) with at least one movable arm (26), preferably with two arms, and covers (27) for covering the milling cutter (5) are coupled to the conveyor system (25).
19. The vehicle according to claim 1, characterized in that it comprises two moveable arms (4).
20. The vehicle according to claims 11, 12 or 19, characterized in that a means (14) for balancing forces acting on the milling cutter (5) is attached to both movable arms (4).
21. A feed preparation system with the use of the autonomous feed preparation vehicle, characterized in that it comprises an autonomous feed preparation vehicle as defined in claim 1, connected to a reloading device for sending feed to downstream feed distribution systems.
22. The feed preparation system according to claim 21, characterized in that a reloading device for sending feed to downstream feed distribution systems enables buffering of excess feed.
23. The feed preparation system according to claim 21, characterized in that the autonomous feed preparation vehicle moves only within the feed kitchen building.

24. The feed preparation system according to claim 21, characterized in that the autonomous feed preparation vehicle is capable of leaving the feed kitchen building.
25. The feed preparation system according to claim 21, characterized in that the autonomous feed preparation vehicle is provided with means for unloading feed from the feed mixing container onto a feeding table.
26. The feed preparation system according to claim 21, characterized in that the feed is detected by weight sensors (3), through which the feed mixing container (2) is connected to the support frame.
27. The feed preparation system according to claim 21 or 26, characterized in that the feed is detected by changes in the weight of the feed container.

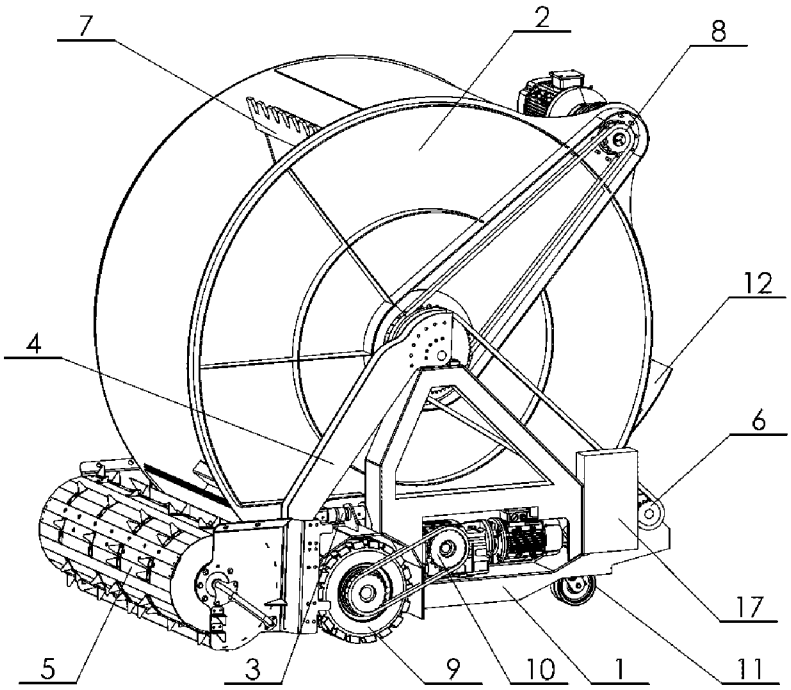

Fig. 1

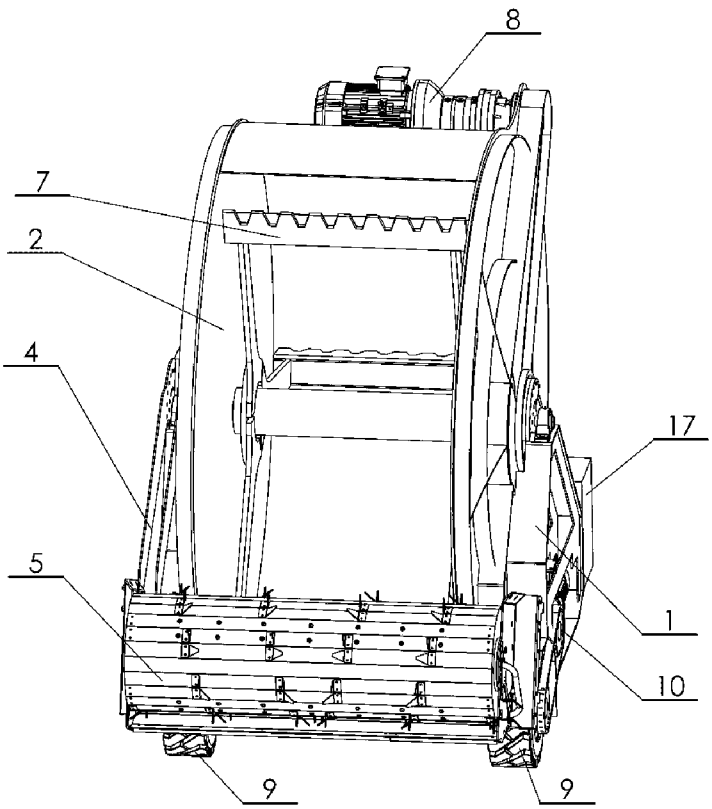

Fig. 1a

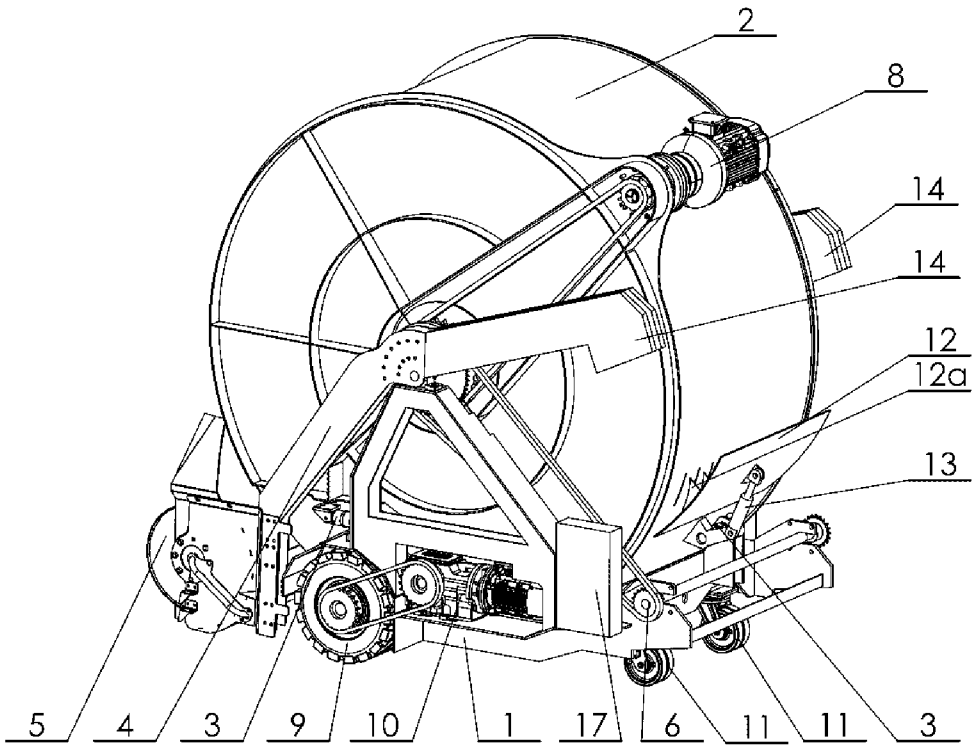

Fig. 2

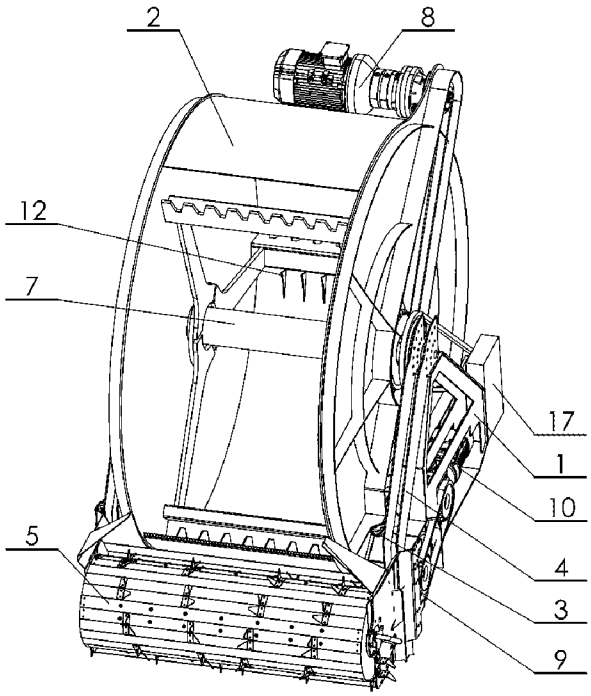

Fig. 3

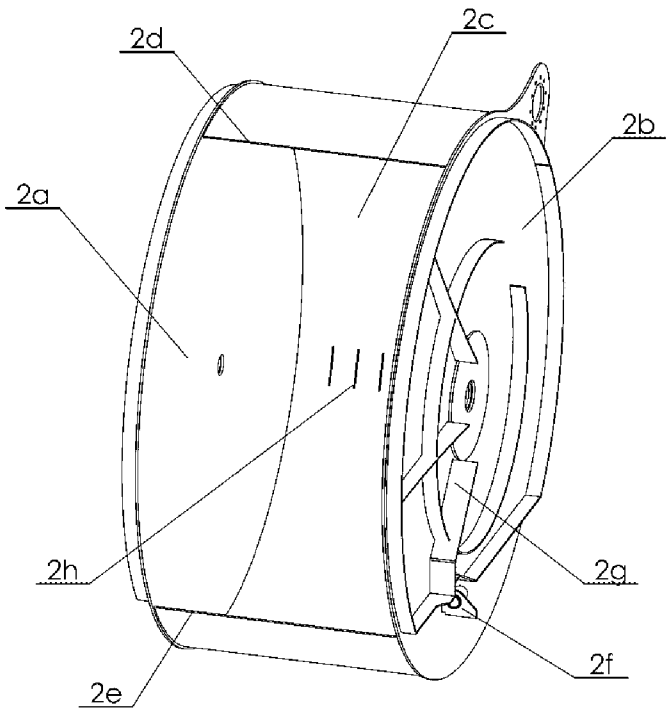

Fig. 4

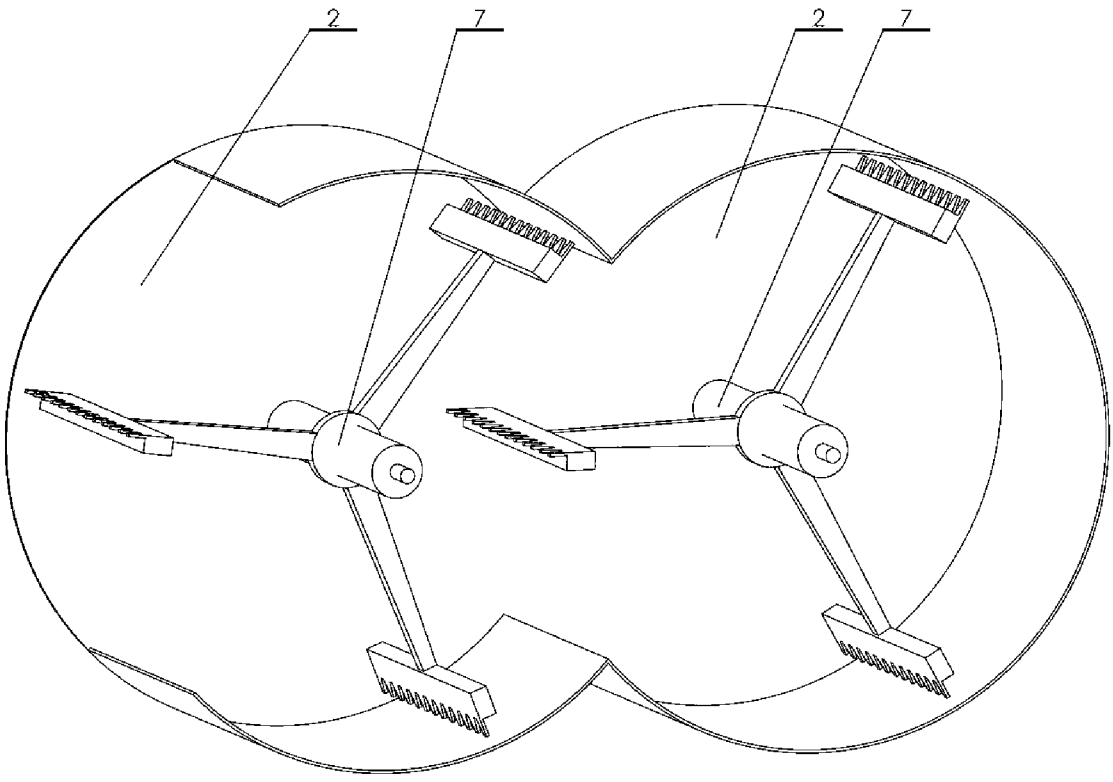

Fig. 4a

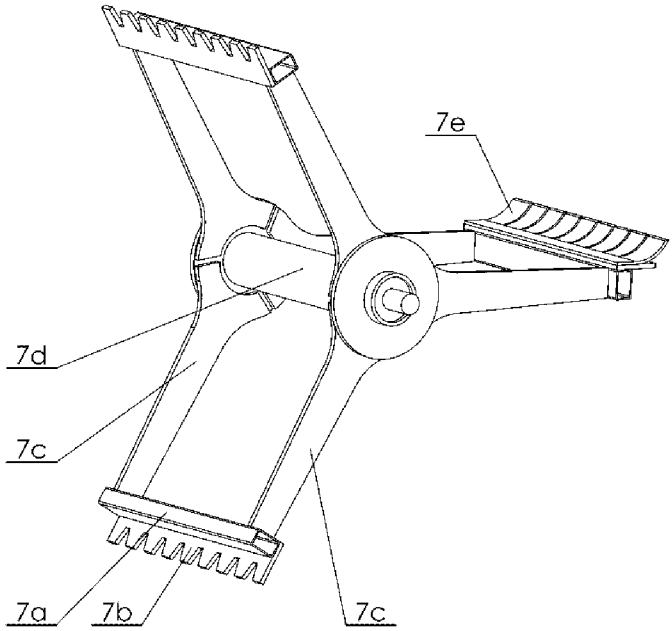

Fig. 5a

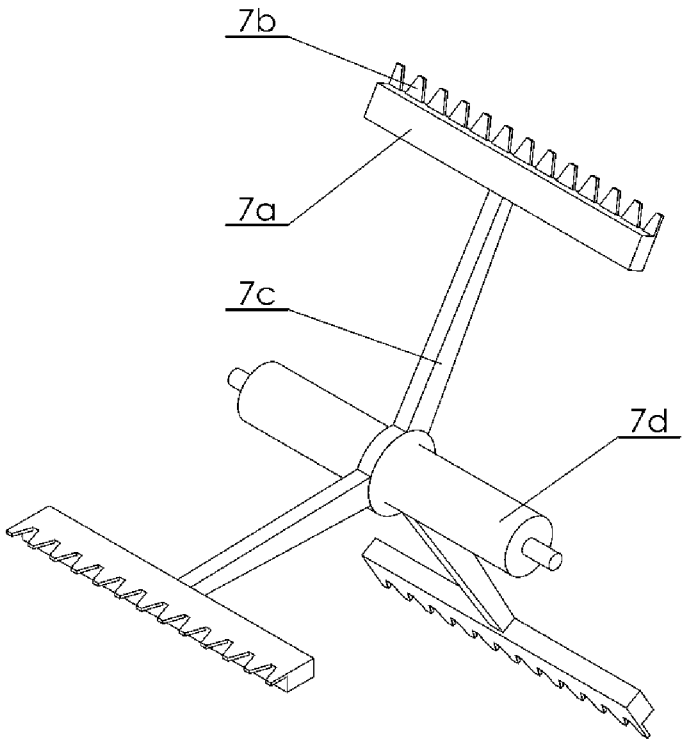

Fig. 5b

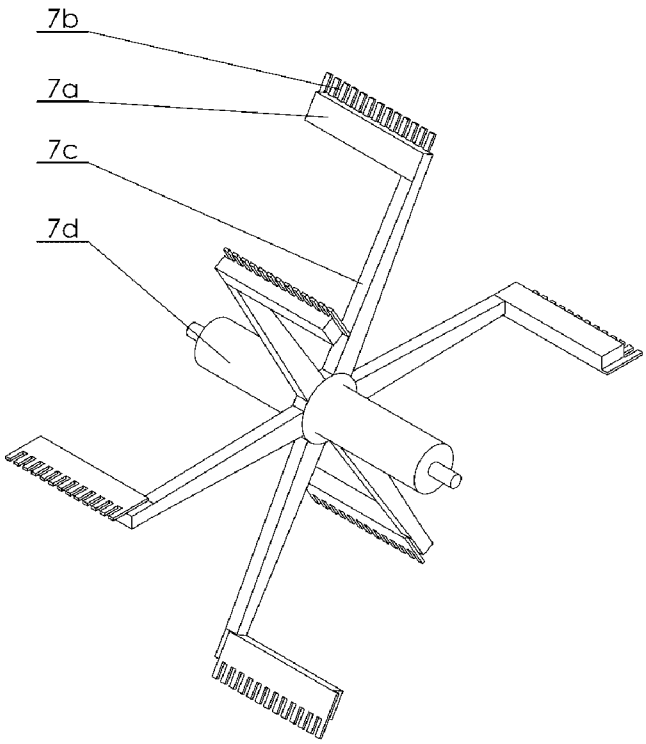

Fig. 5c

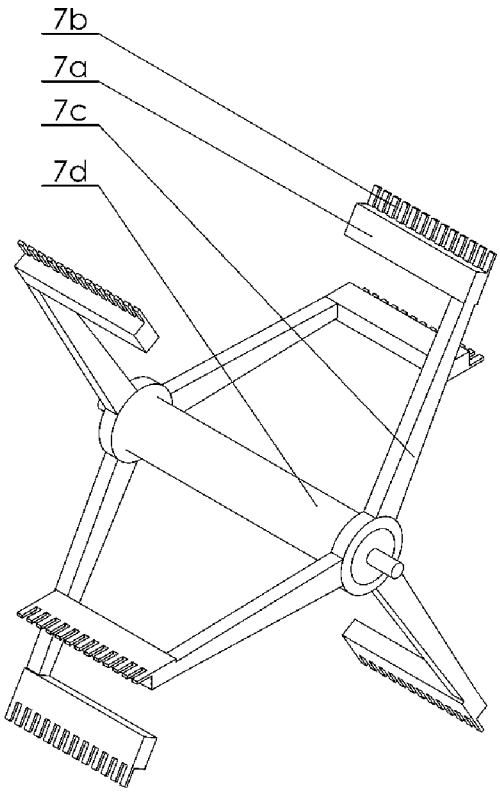

Fig. 5d

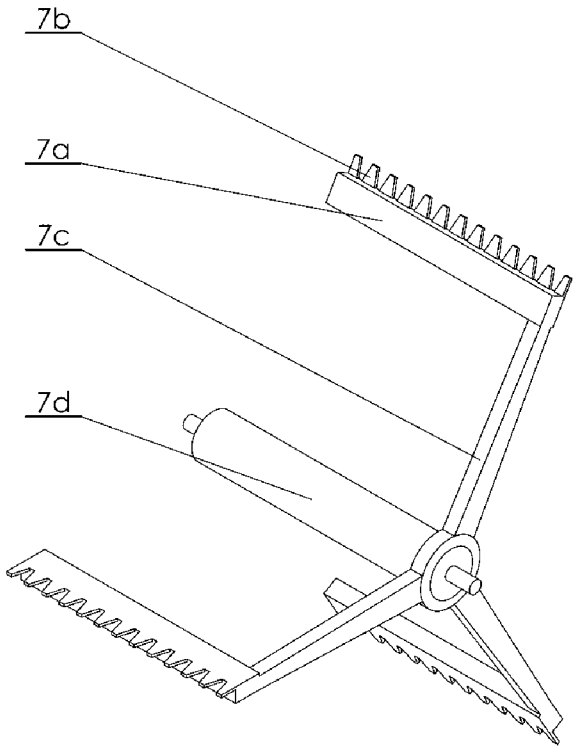

Fig. 5e

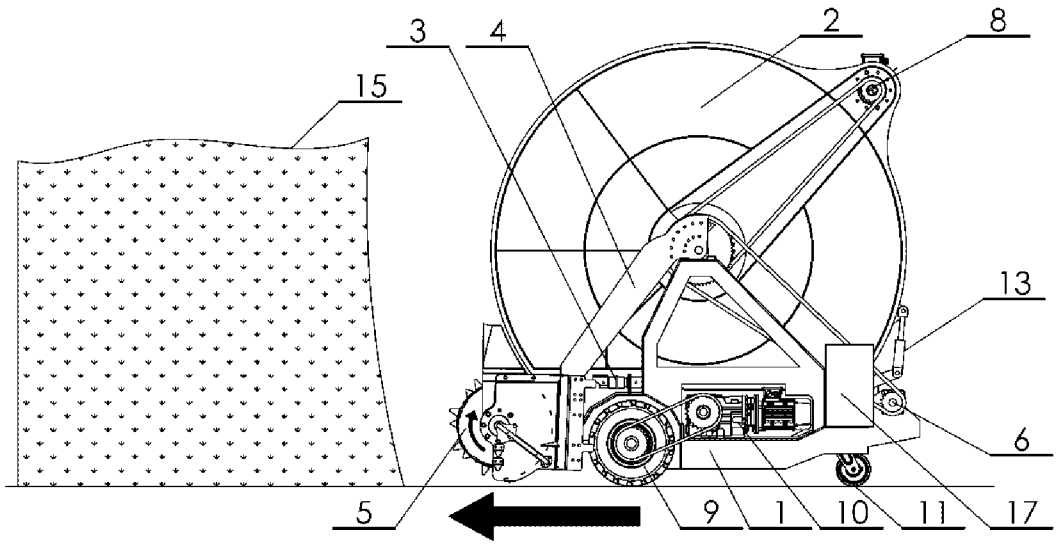

Fig. 6a

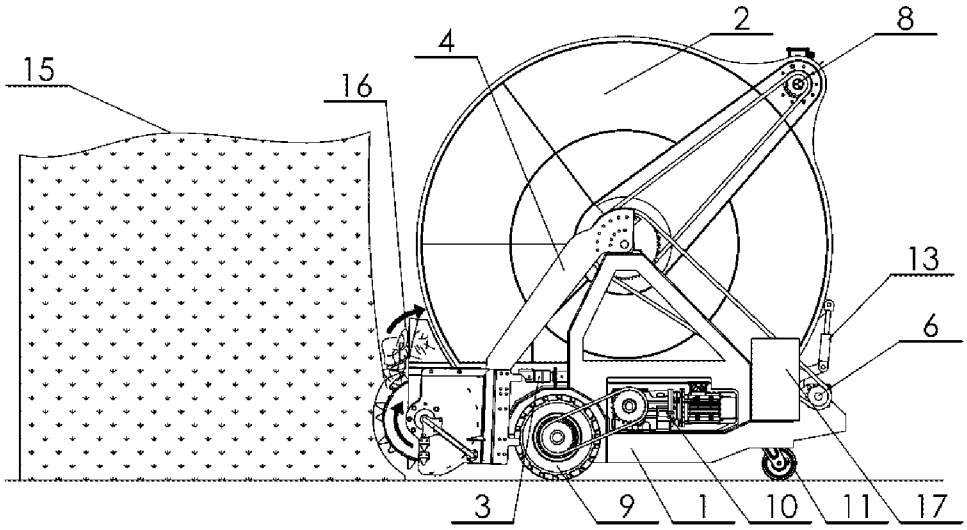

Fig. 6b

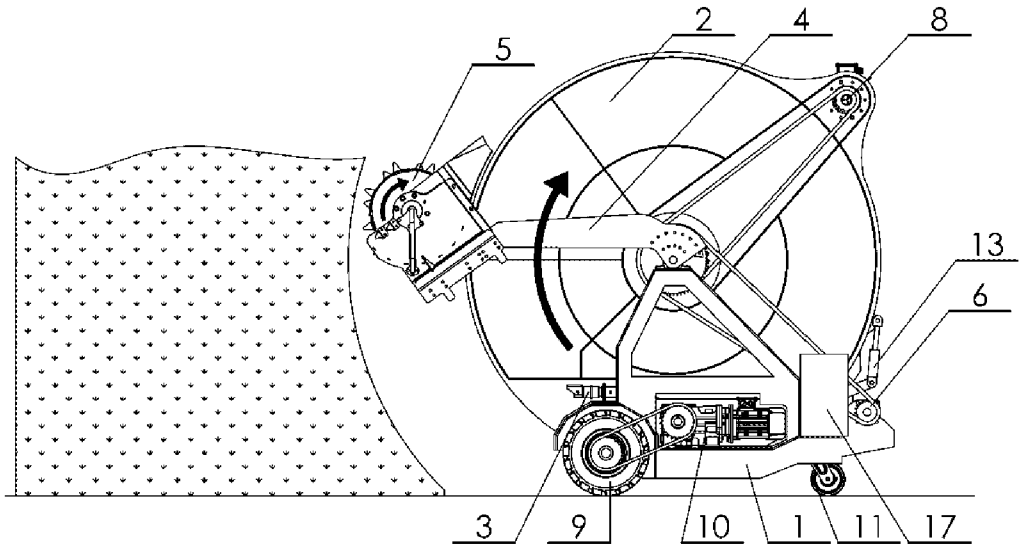

Fig. 6c

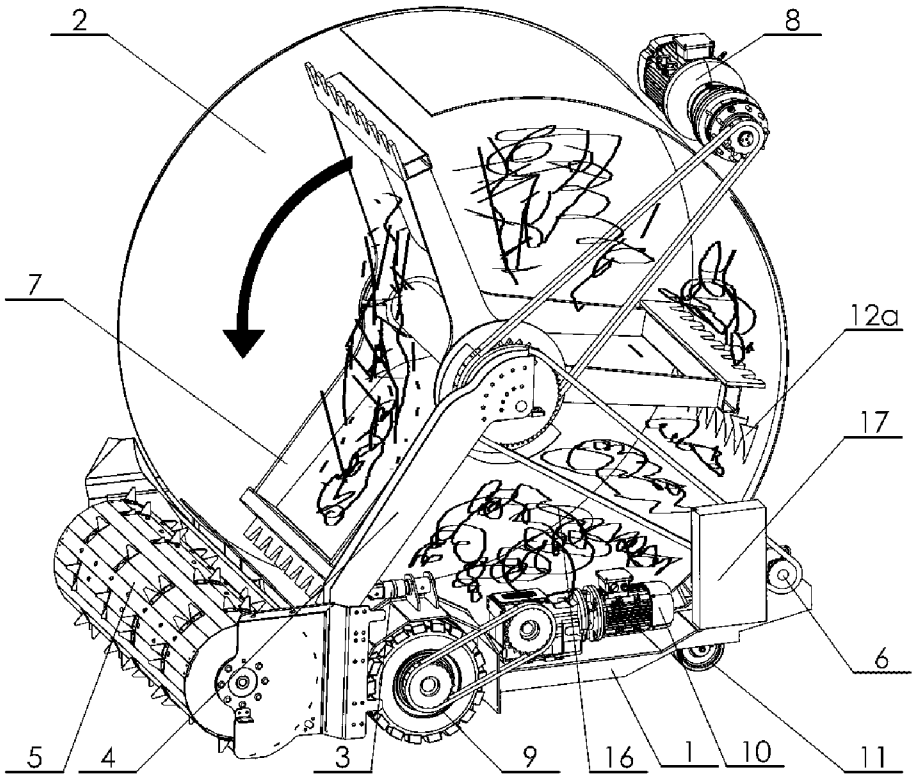

Fig. 7

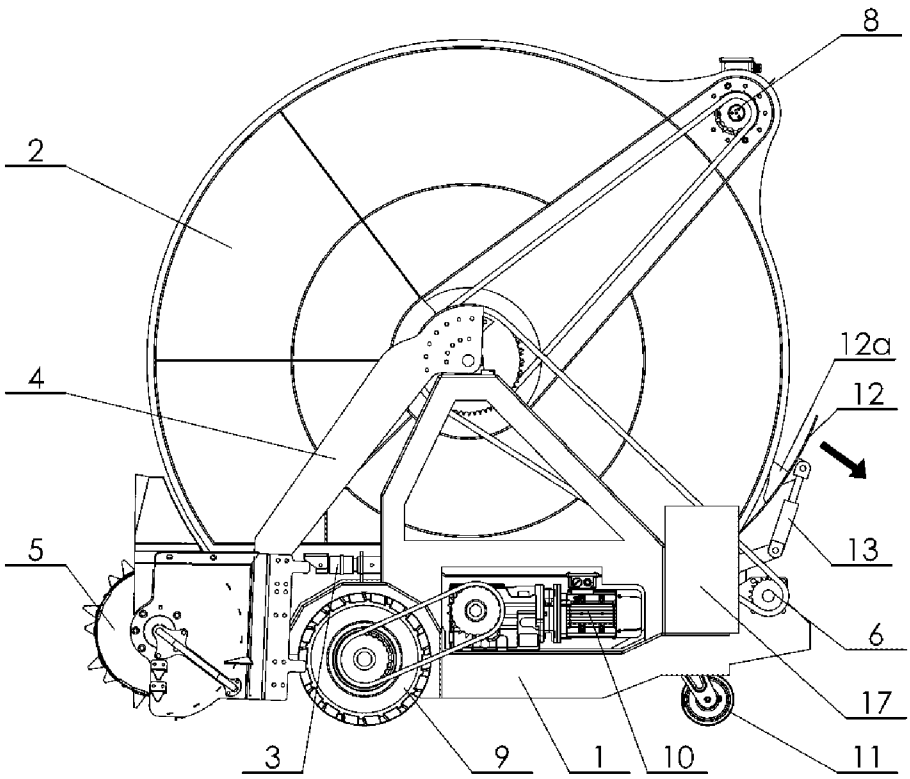

Fig. 8

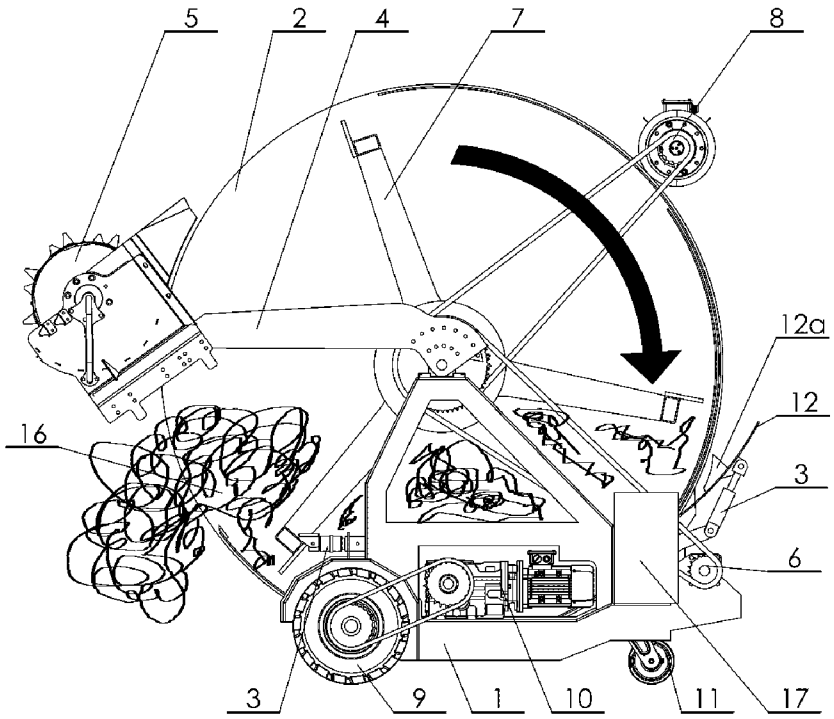

Fig. 9

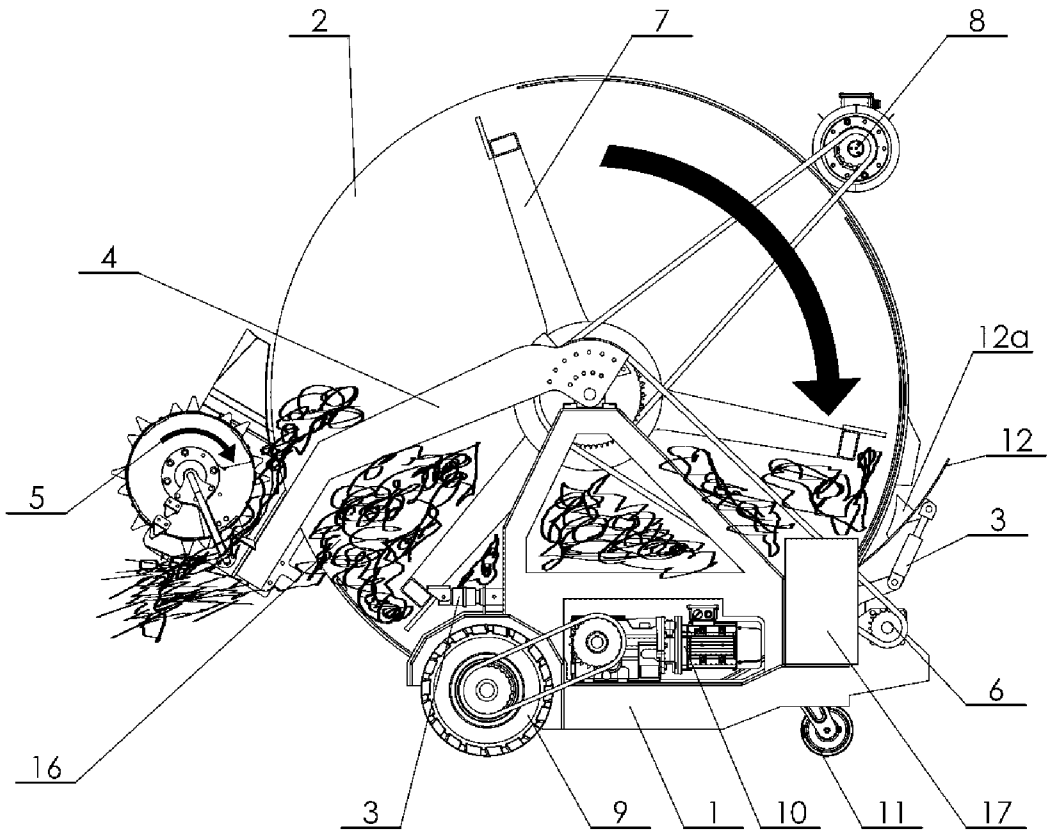

Fig. 10

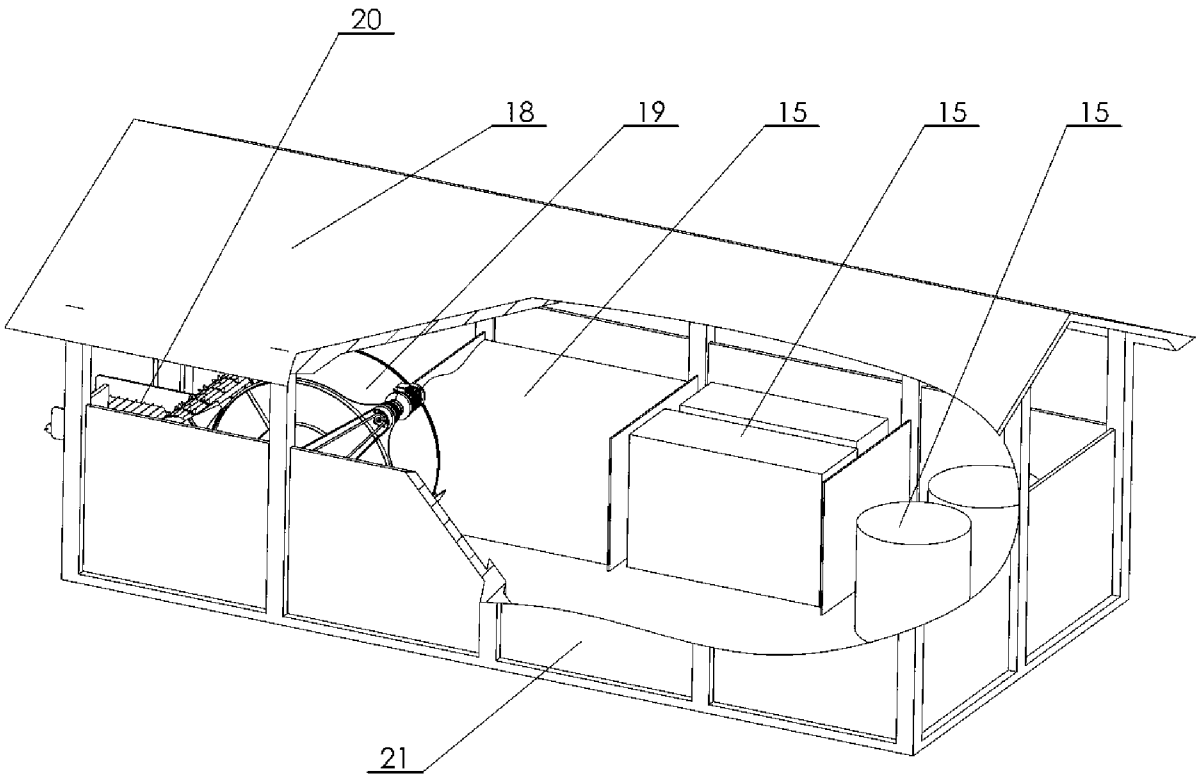

Fig. 11

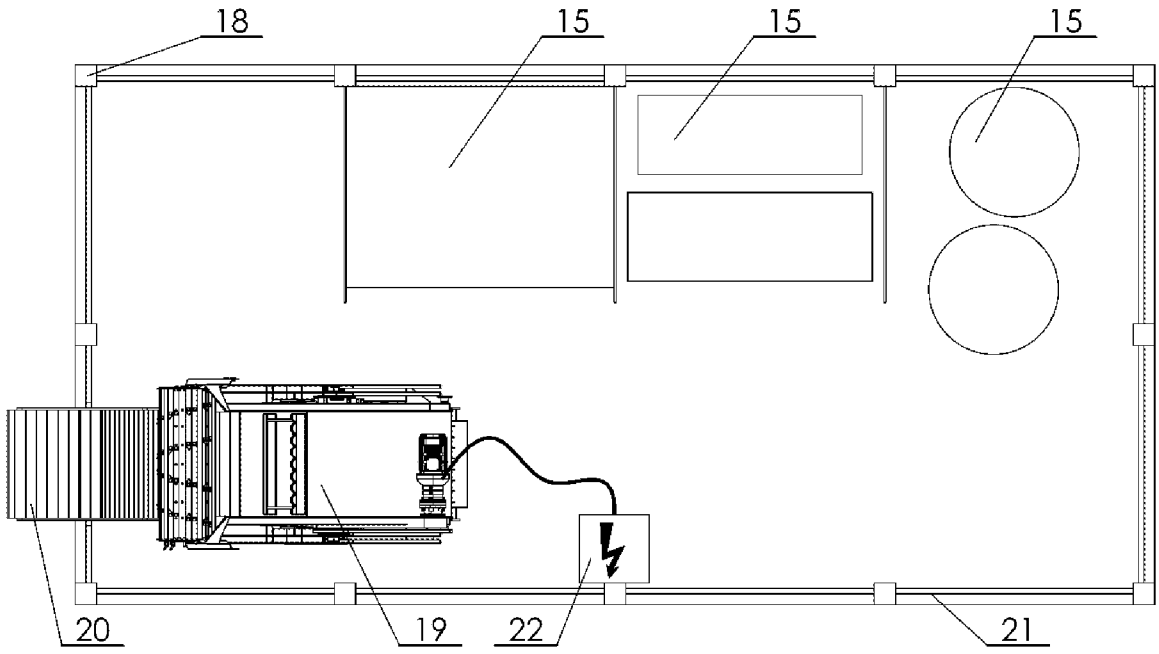

Fig. 12

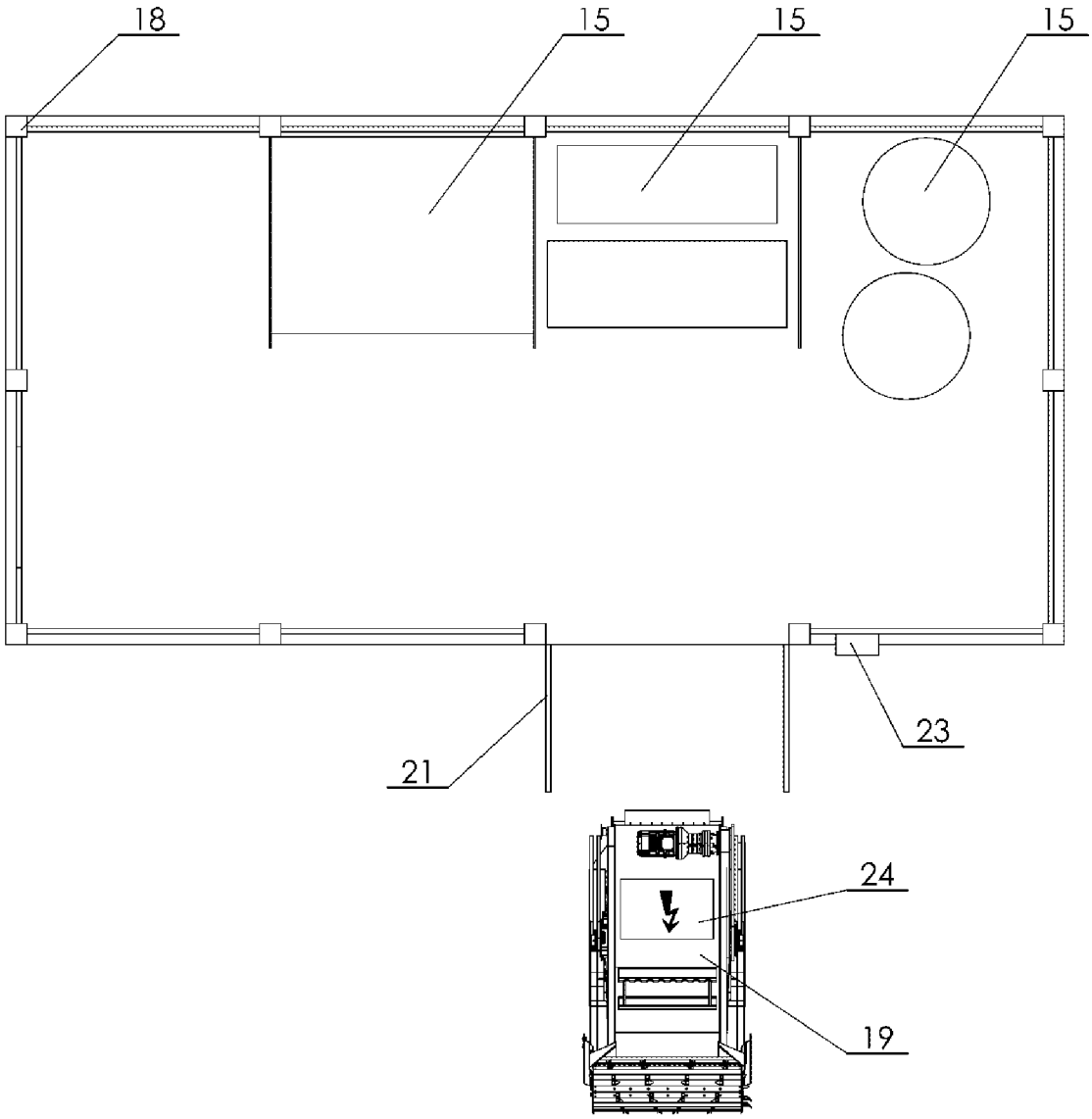

Fig. 13

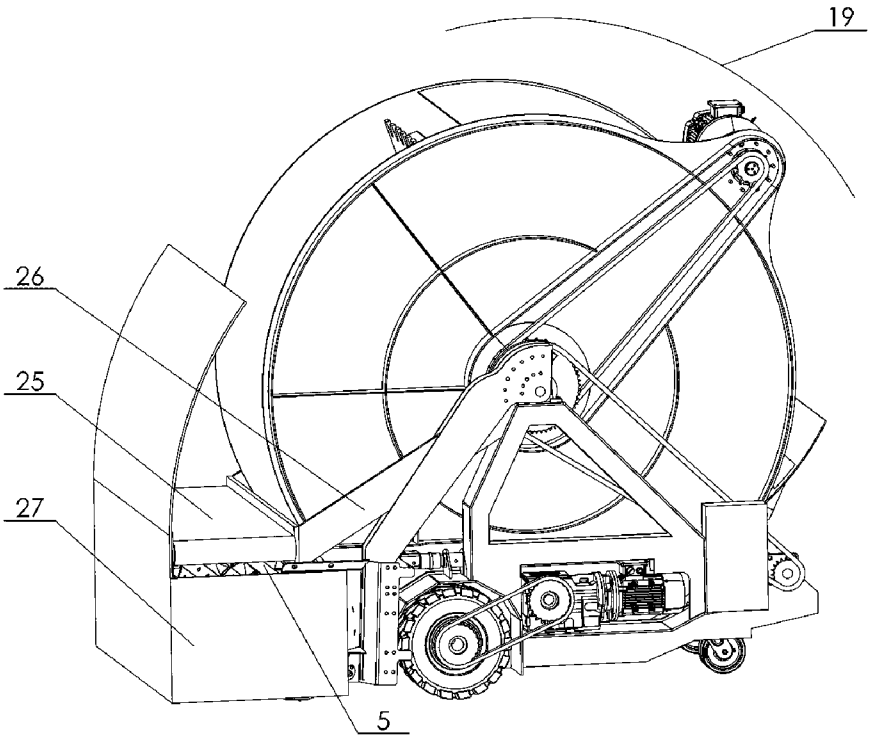

Fig. 14

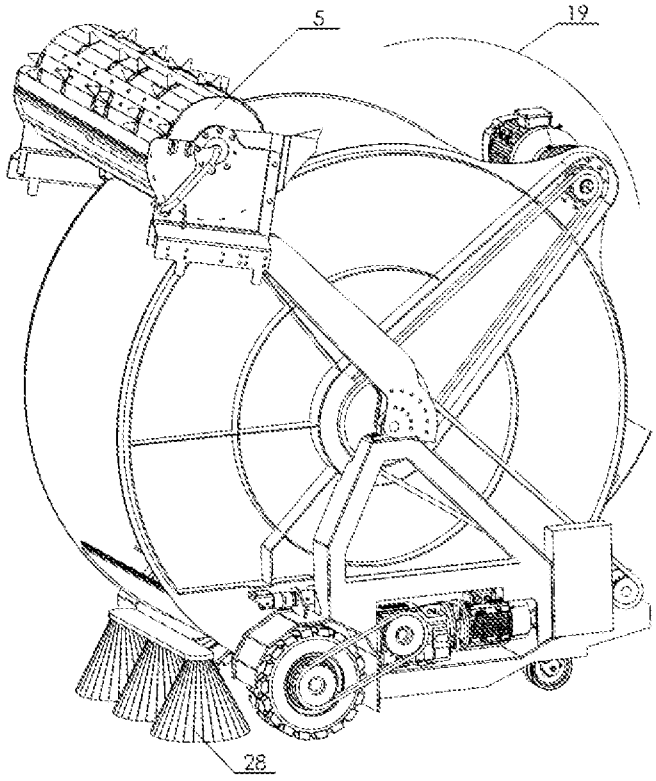

Fig. 15

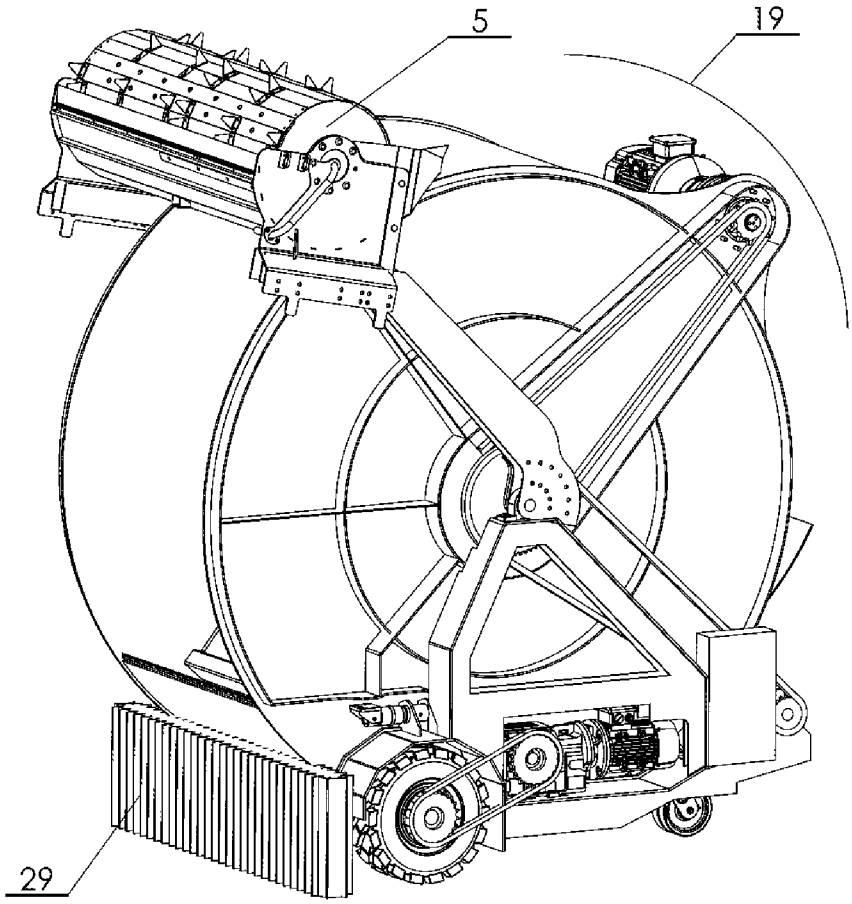

Fig. 16

INTERNATIONAL SEARCH REPORT

International application No
PCT/PL2024/050098

A. CLASSIFICATION OF SUBJECT MATTER

INV. A01K1/10 A01K5/00 A01K5/02 A01F25/20
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

A01K A01F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	NL 1 040 480 C2 (BORST REPARATIE & CONSTRUCTIE BORECO) 7 May 2015 (2015-05-07)	1-13, 15-27
A	page 1, line 3 - page 3, line 23 page 4, lines 14-25 page 7, lines 3-22 figures 2-4	14

Y	US 2017/364089 A1 (STRAUTMANN WOLFGANG [DE] ET AL) 21 December 2017 (2017-12-21)	1-13, 15-27
	paragraphs [0002] - [0018], [0104] - [0108], [0120] - [0124], [0160] - [0162], [0168] - [0170] figures 1-8	

	-/--	

[x] Further documents are listed in the continuation of Box C.

[x] See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance;; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance;; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
5 March 2025	28/03/2025

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Been, Mathieu

INTERNATIONAL SEARCH REPORT

International application No
PCT/PL2024/050098

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 2011/112688 A1 (MCCURDY JOHN JOSEPH [IE] ET AL) 12 May 2011 (2011-05-12) paragraphs [0054] - [0059], [0066] - [0067], [0078] figures 1-4	1-13, 15-27
A	EP 1 062 862 A1 (CALVET ETS [FR]) 27 December 2000 (2000-12-27) paragraphs [0004] - [0013], [0025] - [0037] figures 1-8	14
A	NL 2 009 418 C2 (BRUIN TANKBOUW B V DE) 10 March 2014 (2014-03-10) page 2, line 14 - page 3, line 17 figure 1	1-27
A	DE 196 05 591 A1 (STRAUTMANN & SOEHNE [DE]) 21 August 1997 (1997-08-21) column 1, line 40 - column 2, line 7 figures 1-5	1-27

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/PL2024/050098

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
NL 1040480 C2	07-05-2015	NONE	
US 2017364089 A1	21-12-2017	CA 2968148 A1	26-05-2016
		DE 102014116882 A1	19-05-2016
		EP 3023004 A1	25-05-2016
		PL 3023004 T3	31-01-2018
		RU 2017121215 A	19-12-2018
		US 2017364089 A1	21-12-2017
		WO 2016078757 A1	26-05-2016
US 2011112688 A1	12-05-2011	AU 2009220800 A1	11-09-2009
		AU 2009220801 A1	11-09-2009
		BR PI0909822 A2	06-10-2015
		BR PI0910254 A2	29-09-2015
		CA 2716974 A1	11-09-2009
		CA 2717300 A1	11-09-2009
		CN 102014611 A	13-04-2011
		CN 102014612 A	13-04-2011
		DK 2249635 T3	09-02-2015
		DK 2254403 T3	16-02-2015
		EP 2249635 A2	17-11-2010
		EP 2254403 A2	01-12-2010
		ES 2529197 T3	17-02-2015
		ES 2529583 T3	23-02-2015
		JP 5323100 B2	23-10-2013
		JP 5442644 B2	12-03-2014
		JP 2011512835 A	28-04-2011
		JP 2011517933 A	23-06-2011
		NZ 587575 A	12-01-2012
		NZ 587686 A	30-03-2012
		PL 2249635 T3	29-05-2015
		PL 2254403 T3	29-05-2015
		RU 2010140807 A	20-04-2012
		RU 2010140809 A	20-04-2012
		US 2011064865 A1	17-03-2011
		US 2011112688 A1	12-05-2011
		WO 2009109953 A2	11-09-2009
		WO 2009109954 A2	11-09-2009
EP 1062862 A1	27-12-2000	EP 1062862 A1	27-12-2000
		FR 2795287 A1	29-12-2000
NL 2009418 C2	10-03-2014	NONE	
DE 19605591 A1	21-08-1997	NONE	